Appendix 13

Stormwater Report prepared by Morphum Consultants

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Lot 1 DP 341981, Molesworth Drive | Mangawhai
New Zealand

Subject: Stormwater Report for Lot 1 DP 341981, Molesworth Drive, Mangawhai

Introduction

Morphum Environmental Ltd (Morphum) has been instructed by North City Developments to provide a stormwater report to accompany a private plan change to change site zoning of Lot 1 DP 341981 Molesworth Drive, Mangawhai from residential to commercial. Our following report covers the potential impact of the proposed plan change and a design concept to manage stormwater on the site and mitigate any increase in runoff.

Relevant Documents and References

- Kaipara District Council Engineering Standards
- Kaipara District Plan
- New Zealand Building Code
- Northland Regional Council Soil and Water Plan

Site Description

The subject site covers an area of 7,863m^2 and is located on the eastern side of Molesworth Drive. The site slopes at a grade of approximately 1 in 30 towards Estuary Drive. There are no existing drainage systems on the site, so stormwater currently drains into the underlying sands or runs overland towards the southern end of the site. Stormwater is collected in a swale which runs along Estuary Drive and discharges through a 900mm culvert into the Mangawhai Estuary. There is also an informal overland flow path that runs from the site across Estuary Drive to an estuarine channel on the other side of the road.

It has been identified that the land areas of Allot 93 SO 51283 and Lot 4 DP 99103 across Estuary Road to the southwest of the site have experienced flooding in the past.

Stormwater Management Options

The estuarine channel in Lot 1 DP 448852 downstream of the subject site (discharge point for the 900mm culvert) is situated at elevation close to that of the estuary and is lower than the surrounding lots. Stormwater flows pass through this channel to the estuary and have an insignificant effect on flooding of the downstream properties even in a post-development scenario.

One management option for this site would be to direct stormwater flows directly to the estuary. This option would reduce stormwater land use requirements, could have less safety risk (than ponds, for example), and need less ongoing management than some other stormwater management options. In this case, the culvert crossing Estuary Drive may need to be upgraded and outlet protection may be needed to protect scour.

Under 100% impervious commercial land use less stormwater on the site will percolate through site soils and instead run overland. This increases the amount of runoff leaving the site. Stormwater management can provide detention to pre-development levels. Several options could be utilised that relate to the level of imperviousness:

- Raincrates are proprietary devices which provide detention of stormwater. They are installed underground and can be used in trafficked areas when installed to manufacturer specification.
- Porous concrete, a specific concrete and base aggregate mix, allows stormwater to flow through the surface and into the surrounding soils. This device is used in low traffic areas such as carparks and would be suitable at this site due to its flatness and permeable underlying soils.
- Raingardens can also be used to provide mitigation. These collect runoff from impervious surfaces and release it at a reduced rate into the stormwater network. Raingardens also provide the added benefits of stormwater treatment and amenity value.
- However, if the site is developed with a high level of imperviousness and full development mitigation is required, a detention structure is required. The following section provides a concept design for a stormwater basin.

Runoff calculations have been completed for the site in 2, 10 and 100 year ARI events. Under current conditions, a 0% impervious cover is assumed. Under commercial zoning, there is no maximum impervious area limit, so a 100% impervious cover is assumed. Results of the runoff calculations are shown in Appendix 1. There is an increase in peak flow in a 2 year event of 136%, in a 10 year event of 71%, and in a 100 year event of 34% if no detention device is provided.

Detention Basin Concept Design

This detention basin concept design has been based on pre- vs. post-development flow matching to ensure stormwater peak flow is maintained at pre-developed rates.

The structure has been sized based on a 100% impervious cover to mitigate storms up to the 100 year ARI event. The structure would have 3 low flow outlets, plus an overflow spillway in order to detain stormwater under high runoff events and drain at a slower rate to the stormwater network.

The proposed basin has a volume of 353m^3, and a peak water depth of 1.90 m in the 100 year event The basin would be 2.0m deep with a 7.5m x 7.5m flat base. The top of the basin would be 19.5m x 19.5m and have approximately 1:3 side slopes. The outlet for the basin would take the form of a manhole riser with 3 orifice outlets on the chamber. The orifice sizes and heights are shown in appendix 2. The manhole riser top would act as the outlet for 100 year flows. In events greater than the 100 year ARI event a spillway would be provided. The spillway should be located so that water will flow into the overland flow path leaving the site. Basin calculations are shown in appendix 2.

A pipe leaving the basin from the manhole riser to accommodate the mitigated 100 year ARI flow would be between 450 and 600mm in diameter (depending on the slope and length). Pipe sizing should be determined in the detailed design stage.

Stormwater Treatment

Treatment of stormwater will be dealt with as required by future resource consents depending on the nature of the future use of the site. In particular rain gardens or a detention basin can be designed to provide a stormwater treatment function.

Recommendations

A number of methods can provide for stormwater management for the site that will not exacerbate flooding, provide treatment and provide for maintaining stormwater at predevelopment levels.

Yours sincerely,

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Appendix 1: Stormwater Runoff Calculations

Stormwater mitigation calculations were done to size a detention structure to mitigate peak flows of the post-development scenario to pre-development levels.

Rainfall depths were taken from NIWA, a climate change scenario was added to the depths.

High Intensity Rainfall System V3

Depth-Duration-Frequency results (produced on Wednesday 15th of July 2015)
Sitename: 68 Molesworth Drive
Coordinate system: NZTM2000
Easting: 1742467
Northing: 6003096

Rainfall depths (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	10.2	14.2	17.3	24.2	32.8	53.4	72.6	98.7	110.1	117.4
2	0.5	11.1	15.5	18.8	26.2	35.8	58.4	79.6	108.6	121.1	129.1
5	0.2	14.3	19.9	24.2	33.8	46.5	77	105.8	145.5	162.3	173
10	0.1	16.9	23.6	28.6	40	55.3	92.4	127.7	176.6	197	210
20	0.05	19.8	27.7	33.6	47	65.3	110.1	153	212.6	237.2	252.9
30	0.033	21.7	30.4	36.9	51.6	71.9	121.7	169.7	236.6	264	281.5
40	0.025	23.2	32.4	39.4	55	76.9	130.7	182.6	255.2	284.7	303.5
50	0.02	24.4	34.1	41.4	57.9	81	138.1	193.2	270.5	301.8	321.7
60	0.017	25.4	35.5	43.2	60.3	84.5	144.4	202.4	283.6	316.5	337.4
80	0.012	27.1	37.9	46.1	64.4	90.4	154.9	217.6	305.7	341.1	363.6
100	0.01	28.5	39.8	48.4	67.7	95.2	163.6	230.2	323.9	361.4	385.3

Standard errors (mm)

ARI (y)	aep	Duration 10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
1.58	0.633	1.5	1.6	1.6	1.6	1.7	1.8	2.1	2.3	2.4	2.5
2	0.5	1.5	1.6	1.6	1.6	1.7	2	2.2	2.5	2.6	2.7
5	0.2	1.6	1.6	1.7	1.8	2.1	2.7	3.4	3.5	3.8	4
10	0.1	1.6	1.7	1.8	2	2.8	4	5.2	5	5.5	5.8
20	0.05	1.7	2	2.1	2.5	4	6.1	8.1	7.4	8.2	8.7
30	0.033	1.9	2.2	2.4	2.9	5.1	7.9	10.4	9.2	10.3	10.9
40	0.025	2	2.4	2.6	3.3	6	9.4	12.4	10.7	12	12.7
50	0.02	2.1	2.5	2.9	3.6	6.8	10.7	14.2	12.1	13.5	14.3
60	0.017	2.2	2.7	3.1	3.9	7.5	11.8	15.8	13.2	14.8	15.7
80	0.012	2.3	3	3.4	4.5	8.8	13.9	18.6	15.3	17.1	18.1
100	0.01	2.5	3.3	3.7	4.9	9.9	15.7	20.9	17	19	20.1

Catchment ID		Full Site	Full Site	Full Site	Full Site	Full Site	Full Site
Storm ID		**Pre 2 yr**	**Post 2 yr**	**Pre 10 yr**	**Post 10 yr**	**Pre 100 yr**	**Post 100 yr**
Permeable area	m^2	7,863	0	7,863	0	7,863	0
Impermeable area	m^2	0	7,863	0	7,863	0	7,863
Total area	m^2	7,863	7,863	7,863	7,863	7,863	7,863
Event depth	mm	118	118	200	200	378	378
Initial abstraction	mm	5.0	0.0	5.0	0.0	5.0	0.0
Permeable area curve number		61	61	61	61	61	61
Impermeable area curve number		98	98	98	98	98	98
Site curve number		61	98	61	98	61	98
Potential maximum retention	mm	162.4	5.2	162.4	5.2	162.4	5.2
Runoff depth	mm	46.6	113.4	106.3	194.9	260.1	373.2
Volume	**m^3**	**366.5**	**891.7**	**836.0**	**1,532.2**	**2,045.6**	**2,934.5**
Channelisation factor		1.00	0.60	1.00	0.60	1.00	0.60
Catchment length	km	0.142	0.142	0.142	0.142	0.142	0.142
Catchment slope	m/m	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Time of concentration	hr	0.20	0.17	0.20	0.17	0.20	0.17
Runoff index		0.25	0.92	0.37	0.95	0.53	0.97
Specific peak flow rate		0.07	0.16	0.10	0.17	0.12	0.17
Peak flow	**m^3/s**	**0.065**	**0.154**	**0.152**	**0.261**	**0.371**	**0.496**

Appendix 2: Stormwater Detention Basin Sizing

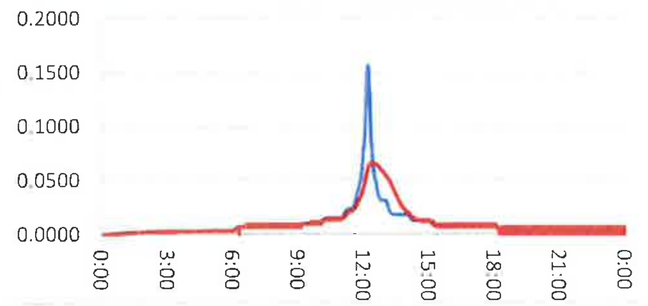
Project:	Molesworth 68	Detention sizing using SCS runoff method
Author:	JE	
Reviewer:	SB	

General fields	Units	Value	General fields	Units	Value
Site Name		Full Site	Base orifice size	m	0.180
Area (Ha)	Ha	0.7863	Base orifice height	m	0
Post Impervious	%	100.0%	1st stack orifice size	m	0.270
Catchment length	m	142	1st stack orifice height	m	1.050
Catchment slope	% m/m	3.0%	2nd stack orifice size	m	0.380
Permeable Curve no.		61	2nd stack orifice height	m	1.440
Post Channelisation		0.6			

Stage Area relationship						
Stage (m)	0.00	0.50	1.00	1.50	2.00	0.00
Area (m²)	56.3	110.3	182.3	272.3	380.3	0.0

Base design event	Units	Value
Design event		Post 2 yr
Rainfall depth	mm	118.4
Runoff depth	mm	113.4
Inflow peak flow	m³/s	0.1563
Outflow peak flow		0.0663
Max stage	m	1.05
Max volume stored	m³	123.4

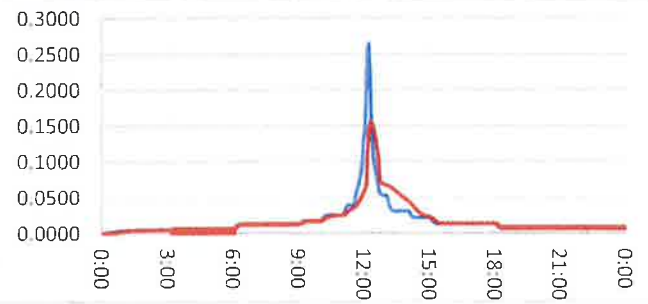
Base design event hydrograph (x = time, y = m³/s)



Inflow = Blue, Outflow = Red

1st Stack design event	Units	Value
Design event		Post 10 yr
Rainfall depth	mm	199.9
Runoff depth	mm	194.9
Inflow peak flow	m³/s	0.2650
Outflow peak flow		0.1554
Max stage	m	1.44
Max volume stored	m³	211.3

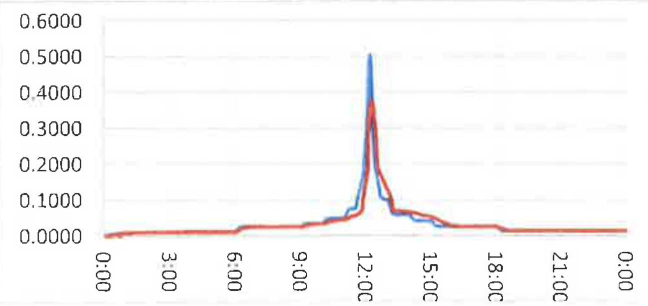
1st stack design event hydrograph (x = time, y = m³/s)



Inflow = Blue, Outflow = Red

2nd Stack design event	Units	Value
Design event		Post 100 yr
Rainfall depth	mm	378.3
Runoff depth	mm	373.2
Inflow peak flow	m³/s	0.5025
Outflow peak flow		0.3763
Max stage	m	1.90
Max volume stored	m³	353.8

2nd stack design event hydrograph (x = time, y = m³/s)



Inflow = Blue, Outflow = Red

Appendix 3: Stormwater Detention Basin Location

Stormwater Mitigation - Concept Design - Molesworth Drive

Stormwater Basin

Property Boundary

0 20 40

m

Client: Private