SURROUNDING AREA

B&A
Urban & Environmental

Site entry to Beach Haven Road

Looking east along Beach Haven Road from site entry - towards Local Centre

Looking west down Beach Haven Road from site entry - towards Ferry.
Note: Bus stops in each direction outside of site

Looking east along Beach Haven Road from corner of Cresta Avenue

PUBLIC TRANSPORT

B&A
Urban & Environmental

SITE

FERRY TIMETABLE

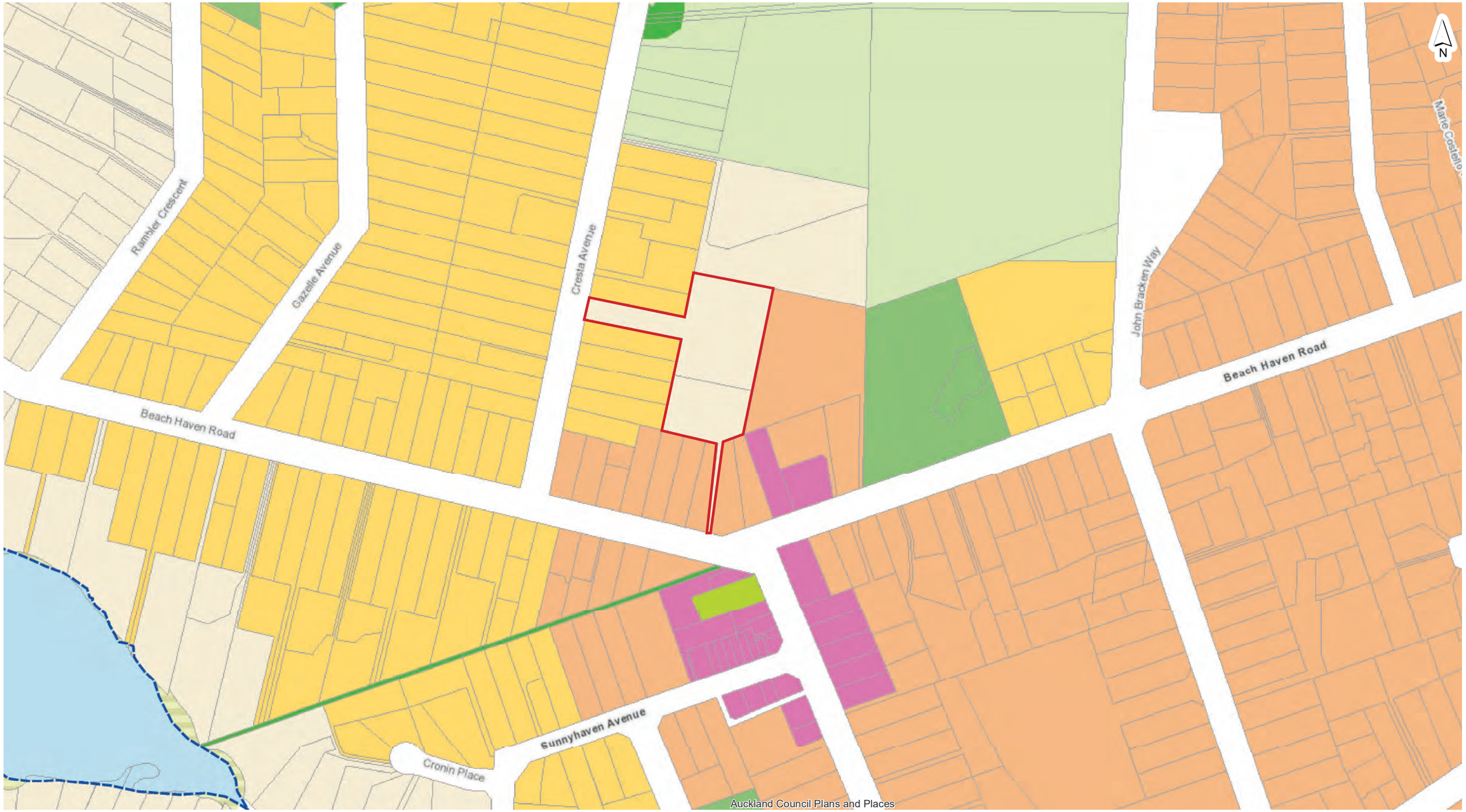
TO: AUCKLAND CITY	TO: BEACH HAVEN
MON - FRI	MON - FRI
6:25 AM	7:05 AM
7:40 AM	8:25 AM
9:00 AM	2:40 PM
3:15 PM	3:55 PM
4:30 PM	5:10 PM
5:45 PM	6:25 PM
7:00 PM	7:40 PM

SUBJECT SITE

B&A
Urban & Environmental

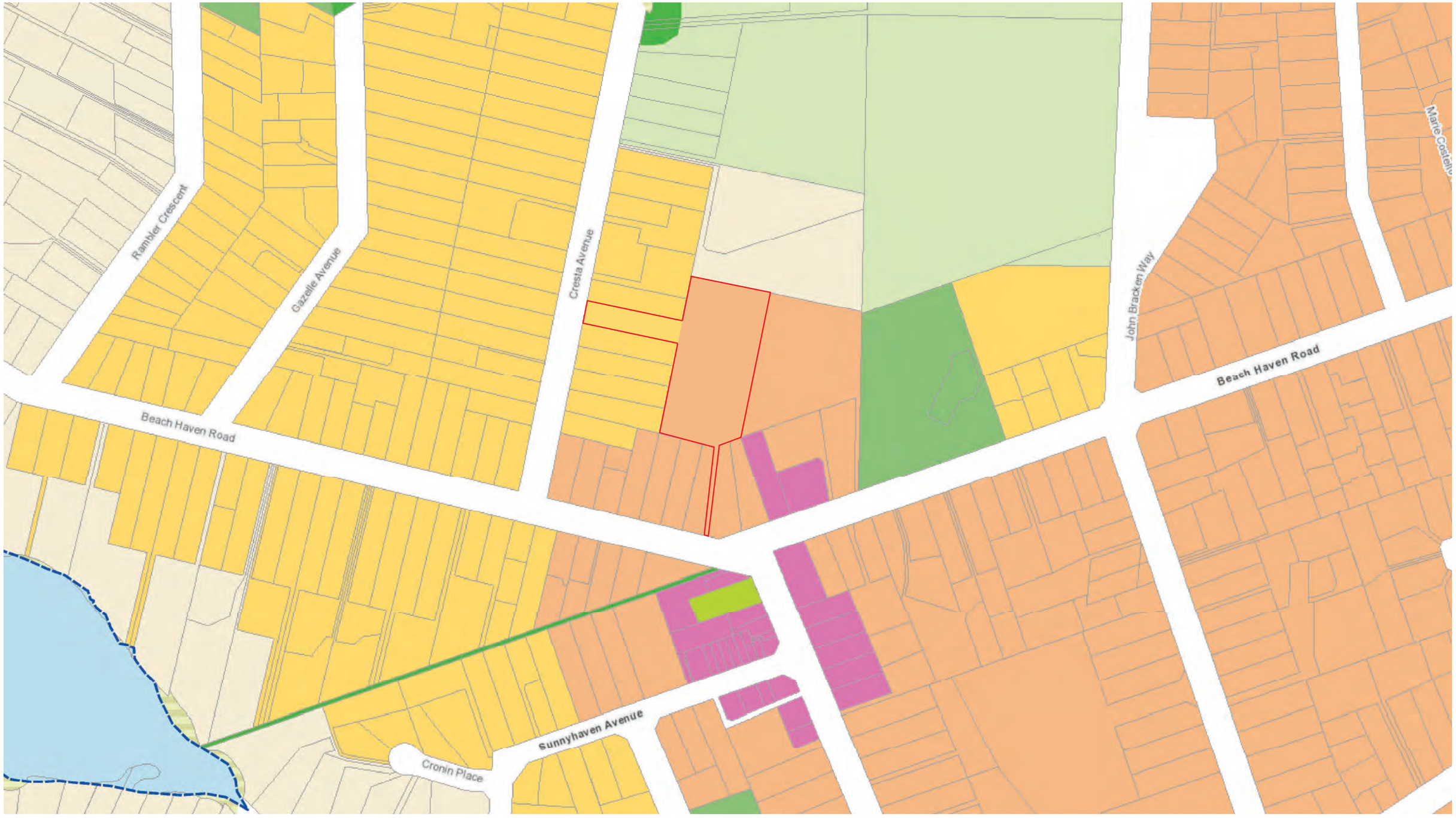
CURRENT ZONING

B&A
Urban & Environmental



PROPOSED ZONING

B&A
Urban & Environmental

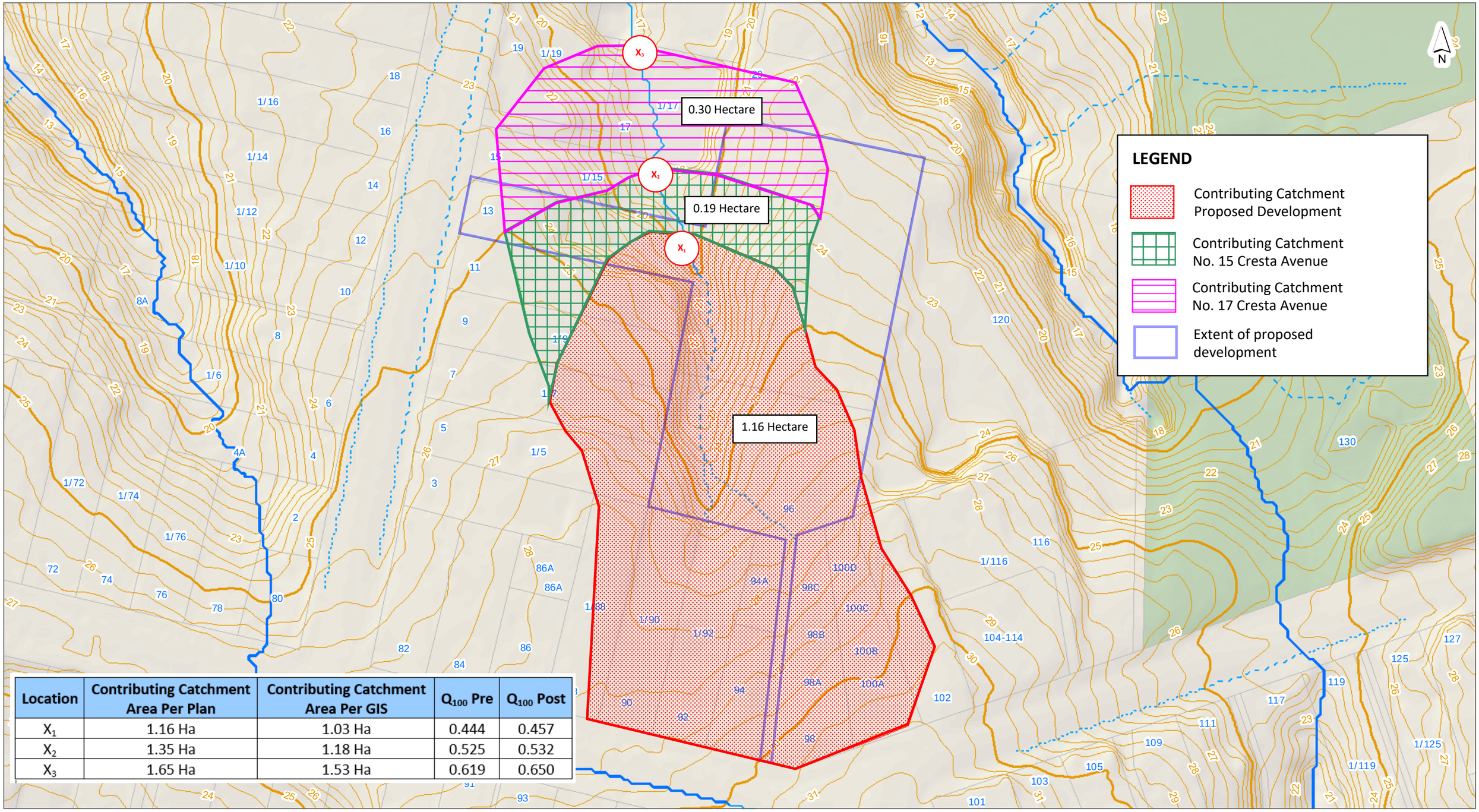


B&A

Urban & Environmental

Appendix C

Engineering Calculations



Location	Contributing Catchment Area Per Plan	Contributing Catchment Area Per GIS	Q_{100} Pre	Q_{100} Post
X_1	1.16 Ha	1.03 Ha	0.444	0.457
X_2	1.35 Ha	1.18 Ha	0.525	0.532
X_3	1.65 Ha	1.53 Ha	0.619	0.650

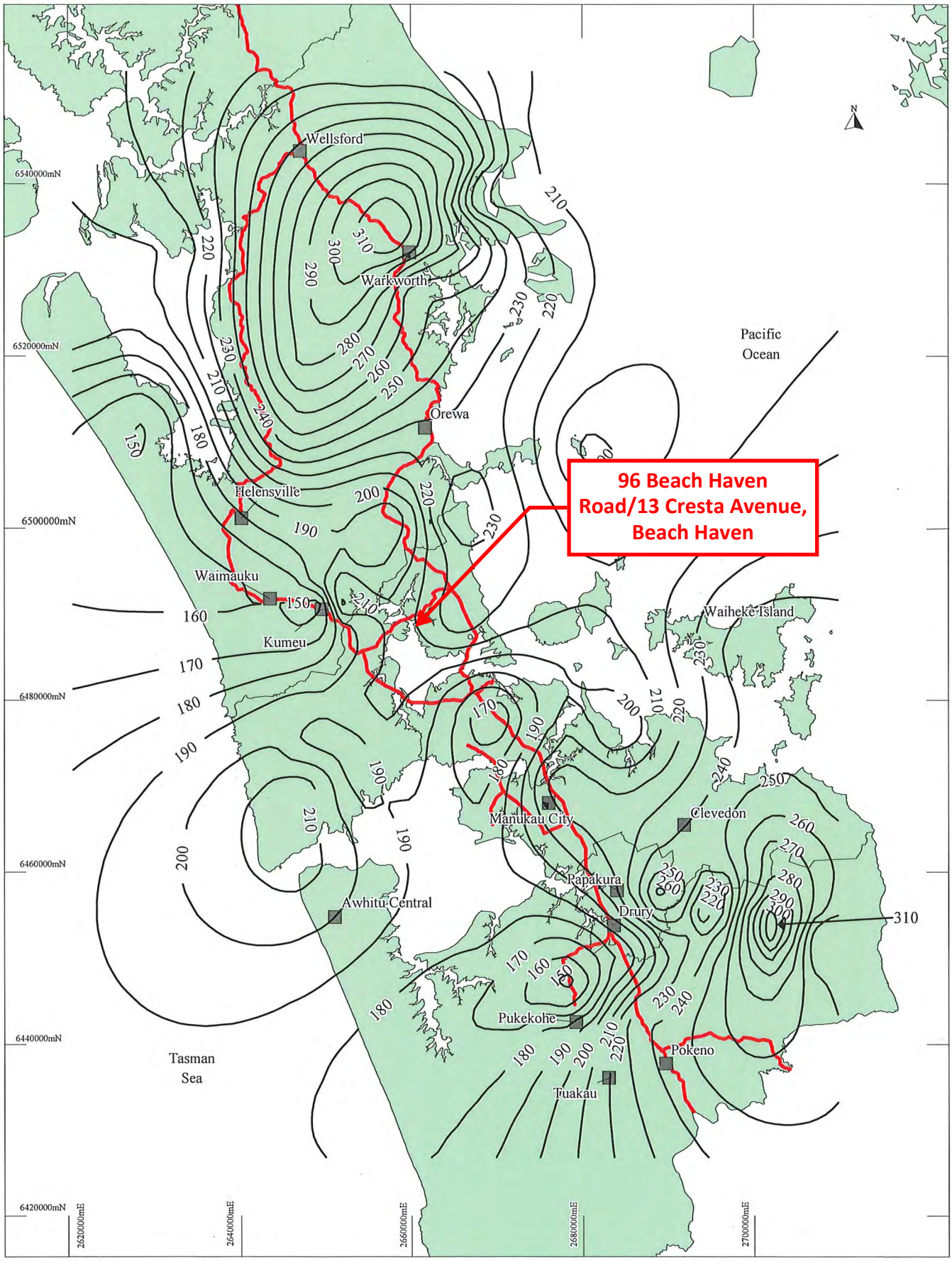
Overland Flowpath Catchment Plan

0 10 20 30
Meters

Scale @ A3
= 1:1,000

Date Printed:
4/08/2021

Auckland Council
Te Kaunihera o Tāmaki Makaurau



A

Auckland *Regional* Council

Legend: — 90 — Rainfall Contour (mm)

State Highways

Figure A.6
100 Year ARI
Daily Rainfall Depth

Scale: 1:600,000 (at A4)
(Revised 25/08/1999)

Workspace: N:(civil)\25\2507757\gis\mapinfo\wor\100yrari.wor Date: 25/08/1999

TP108 Rainfall - Overland Flowpath

Job location: 96 Beach Haven Road/13 Cresta Avenue, Beach Haven

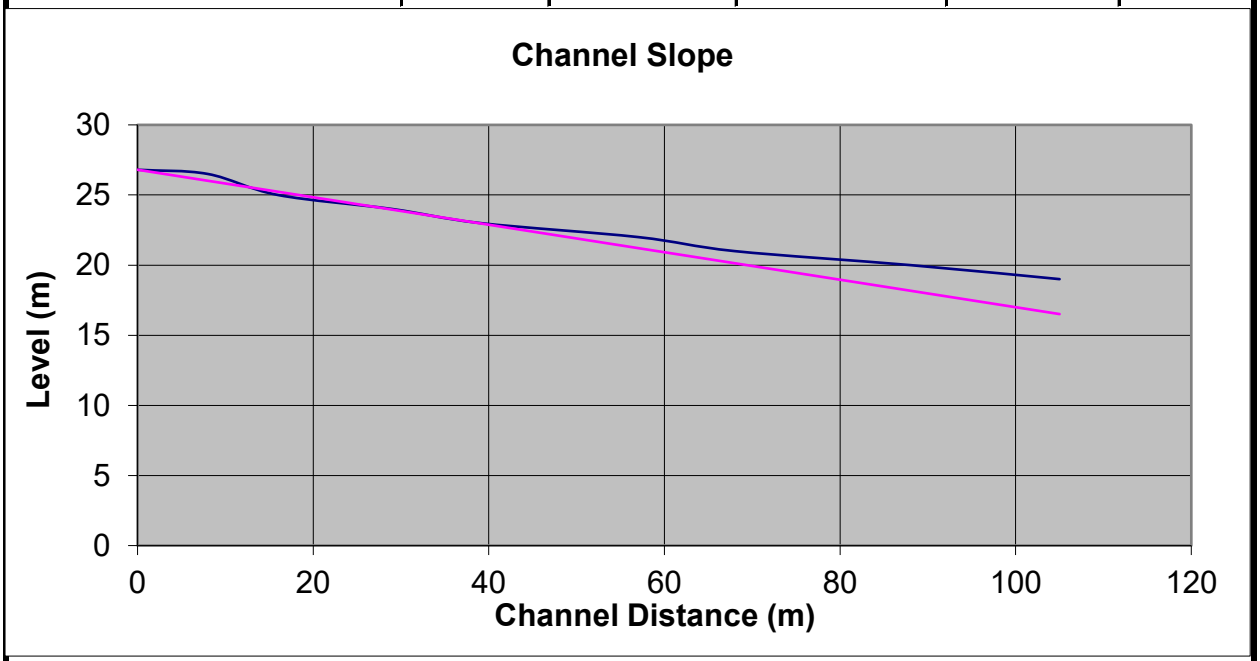
Rainfall Depth	210	mm
ARI	100	years

Duration hr	**Duration** mins	**Depth** mm	**Intensity** mm/hr (Q_{10})
0.166	10.0	28.26	170.22
0.333	20.0	43.45	130.49
0.5	30	53.59	107.19
1	60	75.55	75.55
2	120	102.04	51.02
6	360	156.00	26.00
12	720	200.15	16.68
24	1440	**245.28**	10.30
48	2880	494.48	10.30
72	4320	741.73	10.30

Job	96 Beach Haven Road/13 Cresta Avenue, Beach Haven
Job No	200626-01
Designer	Natalie Naidoo
Date	6/08/2021

SLOPE CALCULATIONS - EQUAL AREA METHOD - TP10

Description	Level (m)	Incremental distance (m)	Running distance (m)	"Area" from TP108	Average Slope Level
Inlet point	26.8	0	0		27
	26.5	8	8	213.2	26
	25	8	16	206	25
	24	13	29	318.5	24
	23	10	39	235	23
	22	18	57	405	21
	21	11	68	236.5	20
	20	16	88	328	18
	19	17	105	331.5	17
			105	0	17
			105	0	17
			105	0	17
			105	0	17
			105	0	17
Channel length (m)			**105**	2273.7	
Average Channel Slope	**-0.09801**				



Overland Flowpath Cross Sections

0 10 20 30
Meters

Scale @ A3
= 1:1,000

Date Printed:
16/07/2021

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Hydrographs- SCS Method - Predevelopment flow from Proposed Development

Project Description 96 Beach Haven Road/13 Cresta Avenue
Beach Haven

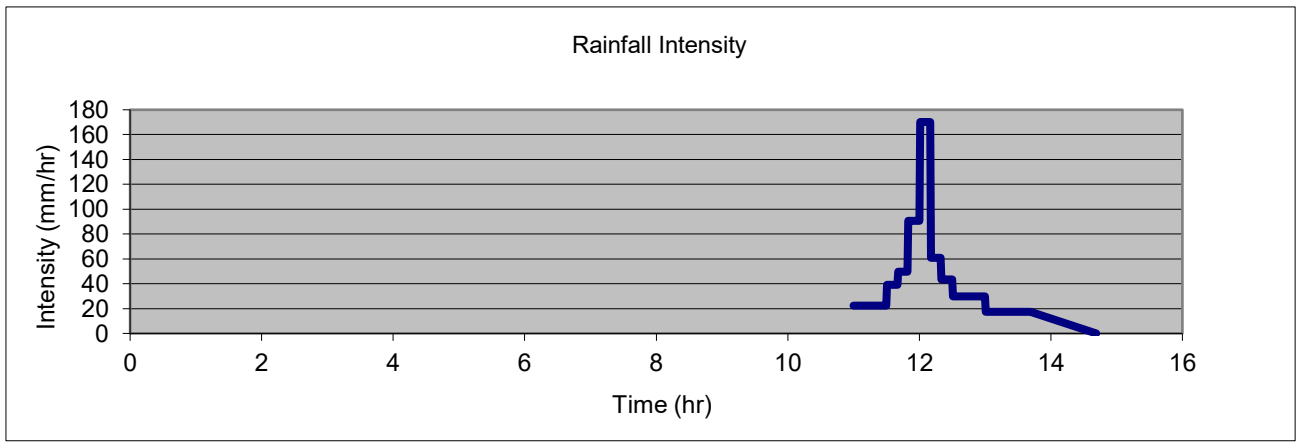
Rainfall Depth (mm) 245.28 100 YEAR ARI

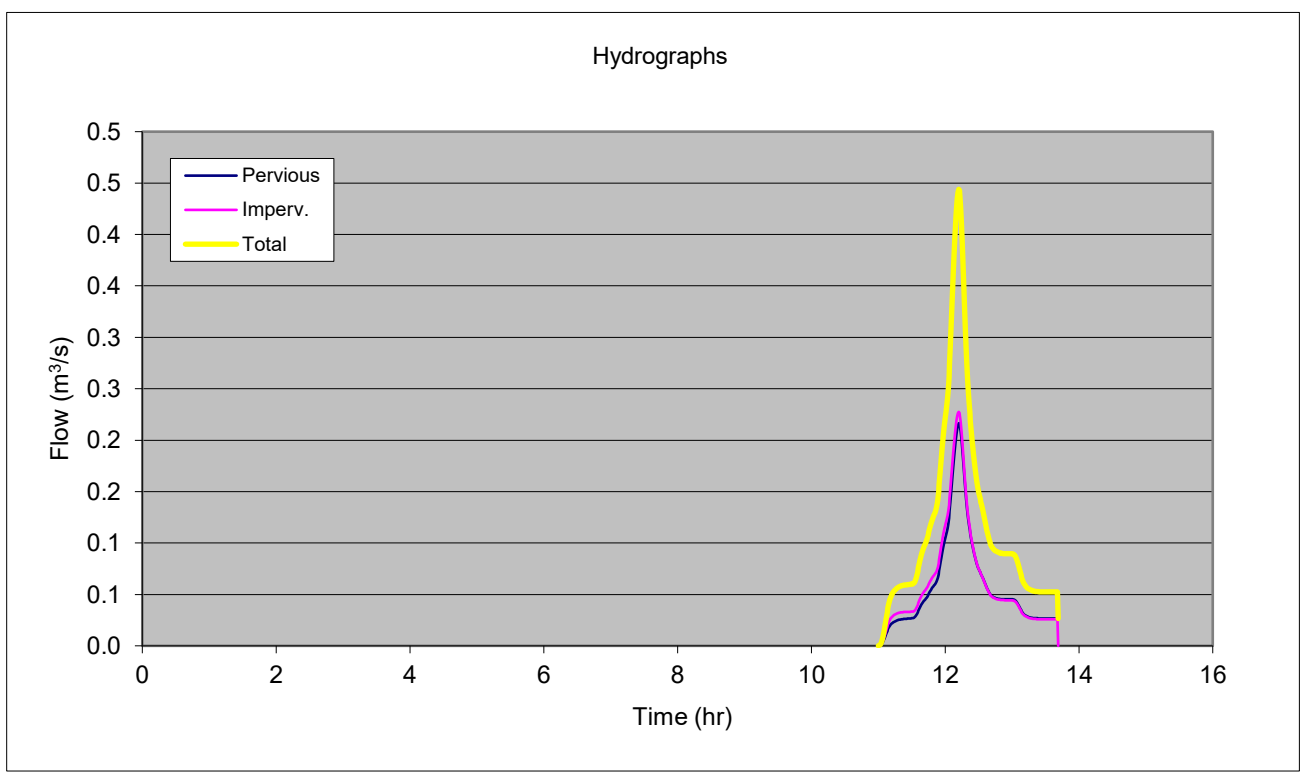
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.6264	0.5336
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	101	101
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	205.1
Peak Flow (m^3/s)	0.216	0.228	0.444
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.83
Runoff Coefficient - Volume	0.71	0.98	0.84





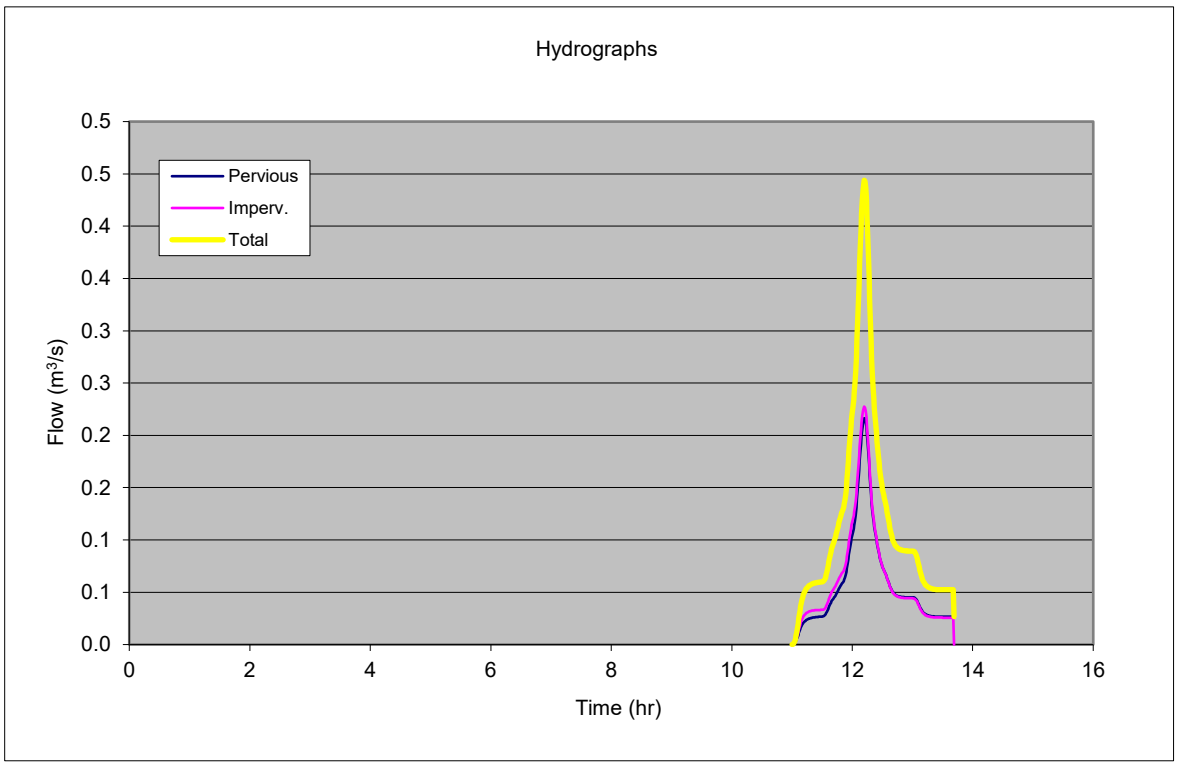
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
Beach Haven

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 1.70%



Time (hr)	Flow (m^3/s)
11.001	0.000
11.347	0.058
11.491	0.060
11.601	0.076
11.694	0.098
11.776	0.115
11.850	0.130
11.918	0.161
11.981	0.210
12.040	0.246
12.096	0.320
12.150	0.403
12.201	0.444
12.230	0.430
12.259	0.387
12.290	0.330
12.320	0.278
12.352	0.240
12.384	0.214
12.417	0.191
12.451	0.170
12.486	0.154
12.522	0.143
12.559	0.133
12.597	0.121
12.637	0.108
12.678	0.099
12.721	0.094
12.767	0.092
12.814	0.090
12.864	0.090
12.917	0.089
12.975	0.089
13.037	0.088
13.106	0.075
13.184	0.060
13.277	0.054
13.398	0.053
13.690	0.027
-1.000	0.000

CHANNEL CAPACITY SECTION PRE-DEVELOPMENT A-A

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	6.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.444
Case B	
Slope (S_o)	10%
Water level (m)	23.53
MFFL	23.68

0.13

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	23.7	0.03		Short Grass
0.5	23.5	0.03		Short Grass
1	23.4	0.03		Short Grass
2	23.4	0.03		Short Grass
2.5	23.50	0.03		Short Grass
3	23.7	0.03		Short Grass
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

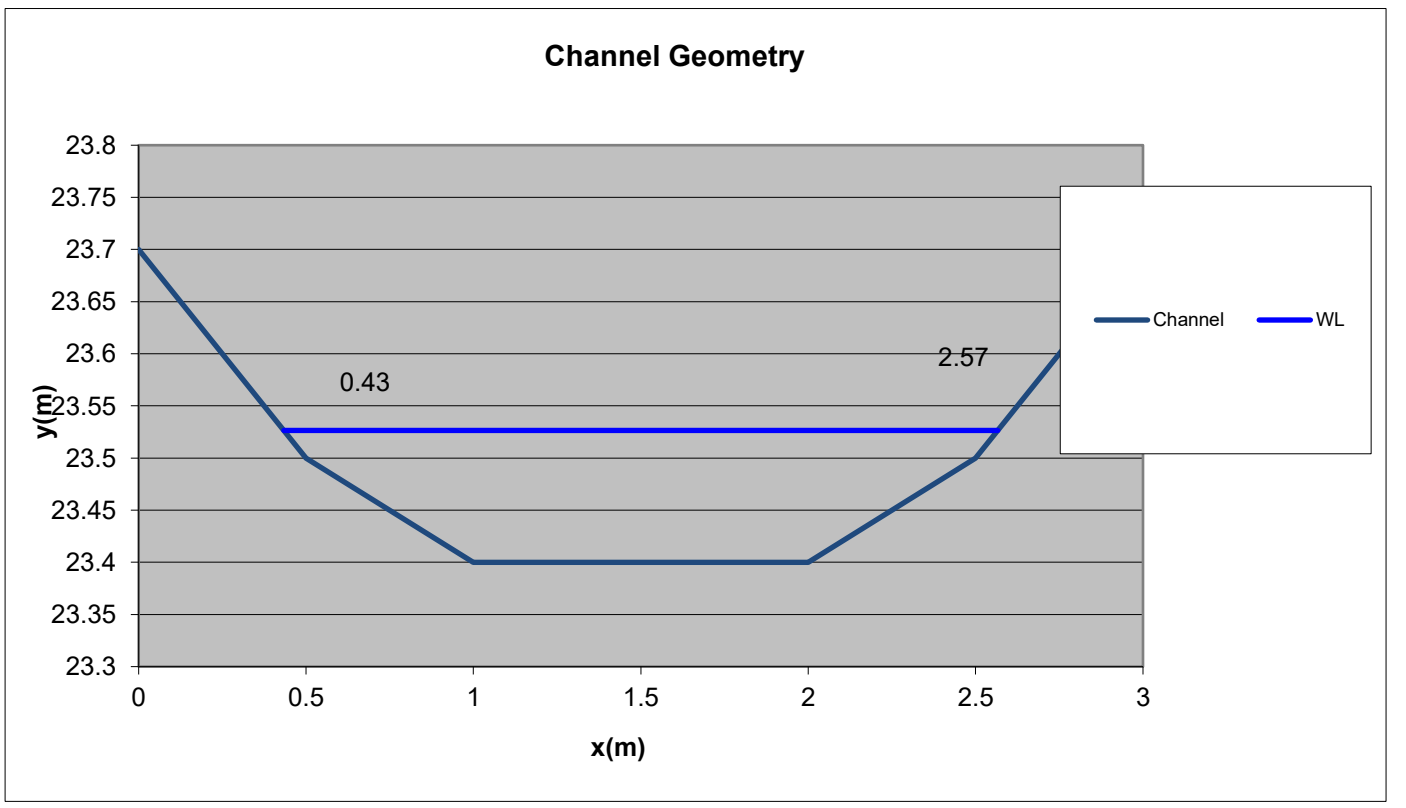
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.445** OK
Velocity (m/s)	2.173
S_o or S_f	0.1000
Energy (m)	23.767
Froude No	2.239
Bed Stress (Pa)	92.885
Equivalent "n"	0.030
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	23.527
Area (A-m^2)	0.205
Width (B-m)	2.132
Perimeter (P-m)	2.163

Critical Flow Conditions	
Flow (m^3/s)	**0.199** INCREASE CHA
Velocity (m/s)	0.971
Energy (m)	23.575

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



CHANNEL CAPACITY SECTION PRE-DEVELOPMENT B-B

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	6.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.444
Case B	
Slope (S_o)	10%
Water level (m)	21.53
MFFL	21.68

0.13

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	22	0.03		Short Grass
0.5	21.5	0.03		Short Grass
1	21.4	0.03		Short Grass
2	21.4	0.03		Short Grass
2.5	21.50	0.03		Short Grass
3	22	0.03		Short Grass
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

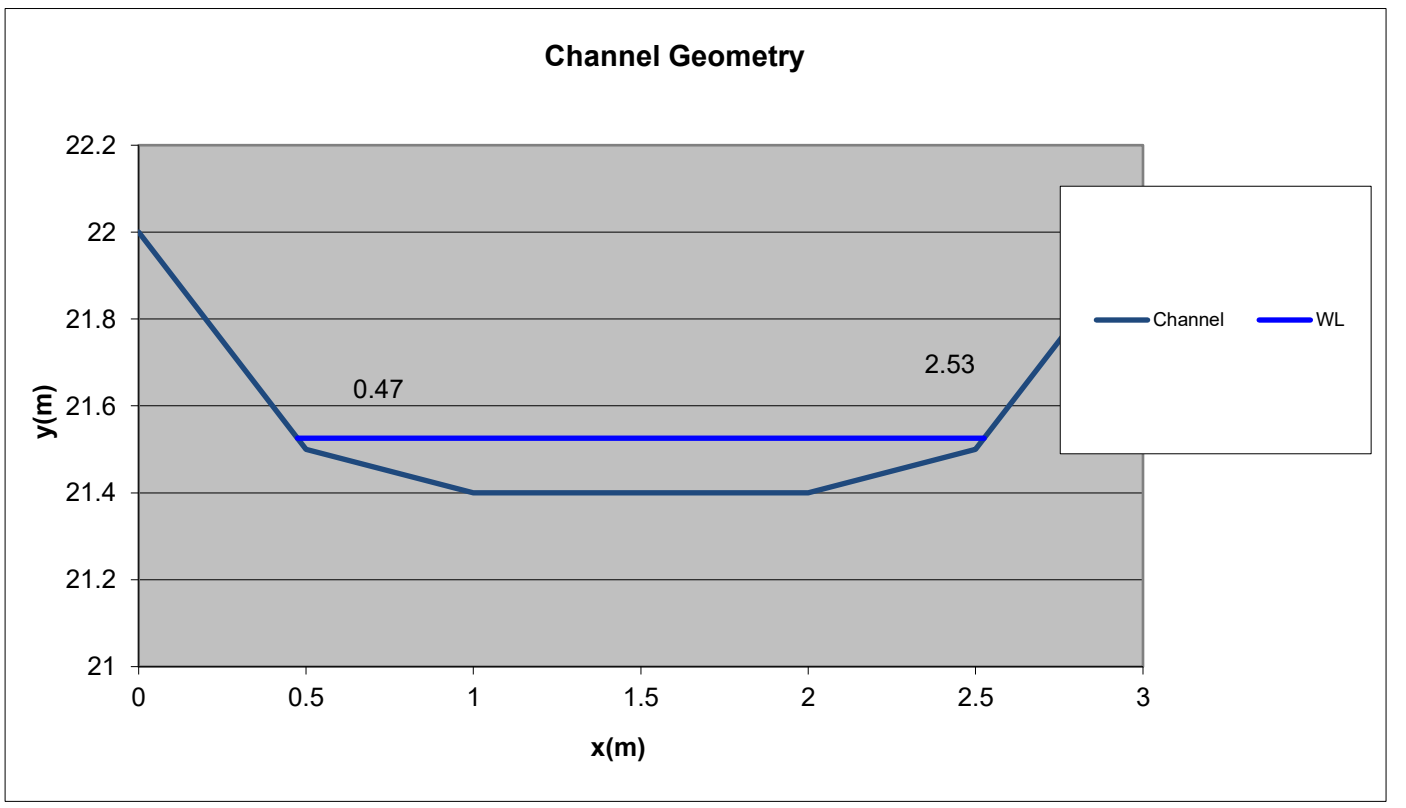
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.445** OK
Velocity (m/s)	2.201
S_o or S_f	0.1000
Energy (m)	21.773
Froude No	2.240
Bed Stress (Pa)	94.730
Equivalent "n"	0.030
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	21.526
Area (A-m^2)	0.202
Width (B-m)	2.051
Perimeter (P-m)	2.092

Critical Flow Conditions	
Flow (m^3/s)	**0.199** INCREASE CHA
Velocity (m/s)	0.983
Energy (m)	21.575

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



AIREY CONSULTANTS LTD.

CHANNEL CAPACITY SECTION PRE-DEVELOPMENT C-C

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	6.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B): B

Case A

Flow (m^3/s): 0.444

Case B

Slope (S_o): 10%

Water level (m): 20.03 | 0.13

MFFL: 20.18

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	20.5	0.03		Property/Parcels
0.5	20.00	0.03		Property/Parcels
1	19.9	0.03		Property/Parcels
2	19.9	0.03		Property/Parcels
2.5	20.00	0.03		Property/Parcels
3	20.5	0.03		Property/Parcels
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

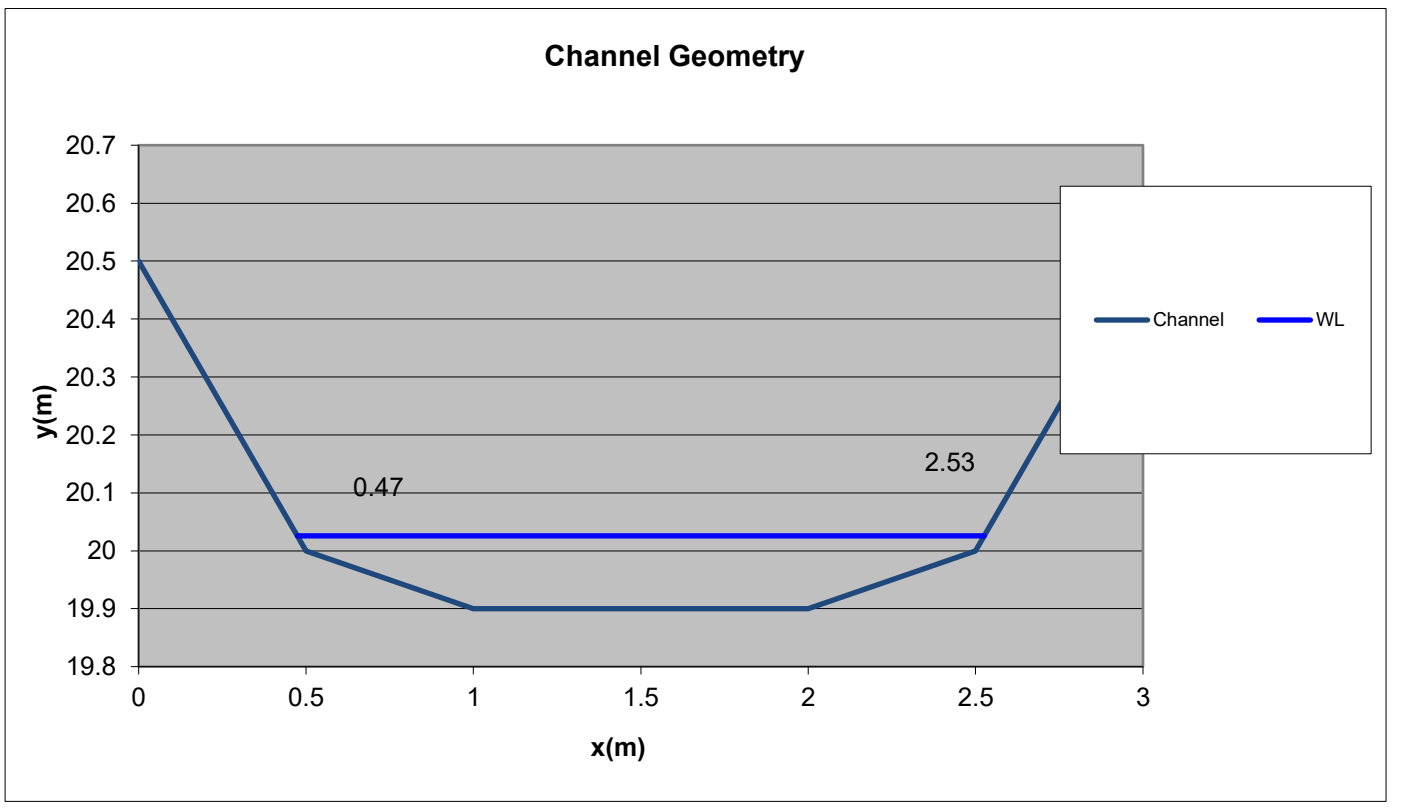
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.445** OK
Velocity (m/s)	2.201
S_o or S_f	0.1000
Energy (m)	20.273
Froude No	2.240
Bed Stress (Pa)	94.730
Equivalent "n"	0.030
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	20.026
Area (A-m^2)	0.202
Width (B-m)	2.051
Perimeter (P-m)	2.092

Critical Flow Conditions	
Flow (m^3/s)	**0.199** INCREASE CHA
Velocity (m/s)	0.983
Energy (m)	20.075

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Hydrographs- SCS Method - Post Development Flow from the Proposed Development

Project Description 96 Beach Haven Road/13 Cresta Avenue
Proposed Development

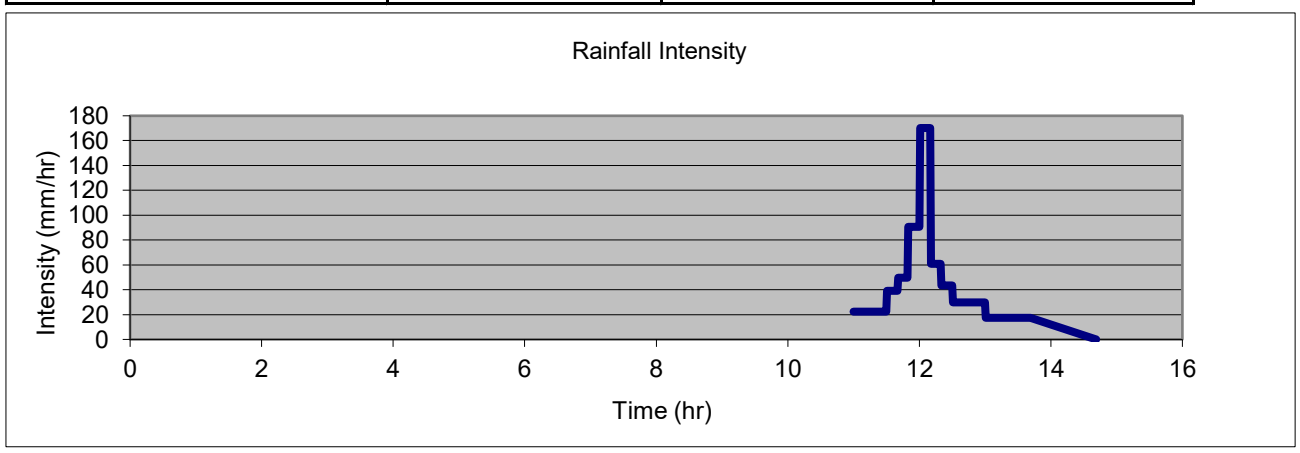
Rainfall Depth (mm) 245.28 100 YEAR ARI

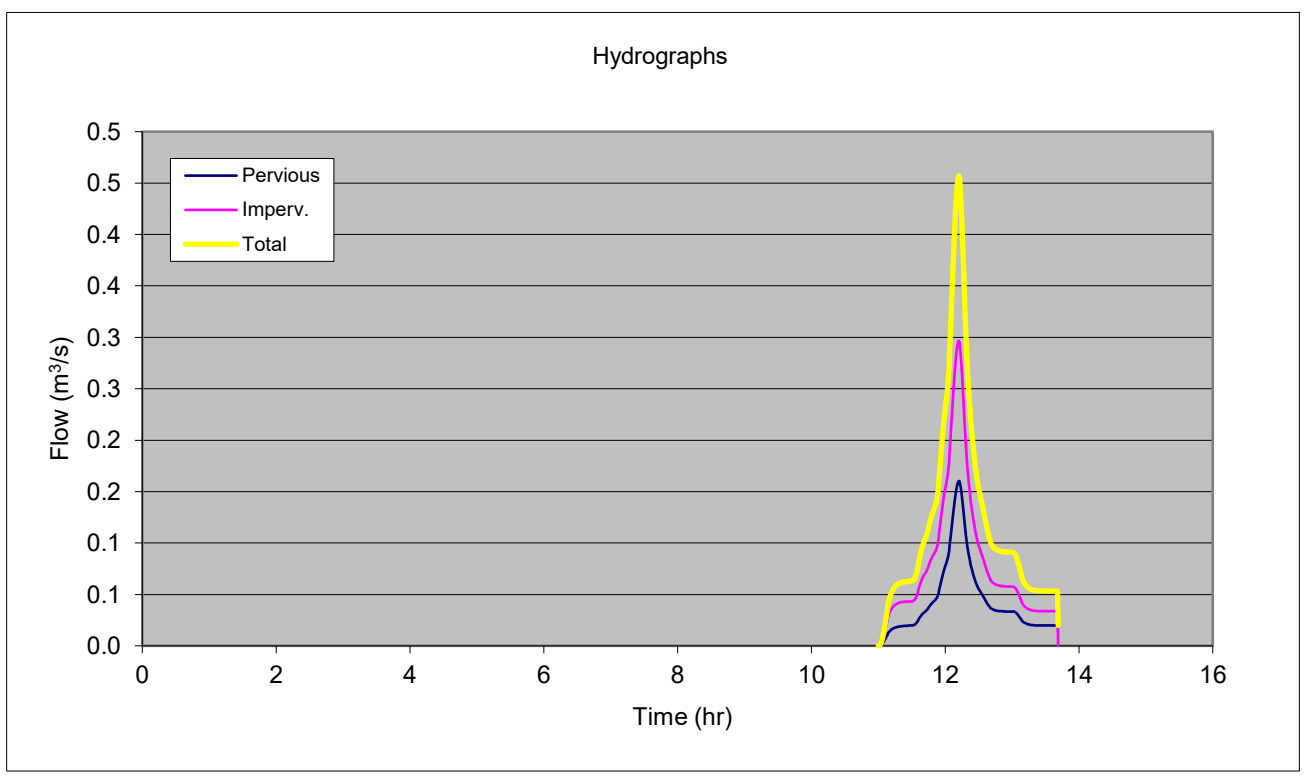
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.464	0.696
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	101	101
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	214.2
Peak Flow (m^3/s)	0.160	0.297	0.457
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.86
Runoff Coefficient - Volume	0.71	0.98	0.87





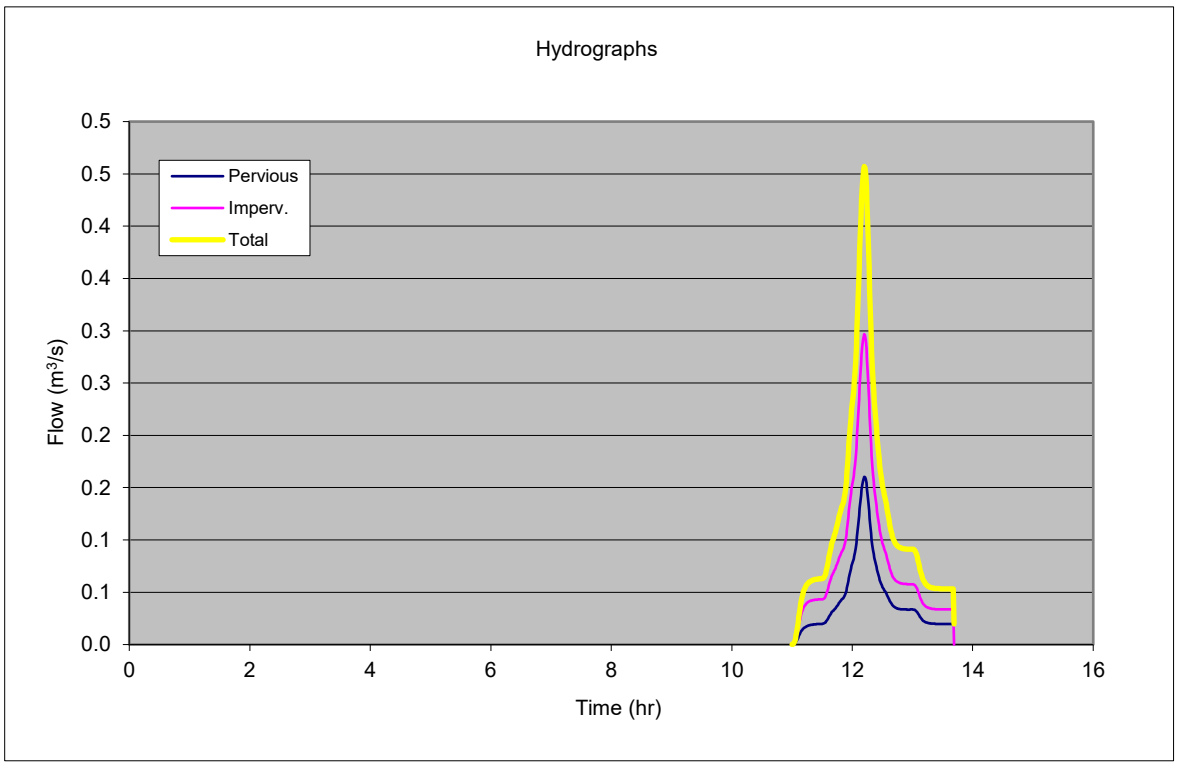
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
Proposed Development

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 2.02%



Time (hr)
11.001
11.347
11.491
11.601
11.694
11.776
11.850
11.918
11.981
12.040
12.096
12.150
12.201
12.230
12.259
12.290
12.320
12.352
12.384
12.417
12.451
12.486
12.522
12.559
12.597
12.637
12.678
12.721
12.767
12.814
12.864
12.917
12.975
13.037
13.106
13.184
13.277
13.398
13.690
-1.000

CHANNEL CAPACITY SECTION POST DEVELOPMENT A-A

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	5.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.457
Case B	
Slope (S_o)	5%
Water level (m)	23.55
MFFL	23.70

0.15

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	23.7	0.03		Short Grass
0.5	23.5	0.03		Short Grass
1	23.4	0.03		Short Grass
2	23.4	0.03		Short Grass
2.5	23.49	0.03		Short Grass
3	23.7	0.03		Short Grass
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

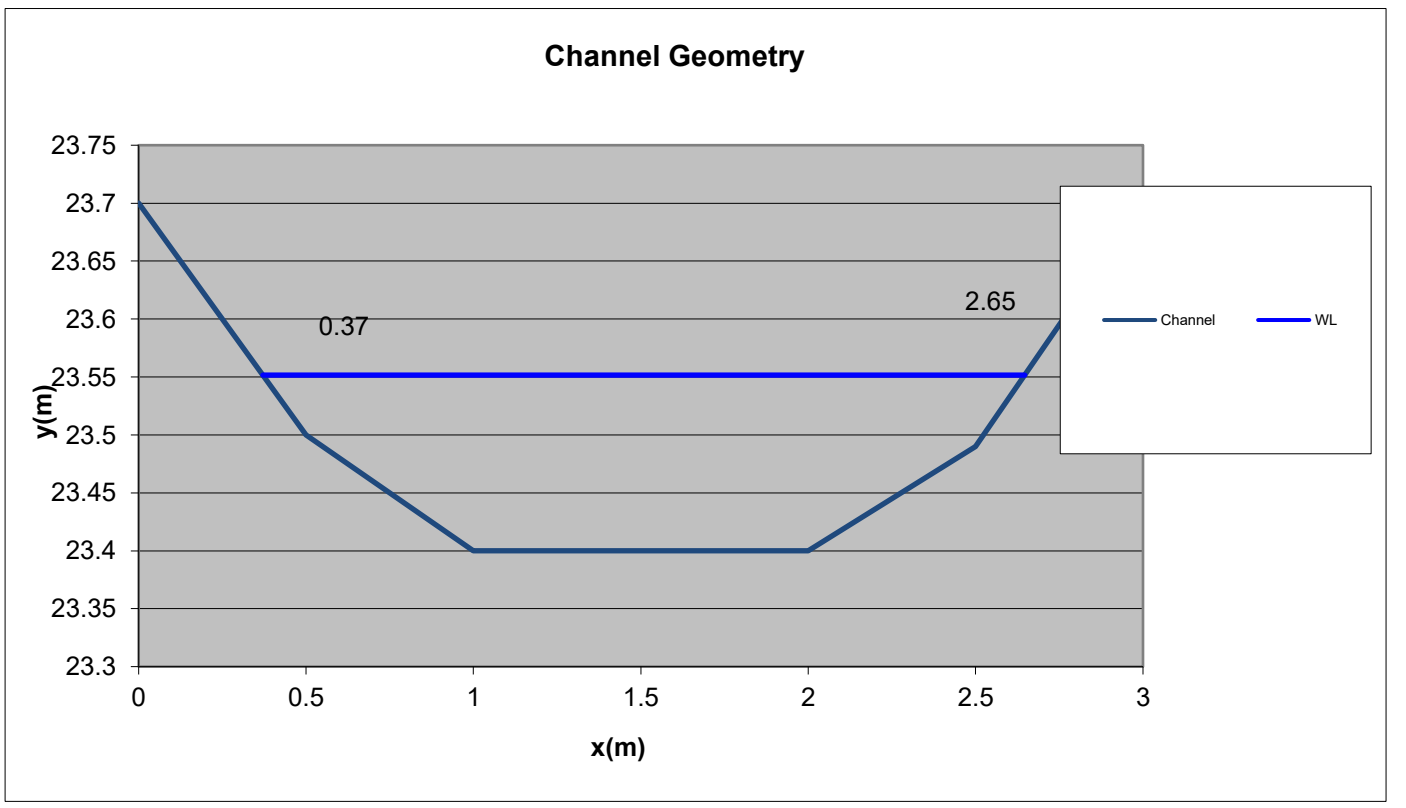
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.458** OK
Velocity (m/s)	1.738
S_o or S_f	0.0500
Energy (m)	23.705
Froude No	1.630
Bed Stress (Pa)	55.817
Equivalent "n"	0.030
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	23.552
Area (A-m^2)	0.264
Width (B-m)	2.276
Perimeter (P-m)	2.316

Critical Flow Conditions	
Flow (m^3/s)	**0.281** INCREASE CHA
Velocity (m/s)	1.066
Energy (m)	23.610

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



CHANNEL CAPACITY SECTION POST DEVELOPMENT B-B

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	5.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.457
Case B	
Slope (S_o)	5%
Water level (m)	21.55
MFFL	21.70

0.15

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	22	0.03		Short Grass
0.5	21.5	0.03		Short Grass
1	21.4	0.03		Short Grass
2	21.4	0.03		Short Grass
2.5	21.50	0.03		Short Grass
3	22	0.03		Short Grass
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

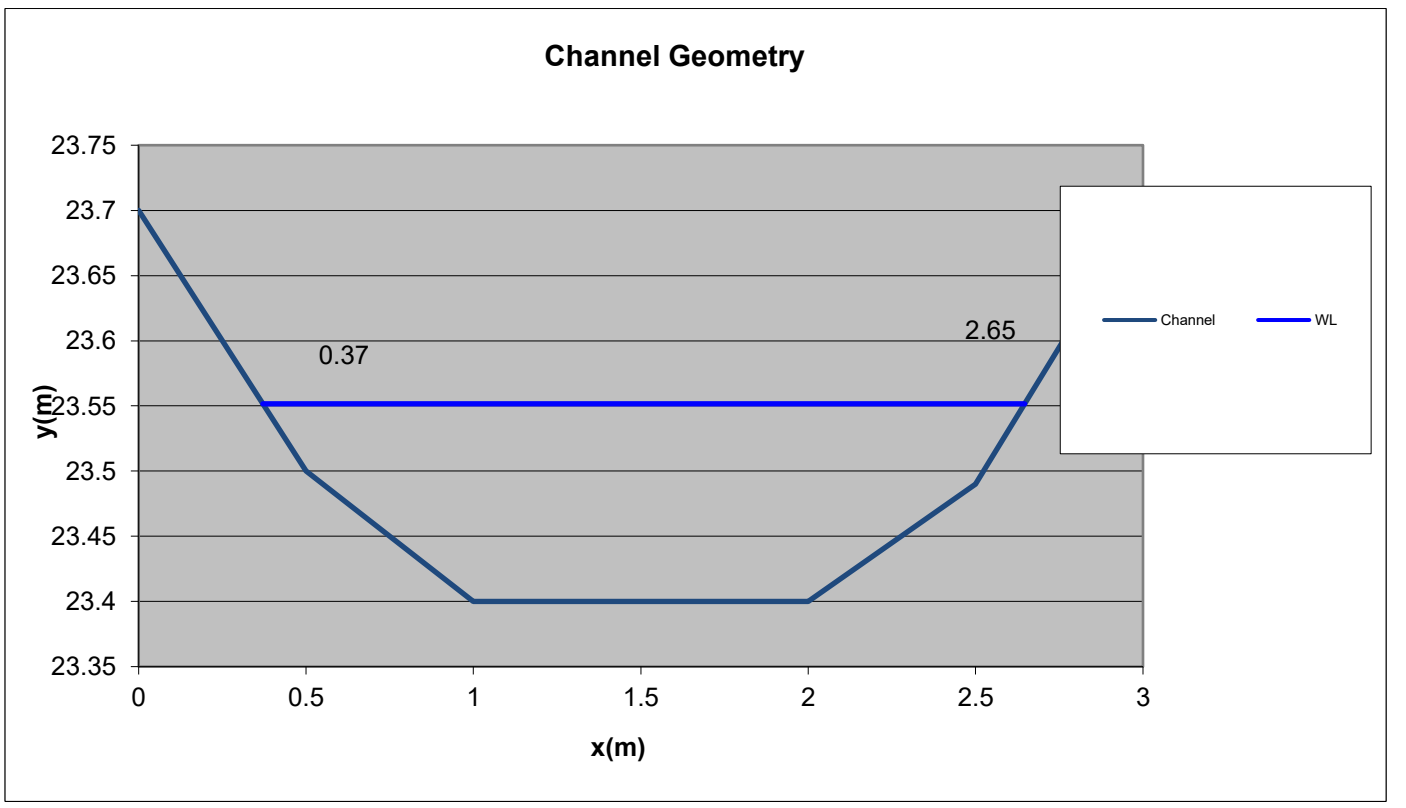
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.458** OK
Velocity (m/s)	1.785
S_o or S_f	0.0500
Energy (m)	21.714
Froude No	1.632
Bed Stress (Pa)	58.108
Equivalent "n"	0.030
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	21.552
Area (A-m^2)	0.257
Width (B-m)	2.104
Perimeter (P-m)	2.167

Critical Flow Conditions	
Flow (m^3/s)	**0.281** INCREASE CHA
Velocity (m/s)	1.094
Energy (m)	21.613

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



AIREY CONSULTANTS LTD.

CHANNEL CAPACITY SECTION POST DEVELOPMENT C-C - REVISION 1

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	16.06.2022
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.457
Case B	
Slope (S_o)	5%
Water level (m)	20.00
MFFL	20.15

0.10

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	20.5	0.013		COAL
0.5	20.00	0.013		COAL
1	19.9	0.013		COAL
2	19.9	0.013		COAL
2.5	20.00	0.013		COAL
3	20.5	0.013		COAL
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

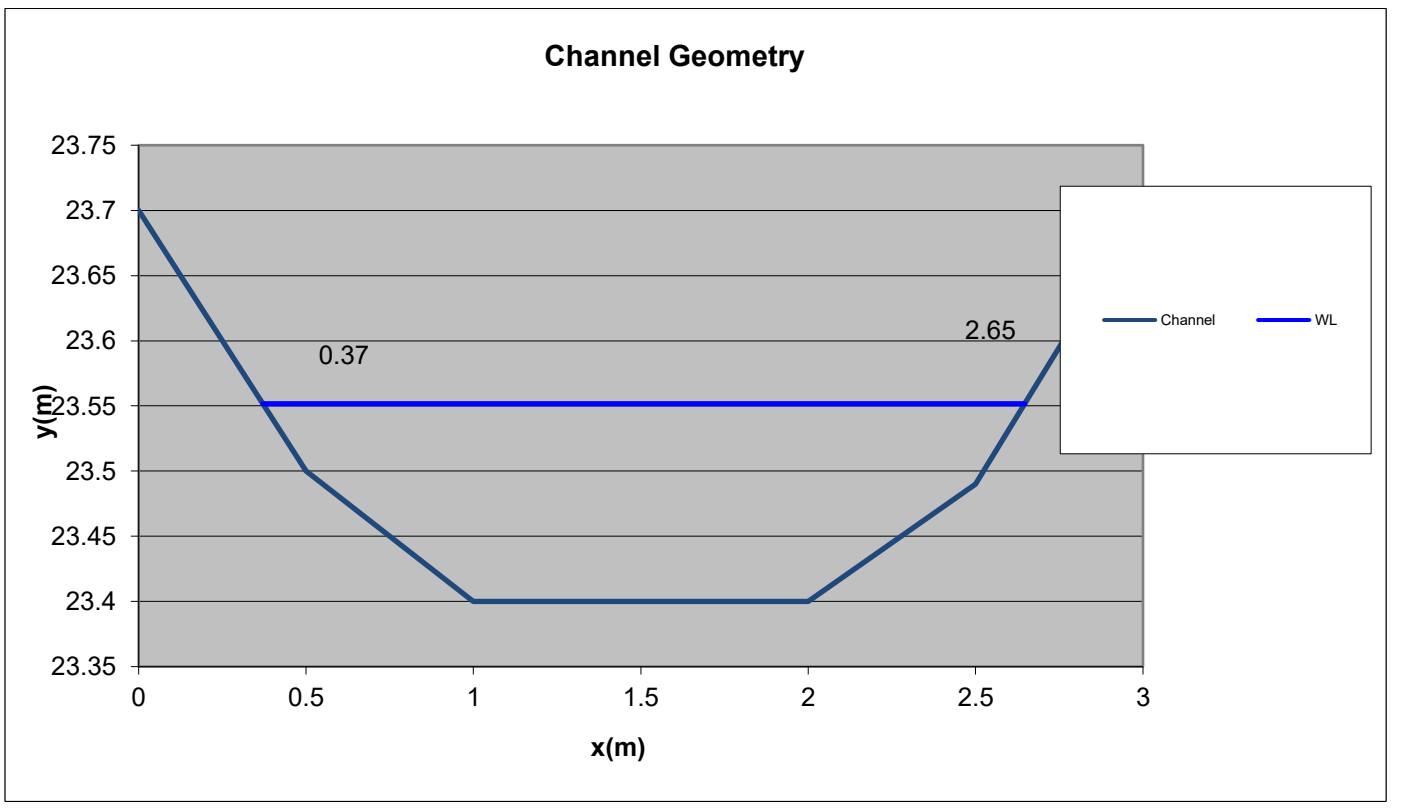
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.458** OK
Velocity (m/s)	3.027
S_o or S_f	0.0500
Energy (m)	20.468
Froude No	3.516
Bed Stress (Pa)	36.687
Equivalent "n"	0.013
Equivalent k_s(mm)	1.75

Geometry for wetted conditions	
Depth (d-m)	20.001
Area (A-m^2)	0.151
Width (B-m)	2.001
Perimeter (P-m)	2.022

Critical Flow Conditions	
Flow (m^3/s)	**0.130** INCREASE CHA
Velocity (m/s)	0.861
Energy (m)	20.038

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Hydrographs- SCS Method - Predevelopment Flow from No. 15 Cresta Avenue

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 15 Cresta Avenue

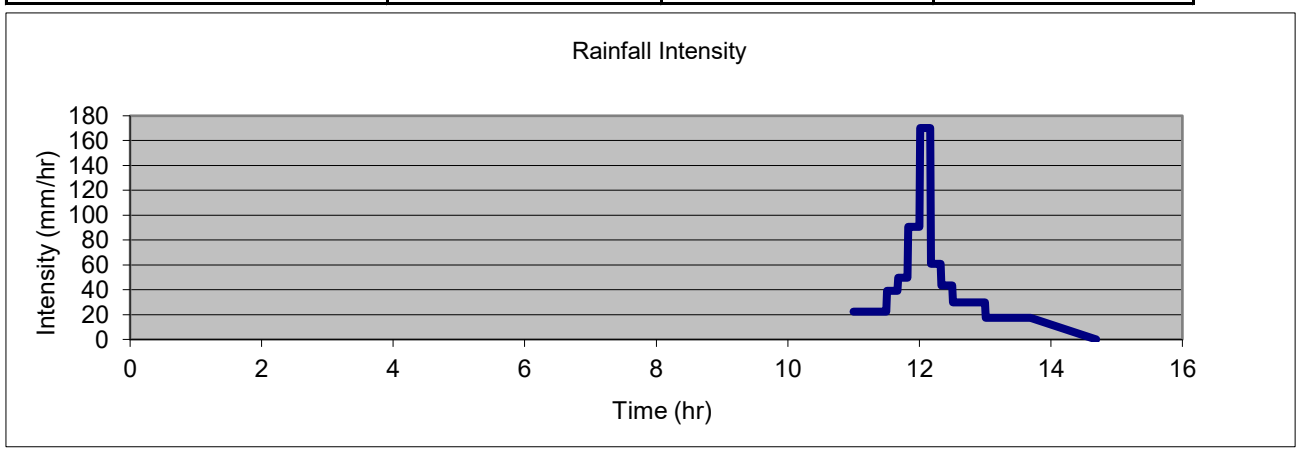
Rainfall Depth (mm) 245.28 100 YEAR ARI

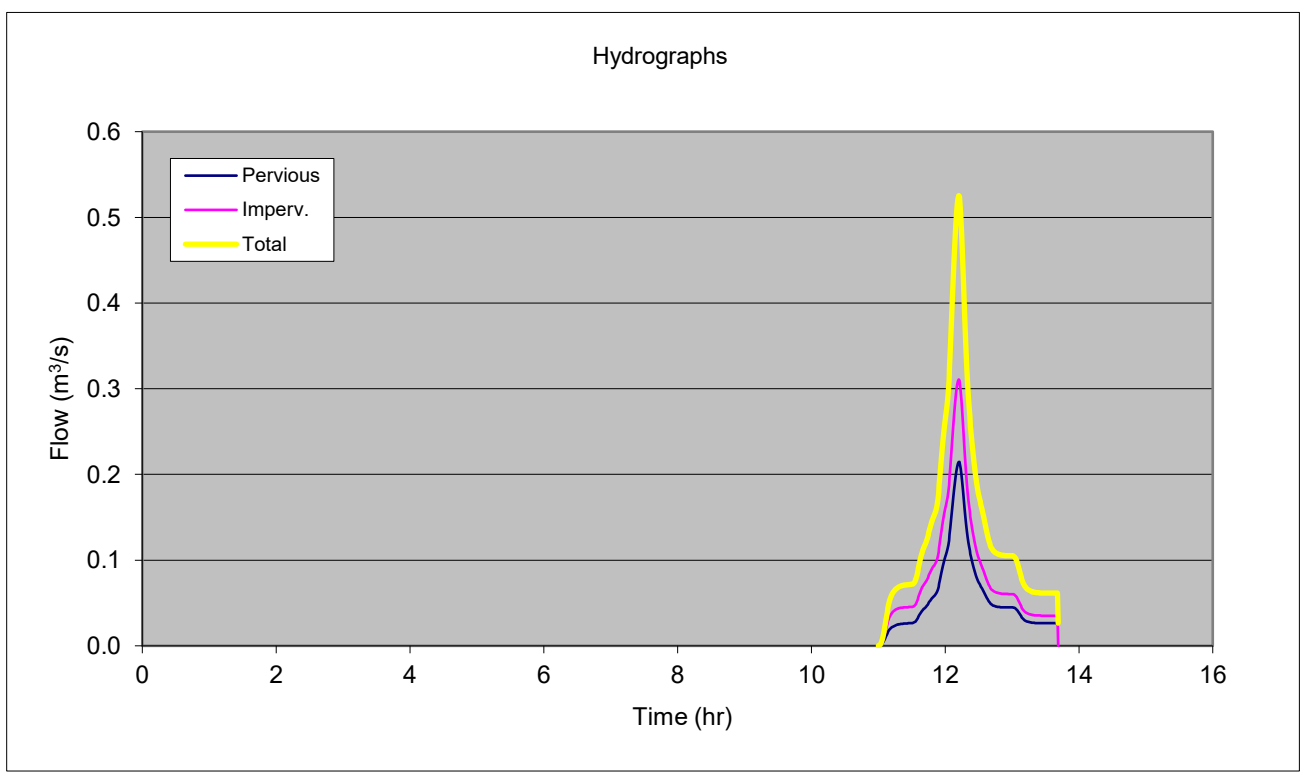
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.621	0.729
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	120	120
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	210.3
Peak Flow (m^3/s)	0.215	0.311	0.525
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.85
Runoff Coefficient - Volume	0.71	0.98	0.86





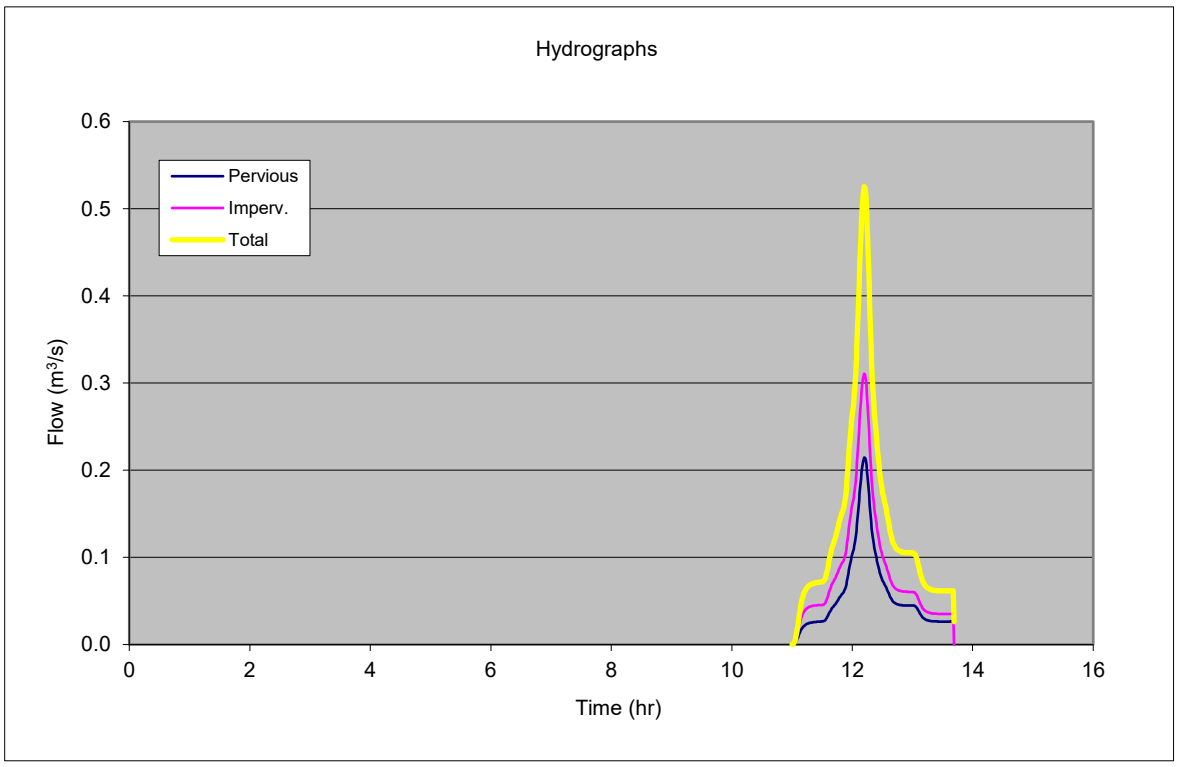
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 15 Cresta Avenue

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 1.88%



Time (hr)	Flow (m^3/s)
11.001	0.000
11.347	0.070
11.491	0.072
11.601	0.091
11.694	0.117
11.776	0.138
11.850	0.155
11.918	0.192
11.981	0.250
12.040	0.292
12.096	0.380
12.150	0.478
12.201	0.525
12.230	0.509
12.259	0.457
12.290	0.390
12.320	0.328
12.352	0.284
12.384	0.253
12.417	0.226
12.451	0.201
12.486	0.182
12.522	0.169
12.559	0.157
12.597	0.142
12.637	0.127
12.678	0.117
12.721	0.111
12.767	0.108
12.814	0.106
12.864	0.106
12.917	0.105
12.975	0.105
13.037	0.104
13.106	0.089
13.184	0.071
13.277	0.064
13.398	0.062
13.690	0.026
-1.000	0.000

CHANNEL CAPACITY SECTION PRE-DEVELOPMENT NO. 15 CRESTA AVE.

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	6.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.525
Case B	
Slope (S_o)	7%
Water level (m)	17.66
MFFL	17.81

0.36

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	18	0.1		Property/Parcels
0.5	17.7	0.1		Property/Parcels
1	17.3	0.1		Property/Parcels
2	17.3	0.1		Property/Parcels
2.5	17.70	0.1		Property/Parcels
3	18	0.1		Property/Parcels
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

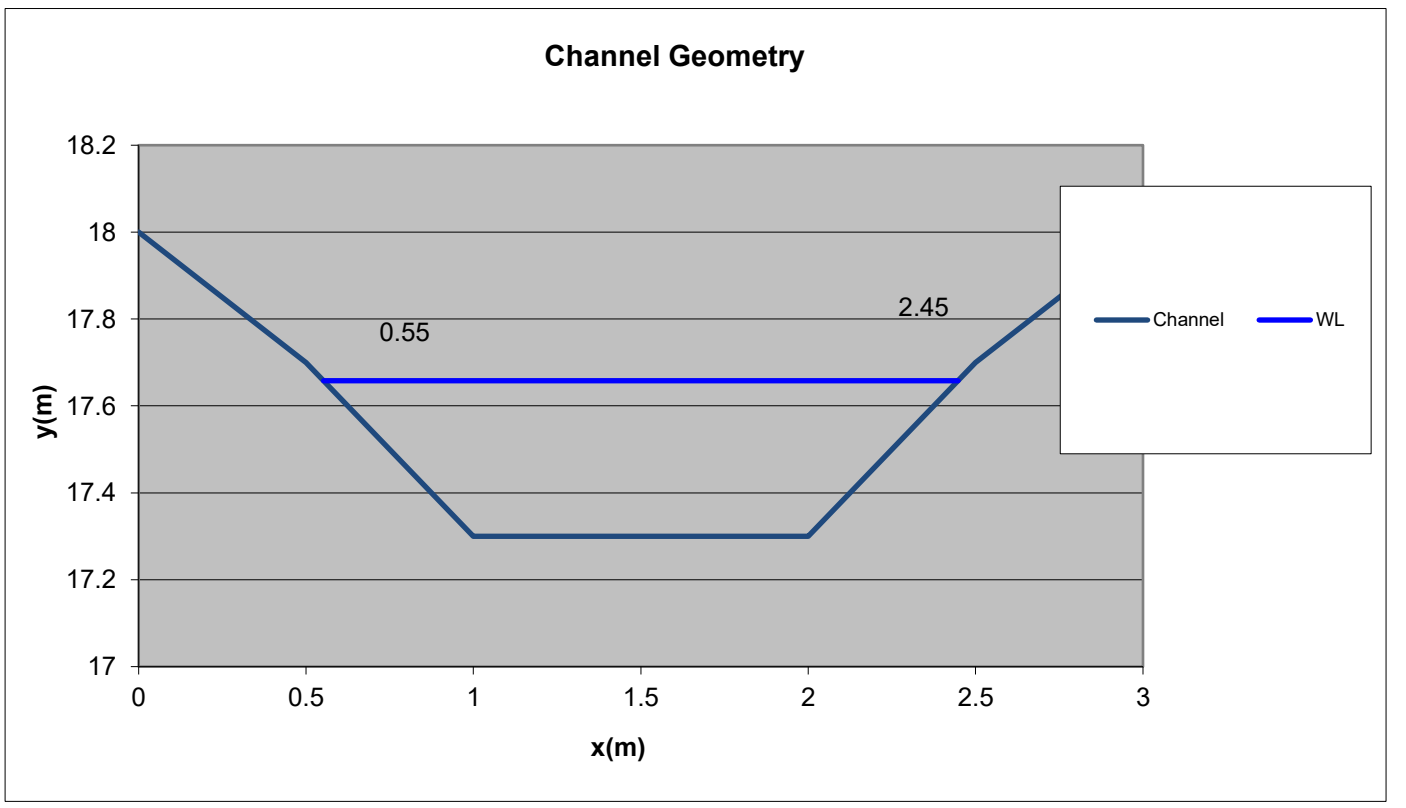
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.529** OK
Velocity (m/s)	1.021
S_o or S_f	0.0700
Energy (m)	17.711
Froude No	0.623
Bed Stress (Pa)	165.808
Equivalent "n"	0.100
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	17.658
Area (A-m^2)	0.518
Width (B-m)	1.895
Perimeter (P-m)	2.146

Critical Flow Conditions	
Flow (m^3/s)	**0.849** OK
Velocity (m/s)	1.638
Energy (m)	17.795

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Hydrographs- SCS Method - Post Development Flow from No. 15 Cresta Avenue

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 15 Cresta

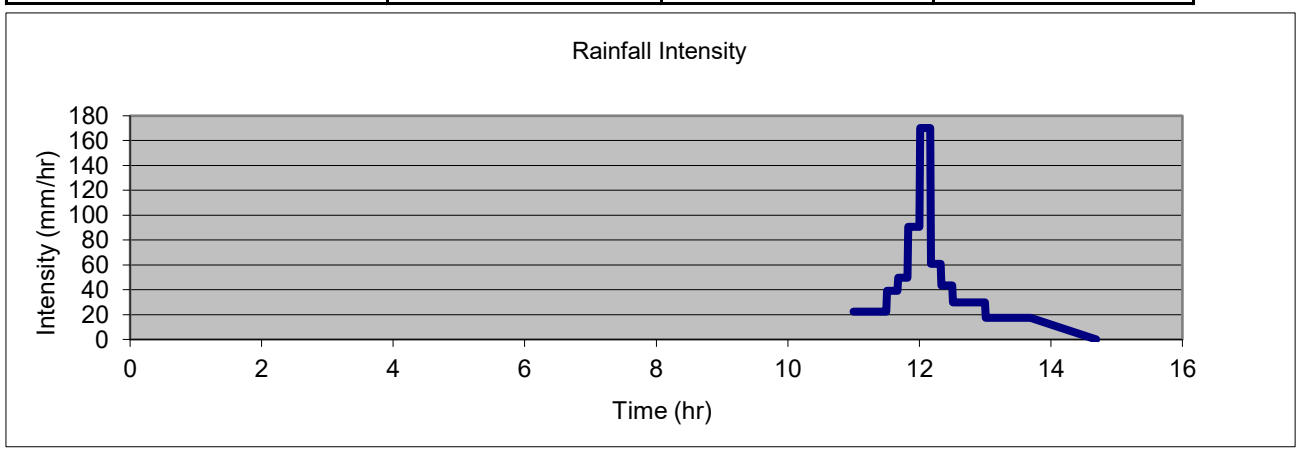
Rainfall Depth (mm) 245.28 100 YEAR ARI

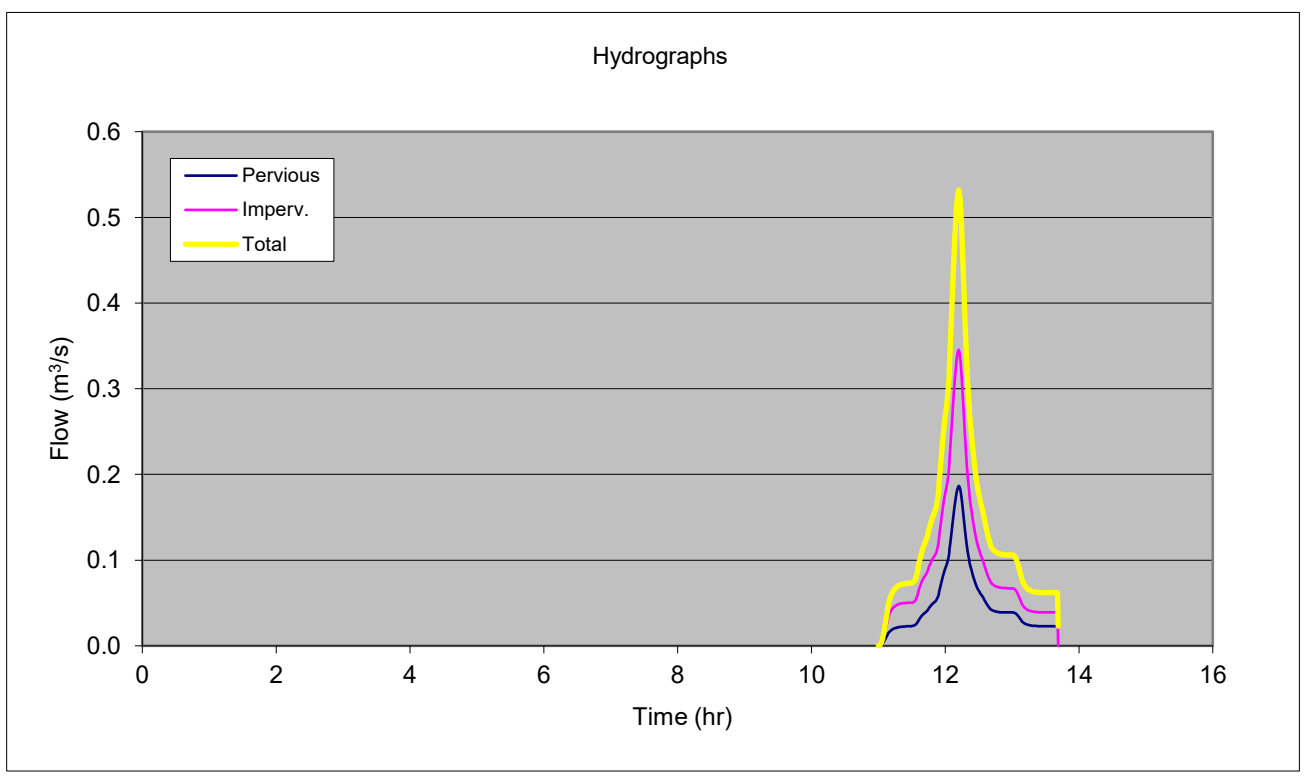
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.54	0.81
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	120	120
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	214.2
Peak Flow (m^3/s)	0.187	0.345	0.532
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.86
Runoff Coefficient - Volume	0.71	0.98	0.87





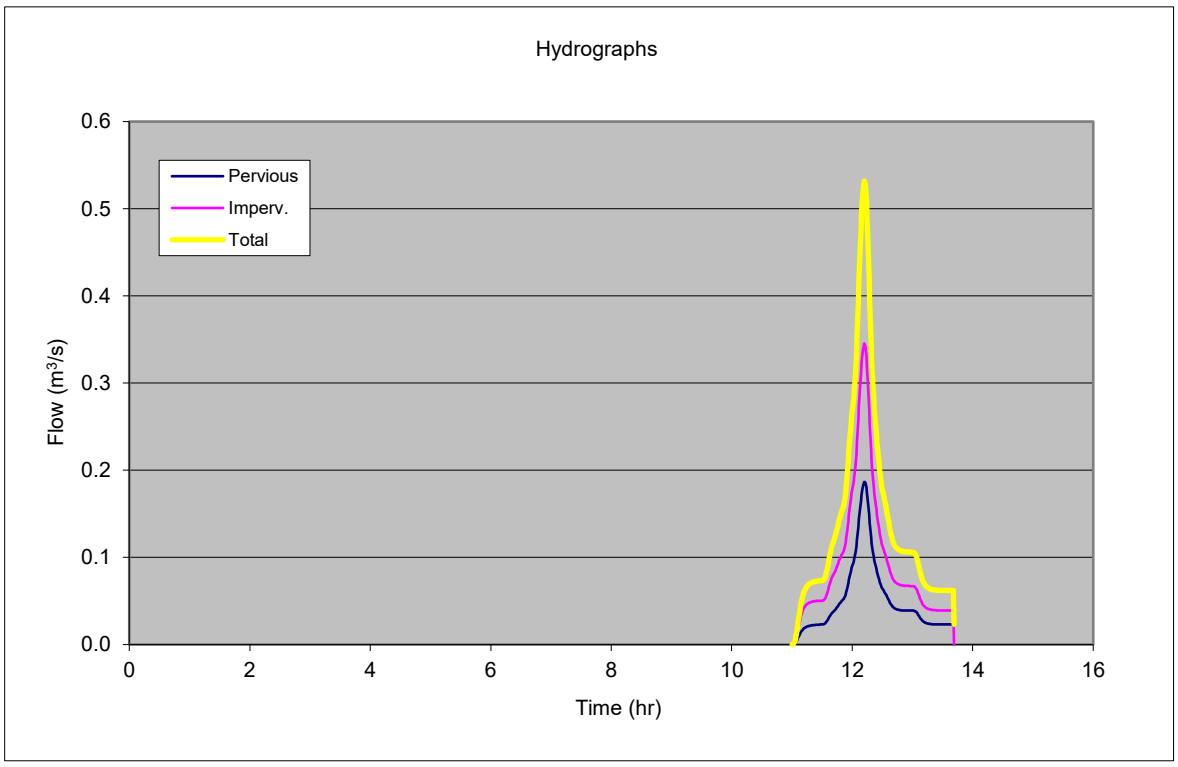
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 15 Cresta

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 2.02%



Time (hr)	Flow (m^3/s)
11.001	0.000
11.347	0.072
11.491	0.073
11.601	0.092
11.694	0.119
11.776	0.140
11.850	0.158
11.918	0.196
11.981	0.254
12.040	0.296
12.096	0.385
12.150	0.484
12.201	0.532
12.230	0.515
12.259	0.463
12.290	0.395
12.320	0.332
12.352	0.287
12.384	0.256
12.417	0.228
12.451	0.203
12.486	0.184
12.522	0.170
12.559	0.159
12.597	0.144
12.637	0.129
12.678	0.118
12.721	0.112
12.767	0.109
12.814	0.107
12.864	0.107
12.917	0.106
12.975	0.106
13.037	0.105
13.106	0.089
13.184	0.071
13.277	0.064
13.398	0.062
13.690	0.023
-1.000	0.000

CHANNEL CAPACITY SECTION POST DEVELOPMENT NO. 15 CRESTA AVE.

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	5.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.532
Case B	
Slope (S_o)	7%
Water level (m)	17.67
MFFL	17.82

0.37

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	18	0.1		Property/Parcel
0.5	17.7	0.1		Property/Parcel
1	17.3	0.1		Property/Parcel
2	17.3	0.1		Property/Parcel
2.5	17.70	0.1		Property/Parcel
3	18	0.1		Property/Parcel
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

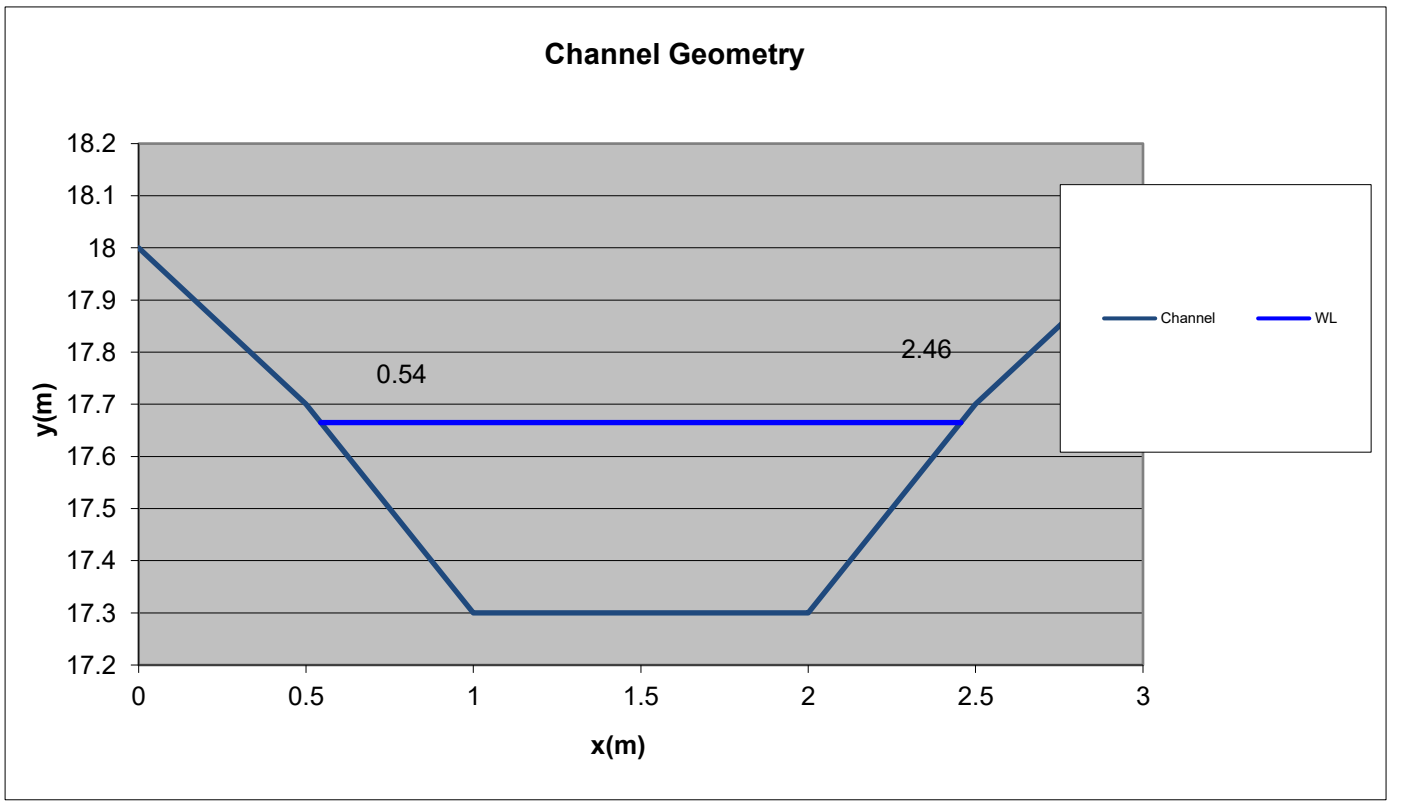
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.548** OK
Velocity (m/s)	1.031
S_o or S_f	0.0700
Energy (m)	17.719
Froude No	0.625
Bed Stress (Pa)	168.315
Equivalent "n"	0.100
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	17.665
Area (A-m^2)	0.532
Width (B-m)	1.913
Perimeter (P-m)	2.169

Critical Flow Conditions	
Flow (m^3/s)	**0.878** OK
Velocity (m/s)	1.651
Energy (m)	17.804

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Hydrographs- SCS Method - Predevelopment Flow from No. 17 Cresta Avenue

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 17 Cresta Avenue

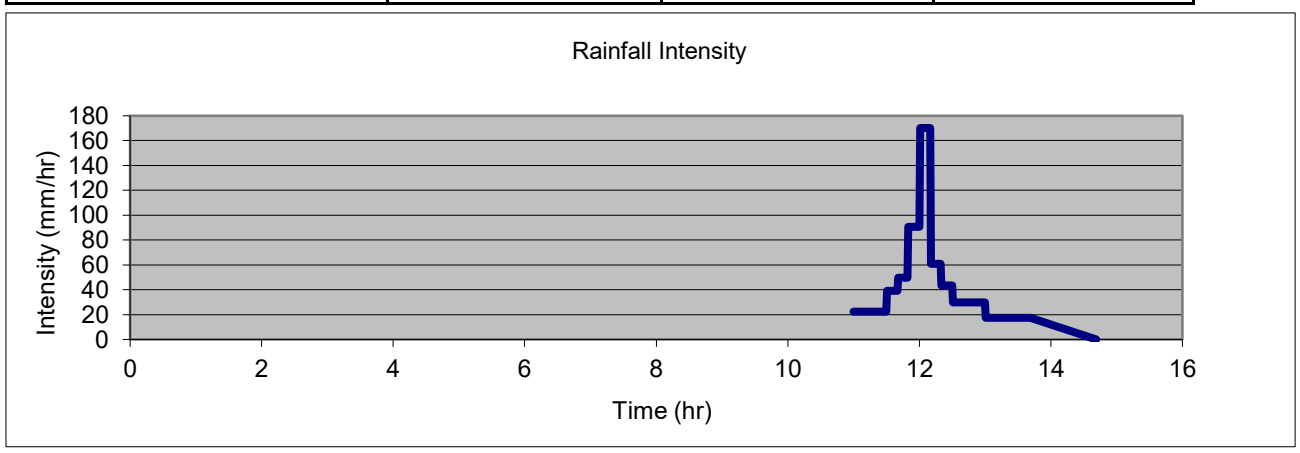
Rainfall Depth (mm) 245.28 100 YEAR ARI

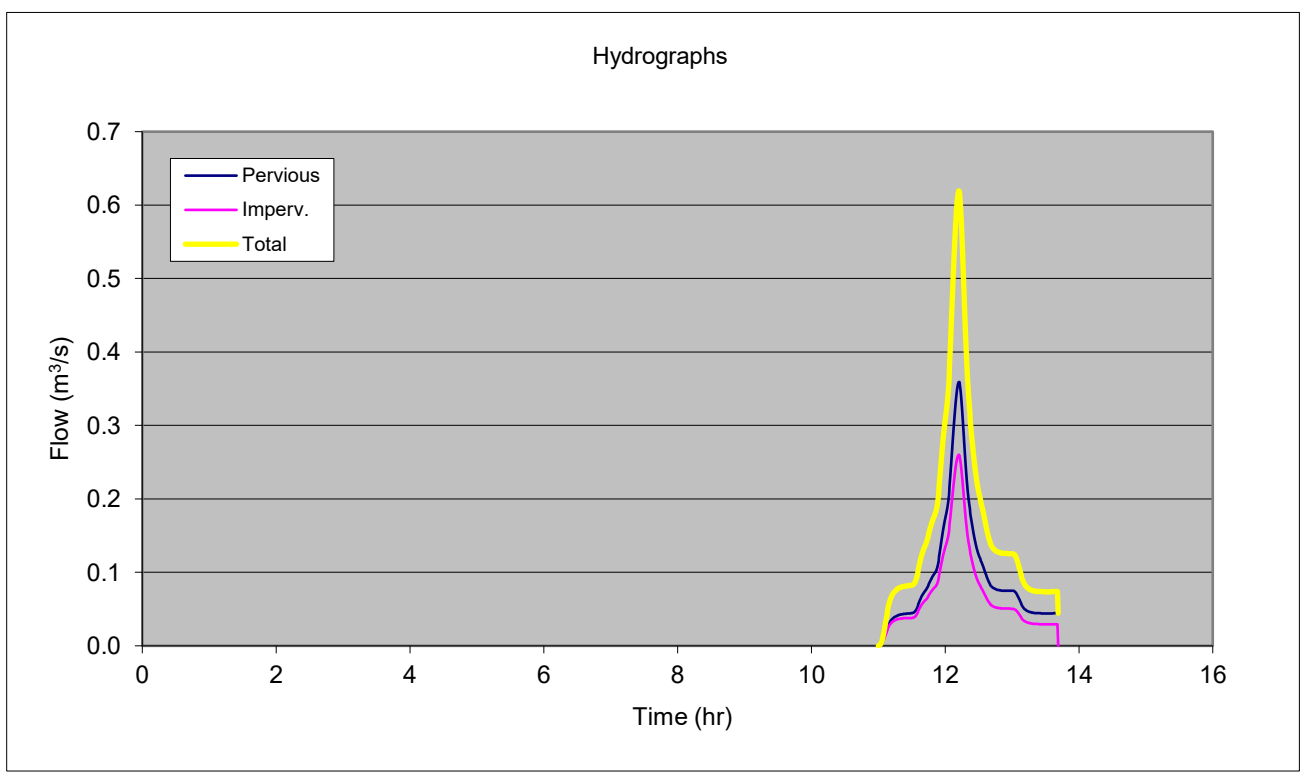
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	1.0395	0.6105
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	157	157
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	199.3
Peak Flow (m^3/s)	0.359	0.260	0.619
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.82
Runoff Coefficient - Volume	0.71	0.98	0.81





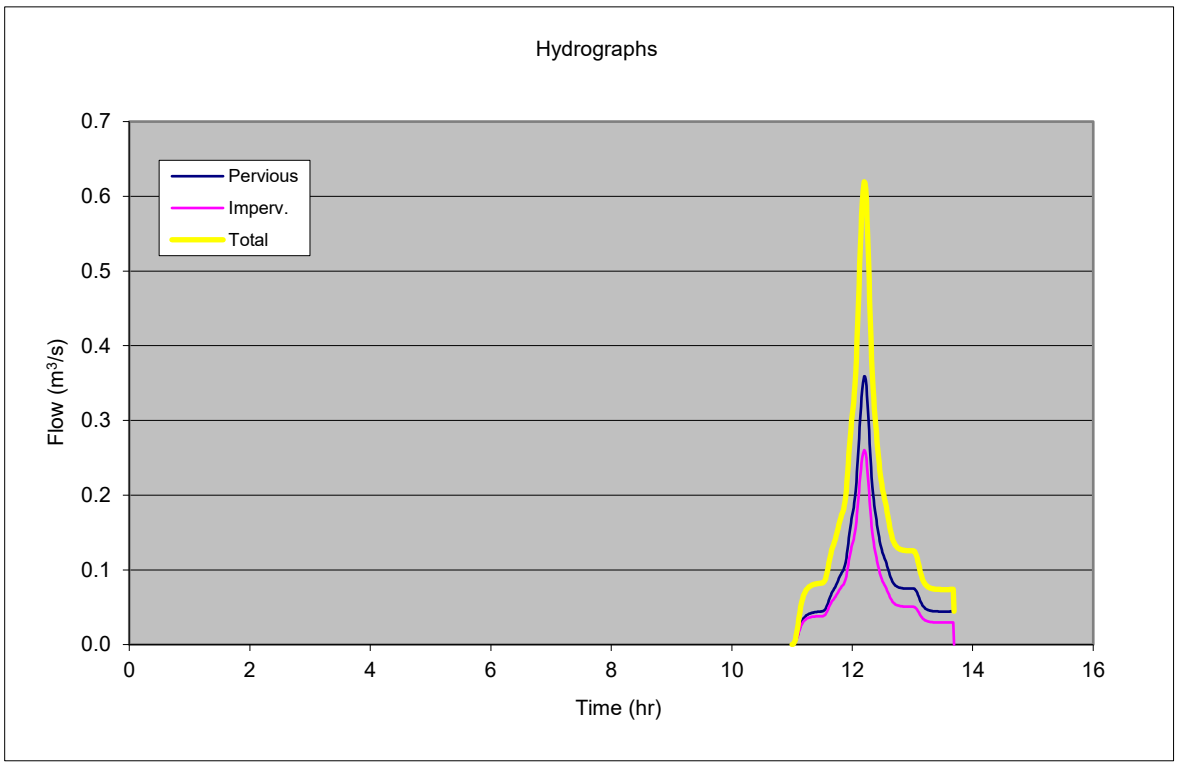
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 17 Cresta Avenue

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 1.48%



Time (hr)	Flow (m^3/s)
11.001	0.000
11.347	0.080
11.491	0.082
11.601	0.104
11.694	0.135
11.776	0.159
11.850	0.180
11.918	0.223
11.981	0.291
12.040	0.341
12.096	0.445
12.150	0.562
12.201	0.619
12.230	0.601
12.259	0.541
12.290	0.462
12.320	0.389
12.352	0.336
12.384	0.300
12.417	0.268
12.451	0.239
12.486	0.216
12.522	0.201
12.559	0.187
12.597	0.169
12.637	0.152
12.678	0.139
12.721	0.132
12.767	0.129
12.814	0.127
12.864	0.126
12.917	0.126
12.975	0.126
13.037	0.124
13.106	0.106
13.184	0.084
13.277	0.076
13.398	0.074
13.690	0.044
-1.000	0.000

CHANNEL CAPACITY SECTION PRE-DEVELOPMENT NO. 17 CRESTA AVE.

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	6.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B
Case A	
Flow (m^3/s)	0.619
Case B	
Slope (S_o)	3%
Water level (m)	17.47
MFFL	17.62

0.47

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	17.5	0.1		Property/Parcels
0.5	17.3	0.1		Property/Parcels
1	17	0.1		Property/Parcels
2	17	0.1		Property/Parcels
2.5	17.30	0.1		Property/Parcels
3	17.5	0.1		Property/Parcels
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

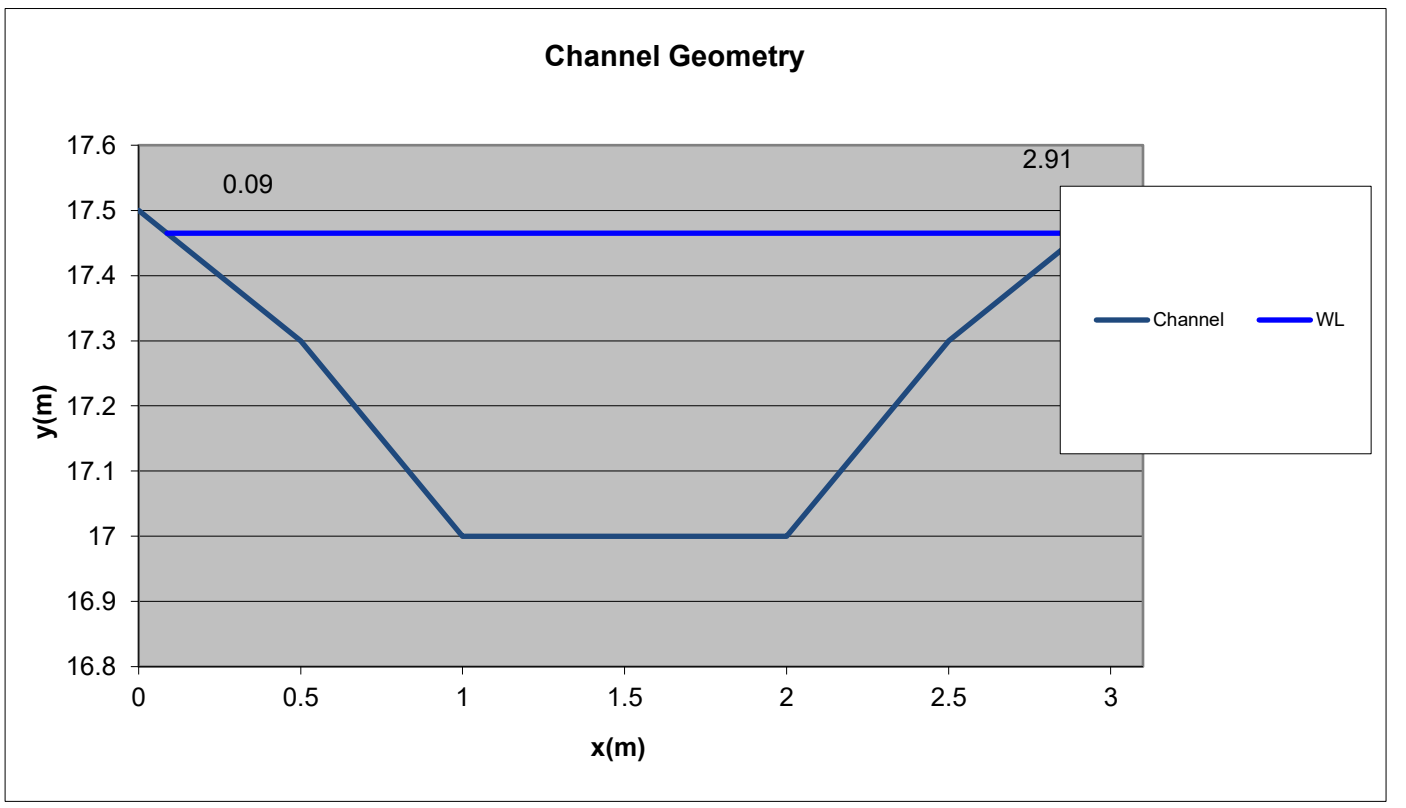
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.622** OK
Velocity (m/s)	0.734
S_o or S_f	0.0300
Energy (m)	17.492
Froude No	0.428
Bed Stress (Pa)	81.704
Equivalent "n"	0.100
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	17.465
Area (A-m^2)	0.848
Width (B-m)	2.825
Perimeter (P-m)	3.055

Critical Flow Conditions	
Flow (m^3/s)	**1.455** OK
Velocity (m/s)	1.716
Energy (m)	17.615

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Hydrographs- SCS Method - Post Development Flow from No. 17 Cresta Avenue

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 17 Cresta Avenue

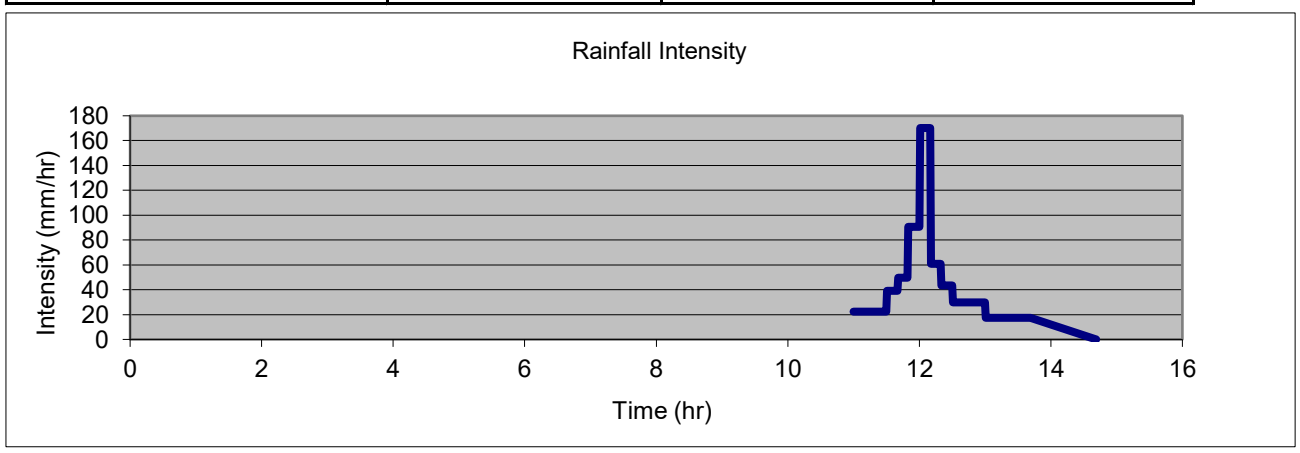
Rainfall Depth (mm) 245.28 100 YEAR ARI

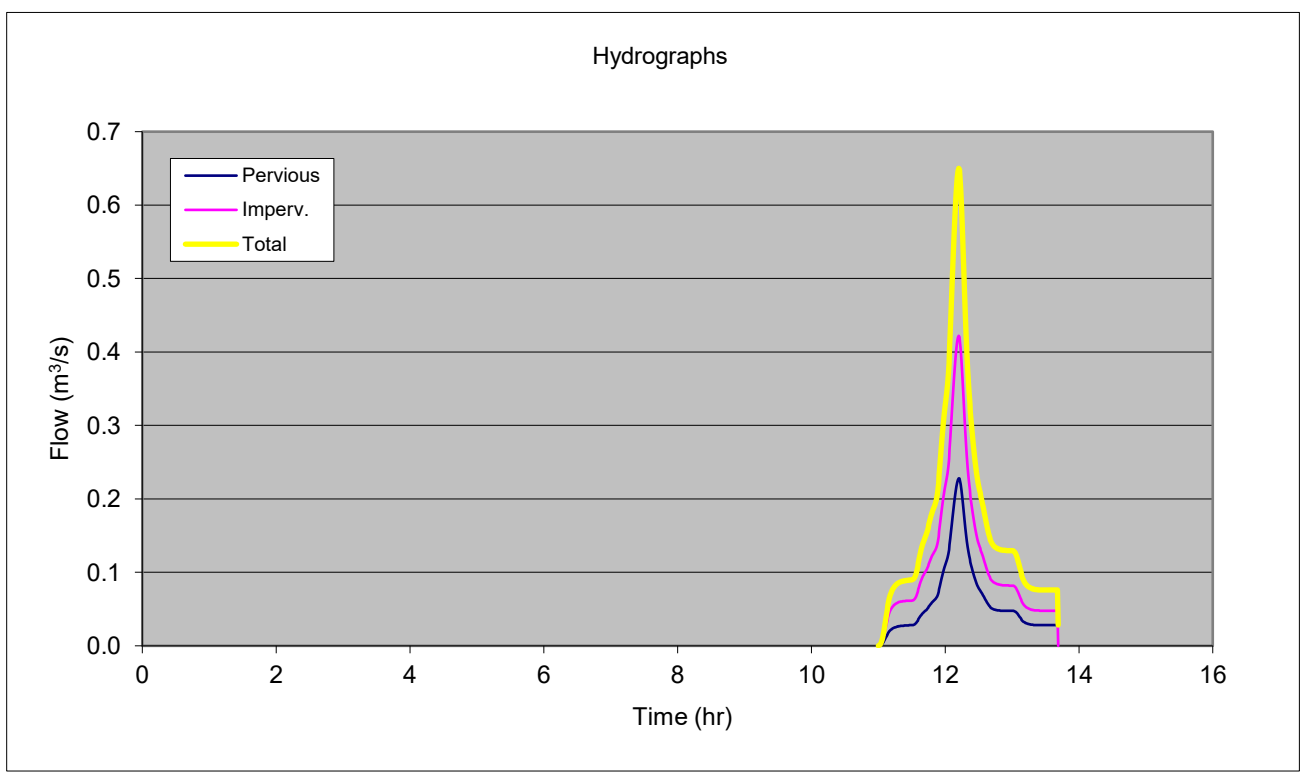
Notes:

1. Inputs
2. Typical inputs for CN, Ia, CF are in 'Typical Inputs' Sheet.
3. Method based on ARC TP108.

Catchment Data	Pervious Area	Impervious Area
Area (ha)	0.66	0.99
Runoff No (CN)	74	98
Initial Loss (Ia-mm)	5	0
Channel Length (L-m)	157	157
Channel Slope (Sc-m/m)	0.1	0.1
Channel Factor (CF-0.6 to 1.0)	0.8	0.6
Time of Concentration (tc-min)	10.0	10.0
Soil storage (S-mm)	89.2	5.2

Outputs			Total
Runoff (mm)	175.2	240.2	214.2
Peak Flow (m^3/s)	0.228	0.422	0.650
Time (hr) at Peak Flow	12.20	12.20	12.20
Rainfall (mm/h) over tc	165.26	165.26	165.26
Runoff Coefficient - Peak	0.75	0.93	0.86
Runoff Coefficient - Volume	0.71	0.98	0.87





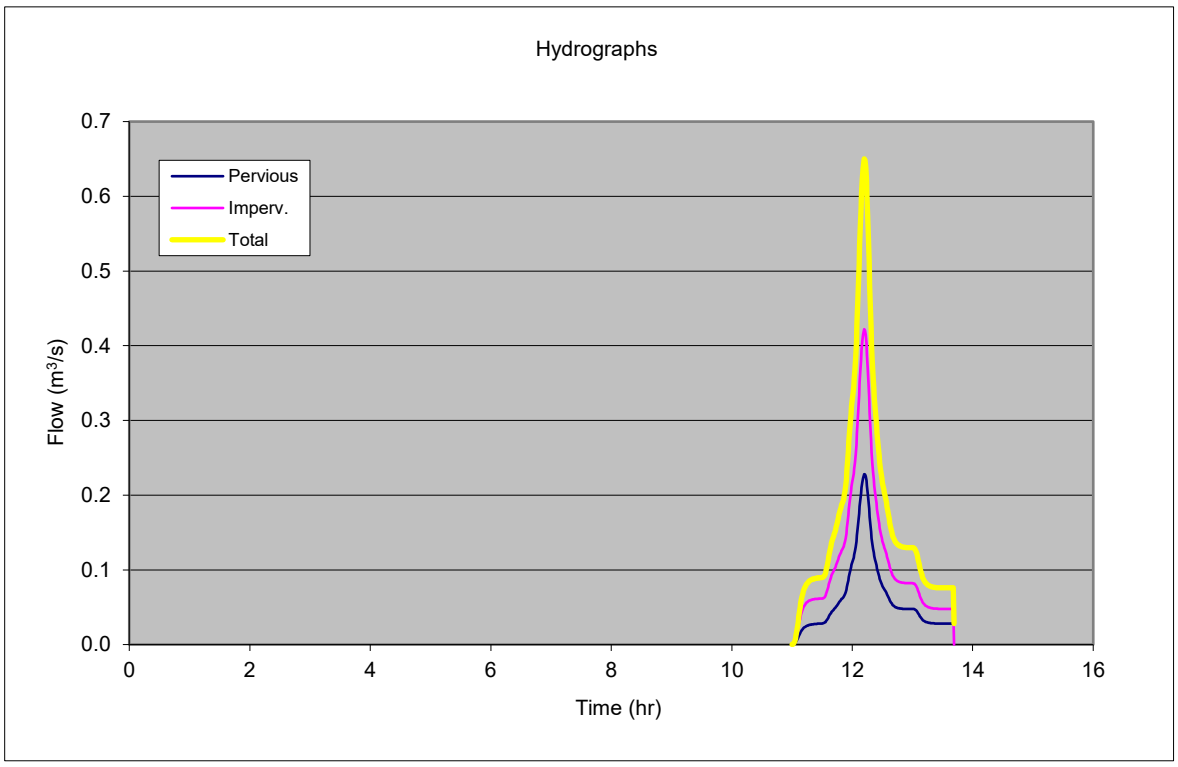
Hydrographs- SCS Method:

Project Description

96 Beach Haven Road/13 Cresta Avenue
No. 17 Cresta Avenue

Total Hydrograph in tabular form: (based on simualtion from above)

Volumetric error in scaling 2.02%



Time (hr)	Flow (m^3/s)
11.001	0.000
11.347	0.088
11.491	0.090
11.601	0.113
11.694	0.146
11.776	0.172
11.850	0.193
11.918	0.239
11.981	0.311
12.040	0.362
12.096	0.471
12.150	0.592
12.201	0.650
12.230	0.630
12.259	0.566
12.290	0.482
12.320	0.406
12.352	0.351
12.384	0.312
12.417	0.279
12.451	0.248
12.486	0.224
12.522	0.208
12.559	0.194
12.597	0.175
12.637	0.157
12.678	0.144
12.721	0.137
12.767	0.133
12.814	0.131
12.864	0.130
12.917	0.130
12.975	0.130
13.037	0.128
13.106	0.109
13.184	0.087
13.277	0.079
13.398	0.076
13.690	0.028
-1.000	0.000

AIREY CONSULTANTS LTD.

CHANNEL CAPACITY SECTION POST DEVELOPMENT NO. 17 CRESTA AVE.

PROJECT NO:	200626-01
PROJECT NAME:	96 Beach Haven Road/ 13 Cresta Avenue
DATE:	5.08.2021
BY:	Natalie Naidoo
REF:	Overland Flowpath Cross Sections

INPUTS

Case (A or B)	B	
Case A		
Flow (m^3/s)	0.650	
Case B		
Slope (S_o)	3%	
Water level (m)	17.48	0.48
MFFL	17.63	

Channel Geometry		Mannings	Sinuosity	
x (m)	y (m)	"n" value		
0	17.5	0.1		Property/Parcel
0.5	17.3	0.1		Property/Parcel
1	17	0.1		Property/Parcel
2	17	0.1		Property/Parcel
2.5	17.30	0.1		Property/Parcel
3	17.5	0.1		Property/Parcel
-1				

The table can input 10 (x,y) co-ordinates.
The (x,y) pairs should be in order
Terminate list by making x = -1.0

Flow distribution is based on velocity and energy gradient common to all parts of the channel. i.e.
$n=(\sum(P_1 n_1^{1.5}+....)/P)^{0.67}$

Sinuosity is the relative length of that flow channel element compared to other elements and input S_o.
Default value is 1.0.

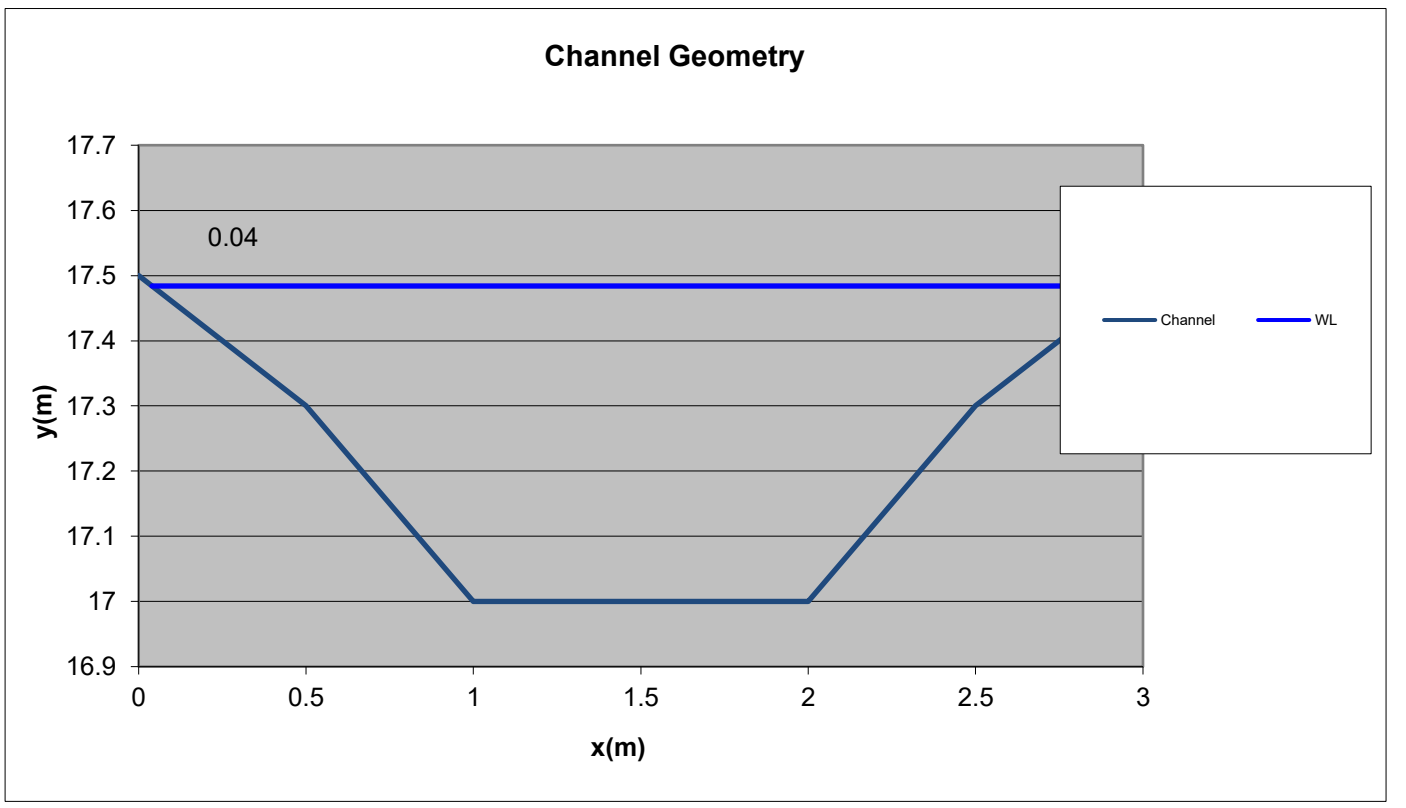
OUTPUTS

Normal Flow Conditions	
Flow (m^3/s)	**0.676** OK
Velocity (m/s)	0.749
S_o or S_f	0.0300
Energy (m)	17.513
Froude No	0.430
Bed Stress (Pa)	84.144
Equivalent "n"	0.100
Equivalent k_s(mm)	N/A

Geometry for wetted conditions	
Depth (d-m)	17.484
Area (A-m^2)	0.903
Width (B-m)	2.920
Perimeter (P-m)	3.157

Critical Flow Conditions	
Flow (m^3/s)	**1.572** OK
Velocity (m/s)	1.741
Energy (m)	17.639

Typical "n" values	
Concrete	0.013
Gunite	0.017
Smooth earth	0.02
Clean channel	0.03
Natural Channel	0.035-0.065
Floodplain	0.05-0.15
Overland flow (grass)	0.2-0.5



Appendix D

Lander Geotechnical – Geotechnical Report

14 April 2021 Ref No: J01675 (Rev1)

Bentley Studios Limited

Attention: Mr L Da-Silva

Dear Leon

RE: Geotechnical Investigation Report for Private Plan Change at 96 Beach Haven Road & 13 Cresta Avenue, Beach Haven

1 PROJECT BRIEF

This report has been prepared for Bentley Studios Limited in support of an application to the Auckland Council for a Private Plan Change (PPC).

1.1 I have undertaken a review of the private plan change, on behalf of Auckland Council in relation to the geotechnical effects.

I hold a NZCE (Civil) and BE (Civil; Hons 1st class, 1st division) and am a Chartered Professional Engineer. My work experience includes significant land subdivisions across South Auckland over the past 20 years on steep and/or compressible ground. I hold the position of Managing Director and Principal Geotechnical Engineer at Lander Geotechnical Consultants Limited based in Manukau.

1.2 In writing this report, the following documents have been reviewed:

- Geotechnical Due Diligence Desktop Study, CMW Geosciences Ltd, Ref No. AKL2020-0310AA Rev.0, dated 30 November 2020.

2 SCOPE AND OBJECTIVES

The scope of this report encompasses the geotechnical suitability and stability of the land associated with the PPC;

- Geotechnical setting and ground conditions for the site, including assessment of natural features and geohazards that may affect future residential development upon the land.
- Geotechnical guidance for future earthworks based on ground conditions likely to be encountered during site stripping and bulk cut operations.
- Broad stability of the site to safely support typical residential structures for likely end use.
- Available historical aerial photographs to infer fills and/or land modification that may have occurred within the watercourse near the north-eastern corner of the site.
- Shallow surface investigations have only been completed within the site boundaries and it is unknown as the characteristics of the soils encountered within the existing watercourse near the north-eastern corner of the site.

- Review groundwater depths and complete a 14 day assessment for reference to the Auckland Unitary Plan (AUP) permanent drawdown effects assessment (E7.) to be completed at a later stage (e.g. during a subdivision Resource Consent stage) if required, once the nature of development concepts (e.g. building and earthworks) are known.

3 SITE DESCRIPTION AND DEVELOPMENT PROPOSALS

Number 96 Beach Haven Road, Beach Haven is legally described as Lot 1 DP 157383, with an area of 2251m^2. Along the northern boundary of this site sits 13 Cresta Avenue with the legal description of Lot 2 DP 157383 comprising an area of 4896m^2. Land gradients across the site are generally flat around 1(v) in 6(h), but steepen to 1(v) in 4(h) towards the gully located along the western boundary of the site which appears to contains the overland flow path from south to north.

There are currently two dwellings located on each site with two separate garage structures located at 96 Beach Haven Road. A stormwater line runs along the western and southern boundary of 96 beach Haven Road as well as a sewer line that cuts through 13 Cresta Avenue.

We understand that the site is proposed for a zone change for the development of future residential housing which will likely require minor earthworks i.e. cuts and fills to develop the proposed housing foundation platforms

4 FIELDWORK AND FINDINGS

4.1 Fieldwork Programme

Our fieldwork was conducted on 4 February 2021 which involved drilling of 16 hand auger boreholes with target depths of between 3.0m and 5.0m in the positions indicated on the appended site plan (refer Figure 1). Three piezometer standpipes were also installed in HA05, HA11 and HA16.

Results of all in-situ tests, detailed descriptions and depths of strata encountered during drilling of the boreholes are appended.

4.2 Geology

A review of GNS digital QMaps indicates that the site is located within the East Coast Bays Formation (ECBF) of the Waitemata Group flysch deposits which consist of alternating beds of sandstones and mudstones. These deposits generally weather to a dark grey, partially weathered ‘transitional’ soils before weathering completely to orange, light grey and brown silts, clays and sands

4.3 Findings

4.3.1 Topsoil

Topsoil was encountered in each of the hand auger boreholes to a depth of between 100m to 800mm (the latter isolated to HA15) but averaged around 300mm.

4.3.2 Residual East Coast Bays Formation

Residual East Coast Bays Formation (ECBF) soils were noted in each hand auger borehole underlying surficial topsoil and alluvial deposits. These deposits consisted of grey, black, orange and

brown clays and silts. Undrained shear strength readings were generally greater than 75 kPa (Stiff) and up to more than 216 kPa (Hard).

4.3.3 Transitional East Coast Bays Formation

The transitional ECBF was encountered within HA12 underlying the residual ECBF at a depth of 3.85m. These soils were described grey silty Clay and undrained shear strengths within this formation were hard as the shear vane was unable to penetrate the soil.

4.3.4 Groundwater

Groundwater was encountered in HA09 and HA15 at depths of 4.0m and 3.0m respectively. Piezometers standpipes were installed in hand auger boreholes, HA05, HA11 and HA16. Results are tabulated below in table 1.

It is worth noting HA05 was tampered with after its installation and was found partially removed from the ground only allowing a monitoring depth of 3.5m BEGL before an obstruction was met. Additionally during the final round of groundwater monitoring HA16 recorded elevated levels of groundwater compared to the other piezometers, this outlying data point has been determined to have been caused due to excess runoff from a period of heaving rainfall just prior to its measurement and is deemed inaccurate (i.e. higher than the actual groundwater level).

Table 1: Groundwater Levels Following Drilling

Borehole	**Groundwater Depth Encountered During Drilling** (m BEGL)	**Standing Groundwater Depth** (m BEGL)			
		4 February 2021 (Completion of drilling)	**9 February 2021** (5 Days)	**12 February 2021** (15 Days)	**19 February 2021** (22 Days)
HA05	N/A	N/A	N/A	N/A	N/A
HA11	N/A	N/A	4.05	3.85	3.85
HA16	N/A	N/A	4.10	3.70	1.70

5 LABORATORY RESULTS

Atterberg limit soils testing of material from HA11 at a depth of 0.5-1.0m returned the following index properties to aid in the determination of an expansive site class for this site.

- Liquid Limit: 103
- Plastic Limit: 40
- Linear Shrinkage: 22%
- Moisture Content 31.4%

6 PROJECT EVALUATIONS AND RECOMMENDATIONS

Based on our site observations and field investigations we are of the opinion the site contains no insurmountable geotechnical hazards that would prevent future residential intensification.

Specific comments and recommendations follow:

6.1 Foundations for Buildings

6.1.1 Bearing Capacity and Settlement Potential

A geotechnical ultimate bearing capacity of 300 kPa should generally be available for all shallow and pad foundations constructed on engineer certified filling and on the natural ground. Anticipated differential settlements are assessed to be within the required building code limits.

Please note, following earthworks, if existing fill is found to underlay any future building platforms then it will need to be undercut and replaced with engineer certified fill (i.e. compacted GAP65 hardfill), subject to engineering direction from the observing geo-professional.

6.1.2 Expansive Site Class

Based on the Atterberg Limit laboratory testing, refer Section 6, visual-tactile assessment of the soils and knowledge of the area, the preliminary assessed expansive site class for this site is H(High); as defined in MBIE Acceptable Solutions and Verification Methods for NZ Building Code Clause B1 Structures, effective 28 November 2019) with characteristic ground movement (Y_s) of up to 78mm.

This site class should be re-assessed during the detailed design (i.e. at Building Consent stage) via Shrink-Swell testing as outlined in MBIE (extract attached)

6.2 Pavement Subgrade

Given the generally very stiff surficial subsoils present across the site, we consider that a design CBR value of 4% maybe adopted for the natural soils if this is a design requirement for driveways. As CBR values are affected by moisture content and trafficking, we recommend that subgrades are only trimmed to final level immediately prior to placing base course and that a programme of Scala Penetrometer testing be carried out during construction to confirm the design value.

6.3 Preliminary Earthworks Comments

Generally speaking, following the removal/ demolition of the existing dwellings and structures located on site, all debris and excavation which is surplus to requirements should be removed from site, in addition if any existing deep topsoil and pre-existing non engineered fill deposits were encountered on site will require undercutting and replacement with engineered fill if located beneath the proposed building platforms, at the discretion of the observing geo-professional.

All vegetation should be removed, and topsoil stripped well clear of the proposed works and stockpiled clear of the building platform also.

This should be re-addressed at a later phase (e.g. a Resource Consent Application).

7 FURTHER WORK

Further geotechnical assessments should be undertaken to support any subsequent Resource Consent or Building Consent applications commensurate with the nature of future development proposals.

8 LIMITATIONS

This report has been prepared solely for the use of our client, Bentley Studios Limited, their professional advisers and the relevant Territorial Authorities in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from boreholes which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report.

If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred back to us immediately.

For and on behalf of Lander Geotechnical Consultants Limited

S.G. Lander

Principal Geotechnical Engineer
CMEngNZ, CPEng

Attachments:

Figure 01: Site Investigation Plan
Hand Auger Boreholes Records
Laboratory Results
MBIE Acceptable Solutions and Verifications Methods for NZ Building Code Clause B1 Structure (extract)

Legend and/or Notes:

- 5m Hand Auger Borehole
- 3m Hand Auger Borehole
- 5m Hand Auger Borehole with Piezometer

BASEMAP: AUCKLAND COUNCIL GEOMAPS DATABASE [RETRIEVED 12.02.21]

revision	description	drawn	approved	date

0 10.0 20.0 30.0
Horizontal Scale (metres)

0 10.0 20.0 30.0
Vertical Scale (metres)

drawn	PL
approved	RP
date	12.02.21
scale	1:500
original size	A3

LANDER geotechnical

client: **BENTLEY STUDIO LIMITED**

project: **96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN**

title: **SITE INVESTIGATION PLAN**

project no: **J01675** figure no: **01**

Template revision: 1:500 (10/12/14)

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA01

Sheet 1 of 16

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
slightly clayey SILT, light grey mottled orange/brown. Very stiff, moist, low plasticity [RESIDUAL EAST COAST BAYS FORMATION]				
0.5		193+		
with trace fine sand				
1.0		193+		
becoming hard				
1.5		UTP		
2.0		UTP		
becoming very stiff, moderately sensitive				
2.5		157/72	2.2	
3.0		141/50	2.8	
EOB at 3.0m. Target Depth.				
3.5				
4.0				
4.5				
5.0				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA02

Sheet 2 of 16

Vane Head:	Logged By:	Processor :	Date:
1750	NM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
silty CLAY, black, light orange/brown and red mottled brown. Hard, dry to moist, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]		0.5		216+		
becoming black and light orange/brown mottled brown		1.0		216+		
becoming orange/brown streaked grey, moist		1.5		216+		
becoming very stiff, insensitive becoming orange streaked light grey, high plasticity		2.0		151/114	1.3	
becoming slightly pumiceous silty CLAY, orange and light grey/white streaked light grey, with trace fine sand		2.5		194/108	1.8	
EOB at 3.0m. Target Depth.		3.0		148/117	1.3	
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA03

Sheet 3 of 16

Vane Head:	Logged By:	Processor :	Date:
2153	JM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
silty CLAY, orange mottled light grey. Hard, moist, medium to high plasticity [RESIDUAL EAST COAST BAYS FORMATION]	0.5	216+		
with trace fine sand				
with trace limonite to 1.2m	1.0	216+		
becoming medium plasticity, with minor fine sand	1.5	216+		
becoming high plasticity, with trace fine sand	2.0	216+		
becoming very stiff, insensitive	2.5	120/77	1.6	
with trace rootlets				
becoming hard, moist to wet	3.0	216+		
slightly clayey fine to medium SAND, orange mottled light grey. Hard, wet, low to no plasticity at 3.3m, becoming light grey	3.5	UTP		Scala Penetrometer Test (blows/100mm)
becoming grey		UTP		
EOB at 3.9m. Too hard to auger further. Scala penetrometer test commenced to 4.9m.	4.0			6 11 12 12 10 10 10 10 11 10
	4.5			
	5.0			
	5.5			
	6.0			

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA04

Sheet 4 of 16

Vane Head:	Logged By:	Processor :	Date:
1750	NM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
clayey SILT, grey mottled orange/brown. Hard, dry to moist, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]					
becoming grey streaked orange/brown	0.5		216+		
becoming orange streaked grey					
becoming moist, insensitive	1.0		201/114	1.8	
becoming medium plasticity	1.5		216+		
becoming very stiff, moderately sensitive becoming grey streaked orange/brown, low plasticity, with trace sand	2.0		194/74	2.6	
becoming hard	2.5		216+		
becoming brown/orange streaked grey					
	3.0		216+		
	3.5		216+		
	4.0		216+		
	4.5		216+		
EOB at 5.0m. Target Depth.	5.0		216+		
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA05

Sheet 5 of 16

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				Piezometer Details:
clayey SILT, orange mottled light grey. Very stiff, moist, low plasticity [RESIDUAL EAST COAST BAYS FORMATION]				0.0m-0.5m - Bentonite Seal
	0.5	193+		0.5m-5.0m - Screened with Filter Sock
becoming medium plasticity				
	1.0	193+		
becoming low plasticity, with trace fine sand				
becoming moderately sensitive	1.5	152/66	2.3	
	2.0	160/52	3.1	
	2.5	171/83	2.1	
fine sandy SILT with minor clay, orange mottled light grey. Loose, moist, low to no plasticity, with trace limonite				
	3.0	193+		
	3.5	193+		
becoming moderately sensitive	4.0	182/58	3.1	
becoming medium dense	4.5	UTP		
slightly clayey SILT with trace fine sand, light grey mottled orange. Hard, wet, low plasticity, with trace limonite				
EOB at 5.0m. Target Depth.	5.0	UTP		
	5.5			
	6.0			

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA06

Sheet 6 of 16

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
silty CLAY, orange mottled light brown. Very stiff, moist, medium plasticity, moderately sensitive [RESIDUAL EAST COAST BAYS FORMATION]						
		0.5		173/78	2.2	
becoming orange mottled light grey						
becoming high plasticity, insensitive		1.0		153/101	1.5	
		1.5		121/72	1.8	
becoming hard		2.0		201+		
clayey SILT, orange mottled light grey. Hard, moist, low to medium plasticity						
		2.5		201+		
		3.0		201+		
EOB at 3.0m. Target Depth.						
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA07

Sheet 7 of 16

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
EOB at 0.3m. Too hard to auger further. Scala penetrometer test commenced and found effective refusal (ER) at 0.4m.		0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0				3 20+ (ER) Scala Penetrometer Test (blows/100mm)

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA08

Sheet 8 of 16

Vane Head:	Logged By:	Processor :	Date:
1750	NM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity
TOPSOIL			
silty CLAY, light brown. Hard, dry to moist, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]			
becoming grey and orange/brown mottled light brown, moist	0.5	216+	
becoming grey streaked orange/brown			
becoming insensitive	1.0	201/111	1.8
becoming very stiff becoming orange/brown streaked grey	1.5	182/105	1.7
	2.0	139/108	1.3
	2.5	139/102	1.4
	3.0	170/120	1.4
becoming high plasticity	3.5	127/99	1.3
	4.0	167/130	1.3
becoming hard	4.5	216+	
EOB at 5.0m. Target Depth.	5.0	201/139	1.4
	5.5		
	6.0		

Standing Water Level | Sample and Laboratory / Other Test Details

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA09

Sheet 9 of 16

Vane Head:	Logged By:	Processor :	Date:
2153	JM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
silty CLAY, orange mottled light grey. Hard, moist, high plasticity [RESIDUAL EAST COAST BAYS FORMATION]	0.5	216+		
becoming moderately sensitive	1.0	213/58	3.7	
with trace fine sand				
becoming very stiff, insensitive	1.5	173/89	1.9	
	2.0	164/99	1.7	
becoming medium to high plasticity, with minor fine sand				
becoming moist to wet	2.5	130/83	1.6	
becoming moderately sensitive	3.0	178/85	2.1	
becoming wet, with some fine sand				
	3.5	160/67	2.4	
clayey fine to medium SAND, orange mottled light grey. Very stiff, wet, low plasticity				
becoming grey, saturated, with minor woody inclusions with moderately thin bed of wood	4.0	178/45	4.0	
becoming grey/brown, without woody inclusions	4.5	159/51	3.1	
EOB at 5.0m. Target Depth.	5.0	190/49	3.9	
	5.5			
	6.0			

Standing Water Level: ▽ at 4.0

LANDER geotechnical

Comments:
Groundwater encountered at 4.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA10

Sheet 10 of 16

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
silty CLAY, orange/brown and light grey mottled light orange. Hard, dry, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]					
	0.5		UTP		
becoming moist					
becoming orange mottled light grey	1.0		201+		
becoming very stiff, insensitive	1.5		170/124	1.4	
	2.0		173/132	1.3	
becoming high plasticity	2.5		147/109	1.3	
	3.0		112/72	1.6	
becoming stiff	3.5		92/72	1.3	
becoming very stiff becoming medium plasticity, with some fine sand	4.0		118/78	1.5	
with minor fine sand becoming hard	4.5		201+		
EOB at 5.0m. Target Depth.	5.0		201+		
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA11

Sheet 11 of 16

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				Piezometer Details: 0.0m-0.5m - Bentonite Seal; 0.5m-5.0m - Screened with Filter Sock
0.5	clayey SILT, light grey mottled orange/brown. Very stiff, moist, low to medium plasticity, moderately sensitive [RESIDUAL EAST COAST BAYS FORMATION]		152/44	3.5	Sample 1 Disturbed 0.5-1.0m
	becoming orange streaked light grey				
1.0			155/55	2.8	
1.5	becoming insensitive		149/97	1.5	
2.0			138/91	1.5	
	silty CLAY, orange streaked grey. Very stiff, moist, high plasticity, insensitive, with trace limonite				
2.5			108/72	1.5	
3.0			105/72	1.5	
3.5			105/69	1.5	Standing Groundwater Level as on 12.02.21 and 19.02.21 (3.85m)
4.0	becoming stiff		72/41	1.8	Standing Groundwater Level as on 09.02.21 (4.05m)
4.5	becoming very stiff		127/77	1.6	
	at 5.0m, becoming moderately sensitive				
5.0	EOB at 5.0m. Target Depth.		110/52	2.1	
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA12

Sheet 12 of 16

Vane Head:	Logged By:	Processor :	Date:
2153	JM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
silty CLAY with trace fine sand, orange mottled light grey. Very stiff, moist, medium to high plasticity, sensitive [RESIDUAL EAST COAST BAYS FORMATION]				
0.5		167/24	7.0	
becoming moderately sensitive becoming high plasticity, without fine sand				
1.0		191/55	3.5	
1.5		157/80	2.0	
becoming insensitive				
2.0		160/111	1.4	
2.5		141/93	1.5	
3.0		179/105	1.7	
becoming moist to wet				
becoming stiff, moderately sensitive				
3.5		96/43	2.2	Scala Penetrometer Test (Blows/100mm)
silty CLAY with trace fine sand, grey. Hard, moist to wet, medium to high plasticity at 3.8m, becoming dark grey/blue		UTP		4
EOB at 3.85m. Too Hard to Auger Further. Scala penetrometer test commenced and found effective refusal (ER) at 4.1m.				12
4.0				20+ (ER)
4.5				
5.0				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA13

Sheet 13 of 16

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
silty CLAY, orange, brown and light grey mottled. Hard, dry, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]	0.5		UTP		
becoming moist					
becoming orange mottled light grey	1.0		201+		
	1.5		201+		
	2.0		201+		
with trace fine sand					
becoming very stiff, moderately sensitive	2.5		184/89	2.1	
becoming stiff, high plasticity, insensitive, without fine sand	3.0		95/58	1.6	
becoming light brown, with some woody inclusions					
becoming orange mottled light grey/white, without woody inclusions					
becoming very stiff	3.5		130/112	1.2	
becoming light grey					
becoming orange mottled light grey	4.0		132/75	1.8	
	4.5		158/109	1.4	
EOB at 5.0m. Target Depth.	5.0		176/115	1.5	
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA14

Sheet 14 of 16

Vane Head:	Logged By:	Processor :	Date:
1750	NM	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity
TOPSOIL			
clayey SILT, light brown. Hard, dry to moist, low to no plasticity [RESIDUAL EAST COAST BAYS FORMATION]			
becoming red and light grey mottled light brown	0.5	216+	
becoming red mottled light brown			
becoming medium plasticity	1.0	188/108	1.7
silty CLAY, grey streaked orange/brown. Very stiff, moist, medium to high plasticity, insensitive	1.5	177/68	1.7
becoming orange/brown streaked grey	2.0	154/139	1.1
becoming red and orange/brown streaked grey	2.5	170/120	1.4
becoming orange/brown streaked grey			
becoming high plasticity	3.0	167/127	1.3
	3.5	182/139	1.3
	4.0	145/120	1.2
	4.5	142/139	1.0
EOB at 5.0m. Target Depth.	5.0	139/108	1.3
	5.5		
	6.0		

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA15

Sheet 15 of 16

Vane Head:	Logged By:	Processor :	Date:
307	RZ	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity
TOPSOIL			
	0.5	132/106	1.2
silty CLAY, orange and brown mottled. Hard, moist, medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]	1.0	201+	
becoming orange and light grey motted, with trace fine sand			
becoming very stiff, insensitive	1.5	115/81	1.4
becoming moderately sensitive	2.0	124/55	2.3
becoming high plasticity, without sand			
becoming insensitive	2.5	104/72	1.4
becoming stiff, saturated	3.0	86/52	1.7
becoming hard, grey	3.5	201+	
becoming very stiff, insensitive	4.0	118/63	1.9
becoming orange mottled grey			
becoming hard	4.5	201+	
EOB at 5.0m. Target Depth.	5.0	201+	
	5.5		
	6.0		

Standing Water Level: ▽ at 2.3m

Sample and Laboratory / Other Test Details

LANDER geotechnical

Comments:
Groundwater encountered at 3.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : BENTLEY STUDIOS LIMITED

Project Location : 96 BEACH HAVEN ROAD & 13 CRESTA AVENUE BEACH HAVEN

Job Number: J01675

Auger Borehole No. HA16

Sheet 16 of 16

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	04.02.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
0.0	TOPSOIL			Piezometer Details:
	clayey SILT, orange streaked grey. Very stiff, moist, low to medium plasticity [RESIDUAL EAST COAST BAYS FORMATION]			0.0m-0.5m - Bentonite Seal
0.5		193+		0.5m-5.0m - Screened with Filter Sock
	becoming medium plasticity			
1.0		193+		
1.5		193+		Standing Groundwater Level as on 19.02.21 (1.70m)
	with trace coarse sand sized white pumiceous inclusions			
	silty CLAY, orange streaked grey. Very stiff, moist, medium to high plasticity, insensitive			
2.0		144/86	1.7	
	with black organic streaks, with trace fine sand			
	clayey SILT, orange mottled light grey. Very stiff, moist, medium plasticity, moderately sensitive, with trace limonite			
2.5		127/50	2.5	
3.0	becoming stiff, insensitive	97/52	1.9	
	silty CLAY, orange streaked light grey. Stiff, moist, medium plasticity, insensitive, with trace limonite			
3.5		86/52	1.7	Standing Groundwater Level as on 12.02.21 (3.70m)
	becoming moderately sensitive			
4.0		75/36	2.1	Standing Groundwater Level as on 09.02.21 (4.10m)
4.5	becoming insensitive	97/64	1.5	
	becoming grey			
5.0	EOB at 5.0m. Target Depth.	75/41	1.8	
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: JM

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

GEOTECHNICS

Our Ref: 1009521.1123.0.0/Rep1
Customer Ref: J01675
19 February 2021

Lander Geotechnical Consultants Limited
Level 3, 3 Osterley way
Manukau
Auckland 2104

Attention: Rosie Garrill

Dear Rosie

96 Beach Haven & 13 Cresta Avenue Beach Haven

Laboratory Test Report

Samples from the above mentioned site have been tested as received according to your instructions and the results are included in this report. Results apply only to the sample(s) tested.

Descriptions are enclosed for your information, but are not covered under the IANZ endorsement of this report.

This report has been prepared for the benefit of Lander Geotechnical Consultants Limited , with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

This report may be reproduced only in full.

Samples not destroyed during testing will be retained for one month from the date of this report before being discarded. If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report prepared by:

.....
Tylah Wardrope
Laboratory Technician

Authorised for Geotechnics by:

.....
Paul Burton
Project Director

Report checked by:

.....
Ryan Milligan
Project Manager
Approved Signatory

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

19-Feb-21
t:\geotechnicsgroup\projects\1009521\1009521.1123\workingmaterial\20210219.96 beach haven & 13 cresta avenue beach haven .tywa.docx

GEOTECHNICS
15C Amber Crescent
Judea
Tauranga 3110
New Zealand
p +64 7 571 0280

Geotechnics Project Number	1009521.1123.0.0
QESTLab Work Order ID	W21TG-0027
Customer Project ID	J01675

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (4 Point), 2.3 & 2.4

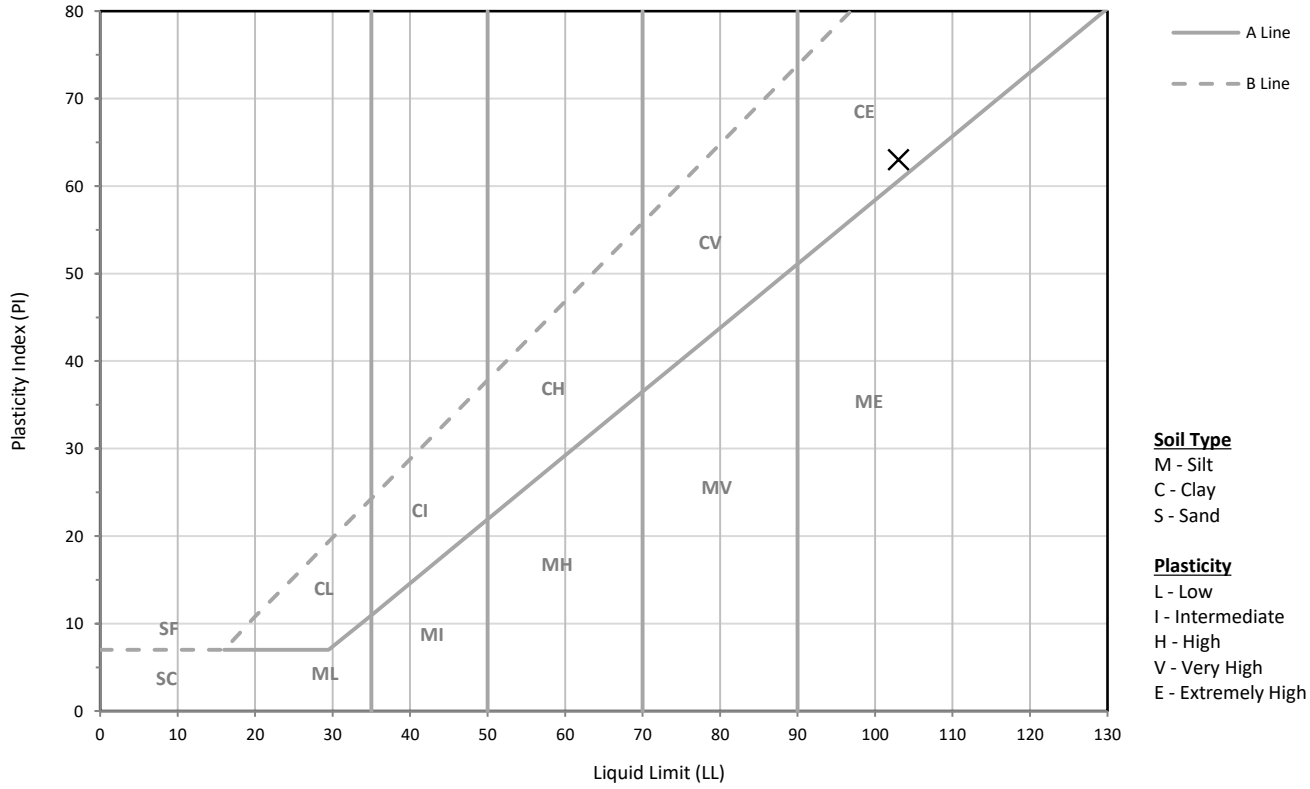
TEST DETAILS

LOCATION	**Description**	96 Beach Haven & 13 Cresta Avenue Beach Haven		
	Data	N/A		
SAMPLE	**Geotechnics ID**	S21TG000063		
	Reference	HA11	**Top Depth**	0.5m
	Sampled By	Others, Tested As Received	**Bottom Depth**	1.0m
	Description	Silty CLAY, with trace rootlets; light brown mixed orange brown. Dry to moist, extremely high plasticity.		
SPECIMEN	**Reference**	N/A	**Depth**	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	**103**
Plastic Limit	**40**
Plasticity Index	**63**

Plasticity Chart - BS 5930:1999



TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • This test result is IANZ accredited.•Date tested 18/02/2021

Approved Signatory	Ryan Milligan
Date	19/02/2021

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Geotechnics Project Number	1009521.1123.0.0
QESTLab Work Order ID	W21TG-0027
Customer Project ID	J01675

Determination of the Linear Shrinkage - NZS 4402:1986 Test 2.6

TEST DETAILS

LOCATION	**Description**	96 Beach Haven & 13 Cresta Avenue Beach Haven		
	Data	N/A		
SAMPLE	**Geotechnics ID**	S21TG000063		
	Reference	HA11	**Top Depth**	0.5m
	Sampled By	Others, Tested As Received	**Bottom Depth**	1.0m
	Description	Silty CLAY, with trace rootlets; light brown mixed orange brown. Dry to moist, extremely high plasticity.		
SPECIMEN	**Reference**		**Depth**	
	Description			

Linear Shrinkage **22%**

TEST REMARKS

• This test result is IANZ accredited.•Date tested 17/02/2021

Approved Signatory Ryan Milligan

Date 19/02/2021

Tauranga
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New Zealand

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Material Test Report

Report No: MAT:S21TG000063
Issue No: 1

Customer: Lander Geotechnical
Address: Level 3, 3 Osterley Way
Manukau, 2104
Project: 96 Beach Haven & 13 Cresta Avenue Beach Haven
Project No.: 1009521.1123.0.0
Customer Reference No.: J01675
Report Authorised By : Ryan Milligan

Approved By:
Ryan Milligan
(Development Manager)
Date of Issue: 19/02/2021

Sample Details

Location	96 Beach Haven & 13 Cresta Avenue Beach Haven
Geotechnics ID	S21TG000063
Sample Reference	HA11
Sample Description	Silty CLAY, with trace rootlets; light brown mixed orange brown. Dry to moist, extremely high plasticity.
Sample Depth	0.5m
Bottom Depth	1.0m

Test Results

Description	Method	Result	Limits
Moisture Content [NZS 4402:1986 Test 2.1]			
Moisture Content (%)		31.4	
Date Tested		15/02/2021	

Comments

This test result is IANZ accredited.

If samples have been taken, and were not destroyed during testing, they will be retained for one month from the date of this report before being discarded.

3.2 Slab-on-ground in expansive soils

3.2.1 NZS 3604 Clause 1.1.2 Buildings covered by this Standard

Amend 1.1.2(a) to read:

"Buildings founded on good ground or on expansive soils where the requirements of 1.1.5 are met"

3.2.2 NZS 3604 New Clause

Add new: "**Clause 1.1.5 Buildings on expansive soils**

Buildings on expansive soils shall be supported on slab-on-ground foundations complying with 7.5.13 and in addition to 1.1.2 shall be limited as follows:

(a) single storey, stand-alone household unit, and

(b) maximum length or width of floor of 24.0 m including any attached garage, and

(c) simple plan shapes such as rectangular, L, T or boomerang, and

(d) concrete slab-on-ground with a minimum thickness of 100 mm and a minimum concrete compressive strength of 20 MPa, and

(e) simple roof forms, incorporating hips, valleys, gables or mono pitches, and

(f) maximum overall height of 7.0 m to roof apex from lowest cleared ground level, and

(g) maximum roof height of 3.0 m, and

(h) roof slope between 10° and 35° from the horizontal, and

(i) maximum span of roof truss 12.0 m, and

(j) external walls maximum of 2.4 m height studs, other than gable end walls and walls to mono-pitched roofs, which shall not exceed 4.0 m.

COMMENT:

Floor plans

Where floor plans incorporate re-entrant corners then continuity of the exterior ground beam shall be maintained by continuing it as an internal beam, with the exterior beam details continued for a length of at least 1.0 m into the internal beam. This is only applicable where internal beams are specified in Tables 7.4A and 7.4B. This is aimed to bring the solution in NZS 3604 in line with Clause 5.3.8 of AS 2870:2011.

Amend 19 Nov 2019

Ground movement

Provision for the additional ground movement effects from trees near to foundations in expansive soils should be considered. Trees remove moisture from the soil for a radius equal to the height of the tree. This causes expansive soils to shrink to varying degrees, and when near houses leads to differential settlement occurring under foundations. Movement of the foundations may lead to cracks in the building and door jamming.

Where existing trees (including trees that have been recently removed) are located closer to the foundations than 1.5 times the mature height of a tree, then additional geotechnical advice should be obtained. Planting of new trees should be avoided near foundations of new buildings or neighbouring buildings on sites with expansive soils.

3.2.3 NZS 3604 Clause 7.5.1

Add the following paragraph at the end of Clause 7.5.1:

"Slabs on expansive soils for buildings meeting the requirements of 1.1.5 shall, in addition to meeting the requirements of 7.5.1 to 7.5.12, meet the requirements of 7.5.13. Where there is conflict the requirements of 7.5.13 shall apply."

3.2.4 NZS 3604 New clause, tables and figures

Add new: **Clause 7.5.13 Slab-on-ground in expansive soils**

7.5.13.1 Identification of expansive soils

7.5.13.1.1 Should reasonable enquiry as outlined in 3.1.3 show any signs of expansive soils, the expansive soil class, as defined in AS 2870, shall be established by one or all of:

(a) enquiry to the local territorial authority, and/or

(b) reference to the certificate of suitability issued in terms of NZS 4431, and/or

(c) a soil test undertaken by a suitably qualified soils engineer.

7.5.13.1.2 Expansive soil class shall be defined as:

(a) Slightly 'S', having an I_{SS} range of 0–1.9%, and a 500 year design characteristic surface movement return (y_S) of 22 mm, or

(b) Moderately 'M', having an I_{SS} range of 2.0–3.7% and a 500 year design characteristic surface movement return (y_S) of 44 mm, or

Amend 19 Nov 2019

(c) Highly 'H', having an I_{SS} range of 3.8–6.5%and a 500 year design characteristic surface movement return (y_S) of 78 mm, or

(d) Extremely 'E', having an I_{SS} range of 6.6–7.5% and a 500 year design characteristic surface movement return (y_S) of 90 mm.

7.5.13.2 Maximum aspect ratio of concrete slabs

The aspect ratio of the concrete slabs or bays of concrete slabs, such as in the case of L, T or boomerang concrete slab shapes, shall not exceed 5 to 1 (length to width).

7.5.13.3 Foundation details

7.5.13.3.1 For the identified expansive soil class the foundation details, external and internal thickenings shall be as follows.

(a) For light wall claddings refer to Table 7.4A and Figure 7.22.

(b) For medium wall or heavy wall claddings refer to Table 7.4B and Figure 7.23.

7.5.13.3.2 Situations where no internal thickenings shall be required are limited to a rectangular slab with long side not exceeding 17.0 m. Where this limit is exceeded, add additional internal thickenings across the slab with the same cross section dimensions and reinforcing as the external footing, so that the centre to centre spacing of thickenings is always less than 17.0 m.

COMMENT:

Design constraints:

a) The characteristic surface movements and the corresponding expansivity classifications have been calculated based on design for ultimate limit state (ULS) conditions for a 1 in 1000 year "extreme" drought event, and the serviceability limit state (SLS) conditions for a 1 in 500 year drought event.

b) Maximum soil movements are calculated to be based on a 500 year return period for SLS, and a 1000 year return period for ULS*;

(*NB: *This differed from the recommendations contained within BRANZ Study Report 120A (BSR120A) which used a 300 year return period for the design level drought conditions)*

Amend 19
Nov 2019

c) Climate parameters adopted from BSR120A of Δu = 1.2 pF, Hs = 1.5 m, and a crack depth of 0.5 Hs

d) The I_{SS} (soil stability index) ranges attributed to the expansivity classifications as defined in 3.2.4 above have been calculated using the parameters presented in BSR120A and Equation 2.3.1 of AS 2870:2011.

e) Sites subject to parameters that differ from those mentioned above, in particular sites where the crack depth is less than 0.75 m, such as cut natural ground or clay backfill, require specific engineering assessment to confirm their appropriate site classification.

f) The effects of nearby trees (whether existing, recently removed, or future planting) are not considered in these solutions. It is recommended that specific geotechnical engineering advice is obtained where a tree is within a lateral distance of 1.5 times its mature height of the foundations.

Maintenance of foundations in expansive soils

Normal maintenance is that work generally recognised as necessary to achieve the expected performance over time of the foundation located on expansive soils. Unless otherwise specified by the designer and noted on the drawings, basic normal maintenance tasks should ensure that:

a) the drainage and wetting of the site is controlled so that extremes of wetting and drying of the soils are prevented, and

b) the position and operation of gardens adjacent to the dwelling are controlled, and the planting of trees near to foundations is suitably restricted, and

c) any leaks which develop in plumbing, storm water or sanitary sewage systems are repaired promptly.

Amend 19
Nov 2019

Table 7.4A **Reinforced concrete foundations in expansive soils for light wall claddings**
Clause 7.5.13 and Figure 7.22

Expansive soil class	Slightly 'S'	Moderately 'M'	Highly 'H'	Extremely 'E'
Soil embedment (De)	375 mm	525 mm	575 mm	625 mm
Top steel (A_S top)	2/D 16	2/ D16	2/ D16	2/ D16
Bottom steel (A_S bottom)	1/ D16	1/ D25	1/ D20	1/ D25
Stirrups	R6/ 125 crs.	R6/ 125 crs.	R6/ 300 crs.	R6/ 300 crs.
Maximum spacing of internal thickenings	no internal thickening	no internal thickening	2.5 m crs.	2.5 m crs.
Depth of thickening (D1)	–	–	400 mm	450 mm
Base width (B1)	–	–	300 mm	350 mm
Top steel (A_S top)	–	–	2/ D20	2/ D20
Bottom steel (A_S bottom)	–	–	2/ D16	2/ D20
Stirrups	–	–	R6/ 150 crs.	R6/ 150 crs.

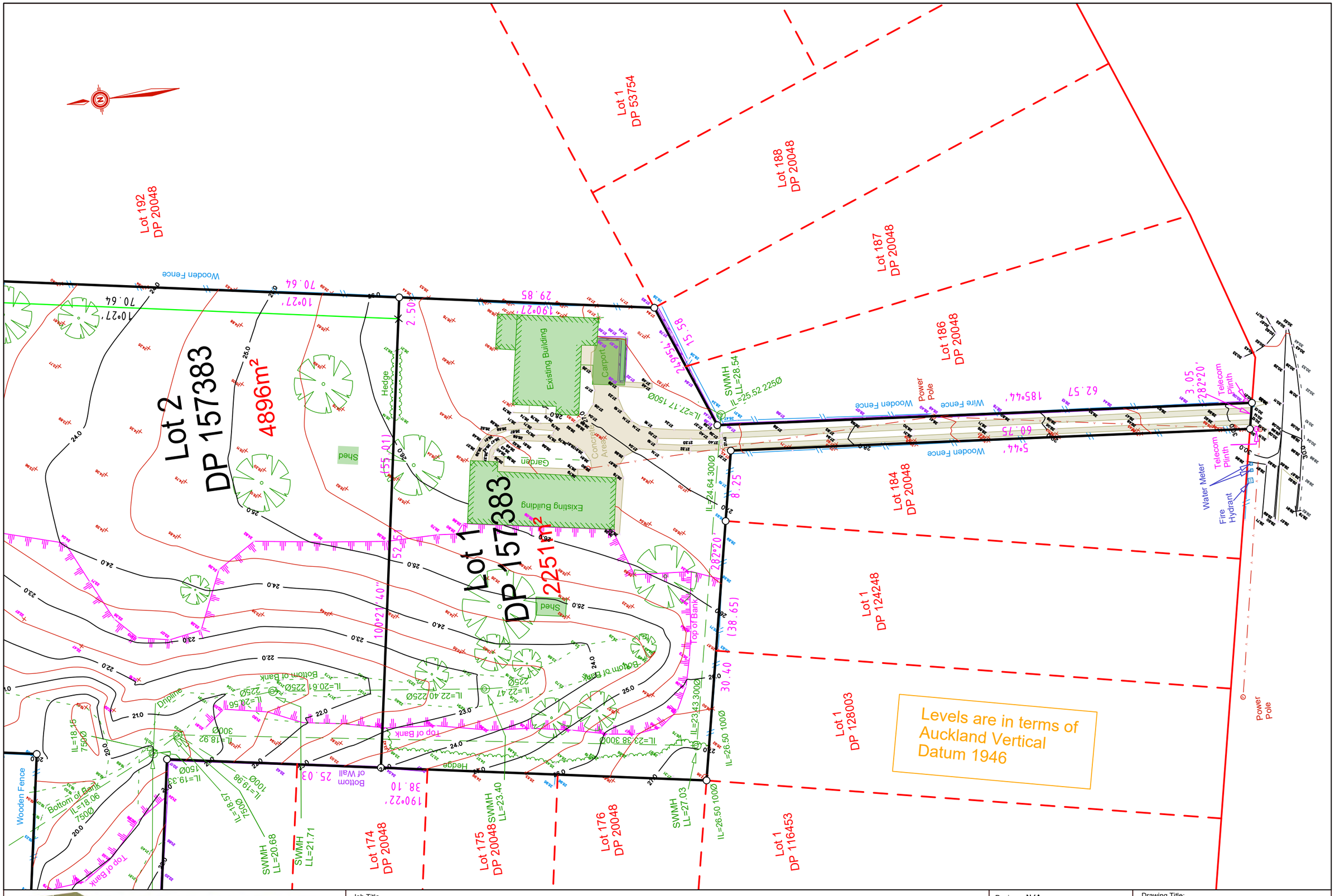
Table 7.4B **Reinforced concrete foundations in expansive soils for medium wall and heavy wall claddings**
Clause 7.5.13 and Figure 7.23

Expansive soil class	Slightly 'S'	Moderately 'M'	Highly 'H'	Extremely 'E'
Soil embedment (De)	500 mm	550 mm	775 mm	800 mm
Top steel (A_S top)	2/ D16	2/ D20	2/ D20	3/ D20
Bottom steel (A_S bottom)	2/ D16	2/ D16	2/ D20	2/ D20
Stirrups	R6/ 125 crs.	R6/ 250 crs.	R6/ 300 crs.	R6/ 300 crs.
Maximum spacing of internal thickenings	–	2.5 m crs.	2.5 m crs.	2.5 m crs.
Depth of thickening (D1)	–	350 mm	450 mm	500 mm
Base width (B1)	–	300 mm	300 mm	350 mm
Top steel (A_S top)	–	2/ D16	3/ D20	3/ D20
Bottom steel (A_S bottom)	–	2/ D16	2/ D16	2/ D20
Stirrups	–	R6/ 125 crs.	R6/ 150 crs.	R6/ 150 crs.

Amend 19
Nov 2019

Appendix E

Easdale Surveyors – Topographical Survey Plans



EASDALE SURVEYORS LTD
39 Meadowland Drive, Howick p: 09 5348452 e: surveyors@easdales.co.nz

Job Title

Topographical Survey
For
Da-Silva Builders
13 Cresta Ave & 96 Beach Haven Rd
Lot 1 and Lot 2 DP 157383

Design	N/A
Survey	ZN&JS
Drawn	ZN
Checked	ML
Date	February 2021
Scale	1: 400 (A3)

Drawing Title:
Site Plan Sheet 1
Surveyed on 03/02/2021

File No.	Rev.	Dwg No.
14424	N/A	

Lot 1
DP 73789

Lot 2
DP 67318

Lot 2
DP 73789

Lot 2
DP 122566

Lot 171
DP 20048

Lot 174
DP 20048

Lot 192
DP 20048

Lot 2
DP 157383

4896m²

Levels are in terms of Auckland Vertical Datum 1946

Adopted from the City Council Database

Power Pole
Telecom Plinth
Dripline
Gate
Garden
Wooden Fence
Existing Building
Concrete Area
Wooden Deck
Paving
Top of Bank
Bottom of Bank
Footpath
Channel
Edge of Seal
Bottom of Wall
Wooden Fence
Garden
Shed
Hedge
Tank
Bottom of Wall
Top of Bank

100°27' 65.98
280°27' 65.98
190°27' 30.48
(55.04) 52.54 280°28'50"
10°27' 70.64
100°21'40" 52.51
(55.01)
190°22' 38.10
10°27' 70.64
5.24
2.50
2.50

WWMH LL=21.50
IL=19.90 150Ø
IL=20.04 150Ø
IL=18.15 750Ø
IL=18.06 750Ø
WW CONN GL=23.31
SWMH LL=19.97
IL=19.33 150Ø
IL=18.92 300Ø
IL=18.57 750Ø
IL=19.98 100Ø
SWMH LL=20.68
IL=20.56 225Ø
IL=20.61 225Ø
SWMH LL=21.71
IL=24.89 150Ø
WWMH LL=25.81
IL=24.92 150Ø
IL=22.40 225Ø
SW CONN GL=21.81
WWMH LL=22.13
IL=21.36 100Ø
IL=19.4 150Ø
IL=19.45 150Ø

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Design	N/A
Survey	ZN&JS
Drawn	ZN
Checked	ML
Date	February 2021
Scale	1: 400 (A3)

Drawing Title:
Site Plan Sheet 2
Surveyed on 03/02/2021

File No.	Rev.	Dwg No.
14424	N/A	