Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: AH20

Sheet 1 of 1

Drill Type:	Hand Auger	Project No:	NL230070	Logged By:	HHe
Drilled By:	HHe	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 5/07/2023
Date Started:	28/8/23	Ground Elevation:		Surface Conditions:	Near level grass
Date Finished:	28/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows) / SHEAR STRENGTH REMOULDED SHEAR ○ v ◉ r 50 100 150 (kPa)	LABORATORY TESTS
TS	0.0		TOPSOIL		0.0		
KERIKERI VOLCANIC FIELD	0.5		SILT, light brown, very stiff, dry, non plastic (WEATHERED TUFF)		0.5	200+ UTP V	
			trace decomposed wood fragments, dark brown with orange mottles				
	1.0		minor clay		1.0	200+ UTP V	
			trace fine to medium sand, light brown				
	1.5		END OF BORE. 1.50 METRES. (TOO HARD TO AUGER, GRAVEL OBSTRUCTION)		1.5	200+ UTP V	
	2.0				2.0		
	2.5				2.5		
	3.0				3.0		
	3.5				3.5		
	4.0				4.0		
	4.5				4.5		
	5.0				5.0		

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP01

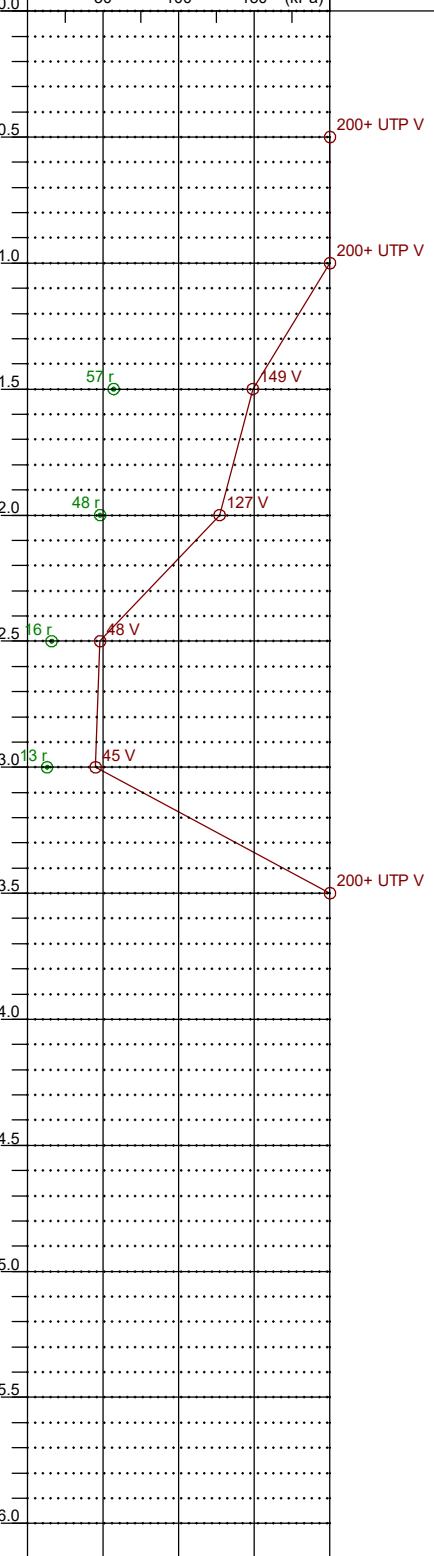
Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Slightly sloping grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF)	
	0.5		dark orange brown, very stiff	
			minor clay, slightly plastic	
TAURANGA GROUP	1.0		SILT some clay, trace fine sand, dark orange, dark yellow, very stiff, moist, slightly plastic (PLEISTOCENE DEPOSITS)	
	1.5		clayey SILT, trace fine sand, yellow, light grey, light orange, very stiff, moist, moderately plastic	
			light grey, yellow	
	2.0		SILT some clay, minor fine sand, orange, dark orange, very stiff, moist, slightly plastic	
			wet	
	2.5		SILT some fine to coarse sand, trace clay, brown, dark grey, firm, saturated, non plastic, pit walls unstable in this layer from 2.5m to 3.5m (VOLCANIC DEPOSITS)	
	3.0			
KERIKERI VOLCANIC FIELD	3.5		moderately weathered, red brown, grey, brown, BASALT, saturated, excavates as angular gravel and cobbles, hard for digger to excavate	
	4.0			
	4.5			
	5.0			
	5.5		END OF BORE. 5.40 METRES. (TARGET DEPTH)	
	6.0			

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ◉ r
50 100 150 (kPa)



LABORATORY TESTS

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP02

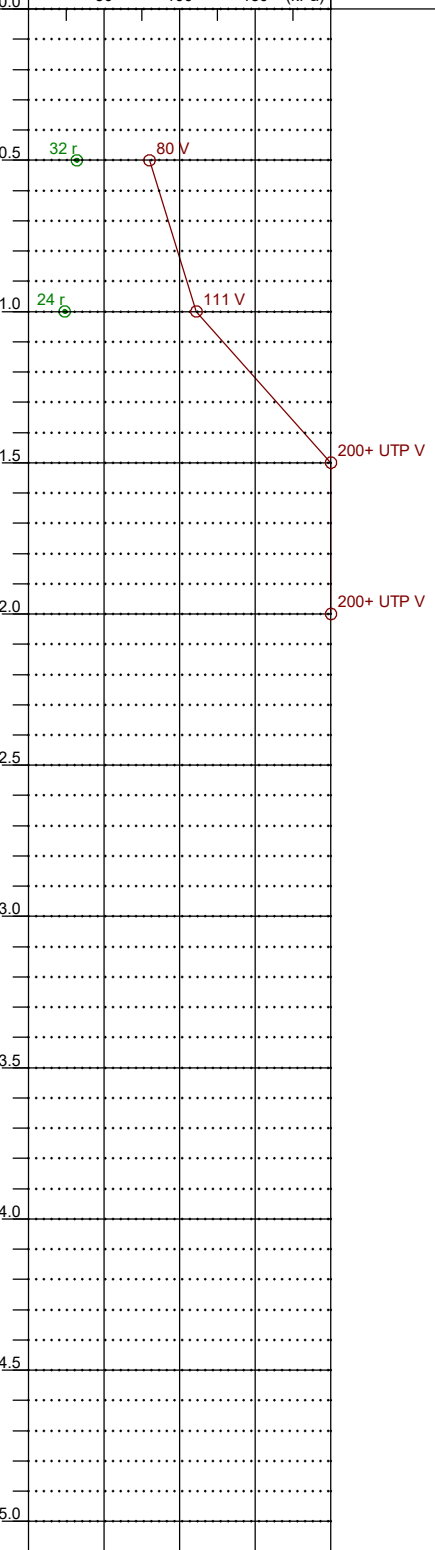
Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Near level grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF) trace roots to 20mm diameter dark orange brown, dark red brown	
	0.5		some fine to coarse angular basalt gravel, some fine to coarse angular basalt cobbles	
	1.0		brown, dark red brown, some cobbles to cobbly	
	1.5		very stiff	
	2.0		basalt BOULDERS, COBBLES, GRAVEL, grey, brown, tightly packed, moist, difficult to excavate (VOLCANIC DEPOSITS)	
	2.5			
	3.0		slightly to moderately weathered, BASALT, difficult to excavate, digger refusal	
	3.5		END OF BORE. 3.10 METRES. (TOO HARD TO EXCAVATE, BASALT)	
	4.0			
	4.5			
	5.0			

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ◉ r
50 100 150 (kPa)



LABORATORY TESTS

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

289 Lincoln Road, Henderson. Phone: (09) 835 1740
www.soilandrock.co.nz

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

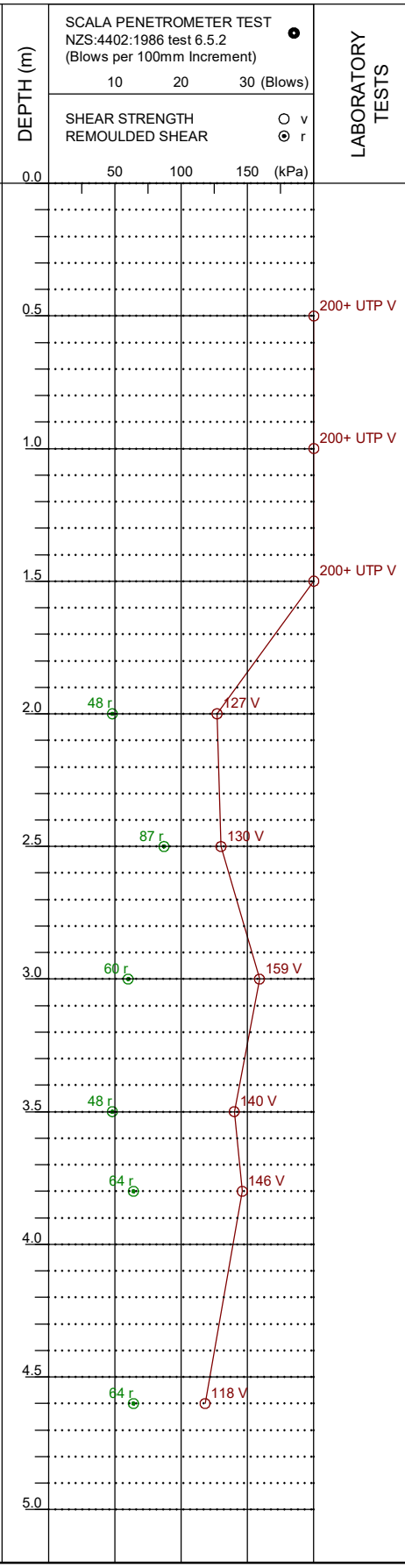
PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP03

Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Slightly sloping grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF)	
			dark orange brown, very stiff	
			some fine to coarse angular basalt, gravel, trace fine to coarse angular cobbles	
	0.5			
	1.0			
	1.5		minor basalt boulders to 80cm diameter	
	2.0			
TAURANGA GROUP			SILT some clay, minor fine sand, dark orange, very stiff, moist, slightly plastic (PLEISTOCENE DEPOSITS)	
	2.5			
			clayey SILT, trace fine sand, orange, yellow, light grey, very stiff, moist, moderately plastic	
	3.0		red, pink, light grey	
	3.5		SILT some fine sand, some clay, pink, red, light grey, very stiff, moist, slightly plastic	
	4.0		pink with light grey streaks	
	4.5			
			END OF BORE. 4.60 METRES. (TARGET DEPTH)	
	5.0			



LABORATORY TESTS

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP04

Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Near level grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows) / SHEAR STRENGTH REMOULDED SHEAR ○ v ◉ r 50 100 150 (kPa)	LABORATORY TESTS
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF)		0.0		
			dark orange brown				
			some angular basalt cobbles to cobbly				
	0.5		some basalt boulders to 60cm diameter		0.5	200+ UTP V	
	1.0		basalt BOULDERS, COBBLES, GRAVEL, grey, brown, tightly packed, moist, difficult to excavate (VOLCANIC DEPOSITS)		1.0	200+ UTP V	
			slightly to moderately weathered, BASALT, difficult to excavate, digger refusal				
	1.5		END OF BORE. 1.30 METRES. (TOO HARD TO EXCAVATE, BASALT)		1.5		
	2.0				2.0		
	2.5				2.5		
	3.0				3.0		
	3.5				3.5		
	4.0				4.0		
	4.5				4.5		
	5.0				5.0		

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP05

Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Near level grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows) / SHEAR STRENGTH REMOULDED SHEAR v r 50 100 150 (kPa)	LABORATORY TESTS
KERIKERI VOLCANIC FIELD	0.0		SILT some fine sand, dark red brown, stiff, moist, non plastic (WEATHERED TUFF)		0.0		
			minor clay, very stiff, slightly plastic				
	0.5		orange brown		0.5		223 V
			some fine to coarse angular basalt gravel, some fine to coarse basalt cobbles				
	1.0		some basalt boulders to 50cm diameter		1.0		223 V
	1.5				1.5		200+ UTP V
	2.0		fine to coarse angular basalt GRAVEL, COBBLES, BOULDERS, grey, brown, tightly packed, moist, difficult to excavate (VOLCANIC DEPOSITS)		2.0		200+ UTP V
	2.5		END OF BORE. 2.20 METRES. (TOO HARD TO EXCAVATE, BASALT)		2.5		
	3.0				3.0		
	3.5				3.5		
	4.0				4.0		
	4.5				4.5		
	5.0				5.0		

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

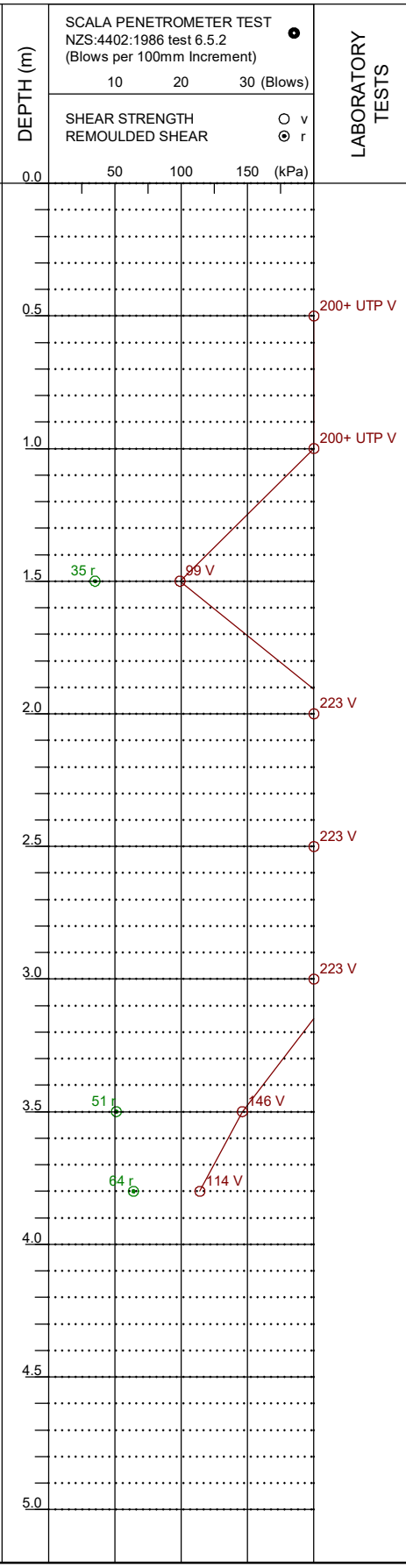
PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP06

Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Near level grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, trace clay, brown, stiff, moist, slightly plastic (WEATHERED TUFF)	
			dark orange brown, very stiff	
	0.5		some fine to coarse angular basalt gravel, minor fine to coarse basalt cobbles	
	1.0			
TAURANGA GROUP	1.5		SILT some clay, some fine sand, yellow, orange, very stiff, moist, slightly plastic (PLEISTOCENE DEPOSITS)	
	2.0		yellow, pink, red	
	2.5			
	3.0		clayey SILT, trace fine sand, yellow, orange, pink, very stiff, moist, moderately plastic	
	3.5		pink, light grey	
	4.0		END OF BORE. 3.80 METRES. (TARGET DEPTH)	
	4.5			
	5.0			



LABORATORY TESTS

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP07

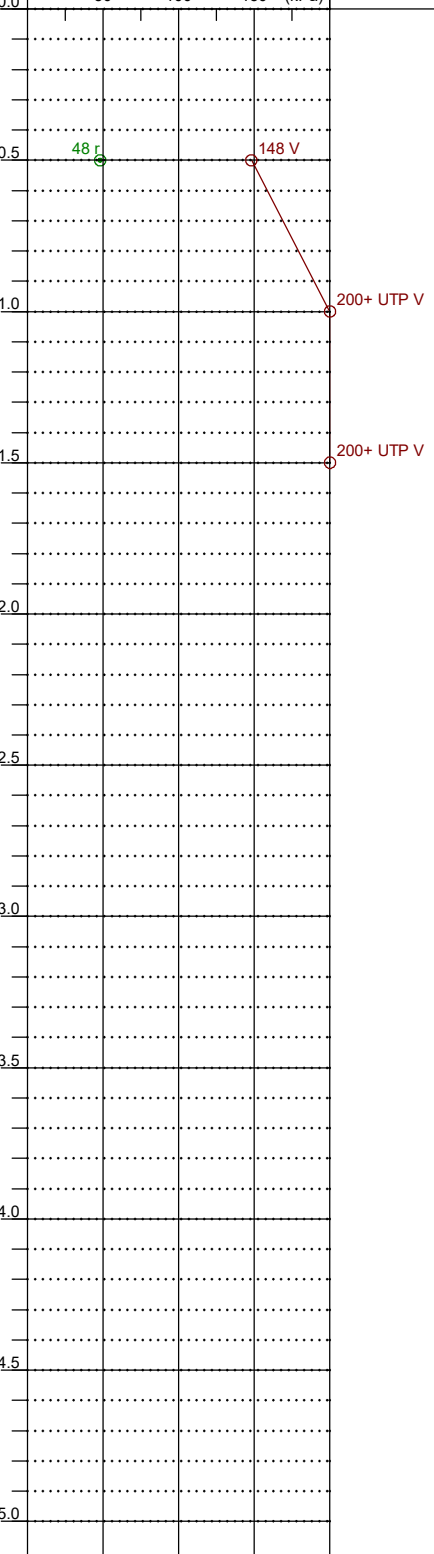
Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Slightly sloping grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF)	
			dark red brown, very stiff	
	0.5		minor fine to coarse angular basalt gravel, minor fine to coarse basalt cobbles	
	1.0		fine to coarse angular, gravely SILT, some fine to coarse basalt cobbles, red brown, dark grey, very stiff, moist, non plastic	
	1.5		angular, fine to coarse basalt COBBLES, grey, brown, hard to excavate (VOLCANIC DEPOSITS)	
	2.0		END OF BORE. 1.60 METRES. (TOO HARD TO EXCAVATE, BASALT)	
	2.5			
	3.0			
	3.5			
	4.0			
	4.5			
	5.0			

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH
REMOULDED SHEAR
○ v
◉ r
50 100 150 (kPa)



LABORATORY TESTS

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Stuart Robinson

PROJECT: Geotechnical Investigation, BIsset Rd & 10 Rimu Pl, Kaikohe

Auger Hole No: TP08

Sheet 1 of 1

Drill Type:	Testpit	Project No:	NL230070	Logged By:	DEG
Drilled By:	Excavator	Coordinates:		Shear Vane No - Calibration Date:	GEO3564 - 2/05/2023
Date Started:	29/8/23	Ground Elevation:		Surface Conditions:	Moderately sloping grass
Date Finished:	29/8/23	Water Level:	Groundwater Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows) / SHEAR STRENGTH REMOULDED SHEAR v r 50 100 150 (kPa)	LABORATORY TESTS
KERIKERI VOLCANIC FIELD	0.0		SILT minor fine sand, brown, stiff, moist, non plastic (WEATHERED TUFF) dark red brown minor fine to coarse angular basalt gravel, trace fine to coarse basalt cobbles		0.0		
	0.5		fine to coarse, angular gravely SILT, some fine to coarse cobbles, brown, red brown, grey, very stiff, moist, non plastic (VOLCANIC DEPOSITS) minor basalt boulders to 40cm diameter		0.5		200+ UTP V
	1.0		fine to coarse angular basalt GRAVEL, some fine to coarse basalt cobbles, some boulders to 50cm diameter, brown, dark grey, tightly packed, moist (VOLCANIC DEPOSITS)		1.0		200+ UTP V
	1.5				1.5		200+ UTP V
	2.0				2.0		200+ UTP V
	2.5		saturated		2.5		200+ UTP V
	3.0		difficult to excavate		3.0		200+ UTP V
	3.5		END OF BORE. 3.00 METRES. (TOO HARD TO EXCAVATE, BASALT)		3.5		
	4.0				4.0		
	4.5				4.5		
	5.0				5.0		

HAND AUGER LOG WITH SCALA NL230070 - AH01-AH20 &TP01-TP10 - BISSET RD & 10 RIMU PL - 2023-08-30.GPJ S+R_2013.GDT 4/9/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

289 Lincoln Road, Waitakere 0612
PO Box 21-424 Henderson, Waitakere 0650
09 835 1740
info@soilandrock.co.nz
www.soilandrock.co.nz

SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NO: NL230070 **TESTED BY:** DEG/JN

JOB NAME: Bisset Rd & 10 Rimu Pl, Kaikohe **DATE:** 28/8/23 to 30/8/23

Depth of Penetration [mm]	AH01	AH02	AH03	AH04	AH05	AH06	AH07	AH08	AH09	AH10	AH11	AH12
DEPTH START[m]	2.40	1.10	5.00	4.65	2.90	2.30	5.00	5.00	1.10	0.80	1.50	0.65
50 mm	4	4	SUNK	4	2	6	3	4	3	8	20+	6
100	20+	3	SUNK	3	5	7	2	3	3	2		6
150		2	1	3	1	8	3	3	2	2		4
200		2	1	3	1	9	4	4	3	2		3
250		2	1	5	0.5	10	3	4	2	2		6
300		2	2	6	0.5	10	3	3	2	4		3
350		3	2	5	1	10	3	5	1	2		2
400		2	3	20+	3	10	3	3	2	2		3
450		2	4		4	10	3	5	4	2		2
500		3	5		4		5	5	3	3		3
550		5	6		20+		5	5	2	2		3
600		4	5				5	9	2	1		3
650		3	8				6	11	1	3		2
700		2	20+				8	12	1	3		2
750		3					10	11	0.5	4		2
800		3					9	10	0.5	4		2
850		6					10	10	2	6		4
900		6					10		5	3		4
950		5					14		3	3		3
1000		6					12		2	5		3
1050		6					10		2	5		4
1100		10							2	5		4
1150		10							2	8		4
1200		10							2	10		3
1250		10							1	10		3
1300		10							2	10		4
1350									2	10		6
1400									1	4		5
1450									3	7		6
1500									4	10		5
1550									3	9		6
1600									4	6		6
1650									4	4		5
1700									4	4		6
1750									7	10		4
1800									20+	10		4
1850										4		5
1900										6		8
1950										14		13
2000										20+		20+
DEPTH END [m]	2.50	2.40	5.70	5.05	3.45	2.75	6.05	5.85	2.90	2.80	1.55	2.65

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Soil&Rock Consultants
Your responsive & cost-effective engineers

289 Lincoln Road, Waitakere 0612
PO Box 21-424 Henderson, Waitakere 0650
09 835 1740
info@soilandrock.co.nz
www.soilandrock.co.nz

SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NO: NL230070 **TESTED BY:** DEG/JN

JOB NAME: Bisset Rd & 10 Rimu Pl, Kaikohe **DATE:** 28/8/23 to 30/8/2

Depth of Penetration [mm]	AH13	AH14	Con't	AH15	AH16	AH17	AH18	Con't	AH19	AH20		
DEPTH START[m]	1.25	0.65	2.65	3.90	1.40	5.00	0.65	2.65	1.60	1.50		
50 mm	4	3	4	10	4	2	1	2	10	13		
100	2	2	6	7	3	3	1	2	11	7		
150	2	3	3	5	3	2	1	2	20+	5		
200	1	2	3	4	2	3	1	2		4		
250	2	10	4	5	4	3	1	2		3		
300	6	11	11	5	3	4	1	2		3		
350	8	6	8	3	2	4	1	2		2		
400	7	7	7	3	2	5	1	1		2		
450	6	6	10	2	2	6	1	2		2		
500	12	6	5	2	2	8	2	3		5		
550	5	13	4	2	2	9	2	4		5		
600	4	9	6	1	3	9	2	3		2		
650	4	7	7	2	2	10	2	2		2		
700	3	6	6	3	2	10	3	2		2		
750	5	4	10	5	7	11	2	3		2		
800	5	5	7	8	12	11	1	4		4		
850	5	4	6	10	6	13	2	5		4		
900	5	4	5	10	5		2	3		2		
950	10	3	6	7	5		2	3		2		
1000	12	5	5	6	9		2	3		2		
1050	20+	6		18	6		2			4		
1100		4		20+	9		2			2		
1150		4			6		2			4		
1200		7			6		2			6		
1250		6			6		2			7		
1300		8			6		2			10		
1350		5			5		3			8		
1400		6			4		2			15		
1450		7			7		2			20+		
1500		5			6		2					
1550		5			7		3					
1600		5			4		2					
1650		7			4		2					
1700		6			5		2					
1750		5			11		2					
1800		5			20+		2					
1850		7					2					
1900		8					2					
1950		5					2					
2000		4					2					
DEPTH END [m]	2.30	2.65	3.65	5.00	3.20	5.85	2.65	3.65	1.75	2.95		

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Soil&Rock Consultants

Your responsive & cost-effective engineers

Appendix C

Laboratory Test Results

Soil&Rock Consultants
Your responsive & cost-effective engineers

289 Lincoln Road, Waitakere 0610
PO Box 21-424 Henderson, Waitakere 0650
09 835 1740
www.soilandrock.co.nz

SS01

Shrink-Swell Test Results

Job Name:	Bisset Road and 10 Rimu Place, Kaikoł	Job No:	NL230070
Date:	5-Sep-23	Tested By:	JN
Sample Location:	SS01 Push	Date Sampled:	30-Aug-23
Sampling method:	Tube	Sampled By:	DEG
Sampling depth (m):	0.5-0.8m	Inert inclusions (%):	0
Sample condition:	Good	Extent of cracking (%):	0
		Extent of crumbling (%):	0

Sample description: clayey SILT, yellow, red, light yellow, very stiff, moist, moderately plastic (NATURAL)

Wet Density	γ (t/m^3) =	1.80
Dry Density	γ_d (t/m^3) =	1.29

Shrinkage Test

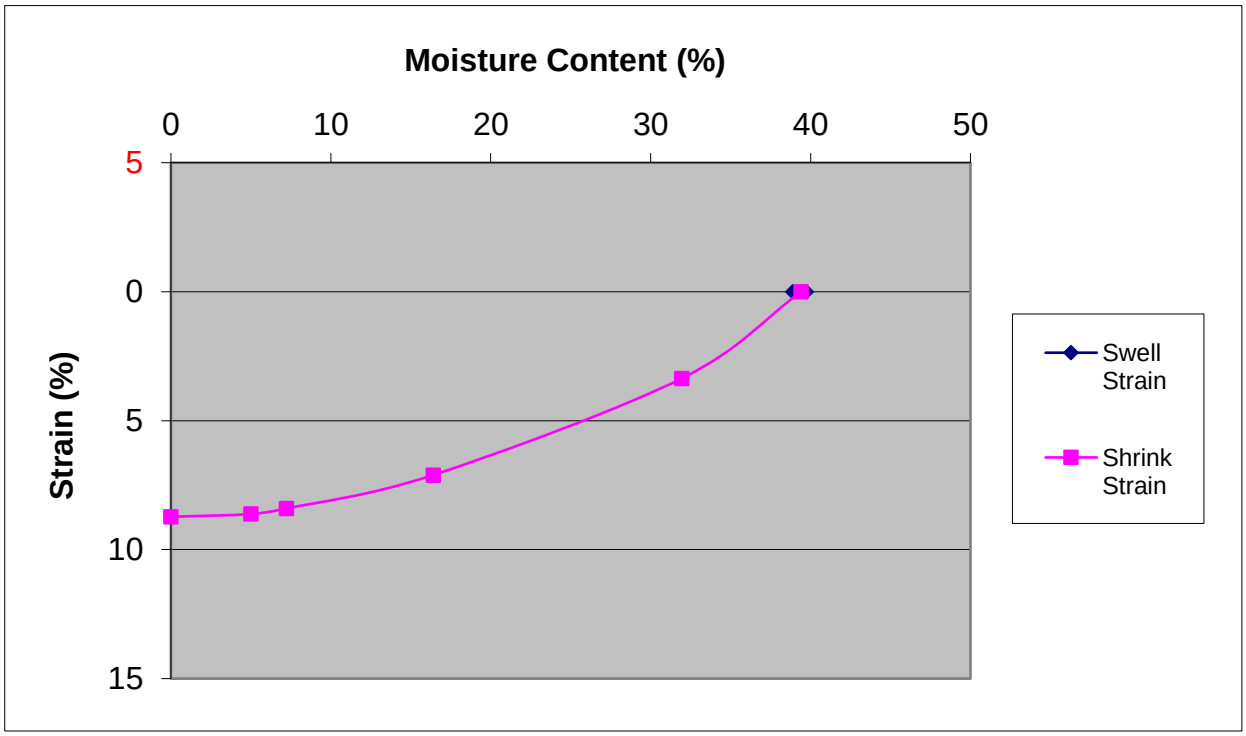
Initial moisture content (%) =	39.4
ε_{sh} = Magnitude of total shrinkage strain (%) =	8.7

Swell Test

ε_{sw} = Magnitude of the swelling strain (%) =	0.0

(Note: The ε_{sw} value is negative if the sample has undergone consolidation)

Initial moisture content (%) =	38.9
Final moisture content (%) =	39.7



Shrink-Swell index **Iss =** **4.9** **Strain per ΔpF (%)**

Testing Method: AS1289.7.1.1 - 2003 Soil reactivity tests

Soil&Rock Consultants
Your responsive & cost-effective engineers
289 Lincoln Road, Waitakere 0610
PO Box 21-424 Henderson, Waitakere 0650
09 835 1740
www.soilandrock.co.nz

and 10 Rimu Pl

SS02

Shrink-Swell Test Results

Job Name:	Bisset Road and 10 Rimu Place, Kaikol	Job No:	NL230070
Date:	5-Sep-23	Tested By:	JN
Sample Location:	SS02 Push	Date Sampled:	30-Aug-23
Sampling method:	Tube	Sampled By:	HHe
Sampling depth (m):	0.5-0.75	Inert inclusions (%):	0
Sample condition:	Good	Extent of cracking (%):	15
		Extent of crumbling (%):	0

Sample description: SILT, some clay, trace fine to medium sand, trace fine angular gravel, brown, black speckles, very stiff, moist, slightly plastic (NATURAL)

Wet Density	γ (t/m^3) =	1.67
Dry Density	γ_d (t/m^3) =	1.18

Shrinkage Test

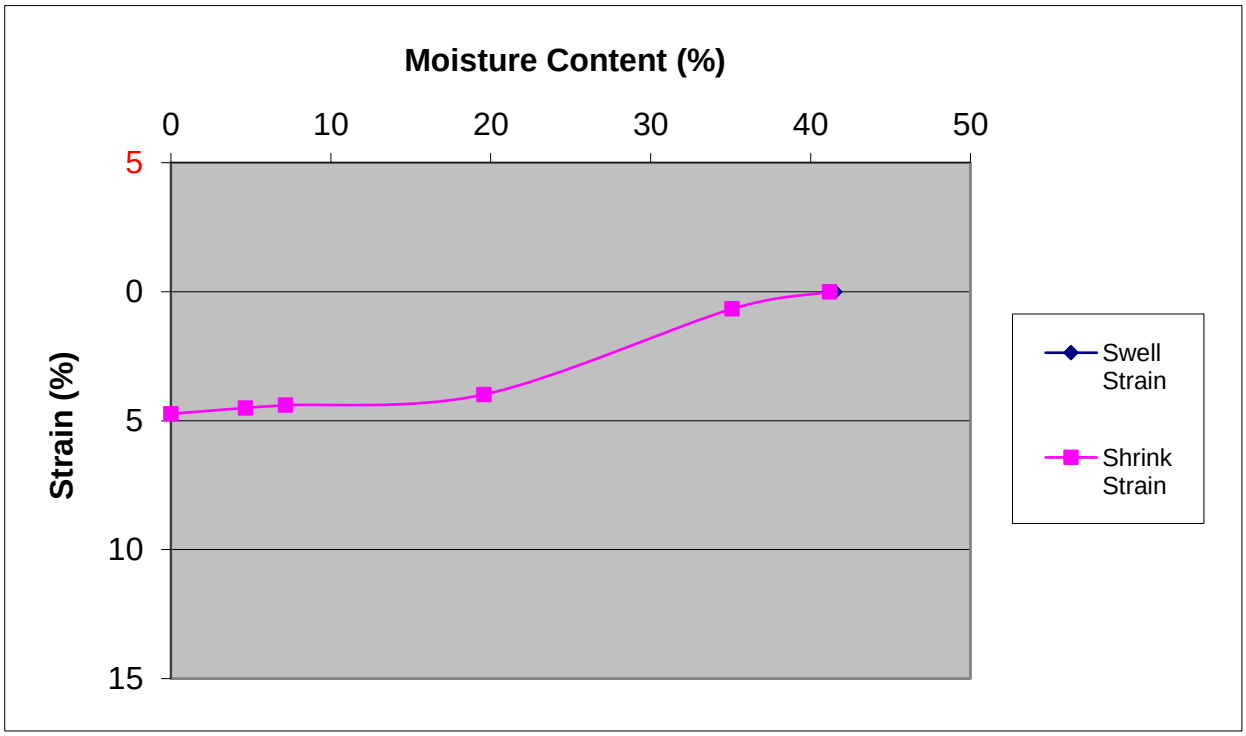
Initial moisture content (%) =	41.2
ε_{sh} = Magnitude of total shrinkage strain (%) =	4.7

Swell Test

ε_{sw} = Magnitude of the swelling strain (%) =	-0.5

(Note: The ε_{sw} value is negative if the sample has undergone consolidation)

Initial moisture content (%) =	41.5
Final moisture content (%) =	41.2



Shrink-Swell index **Iss =** **2.6** **Strain per ΔpF (%)**

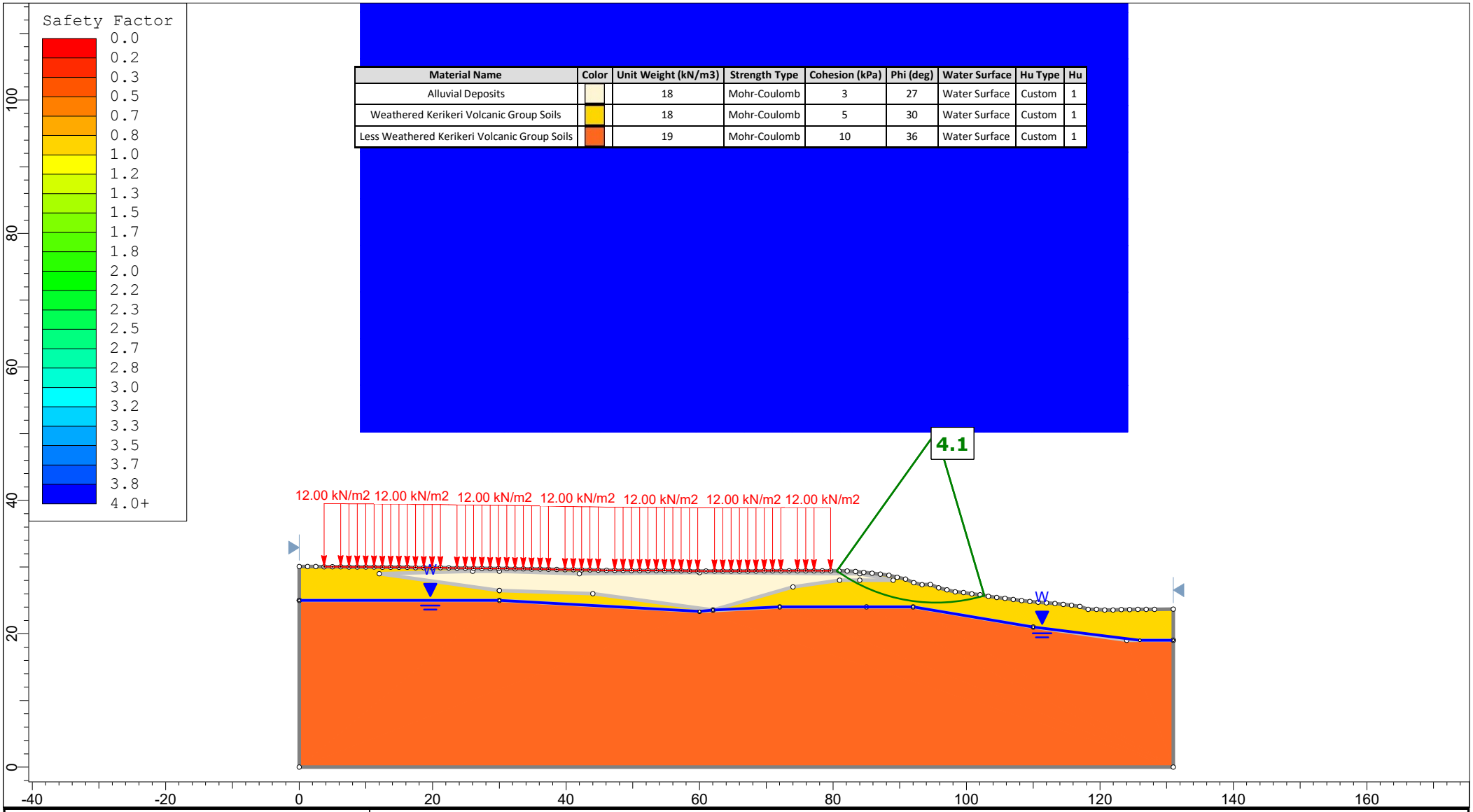
Testing Method: AS1289.7.1.1 - 2003 Soil reactivity tests

Soil&Rock Consultants

Your responsive & cost-effective engineers

Appendix D

Slope Stability Results

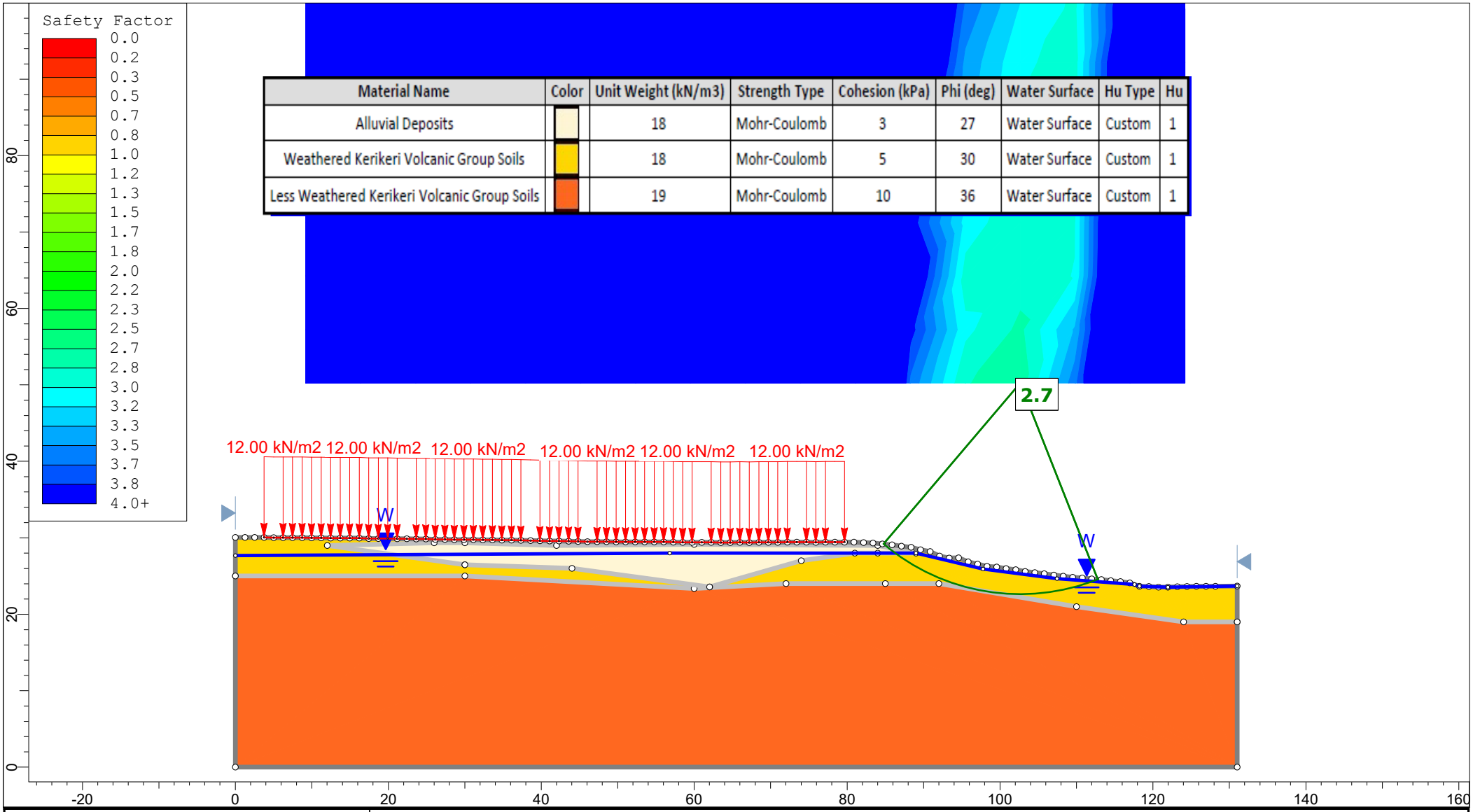


Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - A-A'	*Scenario*	Measured Groundwater Condition
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:793



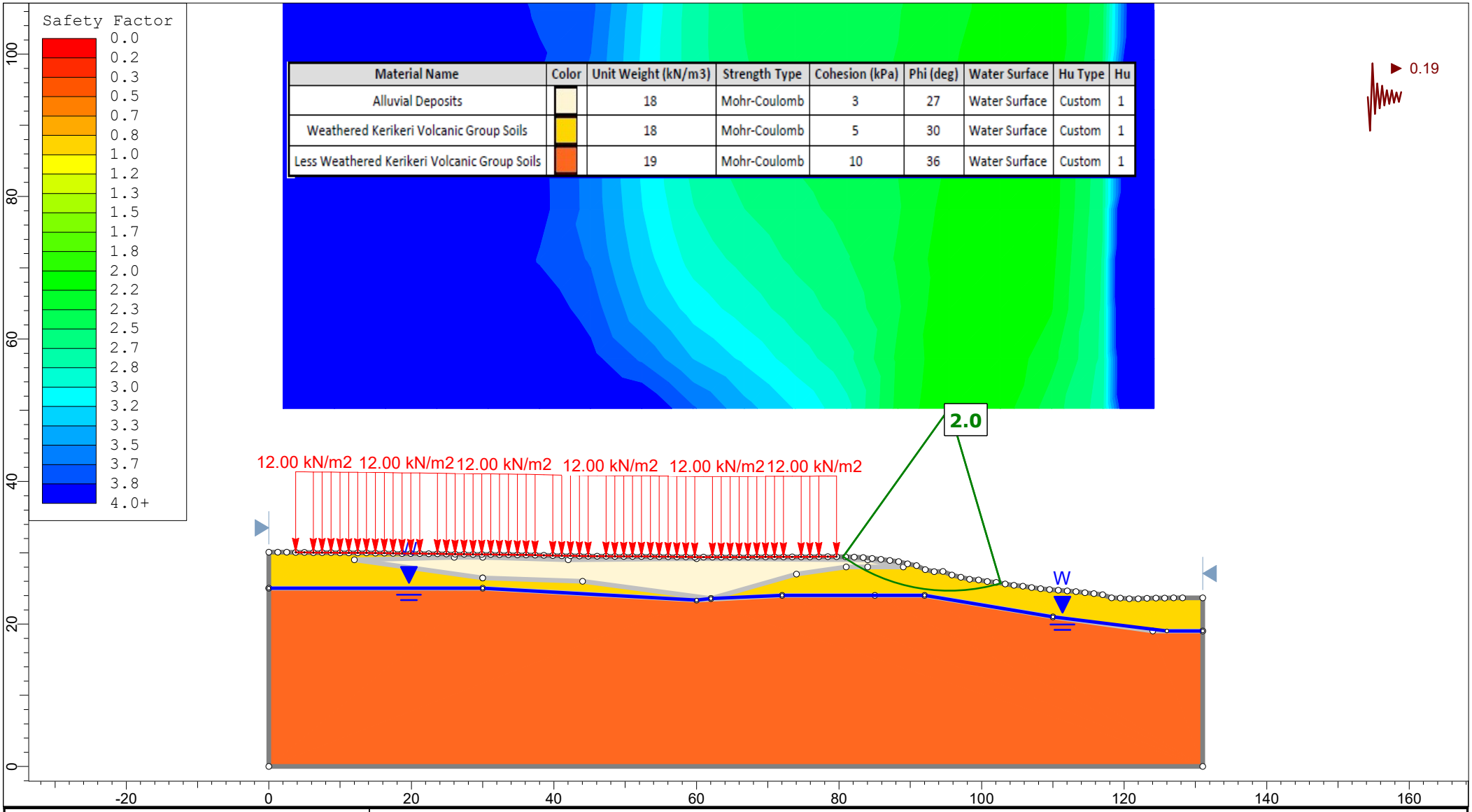
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Alluvial Deposits		18	Mohr-Coulomb	3	27	Water Surface	Custom	1
Weathered Kerikeri Volcanic Group Soils		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Less Weathered Kerikeri Volcanic Group Soils		19	Mohr-Coulomb	10	36	Water Surface	Custom	1

Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - A-A'	*Scenario*	Extreme (Worst Credible) Groundwater Condtion
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:692

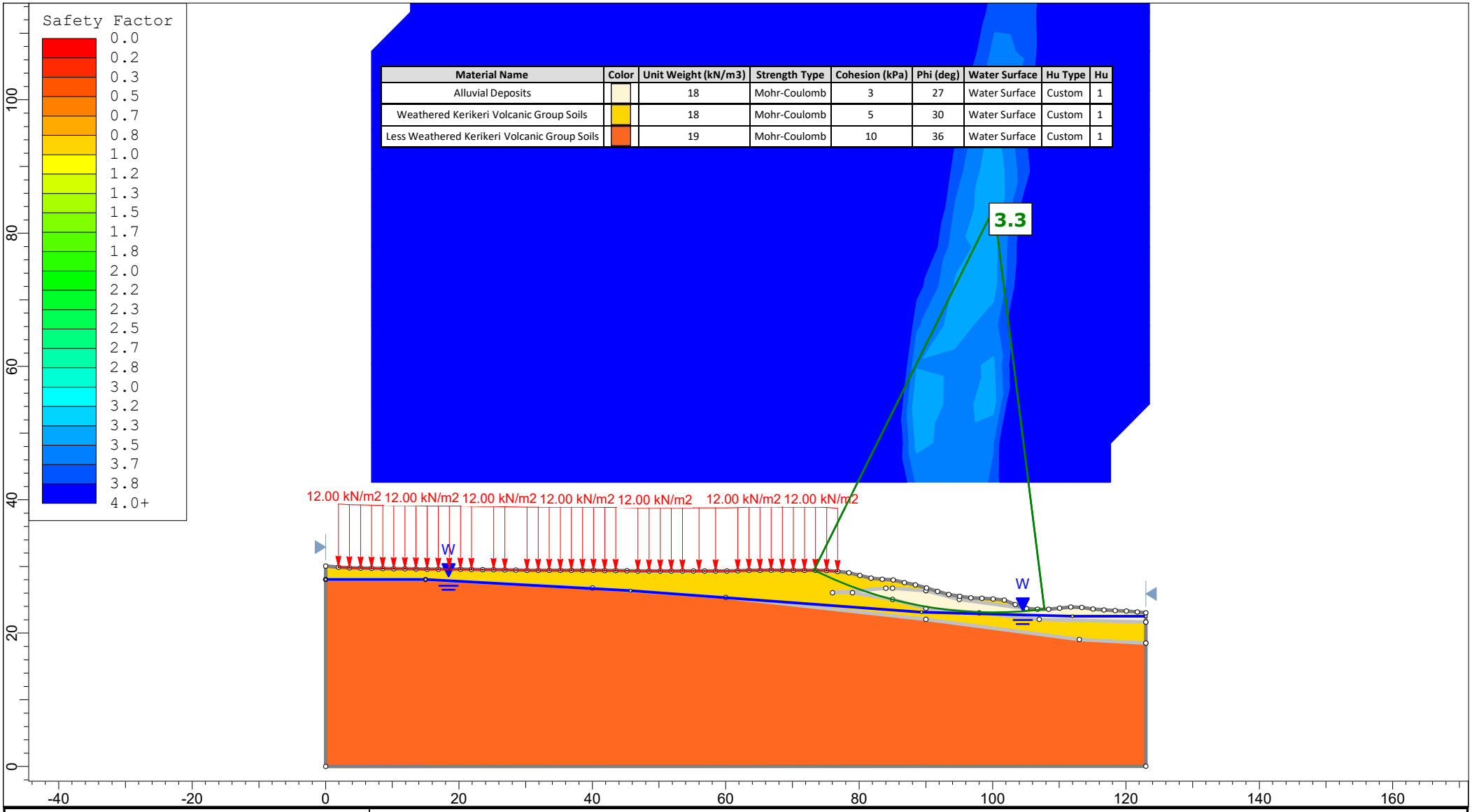


Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - A-A'	*Scenario*	Seismic Loading
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:742



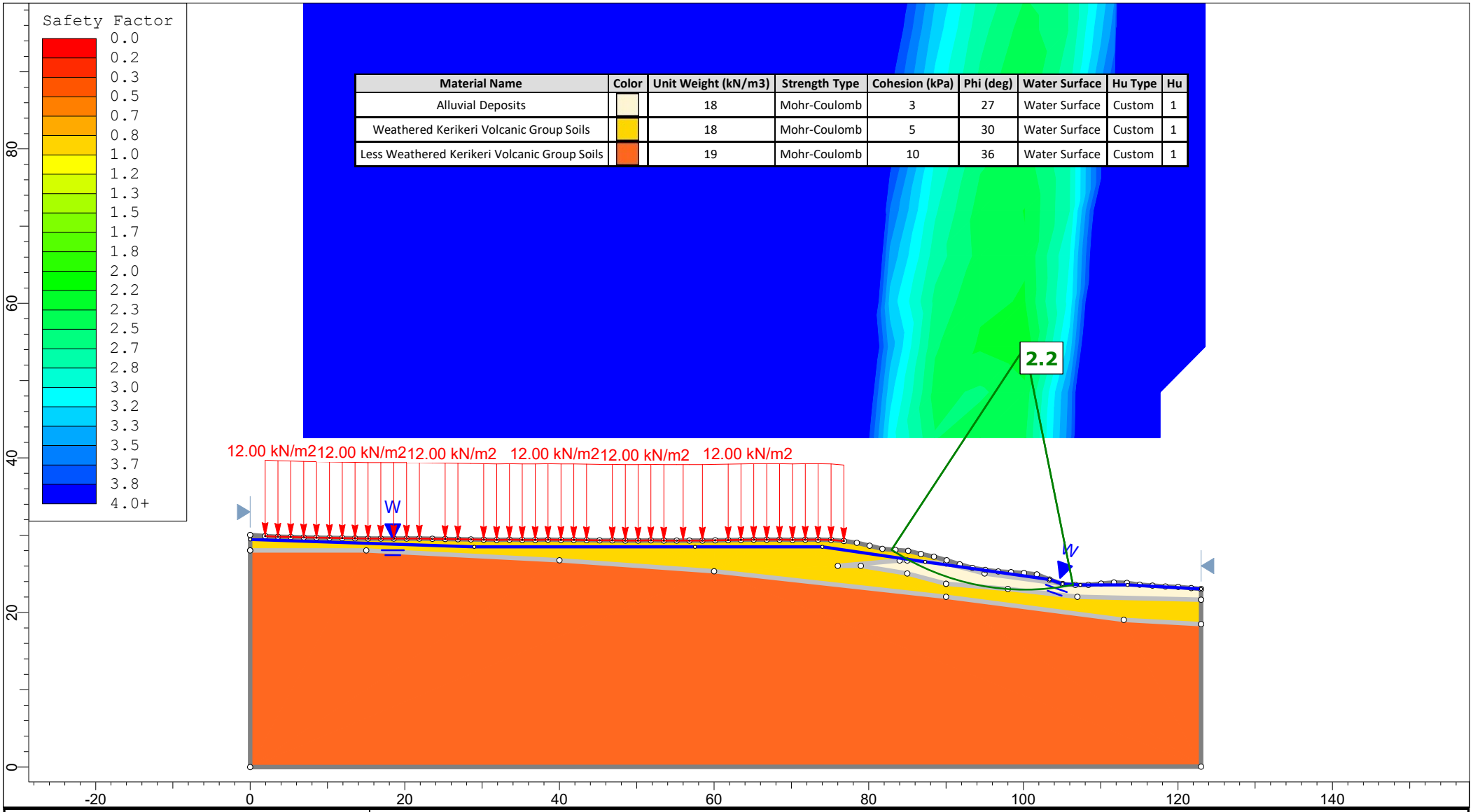
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Alluvial Deposits		18	Mohr-Coulomb	3	27	Water Surface	Custom	1
Weathered Kerikeri Volcanic Group Soils		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Less Weathered Kerikeri Volcanic Group Soils		19	Mohr-Coulomb	10	36	Water Surface	Custom	1

Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - B-B'	*Scenario*	Measured Groundwater Condition
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:793



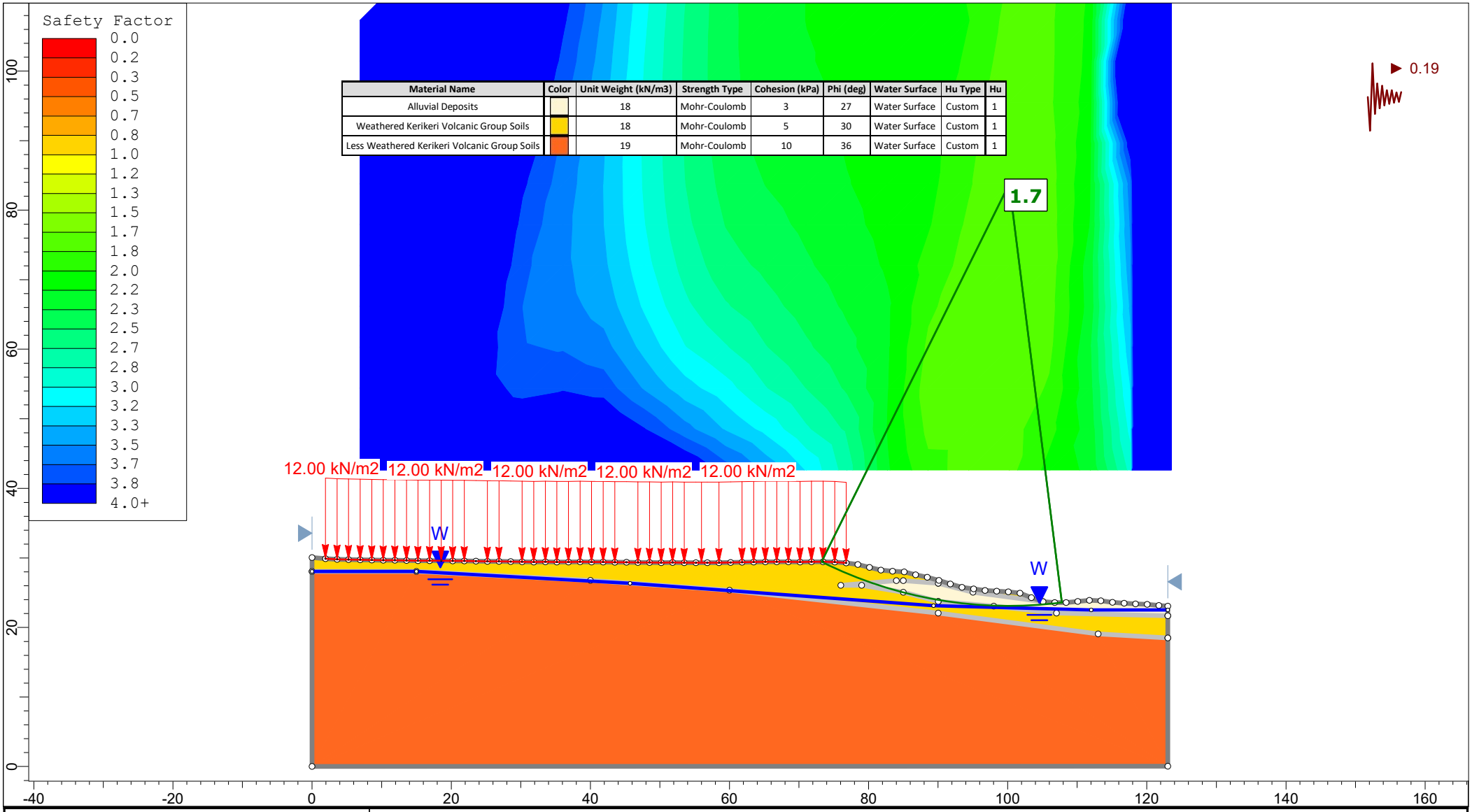
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Alluvial Deposits		18	Mohr-Coulomb	3	27	Water Surface	Custom	1
Weathered Kerikeri Volcanic Group Soils		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Less Weathered Kerikeri Volcanic Group Soils		19	Mohr-Coulomb	10	36	Water Surface	Custom	1

Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - B-B'	*Scenario*	Extreme (Worst Credible) Groundwater Condtion
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:685



Soil&Rock Consultants

Your responsive & cost-effective engineers

SLIDEINTERPRET 9.016

Project	Bisset Road and 10 Rimu Place, Kaikohe		
Analysis	NL230070 - B-B'	*Scenario*	Seismic Loading
Drawn By	AA	*Company*	Soil & Rock Consultants
Date	Oct 2023	*Scale*	1:761

Soil&Rock Consultants

Your responsive & cost-effective engineers

Appendix E

Basalt Construction

Basalt Engineering

Basalt subgrades have a particular set of design and construction characteristics. Hazards/difficulties associated with a basaltic subgrade include the following:

- When located under a layer of surface soil or manmade deposits Large variations in depth to the deposit over short horizontal distances should be expected
- There is no predictable pattern in that variation
- The material may range from loose to tightly-bound cobbles/boulders to intact lava flows. In each case, the material is generally difficult to excavate and can require specialist plant and techniques, ranging from larger excavators fitted with rock buckets to heavy-duty rock breaking plant to explosives, although there are severe restrictions on the use of explosives in most areas. 'Ripping' trials may be required to determine the type of plant required.
- Voids are frequently present ranging in size from cracks to caverns of several metres dimension.
- Basalt flows are frequently episodic and so each basalt layer may be interlaid with weaker material, e.g. ash, welded tuff, scoria or even organic soil deposits.
- Where basalt flows are continuous over considerable depth columnar jointing can be encountered in the absence of horizontal rock defects.
- The lava flows can be thin, overlying weak alluvium. This cannot be determined without intrusive proof drilling
- Foundation designs must consider differential performance as a result of the variable depth to basalt. i.e. transitions from a deeper weathered soil subgrade to shallow basalt are common.
- Strip and pad foundations can be difficult to prepare as the subgrade is frequently a matrix of fine grained soils within fine to coarse gravels. Excavation and cleaning are difficult.
- Pile foundations require specialist drilling techniques, ranging from core drilling to percussion drilling There are a limited number of specialist contractors and a limited pool of equipment available for piling in basalt. Piles sizes are currently limited to 600mm and 800mm diameter with equipment available.
- Construction risk for contractors can involve unstable pile excavations which result in equipment being jammed or even lost in the excavation.
- Proof drilling at the time of foundation preparation is a requirement. For larger commercial projects that drilling can be carried out prior to construction to assist with budgeting, although it must be emphasized even with proof drilling there remains some construction/cost risk
- Voids may require filling. Grouting is generally of limited use in basalts because of long available flowpaths which require large volumes of relatively mobile grout to fill. Experienced contractors have developed methods of concrete-filling voids as they are encountered. This has proven to be more effective and economic than grouting. Considerable volumes of concrete or grout can be consumed.
- Site soil class for the application of NZS 1170.5:2004 is often dependent on the material underlying the basalt flow (Class A or B should not be assumed to apply without geotechnical confirmation)
- Available bearing capacities in basalt rock will be governed by the rock defects rather than the intact strength of the rock.

Examples of Basalt Subgrade Construction

Heavy Duty Rock Breaking to Install Public Services

Highly Variable Basalt Surface

Appendix 4: Wetland Summary Memo

WILD ECOLOGY

NPS-FM wetland summary memo

Part Taraire No 1A Block
and
Lot 1 DP 363959

Bisset Road, Kaikohe

June 2024

DOCUMENT QUALITY ASSURANCE

Bibliographic reference for citation: Wild Ecology (2024). *NPS-FM wetland summary memo prepared for Part Taraire No 1A Block and Lot 1 DP 363959.* Report prepared by Wild Ecology for Sanson Associates.		
Prepared for:	Sanson Associates	
Version:	FINAL (Updated)	
Date:	26/06/2024	
Author:	Madara Vilde Principal Ecologist Wild Ecology	
Revision History		
	FINAL (Updated with NES-FW considerations and effects assessment)	Issue date: 26/06/2024
Status:	FINAL (1st Edition)	Issue date: 14/06/2023
Use and Reliance	This report has been prepared by Wild Ecology on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. This report, all plans, illustrations and other associated material remains the property of Wild Ecology until paid for in full. Copyright and intellectual property rights remain with Wild Ecology. Wild Ecology does not accept any liability or responsibility in relation to the use of this report contrary to the above, or to any person other than the Client. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate, without independent verification, unless otherwise indicated. No liability or responsibility is accepted by Wild Ecology for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.	

CONTENTS

1.0 INTRODUCTION

1.1 Scope

Wild Ecology were engaged by Sanson Associates to carry out a wetland delineation assessment on a site located at Bisset Road, Kaikohe (Lot 1 DP 363959 & Part Taraire 1A Block) ('the Site) to evaluate whether the site contained any habitats meeting the definition of a 'natural inland wetland' as defined within National Policy Statement for Freshwater Management (NPS-FM (2020) and review potential consenting obligations under National Environmental Standards for Freshwater (NES-FW (2020).

The site is zoned as 'Residential' under the Far North District Council (FNDC) District Plan (Operative) and consists of two existing titles with a total site area of approximately 6 ha (Figure 1). A combined land use and subdivision is proposed on the site which will result in the creation of 90 Lots with houses and two vacant Lots plus additional, jointly owned access Lots (JOAL's), reserves and road to vest.

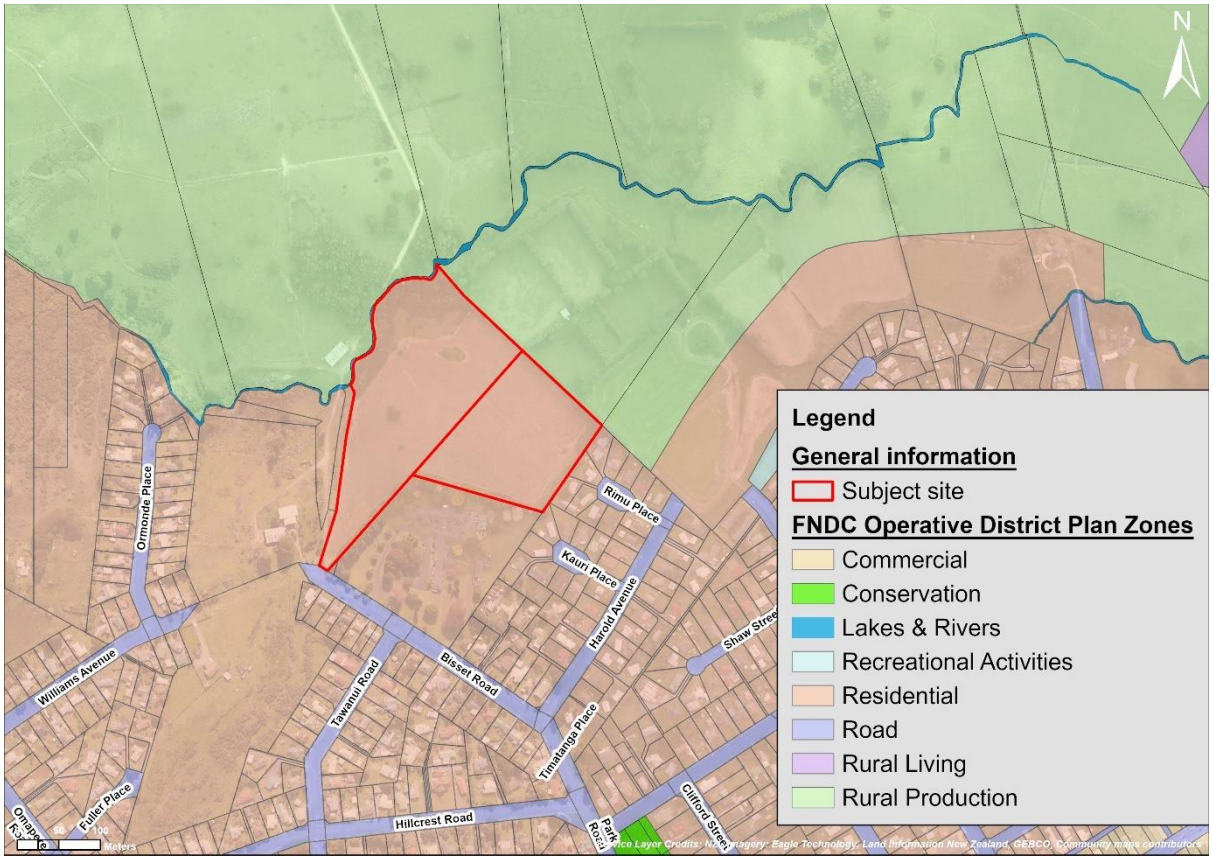


Figure 1: Showing the subject site boundaries and FNDC District Plan (Operative) zoning

Wild Ecology conducted a site walkover visit on June 9th, 2023 to conduct an ecological survey to identify and classify watercourses, and conduct a wetland delineation assessment to identify and delineate 'natural inland wetland' areas within the site boundaries and immediate surrounds that may be affected by the site development.

Watercourses on site and immediate surrounds were classified in general accordance with criteria and definitions outlined in the Proposed Regional Plan for Northland (February 2024).

Wetland delineation survey within the immediate development footprint generally followed wetland assessment methodology based on Ministry for the Environment (MfE) Wetland delineation protocols (2022). Relevant definitions are attached under Appendix 1.

Following the delineation and classification of watercourses and 'natural inland wetland' areas within the site boundaries, this memo provides recommendations to avoid or mitigate any potential adverse effects on natural inland wetland areas on site and outlines potential consenting considerations for any future site development proposal under NES-FW (2020).

2.0 METHODOLOGY

2.1 Desktop Review

The desktop investigation included a review of FNDC overlays, and relevant ecological site information. Ecological databases were also accessed including Retrolens historic aerial imagery, NRC LIDAR aerial imagery and contours, and LINZ river centrelines 1:50000 scale.

2.2 Watercourse classification

Watercourses on site and immediate surrounds were classified in general accordance with criteria outlined in the Proposed Regional Plan for Northland (February 2024) (see Appendix 1 for associated definitions). Classification was made in general accordance with the decision tree outlined under Table 1.

Table 1: Proposed Regional Plan for Northland criteria for permanent, intermittent rivers and streams, ephemeral streams and artificial watercourses

Criterion	Definition
Permanent river or stream	
1	Evidence of continuous flow.
Intermittently flowing river or stream	
1	Evidence of natural pools
2	Well defined channel. Banks and bed can be distinguished.
3	Surface water present (more than 48hrs after a rain event).
4	Rooted terrestrial vegetation not present across the entire cross-sectional width of channel.
5	It appears as a blue line on topographical maps at 1:50,000 scale.
Ephemeral stream	
1	Stream bed above the water table at all times.
2	Water present only during and shortly after rain fall.
	Does not meet classification of an intermittently flowing river or stream.
Artificial watercourse	
1	A man-made channel constructed in or over land for carrying water and includes an irrigation canal, roadside drains and water tables, water supply race, canal for the supply of water for electricity power generation and farm drainage canals.

2	It does not include a channel constructed in or along the path of any historical or existing river, stream or natural wetland.

The surveys were outside the recommended window for classifying intermittent and ephemeral watercourses (July–October) and therefore a conservative approach was taken in respect to stream classification. There were a number of minor rainfall events with a cumulative rainfall of 5.5 mm within 48 hours prior to the June 9th, 2023, survey (Meteorological Service of New Zealand Ltd 2023).

2.3 Wetland delineation

For wetland delineation protocols in the field the NPS-FM refers to the Ministry for the Environment (MfE) Wetland delineation protocols (2022) which are generally based on following the four main steps outlined in Figure 2. The primary step is based on the Vegetation tool for wetland delineation in New Zealand (Clarkson 2013) to determine the status of wetlands. This step relies on the presence or absence of hydrophytic vegetation as being the dominant vegetation type. The list of hydrophytes used in this assessment are as per the most recently revised list (Clarkson *et al.* 2021). The results from the vegetation tool provided conclusive results and therefore dominance and therefore hydric soils tool (Step 3) and wetland hydrology tools (Step 4) were not utilised for this site assessment.

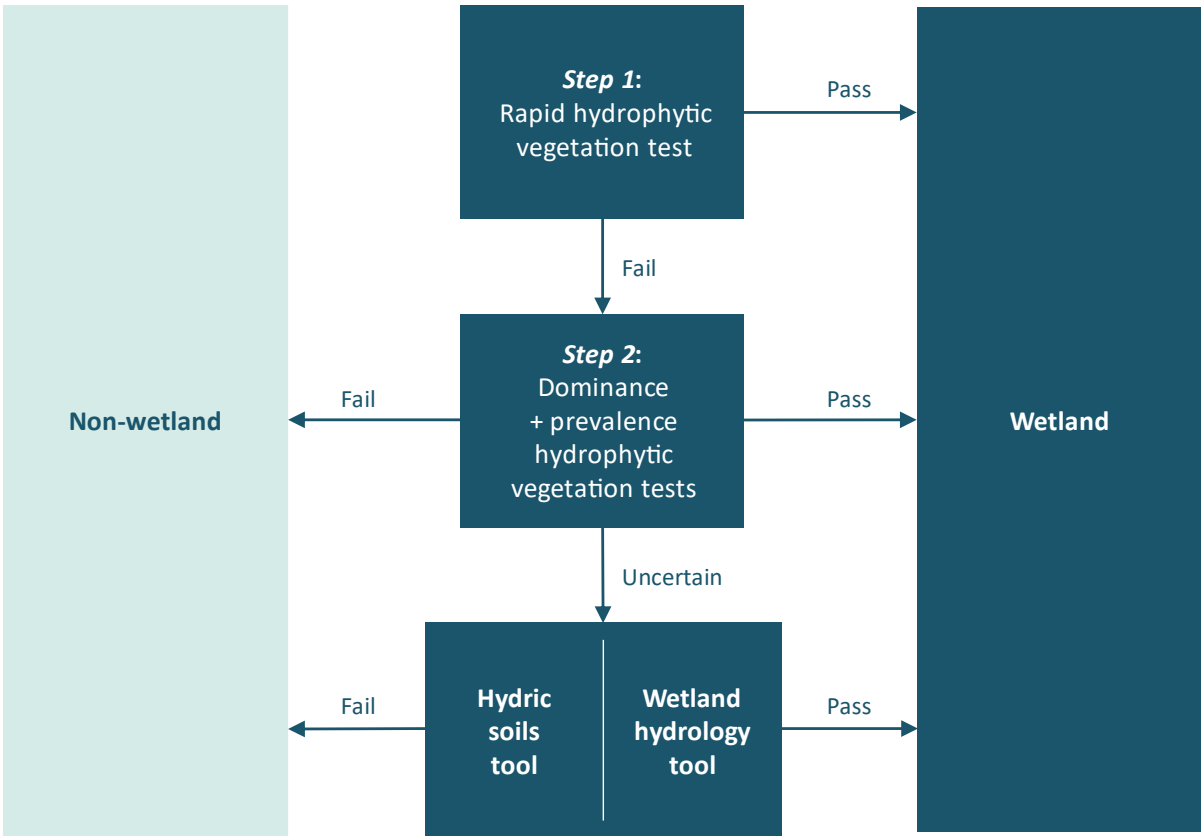


Figure 2: Four steps for delineating wetlands using the hydrophytic vegetation, hydric soils and wetland hydrology tools

In general accordance with MfE (2022) wetland delineation protocols (WDP) the following methodology was applied:

a) An area of wetland type vegetation (total area <2ha) was delineated using a handheld GPS with +/-0.6m accuracy (Trimble DA2).

b) A decision of 'normal circumstances' was made based on typical climatic/hydrologic conditions. Recent low-level disturbance (i.e. stock grazing) was noted and accounted for in the overall assessment.

c) A general description of each area containing wetland type vegetation was noted following wetland delineation with a GPS. Where wetland areas encompassed ephemeral or intermittent waterbodies, the immediate stream channel was included in the assessment where a distinctive open water channel was not present at the time of survey.

d) In each area containing wetland type vegetation, the species in each stratum (herb, sapling/shrub, tree) were identified and percent cover estimated for each of the strata. It should be noted that only herb layer remained somewhat intact within the wetlands onsite because of historic and current land use and land modification.

e) In each area containing wetland type vegetation, hydrophytic vegetation was determined as per Clarkson *et al.* (2021). Where species were not included in the revised Clarkson *et al.* (2021) they were classed according to their known habitat preferences. The basic steps included:

    - For each of the plots a Rapid Test was conducted. All dominant species within the plot must be either OBL or FACW vegetation to confirm if the area is a wetland.

f) Where >50% of the overall vegetation cover consisted of exotic pasture species, these were excluded from the definition of a 'natural inland wetland' as per exclusion (e) (ii) under NPS-FM (2020 – Amended December 2022). As per most recent MfE guidance, improved pasture species were assessed as those described under 'Draft National List of Exotic Pasture Species' (Cosgrove *et al.* 2022) which largely update species that were included as 'pasture species' in the current 4th Edition of Pasture and Forage Plants for New Zealand. The revised 5th Edition contains some additional entries (Stewart, pers comm.) and these have been included (see Appendix 3).

3.0 SITE CHARACTERISTICS AND ANALYSIS

3.1 Site Analysis

Freshwater habitats within the site and immediate surrounds include a permanent stream habitat meandering along the sites north-western boundary, being identified as Mangamutu Stream, a small pond area and a wetland area. These were delineated at part using topographical information obtained from LIDAR and further classified during a site visit on June 9th 2023, with their status determined in accordance with PRPN watercourse definitions. Where there was uncertainty about the classification of a watercourse or waterbody, historic aerial imagery analysis (Retrolens) and professional judgement was utilised.

Having reviewed historic imagery for the site from 1957 (Figure 3), 1982 (Figure 4), 2006 (Figure 5), and most recent aerial imagery from 2020 (Figure 6) it appears that the site has been utilised as a grazing/cropping block at least since 1957. In respect to waterbodies and wetland features, from analysing historic aerial imagery it is apparent that the sites north-western aspect contains obvious patterns of 'wet areas' which is especially evident under Figure 4. Sometime between 1982 and 2006 a small stock watering pond (Figure 7) has been established within this lower lying 'wet' feature which is evident within the sites north-western aspect under Figure 5. Given that the stock pond has been established within what is likely to have been a wetland type habitat, it is deemed that it can not be classified as an artificial waterbody, as it has been historically constructed in or along the path of any historical river, stream or natural wetland.

According to Singers (2018) (Figure 8), the ecosystem type that would have likely once extended along the northern aspect of the site would have been representative of WF7-3 Kahikatea, puriri forest of which representative species were identified both on site and within the immediate surrounds. Based on site observations this area likely forms a floodplain area of the Mangamutu Stream which is supported by FNDC Flood modelling data (2007) shown under Figure 9.

At current day the majority of the site is dominated by exotic pasture and exotic scrubland, with some isolated indigenous trees dotted throughout the pasture areas (Figure 10). No habitat on site or immediate surrounds has been identified as a Protected Natural Area (PNA) or a proposed Significant Ecological Area (SEA). A small open water feature (i.e. stock pond which had been established within what is a likely historic wetland feature) and a wetland feature is present within the sites north-western aspect seeping in a northerly direction and discharging into Mangamutu Stream roughly at the sites north-western boundary. A riverine wetland feature also encompasses the lower lying Mangamutu Stream margins which extend along the site's northern aspect.

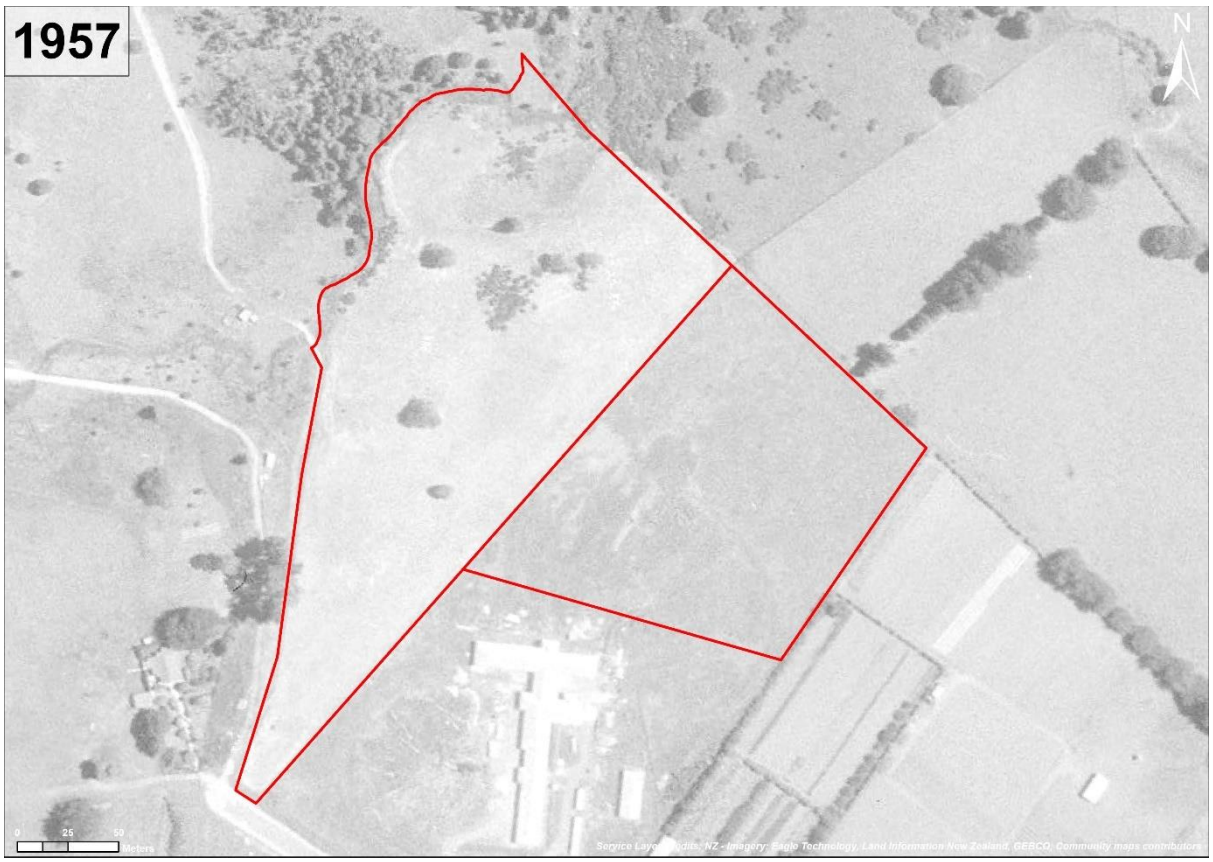


Figure 3: Showing the site boundaries in 1957 (Source: Retrolens)

Figure 4: Showing the subject site boundaries in 1982 (Source: Retrolens)

Figure 5: Showing the subject site boundaries in 2006 (Source: LINZ aerial imagery for Northland)

Figure 6: Showing the subject site boundaries in 2020 (Source: NRC LIDAR)

Figure 7: Showing the stock pond area established on the site's north-western aspect sometime between 1987 and 2006 – this now appears to be disused

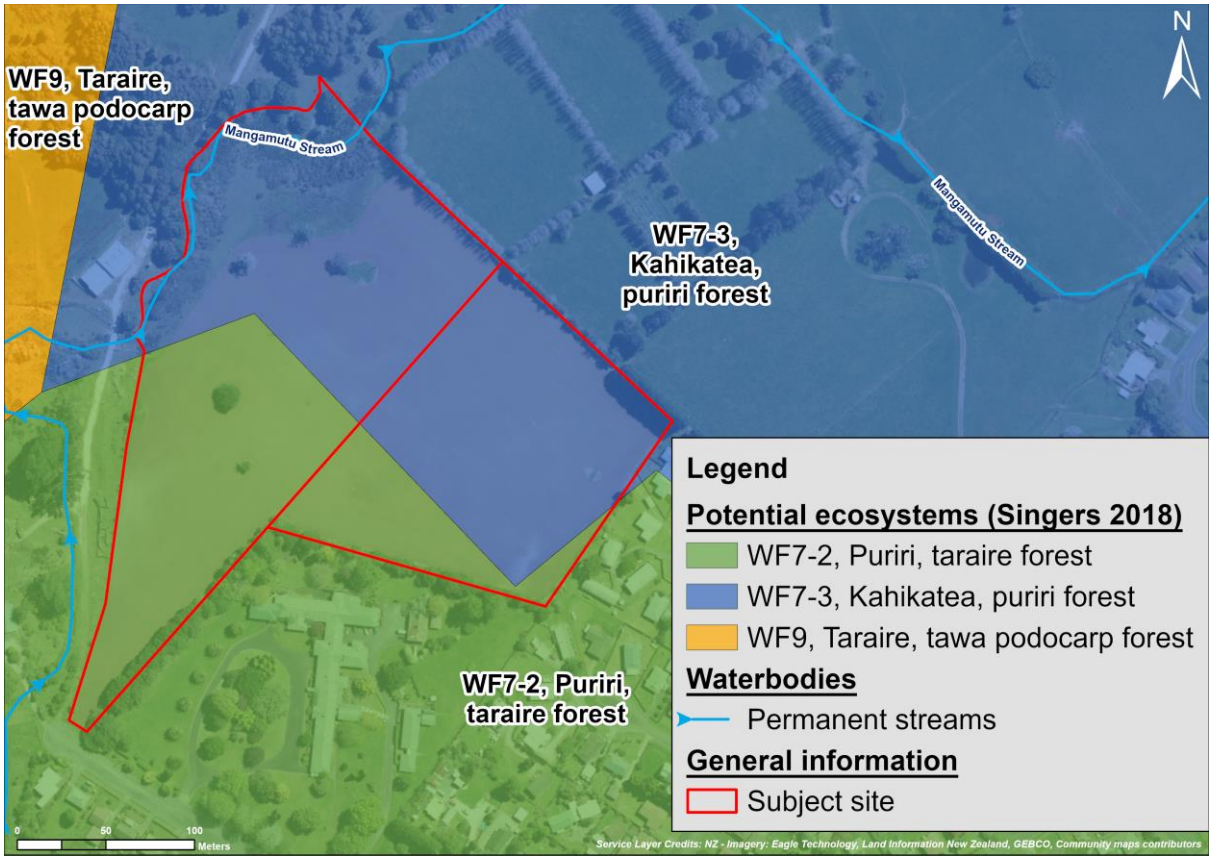


Figure 8: Showing the potential ecosystem layer (Singers 2018)

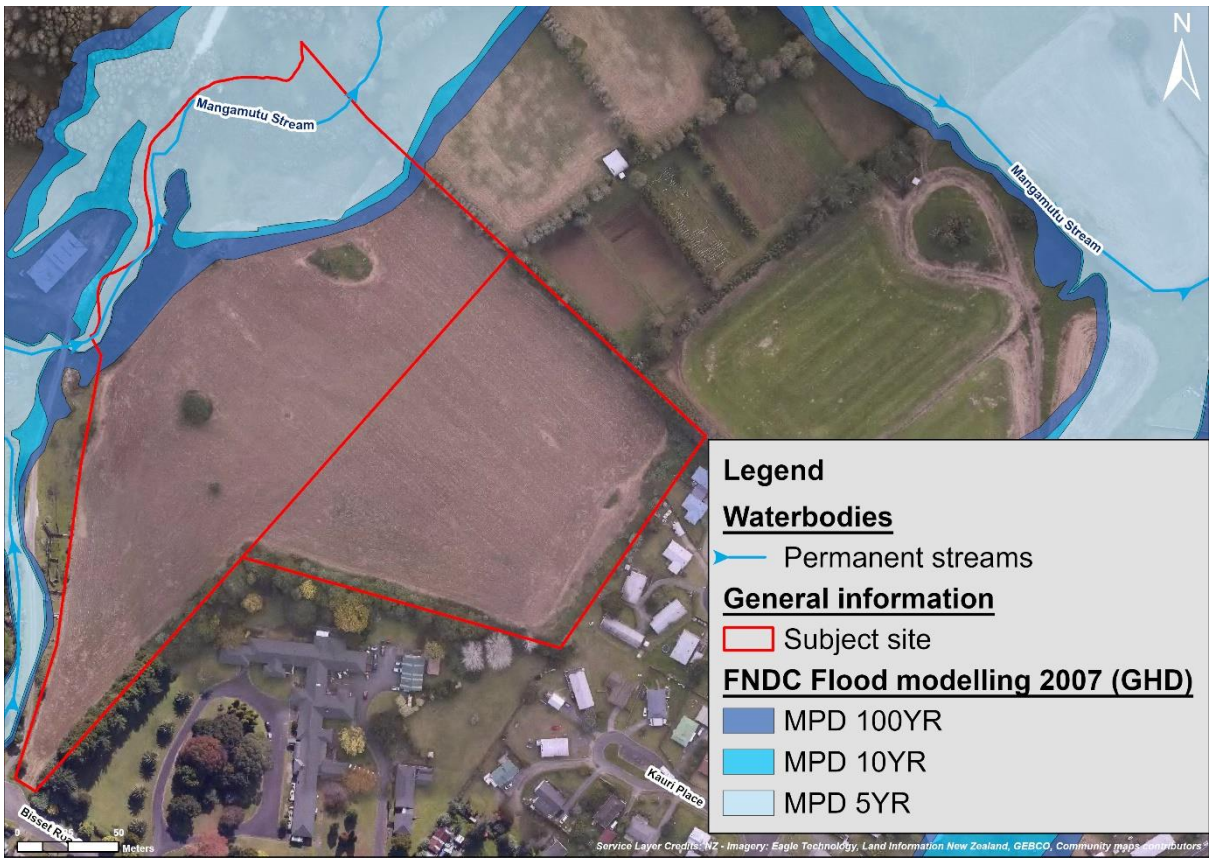


Figure 9: FNDC Flood Modelling (2007 (GHD) overlay

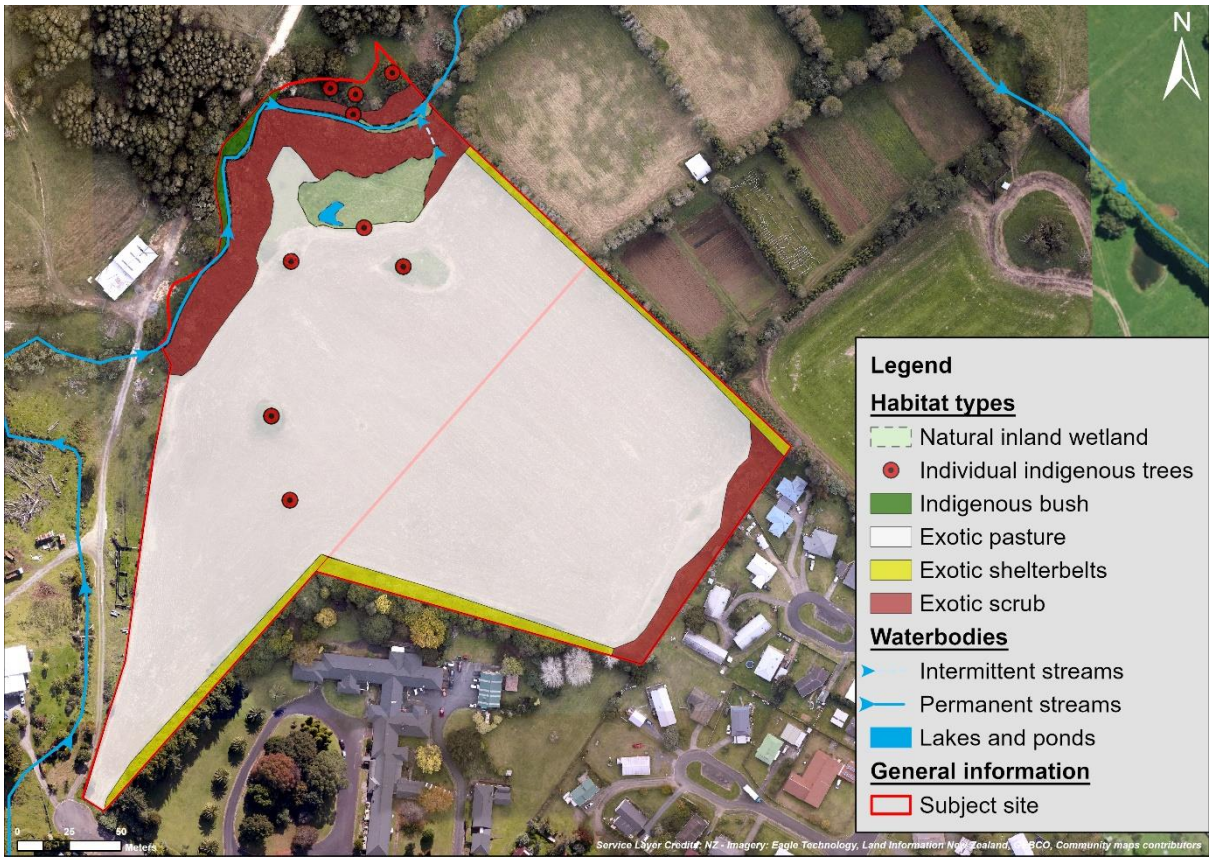


Figure 10: Showing habitat types identified on site during a site visit on June 9th, 2023

3.2 NPS-FM Wetland Assessment

3.2.1 NPS-FM 'natural inland wetland' definition and exclusions

The National Policy Statement for Freshwater (NPS-FM) 2020 provides local authorities with updated direction on how they should manage freshwater under the Resource Management Act 1991. The National Environmental Standard for Freshwater (NES-FW) sets out national rules for works and discharges in the vicinity of natural wetlands.

The RMA (1991) definition of a wetland "*includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions"*.

MfE released an amended version of the NPS-FM and NES-FW on 08/12/22. The revised NPS-FM definition of a 'natural inland wetland' is set out below:

Natural inland wetland means a wetland (as defined in the Act) that is not:

> *(a) in the coastal marine area; or*
> *(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or*
> *(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or*
> *(d) a geothermal wetland; or*
> *(e) a wetland that:*
>
> > *(i) is within an area of pasture used for grazing; and*
> > *(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless*
> > *(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply*

For the purpose of this assessment to assess whether a wetland area comprises more than 50% exotic pasture species cover, the general species composition was assessed against pasture or forage species that have been described under 'Draft National List of Exotic Pasture Species' (Cosgrove *et al.* 2022) which largely update species that were included as 'pasture species' in the current 4th Edition of Pasture and Forage Plants for New Zealand.

Please note that the small stock pond area on site is deemed to have been historically established within a historic wetland area and therefore it is not considered to meet the definition of an artificial watercourse (as defined under PRPN February 2024) or deliberately constructed waterbody (as defined under NPS-FM 2020).

3.2.2 NPS-FM 'natural wetland' delineation assessment

Based on a brief desktop assessment and site visit conducted on June 9th, 2023 it was deemed that the site contains or directly abounds areas of 'wetland' habitats as defined under the RMA.

During a site walkover it was noted that these areas were dominated by a mixture of indigenous and exotic species that are commonly recorded growing within seasonally saturated land, and therefore a wetland delineation assessment based on the rapid wetland delineation test was carried in general accordance with MfE (2022) Wetland delineation methodology. The boundary of the wetland areas was established by utilising a 100m tape between the interface of wetland and non-wetland (pasture/exotic scrub vegetation) by establishing side by side 2m x 2m plots and recording the species assemblages. The results of this assessment are presented under Table 2, Figure 11 and Appendix 2.

Table 2: Wetland description on site

Identifier	Dominant species	Natural inland wetland as defined under NPS-FM	Size
W1	*I.globosa – I. prolifera - P. distichum – J. effusus – J. articulatus*	Yes	1,547 m^2
W2	*P. hydropiper – R repens - C. crocosmiiflora*	Yes	81 m^2
W3	*P. hydropiper – R repens - C. crocosmiiflora*	Yes	36 m^2

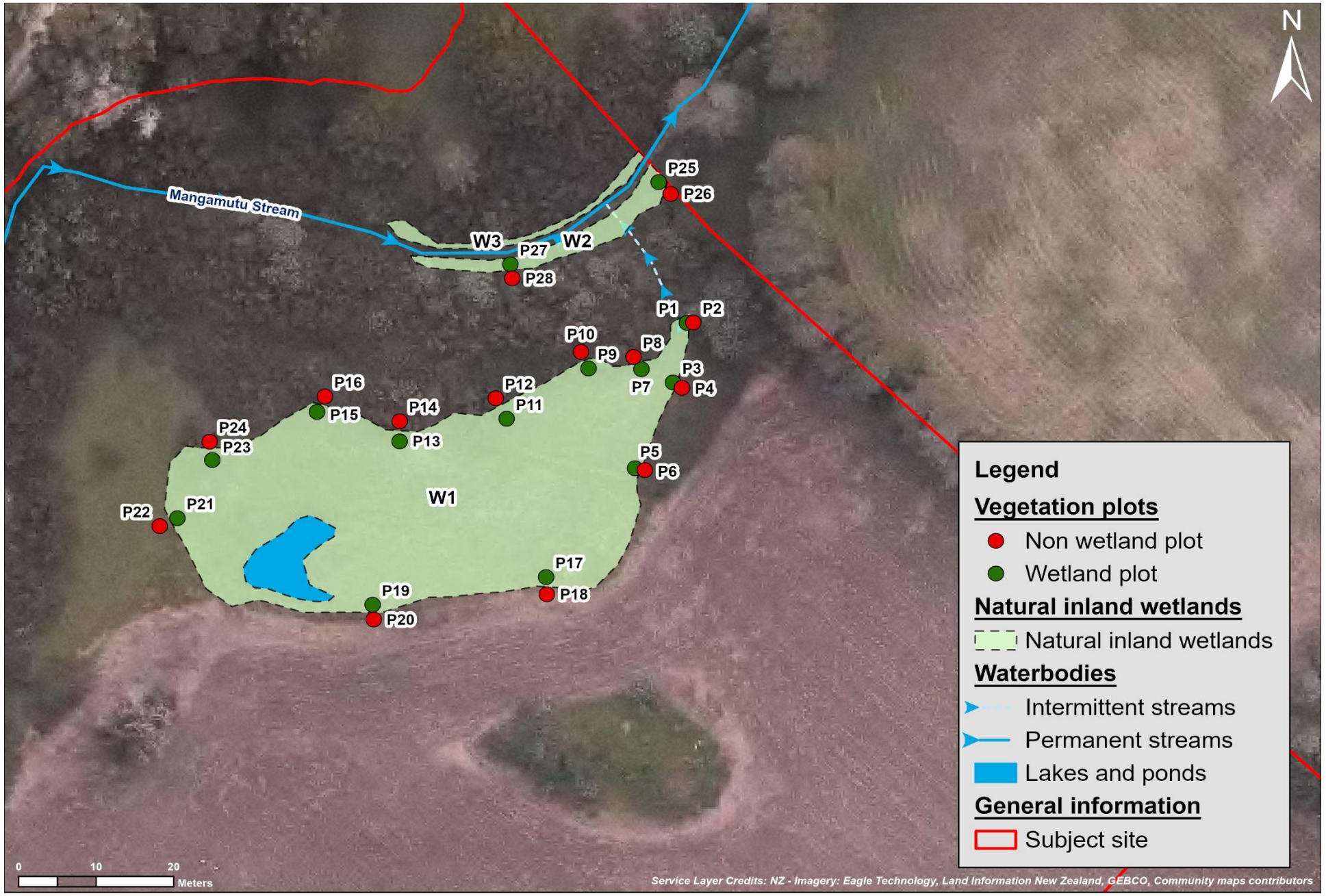


Figure 11: Showing 'natural inland wetland' (NPS-FM) area extent on site and vegetation delineation plot location

W1 (Figure 12) was primarily dominated by 'obligate' swamp millet (*Isachne globosa*), with patches of 'obligate' budding-club rush (*Isolepis prolifera*), interspersed with 'facultative wetland' mercer grass (*Paspalum distichum*) throughout. Other species in this area included 'facultative wetland' soft rush (*Juncus effusus*), fan-flowered rush (*Juncus sarophorus*), 'obligate' jointed twig rush (*Machaerina articulta*) and 'facultative wetland' rautahi (*Carex lessoniana*). Part of the wetland area is fenced, and natural regeneration of species such as swamp millet and rautahi was particularly evident in this area.

At the head of W1 (northern aspect) the wetland area ends abruptly and turns into a more representative intermittent stream habitat flowing in a northerly direction through exotic scrubland and discharges into Mangamutu Stream.

Figure 12: Showing a representative photo of W1 (Photo: June 2023)

W2 and W3 (Figure 13) are riverine wetlands which form a small band of wetland habitat encompassing the lower lying aspects of Mangamutu Stream. The wetland areas are dominated by exotic species including 'facultative wetland' water pepper (*Persicaria hydropiper*), 'facultative' buttercup (*Ranunculus repens*), and 'facultative upland' Montbretia (*Crocosmia x crocosmiiflora*). The remainder of the stream course flowing in a southerly direction has well defined steep banks that are dominated by exotic grasses and exotic scrubland.

Figure 13: Showing a representative photo of W2 and W3 extending along Mangamutu Stream riparian area (Photo: June 2023)

The immediate areas encompassing the wetland habitats (Figure 14) were dominated ither by exotic pasture or exotic scrubland by a range of weedy species including kikuyu (*Cenchrus clandestinus*), gorse (*Ulex europaeus*), blackberry (*Rubus fructicosus* agg.), Woolly nightshade (*Solanum mauritianum*), wandering willie (*Tradescantia fluminensis*), montbretia (*Crocosmia x crocosmiiflora)*, Arum lily (*Zantedeschia aethiopica*), tree privet (*Ligustrum lucidum*) among others. Some of these species are also scattered sparsely through the wetland areas.

Figure 14: W1 is encompassed by exotic scrubland to the west and exotic pasture to the east (Photo: June 2023)

4.0 NES-FW (2020) CONSIDERATIONS

The proposed development (please refer to Chester Scheme Plan and Engineering Drawings) has been designed with the input of the results of the watercourse and wetland classification and delineation provided by Wild Ecology, with the proposed built development to be placed as far as practicable from the sensitive receiving environments.

In respect to NES-FW it is considered that the proposal is a restricted discretionary activity under Regulation 45C 'Urban development' of NES-FW (2020). It is proposed to construct a new wetland and a new reticulated stormwater system to provide stormwater management for the proposed development (see Figure 15).

The installation of the proposed stormwater network will require to take place within a 10m setback of the identified natural inland wetland and stormwater will be partly discharged within 10m setback the existing natural inland wetland and therefore a NES-FW (2020) consent under Regulation 45C(1) and 45C(2) will be required. A basic assessment in relation to consenting obligations under NES-FW (2020) is briefly discussed under Table 3 below.

Due to the proximity of works to be located near a natural inland wetland, and to ensure that potential and actual adverse effects can be avoided, remedied or mitigated it is recommended that the natural inland wetland area on site and its margins are to be enhanced through pest weed control and revegetation planting as part of the development proposal. The proposed revegetation planting has been further addressed in Landscape Reporting and Plans prepared by Greenwood Associates.

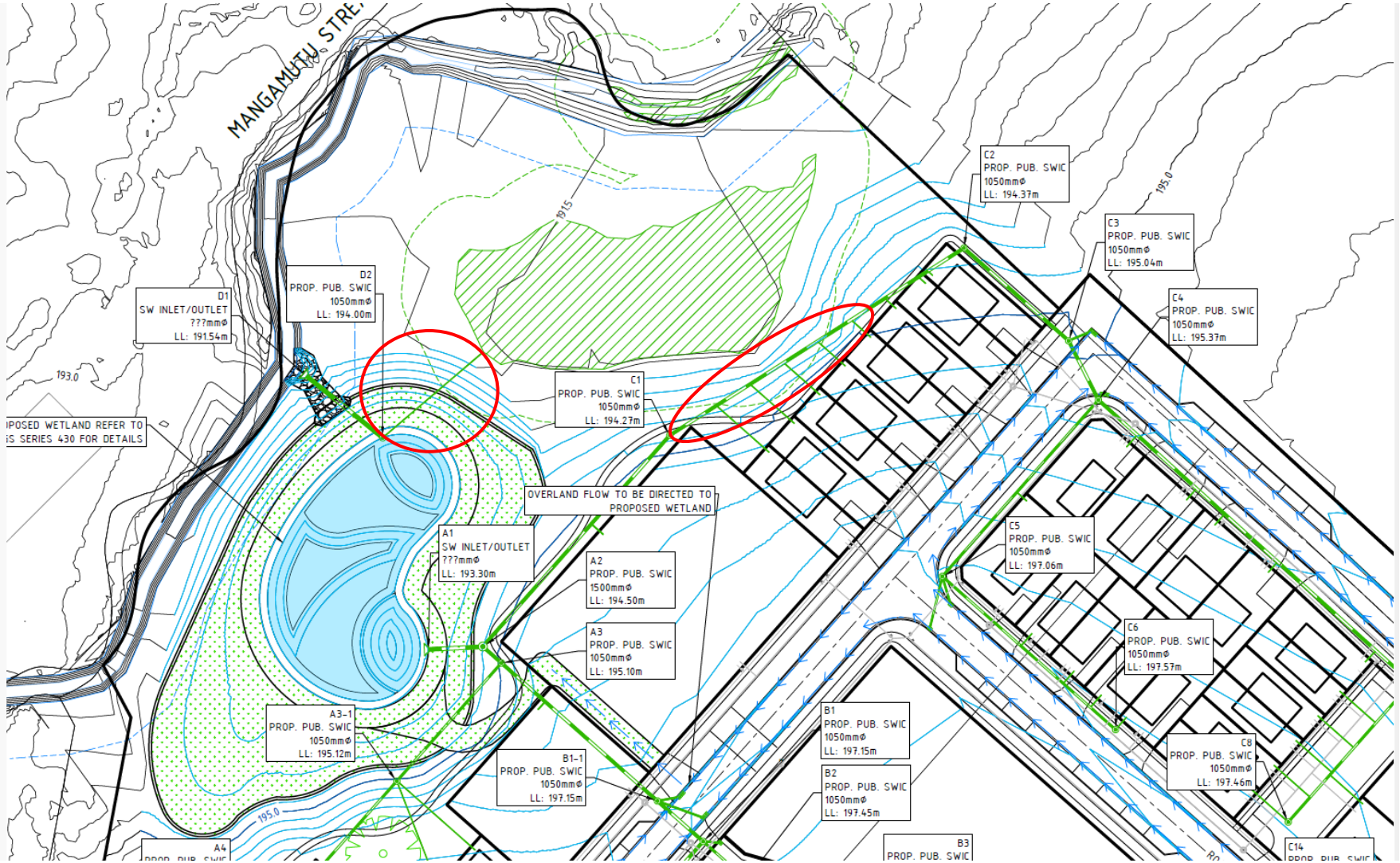


Figure 15: Showing a snippet from Chester Stormwater Layout Plan – red circles identify where earthworks for stormwater network installation will be required to take place within a 10m setback from a natural inland wetland, note that stormwater overflow from the constructed stormwater wetland will be partly discharged into the existing natural inland wetland on site

Table 3: Assessment of NES-FW consenting obligations

NES-FW (2020) Regulation	Comment/assessment
45C Restricted discretionary activities (1) Vegetation clearance within, or within a 10 m setback from, a natural inland wetland is a restricted discretionary activity if it is for the purpose of constructing urban development.	Consent under Regulation 45C(1) is required as the proposal will result in the disturbance and clearance of pastoral exotic vegetation within a 10m setback of a wetland area as part of stormwater network upgrade/construction. Please note that no indigenous vegetation clearance is proposed, and vegetation clearance will be limited to exotic pasture grasses and forbs forming the exotic pasture sward at the location of the existing culvert crossing to be upgraded as part of the development proposal.
(2) Earthworks or land disturbance within, or within a 10 m setback from, a natural inland wetland is a restricted discretionary activity if it is for the purpose of constructing urban development.	Consent under Regulation 45C(2) is required as the proposal requires that the public stormwater network will partly require to be located within a 10m setback of 'natural inland wetland' areas. This will require minor earthworks (approximately 700 m^2 according to Chester Reporting) to take place within a 10m setback of the natural inland wetland area. Site earthworks should be undertaken during suitable weather conditions and dry periods when the wetlands and watercourses are likely to be naturally dry to avoid any potential residual risk to aquatic organisms during the construction of the accessway. All sediment and erosion controls to be installed as per GD05 and associated technical reporting prepared for the site development.
(3) Earthworks or land disturbance outside a 10 m, but within a 100 m, setback from a natural inland wetland is a restricted discretionary activity if it— (a) is for the purpose of constructing urban development; and (b) results in, or is likely to result in, the complete or partial drainage of all or part of the wetland.	Consent under Reg 45C(3) is not required as while earthworks or land disturbance will take place within a 100m setback of a natural inland wetland it will not result or is not likely to result in complete or partial drainage of all or part of the identified wetland areas.
(4) The taking, use, damming, or diversion of water within, or within a 100 m setback from, a natural inland wetland is a restricted discretionary activity if— (a) the activity is for the purpose of constructing urban development; and	Consent under Reg 45C(4) is not required as while the stormwater diversions associated with the site development will occur within a 100m setback from the identified wetland areas and will have a hydrological connection with these areas, they will not change or are unlikely to change the water level range or hydrological function of the wetland.

(b) there is a hydrological connection between the taking, use, damming, or diversion and the wetland; and (c) the taking, use, damming, or diversion will change, or is likely to change, the water level range or hydrological function of the wetland	Reporting prepared by Chester states that it is proposed to feed treated stormwater from the constructed wetland into the existing wetland in a controlled manner, to keep the existing natural wetland water level to its pre-development status.
(5) The discharge of water into water within, or within a 100 m setback from, a natural inland wetland is a restricted discretionary activity if— (a) the discharge is for the purpose of constructing urban development; and (b) there is a hydrological connection between the discharge and the wetland; and (c) the discharge will enter the wetland; and (d) the discharge will change, or is likely to change, the water level range or hydrological function of the wetland.	Consent under Reg 45C(5) is not required as while stormwater will be discharged to water and will have a hydrological connection between the discharge and the wetland, and discharge will enter wetland, the overall volume of water entering the aquatic features is not expected to increase to any quantifiable level. Reporting prepared by Chester states that it is proposed to feed treated stormwater from the constructed wetland into the existing wetland in a controlled manner, to keep the existing natural wetland water level to its pre-development status. These discharges are not likely to change the water level range or hydrological function of the wetland areas.

4.1 Earthworks and Construction Effects

No earthworks are to take place within the existing identified natural inland wetland areas on site. Building platforms, driveways, and other permanent or semi-permanent structures on the new lots have been located as far as practicable outside the identified natural inland wetland areas, however, the public stormwater network construction will require to be constructed within a 10m setback of the natural inland wetland identified on site (Figure 15).

Within the wider site, active site development is likely to involve earthworks and construction effects that would include stripping of soil, formation of driveways/accessways, building platforms and construction of an artificial wetland area. Physical works associated with developing the site have the potential to result in the mobilisation of fine sediment and runoff entering the wetland areas and waterbodies on site. The addition of fine sediment to aquatic environments has the potential to alter water chemistry, result in sediment build-up, increase turbidity and decrease light penetration that affects primary production and feeding for some aquatic species.

It is deemed that indicative built development associated with the proposal has been designed for the effects associated with soil stripping and site preparation for construction to be assessed as less than minor, should appropriate sediment control practices be employed during active site development works to ensure that sediment laden water (runoff or other) is not able to enter the wetland areas on site or immediate surrounds.

However, there remains a residual risk, especially during adverse weather events of these controls being compromised and extraneous material entering wetland habitat. Therefore, adaptive erosion and sediment control practices should be put in place during the physical development of the site. Earthworks should be undertaken during suitable weather conditions and dry periods to avoid any potential residual risk during adverse weather events. Erosion and sediment controls are to be completed prior to earthworks being commenced on site.

To reduce any potential negative effects on the sensitive receiving environment all erosion and sediment control measures are proposed to be constructed and maintained in accordance with the principles and best practice described under Auckland Council technical publication "2016/005: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region" (GD05) and "Section 4, Land Stability and Earthworks." A suitably qualified and experienced person shall supervise the installation of all erosion and sediment controls. Earthworks should be undertaken by an earthworks contractor with experience operating in and around natural wetland environments, and an awareness of the risks, hazards, and environmental sensitivities of these areas.

It is deemed that consent under Regulation 45C(1) and 45C(2) of NES-FW is required as earthworks associated with the site development will have to occur within a 10 m setback from an identified natural inland wetland. Should appropriate erosion and sediment control measures be constructed and maintained in accordance with the principles and best practice, the effects are likely to be low, i.e. less than minor. To reduce any residual risk to the natural inland wetland area it is proposed that the wetland area is enhanced through weed control and planting.

4.2 Stormwater diversions and discharges

It is proposed to construct a new artificial wetland and a new reticulated stormwater system to provide stormwater management for the proposed development. It is proposed to feed treated stormwater from the constructed wetland into the existing wetland in a controlled manner, to keep the existing natural wetland water level to its pre-development status.

From an ecological perspective, the establishment of stormwater infrastructure will occur within a 100m setback from the identified natural inland wetland areas and is anticipated to involve some minor earthworks and will result in some additional hydraulic inputs that are to be diverted downslope, which will be hydraulically connected to the onsite natural inland wetland areas. Chester Reporting states that the water level within the existing wetland area on site will be kept to its pre-development status, and therefore the overall volume of water entering the aquatic features is not expected to increase to any quantifiable level. These discharges are not likely to change the water level range or hydrological function of the existing wetland area. A greater volume of water entering the wetland area will in fact likely positively support the growth of hydrophytic vegetation along the riparian margins and support habitat provision for instream fauna such as fish and invertebrates.

Sufficient sediment and erosion controls will be required for works nearby any watercourses and natural inland wetland area identified on site and will need to adhere to strict sediment control protocols to avoid the discharge of sediment to the downstream environment. If stormwater management and stormwater quality are to meet industry standards, stormwater related effects are expected to be less than minor to the receiving environment.

Stormwater diversions on site will be located within a 100m setback of a natural inland wetlands and will have some hydrological connectivity with the wetland area on site, however the diversion is unlikely to result in any measurable change in water level range or hydrological function of the natural inland wetlands and therefore it is considered that a consent under NES-FW Regulation 45C(4) is not required. It is understood that stormwater will be discharged to water within a 100m setback from an identified natural inland wetland, however these discharges, are unlikely to change the water level range or hydrological function of the wetland therefore consent for stormwater discharges under NES-FW Regulation 45C(5) is not required. Earthworks associated with stormwater infrastructure to be established within a 10m setback of a natural inland wetland area has been addressed under consent required under Regulation 45C(2).

5.0 RECOMMENDED WETLAND ENHANCEMENT

Following the wetland delineation assessment carried out on site and the need for earthworks to be carried out within a 10m setback of identified natural inland wetland areas, Wild Ecology recommended that wetland enhancement and protection should form part of the application to give effect to the effects management hierarchy which aims to avoid, minimise and mitigate potential adverse ecological effects on the environment. This will ensure that any residual effects associated with the earthworks required to be carried out within a 10m setback of the identified wetland areas will be fully mitigated through weed control and revegetation planting.

The area proposed for revegetation planting and enhancement is described under Landscape Reporting and Plans prepared by Greenwood Associates. This extends over the entirety of the 'natural inland wetland' areas delineated on site and their surrounding margins which currently comprise primarily of exotic pasture and/or exotic scrubland. The proposed landscape plantings will provide for a physical separation between the core wetland area and the wider residential development.

The ecological management actions for the wetland enhancement area can be divided into the following:

- Site preparation for planting;
- Conducting revegetation planting utilising appropriate eco-sourced species based on the sites locality and setting;
- Management of biosecurity risks, non-eco sourced plants and environmental pest weeds into the site;
- Ongoing weedy species maintenance and plant replacement.

6.0 CONCLUSIONS

Based on desktop analysis of relevant ecological data, and a site survey visit conducted on June 9th, 2023, the subject site contains 'wetland' habitats as defined under the RMA and 'natural inland wetland' as defined under NPS-FM (2020).

Potential ecological effects on natural inland wetland habitats associated with the Proposal have been assessed under Section 4 of this report. It is considered that the layout of the proposed development has been comprehensively designed to ensure that the development avoids or

mitigates potential adverse effects on the aquatic habitats present within the site boundaries and allows for ecological enhancement of the onsite wetland habitat to be achieved as part of the development proposal (described under Section 5). The subsequent level of potential ecological effects (with mitigation measures implemented) is considered to be low ('less than minor').

Therefore, it is considered that there are no significant constraints to the proposed development of the site, and any potential adverse ecological effects can be sufficiently avoided, remedied or mitigated through a combination of integrated design principles, and NES-FW controls and policies. Provided that they are implemented successfully, adverse effects on the environment would be low (i.e less than minor) and acceptable, and would, in fact, allow for the enhancement of aquatic ecological values within the site boundaries and a deliver a positive biodiversity gain.

7.0 REFERENCES

Clarkson B. (2013). A vegetation tool for wetland delineation in New Zealand. Prepared for Meridian Energy Limited, December 2013.

Clarkson B.R., Fitzgerald N.B., Champion P.D., Forester L., Rance B.D. (2021). New Zealand wetland plant list 2021. Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

Cosgrove, G., Dodd, M., James T. (2022). National list of exotic pasture species (draft). Draft report prepared for the Ministry for the Environment. Retrieved from https://environment.govt.nz/assets/publications/literature-review-national-list-exotic-pasture-species26May2022.pdf

Far North District Council (2009). Operative Far North District Plan. Retrieved from https://www.fndc.govt.nz/Your-council/District-Plan/Operative-plan

Fraser S., Singleton P., Clarkson B. (2018). Hydric Soils – Field Identification guide. Contract report LC3233 for Tasman District Council 2018.

Lynn I.H., Manderson A.K., Page M.J., Harmsworth G.R., Eyles G.O., Douglas G.B., Mackay A.D., Newsome P.J.F. (2009). Land Use Capability Survey Hand-book – a New Zealand handbook for the classification of land 3rd ed. Hamilton. AgResearch, Lincoln; Landcare Research; Lower Hutt, GNS Science. 163p.

Ministry for the Environment. (2022). Wetland Delineation Protocols. Wellington: Ministry for the Environment.

New Zealand Government (2022). Resource Management (National Environmental Standards for Freshwater) Amendment Regulations (No 2) 2022. Retrieved from https://www.legislation.govt.nz/regulation/public/2022/0320/latest/LMS786420.html#LMS786457

New Zealand Government (2022). National Policy Statement for Freshwater Management 2020 – Amended December 2022. Retrieved from https://environment.govt.nz/publications/national-policy-statement-for-freshwater-management-2020-amended-december-2022/

Northland Regional Council (2024). *Proposed Regional Plan for Northland – February 2024*. Retrieved from https://www.nrc.govt.nz/media/2yojfgax/proposed-regional-plan-february-2024.pdf

Singers, N.J.D., Rogers, G.M. (2014) A classification of New Zealand's terrestrial ecosystems. Retrieved from https://www.doc.govt.nz/documents/science-and-technical/sfc325entire.pdf

Singers N., Osborne B., Lovegrove T., Jamieson A., Boow J., Sawyer J., Hill K., Andrews J., Hill S., Webb C. (2017). Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council.

APPENDIX 1 – DEFINITIONS

Resource Management Act 1991

Artificial watercourse

under River definition an 'artificial watercourse' is described as
'including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal'

Coastal Marine Area

Means the foreshore, seabed, and coastal water, and the air space above the water—
(a) of which the seaward boundary is the outer limits of the territorial sea:
(b) of which the landward boundary is the line of mean high water springs, except that where that line crosses a river, the landward boundary at that point shall be whichever is the lesser of—
(i) 1 kilometre upstream from the mouth of the river; or
(ii) the point upstream that is calculated by multiplying the width of the river mouth by 5

River

Means a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal)

Water body

Means fresh water or geothermal water in a river, lake, stream, pond, wetland, or aquifer, or any part thereof, that is not located within the coastal marine area

Wetland

Includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

Proposed Regional Plan for Northland February 2024

Artificial watercourse

A man-made channel constructed in or over land for carrying water and includes an irrigation canal, roadside drains and water tables, water supply race, canal for the supply of water for

electricity power generation and farm drainage canals. It does not include a channel constructed in or along the path of any historical or existing river, stream or natural wetland.

River or stream

A continually or intermittently flowing body of fresh water, excluding ephemeral streams, and includes a stream or modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal except where it is a modified element of a natural drainage system).

Permanent river or stream

Note that there is no definition of a permanent river or a stream within the Proposed Regional Plan for Northland. In the context of this report we have assessed a permanent river as the continually flowing reaches of any river or stream.

Intermittently flowing river or stream

A river that is naturally dry at certain times of the year and has two or more of the following characteristics:

1) it has natural pools, and

2) it has a well-defined channel, such that the bed and banks can be distinguished, and

3) it contains surface water more than 48 hours after a rain event which results in river flow, and

4) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel, and

5) it appears as a blue line on topographical maps at 1:50,000 scale.

Ephemeral river or stream

Reaches with a natural bed level above the water table at all times, with water only flowing during and shortly after rain events, and which do not meet the definition of an intermittently flowing river.

Small river

A river in the small river water quantity management unit.

Artificial watercourse

A man-made channel constructed in or over land for carrying water and includes an irrigation canal, roadside drains and water tables, water supply race, canal for the supply of water for electricity power generation and farm drainage canals. It does not include a channel constructed in or along the path of any historical or existing river, stream or natural wetland.

Overland flow path

The path taken by surface stormwater crossing a property comprising low points in the terrain (not including rivers and identified water courses), which will accommodate flood flows in a one percent annual exceedance probability rainfall event.

Wetland

Includes permanently or intermittently wet areas, shallow water and land water margins, that support a natural ecosystem of plants and animals that are adapted to wet conditions. Note:

1) Wet heathlands (including gumland and ironstone heathlands) are wetlands because they are seasonally wet, consist of wetland vegetation, and are often found in mosaics with other low fertility habitat such as bogs and heathland.

Constructed wetland

A wetland developed deliberately by artificial means or constructed on a site where:

1) a wetland has not occurred naturally previously, or

2) a wetland has been previously constructed legally.

This does not include induced wetland, reverted wetland or wetland created solely for ecological restoration purposes. Artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels are also not constructed wetlands or natural wetlands.

Notes:

1) A constructed wetland may contain emergent indigenous vegetation such as mangroves, rushes and sedges.

2) "Constructed wetland" is the same as "man-made wetland" in the Regional Policy Statement.

Induced wetland

Wetlands that have formed naturally where wetlands did not previously exist, as a result of human activities, such as construction of roads and railways bunds. Does not include a constructed wetland nor any type of wet, damp or boggy ground that might incidentally occur

as a result of land compaction, nor any ditch, drain, silt-trap, pit, bund, stockwater dam, or treatment pond associated with agricultural, pastoral or horticultural activities.

Notes: 1) Induced wetlands are a type of natural wetland.

Natural wetland

Any wetland including an induced wetland and a reverted wetland, regardless of whether it is dominated by indigenous vegetation, but does not include:

1) a constructed wetland, or

2) wet pasture, damp gully heads, or

3) areas where water temporarily ponds after rain, or

4) pasture containing patches of rushes, or

5) artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels.

Reverted wetland

A wetland that has reverted back to its natural state over time. Does not include a constructed wetland.

Notes: 1) A reverted wetland has not been purposefully constructed by mechanical change to hydrological conditions. Reverted wetlands are a type of natural wetland.

Significant wetland

A natural wetland that meets the significance criteria in the Regional Policy Statement, Appendix 5 –"Areas of significant indigenous vegetation and significant habitats of indigenous fauna in terrestrial, freshwater and marine environments". This includes natural wetlands comprising indigenous vegetation exceeding any of the following area thresholds:

1) saltmarsh greater than 0.5 hectare in area, or

2) lake margins and riverbeds with shallow water less than two metres deep

and greater than 0.5 hectare in area, or

3) swamp greater than 0.4 hectare in area, or

4) bog greater than 0.2 hectare in area, or

5) wet heathland(including gumland and ironstone heathland) greater than 0.2 hectare in area, or

6) marsh, fen, ephemeral wetland or seepage greater than 0.05 hectares in area.

Notes:

1) If there is any doubt over wetland extent use: Clarkson, B. R., 2013. A vegetation tool for wetland delineation in New Zealand. Prepared by Landcare Research for Meridian Energy Limited.

2) The Regional Council's wetland mapping indicates the extents of known wetlands – these can be found on the Regional Council's website. The purpose of this mapping is to help locate and identify different wetland types. The maps do not form part of this Plan.

3) The relationship between the various types of wetlands is shown in Appendix H.6 Wetland definitions relationships.

National Policy Statement for Freshwater (NPS-FM 2020)

Natural wetlands

Natural inland wetland means a wetland (as defined in the Act) that is not:

(a) in the coastal marine area; or
(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or
(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or
(d) a geothermal wetland; or
(e) a wetland that:
    (i) is within an area of pasture used for grazing; and
    (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless
    (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply

A 'natural inland wetland' is further defined as a 'natural wetland' that is not in the coastal marine area.

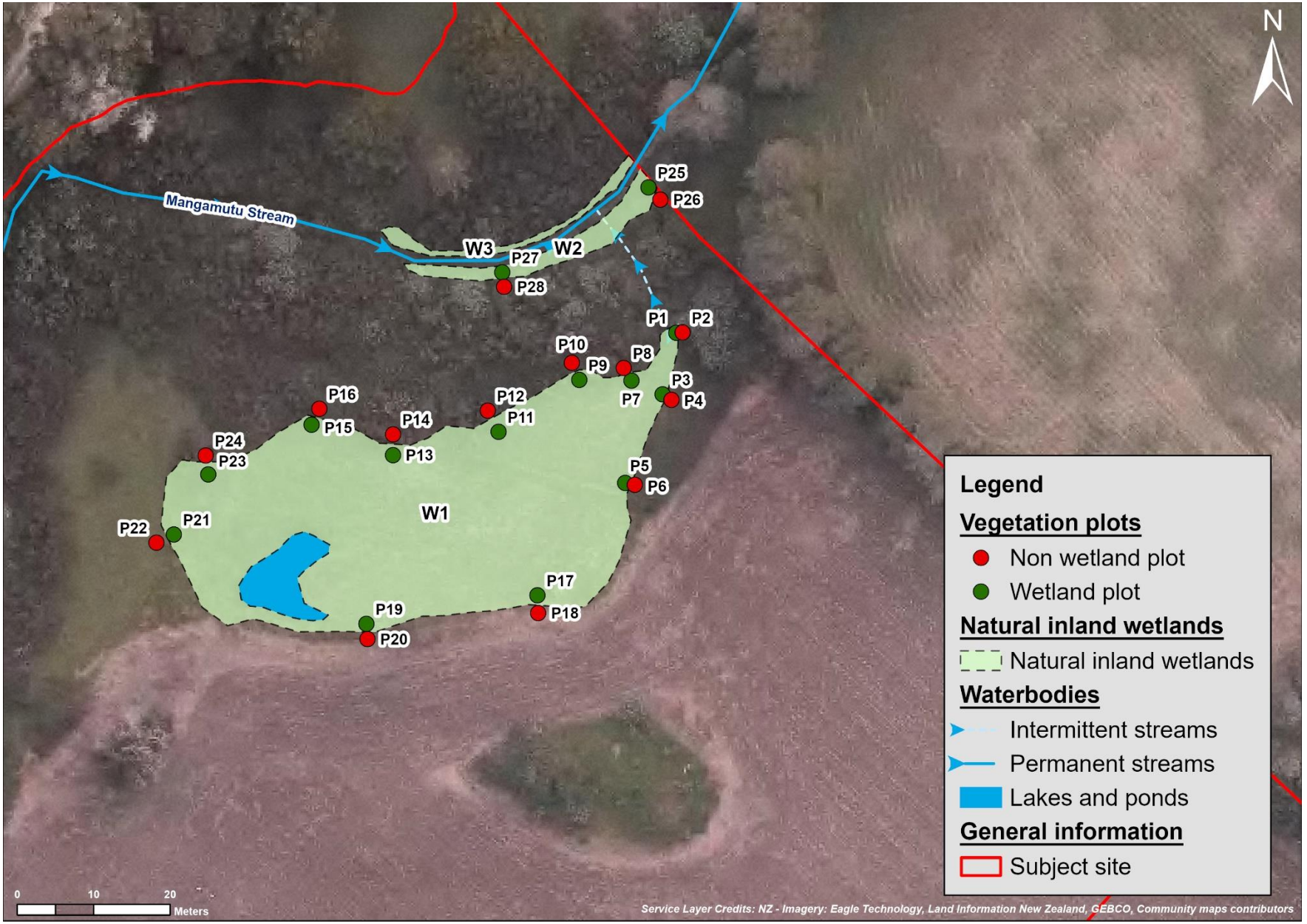
Hydrophytes (hydrophytic vegetation)

Under the vegetation tool for wetland delineation in New Zealand hydrophytes are defined as plant species capable of growing in soils that are often or constantly saturated with water during

the growing season. The hydrophyte categories (wetland indicator status ratings: Clarkson *et al.* 2013) are:

- Obligate (OBL): occurs almost always in wetlands (estimated probability >99% in wetlands)
- Facultative Wetland (FACW): occurs usually in wetlands (67–99%)
- Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66%)
- Facultative Upland (FACU): occurs occasionally in wetlands (1–33%)
- Upland (UPL): rarely occurs in wetlands (<1%), almost always in 'uplands' (non-wetlands).

APPENDIX 2 – WETLAND DELINEATION ASSESSMENT RESULTS



Vegetation plot information

Site		Bisset Road, Kaikohe																										
Date		9/06/2023																										
		Vegetation plots																										
Species		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	P28
Agrostis capillaris																							2%						
Carex lessoniana										65%																			
Cenchrus clandestinus		2%	25%		60%		80%		10%		15%		55%		15%		15%		85%		89%	15%	80%	10%	15%		40%		20%
Crocosmia xcrocosmiiflora																											10%		
Holcus lanatus		5%	15%								10%		5%																
Hypolepis ambigua									10%	5%	10%																		10%
Isachne globosa		40%		98%		95%		95%		5%		35%		30%		30%		50%		50%									
Isolepis prolifera												30%		20%		25%		40%		35%									
Juncus effusus								5%							5%	5%				5%		10%		10%	5%				
Juncus sarophorus																						50%		40%					
Ludwigia palustris														8%															
Machaerina articulata																5%													
Myosotis laxa																													
Paspalum dilatatum																			3%		3%		3%				5%		
Paspalum distichum		30%				3%						10%		30%		30%		10%		10%		10%		20%		5%		3%	
Persicaria hydropiper		3%												12%		5%										90%	5%	90%	5%
Ranunculus repens		20%	55%									5%			8%		10%		5%		3%	15%	15%	10%	5%	5%	25%	5%	40%
Rubus fruticosus				2%	40%	2%	20%				10%	5%	15%		12%		15%								15%				
Rumex obtusifolius																			2%								5%		
Tradescantia fluminensis									10%	5%	45%																	2%	
Trifolium repens																			5%		5%								15%
Ulex europaeus			5%						70%	20%	10%	15%	25%		60%		60%							10%	60%				10%
Total cover		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%
% pasture species (Cosgrove et al. 2022)		7%	40%	0%	60%	0%	80%	0%	10%	0%	25%	0%	60%	0%	15%	0%	15%	0%	93%	0%	97%	15%	85%	10%	15%	0%	45%	0%	35%
Artificial or improved pasture species >50%?		No	No	No	Yes	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Rapid test		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Dominance test		No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No	Yes	No
PI		1.89	3.30	1.04	3.60	1.07	3.80	1.05	3.60	2.35	3.40	1.75	3.80	1.42	3.70	1.40	3.75	1.10	3.93	1.15	3.97	2.45	3.85	2.50	3.70	2.05	3.56	2.09	3.10
NPSFM wetland (Yes or No)		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

Representative plot photos

P1

P2

P3

P4

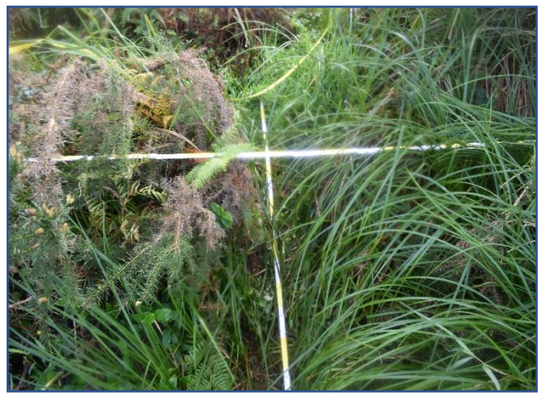
P5

P6

P7

P8

P9



P10

P11

P12

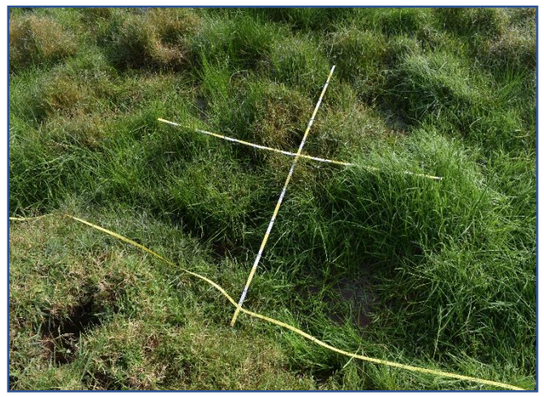
P13

P14

P15

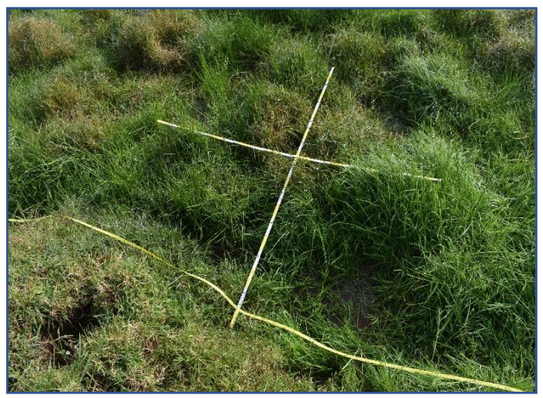
P16

P17



P18

P19



P20

P21

P22

P23

P24

P25

P26

P27

P28

Appendix 5: Traffic Assessment

Engineering Outcomes, Limited
132 Beach Road
PO Box 3048,
Onerahi
Whangarei
New Zealand
Telephone 09 436 5534
E-mail info@e-outcomes.co.nz
Internet www.e-outcomes.co.nz

PROPOSED RESIDENTIAL
BISSET ROAD & RIMU PLACE
KAIKOHE

ASSESSMENT OF TRAFFIC EFFECTS

Prepared by Dean Scanlen,
Engineering Outcomes Ltd
5 July 2024

Table of Contents

1. INTRODUCTION

A total of ninety (90) dwellings are proposed on Part Taraire 1A Block and Lot 1 DP 363959 and part of Part Taraire 1M Block in northwestern Kaikohe. This report is an assessment of the traffic effects of the proposal including measures proposed to mitigate those effects.

2. OVERALL CONCLUSION AND SUMMARY OF MITIGATION MEASURES

Overall, with the standard of the proposed vehicle access, footpaths, links to other roads, on-street parking and proposed pedestrian crossing facility on Hillcrest Road and for the reasons given in this report, it is concluded that the effects of traffic generated by this proposal will be well within acceptable limits.

In particular, the new streets are of a suitable width in conjunction with proposed on-street parking. The internal footpaths link to existing footpaths with most road crossings expected only at the end of one road or at the proposed crossing facility on Hillcrest Road. A short section of Rimu Place with both carriageway and legal corridor narrower than the council standards, will still be adequate. Sight distances and entrance and intersection capacity, including at all locations between the site and Kaikohe CBD, will be more than adequate.

Overall, the risks associated with the traffic generation (including walking trips) and parking demand are concluded to be well within acceptable limits and not an impediment to the granting of the consent.

3. DESCRIPTION OF THE PROPOSAL

The site is located at the end of Bisset Road and comprises all of Part Taraire 1A Block and Lot DP 363959; and part of Part Taraire 1M Block, with a total area of 6.2 hectares. The proposal is the construction of ninety dwellings ranging from one to four bedrooms including ten in a papakāinga (all single bedroom), another thirty-six single-storey units including ten community housing units and some duplex buildings and forty-four units in two-level buildings. The proposal also includes a village green and associated services including vehicle access and parking

The proposal is described in draft plans by Young & Richards entitled “Bisset Road and 10 Rimu Place for Kainga Ora”, referenced Project number 230062 and dated 4 July 2024.

The proposal also includes:

- A network of internal roads to vest[1] and three jointly owned access lots (JOALs) that ensure vehicle access to every lot and links to the two existing public roads – Bisset Road and Rimu Place. The roads to vest are proposed to be narrower than the council standards[2], so on-street parking is provided, mainly in inset bays, to compensate for the absence of parking lanes;
- Internal intersections all being give-way controlled tee intersections, with connections to JOALs uncontrolled but all at right angles to the priority route;

[1] Road 4 is partly on Taraire 1M Block which adjoins the northeastern boundary of Part Taraire 1M Block and is also owned by the applicant.

[2] Operative district plan Appendix 3B-2, which specifies 8 metre carriageways for Type B roads – those with traffic volumes exceeding 150 daily vehicle movements

- Footpaths in accordance with council standards. Footpaths will be continued from the site around the turning head at the end of Bisset Road and along the southern side of the Rimu Place extension, to link with the existing footpaths on those roads;
- A total of 190 parking spaces of which 160 are private spaces associated with the dwelling units and 30 are public spaces on streets. Twenty-seven of the private parking spaces are proposed to be stacked spaces;
- No cul-de-sacs, although the JOALs have no outlets;
- The installation of give-way control at the intersection of Rimu Place and Harold Avenue;
- The removal of the existing parking island at the end of Rimu Place, with the same number of parallel parking spaces proposed along that road instead;
- The realignment of the driveways of three houses that currently lead to the end of Rimu Place, such that those driveways are at right angles to the road and in an orderly layout; and
- The installation of a pedestrian crossing facility on Hillcrest Road a short distance west of Tawanui Road. This is likely to be in the form of a raised "courtesy" crossing, but details are yet to be agreed with the council's roading division.

4. DESCRIPTION OF THE EXISTING ROAD NETWORK

Figure 1 is a map of the road network in relation to the site. Figure 2 is the recommended configuration of the pedestrian crossing facility on Hillcrest Road near Tawanui Road.

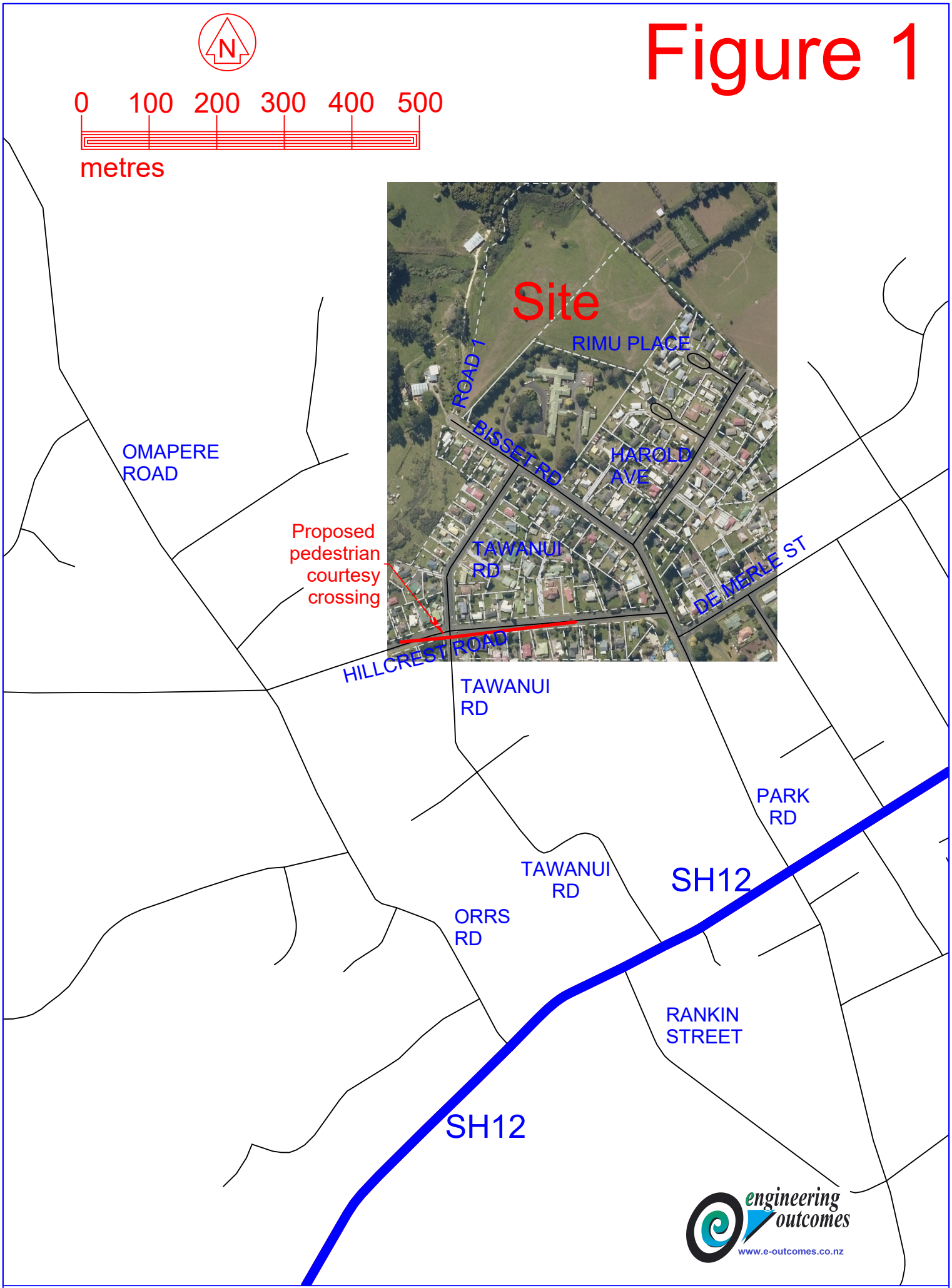
All existing streets in this vicinity are sealed and kerbed with two-lane carriageways of varying width[3]. Most have good lighting and footpaths on one side plus walkable berms on side roads without footpaths. Both connections to public roads are at the very ends of both Bisset Road and Rimu Place. With Road 1, which leads to the end of Bisset Road, a give-way is proposed at its connection at the existing turning head of Bisset Road and the footpath is proposed to be extended around the turning head and connected to the existing footpath along the southern side of Bisset Road. Road 2 is proposed to form a continuous route with Rimu Place, which is currently a cul-de-sac, and give-way control is proposed for Rimu Place (at Harold Avenue).

The existing intersections that the proposal will add the most turning traffic to are Tawanui Road with Bisset Road, Rimu Place with Harold Avenue, Harold Avenue with Bisset Road and Tawanui Road with Hillcrest Road. The Tawanui Road/Hillcrest Road intersection is an at-grade cross with Stop control for both side roads (which are the Tawanui Road approaches). The other intersections are all at-grade tee intersections, two of which are uncontrolled (Tawanui Road with Bisset Road and Rimu Place with Harold Avenue) and one has Stop control (Harold Avenue with Bisset Road). These intersections are all specifically addressed in this assessment.

Broadway, which is part of State highway 12, is the main east-west thoroughfare and busiest road in Kaikohe. A significant proportion of the generated traffic will also travel through the intersection of Broadway and Park Road, which is part of the route between the site and the Kaikohe CBD. That intersection forms an at-grade cross with Station Road, with Stop control on both side roads (with priority for Broadway) The traffic through that intersection will be both quantitatively and proportionally less than for the other listed intersections, but it is a significantly busier intersection and also warrants specific attention.

[3] But generally remarkably wide – physical carriageways up to 13 metres wide and generally exceeding the current width standards. Rimu Place is an exception, with the first section off Harold Avenue having a carriageway width of only 6.0 metres and a legal corridor only 12 metres wide. Harold Avenue has a carriageway width of 11.5 metres and Bisset Road is 11.8 metres wide beyond the entrance to Kaikohe Care Centre, wider to its east. Apart from Rimu Place, all roads have a legal corridor 20 metres wide.

Figure 1



Housing, Bisset Road Kaikohe

Map of road network

12d Model

Scale 1:7000@A4

Wed Jul 3 08:48:19 2024

The intersections of Bisset Road with both Hillcrest Road and De Merle Steet will also experience an increase in traffic, but virtually all additional traffic through those will be on the priority route (Bisset Road and Park Road). The increase in traffic will not be anywhere near enough to cause congestion at either intersection, so no specific assessment is carried out of them.

Figure 2. Recommended configuration of the pedestrian courtesy crossing on Hillcrest Road

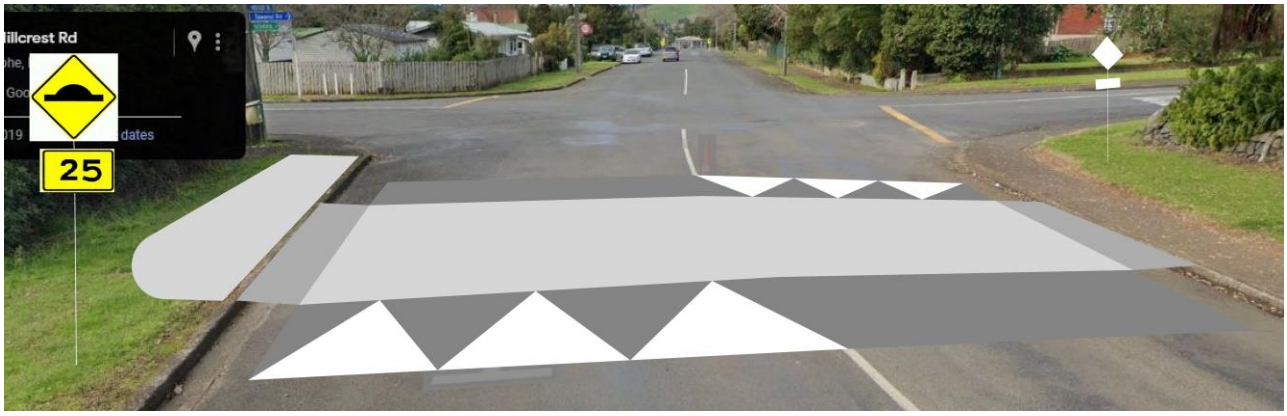


Photo 1. The site viewed from the end of Bisset Road, looking along the proposed route for the main the site access (Road 1) from its connection point, towards the northeast.

Photo 2. Looking southwest along Bisset Road from the proposed connection point for Road 1. The western footpath on Road is proposed to be extended around this turning head to connect to the end of the existing footpath at the location of the red letterbox.

Photo 3. A panorama of Harold Avenue from south (left) to north centred on Rimu Place (centre). The current end of Harold Avenue is at upper right.

Photo 4. A panorama of Rimu Place from its northern side centred 35 metres from Harold Avenue (left). The grassed island at upper right is in the centre of the cul-de-sac and includes angle parking for at least four cars. It is proposed this be replaced by a simple continuation of the road into the development, plus at least four parallel parking spaces.

Photo 5. Looking west along Hillcrest Road from Tawanui Road. The restricted visibility towards the west (at left) will be addressed by the proposed speed control device a short distance west of Hillcrest Road for eastbound traffic. Photo from Google Streetview.

Various improvements to parts of the road network have recently been carried out. The measures most relevant to this project are five new raised pedestrian courtesy crossings – one on Bisset Road a short distance east of Tawanui Road, the other four on Tawanui Road between SH12 and Hillcrest Road.

Speed limits are 50 km/hr on all roads in this vicinity. All of the site is zoned Residential in the operative *Far North district plan*. Bisset Road and Tawanui Road have "access" road status, Hillcrest Road west of Tawanui Road is "low volume" status[4] Park Road Hillcrest Road east of Tawanui Road and have "secondary collector" status[5].

5. TRAFFIC

Unless otherwise stated, all vehicle movements reported here are one-way movements at full development. In relation to the proposal, half of the movements are arrivals and the other half are departures.

5.1 Traffic Generation, Origins and Destinations

Traffic generation is estimated at an average of 8 movements per dwelling unit with three or more bedrooms and 5 to 6 per day for those with two or fewer bedrooms, or a total in the range 600 to 620 movements per day of which 55 to 60 are expected during peak commuter hours.

Applying a qualitative gravity model, the split of generated traffic is expected to be approximately 60/40% Rimu Place and Bisset Road respectively of which:

- 80% travels to/through the CBD by way of Bisset Road and Park Road;
- 12% travels by way of Tawanui Road, of which 80% (10% overall) travels to/from the schools and childcare centre on Tawanui Road and the remainder continues to SH12 and travels west;
- Another 3% travels to/from the west by way of Hillcrest Road and Orrs Road[6]; and
- 5% travels to other destinations within Kaikohe itself and north of Broadway, including two childcare centres (on Park Road), two churches, a large aged-care facility, a Kohanga Reo and a Kura Kaupapa Māori.

A large proportion of turns at the Broadway/Park Road intersection – expected to be at least 90%, will be left out and right in. A large proportion of turns through the other intersections with Broadway will be right out and left in but at much lower overall frequency than those through the Broadway/Park Road intersection.

5.2 Existing Traffic on Existing Roads

The site is at the top of the catchment, so the traffic on the roads at the connection points is low - currently fewer than 100 movements per day. That steadily increases towards Broadway, with Park Road estimated at 2,400 movements per day and Tawanui Road estimated at close to 1,000 movements per day at Broadway.

The traffic on Broadway is estimated at 7,600 movements per day between Tawanui Road and Park Road, 8,700 per day east of Park Road. Orrs Road is the busiest local road north of Broadway, with slightly more than 3,600 movements per day[7].

[4] Despite its traffic approaching 2,000 movements per day. This is almost certainly an error in Mobile Road and possibly also RAMM.
[5] Mobile Road.
[6] Expected to be a somewhat higher proportion than that on Tawanui Road because the southern end of Tawanui Road is now a slow street.
[7] All estimates from Mobile Road and considered reasonable.

5.3 Crashes

The *CAS* database, of crashes reported to the Police, has been searched on all of Bisset Road, Park Road and Tawanui Road, plus all intersections including those with Broadway, for the entire period since the start of 2019.

Five injury-causing crashes have been reported, two of which resulted in more than minor injuries. A fatality occurred on Park Road in January 2024. A driver exiting a property hit the accelerator rather than the brake and was thrown from the vehicle. The proposal will not increase the risks of such an incident. A serious-injury crash occurred at the Tawanui Road/Hillcrest Road intersection in which a northbound vehicle on Tawanui Road drove straight through Hillcrest Road without stopping or checking the way was clear and collided with an eastbound vehicle on Hillcrest Road. This occurred before this part of Tawanui Road was made a slow-street, so crashes of this type have now been fully addressed.

At the Park Road/Station Road intersection with Broadway, three injury-causing crashes plus four non-injury crashes are reported since the start of 2019. One of the injury crashes involved a quad bike that was driven onto the footpath and was the only incident in the entire search area that involved a person on foot. Another, plus another two non-injury crashes, involved vehicles crossing Broadway from one of the side roads to the other. The third injury-causing crash involved a motorbike colliding with the rear of a car that was turning left into Station Road. The other two crashes at the intersection were not related to the presence of the side roads and did not result in injuries.

A small number of crashes are reported at intersections that the proposal will increase the traffic through, but all involved only a single vehicle losing control and none resulted in injuries.

6. ASSESSMENT OF TRAFFIC EFFECTS AND PROPOSED MITIGATION MEASURES

With the proposed road and footpath connections and pedestrian crossing facility, the key traffic issue with the proposal is considered to be the widths of internal roads and Rimu Place. Parking and the capacity of the Broadway/Park Road intersection also warrant specific consideration. The alignment of the proposal with safe-system principles is addressed in section 6.4 and other matters are addressed in section 6.5.

6.1 Road width

It is acknowledged that the internal site accesses, plus part of Rimu Place, are narrower than the council standard[8]. However, recent research has found that the "social cost" of crashes, when standardised by vehicle-kilometres travelled, is similar for roads in both width ranges. It is also generally acknowledged that narrower roads moderate speeds and, conversely, wider roads encourage higher speeds. It is not known what speed limit the council will set for the roads to vest, but the speed limit is not likely to have as much influence as the road width in any event.

Narrower roads also reduce the exposure of people who are crossing them on foot. Overall, the proposed width is considered appropriate and the provision of wider roads is not likely to reduce effects. In fact, it is more likely that wider roads will be counter-productive.

[8] Which specifies a carriageway 8.0 metres wide for Type B urban roads. This compares with the 6.5 metres proposed.

The first 30 metres of Rimu Place has a carriageway only 6.0 metres wide and a legal corridor only 12.0 metres wide with a footpath on only one side (its southern side). The carriageway is a suitable width for the reasons already given. Electricity is the only service that will be delivered to the site through Rimu Place and that is already underground, so there will not be any challenges associated with services in the corridor of that road.

6.2 Parking

The proposed rate of parking spaces, including those on streets, is slightly more than 2.0 parking spaces per dwelling unit and will be more than sufficient. In fact, the provision of some public spaces is more efficient than the provision of all spaces on private sites.

Overall, the proposed parking supply is unlikely to ever be exceeded.

6.3 Intersection Capacity

The intersection with the greatest demand on it and which will be the most affected by the proposal, is that of Broadway and Park Road (also Station Road). It is a cross intersection with priority to Broadway and Stop control on the non-priority legs (Park Road and Station Road). The traffic on Broadway is estimated at 7,600 movements per day between Tawanui Road and Park Road, 8,700 per day east of Park Road. That on Park Road is estimated at 2,400 movements per day and that on Station Road at estimated at close to 4,000 movements per day[9].

In terms of the capacity of this intersection, the following points are relevant:

- Most exits from Park Road – estimated to be at least 60%, will be left turns, with another 30%, or so, being movements between the two side roads[10];
- Most exits from Station Road –estimated to be at least two-thirds (67%), will be right turns, but the proposal will not increase the frequency of those turns[11];
- Both non-priority approaches have two exit lanes and central islands.

The traffic data indicate no more than 7,000 movements on Broadway through the intersection, or some 650 during peak hours – perhaps as many as 450 in one direction (eastbound during morning commuter peak hours). Applying accepted intersection capacity theory, the practical capacity for left turns filtering into such a traffic stream is close to 350 movements per hour, which compares with demand for fewer than 110 movements even with the proposal fully developed[12].

The capacity of right turns out of Park Road will be less – only some 250 movements per hour, but the demand for those turns is not expected to be more than one-seventh of those for left turns, so well within the capacity for those turns. All other turns will have even greater capacity because none requires vehicles to accelerate and filter into the traffic stream.

The demand on other intersections between the site and Broadway including those with Broadway, will not reach anywhere the level expected at Park Road even with the proposal fully developed.

[9] Mobile Road.
[10] With both of Kaikohe's supermarkets, The Warehouse store and Lindvart Park accessed from Station Road.
[11] Neither will left turns into Station Road, nor the risk of crashes involving those turns, increase.
[12] The proposal is expected to increase the traffic through the intersection by a maximum of 500 movements per day to a little under 3,000 movements per day of which 60% is expected to turn left. Relatively conservative parameters have been used in this assessment – gap acceptance of 6 seconds, follow-up headway of 4 seconds.

Overall, capacity issues will never arise at any intersections even with this proposal fully developed.

6.4 Safe-system alignment

The proposal has some consistencies and alignments with safe-system principles especially the proposed pedestrian courtesy crossing, which will reduce speeds to no more than the safe-system threshold for people crossing Hillcrest Road at Tawanui Road – 30 km/hr[13].

It is acknowledged that speeds of most traffic, including within the site, will generally be above the safe-system threshold for vulnerable road users including people on foot. The provision of relatively narrow roads will partly address this. Furthermore, apart from the two recent serious crashes, one of which has been fully addressed by the recent work on Tawanui Road and the other of which the proposal will not increase the risk of, there is no evidence of more than minor harm on any of the roads or intersections that the proposal will significantly increase the traffic on. In particular, not a single incident has been reported involving a person crossing roads. This is despite all of those roads being significantly wider than the roads proposed within this development.

Even so, the likely potential impact of the absence of traffic calming has been investigated by considering a random sample of thirty-two sections of roads in the North Island that are representative of the proposed internal roads[14]. The road sections have been viewed in Google Streetview to determine whether they have any traffic calming in place.

Five of the sections had some traffic calming in place, but only two of those had devices likely to have a significant impact on speeds[15]. Those two – Frederick Street and William Street in Hamilton, represent only 3.3% of the length of all of the road sections examined and only 1.9% of their total usage[16].

This shows that, despite very few representative existing roads having traffic calming, their risk profile is still similar to the average profile for a very large range of urban road widths including the widest roads. On this basis, it is concluded that traffic calming is not warranted on the proposed internal roads.

It is also noted that the *Far North district plan* does not specify the achievement of safe-system speeds. Such is only specified in the 2023 engineering standards and those are not part of the district plan.

[13] As discussed, it will also address the sight-distance restriction along Hillcrest Road west of Tawanui Road, although the operating speeds are already unlikely to be above the threshold for collisions on an angle.

[14] That is, with carriageway widths in the range 6.3 to 6.7 metres and speed limits of 30, 40 or 50 km/hr. Only sections that have been driven by Google Streetview since 2021 have been included. Those roads carry average traffic of 1,300 movements per day – significantly more than the proposed internal roads even at full subdivision development. However, the roads can be compared accurately enough by standardising using the "vehicle-kilometres travelled" parameter.

[15] Karaka Bay Road and Shelly Bay Road in Wellington have speed humps, but at 0.5 and 1.0 kilometre intervals respectively, which compares with the interval recommended or a significant impact on speed - 100 metres. Maggie Place in Hamilton, has a single short narrowed section with cobbled strip at each end.

[16] When determined by vehicle-kilometres travelled.

6.5 Other matters

There are permanent visibility restrictions[17] in relation to one intersection – along Hillcrest Road west of Tawanui Road (see photo 5). This will be addressed by the proposed speed control device a short distance west of Hillcrest Road for eastbound traffic[18]. Parking on Broadway has the potential to create visibility restrictions from the Broadway intersections, but none of the reports on the crashes at those intersections gives such restrictions as a factor. Furthermore, a majority of those crashes did not result in injuries and not one resulted in more than minor injuries. The goal of the Road to Zero road safety strategy is the elimination of crashes that result in death or serious injury.

People will have to cross several existing roads when walking between the site and some destinations. Crossings of Harold Avenue can be made at its end where there is very little traffic and speeds well within safe-system thresholds. The next most frequent crossing point is expected to be Hillcrest Road, which is addressed by the proposed new raised courtesy crossing.

The only other crossing point that does not currently have crossing facilities is Bisset Road at Harold Avenue. This is only likely to be used by people when walking to and from the CBD, because the internal roads and Tawanui Road provide the shortest route to/from the schools from all parts of the site. The site is approximately 1 kilometre from the near edge of the CBD, so walking trips to and from it will be relatively rare. The visibility is excellent along Bisset Road at Harold Avenue and the existing raised table near Tawanui Road will reduce the speeds of at least eastbound traffic. Overall, with the small number of crossings at this location a crossing facility is not considered warranted.

The sight distances associated with the proposed Bisset Road intersection and the existing Rimu Place intersection exceed the highest standard applicable to safety.

Construction will not involve significant earthworks, so will not generate traffic at anywhere near a rate that has the potential to cause congestion or other significant nuisance.

7. FAR NORTH DISTRICT PLAN ASSESSMENT CRITERIA

There are two sets of criteria in the plan relevant to traffic movement/management and one relating to access. Each criterion is quoted here in bold, with the assessment following in normal type. A number of the criteria are repeats from other sections and those are not repeated here. The criteria relating to parking are not assessed because the parking will be adequate to service the development.

Rule 15.1.6A.4.1: Traffic Intensity

(a) The time of day when the extra vehicle movements will occur.

The traffic generation occur across most of any day but with peaks on weekdays at each end of the working day and somewhat smaller peaks on Saturdays around noon.

[17] Caused by complying sightlines that currently cross into private land and, in this case, with large trees planted along the boundary.
[18] And, in fact, will create an overall betterment.

(b) The distance between the location where the vehicle movements take place and any adjacent properties.

Road 1 is 45 metres clear of the nearest buildings of the adjoining aged care centre and Road 3 is at least 50 metres clear of them. Rows of dwellings are proposed between both roads and the care centre, so the traffic noise will be significantly dampened by them.

The nearest house is off the end of Bisset Road and is 50 metres clear of Road 1.

(c) The width and capability of any street to cope safely with the extra vehicle movements.

The roads internal to the development are proposed to be sealed with two lanes and to be of a suitable width for the traffic generated by the proposal. Rimu Place is also adequate, see section 6.1. Other existing roads all at least meet the width specifications of the operative *Far North district plan*.

(d) The location of any footpaths and the volume of pedestrian traffic on them.

Footpaths are proposed along the roads and accesses internal to the development in accordance with the operative *Far North district plan*. That on the western side of Road 1 will connect to an existing footpath along the southern side of Bisset Road (opposite the site). There is also a footpath along the eastern side of Harold Avenue (opposite Rimu Place).

The proposed pedestrian courtesy crossing will ensure a suitable connection between the site and existing footpaths and continuous connections to two schools[19]. Other existing points at which the proposal is likely to increase road crossings by people on foot are addressed in section 6.5.

(e) The sight distances associated with the vehicle access onto the street.

The sight distances associated with the proposed intersections all exceed the highest standard applicable to safety. The new courtesy crossing addresses the sight distance restriction along Hillcrest Road west of Tawanui Road.

(f) The existing volume of traffic on the streets affected.

This is given in section 5.2.

(g) Any existing congestion or safety problems on the streets affected.

There is no known, nor likely, congestion on roads in Kaikohe and, as shown in section 6.3, the proposal will not create any. On roads that the proposal will significantly increase traffic on, the only recent crashes that resulted in more than minor injuries have either been fully addressed by recent traffic calming devices on Tawanui Road or the associated risks will not be increased by the proposal. A brief assessment of the safe-system alignment of the proposal is given in section 6.4. See also section 6.5.

[19] The footpath on Tawanui Road north of Hillcrest Road is on the western side, so the location of the facility west of Tawanui Road is at least logical.

(h) With respect to effects in local neighbourhoods, the ability to mitigate any adverse effects through the design of the access, or the screening of vehicle movements, or limiting the times when vehicle movements occur.

The neighbourhood is almost entirely residential. Rows of dwellings are proposed between new roads and the adjoining aged care centre, so the traffic noise on the new internal roads will be significantly dampened by them. There is also a minimum of 55 metres clearance between Bisset Road and the nearest care centre building.

(i) With respect to the effects on through traffic on roads with more than 1000 vehicle movements per day, the extent to which Council's "Engineering Standards and Guidelines" (2004) are met.

None of the internal roads will exceed 1000 vehicle movements per day. Most existing roads beyond the site will do, but only remote from the site all at least meet council standards for carriageway width.

(j) Effects of the activity where it is located within 500m of reserve land administered by the Department of Conservation upon the ability of the Department to manage and administer that land.

The activity is not located within 500m of reserve land administered by the Department of Conservation.

(k) The provision of safe access for pedestrians moving within or exiting the site

The proposed raised courtesy crossing and existing footpath connection to the site will ensure a suitable connection between the site and common destinations including two schools.

Section 15.1.6A.7: General Assessment Criteria, Traffic

This section includes eleven criteria. Criteria (a), (j), (k) and (l) are unique to this section of the plan. Criteria (b) to (i) are identical to criteria (a) to (h) of the assessment criteria in 15.1.6A.4.1, respectively, and have already been assessed in the previous section. This section is restricted to the criteria unique to 15.1.6A.7.

(a) The extent to which the expected traffic intensity exceeds the threshold set by the Traffic Intensity Factor (TIF) contained in Appendix 3A in Part 4 of the district plan.

The proposal will not enable traffic generation at levels above those anticipated by the proposed district plan for subdivision at the controlled activity density, which is 600 sq.m lots for sewered sites. Assuming 70% of the controlled activity density can be achieved when accounting for the effects of access, other services, unsuitable land and lot configuration, the district plan will enable some seventy lots in a conventional subdivision, for which the TIF is 700 movements per day.

(j) With respect to the effects on through traffic on arterial roads, strategic roads and State Highways, any measures such as right-turn bays, flush medians, left turn deceleration tapers, etc. proposed to be installed on the road as part of the development to accommodate traffic turning into and out of the site.

The proposal does not warrant any central turning bays, left-turn lane nor any acceleration lanes.

(k) The extent to which the activity may cause or exacerbate natural hazards or may be adversely affected by natural hazards, and therefore increase the risk to life, property and the environment.

No significant earthworks are proposed in relation to the proposal, so that cannot cause or exacerbate natural hazards. Stormwater will be managed as covered in the site suitability report. Steel chequer plates will be provided at each end of the proposed courtesy crossing to provide a pathway for water to flow past it.

(l) Whether providing or having access to bicycle parking, shower/changing facilities or alternative transportation would reduce the number of vehicle movements associated with the proposed activity.

There will be sufficient space for bicycle parking with each dwelling.

15.1.6C.4.1 Property Access

(c): Any foreseeable future changes in traffic patterns in the area.

No significant projects or road links are planned that might significantly change the patterns of traffic in this vicinity.

(d): Possible measures or restrictions on vehicle movements in and out of the access.

With the intersection capacities being so far above adequate, there is no need for restrictions on any turns.

(e): The adequacy of the engineering standards proposed and the ease of access to, from, and within, the site.

The proposed access, footpaths and other pedestrian facilities will facilitate ease of access and compliance with the engineering standards for the reasons given.

(f): The provision of access for all persons and vehicles likely to need access to the site, including pedestrian, cycle, disabled, vehicular.

The internal footpaths and proposed pedestrian facility will ensure adequate access to all lots for all transport modes including people with impaired mobility.

(g): The provision made to mitigate the effects of stormwater runoff, and any impact of roading and access on waterways, ecosystems, drainage patterns or the amenities of adjoining properties.

Storm management is addressed in the site-suitability report. Steel chequer plates will be provided at each end of the proposed courtesy crossing to provide a pathway for water to flow past it.

(h) relates to sites with a road frontage on Kerikeri Road so is not relevant.

(i) The provisions of the roading hierarchy, and any development plans of the roading network.

No significant projects or road links are planned that might significantly change the patterns of traffic in this vicinity. See the comments with Criterion (c).

(j) The need to provide alternative access for car parking and vehicle loading in business zones by way of vested service lanes at the rear of properties, having regard to alternative means of access and performance standards for activities within such zones.

This site is not in a business zone.

(k) Any need to require provision to be made in a development for the vesting of reserves for the purpose of facilitating connections to future roading extensions to serve surrounding land; future connection of pedestrian accessways from street to street; future provision of service lanes; or planned road links that may need to pass through the development; and the practicality of creating such easements at the time of development application in order to facilitate later development.

Also (l) Enter into agreements that will enable the Council to require the future owners to form and vest roads when other land becomes available (consent notices shall be registered on such Certificates of Title pursuant to Rule 13.6.7).

The proposal includes strong links to and between existing roads, so nothing would be gained with the provision access to areas outside the site using the mechanisms described.

Part Taraire M1 Block is zoned Rural Production, so is not anticipated for residential development.

(m) With respect to access to a State Highway that is a Limited Access Road, the effects on the safety and/or efficiency on any State Highway and its connection to the local road network and the provision of written approval from the New Zealand Transport Agency.

The access is not to a State Highway.

Dean R Scanlen
BE(Hons)(Civil), CPEng, IntPE(NZ)

Appendix 6: Land Development Report

Land Development Report

Bisset Road and 10 Rimu Place, Kaikohe
Proposed Residential Development

Prepared For:
Kāinga Ora

Job No.: 15443

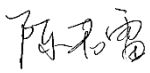
Rev: 0 Date: 2 July 2024

CHESTER

Revision History

Revision No	Description/comments	Prepared By	Date
0	First Issue	J. Chen	02/07/2024

Document Control

Action	Name	Signed	Date
Prepared by	J. Chen Civil Engineer		02/07/2024
Reviewed by	N. Jull Civil Engineer		02/07/2024
Approved by	S. Rankin CPEng – Civil Engineer		02/07/2024

Distribution

Business/company	Attention	Role

Table of Contents

Table of Figures

List of Tables

1 Introduction

Chester Consultants Ltd (Chester) has been engaged by Kāinga Ora – Homes and Communities to provide a Land Development Report with respect to the proposed development at Bisset Road and 10 Rimu Place, Kaikohe.

This report has been prepared solely for the benefit of this specific project, and Far North District Council (FNDC). Chester accepts no liability for inaccuracies in third party information used as part of this report. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

This report is based on development data provided by the client, and data obtained from Far North District Council and Northland Regional Council maps current to the site at the time of this document's production. Should alterations be made which impact upon the development not otherwise authorised by this report then the design / comments / recommendations contained within this report may no longer be valid.

In the event of the above, the property owner should immediately notify Chester to enable the impact to be assessed and, if required, the design and or recommendations shall be amended accordingly and as necessary.

2 Existing Site Description

The development site is made up of five (5) parent lots of Part Taraire 1A Block, Lot 1&2 DP 363959, 10 Rimu Place, Kaikohe and Taraire 1M Block. The total development area is 61608m^2. The site is generally flat with a minor ridge line running southwest to northeast bisecting the site, the ground has been stripped a few years ago and topsoil is stockpiled on site, the ground is predominantly covered in grass with a few established trees. A natural wetland is located within the northern corner of the site. There is no existing dwelling within Part Taraire 1A Block and Lot 1 DP 363959, an existing dwelling is within 10 Rimu Place. The site is bounded by an existing watercourse to the north, rural properties to the east and west, the Kaikōhe Care Centre Rest Home & Dementia Unit & Hospital to the south, and stand-alone single house residential lots to the southeast.

Figure 1: Existing site aerial image (FNDC GIS maps 27/06/2024)

The site is zoned as 'Residential' under the Far North District Council Operative Plan and 'General Residential' under the Far North District Council Proposed District Plan.

The site has road frontage to Bisset Road to the southwest and Rimu Place to the southeast.

The NRC GIS Natural Hazards Map does not show the site within a flood hazard zone, the GHD 2007 Flood Modelling shows a flood zone within the northern corner of the site around the natural wetland area.

Figure 2: Existing Natural Wetland (Chester 05/09/2023)

Figure 3: Generally Flat Terrian and Topsoil Stockpile (Chester 05/09/2023)

3 Proposal

A combined land use and subdivision is proposed on the site which will result in 90 residential Lots and two vacant Lots plus jointly owned access Lots (JOAL's), reserves and road to vest. Figure 4 below shows the full built out development. It is proposed that the development could be completed in 3 stages.

	TYPOLOGY	LEVEL	# BED	Unit GFA	Units	Car Parks
Papakainga	1BS-V1	1	1	55 m²	10	10
Community Housing Units	1BS-V1	1	1	55 m²	10	10
	PNL-2B	1	2	60 m²	13	26
	KO-B6	2	2	82 m²	14	28
	PNL-3B, 3BS-V1	1	3	91 m², 106 m²	13	26
	KO-EN3, KO-ES3, KO-G6, YR-SQR, YR-SQR-D	2	3	116 m², 134 m²	16	32
	KO-O3, KO-P3, KO-OS3, KO-Q6	2	4	136 m²	14	28
			Total	---	90	160

Figure 4: Proposed site plan (Young & Richards Ltd Ref: A2-00-2200)

This report is intended to accommodate a Resource Consent application and will comment on the following:

- Earthworks, Erosion & Sediment Control,
- Access,
- Water Supply,
- Wastewater,
- Stormwater,
- Flood Risk Assessment

This report is intended to be read in conjunction with the accompanying Chester drawings.

4 Earthworks, Erosion & Sediment Control

4.1 Earthworks

Earthworks are proposed across the site to form a constructed wetland, ensure flat building areas, maintain minimum grades on roads and manage secondary flow. Given the flat to gently sloping nature of the site, no significant batters or retaining will be required to form the land for access or building platforms. No earthworks are proposed within the existing natural wetland area however there are earthworks proposed to form the constructed wetland within 10m of the stream to the north of the site and the existing natural wetland.

4.1.1 Earthworks Area and Volume

Table 1 below summarises the bulk earthwork volumes required in terms of existing ground versus proposed ground as shown on the civil drawings.

Table 1: Cut – Fill Volumes

Location	Area (m^2)	Cut (m^3)	Fill (m^3)	Net (m^3)
Within 10m Offset of Existing Wetland	700	-1	+273	+272
Within 10m Offset of Stream	610	-26	+510	+485
Within 1%AEP Flood Extent	687	-26	+435	+409
Total Site	56641	-9414	+9366	-47

4.1.2 Cut/Fill Depths

Maximum cut and fill depths are anticipated to be approximately 4.50m cut and 2.00m fill around the constructed wetland. The remainder of the site consists of cut and fill depths less than 0.5m.

4.1.3 Construction Methodology

In general terms the proposed earthworks operations will involve topsoil being stripped and stockpiled onsite with minor cut and fill undertaken to achieve sub-grade levels. There is very little topsoil depth identified across the existing site so excess topsoil is not anticipated. Topsoil will be re-spread across the site around the houses and across vacant Lots, dependent on final development execution and staging. The existing stockpiles on site will be tested and incorporated into the works where suitable. There is provision to lose any additional material within the large reserve area in the north of the site with slight adjustment to finished levels outside the floodplain and 10 m setbacks. The cut fill operation will win cut from the proposed wetland and road undercuts and place it in locations of fill. Earthworks will be balanced meaning there will not be a need for large construction traffic volumes importing or exporting soil as part of the works.

4.2 Erosion and sediment control

Best practice erosion and sediment control will be implemented to mitigate the effect of the earthworks to the surrounding environment. The sediment control devices will be constructed in general accordance with Auckland Council's Guidance Document 005 (GD05) and may include, but not be limited to the following:

- Stabilised Construction Entranceway,
- Silt Fences / Super Silt Fences,
- Clean / Dirty water diversion bunds,
- Decanting earth bunds,
- Sediment retention pond,
- Progressive site stabilisation.

The Contractor will be ultimately responsible for specific design, installation, maintenance, and removal of various protection measures in accordance with GD05 as necessary to align with actual construction operations and staging.

Refer to drawing 210 of the accompanying civil design drawings for more information and an indicative erosion and sediment control plan.

5 Access

The site has road frontage to Bisset Road to the southwest and Rimu Place to the southeast. The entire development will consist of the construction and vesting of four (4) public roads, and the construction of five (5) jointly owned access lots (JOALS) to provide access to all proposed units as per the FNDC engineering standards. It is proposed to remove the existing dwelling at 10 Rimu Place and join the proposed public road to Rimu Place.

Figure 5: Existing sealed Bisset Road turning head (Chester 05/09/2023)

Figure 6: End of Rimu Place (Chester 05/09/2023)

Final tie-in details between the proposed public road and existing Bisset Road and Rimu Place shall be confirmed at detailed design stage.

Refer to drawing 700 and 800 of the accompanying civil design drawings and Traffic Report by Engineering Outcomes Ltd for further details.

6 Water Supply

6.1 Potable Water Supply

6.1.1 Existing Reticulation and Connections

As per the FNDC GIS data, both Bisset Road and Rimu Place have 40mmØ rider main and 100mmØ pipe main extending to the end of public road reserve. 10 Rimu Place has an existing water meter connection to the main.

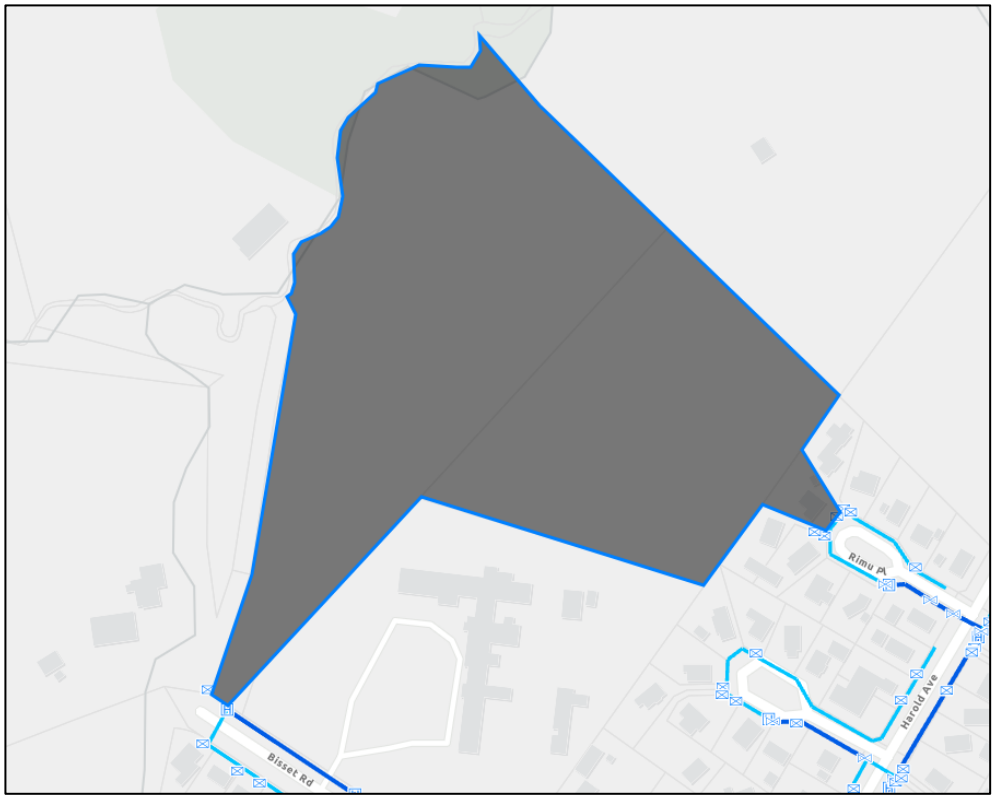


Figure 7: Existing water supply reticulation (FNDC GIS maps, 11/12/2023)

6.1.2 Increase in Water Supply Demand

Table 2 below sets out the estimated water supply demand from the proposed development based on the method set out in the FNDC Engineering Standards 2023.

Table 2: Estimated Water Demand

Typologies / Stage	Number of Typologies Proposed	Design Occupancy (i.e. Persons per Typology)	Catchment Design Population	Domestic Demand (L/p/day)	Daily Peaking Factor	Hourly Peaking Factor	Average Daily Demand (m3/d)	Peak Day Demand (m3/d)	Average (Hourly) Demand (L/s)	Peak (Hourly) Demand (L/s)
1 Bedroom	20	2	40	300	2	5	12.00	24.00	0.28	1.39
2 Bedroom	27	3	81	300	2	5	24.30	48.60	0.56	2.81
3 Bedroom	29	4	116	300	2	5	34.80	69.60	0.81	4.03

4 Bedroom	14	5	70	300	2	5	21.00	42.00	0.49	2.43
Vacant Lots	2	6	12	300	2	5	3.60	7.20	0.08	0.42
Stage 1	*34*		*97*				29.10	58.20	0.67	3.37
Stage 2	*24*		*85*				*25.50*	*51.00*	*0.59*	*2.95*
Stage 3	*34*		*137*				*41.10*	*82.20*	*0.95*	*4.76*
Total	92		319				95.70	191.40	2.22	11.08

6.1.3 Proposed Water Reticulation

It is proposed to extend a 150mmØ principle main through the proposed development that connects through from Bisset Road to Rimu Place. The connection through to Rimu Place will only happen at stage 2 so at the completion of stage 1 water will be coming solely from the main in Bisset Road. Internally the development will be reticulated with a water supply network designed in accordance with the FNDC Engineering Standards 2023. A water meter will be provided for each new lot with public road frontage, meter banks will be provided at the start of each JOAL to service the rear lots.

Refer to drawing 600 of the accompanying civil design drawings for further details.

6.2 Fire Fighting Water supply

The site's water supply classification for firefighting is FW2 as per the Engineering Standards and SNZ PAS 4509:2008.

The requirement for FW2 is 12.5L/s within 135m (hose run) and an additional 12.5L/s within 270m (hose run) from a maximum of 2 hydrants. It is proposed to reticulate the subdivision and install new fire hydrants within the proposed development to provide sufficient firefighting water supply coverage.

6.3 Existing Water Supply Network Upgrades

There are existing water capacity constraints within the wider Kaikohe Network which are being resolved as part of the Infrastructure Acceleration Fund (IAF) Outcome Agreement between Kāinga Ora, THOON and the FNDC. The infrastructure upgrades being implemented are targeted at providing network capacity for this development and two others but will also provide a wider benefit to Kaikohe. Further discussion on the IAF agreement is included in Section 7.3 of this report as it relates more to wastewater.

With respect to water supply, the key IAF upgrade work package that has been identified so that the network can service the proposed development is the upgrade of the line within Bisset Road from a 100mmØ to a 150mmØ as shown in Figure 8 below.

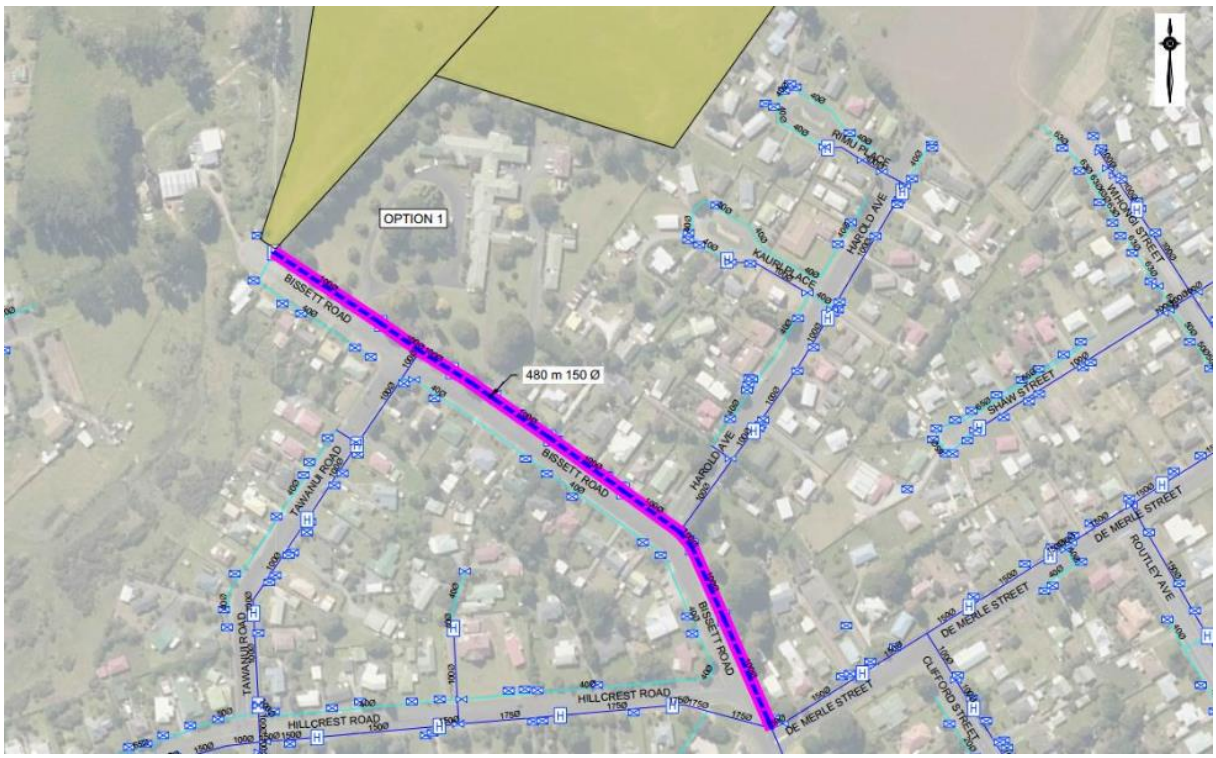


Figure 8: Bisset Road water main renewal works (Haigh Workman)

There is also another option to provide network capacity for the site which is to upgrade the line on Harlod Ave as shown in Figure 9 below. This option is less favourable because it does not align so well with the proposed development staging and could potentially require the Rimu Place Road to be pushed through at stage 1. Nevertheless, the proposed development could adapt staging to suit this option should the IAF determine that to be the best option for the wider network.

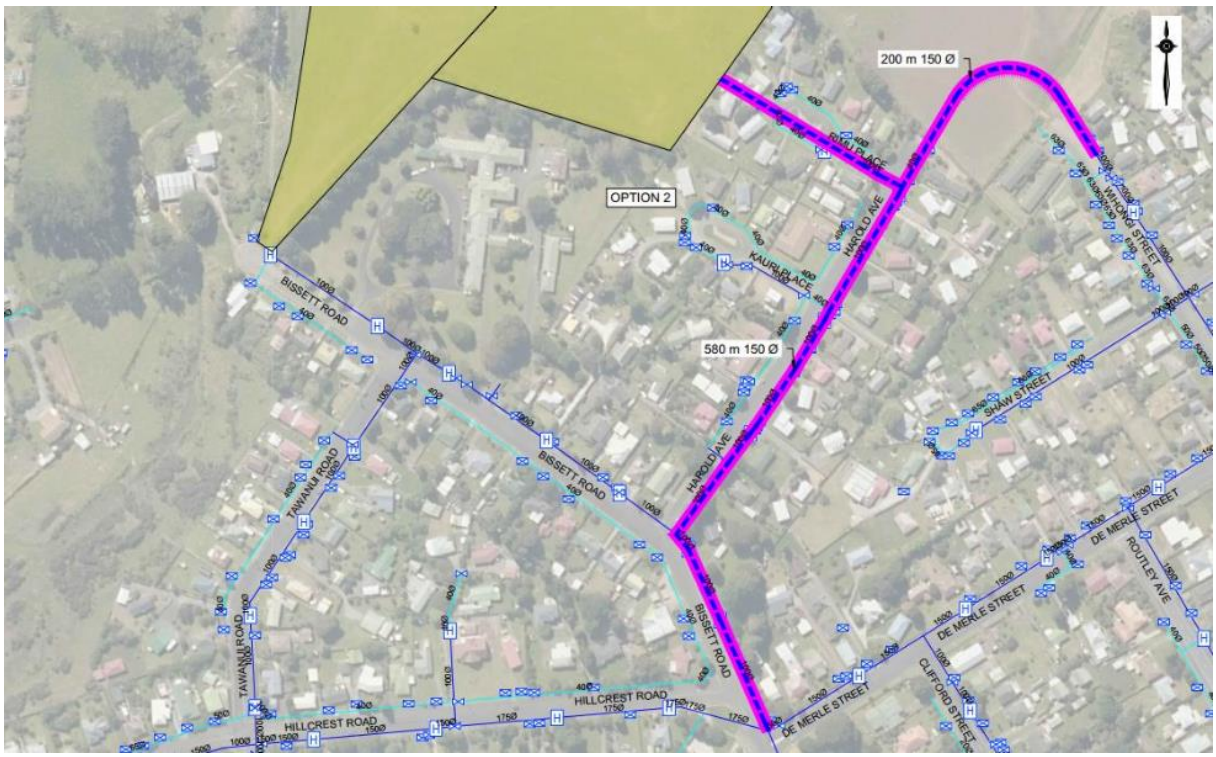


Figure 9: Harold Ave water main renewal works (Haigh Workman)

6.3.1 Water Supply Conditions

Like with wastewater it is important that both the Bisset Road development and IAF works can occur simultaneously but independent of each other. As such we recommend a condition like the following:

Prior to s224c the consent holder shall provide evidence that each lot has a metered connection to Councils reticulated water supply system and that the network has capacity for the calculated demand in accordance with the requirements of Councils Engineering Standards and Guidelines.

7 Wastewater

7.1 Existing Reticulation

As per the FNDC GIS data and the site topographical survey plan, there is an existing wastewater inspection chamber and 150mmØ clay and concrete gravity main public wastewater line which runs through the eastern corner of the property.

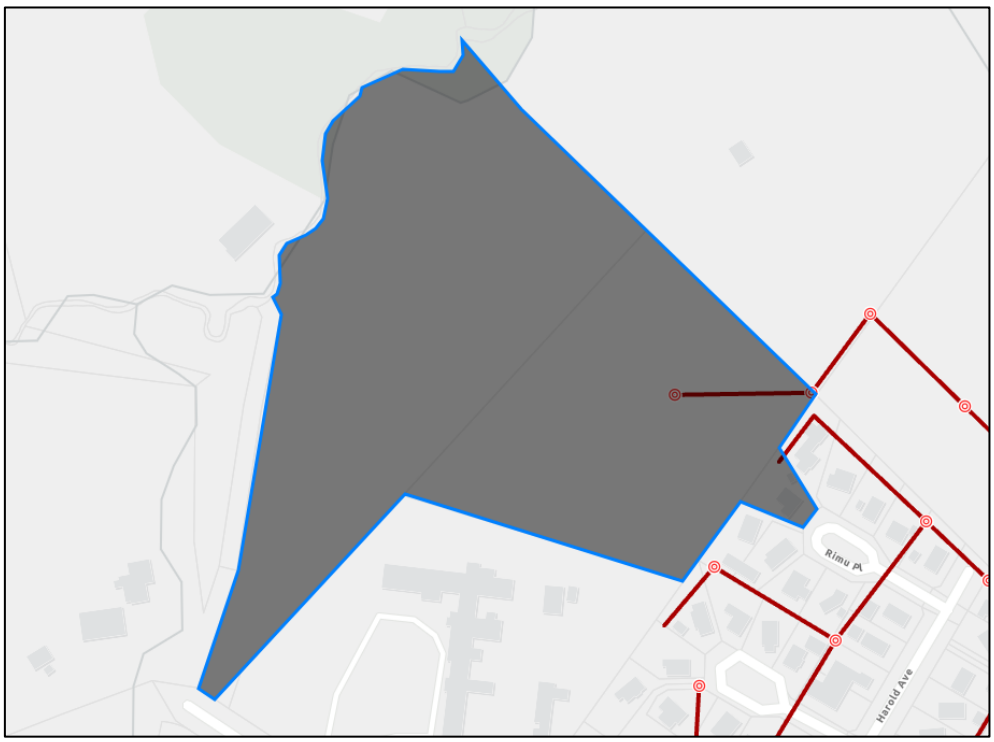


Figure 10: Existing wastewater reticulation (FNDC GIS maps, 15/11/23)

7.2 Proposed Wastewater Connections

It is proposed to remove the existing inspection chamber and the 150mmØ clay pipe and extend the 150mmØ gravity wastewater reticulation through the proposed development site to service the proposed units.

All the lots will be serviced by new private connections from the proposed wastewater main extension.

Refer to drawing 500 of the accompanying civil design drawings for further details.

7.2.1 Increase in Wastewater Demand

Table 3 below sets out the estimated wastewater demand from the proposed development based on the method set out in the FNDC Engineering Standards 2023.

Table 3: Estimated Wastewater Demand

Typologies / Stage	Number of Typologies Proposed	Design Occupancy (i.e. Persons per Typology)	Catchment Design Population	Average Dry Weather Flow Allowance (L/d/p)	Dry weather diurnal PF	Infiltration Factor	Average Dry Weather Flow (L/s)	Peak Dry Weather Flow (L/s)	Peak Wet Weather Flow (L/s)	Daily Design Volume (m3)
1 Bedroom	20	2	40	200	2.5	5	0.09	0.23	0.46	8
2 Bedroom	27	3	81	200	2.5	5	0.19	0.47	0.94	16.2
3 Bedroom	29	4	116	200	2.5	5	0.27	0.67	1.34	23.2
4 Bedroom	14	5	70	200	2.5	5	0.16	0.41	0.81	14
Vacant Lots	2	6	12	200	2.5	5	0.03	0.07	0.14	2.4
Stage 1	*34*		*97*				*0.22*	*0.56*	*1.12*	*19.4*
Stage 2	*24*		*85*				*0.20*	*0.49*	*0.98*	*17*
Stage 3	*34*		*137*				*0.32*	*0.79*	*1.59*	*27.4*
Total	92		319				0.74	1.85	3.69	63.8

7.3 Wastewater Network Capacity

7.3.1 Background

There are existing wastewater capacity constraints within the wider Kaikohe Network which are being resolved as part of the Infrastructure Acceleration Fund (IAF) Outcome Agreement between Kāinga Ora, THOON and the FNDC. The infrastructure upgrades being implemented are targeted at providing network capacity for this development and two others but will also provide a wider benefit to Kaikohe.

Because the IAF agreement will ensure capacity in the network for this development the key consideration becomes timing. i.e. ensuring that the IAF upgrade works are completed prior to demand on the network or alternatively mitigation measures implemented in the interim until the IAF works are fully completed.

7.3.2 Consenting Strategy

It is important to note that it is in the best interests of both this development and the IAF to align completion of the development (i.e. the demand) with the IAF upgrades (i.e. capacity) as close as practical. This is to ensure there is not underutilised infrastructure spend and that the housing needs of Kaikohe are met as soon as possible.

To achieve this a consenting strategy is required to enable the Bisset Road Development to procced through Resource Consent, Engineering Plan Approval and Building Consent prior to the physical IAF works being completed and both the IAF works and Bisset Road works completed simultaneously.

We propose that this is achieved by issuing consent with a consent notice condition like the following:

Advice Note:

The FNDC advises that due to constraints with the wastewater network servicing Kaikohe, approval to connect additional sites and / or dwellings to the wastewater system may not be provided for some years. Until such time that wastewater servicing meeting the relevant standards is in place, the issue of a s224(c) certificate for the sites will not be possible or alternatively issued subject to the following consent notice condition.

Prior to the issuance of a Code of Compliance Certificate for any building work relying on connection to the public wastewater system the written approval from councils Asset Manager shall be obtained and provided confirming that the council wastewater system can service the site.

The above is like what has been used by Water Care Services Limited and Auckland Council for development in Warkworth that is occurring simultaneously with the Snells Beach WWTP.

7.3.3 Infrastructure Acceleration Fund (IAF) Works

The following is a summary of the infrastructure works identified at IAF feasibility stage as being required to be completed to provide network capacity. For further details please refer to the *'Wastewater & Water Supply Reticulation Feasibility Report for Infrastructure Acceleration Fund Housing at Kaikohe'*, completed by; Haigh Workman Ltd, revision B, dated 14 November 2023.

Immediate Downstream Line Renewal

Renewal of the 150mm diameter 360m long wastewater line and 10m pipe bridge directly downstream of the Bisset Road site.

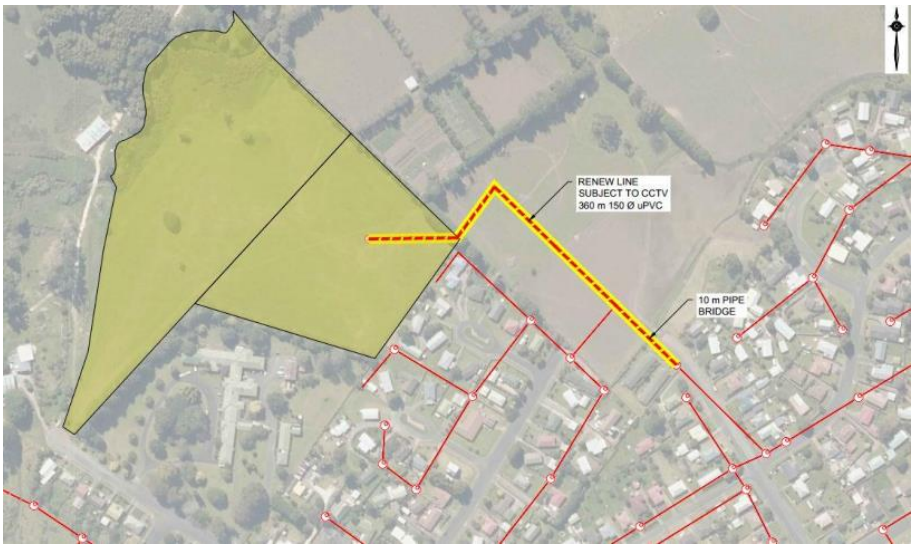


Figure 11: Bisset Road WW Line Renewal Works

Shared Wastewater Pipeline

Implementation of either one of the following two options:

Option 1 – Renewal of the existing WW gravity main from Wihongi Street to the WWTP.

Figure 12: Shared Wastewater Pipeline – Option 1

Option 2 – Installation of a WWPS and rising main from Hongi Street to the WWTP.

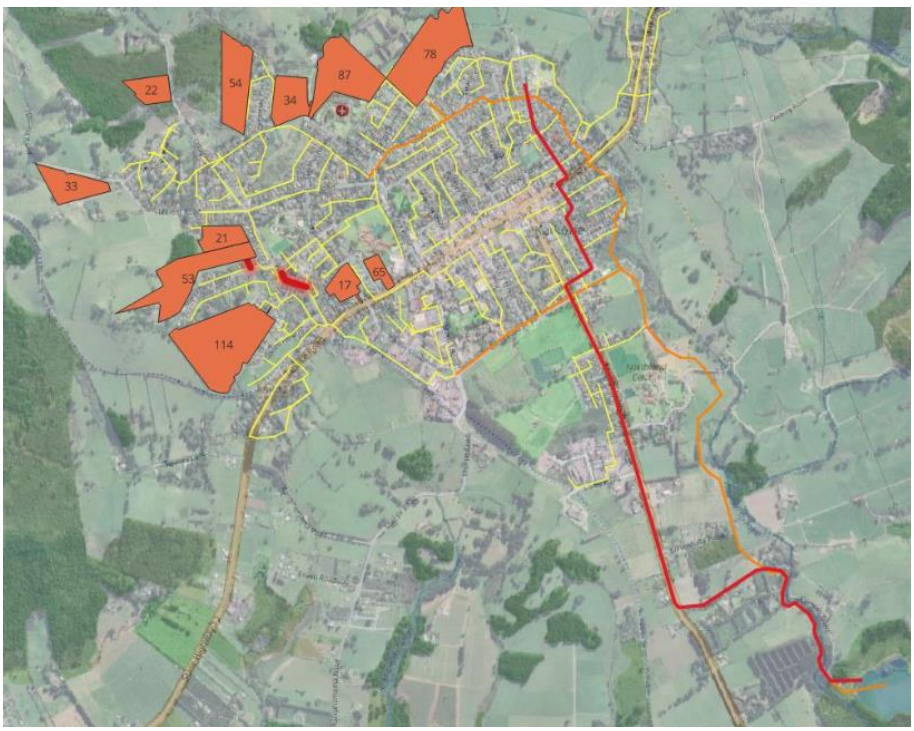


Figure 13: Shared Wastewater Pipeline – Option 2

7.3.4 Development Program Versus IAF Program

The IAF upgrade works are programmed for completion March 2026 meaning network capacity should be available then. Table 4 below is a basic development programme that aligns with the IAF program and would utilise the consenting strategy outlined in Section 7.3 above.

Table 4 Indicative Bisset Road Development Program

Bisset Road Development Stage	Allowance	Start	End
Resource Consent Approval		Underway	Jul-24

Detailed Design and EPA (Civil)	3 Months	Jul-24	Sep-24
Contractor Procurement (Civil)	2 Months	Sep-24	Oct-24
Building Consent & Contractor Procurement (Vertical)	6 Months	Oct-24	Feb-25
Stage 1 – At Least Circa 30 Units / Lots			
Infrastructure Works (Subdivision)	*8 Months*	Nov-24	Jun-25
House Construction	*8 Months*	Jul-25	Feb-26
Subdivision Completion and s224c	*3 Months*	Jun-25	Aug-25
House Code of Compliance (CCC)	*1 Month*	Feb-26	Mar-26

In our opinion the development program above is relatively optimistic and represents the earliest time additional demand would be put on the wastewater system. It assumes 30 units / lots as a first stage. Dependent on final development and funding drivers it could be that all stages are completed simultaneously which would likely push the program out slightly but achieve total build out sooner. In any event the risk to council in providing resource consent for Lots / units ahead of network capacity is mitigated by the proposed conditions.

8 Stormwater

8.1 Existing Network

Based on FNDC GIS data and site topographical survey plan, the site is not reticulated. An existing natural watercourse flows from west to east is located north of the site. There is an existing 300mmØ pipe that serves the neighbouring hospital site to the south.

8.2 Proposed Network

It is proposed to construct a wetland and a new reticulated stormwater system to provide stormwater management for the proposed development. The entirety of the primary network flow and majority of the secondary network flow will be captured by the proposed wetland. The existing 300mmØ pipe that serves the neighbouring hospital site to the south will be picked up by the proposed network and taken to the constructed wetland.

Refer to drawing 400 of the accompanying civil design drawings for further details.

8.3 Existing Natural Wetland

It is proposed to feed treated stormwater from the constructed wetland into the existing wetland in a controlled manner, to keep the existing natural wetland water level to its pre-development status.

8.4 Stormwater Management

Best practical stormwater management approach has been considered to ensure effects on the stormwater network and downstream receiving environments are less than minor. The following sections discuss what we propose for the development in accordance with Table 4-1 of the FNDC Engineering Standards 2023 considering site-specific catchment characteristics.

8.4.1 Stormwater Quality Treatment

Full water quality treatment is provided for the proposed development. A constructed wetland specifically designed in accordance GD01 is proposed. It will provide runoff treatment through a combination of physical and biological process. Upstream of the wetland catchpits are proposed which will act as gross pollutant traps and reduce maintenance requirements on the wetland.

8.4.2 Volume (Stream Protection)

Volume management is required when discharging directly into a natural stream or modified channel. In this instance the project is discharging low flows into the existing wetland and high flows directly to the stream.

On-site re-use is not proposed as part of the development because on-site tanks and re-use systems present a very high on-going maintenance cost that is not appropriate for social housing situations and are not generally accepted by Kāinga Ora. On-site soakage is not appropriate on this site for this development.

In leu of re-use or ground soakage, the proposed wetland has been specifically designed to provide extended detention. This is widely accepted as best practice for stream channel erosion protection should retention options not be suitable. Furthermore, the discharge will be controlled, and erosion protection is proposed by way of an engineered outlet and riparian planting.

8.4.3 Flow Attenuation (50% and 20% AEP event)

The site is in the upper catchment, and discharges into an existing natural watercourse that flows into the Punakitere River. In this instance flow attenuation is required and will be provided by the constructed wetland through controlled attenuation and release to limit the post-development 50% and 20% AEP event flow rates to 80% of the pre-development flows.

8.4.4 Flood Control (1% AEP event)

Flooding Hazards have been identified downstream of the site, flood control for 1% AEP event will be provided by the constructed wetland to limit the post-development 1% AEP event flow rates to 80% of the pre-development 1% AEP event flow rates.

8.5 Stormwater Management Device Selection

In our opinion an offline-constructed wetland is the best practical option to achieve the stormwater management outcomes for this site and note the following considerations:

- The existing site has a natural wetland (neighbouring the proposed wetland) i.e. a wetland is the best option to mimic natural hydrology in the catchment. Whilst also protecting and enhancing the existing natural wetland.
- The topography of the site naturally provides a logical location for the constructed wetland.
- Kāinga Ora have policies against having attenuation tanks and pumps attached to the social housing units, to reduce the level of maintenance required and reduce the risk that stormwater outcomes are not achieved becasue devices are damaged or not maintined properly.
- Wetlands maximise multiple benefits including amenity, biodiversity, and neighbourhood design (see Figure 14 below).
- Having the 92 Lots plus the upstream catchment (Age care facility) being serviced by a single device provides a positive economy of scale situation i.e. the capital cost to build one wetland is less than the cost of multiple devices throughout the catchment. The on-going maintenance requirements would also be less.
- Alternate options such as rain gardens throughout the public road, JOALs and private lots would likely have both higher capital and ongoing construction and maintenance costs. For example, the proposed public road area is circa 7500m^2. To treat this with rain gardens based on 2% of catchment area sizing for SWQT only, 150m^2 of treatment area would be required. This equates to 75 individual 2m^2 rain gardens.

Opportunities to improve	Social & cultural values						Environmental values (in addition to water quality)				
● High potential ○ Some potential - Little/no potential	Potential alignment with mana whenua values	Incorporating Te Aranga design principles	Improved amenity	Improved community connectedness	Improved public safety	Education	Habitat improvement	Connecting green corridors	Plant diversity	Bird, insect and reptile diversity	Plant ecosourcing
Pervious pavement	●	○	○	●	●	●	-	-	-	-	-
Living roof	●	●	●	●	○	●	○	○	●	●	●
Rainwater tank	●	○	●	○	○	●	-	-	-	-	-
Infiltration device	○	○	-	○	○	●	-	-	-	-	-
Vegetated swale	●	●	○	○	○	●	○	○	○	○	●
Bioretention swale	●	●	○	○	○	●	○	○	○	○	○
Raingardens	●	●	○	●	●	●	○	○	●	●	●
Stormwater tree pits	○	●	○	●	●	●	○	-	○	○	●
Planter boxes	○	●	○	●	●	●	○	-	○	○	○
Constructed wetland	●	●	●	●	○	●	●	●	●	●	●
Wet pond	-	-	●	●	○	●	●	●	●	●	●
Dry pond (detention basin)	○	○	●	●	●	●	○	○	○	○	○

Figure 14: Multiple benefits of devices table from GD01

8.6 Vesting of the Wetland

We understand form concept development meetings held with the council that they are supportive of the proposal for a constructed wetland from a stormwater management perspective. However, council hold reservations with respect to the device being vested to council as a public asset. We understand that this is largely due to operation and maintenance responsibilities and on-going costs, particularly those associated with the wider land area. To this end we provide the following points of consideration:

- The wetland is designed for the maximum probable development (MPD) catchment including the upstream age care facility site meaning it provides a wider benefit than to just the development site.
- The proposed development will result in 92 lots that will all contribute by way rates to councils' maintenance obligations.
- The highest contaminant yielding feature within the catchment is the proposed public roads. Should the constructed wetland not be proposed then alternate devices to manage run-off from these areas would be required e.g. raingardens in the road reserve.
- Long-term sustainability of the proposed device is better if the asset is publicly owned as council have existing resources and expertise to effectively manage stormwater systems.
- It does not make sense to have a public stormwater network discharge into a private device.
- The wetland and surrounding drainage reserve has landscaping and planting specifically designed to be 'low maintenance'.

- Operation and Maintenance manuals can be required at s224c by way of condition.
- On-going maintenance establishment conditions for the planting can be imposed including bonds to ensure plants are fully established and weeding as occurred before council take over the maintenance responsibility long term.
- The drainage reserve along with the adjacent esplanade provides amenity that should be available to the wider Kaikohe community not just the development lot owners.
- The devices have been specifically designed in an accordance with the relevant Engineering Standards and Guidelines to a public standard.

Considering the above, it is our opinion that the proposal results in a public stormwater network including the drainage reserve that is fit for purpose and economical to operate and maintain particularly considering the scale of the catchment it serves. We believe that it would be inappropriate for council in this instance to not take ownership of the device. However, if council maintains its position and not accept the drainage reserve and associated devises for vesting, then an incorporated society or similar to be set up to maintain the asset and consent granted with conditions accordingly.

8.7 Constructed Wetland Design

The following sections summarise the design which has been completed using Autodesk Storm and Sanitary Analysis (SSA) hydrologic and hydraulic modelling software and Autodesk Civil 3D in accordance with the following guideline documents:

- FNDC Engineering Standards 2023 Version 0.6
- GD01 Stormwater Management Devices
- United States NRCS (SCS) TR-55 Urban Hydrology for Urban Watersheds (unit hydrograph)

8.7.1 SSA Hydrologic/Hydraulic Model Input

Table 5 below summarises the hydrologic and hydraulic model input parameters.

Table 5: SSA Model Input Parameters

Parameter	Input	Note
Catchment Area	7.46 Ha	MPD catchment including the upstream site
PWV Rainfall Depth	25 mm	90th Percentile Storm Event Rainfall Depth Equivalent
50% AEP Rainfall Depth	133 mm	HIRDS Normalised Rainfall plus 20% for Climate Change
20% AEP Rainfall Depth	175 mm	HIRDS Normalised Rainfall plus 20% for Climate Change
1% AEP Rainfall Depth	313 mm	HIRDS Normalised Rainfall plus 20% for Climate Change
Time of Concentration	10 min	Minimum
Pervious SCS Curve Number	74	Group C Soils, Open Space, Good Grass Cover
Impervious SCS Curve Number	98	Impervious Area
Orifice Coefficient	0.61	
Storm Profile:	Type 1A	From USDA Soil Conservation Service TR-55

8.7.2 Modelling Methodology

Using Autodesk Storm and Sanitary Analysis (SSA) and Autodesk Civil 3D, we have run iterative models to appropriately size the proposed wetland and control orifices to provide peak flow attenuation for the 50%, 20% and 1% AEP design storms so that post-development peak flows are less than 80% of the pre-development run-off flow rates.

Conservative approaches are used for the wetland design, 50% MPD scenario has been adopted for the post-development catchment. Note that due to nature of the existing topography, a portion of the post-development secondary stormwater run-off will bypass the proposed wetland, this has been considered in our SSA model, the bypassing flow has been calculated conservatively assuming only the 20% AEP flow from the subject catchment will be conveyed to the wetland by primary network.

Based on the volume and sizing requirements for each component outlined in GD01, and the master plan provided, hydraulic model in SSA and civil model in Civil 3D has been completed, refer to Figure 15 and accompany civil drawings for further details.

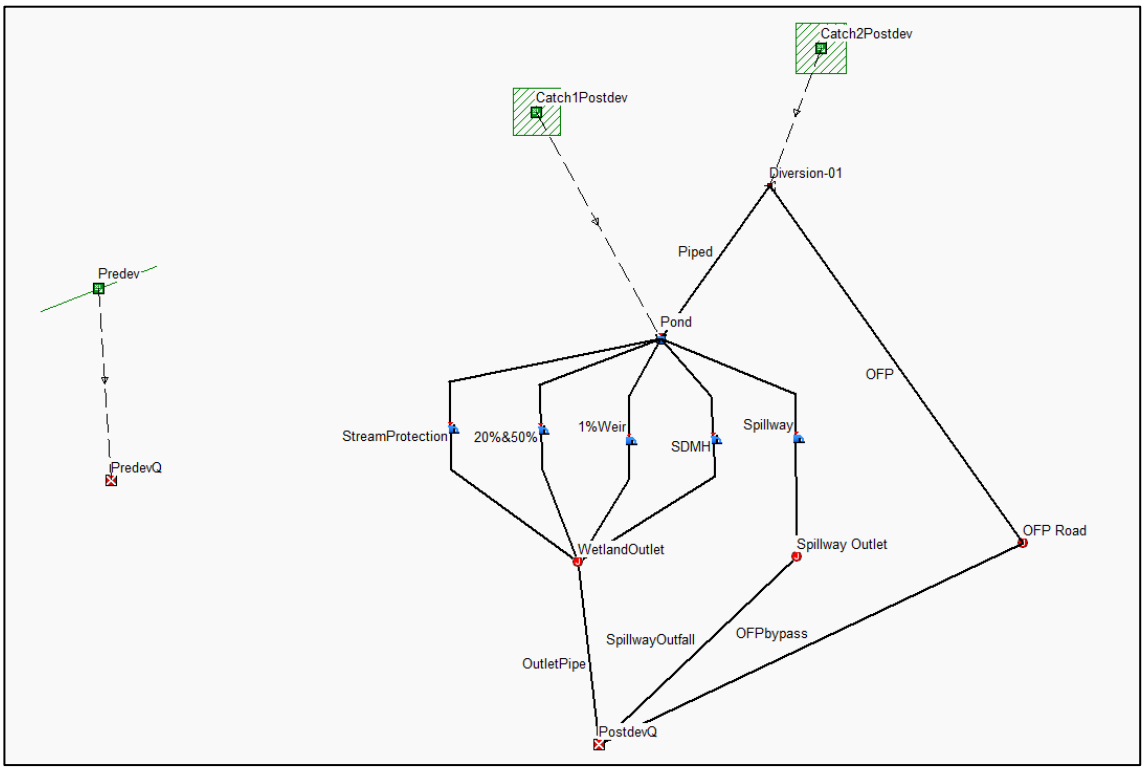


Figure 15: Autodesk Storm and Sanitary Analysis (SSA) model for proposed wetland

8.7.3 Model Output

Table 6 and Figure 16 below summarises the model output and the wetland component sizing. For further details please refer to the appendix and accompanying civil drawings.

Table 6: SSA Wetland Design Output

Component	Proposed Value	Design Requirement	Note
Permanent Water Volume (m^3)	789	Min 455	PWL RL 192.5
Wetland Treatment Surface Area (m^2)	1131	Min 607	Ponding Depth Coefficient 0.75
Forebay Volume (m^3)	84	Min 68	15% of PWV
Forebay Surface Area (m^2)	134	Min 113	10% Wetland Area
Wetland Storage Volume (m^3)	4335	Min 3749	1% + CC Storm Event Detention Volume
1% AEP Storm Event Maximum Water Level	RL 193.95		Surface Area = 3610 m^2
Flow Velocity (m/s)	0.03	Max 0.1	0.1 m/s for up to 50% AEP Event
Stream Protection Volume (m^3)	909	909	70mmØ Orifice @ PWL
50% AEP Storm Event Flow Rate (l/s)	219	Max 260	375mmØ Orifice @ RL 192.67
20% AEP Storm Event Flow Rate (l/s)	318	Max 419	375mmØ Orifice @ RL 192.67
1% AEP Storm Event Flow Rate (l/s)	696	Max 703	0.5mW x 0.6mH Weir @ RL 193.4
Emergency Spillway	RL 194.1		