Barrenjoey Consulting Engineers pty ltd
Stormwater Structural Civil
abn 13124694917 acn 124694917

WHALE BEACH
NEIGHBOURHOOD CENTRE
231 WHALE BEACH RD WHALE BEACH

STORMWATER ASSET
RELOCATION INVESTIGATION & REPORT
Job No 190210

PO Box 672 Avalon NSW 2107
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Introduction

In association with a proposed commercial / residential development at No 231 Whale Beach Rd Whale Beach (refer plans by Richard Cole Architects) Barrenjoey Consulting Engineers p/l (BCE) have been commissioned to investigate Northern Beaches Councils stormwater assets (and associated issues) as identified in the pre-lodgement meeting (PLM 2019/0015 7th February 2019).

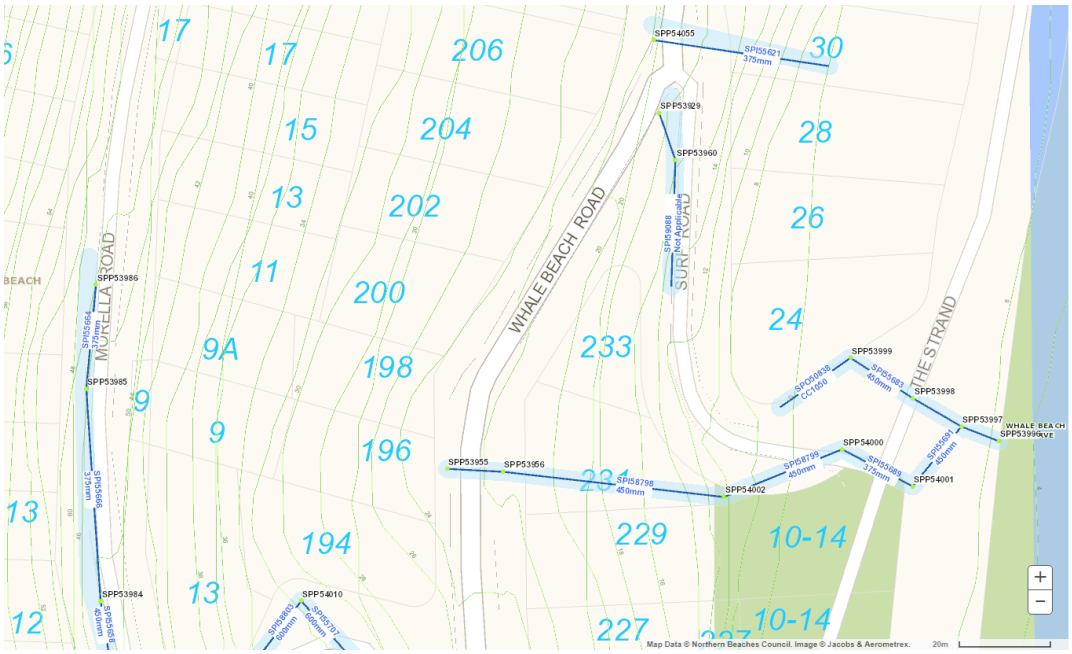
The areas topography result in a natural depression in Whale Beach Rd immediately adjacent to No 231, this depression contains conventional stormwater assets, kerb inlet pits and pipes. The system continues through No 231 with a 450 RCP pipe along the southern boundary (with no established easement).

BCE have been commissioned to design and detail the relocation of Councils existing stormwater asset (450 dia RCP) from the sites southern boundary to along Whale Beach Rd / Surf Rd and to manage potential overland flow (from Whale Beach Rd) through No 231 (see the *Whale Beach Rd Stormwater Infrastructure Works* plans SW1 and SW2 reduced copies attached).

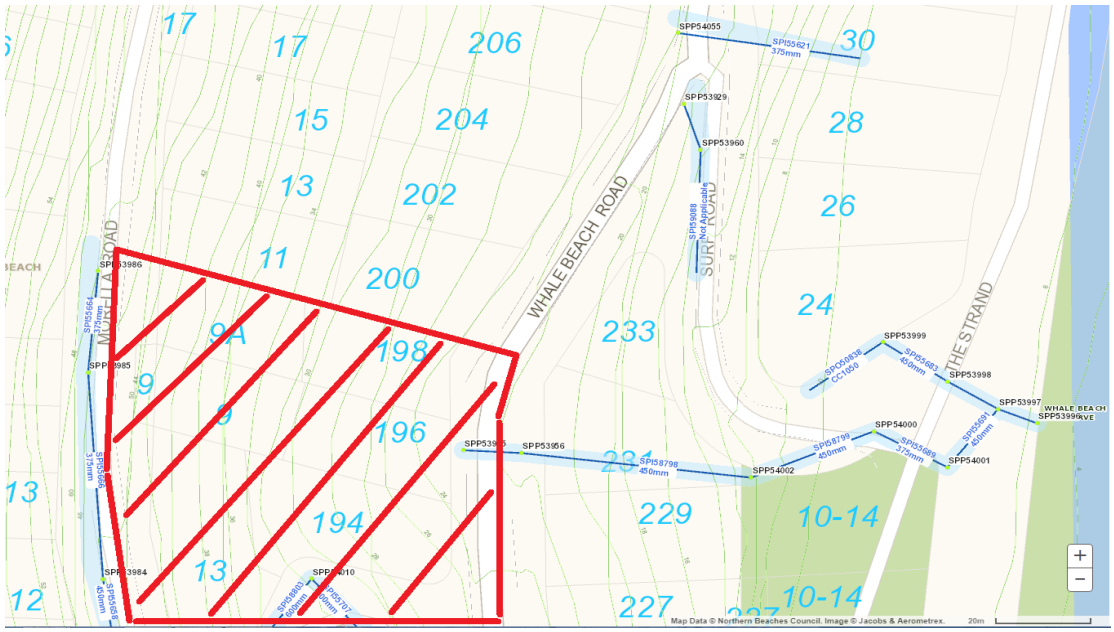
BCE prepared a Preliminary Stormwater Asset Relocation Investigation & Report (dated 29 05 2019) for Council submission and review, this revised Report incorporates Councils comments and requirements (see email dated .01/07/2019 attached).

Natural depression in Whale Beach Rd adjacent to No 231

Hydrologic / Hydraulic Analysis



Existing Infrastructure layout
(Northern Beaches Council Planning Maps)



Catchment extents
(Northern Beaches Council Planning Maps)

Catchment area	- 6300m2 (as confirmed during a significant rainfall event on the 9th Feb 2020) extending west to Morella Rd extending south to Surf Rd / Whale Beach Rd intersection Extending north to a crest on Whale Beach Rd	
DRAINS analysis (see attached results data)	5% AEP Event	1% AEP Event
<u>Pre - development</u>		
Total flow	- 352 l/s	- 432 l/s
Flow into pipe system (allowing for 50% pit blockage)	- 230 l/s	- 232 l/s
Overland flow thru No 231	- 120 l/s	- 204 l/s
<u>Post - development</u>		
Total flow	- 352 l/s	- 432 l/s
Flow into pipe system (allowing for 50% pit blockage)	- 316 l/s	- 366 l/s
Overland flow thru No 231	- 32 l/s	- 60 l/s

<u>Overland Flow Hydraulic Analysis</u>

It is to be noted that the behaviour of the catchments extent / overland flows was observed during a significant rainfall event on the 9th Feb 2020.

Pre development

Flows generated by the catchment will concentrate in the western kerb and gutter of Whale Beach Rd (170mm depth), south of No 231 in the proximity of the Surf Rd Intersection.
As the flows move north along Whale Beach Rd they will exceed the western kerb and gutter capacity and extend into the eastern kerb and gutter of Whale Beach Rd, eventually exceeding both kerb and gutter capacities and spilling (in part) over the eastern road verge into No 229 Whale Beach Rd.
It is to be noted that for the purposes of this study (and conservative analysis) it is assumed all overland flows are directed to the sag point adjacent to No 231 Whale Beach Rd.
Flows along the western side of Whale Beach Rd will be collected into the piped system by a conventional kerb inlet pit, as this pits capacity is exceeded flows will crest the

centreline of Whale Beach Rd (120mm depth) and pond adjacent to the kerb inlet pit on the eastern side of the road immediately adjacent to No 231.
Flow will crest the kerb/ footpath (180mm depth) and spread (30mm depth) across the concreted area in front of the building at No231, the majority of flow falling to the southern boundary of No 231, though some flows will enter the building at No 231.
It is to be noted that for the purposes of this study (and conservative analysis) it is assumed all overland flows are directed to the southern boundary of No 231.
Flows will disperse into the front garden area of No's 229 and down the side access stair of No 231.
Flows will travel along the common boundary of No 229 / 231 (130mm / 40mm / 110mm depth) before spreading across the Council Reserve (30mm depth) below the site fronting The Strand / Whale Beach carpark.

Post development

Flows generated by the catchment will concentrate in the western kerb and gutter of Whale Beach Rd (170mm depth), south of No 231 in the proximity of the Surf Rd Intersection.
As the flows move north along Whale Beach Rd they will exceed the western kerb and gutter capacity and extend into the eastern kerb and gutter of Whale Beach Rd, eventually exceeding both kerb and gutter capacities and spilling over the eastern road verge into No 299 Whale Beach Rd (190mm depth).
It is to be noted that for the purposes of this study (and conservative analysis) it is assumed all overland flows are directed to the sag point adjacent to No 231 Whale Beach Rd.
Flows on the western side of Whale Beach Rd will be collected into the piped system by a conventional kerb inlet pit, as this pits capacity is exceeded flows will crest the centreline of Whale Beach Rd (120mm depth) and pond adjacent to the kerb inlet pit on the eastern side of the road immediately adjacent to No 231 (140mm depth). This pit system is to be significantly upgraded (2x2.4m lintel pits) to ensure greater capture of surface flows and to direct these flows into the new piped system.
Remaining flow will crest the kerb/ footpath and spread across the concreted area in front of the building at No231, with a new sunken area constructed to guide all flows (40mm depth) to the southern boundary of No 231.
A 600x600mm overland flow path is to be constructed along the southern boundary of No 231 to convey all flows (90mm / 30mm depth) along this boundary before allowing the flow to spread across the Council Reserve (30mm depth) below the site fronting The Strand / Whale Beach carpark.

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Asset Relocation Proposal

It is proposed to decommission the existing pipe through No 231 with a new pipe (450 dia RCP tbc) to be laid along Whale Beach Rd to / down Surf Rd and reconnecting with the existing infrastructure below the site (within the Whale Beach carpark area).

The new system is to be designed and constructed (with increased inlet pit/s) to collect and convey runoff flows generated by a 5% AEP storm event. Noting this will be a significantly greater system capacity than that currently in place and thus significantly reducing overland flows entering the development site, the neighbouring property (No 229 Whale Beach Rd) and being conveyed across the lower Council Reserve

Overland flows generated by larger storm events (1% AEP) and/or system blockages are to be addressed by the construction of a culvert / overland flow path along the southern boundary of No 231. Noting the design proposal ensures significant reduction in overland flows entering the neighbouring property (No 229 Whale Beach Rd) and being conveyed across the lower Council Reserve

See attached results data from *DRAINS* and *HECRAS* analysis of the predevelopment and post development systems (for detailed review refer to supplied electronic data).

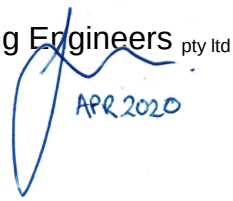
Summary

It is our opinion that the improved collection system, relocation of Councils asset along Whale Beach / Surf Rd and control of potential overland flows through No 231 can be achieved with the implementation of conventional drainage infrastructure as detailed in the plans issued by this office, noting the implementation of these works will significantly decrease the potential for flood conveyance to No229 Whale Beach Rd and the Council Reserve fronting The Strand.

It is to be noted that, due to the many complex factors that can affect a site, the subjective nature of a risk analysis, and the imprecise nature of the science of flood analysis, the risk of persons being injured, to life and property cannot be completely removed. The recommendations within this Report do not remove the risk associated with the predicted flooding event, though lower those risks to an acceptable level reasonably anticipated by the community in everyday life.

Should further information regarding this matter be required please contact our office as outlined below.

Regards
Barrenjoey Consulting Engineers pty ltd
per
Lucas Molloy (Director)
BE CPEng NER



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EXISTING INFRASTUCTURE

No 231 Whale Beach Rd
Existing kerb inlet pit etc - 1

No 231 Whale Beach Rd
Existing kerb inlet pit etc - 2

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WHALE BEACH ROAD STORMWATER
INFRASTRUCTURE WORKS
(plans by Barrenjoey
Consulting Engineers pty ltd)

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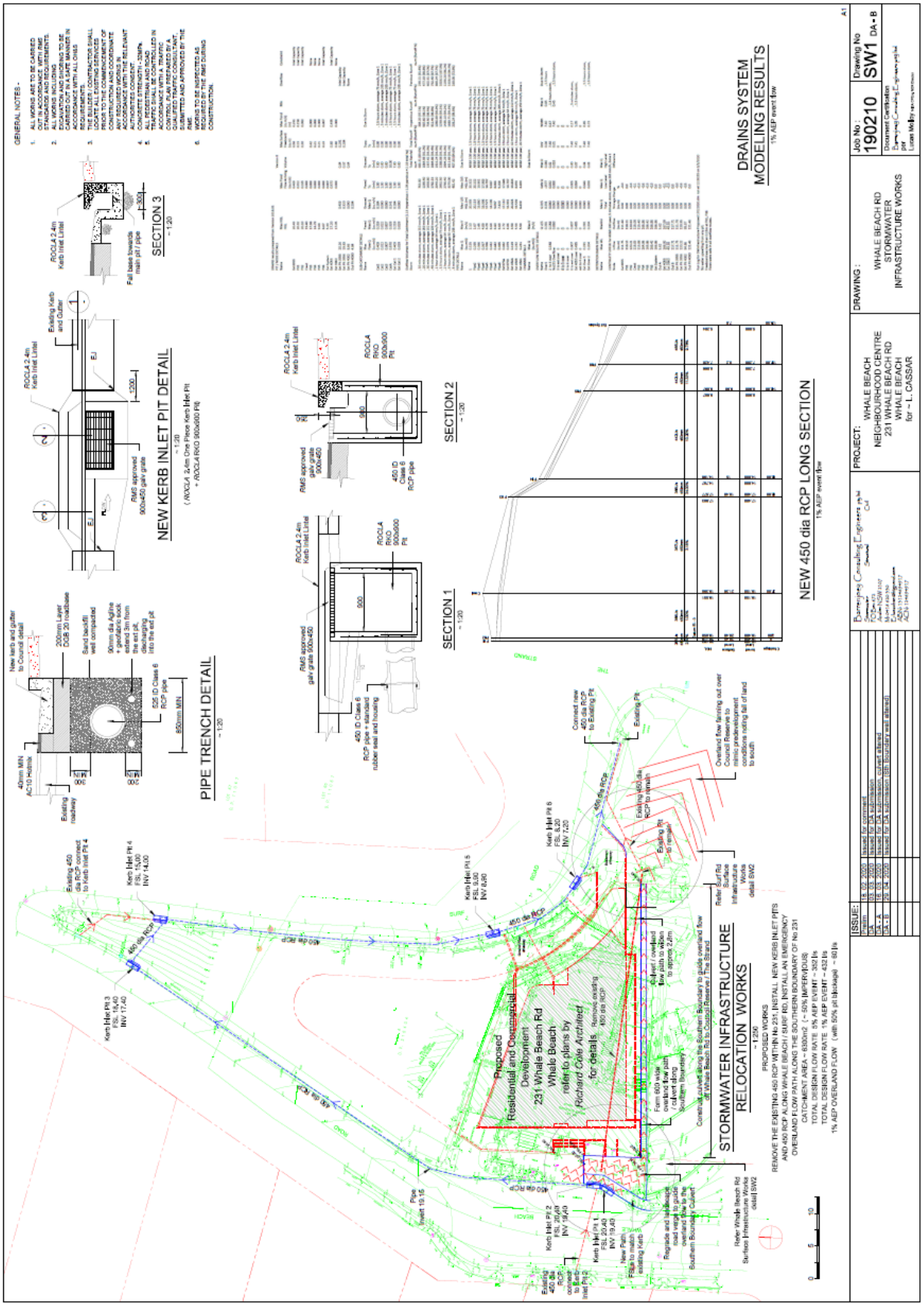

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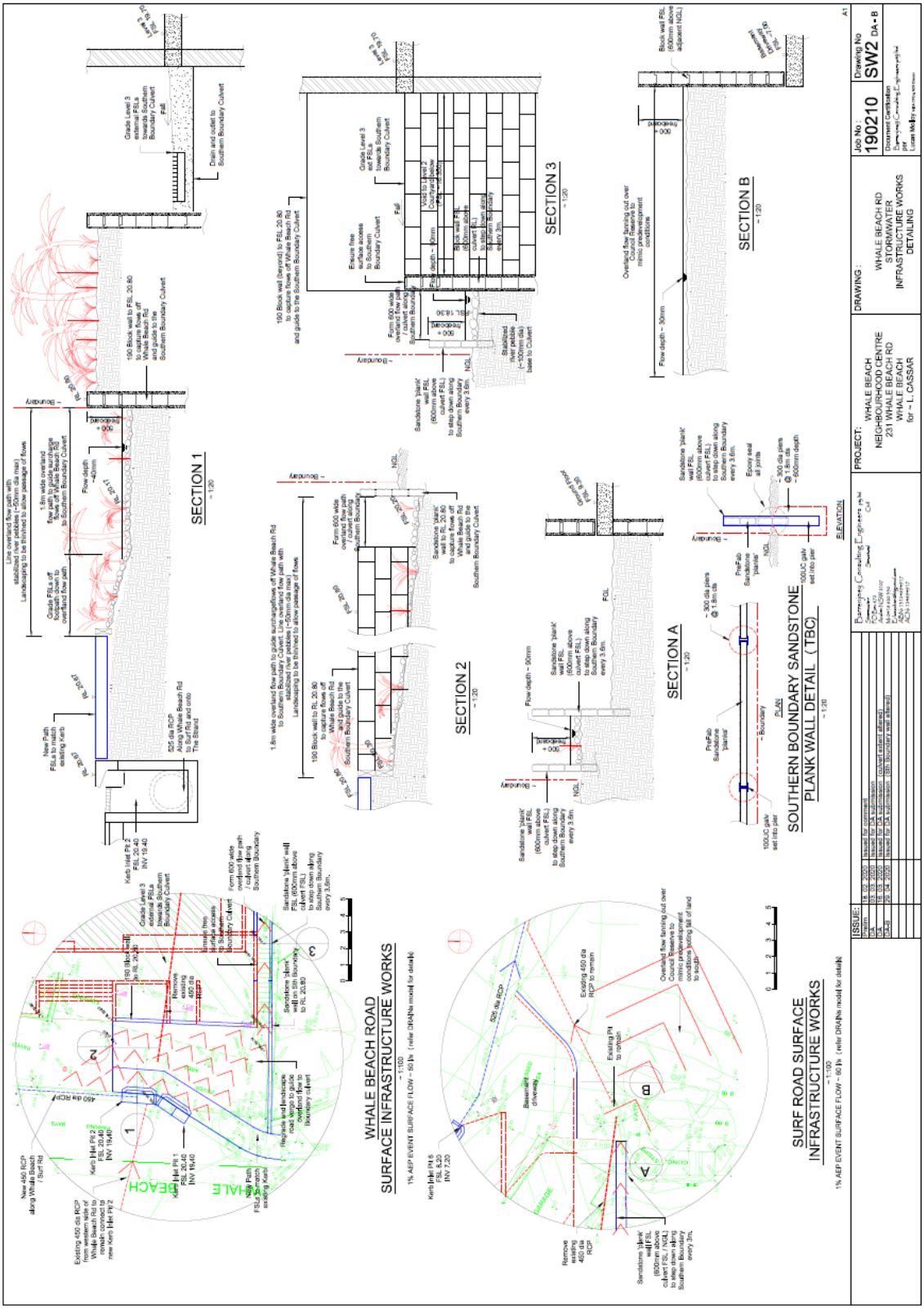

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DRAINS MODELING RESULTS
(by Barrenjoey
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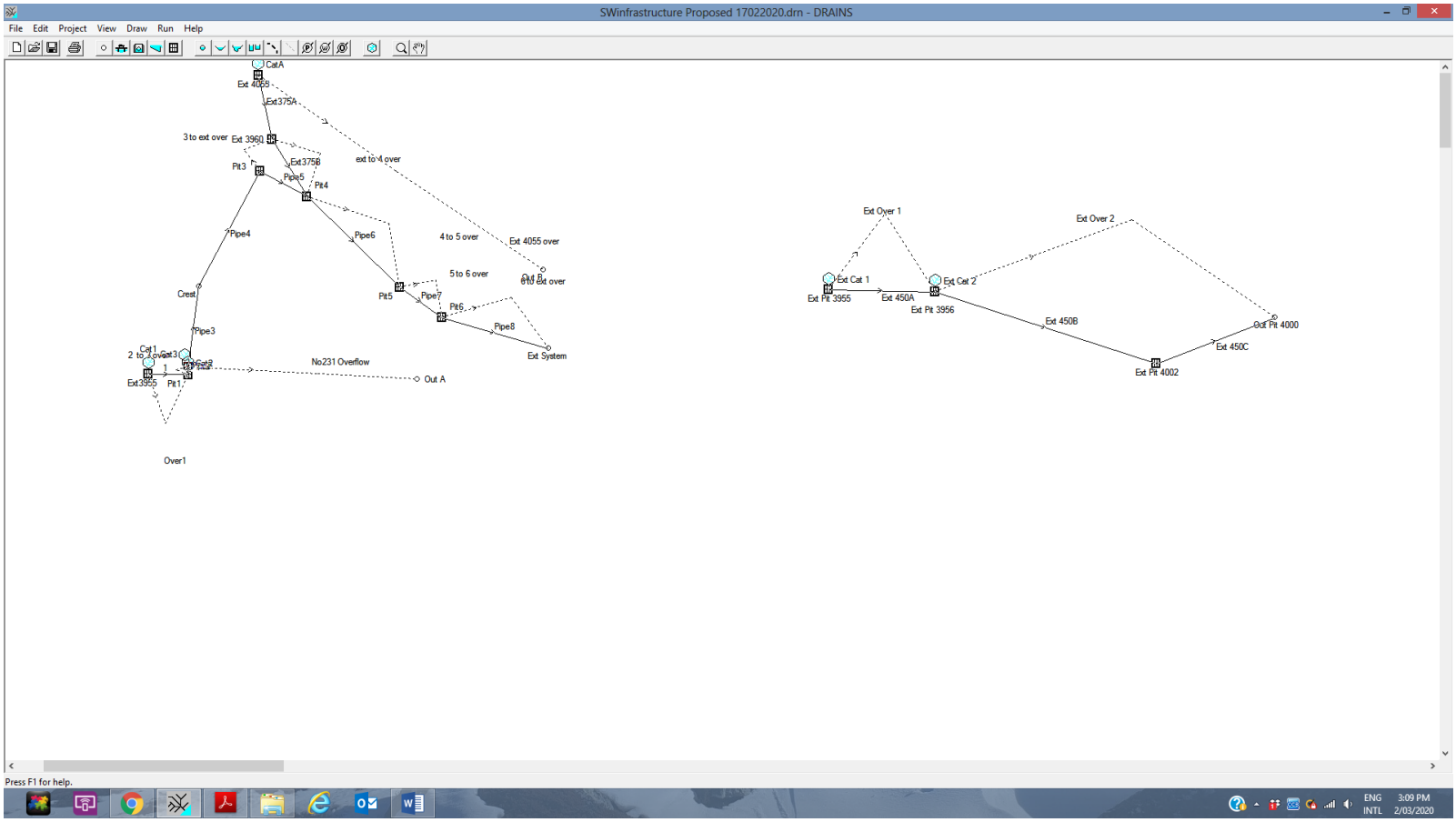

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DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Version 8 Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Ext3955	20.43		0.403		0.58	0.291	Inlet Capacity
Pit1	20.32		0.312		0.13	0.158	Inlet Capacity
Pit2	20.10		0.165		0.30	0.060	Inlet Capacity
Crest	19.40		0.000				
Pit3	17.98		0.000		0.42	0.000	None
Pit4	14.79		0.000		0.21	0.000	None
Pit5	9.69		0.000		0.21	0.000	None
Pit6	8.07		0.000		0.13	0.007	Inlet Capacity
Ext System	5.20		0.007				
Ext 4055	17.20		0.570		0.80	0.495	Inlet Capacity
Ext 3960	17.05		0.000		0.80	0.000	None
Ext Pit 3955	20.16		0.403		0.84	0.291	Inlet Capacity
Ext Pit 3956	19.83		0.320		0.57	0.204	Inlet Capacity
Ext Pit 4002	8.66		0.000		0.64		None
Out Pit 4000	4.84		0.204				

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	0.403	0.219	0.184	1.00	7.00	0.00	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Cat2	0.022	0.022	0.000	1.00	0.00	0.00	AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1
Cat3	0.007	0.007	0.000	1.00	0.00	0.00	AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1
CatA	0.570	0.329	0.241	5.00	10.00	0.00	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Ext Cat 1	0.403	0.219	0.184	1.00	7.00	0.00	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Ext Cat 2	0.029	0.029	0.000	1.00	0.00	0.00	AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.13 impervious + 1.05 pervious = 2.18 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, 10 minutes storm, average 210 mm/h, Zone 1	763.00	683.31 (89.6%)	384.20 (97.1%)	299.11 (81.4%)		
AR&R 100 year, 20 minutes storm, average 159 mm/h, Zone 1	1155.40	1064.93 (92.2%)		587.60 (98.1%)	477.33 (85.8%)	
AR&R 100 year, 30 minutes storm, average 132 mm/h, Zone 1	1438.80	1337.41 (93.0%)		734.50 (98.5%)	602.91 (87.0%)	
AR&R 100 year, 45 minutes storm, average 109 mm/h, Zone 1	1782.15	1664.86 (93.4%)		912.46 (98.8%)	752.40 (87.7%)	
AR&R 100 year, 1 hour storm, average 94 mm/h, Zone 1	2049.20	1916.24 (93.5%)		1050.89 (98.9%)		865.34 (87.7%)
AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1	2452.50	2288.08 (93.3%)		1259.96 (99.1%)		1028.12 (87.0%)
AR&R 100 year, 2 hours storm, average 64 mm/h, Zone 1	2790.40	2594.29 (93.0%)		1435.10 (99.2%)		1159.20 (86.2%)
AR&R 100 year, 3 hours storm, average 50 mm/h, Zone 1	3270.00	3011.89 (92.1%)		1683.71 (99.3%)		1328.18 (84.3%)
AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1	481.42	407.30 (84.6%)	238.24 (95.5%)	169.06 (72.9%)		

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
1	0.125	2.10	20.335	20.322	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe2	0.265	1.67	20.119	20.102	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe3	0.366	2.45	19.850	19.551	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe4	0.367	4.09	19.398	17.983	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe5	0.366	6.29	17.577	14.787	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe6	0.442	6.64	14.196	9.687	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe7	0.442	6.60	9.097	8.066	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Pipe8	0.465	6.63	7.420	5.204	AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1
Ext375A	0.082	2.72	17.110	17.046	AR&R 100 year, 3 hours storm, average 50 mm/h, Zone 1
Ext375B	0.079	4.06	16.931	14.787	AR&R 100 year, 2 hours storm, average 64 mm/h, Zone 1
Ext 450A	0.119	3.59	20.028	19.834	AR&R 100 year, 10 minutes storm, average 210 mm/h, Zone 1
Ext 450B	0.232	5.53	19.539	8.659	AR&R 100 year, 1 hour storm, average 94 mm/h, Zone 1
Ext 450C	0.231	5.53	8.439	4.839	AR&R 100 year, 20 minutes storm, average 159 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
Over1	0.291	0.291	132.000	0.046	0.04	7.40	0.85	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
2 to 3 over	0.158	0.158	0.000	0.032	0.02	7.40	0.67	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
No231 Overflow	0.060	0.060	675.000	0.018	0.01	7.40	0.45	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
3 to ext over	0	0	-52882767872.000		0	0	0	0
4 to 5 over	0	0	0.000	0	0	0	0	
5 to 6 over	0	0	0.000	0	0	0	0	
6 to ext over	0.007	0.007	0.000	0.005	0.00	7.40	0.17	AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1
Ext 4055 over	0.495	0.495	0.000	0.064	0.07	7.41	1.05	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
ext to 4 over	0	0	0.000	0	0	0	0	
Ext Over 1	0.291	0.291	0.000	0.046	0.04	7.40	0.85	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1
Ext Over 2	0.204	0.204	0.000	0.038	0.03	7.40	0.73	AR&R 100 year, 1.5 hours storm, average 75 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 100 year, 5 minutes storm, average 265 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Ext3955	111.75	111.80	0.00	-0.0
Pit1	118.13	118.11	0.00	0.0
Pit2	120.21	120.64	0.00	-0.4
Crest	115.03	115.08	0.00	-0.1
Pit3	115.08	115.40	0.00	-0.3
Pit4	164.95	165.86	0.00	-0.6
Pit5	165.86	166.42	0.00	-0.3
Pit6	166.42	166.86	0.00	-0.3
Ext System	166.86	166.86	0.00	0.0
Out A	5.62	5.62	0.00	0.0
Ext 4055	166.92	167.09	0.00	-0.1
Ext 3960	49.38	49.55	0.00	-0.3
Out B	117.71	117.71	0.00	0.0
Ext Pit 3955	111.75	111.78	0.00	-0.0
Ext Pit 3956	120.22	120.95	0.00	-0.6
Ext Pit 4002	94.86	95.37	0.00	-0.5
Out Pit 4000	121.46	121.46	0.00	0.0

Run Log for SWinfrastructure Proposed 17022020.drn run at 16:02:10 on 2/3/2020
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit1, Pit6
Flows were safe in all overflow routes.

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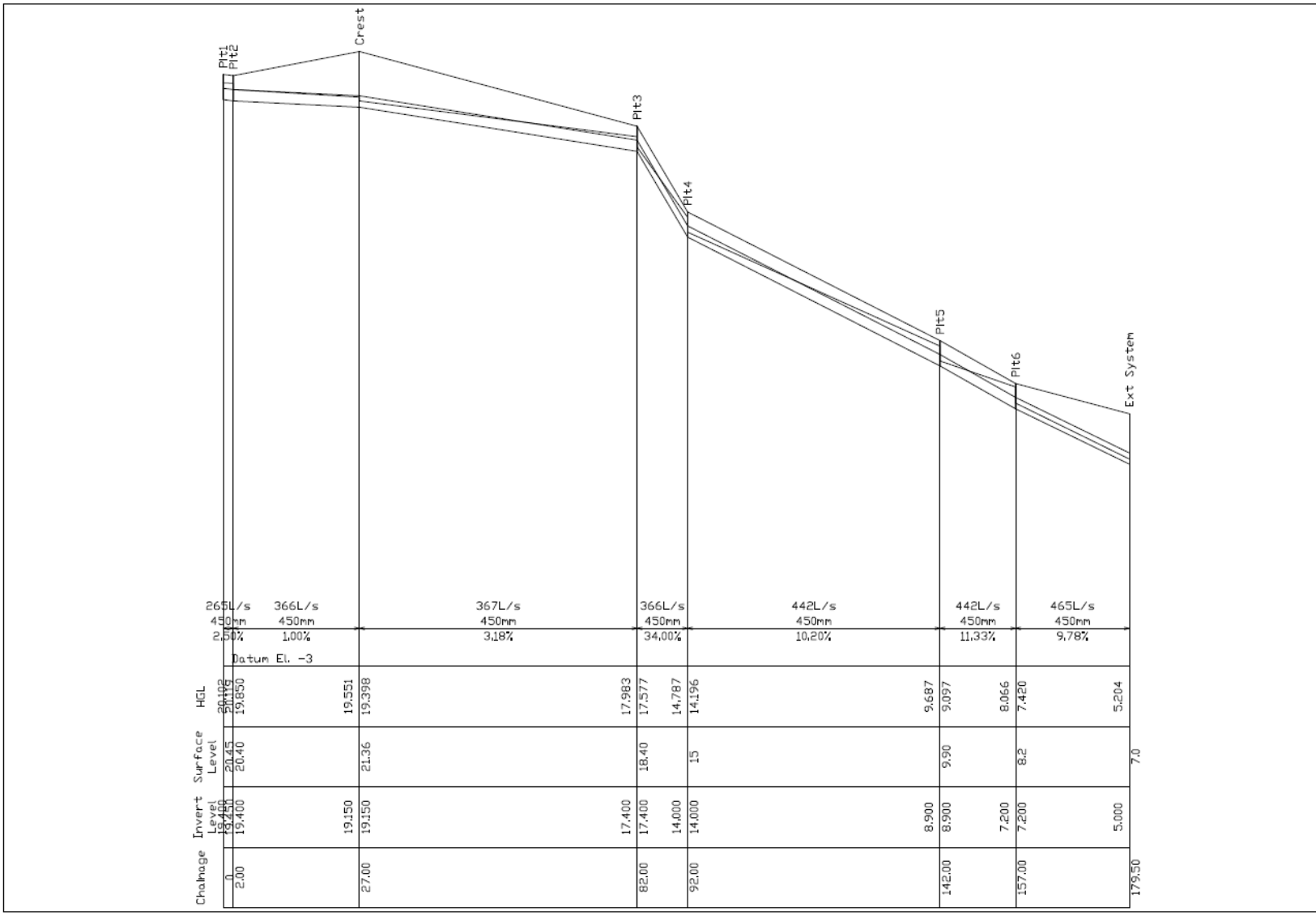

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HEC RAS MODELING RESULTS
(by Barrenjoey
Consulting Engineers pty ltd)

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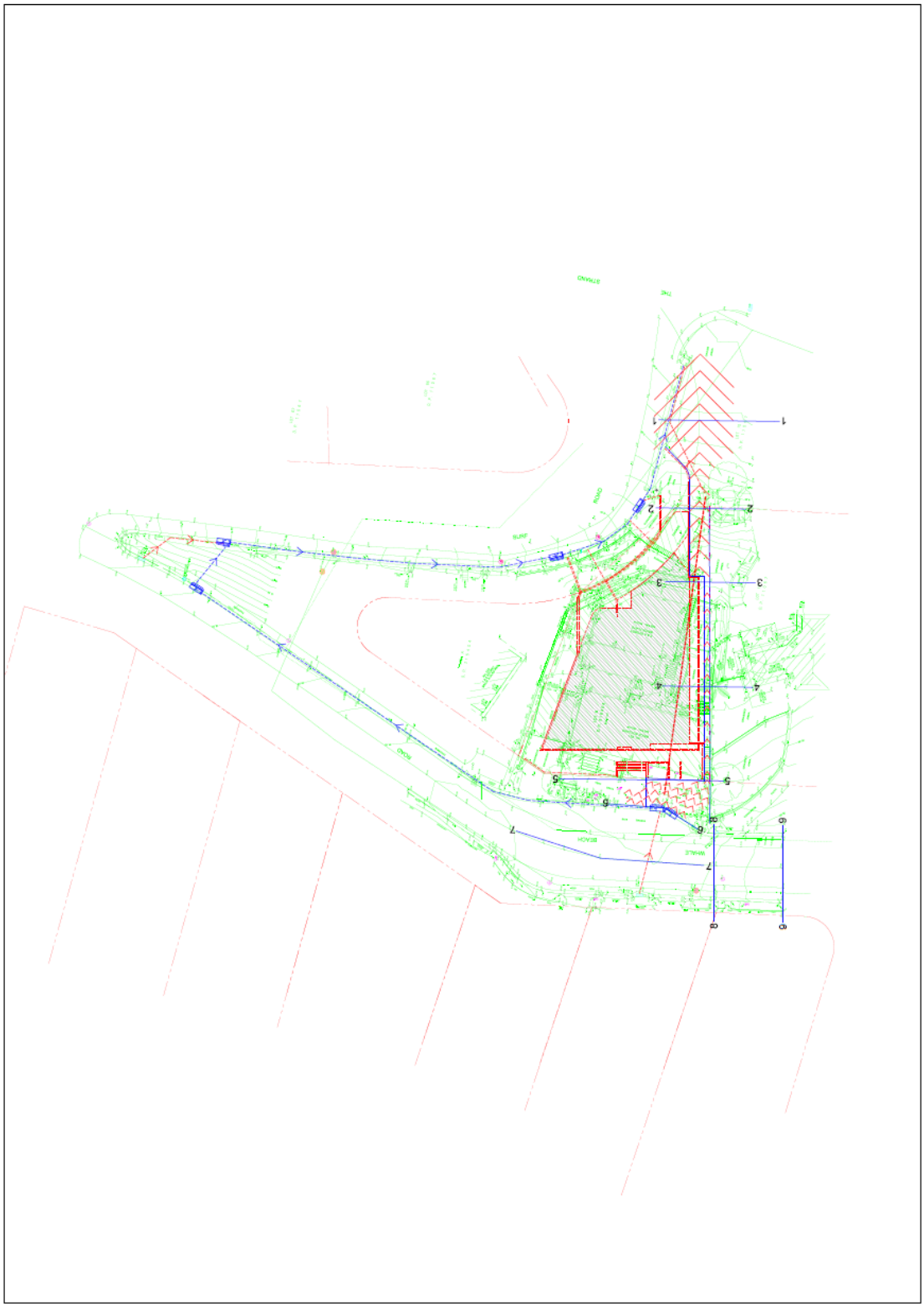
HECRAS cross section layout



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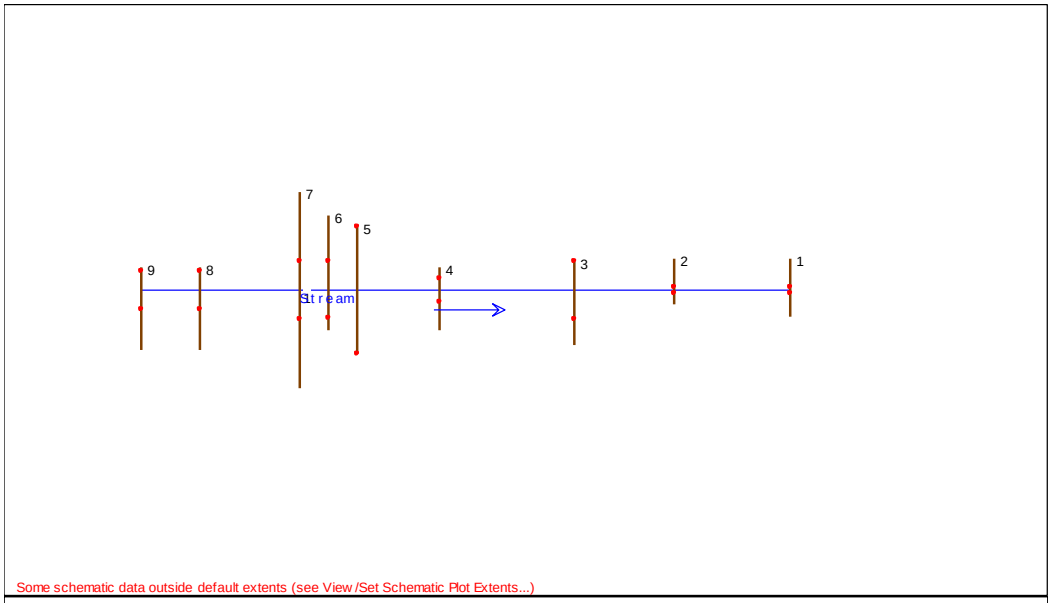
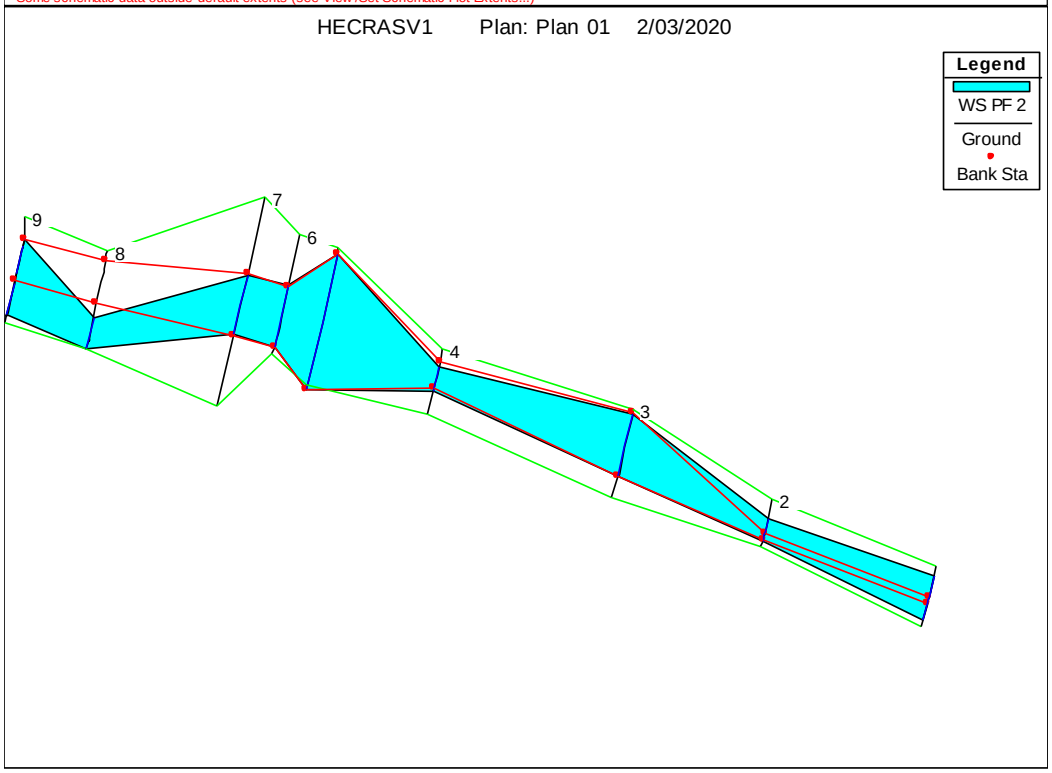
Pre Development





Reach	Sta	Profile	Q (m3/s)	Ch El (m)	W.S. Elev (m)	W.S. (m)	E.G. El (m)	Slope (m/m)	Vel (m/s)	Flow Area (m2)	Width (m)	Froude #
1	9	PF 2	0.43	22.33	22.47	22.47	22.50	0.004448	0.57	0.60	9.40	0.84
1	8	PF 2	0.43	21.51	21.43	21.43	21.48	0.006228		0.43	4.83	0.00
1	7	PF 2	0.43	21.15	21.27	21.27	21.30	0.005832	0.77	0.56	9.50	1.01
1	6	PF 2	0.43	20.65	20.83		20.84	0.001102	0.46	0.94	10.00	0.48
1	5	PF 2	0.43	20.78	20.81	20.81	20.83	0.009221	0.63	0.68	21.99	1.15
1	4	PF 2	0.20	17.83	17.96	17.96	17.99	0.023455	0.86	0.24	3.84	1.04
1	3	PF 2	0.20	14.50	14.54	14.54	14.55	0.026954	0.59	0.35	9.86	1.00
1	2	PF 2	0.20	9.10	9.21	9.21	9.25	0.016876	1.00	0.26	3.64	0.96
1	1	PF 2	0.20	5.95	5.98	5.98	6.11	0.346943	2.06	0.14	7.11	3.57

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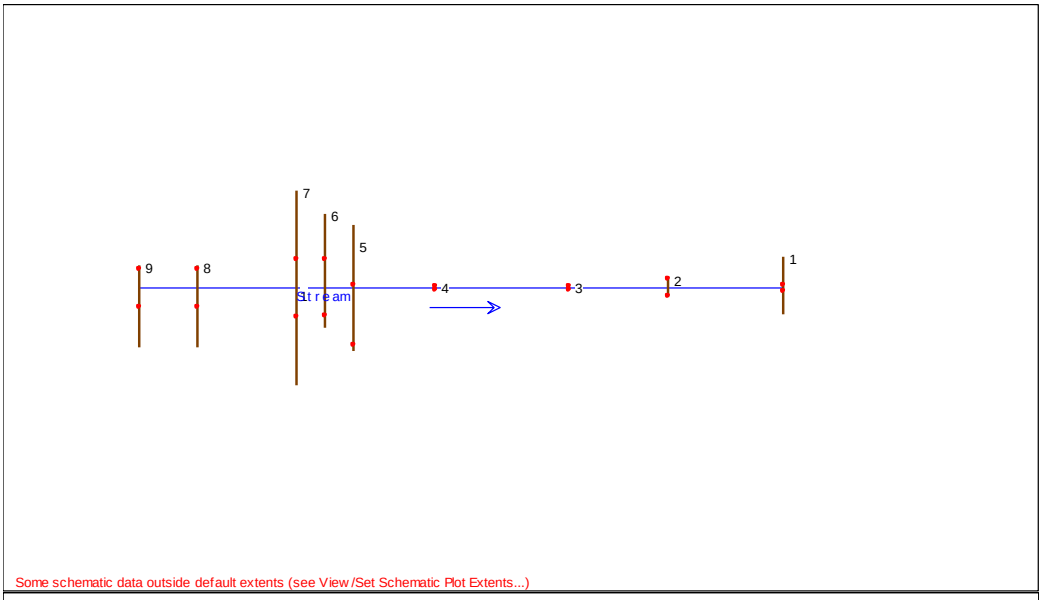
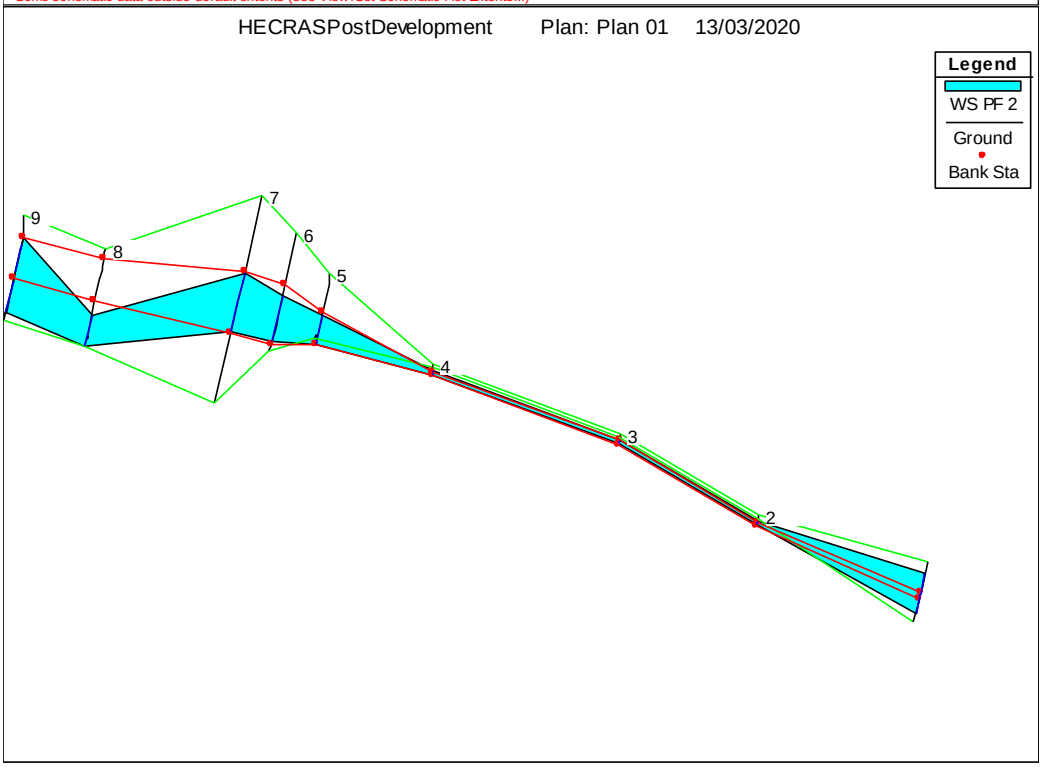
Post Development





Reach	Sta	Profile	Q (m3/s)	Ch El (m)	W.S. (m)	Crit W.S. (m)	Elev (m)	Slope (m/m)	Vel (m/s)	Area (m2)	Width (m)	Froude #
1	9	PF 2	0.43	22.33	22.47	22.47	22.50	0.004448	0.57	0.60	9.40	0.84
1	8	PF 2	0.43	21.51	21.43	21.43	21.48	0.006228		0.43	4.83	0.00
1	7	PF 2	0.43	21.15	21.27	21.27	21.30	0.005832	0.77	0.56	9.50	1.01
1	6	PF 2	0.43	20.65	20.79	20.79	20.82	0.005395	0.83	0.52	7.48	1.00
1	5	PF 2	0.06	20.10	20.14	20.14	20.16	0.031793	0.51	0.12	4.63	1.03
1	4	PF 2	0.06	17.83	17.92	17.92	17.98	0.023623	1.06	0.06	0.60	1.10
1	3	PF 2	0.06	14.50	14.59	14.59	14.65	0.023625	1.06	0.06	0.60	1.10
1	2	PF 2	0.06	9.70	9.79	9.79	9.85	0.023623	1.06	0.06	0.60	1.10
1	1	PF 2	0.06	5.95	5.98	5.98	6.00	0.040030	0.67	0.12	6.74	1.20

Barrenjoey Consulting Engineers pty ltd
Stormwater Structural Civil
abn 13124694917 acn 124694917

COUNCIL COMMENTS
RE CONCEPTUAL DESIGN

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Hi Lucas,
I have received response from Council Stormwater Operation & Planning Team.
These comments are only preliminary in nature and a detail assessment can only be provided upon a DA lodgement.

1. The proposal is to divert Council's existing stormwater 450mm pipe along the Whale Beach Road and Surf Roads in the report prepared by Lucas Molloy of Barrenjoey Consulting Engineers pty ltd, is supported in principal. All associated costs with the relocation of Councils drainage system, any utility services adjustments reinstatement are to be borne by the owner.
2. Council pipe line shall be located below the kerb and gutter.
3. The pipe cover and grades must comply with the manufacturer's specifications.
4. All existing drainage system in Surf Road are to be connected into the proposed drainage system.
5. The proposed culvert under the driveway (South-west corner) with a grating is not supported due to blockage, maintenance issues and overflow considerations. An unobstructed overland flow path for the 100 year ARI flows must be provided.
6. The hydraulic analysis must consider 50% flow restrictions at the inlet pits.
7. The 100 year ARI flood flow level must be established in AHD for the proposed future floor levels and basement entry levels which shall be a minimum of 500 mm above the 100 year flood level. This is to ensure that the proposed future dwellings and basement car parking areas are protected in major storm events.
8. The consultant must establish the pre-development and post-development 100 year ARI stormwater flows to ensure the adjoining properties are not worse off post development. Detail survey is required for the adjoining property in order to demonstrate and establish the overland flow path.
9. The open channel created by walls (Southern boundary) should fully comply with Pittwater 21 DCP – 2014 – Section B5.12 (see link below) to withstand Scour, and to avoid adverse impact on adjoining properties.
https://eservices.northernbeaches.nsw.gov.au/ePlanning/live/pages/plan/Book.aspx?exhibit=PDCP&hid=11881
10. Establishment of an easement/restrictions are to comply with Pittwater 21 DCP.
11. Proposed overland flow paths must be controlled to ensure that any future development of the Council Reserve is not compromised.
12. The applicant is to submit with the DA a hydraulic report and model like HEC-RAS showing the 100 Year Average Recurrence Interval (ARI) stormwater flow over the subject site, prepared by a Chartered Professional Civil Engineer of Engineers Australia. All calculations are to be carried out in accordance with the guidelines provided in "Australian Rainfall and Run Off", a publication of the Institution of Engineers, Australia. All levels are to be shown in Australian Height Datum (AHD). It is to be noted that no development is permitted over Council's drainage system which includes the established 1 in 100 ARI storm water overland flow path for the subject site. The flood study must be taken upstream and downstream beyond the subject site (at least 15-20 metres from the common boundaries affected by the overland flow).

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northern beaches council

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