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OVERLAND FLOW AND FLOOD ANALYSIS

FOR

3 QUARRY ROAD
DURAL NSW 2158

Revision No	Status	Issue Date	Prepared By	Reviewed By	Approved By
A	Final	31/01/2017	S. Khan	L. Panagopoulos	P Sancandi

Job no. 16033

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ABBREVIATIONS

AHD	Australian Height Datum	RL	Reduced Level
ARI	Annual Recurrence Interval	TWL	Top Water Level
Ha	Hectares	VD	Velocity & Depth Product
L/s	Litres per second		

2.0 INTRODUCTION

This report has been prepared by Marchese Partners Engineering (*MPE*) to assist relevant Stakeholders in determining the hydrology of the existing local catchment for the site 3 Quarry Road, Dural. The existing site is a grassed area with one existing single storey brick house and a retaining wall located north of the site. The proposed development is a Retirement Village with 9 buildings and landscape areas. The total site area is 2.97 ha and the site boundary is shown in the locality map in *Figure 1*. A small dam is present outside the western boundary of the site.

Figure 1 – Locality Plan

The site is grassed area with a single storey brick building located north of the site. It is proposed that the site will be occupied by nine (9) residential buildings with a central landscape on the ground floor.

This report defines the upstream catchment analysis from Old Northern Road and Quarry Road, towards the creek flow which includes the development site. In addition, the report also addresses the following:-

- Estimates the peak catchment discharges for the 20 and 100 Year ARI storm events for the existing catchment.
- Estimates the flood depth along the site boundary for the 10, 20 and 100 Year ARI storm events.
- Provides a recommendation for the proposed Finished Floor Level and Basement Threshold Levels which meet the requirements of the Local Government Authority, Hornsby Shire Council.

All catchment discharges and flood levels were analysed using DRAINS modelling software. DRAINS is a time area, unit hydrograph, runoff routing programme for modelling urban stormwater systems and analysing their hydrological behaviour.

3.0 STUDY AREA

The catchment covers an area of 26 ha consisting of Vineys Road, Quarry Road, the proposed development, a dam, developed areas, grassed areas, and vegetated reserve. The upstream catchment is bounded by Old Northern Road, North of Vineys Road, South of Quarry Road and East of Site.

During extreme storm events it is anticipated that the catchment bounded by Old Northern Road and Quarry Road will pond into the site and spill into Trunks Creek. This creek continues into Berowra Creek which leads into the Hawkesbury River.

The total catchment and sub catchments are shown in *Attachment 1-1: Existing Condition.*

The elevation of the catchment varies from approximately RL 220.00 metres AHD on Old Northern Road to RL 180.00 metres AHD at the sag point, east of catchment which leads into Trunk's creek.

4.0 THE EXISTING SITE

A site survey was conducted on Wednesday, 14th December 2016. The survey shows site analysis around the catchment boundary and the site boundary as shown in *Figure 2*. The flood analysis catchment boundary is along Old Northern Road and includes the sub-catchments from Quarry Road and Vineys Road. The northern site boundary meets Vineys Road and the southern boundary meets Quarry Road.

The site survey images 1 to 9 (see *Attachment 3*) show the site grading catchment area by green arrows in the F*igure 2* below. The overall site falls west to east towards the path of Trunks Creek. Old Northern Road falls towards Quarry Road. Vineys Road and Quarry Road both have a falling gradient towards east. Refer to *Figure 2* below for an overall site survey plan.

The site survey shows the location of a dam near the western site boundary which has a flow path through the site and forms a gully leading to a creek downstream. There is a road sag on Vineys Road near the intersection of Vineys Lane. There is another road sag on Quarry Road east of site as shown by the *Figure 2* below. Kerb entry pits were found in the site survey along Quarry Road.

Figure 2 – Site Survey Plan

5.0 APPROACH TO THE STUDY

The approach taken to the study can be summarised as follows: -

- ***Hydrology***

The catchment for the overall site includes the sag areas on Vineys Road and Quarry Road which has been modelled to determine the peak catchment discharges from the site and flood levels for a 20 and 100 Year ARI storm event using the DRAINS modelling programme.

- ***Hydraulics***

The analysis of the overland runoff from the western boundary of the catchment area to the eastern boundary of the proposed site and the creek has been completed using the Manning's equation within DRAINS which calculates steady state discharge for a given cross-sectional area and hydraulic grade.

This calculation has been completed to verify the flood and stormwater discharge requirements of the proposed development to co-ordinate the 100 Year ARI flood level against the proposed Finish Floor Level and Basement Threshold Level for the proposed development.

6.0 HYDROLOGICAL ANALYSIS

6.1 Data

The detailed survey information from Higgins Surveyors outlines the topography and existing drainage infrastructure within the catchment.

A detailed site inspection of the site was undertaken on 14th December 2016 in sunny conditions to verify the existing drainage infrastructure and determine the extent of the catchment.

6.2 DRAINS Model

The catchment peak discharges were calculated using DRAINS modelling software. The catchment was divided into seven (7) sub-catchments as shown on drawings in *Attachment 1-1*.

An ILSAX model was created for the existing catchment with the following catchment characteristic factor values was created in the DRAINS model:-

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

The times of concentration are 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 DRAINS model for the existing site (refer to *Attachment 2-1*) is shown below:

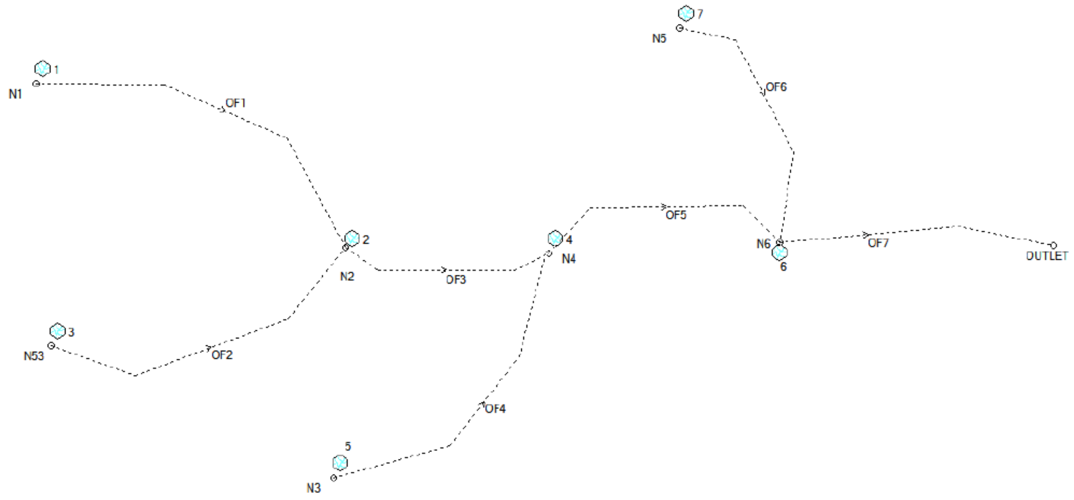


Figure 3 – Existing Site DRAINS Model

The DRAINS model shows the location of node N2 which calculates the discharge of flow from the Dam when the flood enters the proposed site location at the Western Site Boundary. The node N4 shows the critical location as water leaves the proposed site, on the Eastern Site boundary. Refer to *Figure 3* above for the site boundary locations. The Outlet Node shows the eastern boundary of the catchment where the water travels into the Creek. The points of interest for the existing model flood analysis are N2, N4 and Outlet to creek.

At node **N2** on the western boundary of the proposed site, the critical duration for the 100 Year ARI storm event is the 1 hour storm with a peak discharge of **1.601 m^3/s,** as shown by OF3 in the Node Diagram. The respective peak for the 20 Year ARI storm event is **1.04 m^3/s** which occurs for the 1 hour storm.

With respect to the discharge node **N4** on the eastern boundary of the proposed site, the critical duration for the 100 Year ARI storm event is the 1 hour storm with a peak discharge of **2.92 m^3/s,** as shown by OF5 in the Node Diagram (*see Attachment 2-1*). The respective peak for the 20 Year ARI storm event is **1.91 m^3/s** which occurs for the 1 hour storm.

The total catchment discharge is at node **Outlet**, 20m east of the catchment boundary shown in *Attachment 1-1*. The critical duration for the 100 Year ARI storm event is the 1 hour storm with a peak discharge of **5.14 m^3/s,** as shown by OF7 in the Node Diagram (*see Attachment 2-1*). The respective peak for the 20 Year ARI storm event is **3.32 m^3/s** which occurs for the 1 hour storm.

For the detailed DRAINS model results for the existing site, refer to *Attachments 2-1, 2 & 3.*

6.3 Existing Catchment Discharges

The 20 and 100 Year ARI catchment peak discharges at relevant locations for various storm durations are presented below:

Table 5.3 – Catchment Discharges

SUB CATCHMENT	NODE	LOCATION DESCRIPTION	STORM EVENT ARI	CATCHMENT DISCHARGE FOR STORM DURATION (m^3/s)		
				20 min	60 min	120 min
1	N1	North-Western catchment	20	0.15	0.19	0.17
			100	0.25	0.27	0.20
2	N2	Western catchment including Dam	20	0.36	0.50	0.47
			100	1.35	1.60	1.21
3	N53	South Western catchment	20	0.30	0.41	0.37
			100	0.49	0.64	0.49
4	N4	Site area and inflows from North, West and South catchments	20	0.82	1.04	0.91
			100	2.45	2.92	2.17
5	N3	Southern catchment	20	0.22	0.29	0.26
			100	0.36	0.42	0.32
6	N6	Eastern catchment, East of site	20	1.50	1.91	1.71
			100	0.88	1.14	0.87
7	N5	Northern catchment	20	0.54	0.73	0.65
			100	0.88	1.14	0.87
Total	Outlet	Outlet from catchment adjoining creek	20	1.77	2.51	3.32
			100	4.12	5.14	3.86

The 20 and 100 Year ARI inputs and results are presented in *Attachment 2*.

The Unit Hydrographs (*see Figures 4 to 9*) are presented for the peak catchment discharges for the Western Site boundary (N2), Eastern Site Boundary (N4) and the total catchment Outlet. These hydrographs present the overall catchment discharge for each area from the commencement of each of the storm events through to when the catchment returns to its pre storm state.

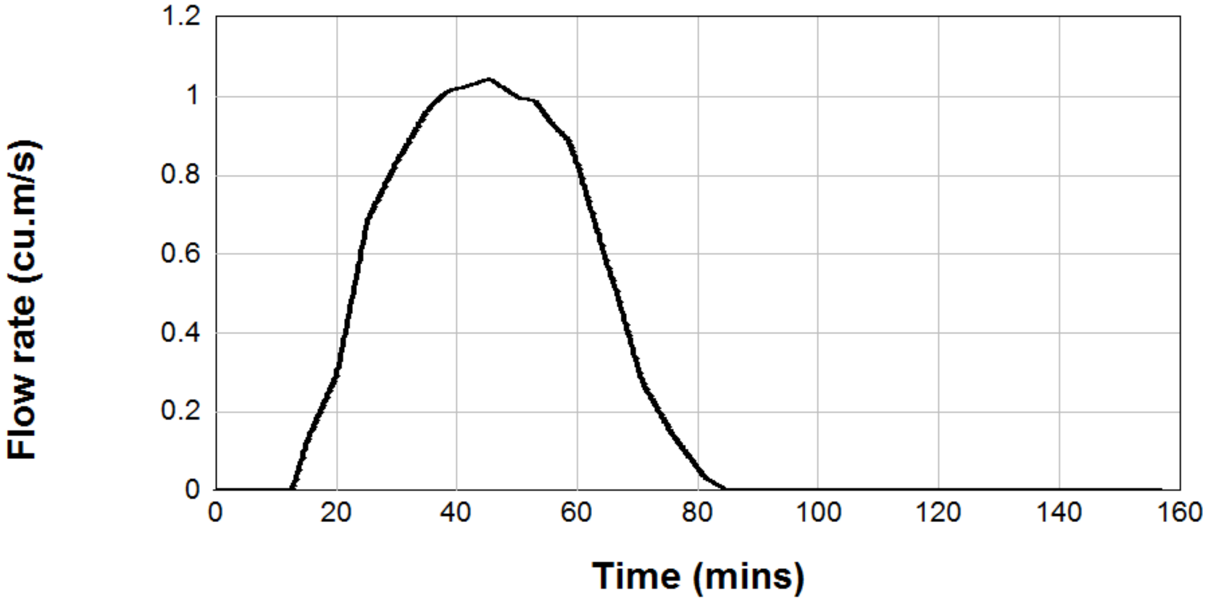


Figure 4 – Western Site Boundary Node N2 – 20 Year ARI Storm – 60 minute duration

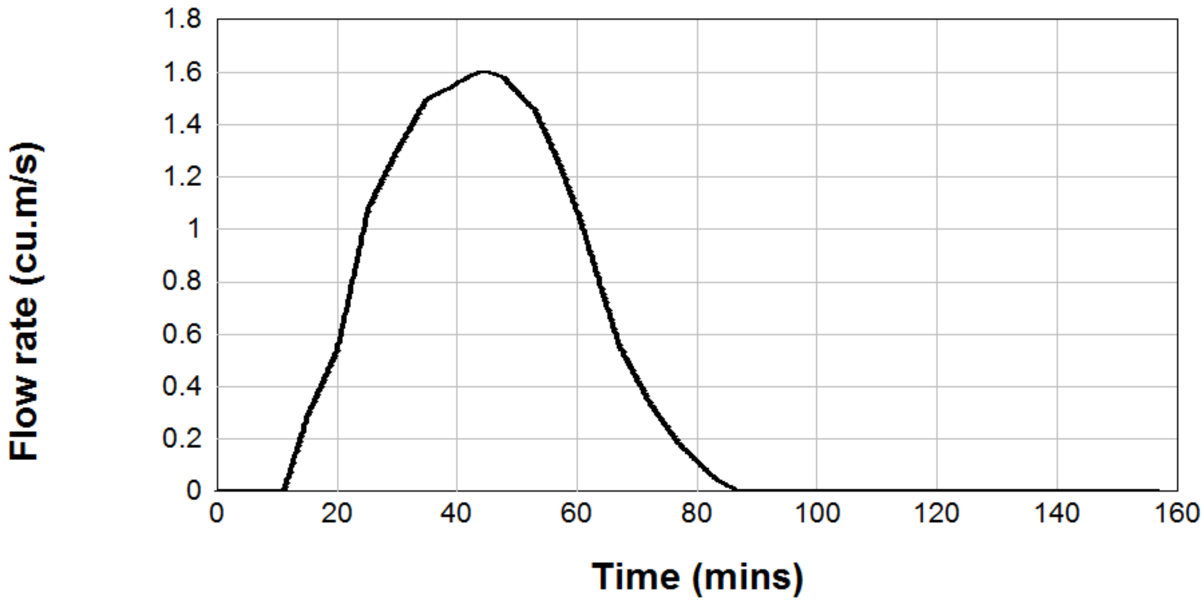


Figure 5 – Western Site Boundary Node N2 – 100 Year ARI Storm – 60 minute duration

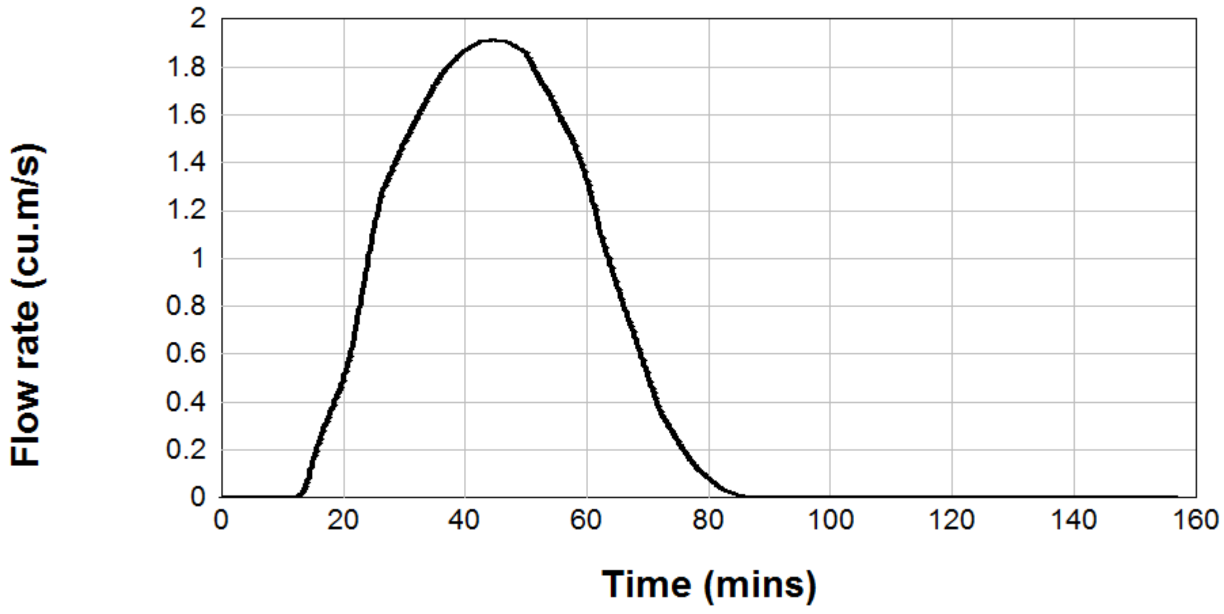


Figure 6 – Eastern Site Boundary Node N4 – 20 Year ARI Storm – 60 minute duration

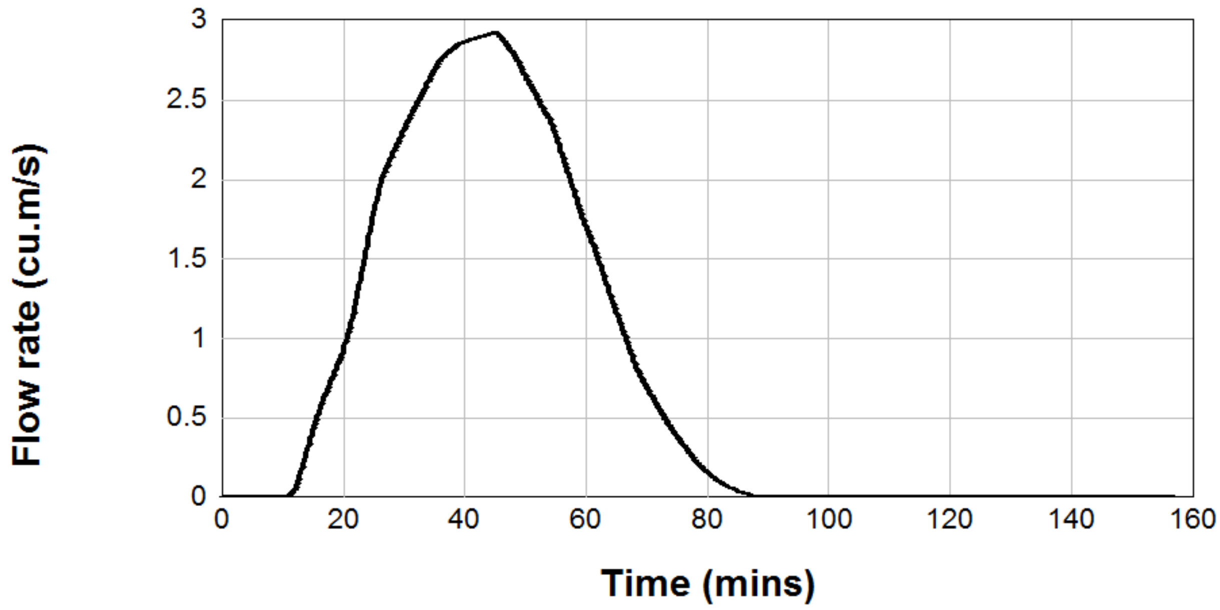


Figure 7 – Eastern Site Boundary Node N4 – 100 Year ARI Storm – 60 minute duration

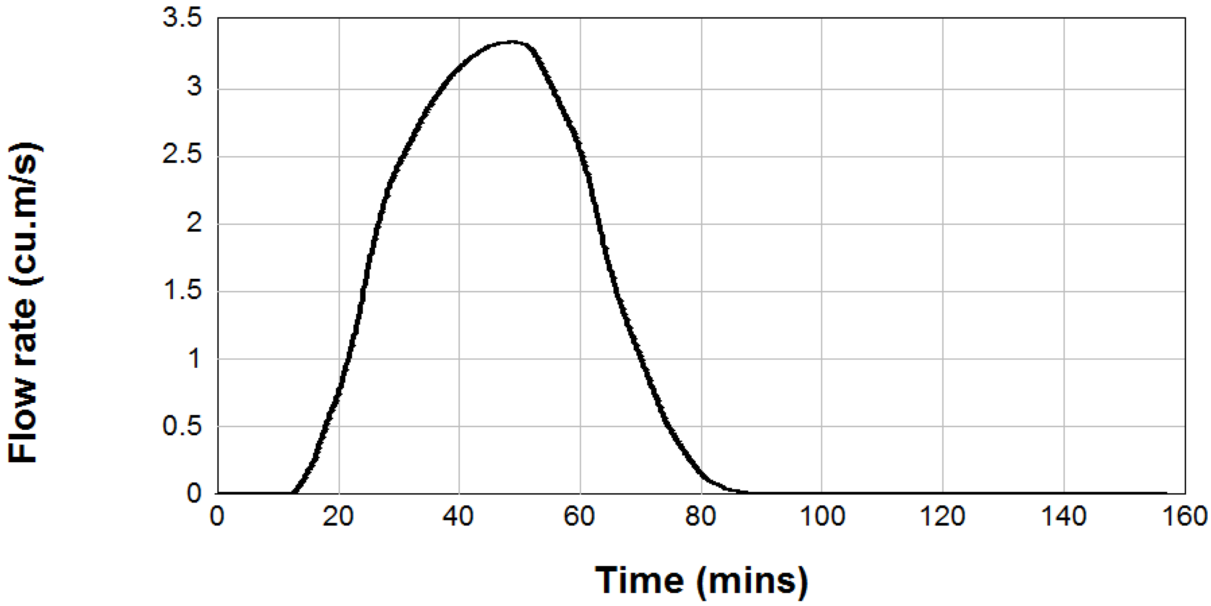


Figure 8 – Catchment Outlet – 20 Year ARI Storm – 60 minute duration

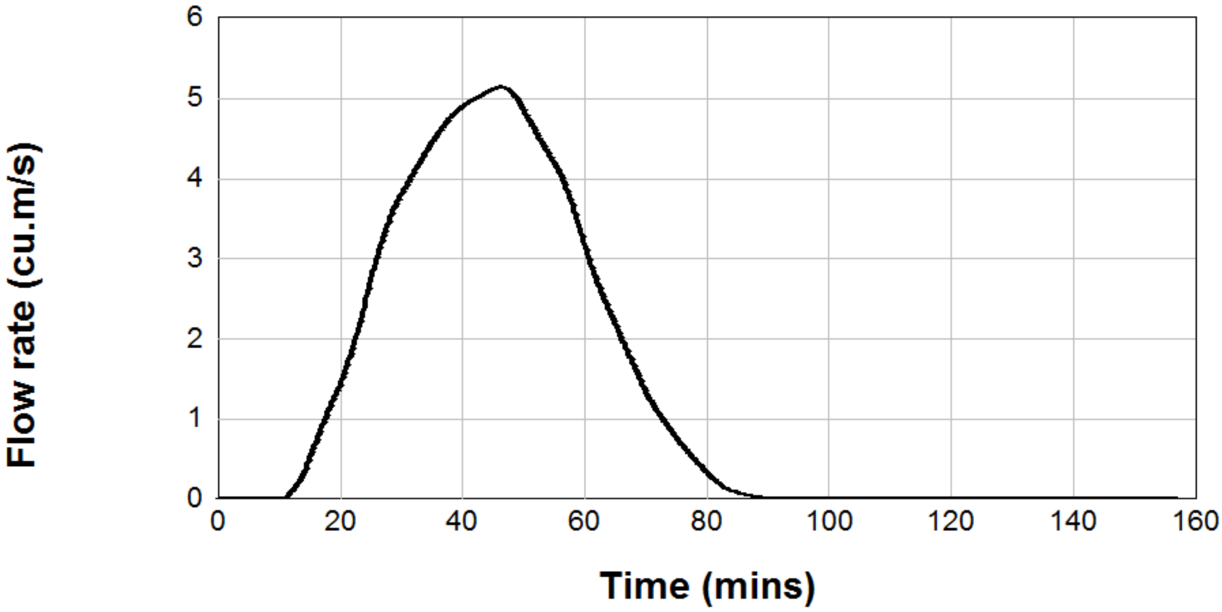


Figure 9 – Catchment Outlet – 100 Year ARI Storm – 60 minute duration

6.4 Overland Flow Depths

The overland flow depths from the DRAINS modelling programme have been scrutinised in the following locations:-

- Existing Conditions – Western Site boundary (OF3)

The total discharge applicable to the western boundary of the proposed development as analysed by DRAINS modelling for the 100 Year ARI critical storm duration of 60 minutes is **1.6 m^3/s**. In its existing condition, the western boundary has a batter slope down from the North and South boundaries of the catchment which falls towards the dam at the base of the batter. A headwall can be constructed to convey the flood to the eastern boundary using a pipe drainage running through the site. This concept will be further discussed in the report using a DRAINS analysis. The typical overland flow cross section is presented below.

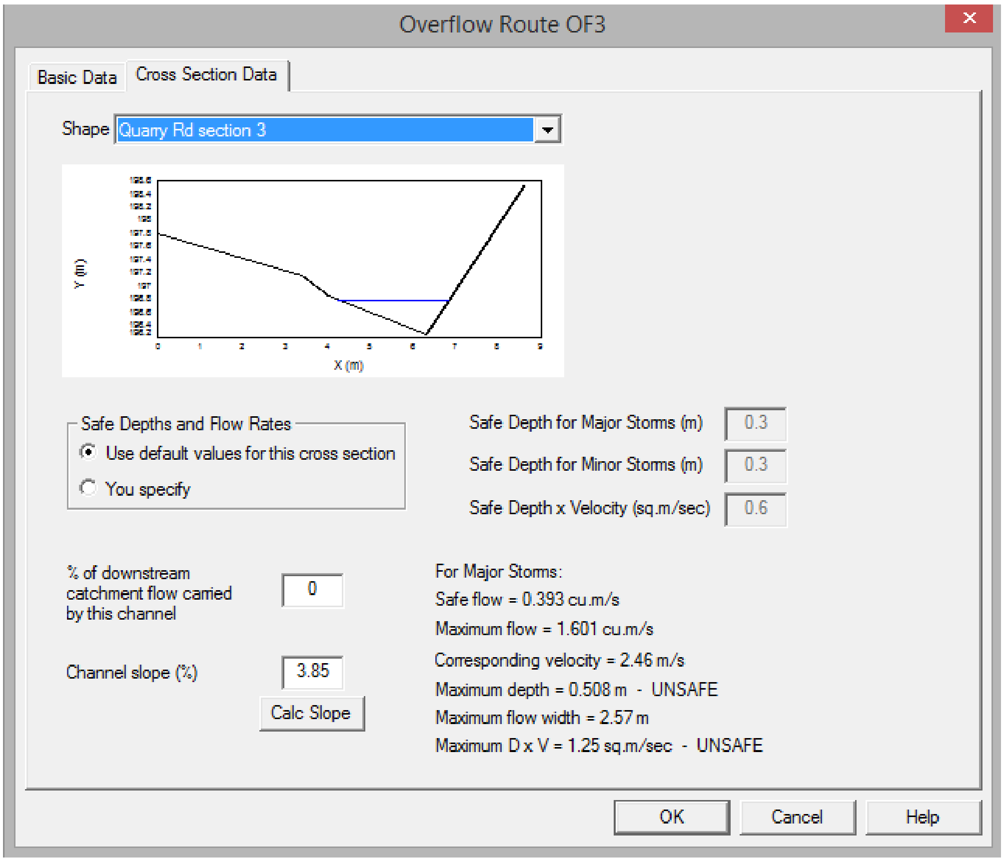


Figure 10 – Overland Flow Cross-section OF3

❖ Existing Conditions – Eastern Site boundary (OF5)

The total discharge applicable to the eastern boundary of the proposed development as analysed by DRAINS modelling for the 100 Year ARI critical storm duration of 60 minutes is **2.92 m³/s**. In its existing condition, the eastern site boundary has a batter slope down from the northern catchment and a flatter batter from the southern catchment. The overland flow path continues to fall east towards the creek. The typical overland flow cross section is presented below.

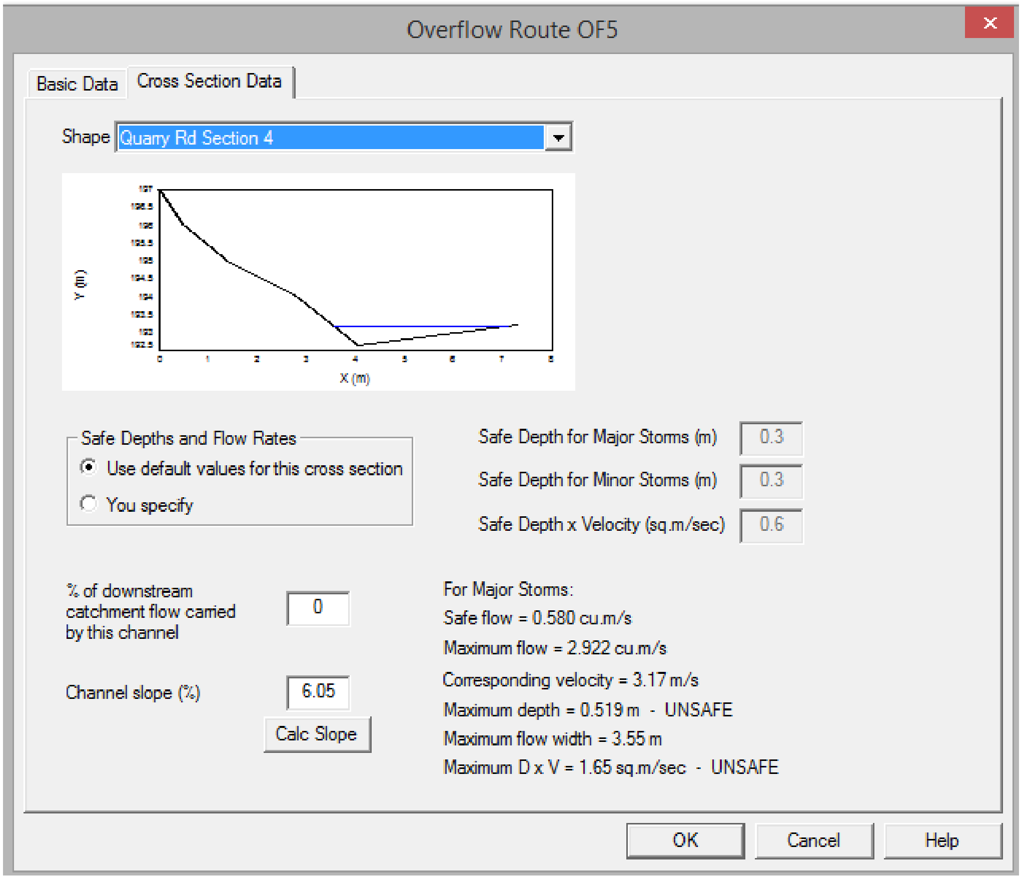


Figure 11 – Overland Flow Cross-section OF5

A summary of the hydraulic analysis for the Existing Conditions 100 Year storm is presented below showing the total discharge, flow velocity and flow depth for both overland flow paths: -

Table 5.4 – Overland Flow Depths and Velocities

LOCATION	TOTAL DISCHARGE (m3/s)	MAXIMUM FLOW VELOCITY (m/s)	MAXIMUM FLOW DEPTH (mm)
West Boundary	1.6	0.624	520
East Boundary	2.92	0.663	530

From *Figures 10 & 11* and *Table 5.4* above it can be seen that the Proposed Site will require treatment to convey stormwater around the proposed development to contain sufficient capacity to convey the 100 Year ARI storm event within pathway of the catchment outlet.

6.5 Proposed Condition DRAINS Analysis

A DRAINS model was created with the addition of a head wall and DN 1200mm pipe system to carry the flood along the site and divert excess overland flow around the proposed development. Based on the analysis it is recommended that a head wall and DN 1200mm pipe system is used for the proposed development to convey flood through the site and provide the minimum 500mm freeboard requirement in compliance with Hornsby Shire Council's conditions.

The node diagram for the proposed design is shown below in *Figure 12*.

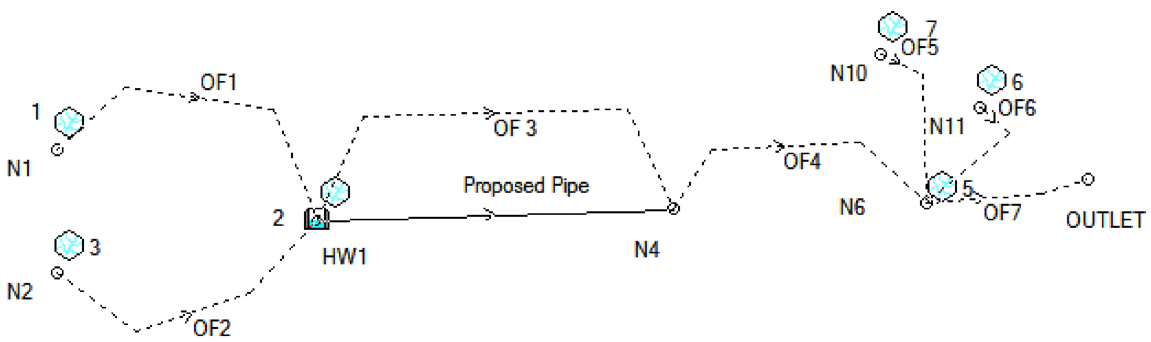


Figure 12 – Proposed Site DRAINS Model

The proposed pipe and head wall HW1 system shown in *Figure 12* above is applied in the DRAINS analysis. The flood is carried by the pipe system through HW1 and released to the existing system at node N4 which has an overland flow path OF4.

The freeboard is achieved based on the ground floor level of RL 200m (*see Figure 13 below*) and the Hydraulic Grade Line Analysis of the pipe system (*Figure 14)* where the maximum flood level is RL 198.227 m against the proposed building. This gives a freeboard well above the minimum council requirements for a freeboard of 500 mm.

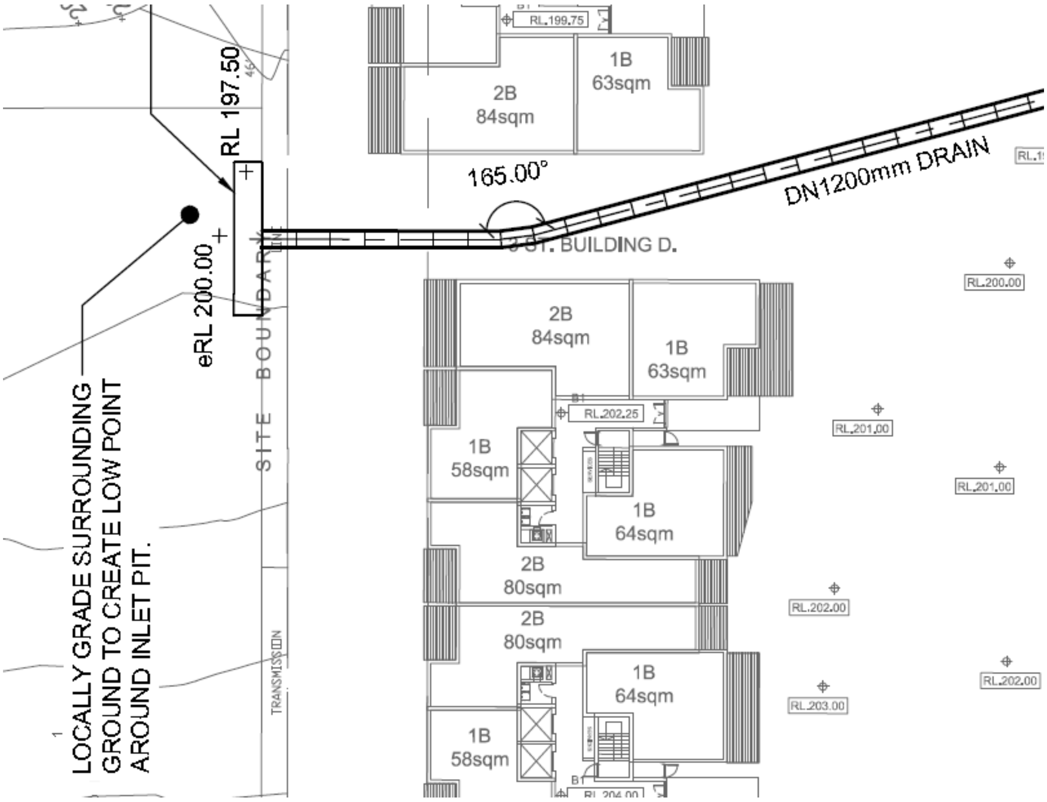


Figure 13 – Proposed Finished Ground Floor Levels

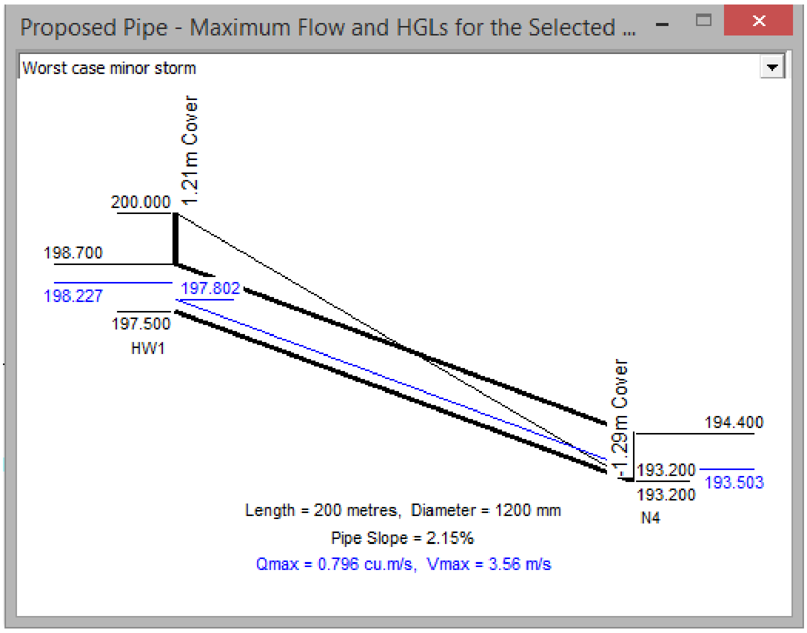


Figure 14 – Hydraulic Grade Line Analysis of Pipe System

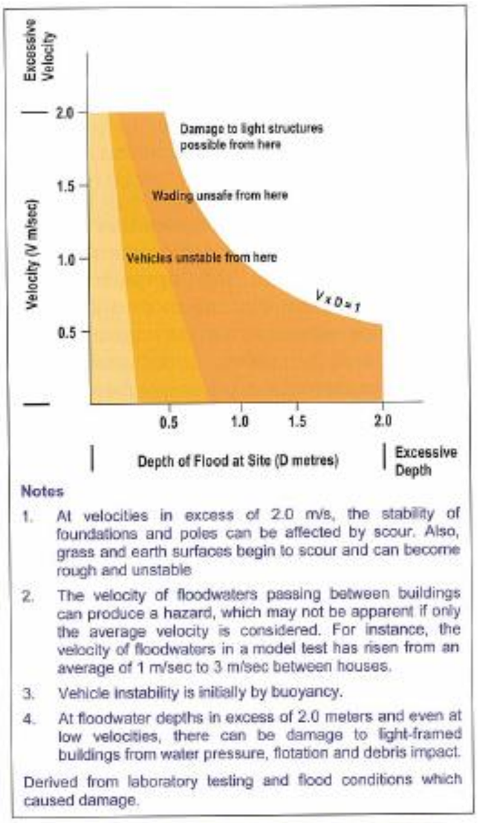
DRAINS modelling results of the proposed condition and the Upstream Catchment Analysis drawings have been included in the *Attachments 1 and 2.*

Based on the 100 Year ARI critical storm duration of 60 minutes the pipe has a peak flow of **1.61 m^3/s** with nil overland flow. The depth and velocity product is required to be assessed to determine the safety of the proposed flood diversion along the site boundary and the possible effect this could have on the total catchment discharge during peak catchment discharges.

6.6 Flood Risk Analysis

The depth velocity product of the site overland flow has been assessed at **1.61 m^3/s** in DRAINS with a depth of **400 mm** and velocity of **0.48 m/s** for the proposed condition. When these values are plotted on *Figure L1* below they return a risk category of LOW. This categorisation is considered acceptable for the eastern boundary as the VD product is safe after the proposed treatment.

The VD product for these overland flow routes are generally within acceptable limits deemed by the NSW Floodplain Management manual.



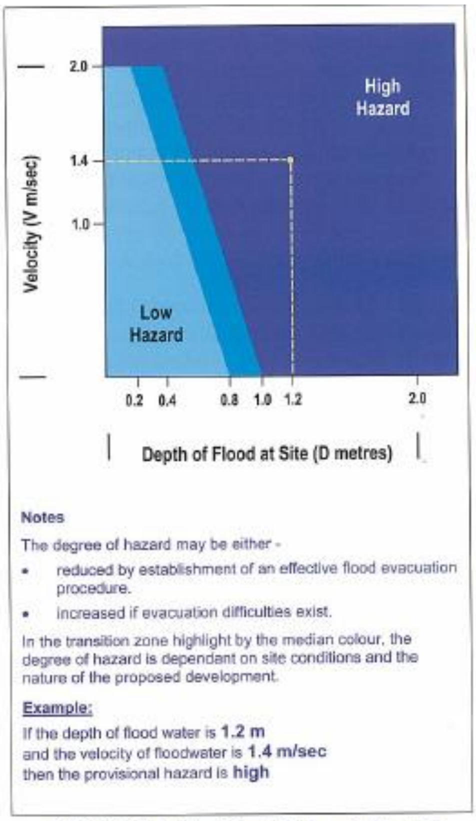


FIGURE L1 - Velocity & Depth Relationships

FIGURE L2 - Provisional Hydraulic Hazard

Excerpt: the NSW Floodplain Management manual

7.0 CONCLUSION

The findings of the hydrological analysis for the existing upstream condition estimates a peak discharge of 1.6 m^3/s leading into the site at the western site boundary for 100 Year ARI event. The peak discharge exiting away from the site is 2.92 m^3/s away from the eastern boundary of the proposed site. The catchment discharges have been discussed in *Section 5.2* and presented in *Table 5.3*.

The overland flow depths and velocities were analysed once the discharge rates were determined. It is recommended that a headwall and pipe system be constructed along the site from the western boundary to the eastern boundary of the proposed development to convey the upstream catchment discharge through the site.

The depth of flow along the western site boundary is 520 mm with a corresponding velocity of 1.60 m/s. The maximum depth of flow along the eastern site boundary is 530 mm with a corresponding velocity of 2.92 m/s. With the design of a headwall on the western boundary, the hydraulic grade line is RL 198.227 m with the proposed ground floor RL 200 m. This gives a freeboard of 1.77m which is well above the council requirements of 0.5m.

The pipe designed for the 100 Year ARI event flood level is of diameter 1200 mm. *Figure 14* in *Section 5.5* presents the Hydraulic Grade Line Analysis of the pipe where the maximum water in the pipe is RL 197.802 m, which is below the centre line of the pipe. This shows the proposed pipe has the capacity to cater for more than double the 100 Year ARI flood event level. The proposed design and ground floor levels are presented in *Attachment 1* Upstream Catchment Drawings.

The velocity depth product analysis of the overflow path from the proposed design was discussed in *Section 5.6*. The overland flow on the eastern site boundary is found to be in the LOW risk category after the proposed design is applied. This verifies the overland flow routes of the upstream catchment is acceptable within the NSW Floodplain Management limits.

ATTACHMENT 1 **UPSTREAM CATCHMENT ANALYSIS DRAWINGS (Figures 1 to 8)**

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A	19.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.1	CA
B	20.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.2	CA
C	23.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.3	CA
D	25.01.17	DEVELOPMENT APPLICATION FINAL REPORT	CA
E	31.01.17	DEVELOPMENT APPLICATION FINAL REPORT RE-ISSUE	CA

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PROJECT
STORMWATER DRAINAGE
3 QUARRY ROAD,
DURAL, NSW, 2158

DRAWING TITLE
3 QUARRY ROAD DURAL
UPSTREAM CATCHMENT ANALYSIS
EXISTING CONDITION

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:1250	Jan 23, 2017	CA	LP
JOB	DRAWING		REVISION
2016-1029	FIGURE 1		E

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STORMWATER DRAINAGE
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3 QUARRY ROAD DURAL
UPSTREAM CATCHMENT ANALYSIS
PROPOSED CONDITION BASEMENT 2

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JOB	DRAWING		REVISION
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3 QUARRY ROAD,
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UPSTREAM CATCHMENT ANALYSIS
PROPOSED CONDITION BASEMENT 1

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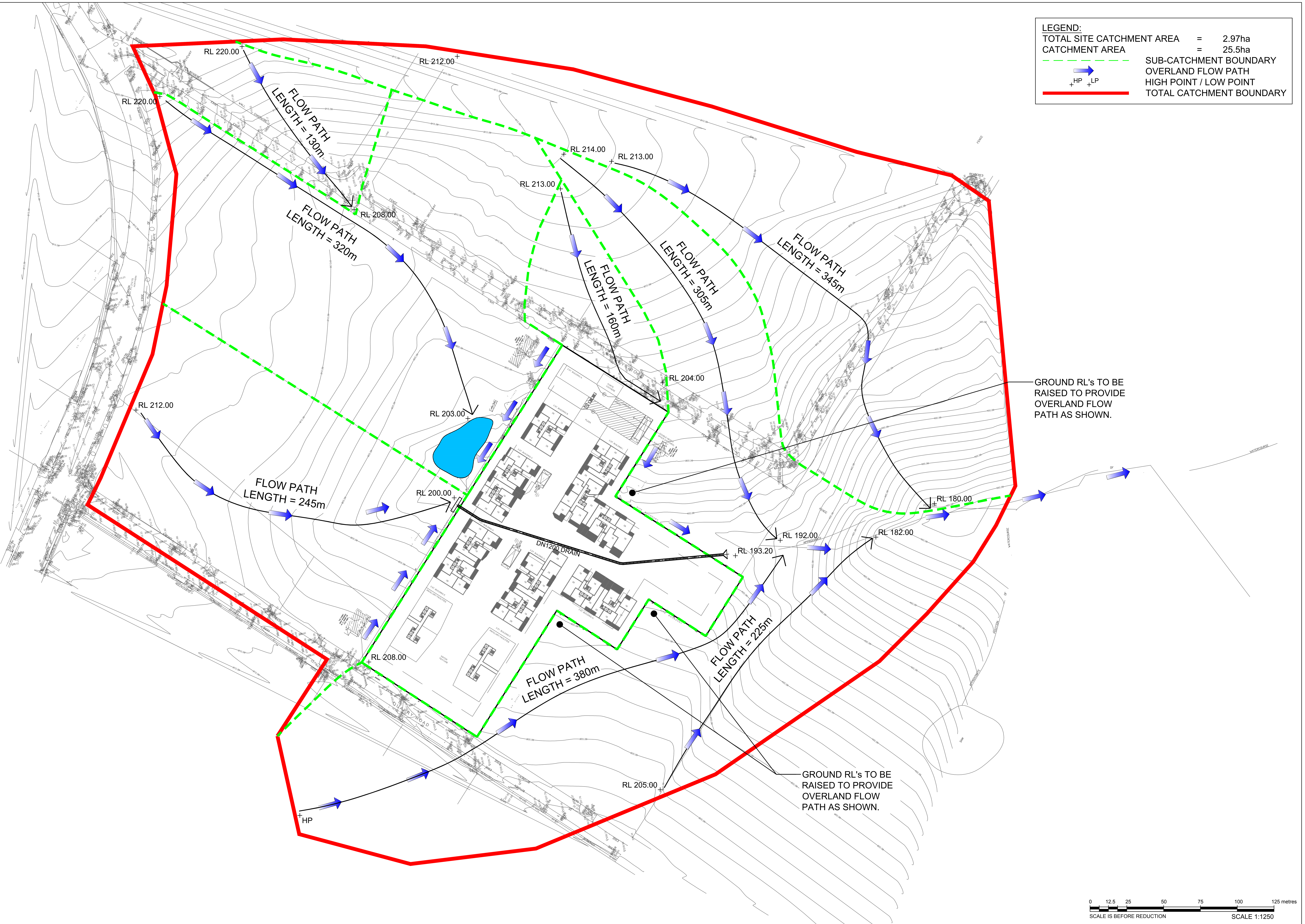
2016-1029	FIGURE 3		E



LEGEND:

TOTAL SITE CATCHMENT AREA = 2.97ha
CATCHMENT AREA = 25.5ha

SUB-CATCHMENT BOUNDARY
OVERLAND FLOW PATH
HP LP HIGH POINT / LOW POINT
TOTAL CATCHMENT BOUNDARY

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PROPOSED CONDITION GROUND FLOOR

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2016-1029	FIGURE 4		E

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DEVELOPMENT APPLICATION

REVISION	DATE	DESCRIPTION	BY
A	19.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.1	CA
B	20.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.2	CA
C	23.01.17	DEVELOPMENT APPLICATION DRAFT ISSUE No.3	CA
D	25.01.17	DEVELOPMENT APPLICATION FINAL REPORT	CA
E	31.01.17	DEVELOPMENT APPLICATION FINAL REPORT RE-ISSUE	CA

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PROJECT
STORMWATER DRAINAGE
3 QUARRY ROAD,
DURAL, NSW, 2158

DRAWING TITLE
3 QUARRY ROAD DURAL
CONCEPT TRENCH DRAINAGE
BASEMENT 2 PLAN

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:500	Jan 23, 2017	CA	LP
JOB	DRAWING		REVISION
2016-1029	FIGURE 5		E

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PROJECT
STORMWATER DRAINAGE
3 QUARRY ROAD,
DURAL, NSW, 2158

DRAWING TITLE
3 QUARRY ROAD DURAL
CONCEPT TRENCH DRAINAGE
BASEMENT 1 PLAN

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:500	Jan 23, 2017	CA	LP
JOB	DRAWING		REVISION
2016-1029	FIGURE 6		E

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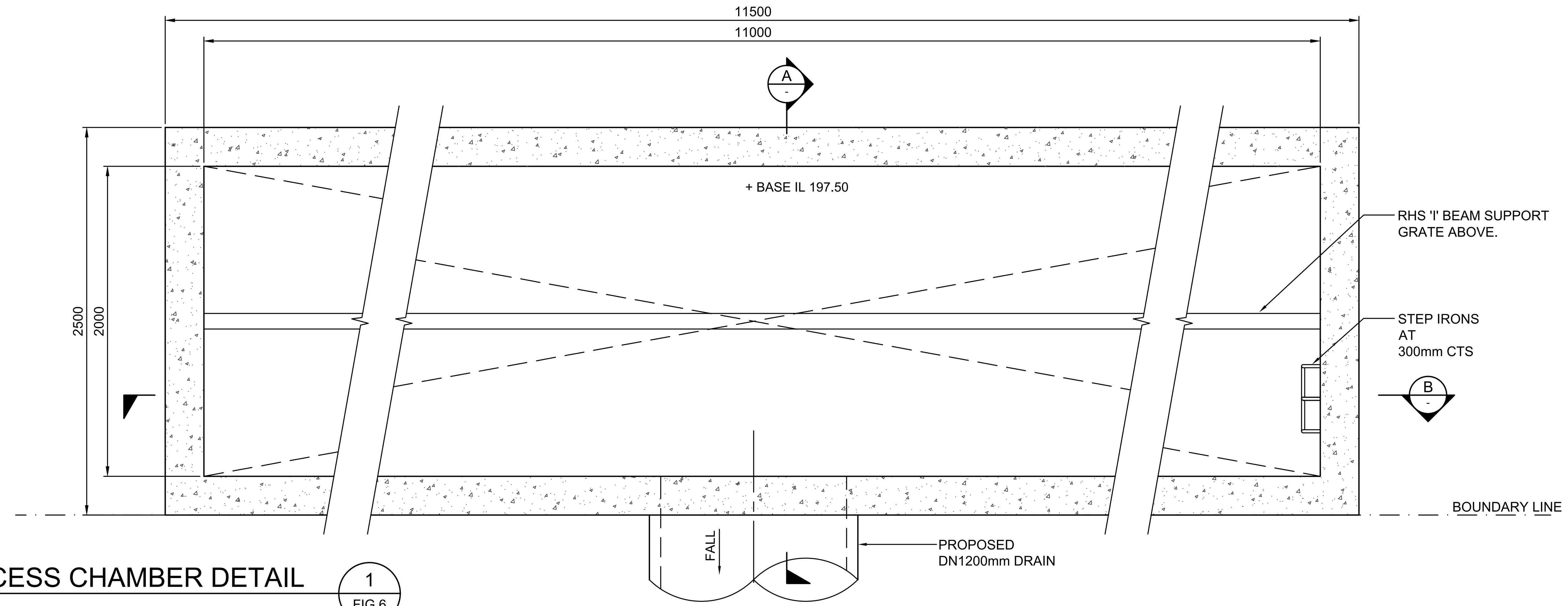
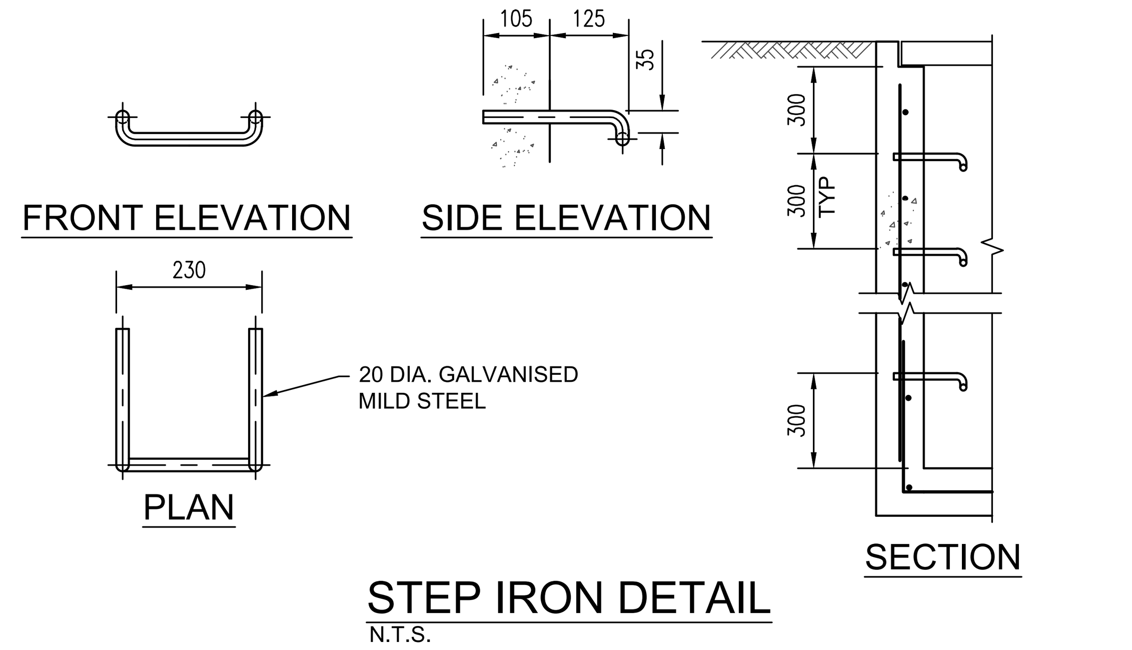
PROJECT
STORMWATER DRAINAGE
3 QUARRY ROAD,
DURAL, NSW, 2158

DRAWING TITLE
3 QUARRY ROAD DURAL
CONCEPT TRENCH DRAINAGE
GROUND FLOOR PLAN

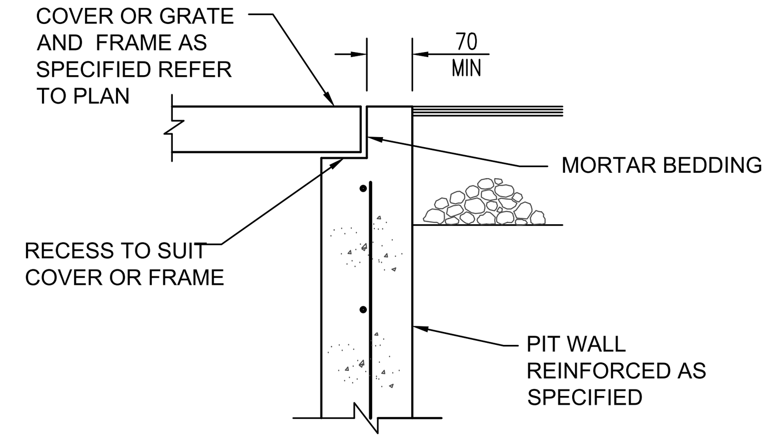
SCALE	DATE	DRAWN	CHECKED
A1 @ 1:500	Jan 23, 2017	CA	LP
JOB	**DRAWING**		**REVISION**
2016-1029	FIGURE 7		E



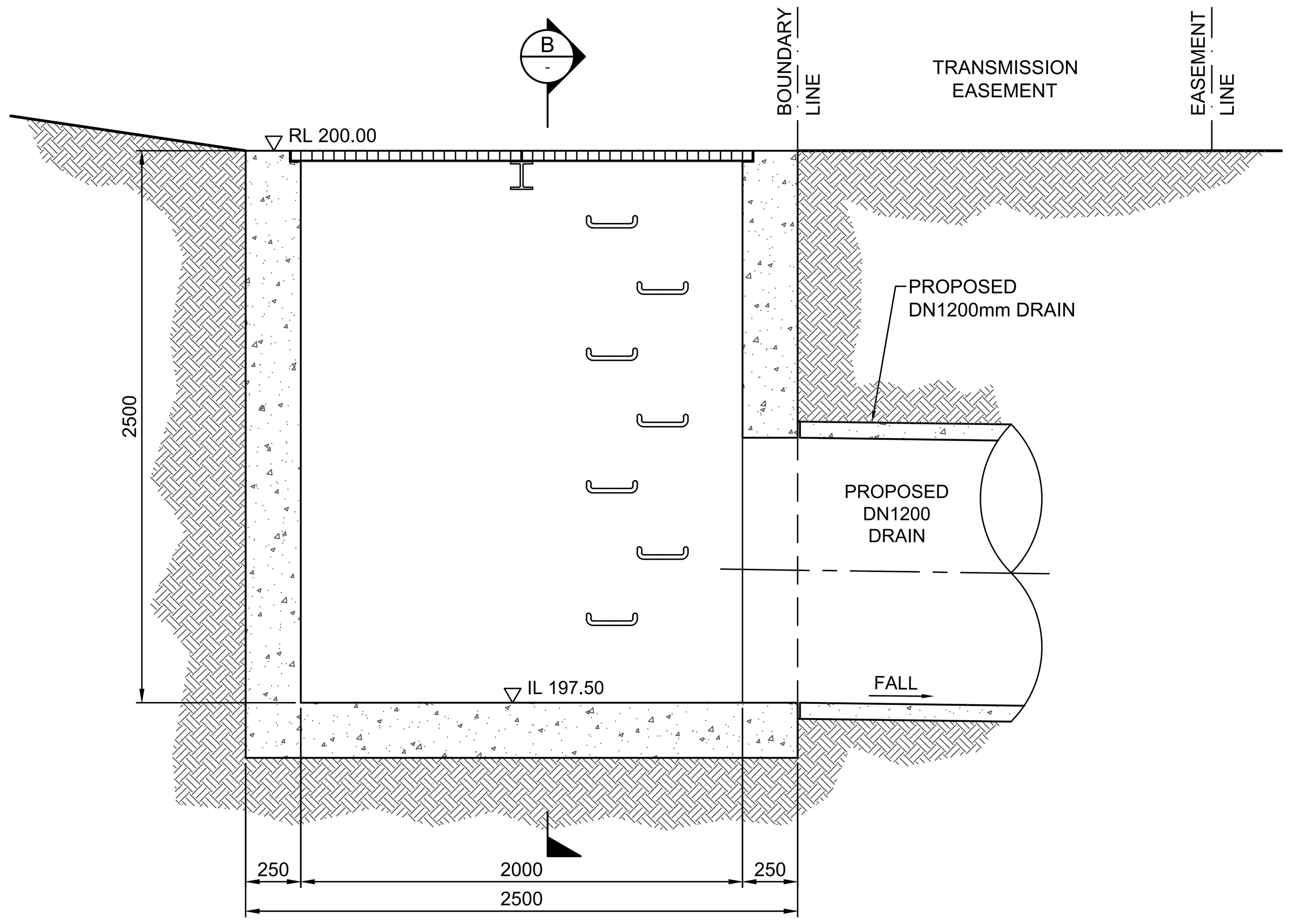
INLET ACCESS CHAMBER DETAIL
SCALE: 1:25
1
FIG 6



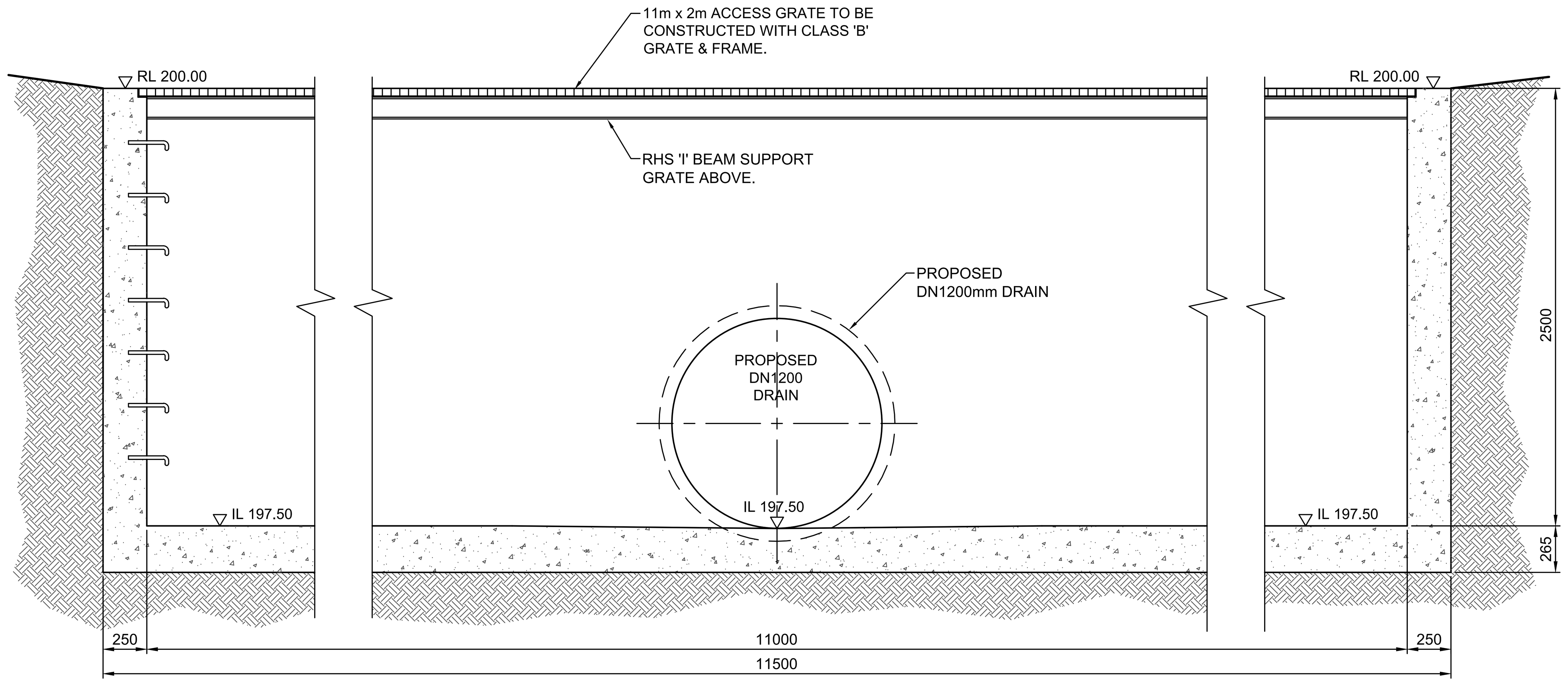
STEP IRON DETAIL
N.T.S.



PIT EDGE DETAIL A
SCALE 1:10



SECTION - A
SCALE: 1:25
A
-



SECTION - B
SCALE: 1:25
B
-

0 100 200 400 600 800 1000mm
SCALE IS BEFORE REDUCTION
SCALE 1:10

0 250 500 1000 1500 2000 2500mm
SCALE IS BEFORE REDUCTION
SCALE 1:25

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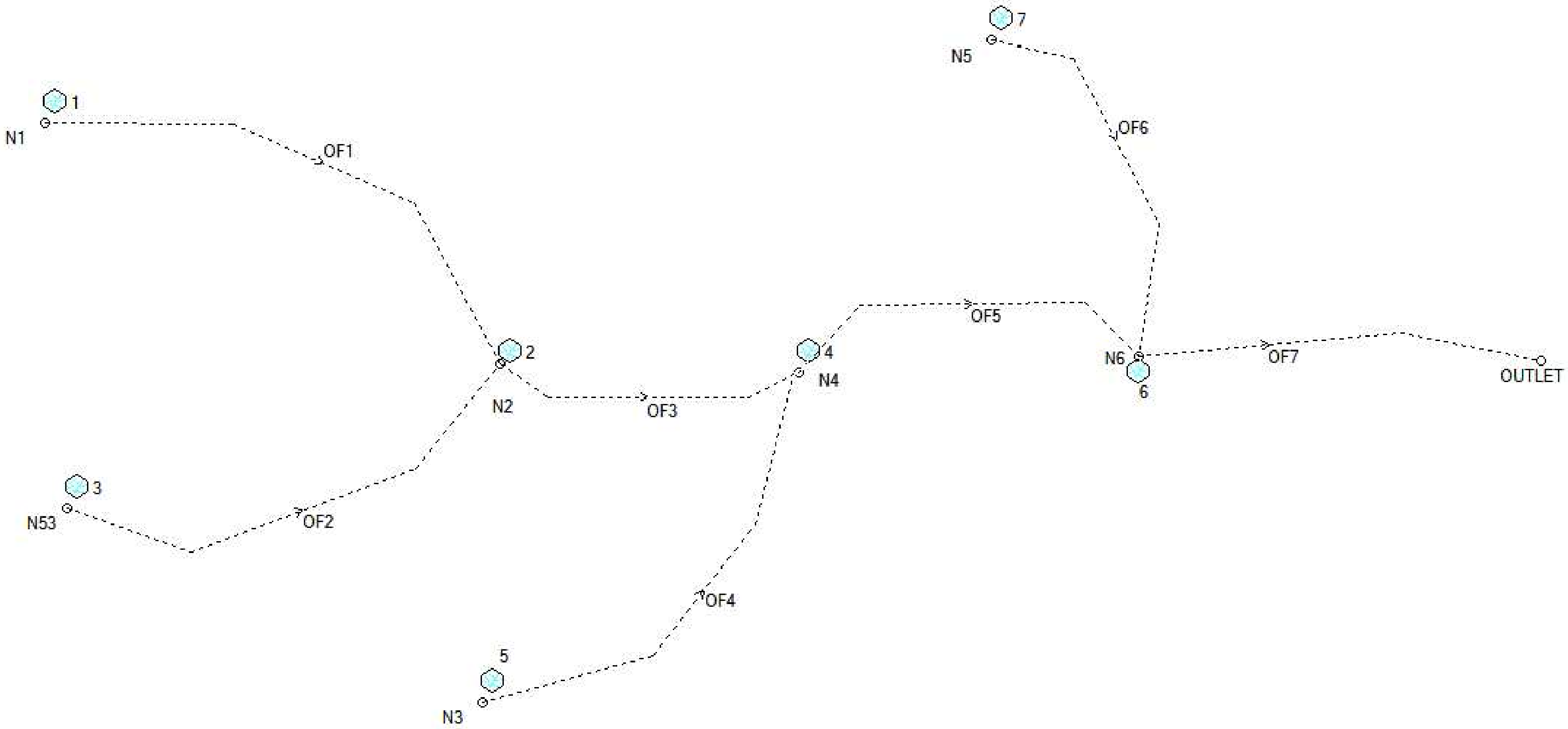
PROJECT
STORMWATER DRAINAGE
3 QUARRY ROAD,
DURAL, NSW, 2158

DRAWING TITLE
3 QUARRY ROAD DURAL
CONCEPT TRENCH DRAINAGE
INLET PIT GENERAL ARRANGEMENT

SCALE	DATE	DRAWN	CHECKED
A1 @ 1:25	Jan 23, 2017	CA	LP
JOB	DRAWING		REVISION
2016-1029	FIGURE 8		E

ATTACHMENT 2 **<u>FLOOD MODELLING OF CONDITIONS USING DRAINS MODELLING PROGRAM</u>**

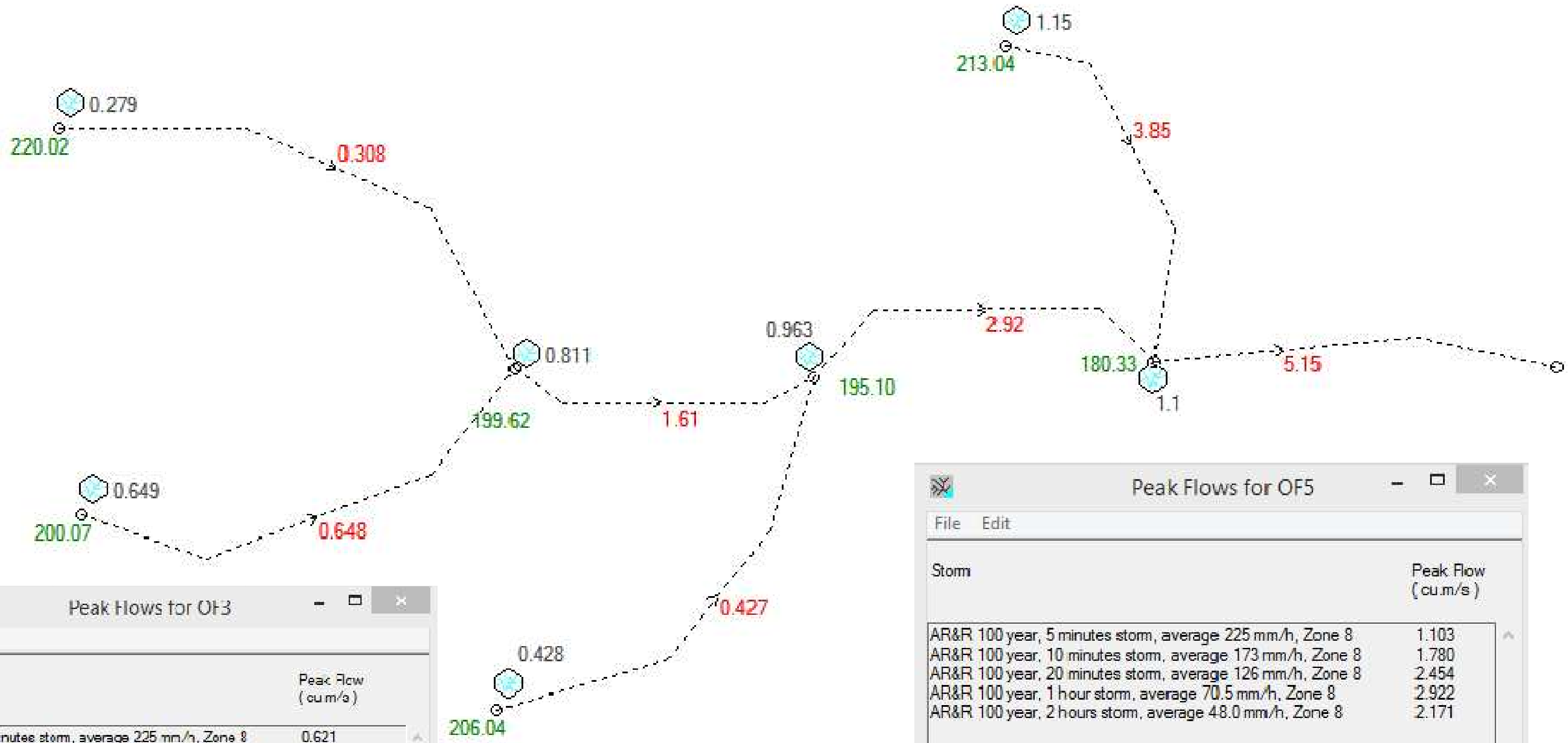
3 Quarry Road, Dural NSW



<u>DRAINS Model Node Diagram – Existing Conditions</u>

Job No. 2016-1029

3 Quarry Road, Dural NSW



Peak Flows for OF3

File Edit

Storm	Peak Flow (cu.m/s)
AR&R 100 year, 5 minutes storm, average 225 mm/h, Zone 8	0.621
AR&R 100 year, 10 minutes storm, average 173 mm/h, Zone 8	0.989
AR&R 100 year, 20 minutes storm, average 126 mm/h, Zone 8	1.351
AR&R 100 year, 1 hour storm, average 70.5 mm/h, Zone 8	1.601
AR&R 100 year, 2 hours storm, average 48.0 mm/h, Zone 8	1.219

Peak Flows for OF5

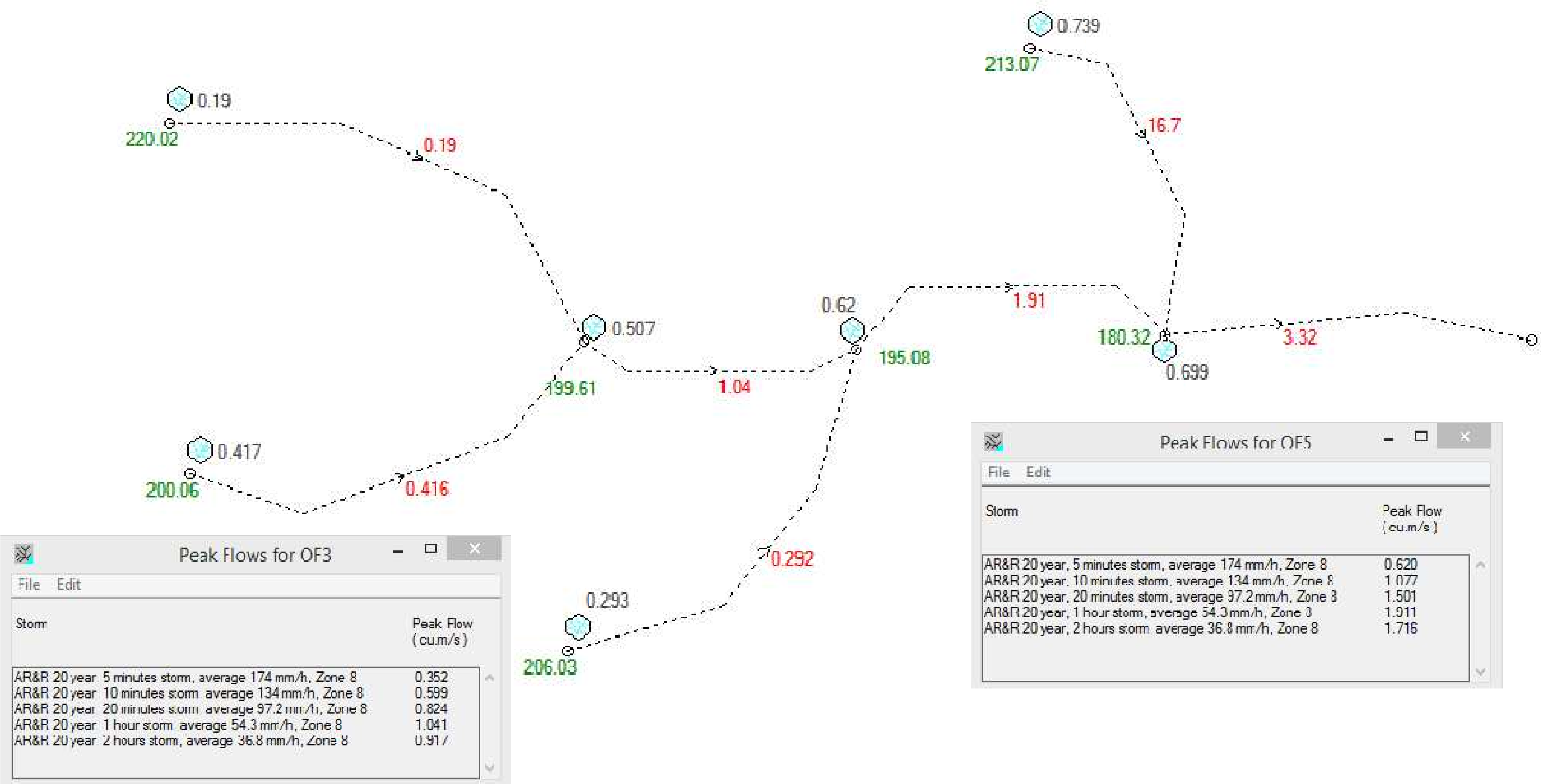
File Edit

Storm	Peak Flow (cu.m/s)
AR&R 100 year, 5 minutes storm, average 225 mm/h, Zone 8	1.103
AR&R 100 year, 10 minutes storm, average 173 mm/h, Zone 8	1.780
AR&R 100 year, 20 minutes storm, average 126 mm/h, Zone 8	2.454
AR&R 100 year, 1 hour storm, average 70.5 mm/h, Zone 8	2.922
AR&R 100 year, 2 hours storm, average 48.0 mm/h, Zone 8	2.171

<u>100 Year Storm, Worst Case Scenario – Existing Conditions</u>

Job No. 2016-1029

3 Quarry Road, Dural NSW



Peak Flows for OF3

Storm	Peak Flow (cu.m/s)
AR&R 20 year, 5 minutes storm, average 174 mm/h, Zone 8	0.352
AR&R 20 year, 10 minutes storm, average 134 mm/h, Zone 8	0.599
AR&R 20 year, 20 minutes storm, average 97.2 mm/h, Zone 8	0.824
AR&R 20 year, 1 hour storm, average 54.3 mm/h, Zone 8	1.041
AR&R 20 year, 2 hours storm, average 36.8 mm/h, Zone 8	0.917

Peak Flows for OF5

Storm	Peak Flow (cu.m/s)
AR&R 20 year, 5 minutes storm, average 174 mm/h, Zone 8	0.620
AR&R 20 year, 10 minutes storm, average 134 mm/h, Zone 8	1.077
AR&R 20 year, 20 minutes storm, average 97.2 mm/h, Zone 8	1.501
AR&R 20 year, 1 hour storm, average 54.3 mm/h, Zone 8	1.911
AR&R 20 year, 2 hours storm, average 36.8 mm/h, Zone 8	1.716

<u>20 Year Storm, Worst Case Scenario – Existing Conditions</u>

Job No. 2016-1029

Project: **3 Quarry Rd, Dural NSW** **<u>Existing Condition - DRAINS Input Data Sheet</u>** 25/01/2017
Job No. 2016-1029

PIT / NODE DETAILS Version 13

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
N2	Node					199.54		0		757.292	-375.347		1		No	
N1	Node					208		0		670.031	-329.439		4		No	
N6	Node					180		0		879.574	-374.204		7		No	
N4	Node					195		0		814.372	-376.995		41		No	
N3	Node					206		0		753.755	-440.291		47		No	
N5	Node					180		0		851.21	-313.699		57		No	
N53	Node					200		0		674.384	-403.117		174		No	
OUTLET	Node					180		0		956.368	-374.986		1344		No	

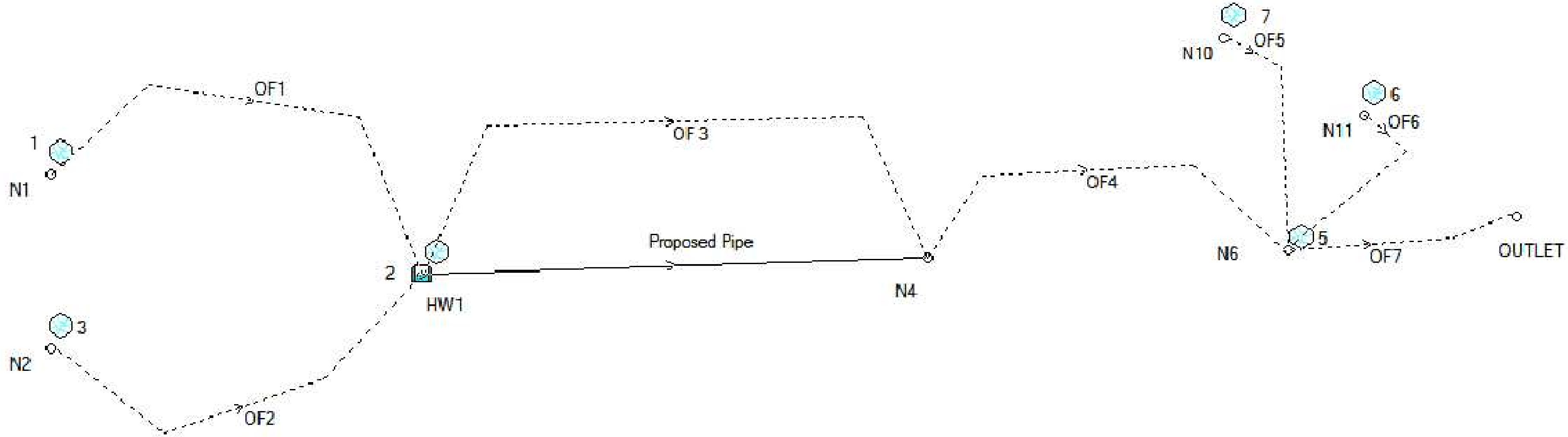
SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
2	N2	4.38	0	97	3	5	5	5	-1	320	20	-1	5.31	3.1	-1	0.2	0.013	0				1
1	N1	1.04	0	100	0	5	5	5	-1	130	-1	-1	9.23	-1	-1	0.2	-1	0				1
6	N6	5.51	0	98	2	5	5	5	-1	305	21	-1	7.21	1.6	-1	0.2	0.013	0				1
4	N4	4.46	0	97	3	5	5	5	-1	226	19	-1	5.75	3.5	-1	0.2	0.013	0				1
5	N3	1.66	0	86.7	13.3	5	5	5	-1	104	21	-1	3.2	8.6	-1	0.2	0.013	0				1
7	N5	5.33	0	93.6	6.4	0	5	5	-1	306	39	-1	9.56	7.69	-1	0.2	0.013	0				1
3	N53	3.12	0	94.4	5.5	5	5	5	-1	235	10	-1	4.89	0.9	-1	0.2	0.013	0				1

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Stor (m)	SafeDepth Minor Stor (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF3	N2	N4	1.1				Quarry Rd sectior	0.3	0.3	0.6	3.85	0	44	199.54	195	118
OF1	N1	N2	0.3				Quarry Rd sectior	0.3	0.3	0.6	26.48	100	12	220	199.54	77.26
OF7	N6	OUTLET	0.4				Swale with 1:4 sic	0.45	0.3	1	0.5	0	1345	180	180	20
OF5	N4	N6	2				Quarry Rd Sectior	0.3	0.3	0.6	6.05	0	53	195	180	248
OF4	N3	N4	1.2				Swale with 1:6 sic	0.15	0.1	1	8.73	0	2214	206	195	126
OF6	N5	N6	0.2				Swale with 1:4 sic	0.45	0.3	1	64.71	0	58	213	180	51
OF2	N53	N2	0.5				Quarry rd section	0.3	0.3	0.6	1.24	0	175	200	199.54	37

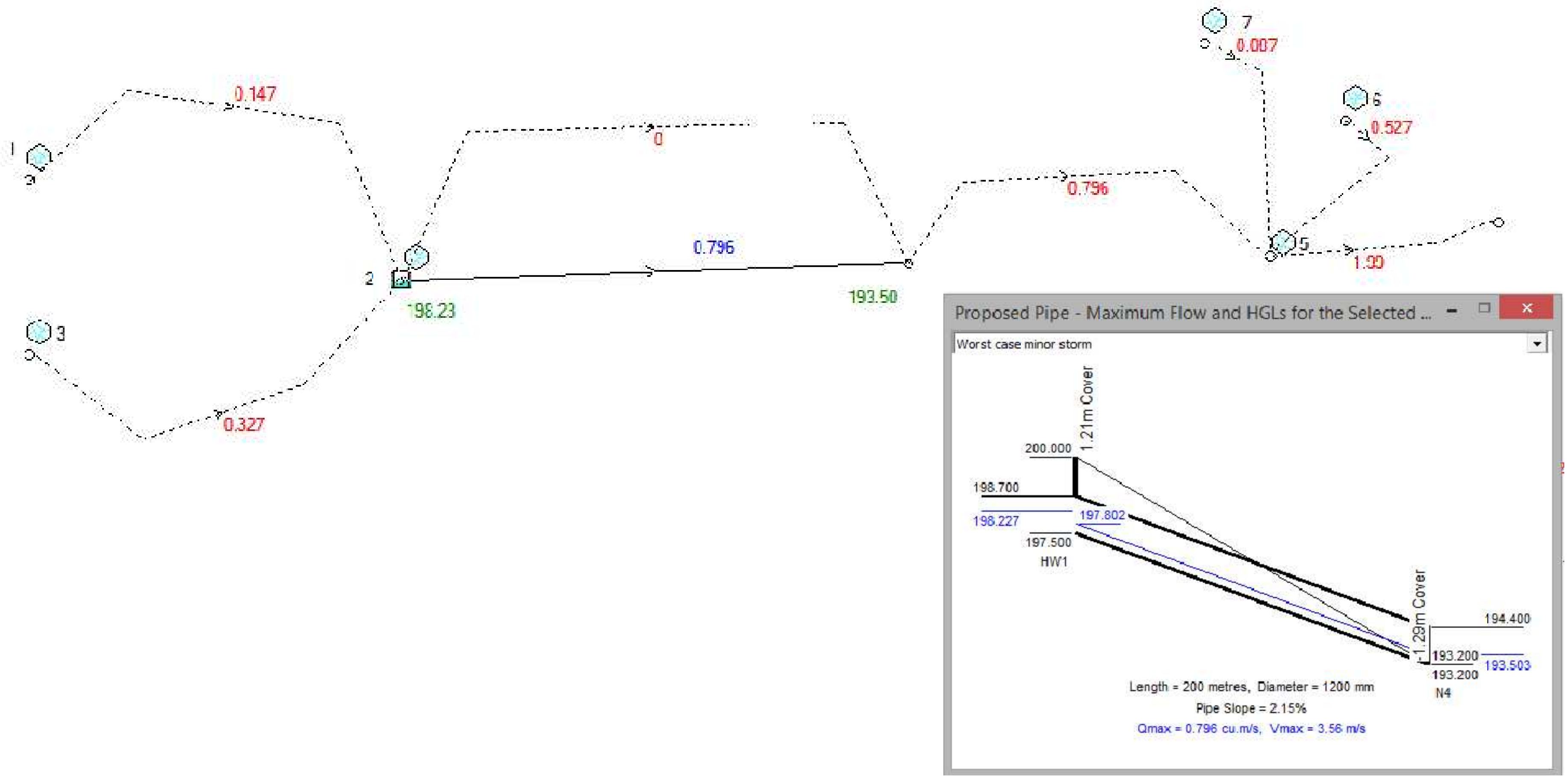
3 Quarry Road, Dural NSW



<u>DRAINS Model Node Diagram – Proposed Conditions</u>

Job No. 2016-1029

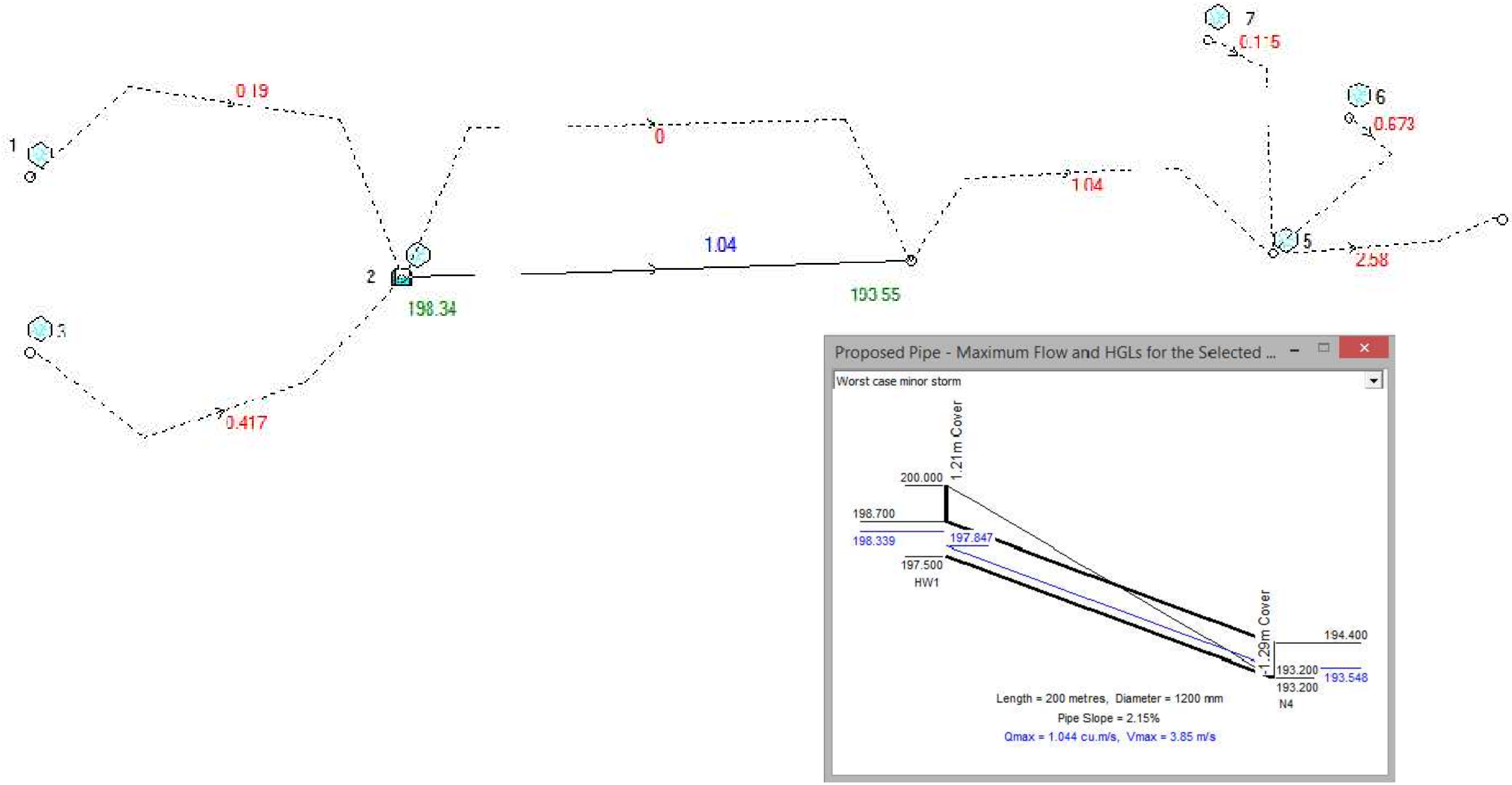
3 Quarry Road, Dural NSW



10 Year Storm, Worst Case Scenario – Proposed Conditions

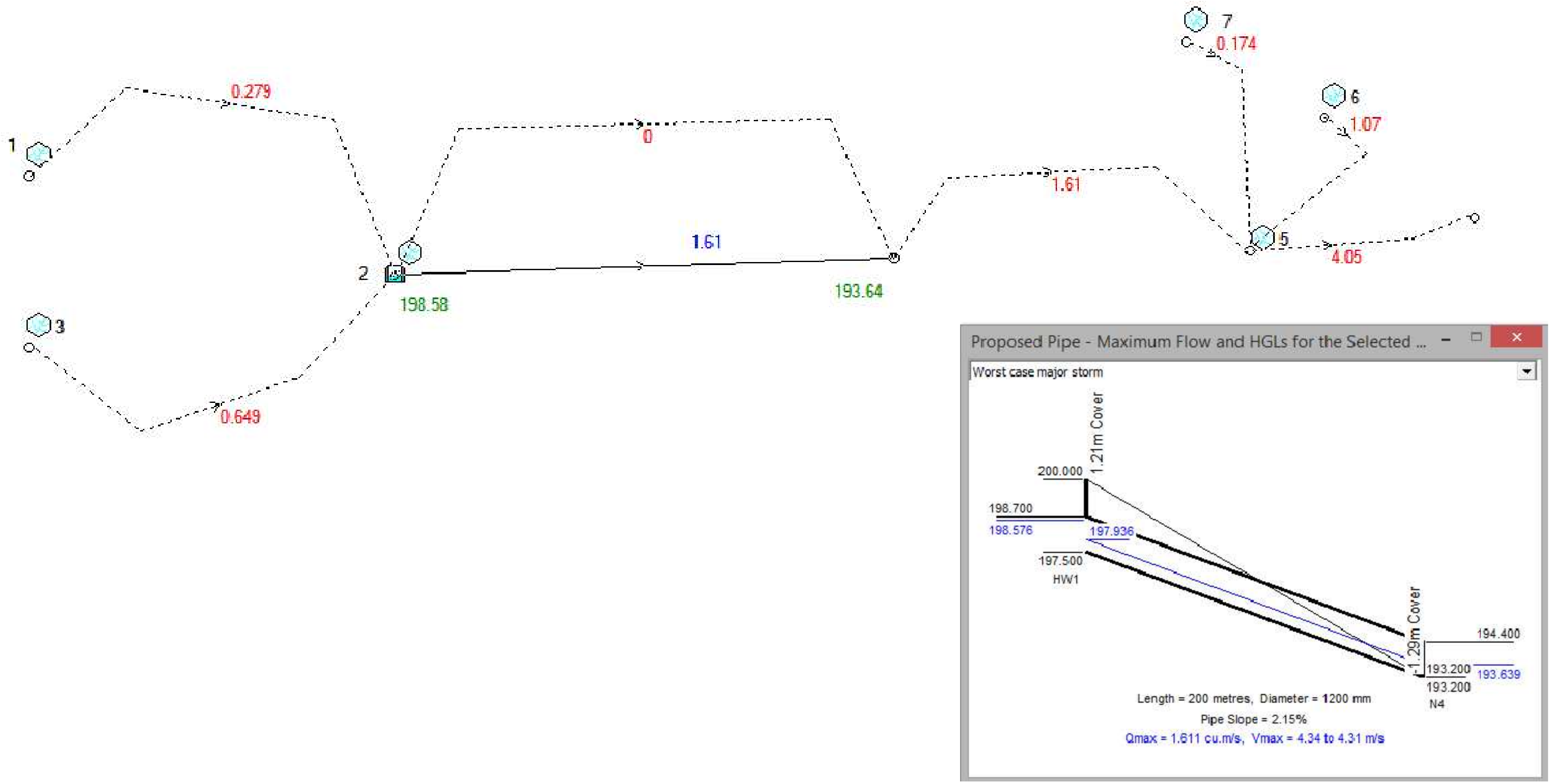
Job No. 2016-1029

3 Quarry Road, Dural NSW



<u>20 Year Storm, Worst Case Scenario – Proposed Conditions</u>

3 Quarry Road, Dural NSW



<u>**100 Year Storm, Worst Case Scenario – Proposed Conditions**</u>

Project: **3 Quarry Rd, Dural NSW** **<u>Proposed Condition - DRAINS Input Data Sheet</u>** 25/01/2017
Job No. 2016-1029

PIT / NODE DETAILS Version 13

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
N1	Node					208		0		729.587	-367.976		4		No	
N6	Node					180		0		821.457	-373.504		7		No	
N2	Node					200		0		729.587	-380.897		174		No	
OUTLET	Node					180		0		838.469	-371.097		1344		No	
HW1	Headwall				0.5	200		0		757.154	-375.354		3901			
N4	Node					193.2		0		794.758	-374.17		41		No	
N10	Node					213		0		816.65	-357.823		4084		No	
N11	Node					213		0		827.08	-363.547		4095		No	

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
1	N1	1.04	0	100	0	5	5	5	-1	130	-1	-1	9.23	-1	-1	0.2	-1	0				1
5	N6	7.49	0	100	0	5	5	5	-1	395	-1	-1	6.5	-1	-1	0.2	-1	0				1
3	N2	3.12	0	94.4	5.5	5	5	5	-1	235	10	-1	4.89	0.9	-1	0.2	0.013	0				1
2	HW1	4.38	0	97	3	5	5	5	-1	320	20	-1	5.31	3.1	-1	0.2	0.013	0				1
7	N10	0.73	0	100	0	5	5	5	0	160	-1	0	5.625	-1	0.013	0.2	-1	0				1
6	N11	5.33	0	100	0	5	5	5	-1	345	-1	-1	9.565	-1	-1	0.2	-1	0				1

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)
Proposed F	HW1	N4	200	197.5	193.2	2.15	Concrete, u	1200	1200	0.013	NewFixed	1	N4	0					

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Stor (m)	SafeDepth Minor Stor (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF1	N1	HW1	0.8				Quarry Rd	0.3	0.3	0.6	26.48	100	12	220	199.54	190
OF7	N6	OUTLET	0.4				Swale with	0.45	0.3	1	0.5	0	1345	180	180	20
OF2	N2	HW1	0.5				Quarry rd s	0.3	0.3	0.6	1.24	0	175	200	199.54	37
OF 3	HW1	N4	1.9	200	3	2	Channel se	0.09	0.03	1	3.4	0	3932	200	193.2	200
OF4	N4	N6	1.3				Quarry Rd	0.3	0.3	0.6	7.33	0	4059	193.2	180	180
OF5	N10	N6	1				Overflow a	0.05	0	0.6	17.55	0	4089	213	180	188
OF6	N11	N6	2.5				Overflow a	0.05	0	0.6	9.57	0	4101	213	180	345

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover	Cover (m)	
Proposed F	Concrete, u	1200	0.6	-1.29	Unsafe

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ATTACHMENT 3 **SITE SURVEY**

The site survey was conducted on 14th December 2016:

Image 1: Quarry Road has a road fall towards east

Image 2: Quarry Road has a road sag east of the southern site boundary

Image 3: Quarry Road falls east from Old Northern Road towards the site.

Image 4: Vineys Road is a gravel road located north of the site which falls towards the eastern site boundary

Image 5: Vineys Road has a road sag near the cross intersection at Vineys Lane.

Image 6: The northern site boundary has an existing single storey brick house and green areas

Image 7: Vineys Road has a falling gradient towards east of site.

Image 8: At the bend of Vineys Road located north of site, the road falls towards the site.

Image 9: Old Northern Road falls south towards Quarry Road