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SITE COMPATIBILITY CERTIFICATE
FLOOD ANALYSIS REPORT

FOR

CHATSWOOD GOLF CLUB
128 BEACONSFIELD ROAD, CHATSWOOD NSW 2067

Revision No	Status	Issue Date	Prepared By	Reviewed By	Approved By
A	Draft	26/04/2017	SK	L. Panagopoulos	PS
B	Final	18/05/2017	LP	L. Panagopoulos	PS
C	Final	14/06/2017	LP	LP	PS

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1.0 INTRODUCTION AND OVERVIEW

This report discusses the impact of the proposed development and the relationship with the upstream catchment flood analysis that has been undertaken as part of this report.

The following drawings have been prepared by Marchese Partners Engineering in support of the drawings prepared by Architects, Marchese Partners: -

- DA-C-0001 Upstream Catchment Analysis – Existing Condition
- DA-C-0002 Upstream Catchment Analysis – Proposed Ground Floor

This report addresses the following key areas:-

1. Flood analysis on the Upstream Catchment with DRAINS modelling software.
2. Defines the overland flow corridors outside of the site and their effect on the existing Golf Course and the proposed building development
3. The extent of partial flooding within the site area and the effect on the Finished Floor Level (FFL) and the site levels across the proposed development
4. Proposes mitigation measures to address overland flow and integrate solutions to provide flood protection to the proposed building development.

2.0 THE EXISTING SITE

Chatswood Golf Club is located north of Mowbray Road West and west of Beaconsfield Road, near Lane Cove River. The existing club is to be temporarily relocated south west and the proposed building location is shown in the site plan below.

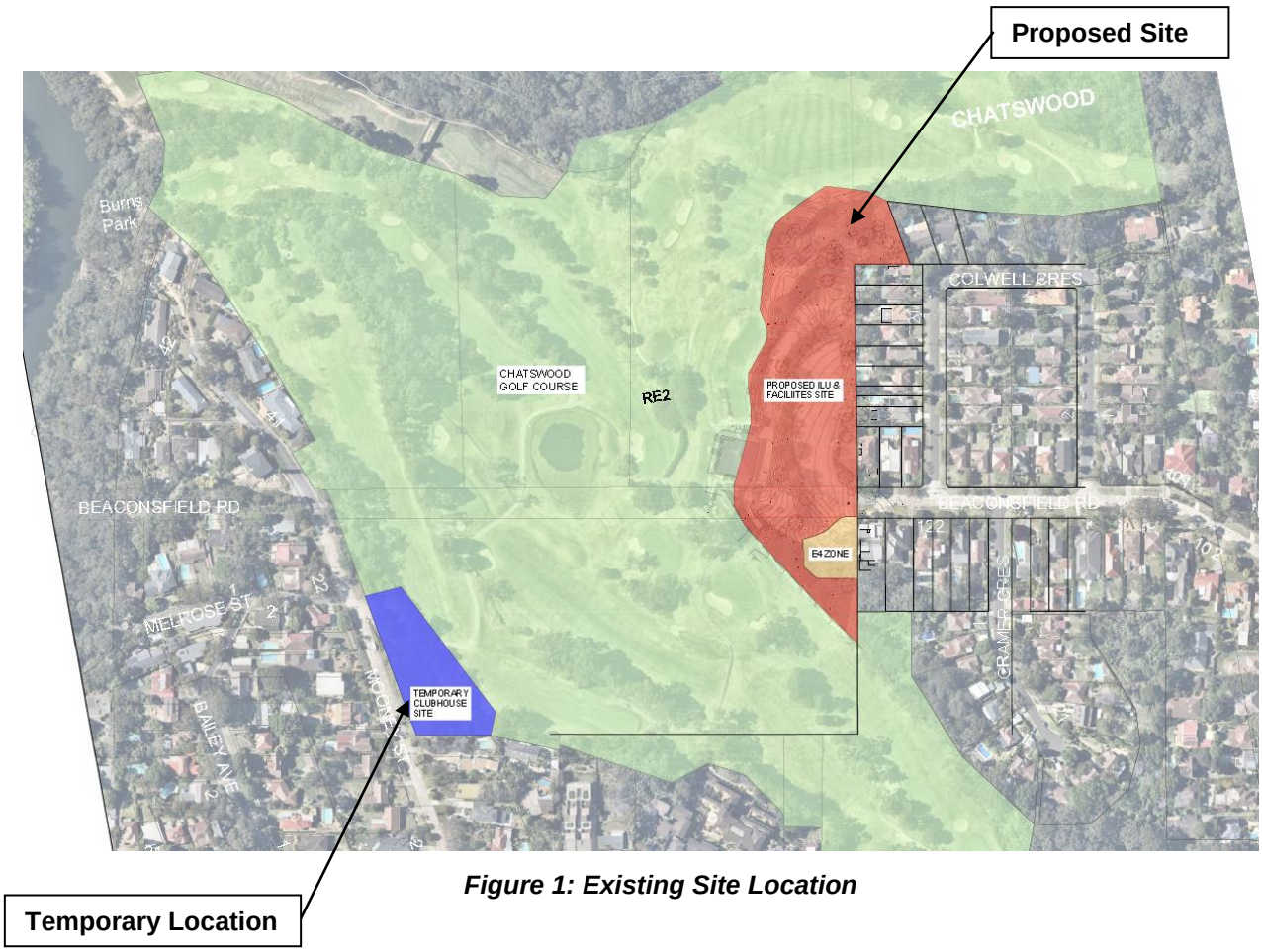


Figure 1: Existing Site Location

The Survey Plan prepared by JBW Surveyors shows that:-

- The overall land has a fall towards Chatswood Golf Course.

3.0 FLOOD ANALYSIS

The upstream catchment is bounded by Fullers Road to the north, Pacific Highway to the east, Mowbray Road West to the south and Mooney Street to the West. The catchment contains three major overflow systems being a gully, a creek and Beaconsfield Road which flows into the same path leading into Lane Cove River. The upstream catchment plan can be presented in Appendix A Drawing DA-C-0001. The three (3) overland flow paths shown in the Upstream Catchment Plan (Appendix A Drawing DA-C-0001) fall from east to west with their flow path lengths shown. These overland flow paths fall from east to west towards the site which slopes into a gully west of site and continues into Lane Cove River. This suggests the site will suffer some flood inundation from the upstream overflows emanating from Beaconsfield Road and the upstream residential housing area (11 properties) located immediately to the east of the site with Colwell Crescent. This area is depicted on the upstream catchment plan DA-C-001 as area A_{m2}.

Figure 2:- Colwell Crescent Upstream Residential Catchment area
(Extract from Appendix A Drawing DA-C-0001)

A DRAINS model was created for the upstream catchment flood analysis of Chatswood Golf Club. The upstream catchment was determined using site inspections and the provided survey plans. The DRAINS model for the Existing Condition was analysed for the 100 Year ARI Storm event. The following characteristic factor values were used in the model:-

- Paved area depression storage 1mm
- Grassed area depression storage 5mm
- Soil Type 3
- Antecedent Moisture Content (AMC) 3

The times of concentration were calculated using the Kinematic Wave Equation by the DRAINS software. Flow length, slope of the catchment, impervious and pervious percentage and roughness were input into each catchment node to determine the time of concentration for each sub-catchment. The upstream catchment and flow paths are shown in Appendix A Drawing DA-C-0001. The DRAINS model node diagram and results are shown in Appendix B - DRAINS 1 and 2. The existing pits and stormwater system on Beaconsfield Road has been included in the DRAINS model.

The DRAINS model for the existing site is shown in Figure 3 below:-

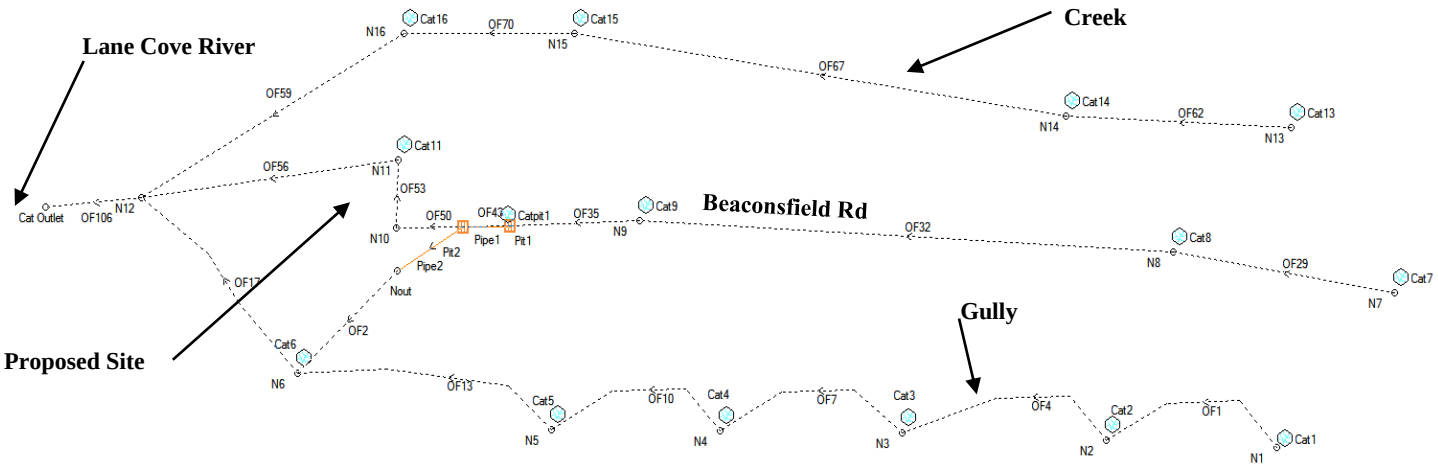


Figure 3: DRAINS Modelling Node Diagram

The results for the 100 Year ARI storm are shown below in the following Figure 5. The total catchment Peak discharge to Lane Cove River is 40m³/s for the 100 Year ARI for a 2 hour duration storm event. The gully overflows from Mowbray Road West towards Chatswood Golf Course, bypassing the proposed area and then meets the upstream catchment west of the proposed development. The peak flow entering the golf course from the gully is 18.8m³/s for the 2 hour duration. The temporary location of Chatswood Golf Club to the south west of the proposed development also overflows into the gully as shown in Figure 4 below.

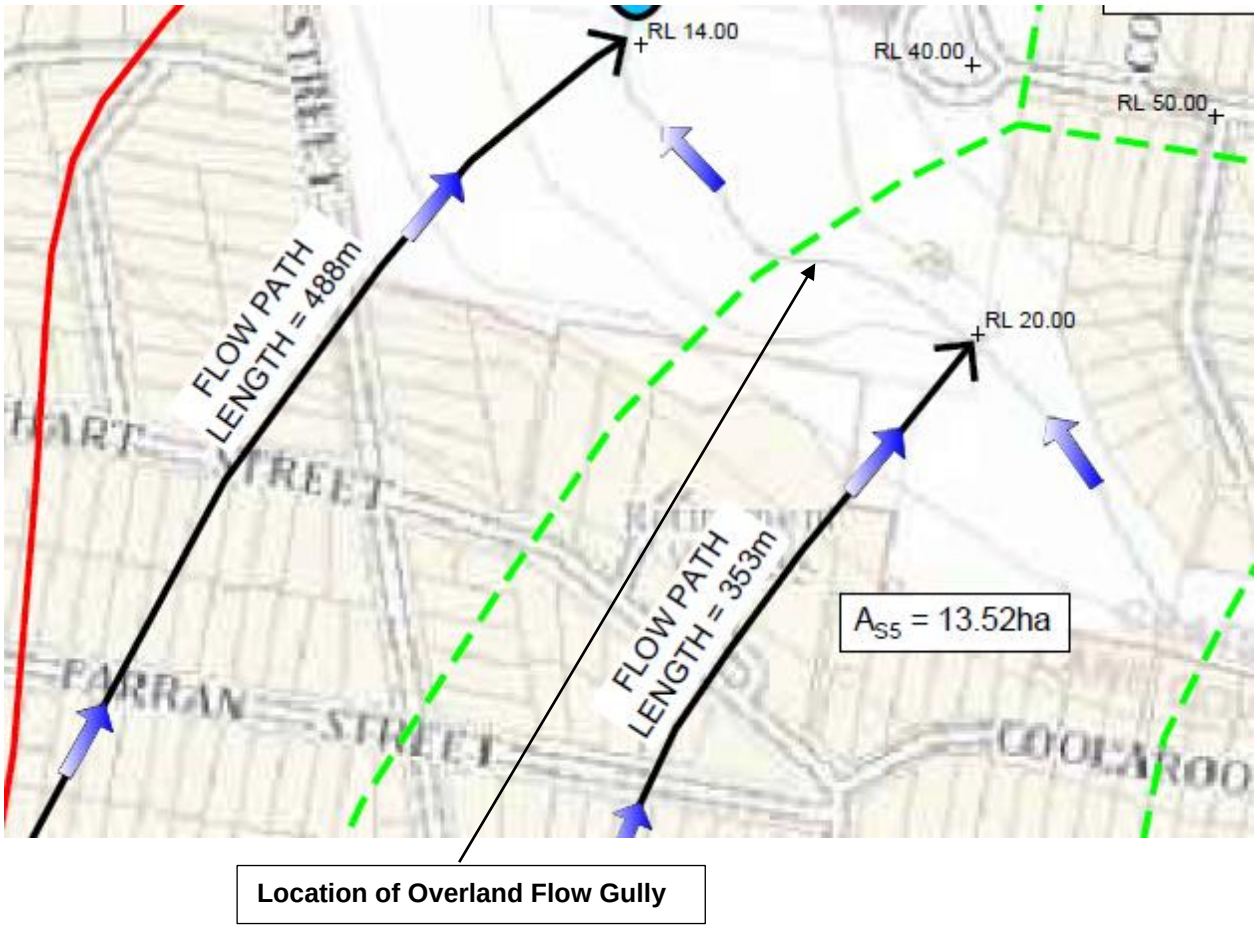


Figure 4:- Location of gully within the Golf Course

(Extract from Appendix A Drawing DA-C-0001)

The overflow from Beaconsfield Road is partially collected by the stormwater system on Beaconsfield Road which overflows into the gully as shown by the 100 Year ARI DRAINS model below. The remaining flood flow from the road continues into the proposed site with a peak flow of 1.73m³/s for the 20 minute duration and then continues downstream into the main creek corridor.

The Northern flow path follows the creek and collects upstream flow from Fullers road. This overflows into the golf course and then out to the river. The peak flow from the overflow into the golf course is 35.1m^3/s for the 2 hour duration.

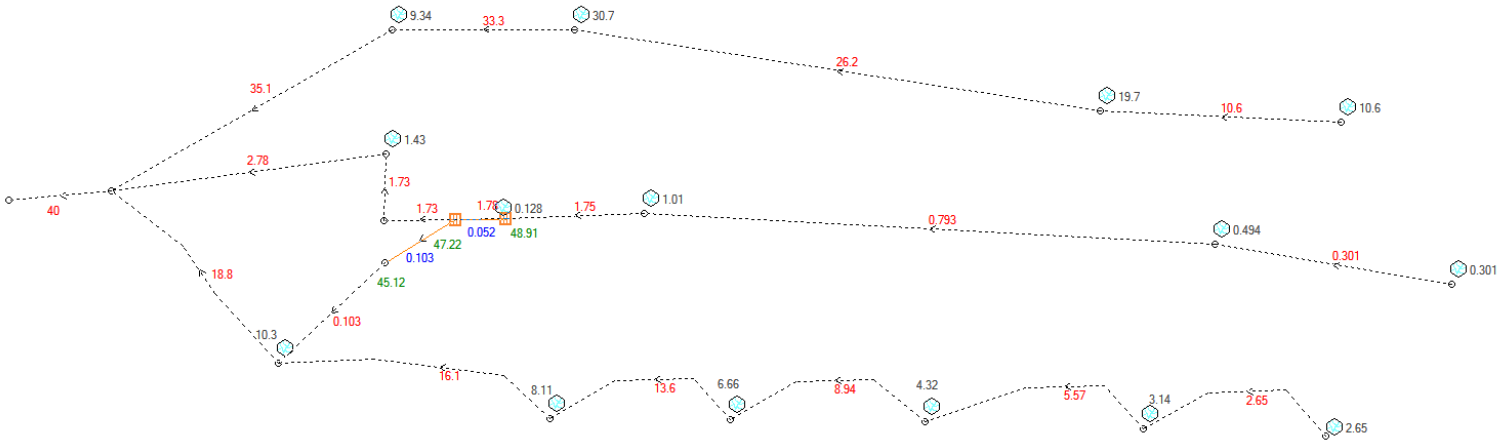


Figure 5: DRAINS Model for 100 Year Storm event

The following sections show the flood depth as noted;

Section AA is the overflow entering the golf course from the gully with maximum depth 0.88m, velocity 0.85m/s and maximum flow of 16.065m^3/s. See Figure 6 below for Section AA.

Section BB is the overflow of the creek towards the gully and river channel. The maximum depth for this section is 3.270m with velocity 0.65m/s and maximum flow 35.059m^3/s. See Figure 7 for Section BB.

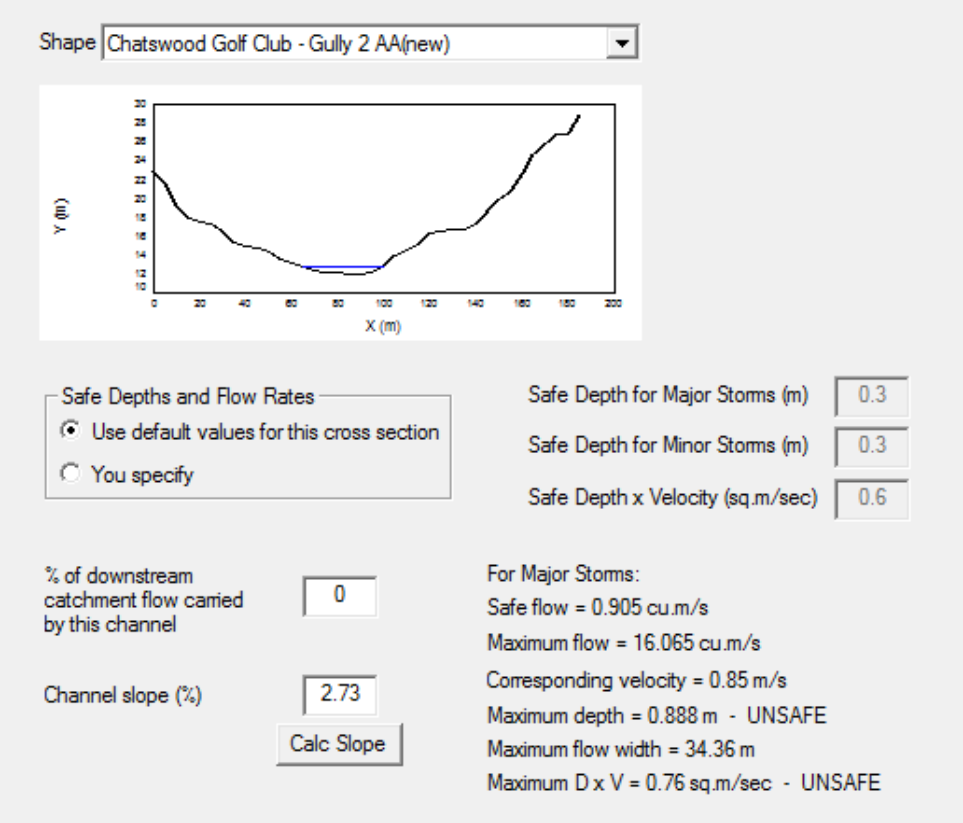


Figure 6: Section AA for 100 Year Storm event

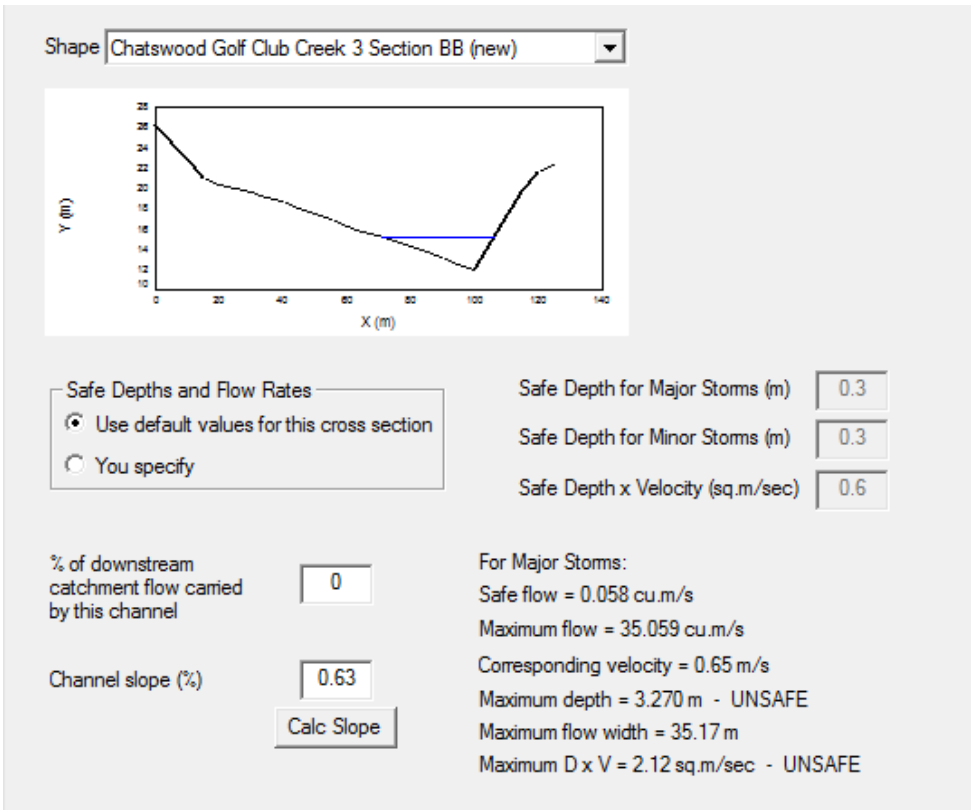


Figure 7: Section BB for 100 Year Storm event

4.0 FLOOD IMPACT ON FINISHED FLOOR LEVELS

The Flood Analysis model from DRAINS modelling software was completed for the existing condition.

The proposed mitigation measures include the following (Refer Appendix A Drawing DA-C-0002):-

- A surface inlet grade to be constructed across the end of Beaconsfield Road which will capture the full 100 Year ARI overflow. Sizing of the inlet will be subject to detailed design but at this stage the nominal may be 6m long by 1m wide by 1m deep, the location of the grating system is presented below on Figure 8.

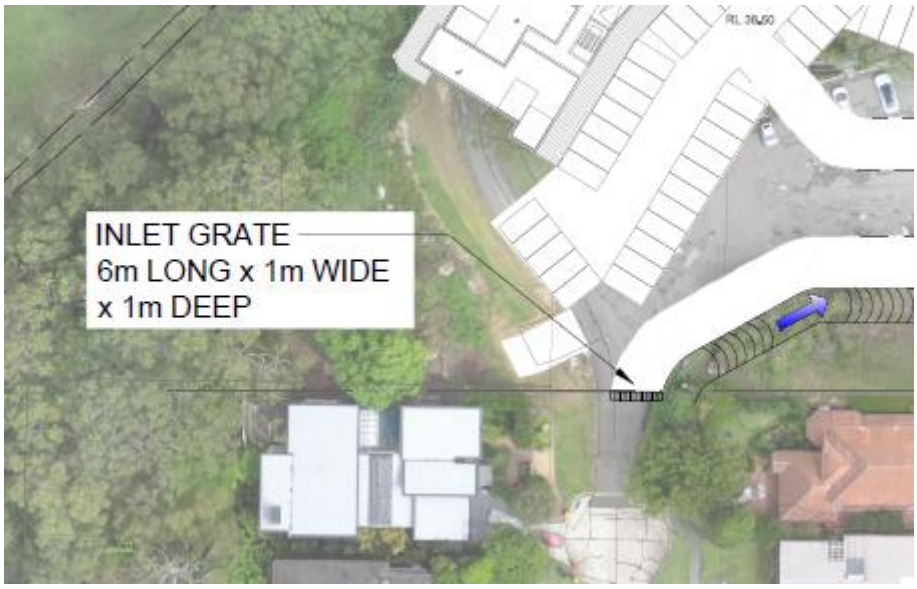


Figure 8:- Location Driveway Entry Inlet Grate to trap overland flow

- An overland flow diversion swale of 4m wide with 1(V):4(H) batters and 1m depth at the invert of the easement. Its purpose will be to divert overland flow from the adjacent residential properties. Diversion of flow will be around to the north of the Club House development. Refer to Figure 9 below.

Figure 9:- Location of Proposed Overland flow swale

The proposed mitigation measures will provide an appropriate mitigation against flooding of the proposed building development and will protect the proposed Finished Floors.

5.0 CONCLUSION

This Flood Analysis report for the proposed Chatswood Golf Club development has identified three overland flow corridors being :-

- The Beaconsfield Road and Colwell Crescent overland flow paths;
- The Northern flow path upstream of Fullers Road;
- A wider gully traversing the golf course immediately to the north of the temporary Golf Club and carpark.

The results of the analysis show that the site will be affected by overland flow emanating from Beaconsfield Road and the immediate upstream residential properties immediately to the east within Colwell Crescent.

The Flood Analysis model from DRAINS modelling software was completed for the existing condition. The proposed mitigation measures include the following (Refer Appendix A Drawing DA-C-0002):-

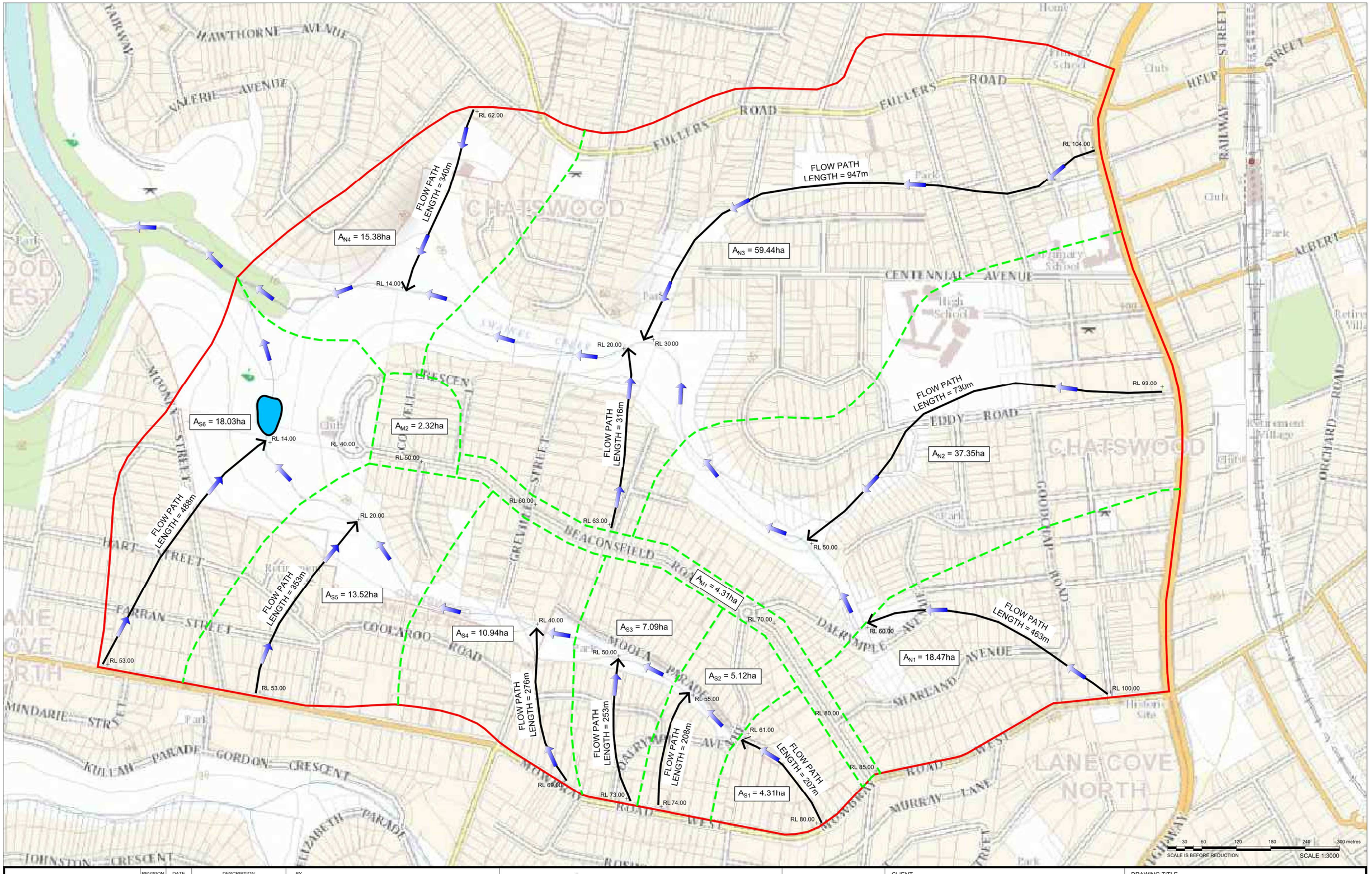
- A surface inlet grade to be constructed across the end of Beaconsfield Road which will capture the full 100 Year ARI overflow. Sizing of the inlet will be subject to detailed design but at this stage the nominal may be 6m long by 1m wide by 1m deep.
- An overland flow diversion swale of 4m wide with 1(V):4(H) batters and 1m depth at the invert of the easement. Its purpose will be to divert overland flow from the adjacent residential properties. Diversion of flow will be around to the north of the Club House development.

The Northern flow path follows the creek and collects upstream flow from Fullers road and overflows onto the norther edges of the golf course and then out to the river. The analysis demonstrates that there is no impact on the course or the building development and neither will the proposed buildings impact on the current natural flows. These flows are contained within the current creek and therefore there is no perceived additional risk to life and property.

To the south of the proposed building there is a natural gully traversing the golf course. The analysis shows that neither the new building nor the temporary building will affect these natural flows. The temporary building Finished Floor Levels will be set a minimum 500mm above the calculated overland flow levels.

APPENDIX A MARCHESE PARTNERS ENGINEERING DRAWINGS

- DA-C-0001 Upstream Catchment Analysis – Existing Condition
- DA-C-0002 Upstream Catchment Analysis – Proposed Ground Floor



IMPORTANT NOTES:

Do not scale from drawings. All dimensions to be checked on site before commencement of work. All discrepancies to be brought to the attention of the Architect. Larger scale drawings and written dimensions take preference. This drawing is copyright and the property of the author, and must not be retained, copied or used without the express authority of MARCHESE + PARTNERS INTERNATIONAL PTY. LTD.

SITE COMPATIBILITY CERTIFICATE

REVISION	DATE	DESCRIPTION	BY
A	26.04.17	SITE COMPATABILITY STATEMENT DRAFT ISSUE No.1	CA
B	01.05.17	FINAL ISSUE	CA
C	22.05.17	FINAL RE-ISSUE	CA

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TN MN

CLIENT
CHATSWOOD GOLF CLUB

PROJECT
STORMWATER DRAINAGE
128 BEACONSFIELD ROAD,
CHATSWOOD, NSW, 2067

DRAWING TITLE
CHATSWOOD GOLF CLUB
UPSTREAM CATCHMENT ANALYSIS
EXISTING CONDITION

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:3000	April 18, 2017	CA	LP

JOB	DRAWING	REVISION
2017-1040	DA-C-0001	C

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PROJECT
STORMWATER DRAINAGE
128 BEACONSFIELD ROAD,
CHATSWOOD, NSW, 2067

DRAWING TITLE
CHATSWOOD GOLF CLUB
UPSTREAM CATCHMENT ANALYSIS
PROPOSED GROUND FLOOR

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:500	April 18, 2017	CA	LP
JOB	DRAWING		REVISION
2017-1040	DA-C-0002		C

APPENDIX B DRAINS FLOOD ANALYSIS

- DRAINS 1 Node Diagram – Existing Condition
- DRAINS 2 100 Year Storm – Existing Condition
- DRAINS 3 Results Data Sheet

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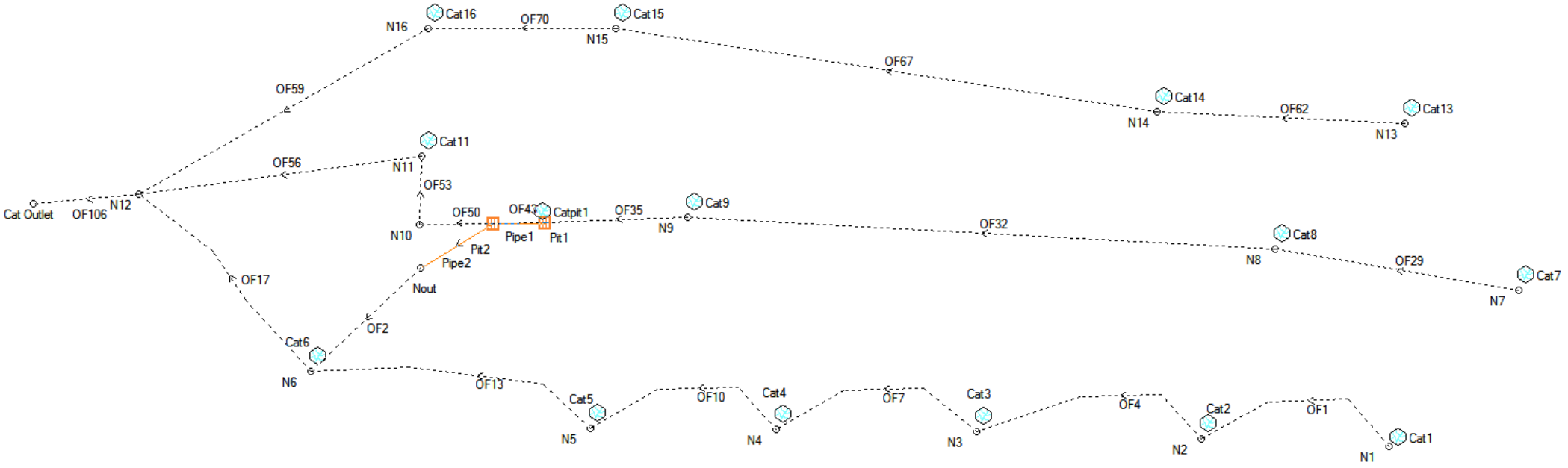

DRAINS 1 - DRAINS Model Node Diagram – Existing Condition

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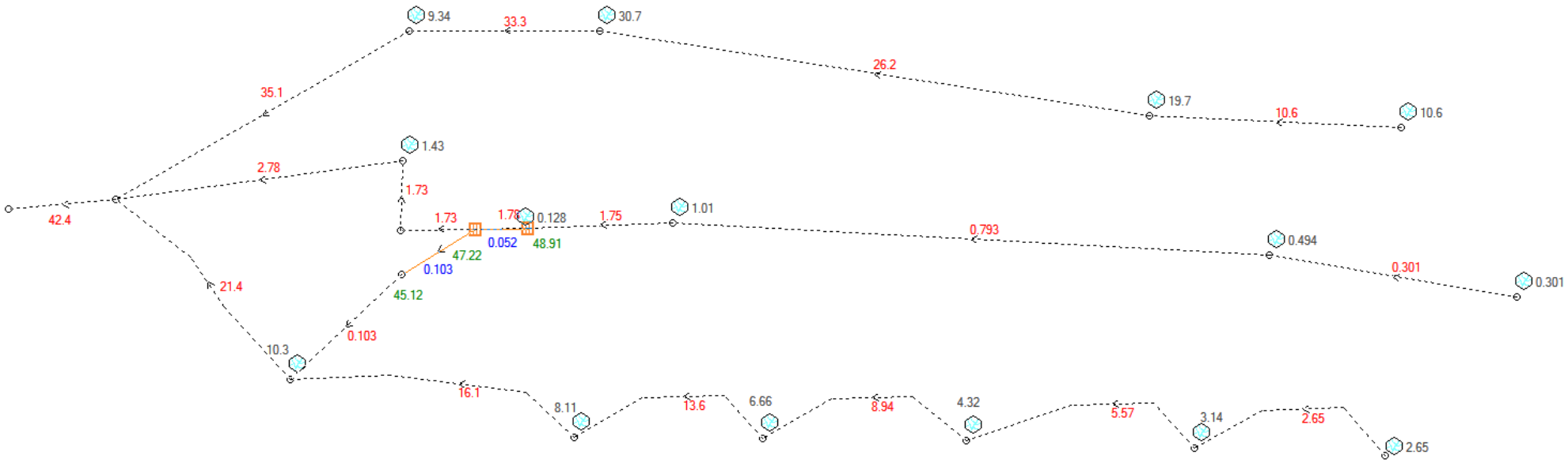

DRAINS 2 - DRAINS Model for 100 Year Storm – Existing Condition

DRAINS results prepared from Version 2016.10

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit1	48.91		1.852		0.75	1.781	Inlet Capacity
Pit2	47.22		1.781		1.09	1.73	Inlet Capacity
Nout	45.12		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Cat1	2.649	2.649	0	8.73	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat2	3.145	3.145	0	8.76	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat3	4.32	4.32	0	9.23	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat5	8.109	8.109	0	10.12	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat4	6.659	6.659	0	9.32	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat6	10.251	10.251	0	11.53	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat7	0.301	0.301	0	8.41	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat8	0.494	0.494	0	9.38	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat9	1.012	1.012	0	14.64	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat11	1.425	1.425	0	8.74	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat13	10.636	10.636	0	11.16	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat14	19.7	19.7	0	14.12	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat15	30.685	30.685	0	14.75	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Cat16	9.344	9.344	0	9.43	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
Catpit1	0.128	0.128	0	6.91	5	5	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1

Outflow Volumes for Total Catchment (195 impervious + 0.00 pervious = 195 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm	42341	40386.93 (95.4%)	40386.93 (95.4%)	0.00 (0.0%)
AR&R 100 year, 10 minutes storr	66442.8	64488.67 (97.1%)	64488.67 (97.1%)	0.00 (0.0%)
AR&R 100 year, 20 minutes storr	100967	99012.84 (98.1%)	99012.84 (98.1%)	0.00 (0.0%)
AR&R 100 year, 30 minutes storr	126045.9	124091.59 (98.4%)	124091.59 (98.4%)	0.00 (0.0%)
AR&R 100 year, 1 hour storm, av	175877.98	173923.73 (98.9%)	173923.73 (98.9%)	0.00 (0.0%)
AR&R 100 year, 2 hours storm, a	236461.44	234505.83 (99.2%)	234505.83 (99.2%)	0.00 (0.0%)
AR&R 100 year, 3 hours storm, a	277892.09	275936.97 (99.3%)	275936.97 (99.3%)	0.00 (0.0%)
AR&R 100 year, 6 hours storm, a	363481.22	361530.41 (99.5%)	361530.41 (99.5%)	0.00 (0.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	0.052	3.16	48.815	47.575	AR&R 100 year, 5 minutes storm, average 260 mm/h, Zone 1
Pipe2	0.103	3.77	47.093	45.123	AR&R 100 year, 6 hours storm, average 31.0 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF1	2.649	2.649	1.566	0.366	0.32	13.66	0.86	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF4	5.573	5.573	1.267	0.549	0.53	15.49	0.97	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF7	8.942	8.942	1.732	0.59	0.83	15.9	1.4	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF13	16.065	16.065	8.891	0.428	0.4	41.25	0.92	AR&R 100 year, 30 minutes storm, average 129 mm/h, Zone 1
OF10	13.65	13.65	1.142	0.873	1.06	18.73	1.21	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF17	21.428	21.428	2.555	1.079	1.02	22.02	0.94	AR&R 100 year, 2 hours storm, average 60.5 mm/h, Zone 1
OF106	42.423	42.423	0.432	1	3.54	20	3.54	AR&R 100 year, 2 hours storm, average 60.5 mm/h, Zone 1
OF29	0.301	0.301	0.944	0.178	0.39	4.31	2.16	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF32	0.793	0.793	1.341	0.218	0.45	6.91	2.05	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF35	1.747	1.747	0.568	0.265	1.1	4.19	4.14	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF53	1.73	1.73	0.59	0.439	0.99	3.51	2.25	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF56	2.778	2.778	1.136	0.419	0.17	33.54	0.4	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF62	10.636	10.636	8.668	0.338	0.12	92.52	0.36	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF67	26.189	26.189	8.22	0.591	0.29	101.88	0.49	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF70	33.299	33.299	4.922	0.925	0.42	88.5	0.45	AR&R 100 year, 2 hours storm, average 60.5 mm/h, Zone 1
OF59	35.059	35.059	7.62	0.74	0.43	89.79	0.58	AR&R 100 year, 2 hours storm, average 60.5 mm/h, Zone 1
OF43	1.781	1.781	1.295	0.154	0.79	2.94	5.13	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF50	1.73	1.73	0.558	0.187	0.74	5.27	3.94	AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1
OF2	0.103	0.103	1.418	0.066	0.05	2.26	0.74	AR&R 100 year, 6 hours storm, average 31.0 mm/h, Zone 1

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 155 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N1	2183.73	2183.73	0	0
N2	4777.87	4777.87	0	0
N3	8370.14	8370.13	0	0
N5	20763.2	20763.2	0	0
N4	13913.06	13913.07	0	0
N6	30091.61	30091.6	0	0
N12	98846.25	98838.59	0	0
N7	246.75	246.75	0	0
N8	658.67	658.67	0	0
N9	1646.67	1646.67	0	0
N10	1554.81	1554.81	0	0
N11	2730.28	2730.28	0	0
N13	9358.14	9358.14	0	0
N14	28282.13	28282.12	0	0
N15	58398.36	58398.43	0	0
N16	66191	66190.95	0	0
Pit1	1748	1748.02	0	0
Pit2	1748.02	1748.02	0	0
Nout	193.21	193.21	0	0
Cat Outlet	98417.74	98417.74	0	0

Run Log for 2017 run at 14:52:09 on 24/4/2017

No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow in the following overflow routes is unsafe: OF106, OF70, OF67, OF62, OF59, OF56, OF50, OF43, OF35, OF17, OF13, OF10, OF7, OF4, OF1