

	4 Fred Thomas Drive, Takapuna, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel: 09 489 7872 Email: riley@riley.co.nz	Project No:	220372	Page	1	of	7
		Project:	Southland Wind Farm				
	22 Moorhouse Avenue, Addington, Christchurch 8011 PO Box 4355, Christchurch 8140 Tel: 03 379 4402 Email: rileychch@riley.co.nz	Calc:	MM	Date:	01/07/2025		
		Check:	VM	Date:	01/07/2025		
Description:	Preliminary Culvert Design						

Aim:

- Size culverts required for the site based on the contributing catchments and the stormwater flows they produce.

Note: This Appendix is applicable for the culverts designed by Riley. Culverts designed by WWLA, specific to wetland flow paths are detailed within the WWLA Concept Hydrological Design Report.

Method of Calculations:

Maximum upstream catchment areas and culvert sizes have been determined based on the following assumptions:

1. The runoff coefficients have been adopted from NZBC Verification Method E1/VM1 Table 1. The coefficients adopted for various areas of the site are summarised in the table below. Additional contribution from hardstands is assumed to be negligible and so catchments are entirely model based on the three cover types below.

Site Location	Cover Type	Run-off Coefficient
Matariki Forest & Davidson Road West	Medium soakage soil - cultivated	0.20
Jedborough Plateau	Medium soakage soil - bush and scrub cover	0.25
Remainder of Jedborough Station	Medium soakage soil - pasture and grass cover	0.30

2. Slope correction factors have been applied to the run-off coefficients as per NZBC Verification Method E1/VM1 Table 2.

Ground Slope	C adjustment
0-5%	-0.05
5-10%	0
10-20%	+0.05
20& or steeper	+0.01

3. Historic rainfall intensities have been taken from NIWA (HIRDS) and adjusted for climate change. This has been achieved by applying a factor of percentage adjustment per 1°C temperature increase over an estimated 1.9°C warming in Southland to 2090.

	4 Fred Thomas Drive, Takapuna, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel: 09 489 7872 Email: riley@riley.co.nz	Project No:	220372	Page	2	of	7
		Project:	Southland Wind Farm				
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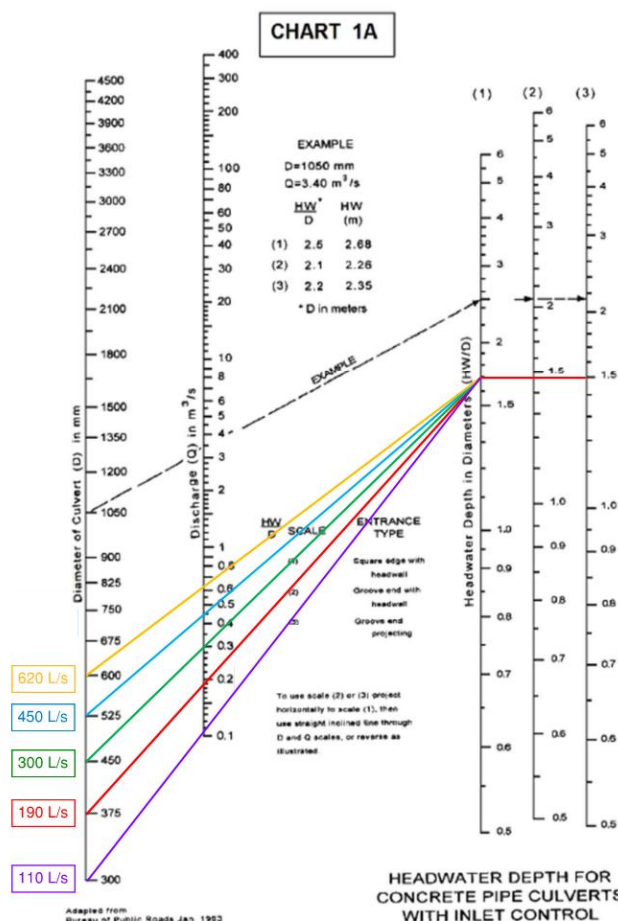
4. 10% AEP + Climate change Design Rainfall

Event Duration	10min	20min	30min	1hr
Historic Rainfall Intensity (mm/hr) - HIRDS	54	37.3	30	20.7
Factor of percentage adjustment per 1°C	8.0	7.0	7.6	7.4
Climate Change Adjusted Rainfall Intensity (mm/hr)	62.2	42.3	34.3	23.6

5. To assess the time of concentration (t_c) for each catchment identified, the Ramser-Kiripich formula has been used, in accordance with NZBC E1/VM1, where L is the length of catchment along the flow path and H is the elevation difference across the catchment.

$$t_c = 0.0195 \left(\frac{L^3}{H} \right)^{0.385}$$

6. Nomographs (Chart 1A) and inlet control have been used to size culverts.



7. Assume acceptable for headwater to build-up 1.5 times pipe diameter.

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		Project:	Southland Wind Farm					
		Calc:	MM	Date:	01/07/2025			
		Check:	VM	Date:	01/07/2025			
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Results:

Diameter (mm)	Number of Culverts	Length (m)
300	65	916
375	16	330
450	6	73
525	4	94
600	4	101
750	9	154
900	3	50

Culvert ID	Catchment Area (ha)	Slope Adjusted C	Time of Concentration (min)	Design Flow (l/s)	Culvert dia. (mm)	Type
1	0.1	0.20	10.0	3.6	300	D
2	1.7	0.20	10.0	57.9	300	B
3	0.7	0.25	10.0	31.7	300	B
4	0.2	0.15	10.0	5.9	300	D
5	0.4	0.20	10.0	13.4	300	B
6	7.8	0.25	10.0	337.5	525	B
7	11.9	0.20	10.0	410.3	525	D
8	10.6	0.25	10.0	459.4	600	D
9	3.2	0.20	10.0	110.4	375	D
10	3.0	0.20	10.0	103.5	300	B
11	0.8	0.20	10.0	28.6	300	D
12	0.3	0.15	10.0	6.5	300	D
13	1.5	0.15	10.0	38.7	300	B
14	2.3	0.15	10.0	58.6	300	B
15	0.6	0.25	10.0	25.0	300	C
16	0.1	0.15	10.0	2.9	300	C
17	1.1	0.15	10.0	28.8	300	B

	4 Fred Thomas Drive, Takapuna, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel: 09 489 7872 Email: riley@riley.co.nz	Project No:	220372	Page	4	of	7
		Project:	Southland Wind Farm				
	22 Moorhouse Avenue, Addington, Christchurch 8011 PO Box 4355, Christchurch 8140 Tel: 03 379 4402 Email: rileychch@riley.co.nz	Calc:	MM	Date:	01/07/2025		
		Check:	VM	Date:	01/07/2025		
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Culvert ID	Catchment Area (ha)	Slope Adjusted C	Time of Concentration (min)	Design Flow (l/s)	Culvert dia. (mm)	Type
18	4.8	0.20	10.0	166.2	375	D
19	0.8	0.15	10.0	19.4	300	D
20	1.3	0.15	10.0	34.8	300	B
21	6.9	0.20	10.0	240.0	450	D
22	19.6	0.25	10.8	846.2	750	B
23	26.2	0.20	14.7	905.7	750	B
24	24.0	0.20	14.0	830.3	750	D
25	2.2	0.15	10.0	56.9	300	A
26	0.7	0.15	10.0	18.3	300	C
27	0.2	0.20	10.0	7.0	300	C
28	0.8	0.15	10.0	20.3	300	C
29	0.3	0.15	10.0	6.9	300	C
30	7.2	0.20	10.7	249.6	450	D
31	0.1	0.20	10.0	3.9	300	D
32	31.5	0.20	12.4	1088.3	750	A
33	4.6	0.20	10.0	159.3	375	A
34	41.0	0.20	15.2	1418.4	900	C
35	1.4	0.15	10.0	34.9	300	D
36	0.6	0.15	10.0	15.8	300	C
37	0.1	0.15	10.0	3.4	300	D
38	21.1	0.20	11.5	727.5	750	A
39	4.2	0.20	10.0	143.4	375	D
40	4.5	0.20	10.0	153.6	375	D
41	5.1	0.20	10.0	176.4	375	A
42	13.5	0.20	10.0	468.1	600	A
43	0.4	0.15	10.0	11.3	300	B
44	0.1	0.20	10.0	4.2	300	C
45	0.2	0.25	10.0	9.9	300	D

	4 Fred Thomas Drive, Takapuna, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel: 09 489 7872 Email: riley@riley.co.nz	Project No:	220372	Page	5	of	7
		Project:	Southland Wind Farm				
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Culvert ID	Catchment Area (ha)	Slope Adjusted C	Time of Concentration (min)	Design Flow (l/s)	Culvert dia. (mm)	Type
46	0.5	0.25	10.0	20.6	300	A
47	0.2	0.20	10.0	6.6	300	D
48	14.3	0.25	11.5	617.2	600	A
49	1.7	0.25	10.0	72.2	300	C
50	0.1	0.20	10.0	2.2	300	C
51	0.1	0.20	10.0	1.9	300	D
52	0.2	0.20	10.0	6.8	300	D
53	0.3	0.20	10.0	9.6	300	B
54	0.2	0.20	13.0	8.4	300	D
55	0.7	0.25	10.0	30.3	300	D
56	0.2	0.20	10.0	6.1	300	D
57	0.5	0.25	10.0	19.9	300	C
58	0.02	0.20	10.0	0.7	300	D
59	2.2	0.25	10.0	96.3	300	C
60	1.7	0.20	10.0	57.1	300	C
61	0.2	0.20	10.0	8.1	300	D
62	0.1	0.25	10.0	2.7	300	D
63	1.0	0.25	10.0	42.3	300	C
64	2.7	0.30	10.0	138.6	375	A
65	1.0	0.25	10.0	43.0	300	C
66	0.2	0.25	10.0	10.0	300	D
67	1.3	0.30	10.0	68.9	300	D
68	1.2	0.30	10.0	61.2	300	D
69	0.1	0.25	10.0	5.9	300	C
70	0.7	0.30	10.0	33.8	300	A
71	0.5	0.25	10.0	19.8	300	D
72	1.2	0.25	10.0	49.5	300	C
73	32.8	0.25	17.4	1415.9	900	B

	4 Fred Thomas Drive, Takapuna, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel: 09 489 7872 Email: riley@riley.co.nz	Project No:	220372	Page	6	of	7
		Project:	Southland Wind Farm				
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Culvert ID	Catchment Area (ha)	Slope Adjusted C	Time of Concentration (min)	Design Flow (l/s)	Culvert dia. (mm)	Type
74	0.6	0.25	10.0	25.4	300	B
75	0.2	0.35	10.0	10.7	300	D
76	0.03	0.35	10.0	1.8	300	D
77	20.7	0.25	16.2	894.0	750	A
78	8.9	0.30	10.0	463.6	600	B
79	9.3	0.25	10.6	400.3	525	B
80	3.2	0.30	10.0	166.5	375	A
81	0.04	0.25	10.0	1.6	300	D
82	0.4	0.25	10.0	18.8	300	C
83	0.2	0.25	10.0	6.7	300	B
84	0.4	0.25	10.0	17.3	300	C
85	0.1	0.25	10.0	4.0	300	D
86	5.7	0.30	10.0	294.9	450	A
87	1.9	0.30	10.0	97.1	300	D
88	0.6	0.20	10.0	20.6	300	D
89	1.3	0.20	10.0	46.4	300	B
90	4.1	0.20	10.0	142.1	375	B
91	3.0	0.25	10.0	130.5	375	C
92	5.3	0.15	10.0	136.0	375	B
93	25.8	0.20	10.0	892.2	750	A
94	17.9	0.25	10.0	772.8	750	A
95	1.4	0.20	10.0	47.7	300	C
96	5.9	0.25	10.0	253.6	450	B
97	5.6	0.25	10.0	242.1	450	C
98	2.7	0.25	10.0	115.3	375	C
99	2.8	0.15	10.0	73.0	300	C
100	15.8	0.25	10.0	684.0	750	C
101	33.2	0.25	13.0	1434.4	900	B

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		Project:	Southland Wind Farm					
		Calc:	MM	Date:	01/07/2025			
		Check:	VM	Date:	01/07/2025			
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Culvert ID	Catchment Area (ha)	Slope Adjusted C	Time of Concentration (min)	Design Flow (l/s)	Culvert dia. (mm)	Type
102	3.3	0.20	10.0	113.2	375	C
103	3.1	0.25	10.0	133.6	375	D
104	4.1	0.25	10.0	175.8	375	B
105	3.4	0.20	10.0	115.9	375	A
106	3.9	0.35	10.0	238.5	450	D
107	7.9	0.25	10.0	340.8	525	A

