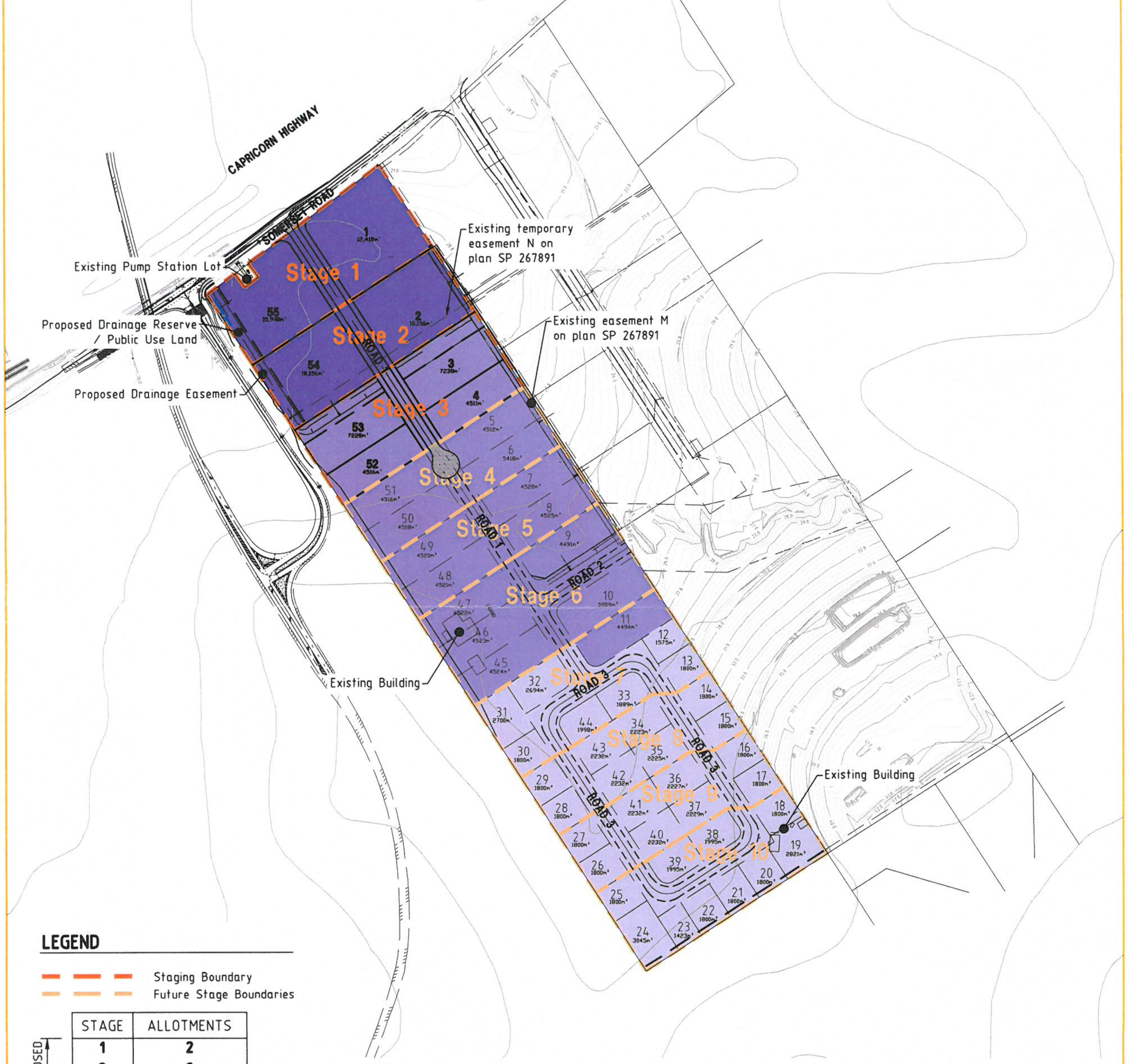
ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/55-2015

Dated: 12 November 2018



LEGEND

Staging Boundary

Future Stage Boundaries

	STAGE	ALLOTMENTS
PROPOSED	1	2
PROPOSED	2	2
PROPOSED	3	4
FUTURE ROL APPLICATION	4	4
FUTURE ROL APPLICATION	5	4
FUTURE ROL APPLICATION	6	5
FUTURE ROL APPLICATION	7	8
FUTURE ROL APPLICATION	8	8
FUTURE ROL APPLICATION	9	8
FUTURE ROL APPLICATION	10	10

SUMMARY OF DEVELOPMENT

- Low Impact Industry - 33 Lots (Stages 7-10)
- Medium Impact Industry - 18 Lots (Stages 3-7)
- High Impact Industry - 4 Lots (Stages 1-2)

Total No. Proposed Lots = 55

Total Area = 23.74ha.

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
PRELIMINARY STAGING LOT LAYOUT
R14205 Revision 1

0 12.5 50.0m 1:2500 (A1)

0 25.0 100.0m 1:5000 (A3)

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calibre CONSULTING

LEGEND

- S — Existing Sewer Main
- Top of Batter
- Toe of Batter
- 22.50 — Proposed Contours
- S — Proposed Sewer line

N

ROCKHAMPTON REGIONAL COUNCIL

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ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
PRELIMINARY SEWER LAYOUT
R14205 Revision 1

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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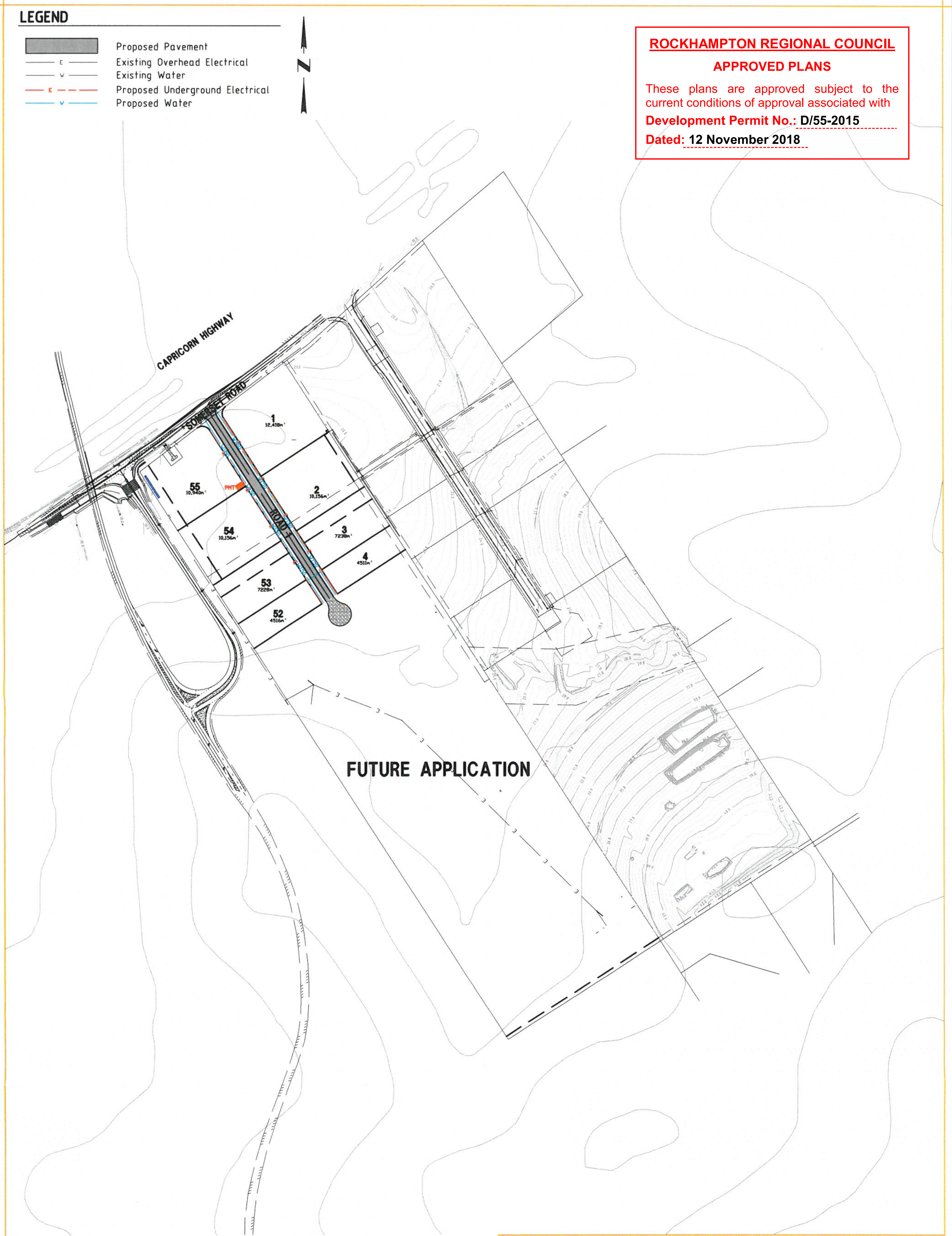

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Dated: 12 November 2018

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
WATER AND ELECTRICAL LAYOUT PLAN
R14205 Revision 1

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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LEGEND

- Existing Drainage Line
- Top of Batter
- Toe of Batter
- Existing Contours
- Proposed Stormwater Pipe
- Stormwater Catchment

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ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
STORMWATER CATCHMENT PLAN
R14205

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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LEGEND

- Bio-Retention Filter Area
- Existing Sewer Main (S)
- Top of Batter
- Toe of Batter
- Proposed Contours (22.50)
- Proposed Subsoil Drainage (DS)
- Grassed Weir Approx 40m long

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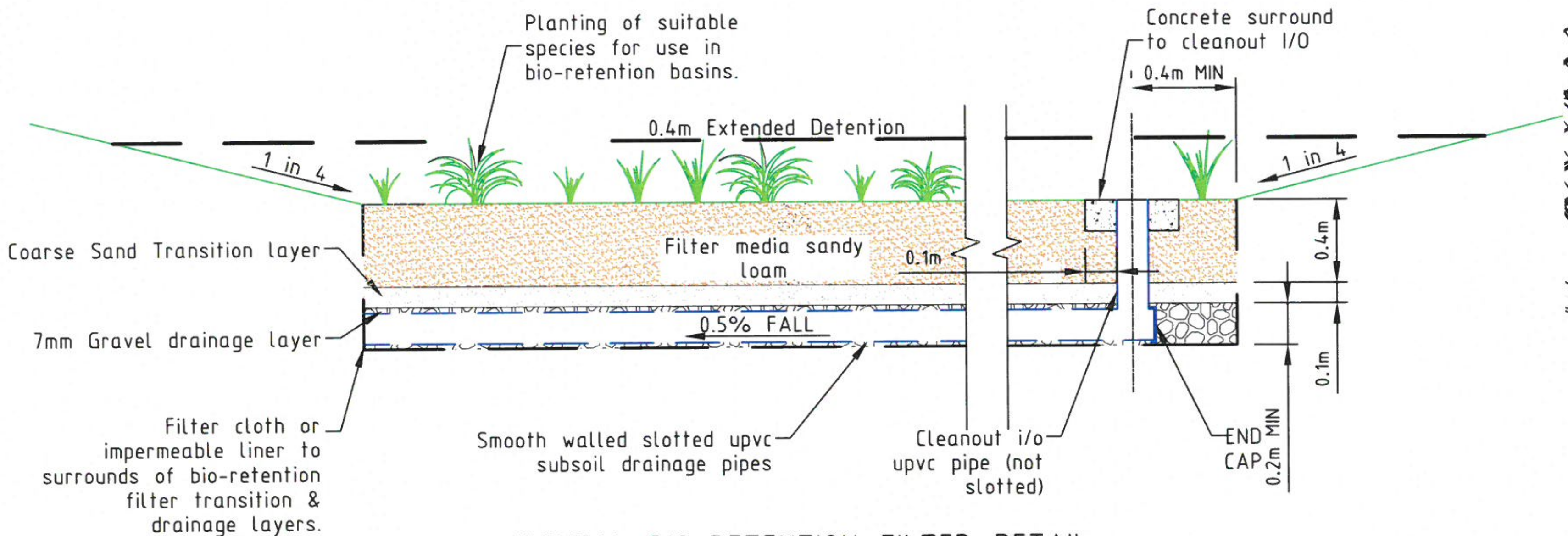
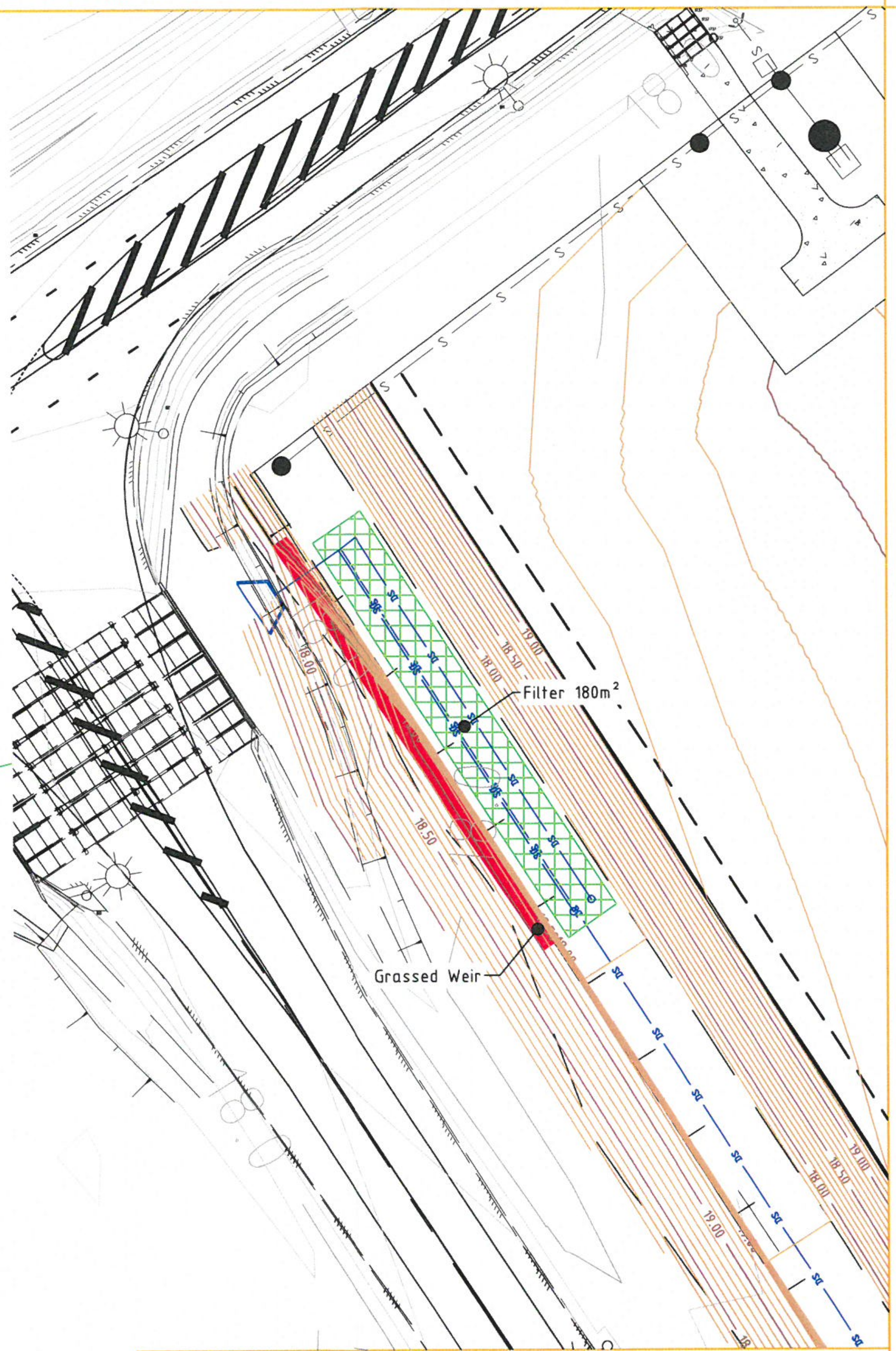


TYPICAL BIO-RETENTION FILTER DETAIL

N.T.S



ZEBRA INDUSTRIAL ESTATE FOR RON & TRACEY BOWES STORMWATER BASIN PLAN

R14205 **Revision 1**

Scale: 0 1.25 5.0m 1:250 (A1); 0 2.5 10.0m 1:500 (A3)

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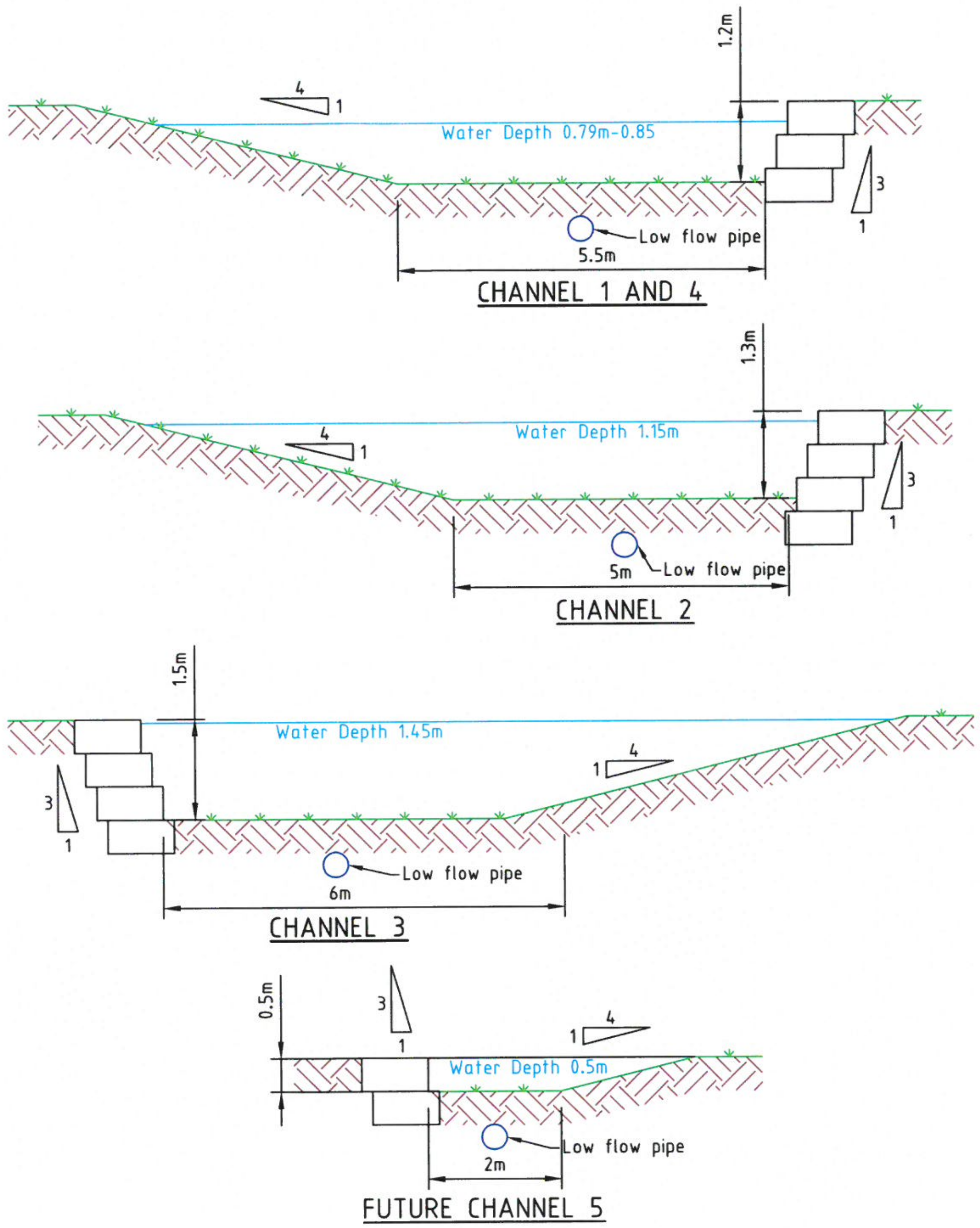

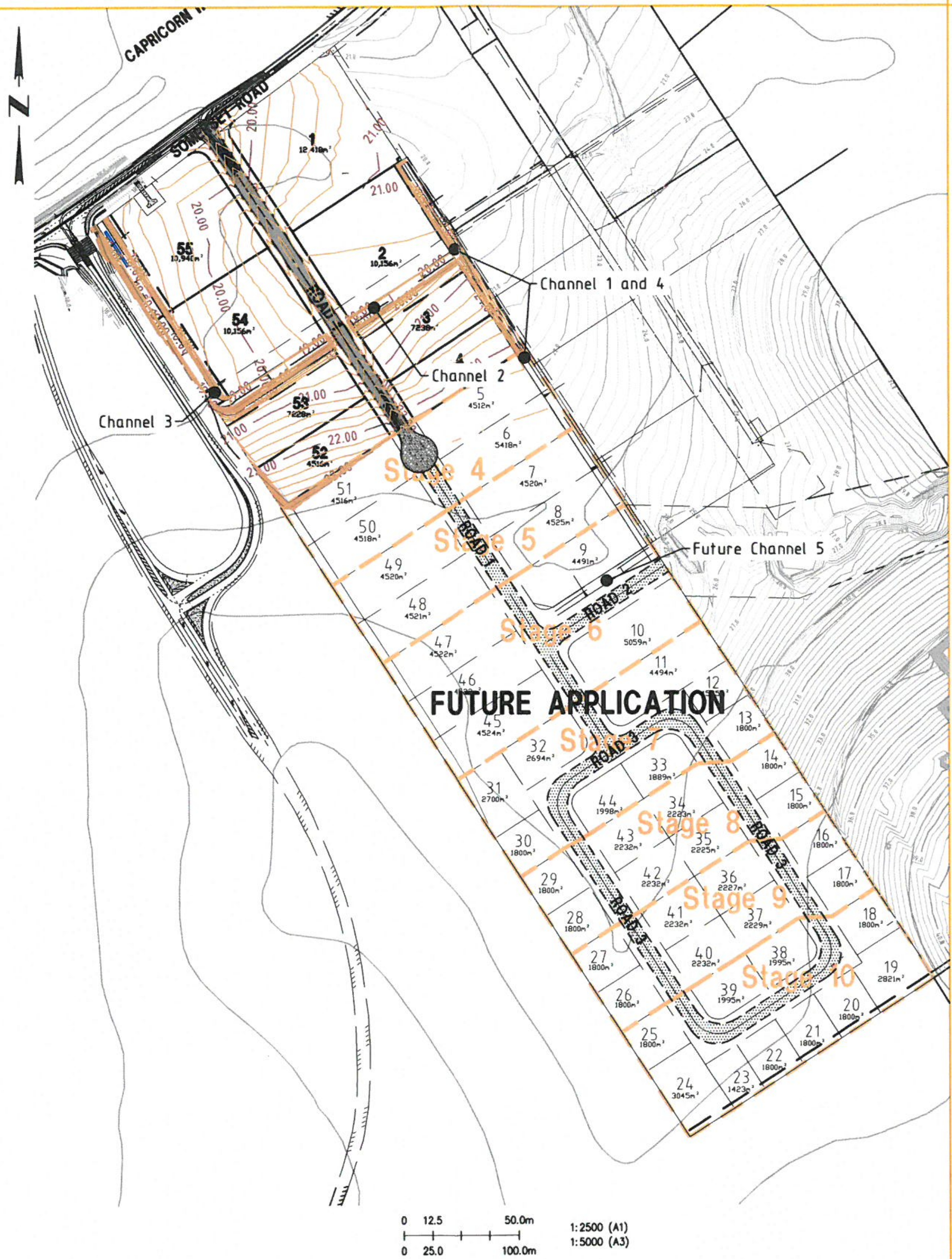

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
CHANNEL CROSS SECTIONS PLAN
R14205 Revision 1

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LEGEND

- Basin Filter Area
- Exiting Contours
- Water Quality Catchments

N

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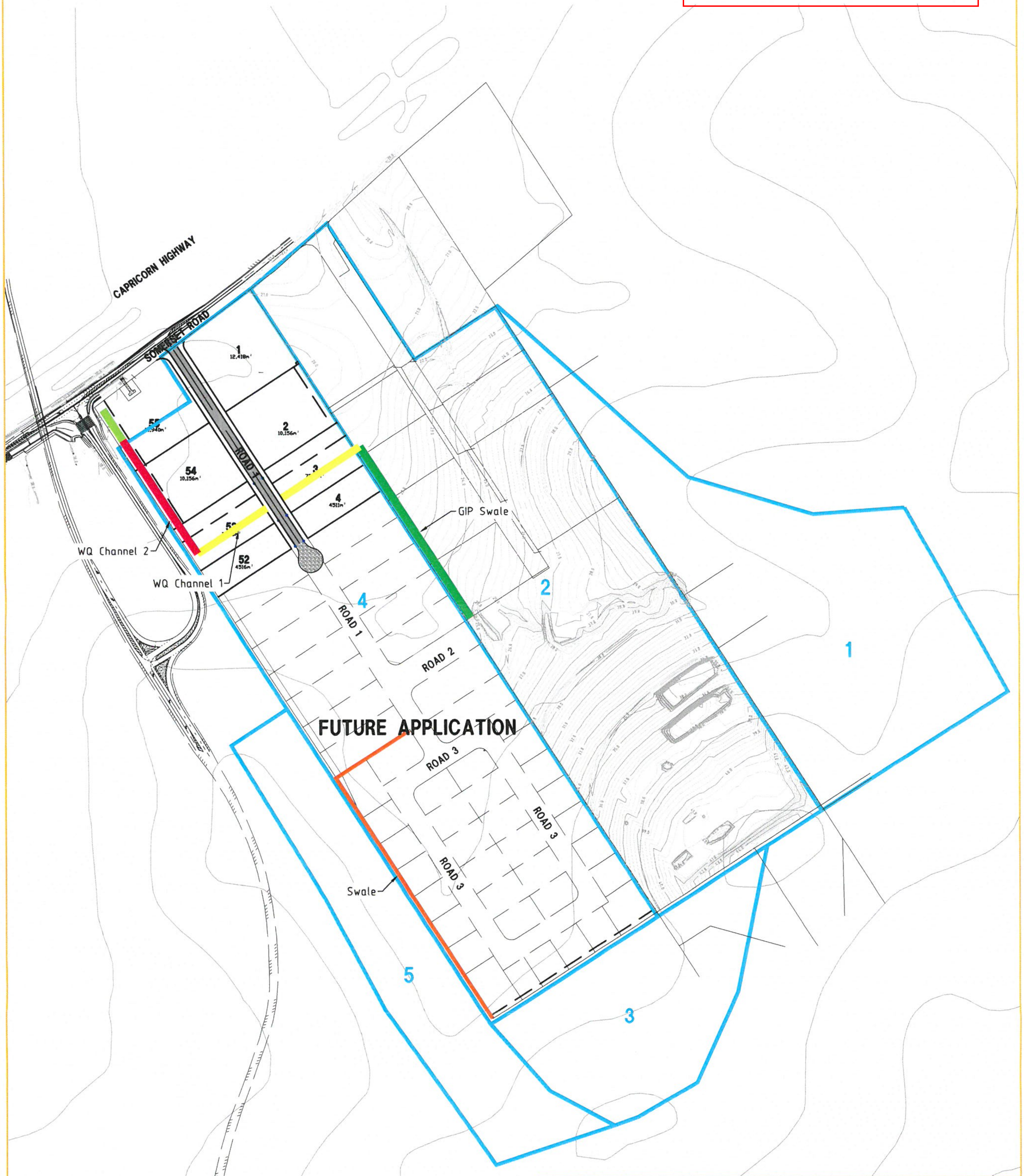

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
STORMWATER WATER QUALITY CATCHMENT PLAN
R14205

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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calibre CONSULTING

LEGEND

——— D ———	Existing Drainage Line
——┬——┬——	Top of Batter
—— ——	Toe of Batter
— 22.50 —	Proposed Contours
—— D ——	Proposed Stormwater Pipe

N

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ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
STORMWATER MANAGEMENT PLAN
R14205 Revision 1

0 12.5 50.0m — 1:2500 (A1)
0 25.0 100.0m — 1:5000 (A3)

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LEGEND

Industrial Access

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
ROAD HIERARCHY PLAN
R14205 Revision 1

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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Dated: 12 November 2018

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
ROAD LAYOUT PLAN
R14205-SK08 Revision 1

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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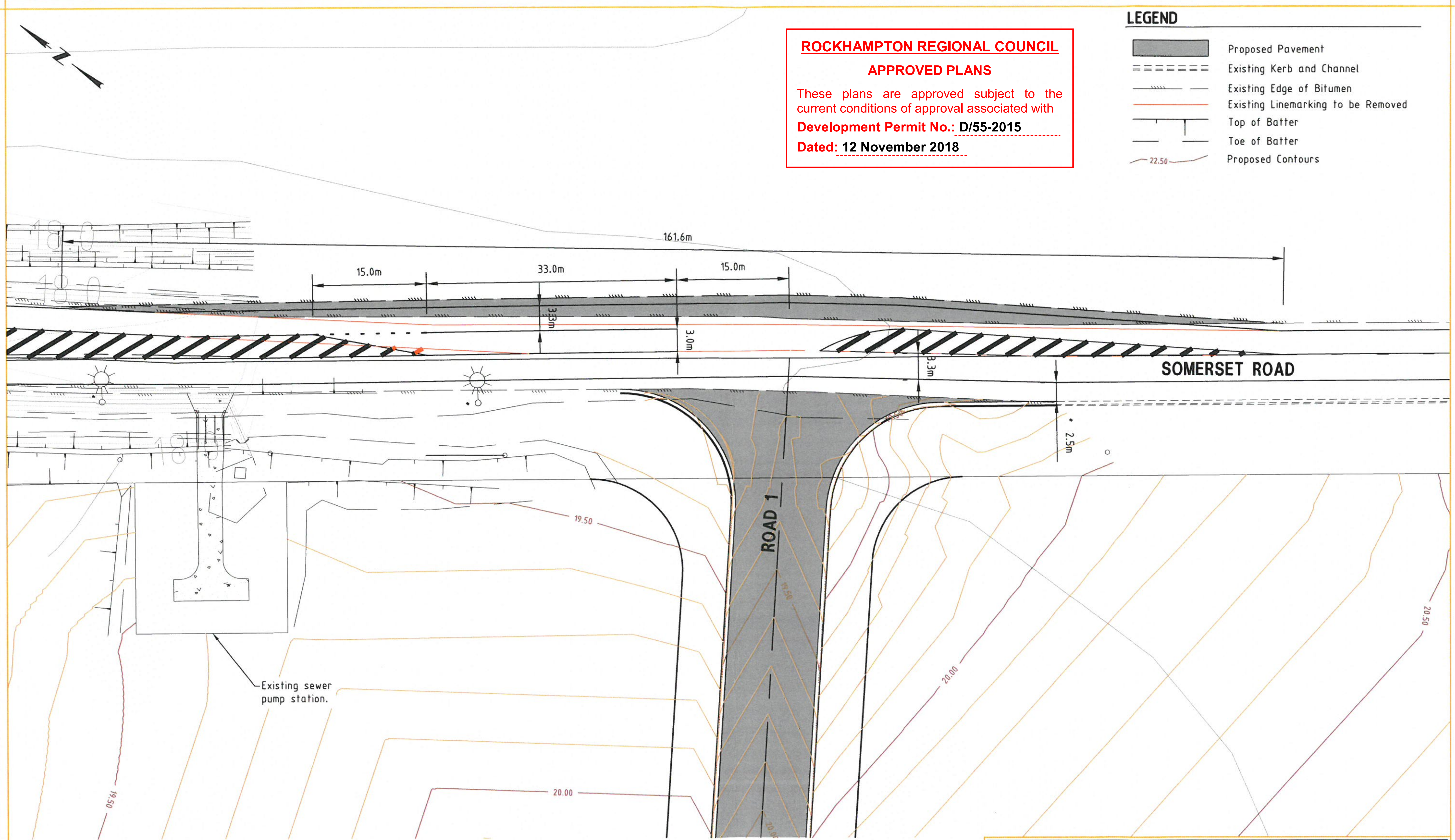

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
INTERSECTION DETAILS PLAN
R14205 Revision 1

0 1.25 5.0m 1:250 (A1)
0 2.5 10.0m 1:500 (A3)

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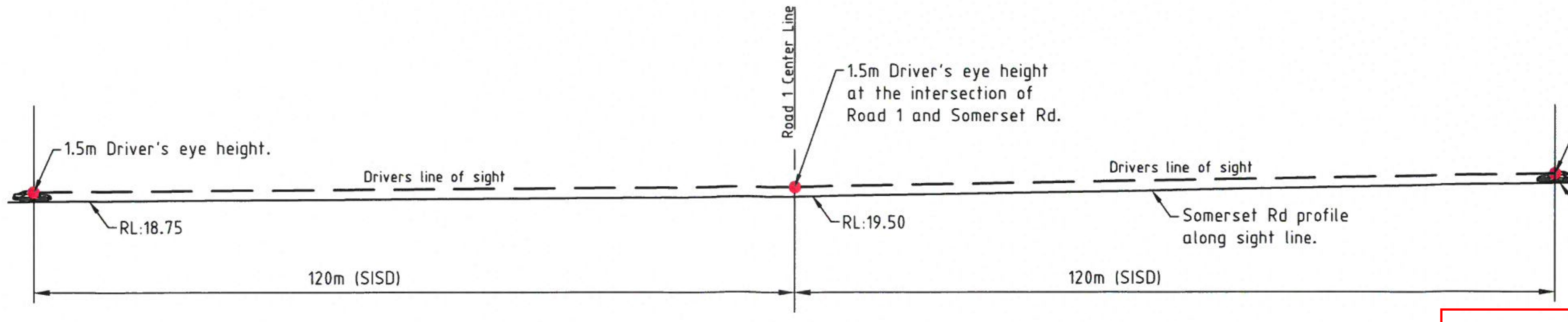
LEGEND

- Proposed Pavement
- Existing Kerb and Channel
- Existing Edge of Bitumen
- Travel distance
- Driver's Line of Sight
- Top of Batter
- Toe of Batter
- Proposed Contours (22.50)



ELEVATION
Scale 1:1000

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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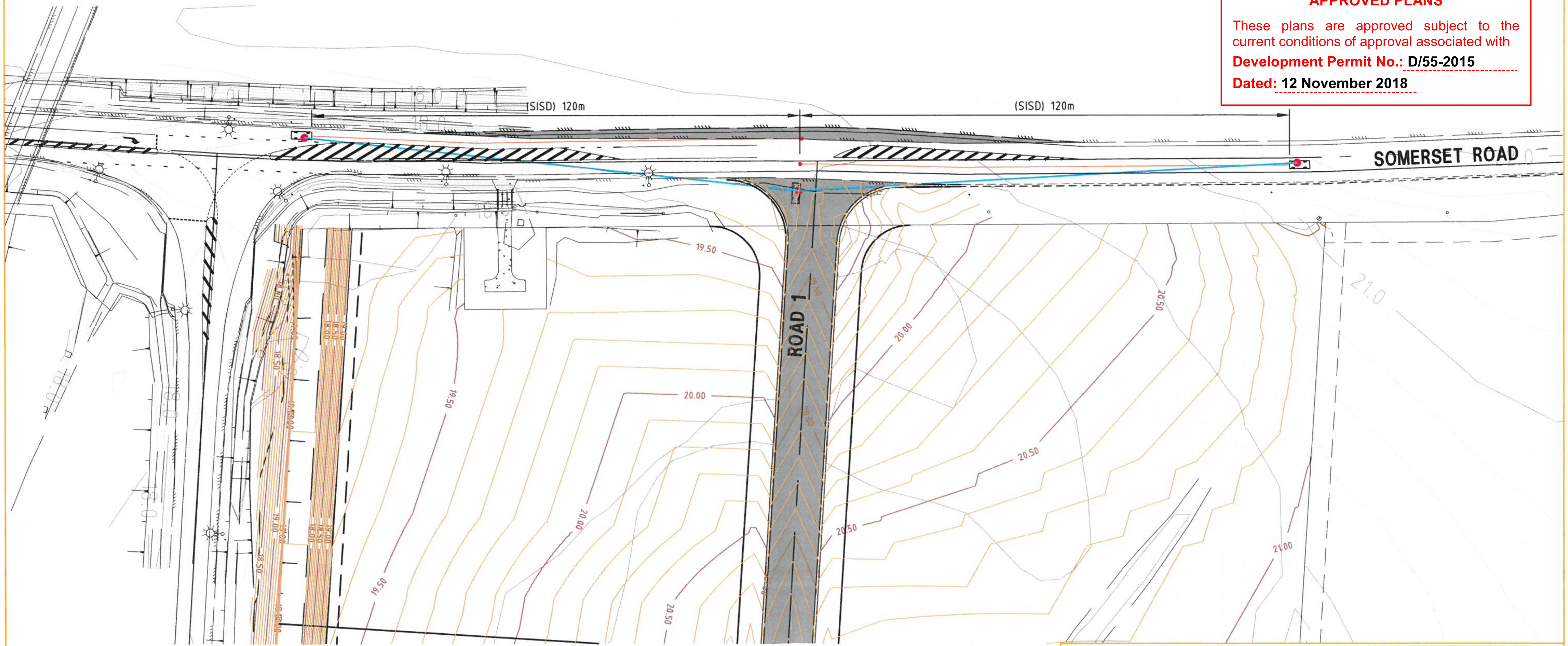

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
INTERSECTION SIGHT DISTANCE PLAN
R14205 Revision 1

0 2.5 10.0m 1:500 (A1)
0 5.0 20.0m 1:1000 (A3)

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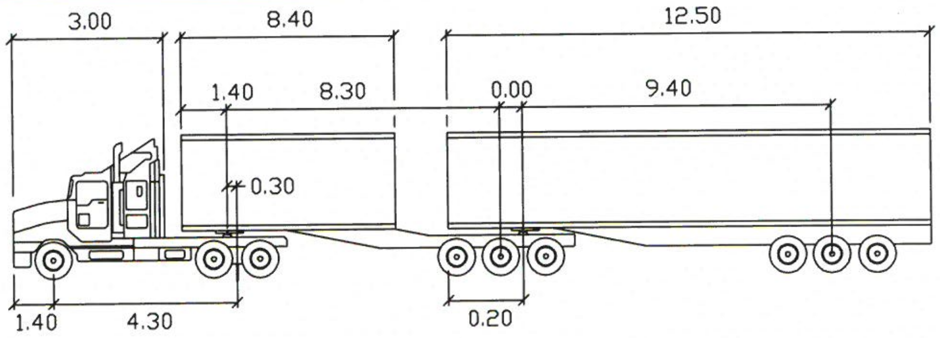

B-DOUBLE 26M meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0
Trailer Width	: 2.50	Steering Angle	: 22.2
Tractor Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

ZEBRA INDUSTRIAL ESTATE
FOR RON & TRACEY BOWES
VEHICLE TURNPATH PLAN
R14205 Revision 1

0 12.5 50.0m 1:2500 (A1)
0 25.0 100.0m 1:5000 (A3)

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BROWN

Regional Stormwater Management Plan

Gracemere Industrial Area

East of Gracemere Overpass

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/55-2015

Dated: 12 November 2018

March 2014

B13313.W-01D

Prepared for Gracemere Industry Park Developments Pty Ltd

Water & Environment Engineering Division

Smart Consulting

COMMERCIAL IN CONFIDENCE

Brown Consulting (QLD) Pty Ltd
Level 6, 199 Grey Street
SOUTH BRISBANE QLD 4101
PO BOX 10349
ADELAIDE ST QLD 4000
Ph: (07) 3895 3444

2013

DOCUMENT CONTROL

B13313.W-01

Issue	Date	Issue Details	Author	Checked	Approved
A DRAFT	29/11/2013	Draft for Internal Review	AH	MS (RPEQ 9485)	MS
B DRAFT	05/12/2013	Draft for Internal Review	AH	MS (RPEQ 9485)	MS
B	20/12/2013	For Council Approval	AH	MS (RPEQ 9485)	MS
C	23/01/2014	For Council Approval	AH/BF	MS (RPEQ 9485)	MS
D	13/03/2014	For Council Approval	AH/BF	MS (RPEQ 9485)	[signature]

Table of Contents

List of Figures

List of Tables

1. Introduction

Brown Consulting (Qld) Pty Ltd has been commissioned by Gracemere Industry Park Pty Ltd to prepare a Stormwater Management Plan (SMP) for the Gracemere Industrial Area, east of the Gracemere Overpass. This report investigates the impacts of existing infrastructure under two scenarios:

- Development of 245 Somerset Road (Lots 2 and 50 on SP260358); and
- Development of future industrial land on the eastern side of the Gracemere Overpass.

This report has also been prepared to address Item 1 of Rockhampton Regional Councils (RCC) Information Request dated 12 November 2013 for the 245 Somerset Road development.

Issue C of this report provides further clarification of percentage impervious values adopted for developed hydrological analysis, refer to **Section 3.3** for details.

1.1 Scope of this Report

This SMP addresses the management of stormwater quality and quantity during the operational phase of the development. Best Practise Water Sensitive Urban Design (WSUD) measures have been adopted for the management of stormwater runoff from the site.

This report demonstrates that the requirements of Rockhampton Regional Council (RRC), the *Queensland Urban Drainage Manual Third Edition 2013 Provisional* (QUDM, 2013) and State Planning Policy (2013) can be achieved in terms of stormwater management.

2. Site Characteristics

2.1 Location

Located within the suburb of Gracemere within the Rockhampton Regional Council (RRC) local government area, the site has real property descriptions of Lot 2 and Lot 50 on SP260358. The site of approximately 21.8ha extends South East from Somerset Road which is its only current access point. **Figure 2.1** below shows the approximate location of the site.

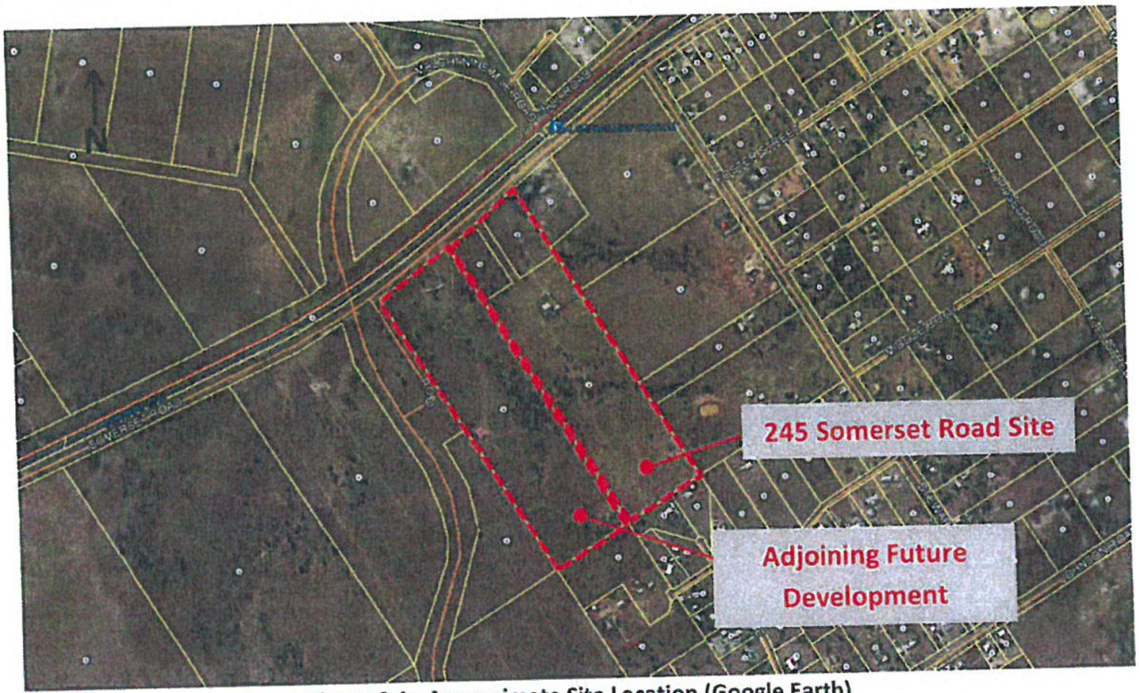


Figure 2.1: Approximate Site Location (Google Earth)

2.2 Existing Topography, Drainage and Vegetation

From topographical information available, the site is part of a catchment that drains roughly North West and has a discharge location on the western side of the Gracemere Industrial Access Road overpass. Once discharged at this location the water enters a culvert on the adjacent side of the Capricorn Highway, eventually draining to Neerkol Creek.

Being located towards the outskirts of Gracemere the site is surrounded by acreage properties. Currently the majority of the land is open grassed areas with some existing vegetation.

The site itself consists mainly of grassed areas similar to its surroundings and also contains two small dams.

3. Hydrology

Hydrological analysis has been undertaken to determine the impact of the site development and surrounding industrial development east of the Somerset Connection Road overpass on the existing culverts discharging under the Central Rail line and the Capricorn Highway. The analysis undertaken involved the following:

- Determining the catchment area to the culverts under the Capricorn Highway;
- Developing a Watershed Bounded Network Model (WBNM) to determine existing flows;
- Comparison of the WBNM flows with the *Gracemere Catchments Flood Study* (Aurecon, 2012); and
- Modelling of the site and surrounding area developed as proposed to determine changes in flow.

3.1 Catchments

The catchment to the Capricorn Highway was determined based on a digital terrain model (DTM) provided by RRC. Drawing No. **B13313.W-F001** in **Appendix B** shows the existing catchments boundaries. Areas for each sub-catchments are shown within **Table 3.1** below. Percent impervious values were adopted generally in accordance with Aurecon 2012, however a higher values has been adopted for some catchments based on the existing landuse within the sub-catchment.

Table 3.1: Existing Catchment Parameters

Subcatchment	Area (ha)	% Impervious
502	23.50	5%
504	3.10	20%
505	2.93	10%
506	40.80	5%
507	96.66	5%
508	3.32	5%
509	62.03	2%
513	65.13	0%
515	45.04	2%
520	64.67	5%
521	77.36	5%
522	23.84	2%
523	10.96	5%
Total	**519.32**	**3.7%**

3.2 Existing Scenario WBNM Analysis

Modelling of the existing scenario peak flows for the 1 to 100 year ARI events for the 45 to 270 minute duration storms for all catchments has been undertaken using WBNM. WBNM is an advanced Windows based hydrological software package for simulation of runoff from natural and partially developed urban catchments. The flows generated by the WBNM model were compared to the flows determined by Aurecon 2012 at the Capricorn Highway Culverts.

3.2.1 Losses/Model Parameters

Initial and continuing losses were initially selected in accordance with Table 6.6 of AR&R (1987). The model was calibrated by adjusting the losses and Lag Parameter (C) values. The following parameters were adopted for the WBNM model for all sub-catchments:

- C Value of 1.8;
- Initial Loss of 30mm; and
- Continuing Loss of 2.5 mm/hr

These values are within the ranges specified by AR&R and the WBNM User Guide. A 30mm initial loss was adopted in order to verify that the flows produced by WBNM were similar to the flows produced by the Queensland Rational Method (QRM).

3.2.2 Rainfall Data

Design storm rainfall hydrographs were generated in WBNM using the Log Normal Intensities and Geographical Factors for Rockhampton Regional Council.

3.2.3 Existing Scenario Results

The existing scenario WBNM results for flows discharging to the Capricorn Highway are shown in **Table 3.2** below. A comparison of the WBNM flows and the Aurecon 2012 flows is also provided. An additional verification to the Queensland Rational Method was also undertaken. Refer to **Appendix B** for details of the QRM calculations.

Table 3.2: Existing WBNM Results

ARI	WBNM (m^3/s)	Aurecon (m^3/s)	QRM (m^3/s)
1	8.74	-	13.12
2	14.72	-	18.06
5	24.70	29.10	26.09
10	31.07	33.40	31.27
20	40.46	39.00	38.28
50	53.33	48.80	49.69
100	64.09	60.20	59.10

As shown the WBNM results are generally similar to both the Aurecon 2012 and the QRM results. It is noted that the WBNM flows for the 1 and 2 year ARI events are lower than the QRM, this may be due to the QRM over estimating flows for the lower recurrence intervals events. Flows for the 100 year ARI events are similar across all three methodologies. Therefore the WBNM configuration is considered to be appropriate.

3.3 Developed WBNM Analysis

The following two scenarios have been modelled to determine the impact of the developments of the site and the industrial area east of the Somerset Connection Road Overpass:

- **Scenario A**: Development of the Site Only; and
- **Scenario B**: Development of the site and industrial areas east of the Somerset Connection Road.

3.3.1 Updated Catchments

Catchments were updated in order to account for the changed in percentage impervious for each modelled scenario. Routing factors were also updated were applicable to account for reduced flow times through the catchments east of the Somerset Connection Road Overpass. **Table 3.3** shows the revised catchments areas and percent impervious.

Table 3.3: Developed Scenario Catchment Parameters*

Subcatchment	Scenario A		Scenario B	
	Area (ha)	% Impervious	Area (ha)	% Impervious
5021	8.39	70%	8.39	70%
5022	9.04	70%	9.04	70%
5023	10.32	70%	10.32	70%
506	38.52	5%	38.52	70%
Total	**521.29**	**7%**	**521.29**	**12%**

*- Modified subcatchments shown only. Total values include all other unmodified subcatchments as per **Table 3.1**

The following percentages impervious values have been adopted for the developed scenario:

- Low Impact Industry Precinct – 80%
- Medium Impact Industry Precinct – 50%
- High Impact Industry Precinct – 30%

The percentage impervious values above are for the landuses shown on *the Gracemere Stanwell Zone Precincts Map* shown **Appendix A**. These values have been adopted based on discussions between Brown Consulting (Jeff Davey) and Rockhampton Regional Council (undertaken on 18 October 2013). As the exact proportion of each type of Industrial Precinct is unknown at this time, a percentage impervious value of 70% has been adopted for the industrial catchments. This value is conservative as it assumes more Low Impact Industry resulting in a higher overall percentage impervious value. The average percentage impervious of the three types of development is only 53%, whereas 70% has been modelled. If modelling was undertaken exactly as per the Precinct Plan the percentage impervious values shown in **Table 3.4** would be have been modelled for each sub-catchment.

Table 3.4: Precinct Plan Percentage Impervious

Sub Catchment	% Impervious
5021	72%
5022	37%
5023	44%
506	60%

NOTE: Percentage impervious values are for Scenario B

As the percentage impervious values adopted in **Table 3.3** are greater than adopted in the precinct plan they are considered conservative.

3.3.2 Scenario A Results

Scenario A results and comparison to the existing flows at the Capricorn Highway (and rail corridor) are shown within **Table 3.5** below. As shown the development of the proposed site results in no perceivable change in flows at the Capricorn Highway.

Table 3.5: Scenario A Results at Capricorn Highway / Rail Corridor

ARI	Existing (m^3/s)	Scenario A (m^3/s)	Difference (%)
1	8.74	8.93	2%
2	14.72	14.83	1%
5	24.70	24.74	0%
10	31.07	30.98	0%
20	40.46	40.50	0%
50	53.33	53.36	0%
100	64.09	64.01	0%

There is no change in peak flow at the Capricorn Highway due to the timing of the hydrograph from the sub-catchments east of the underpass compared to the remainder of the catchment. As a result of the developed (and subsequent increase in impervious area) the critical flow time for the sub-catchments east of the highway has reduced, allowing the peak flow from this catchment to discharge earlier than the peak flow from the remainder of the catchment. **Figure 3.1** below shows the Existing and Scenario A hydrographs at the Capricorn Highway for the critical duration storm.

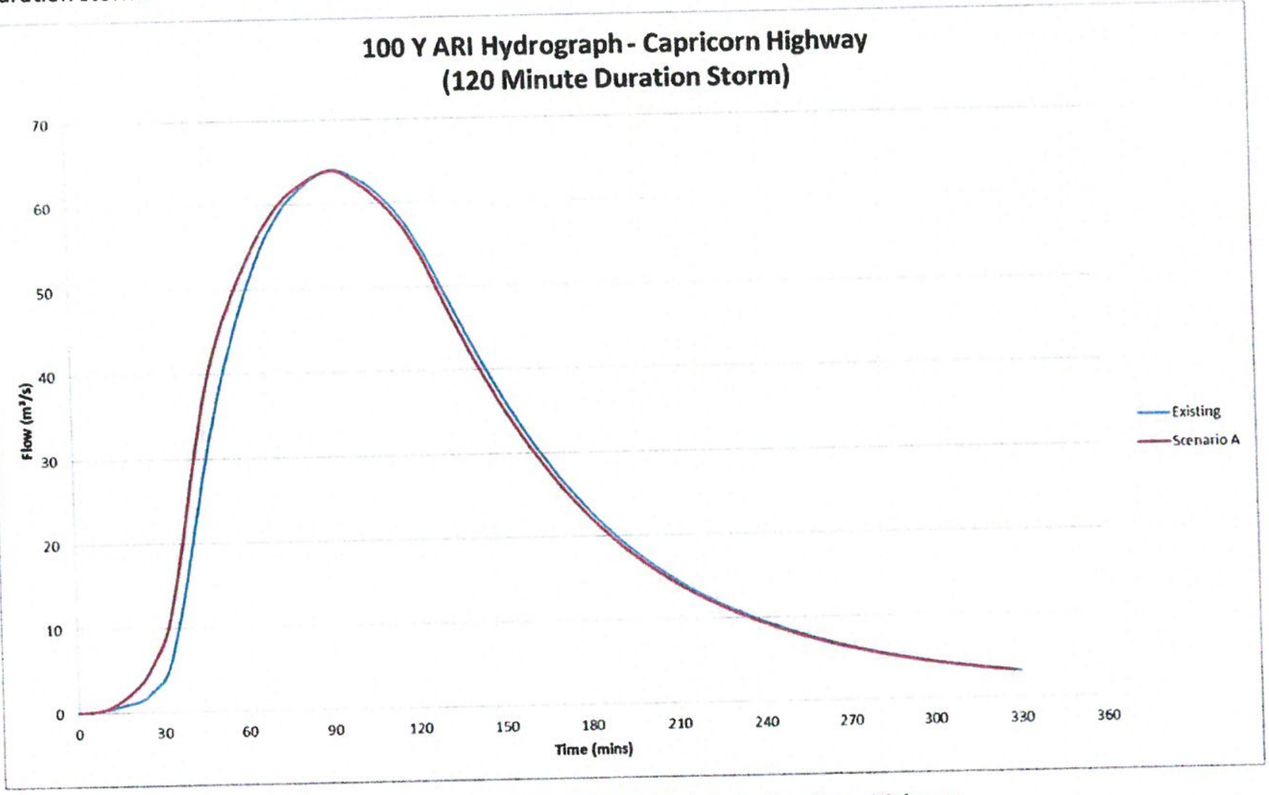


Figure 3.1: Scenario A 100 Year ARI Discharge - Capricorn Highway

Peak flow results at the culverts under Somerset Connection Road are presented in **Table 3.6** below. As shown whilst there is an increase in peak flow the road would remain trafficable during flooding from the catchment east of Somerset Connection Road.

Table 3.6: Scenario A Results at Somerset Connection Road Culverts

ARI	Existing (m^3/s)	Scenario A (m^3/s)	Difference (%)	Impact on Culverts
1	0.886	3.93	136%	Culverts Have Capacity
2	1.469	5.02	78%	Culverts Have Capacity
5	2.496	7.89	63%	Culverts Have Capacity
10	3.295	10.00	60%	Culverts Have Capacity
20	4.377	12.94	54%	Culverts Have Capacity
50	5.704	15.60	42%	70mm flow over road V.D 0.01
100	6.863	18.70	40%	130mm flow over road V.D 0.08

A 50% blockage scenario was also undertaken to determine if the road will still be trafficable if half the culvert cells were blocked. It was determined that under 50% blockage conditions in a 100 year ARI event the flow depth over the road is 0.28m and the Velocity Depth (D.V) product is 0.25. Under 50% culvert blockage conditions the road would remain trafficable during flooding from the catchment east of Somerset Connection Road.

Please note that the results presented above are based on flooding from the catchment east of Somerset Connection Road only. In a 100 year ARI flood event Somerset Connection Road is also impacted by flooding from the main flowpath and catchment upstream of the Capricorn Highway. As shown on Figure 22 of Aurecon's Flood Study, the 100 year ARI water surface level upstream of the Capricorn Highway is 18.60m, which results in a flow depth greater than 0.3m over Somerset Connection Road. Therefore Somerset Connection Road is not trafficable due to backwater flooding from the main flowpath. Refer to **Appendix C** for details of the Somerset Connection Road calculations.

3.3.3 Scenario B Results

Scenario B results and comparison to the existing flows at the Capricorn Highway are shown within **Table 3.7** below. As shown the development of the proposed site and surrounding industrial area results in no perceivable change in flows at the Capricorn Highway.

Table 3.7: Scenario B Results at Capricorn Highway

ARI	Existing (m^3/s)	Scenario B (m^3/s)	Difference (%)
1	8.74	9.19	5%
2	14.72	14.96	2%
5	24.70	24.74	0%
10	31.07	31.01	0%
20	40.46	40.50	0%
50	53.33	53.29	0%
100	64.09	63.82	0%

As discussed for Scenario A above there is no perceivable change in flow due to the timing of the hydrograph for the sub-catchments east of the overpass compared to the remainder of the catchment. **Figure 3.2** below shows the 100 year ARI hydrograph for Scenario B and the existing flows at the Capricorn Highway.

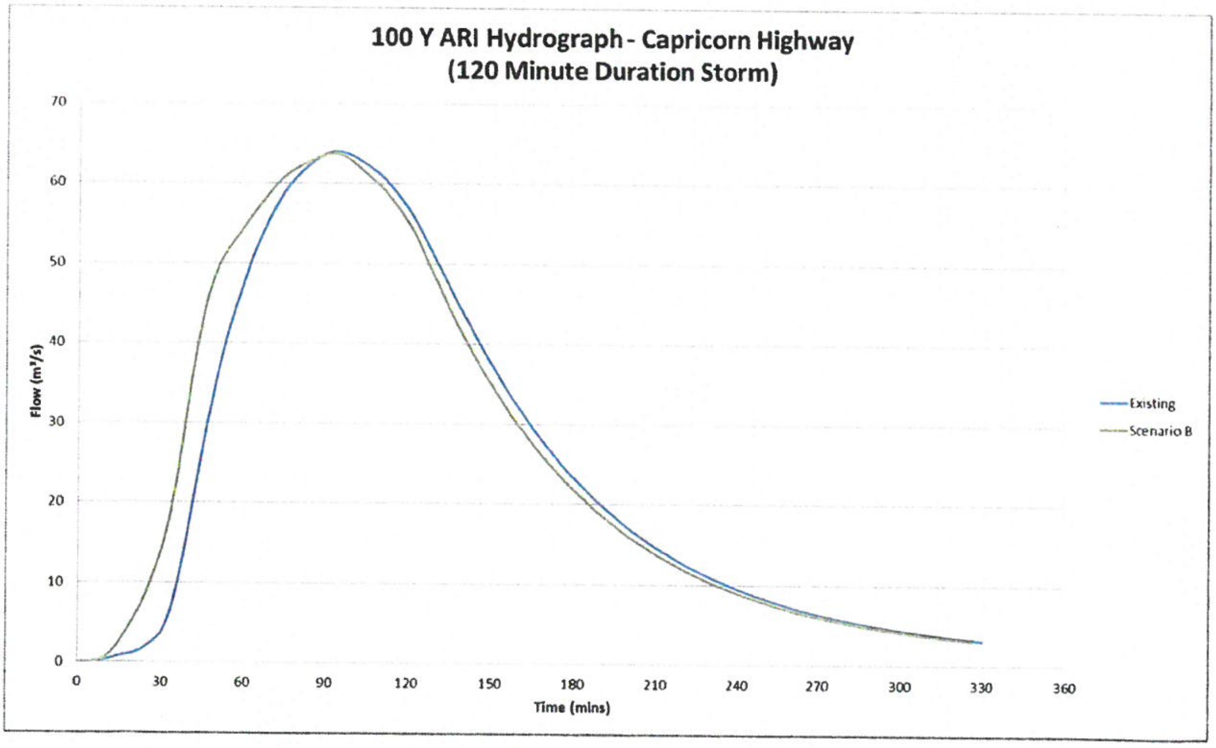


Figure 3.2: Scenario B 100 Year ARI Discharge - Capricorn Highway

Peak flow results at the culverts under Somerset Connection Road are presented in **Table 3.8** below. Whilst there has been an increase in peak flow the culverts under Somerset Connection Road appear to have sufficient capacity to convey the 100 year ARI flow from the catchment east of Somerset Connection Road.

Table 3.8: Scenario B Results at Somerset Connection Road Culverts

ARI	Existing (m^3/s)	Scenario B (m^3/s)	Difference (%)	Impact on Culverts
1	0.886	8.48	409%	Culverts Have Capacity
2	1.469	10.79	282%	Culverts Have Capacity
5	2.496	14.51	199%	10mm flow over road V.D < 0.01
10	3.295	17.10	173%	80mm flow over road V.D 0.04
20	4.377	20.73	147%	170mm flow over road V.D 0.12
50	5.704	24.44	123%	240mm flow over road V.D 0.20
100	6.863	28.35	113%	290mm flow over road V.D 0.26

A 50% blockage scenario was also undertaken to determine if the road will still be trafficable if half the culvert cells were blocked. It was determined that under 50% blockage conditions in a 100 year ARI event the flow depth over the road is 0.38m and the V.D product is 0.39. However as discussed at the end of **Section 3.3.2** Somerset Connection Road is not trafficable due to backwater flooding from the main flowpath. Providing additional culvert cells will have little benefit as the road is already flood impacted. Refer to **Appendix C** for details of the Somerset Connection Road calculations.

3.4 Waterway Stability Management

As outlined in the SPP (2013) the design objective for waterway stability management is to mitigate the peak 1 year ARI event developed discharge to the pre-developed (existing) peak discharge.

As demonstrated above there will be no significant increase in peak discharge for the 1 year ARI event to the Capricorn Highway Culverts for either scenario, therefore satisfying the waterway stability management requirements for the development.

3.5 Channel and Culvert Sizing within the Site

Two channels and two box culvert crossings are proposed to convey flows through the site from the proposed development and the upstream catchment. The location and sizes of these channels and culverts are shown on Drawing **B13313.W-SK01** in **Appendix E.**

Manning's calculations were undertaken in order to determine the channel sizes as indicated in **Appendix E**. The assumptions and further details of the manning's calculations are provided in **Appendix C.**

4. Stormwater Quality

It is expected that the proposed development will increase the stormwater pollutants that are exported from the subject site. A treatment train of suitable Stormwater Quality Improvement Devices (SQIDs) has been proposed to intercept and capture the pollutants so that the potential impacts on creeks and waterways downstream are mitigated.

It is therefore important to highlight the following:

- The identification of key stormwater pollutants associated with the development;
- The Water Quality Objectives (WQOs) identified for the catchment;
- Proposed measures to mitigate the increase in pollutant export; and
- Modelling of the proposed measures and comparison to the identified WQOs.

4.1 Pollutants of Concern

Typical key pollutants expected to be generated during the operational (post-construction) phase of the planned development are listed as follows, with those presented in capitals being the key pollutants to be targeted for treatment:

- LITTER
- SEDIMENT
- Oxygen demanding substances (possibly present)
- NUTRIENTS (N & P)
- Pathogens / Faecal coliforms
- Hydrocarbons
- HEAVY METALS (associated with fine sediments)
- Surfactants
- Organochlorines & organophosphates
- Thermal pollution
- pH altering substance

Only the key pollutants will be further addressed within this report, however the proposed treatment train developed will adequately mitigate the other pollutant loads. As heavy metals are predominantly associated with fine sediment, the controls used to reduce the total suspended solids will also adequately reduce loads of heavy metals.

4.2 Water Quality Objectives

The load reduction WQO's presented in **Table 4.1** below have been adopted from the SPP (2013).

Table 4.1: Load Reduction Water Quality Objectives

Pollutant	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Gross Pollutants
Load Reduction Target	85%	60%	45%	90%

4.3 MUSIC Modelling Methodology

Water quality modelling of the proposed site has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 5.1.16, developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC enables the user to conceptualise the transfer of pollutants through a stormwater drainage system and provides an aid in quantifying the effectiveness of the proposed stormwater quality treatment train. MUSIC only provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

With the proposed SQIDs included. The MUSIC model was setup in accordance with Water by Design *MUSIC Modelling Guidelines* (2010).

4.3.1 Meteorological Data

Six minute pluviographic data was sourced from the Bureau of Meteorology (BOM) for Rockhampton Aero (Station No. 039083). The mean annual rainfall over the station's entire rainfall data period is 807mm. Based on this and the availability of pluviograph data the 10 year period from 1st January 1986 to 31st December 1995 has been adopted for the rainfall duration. The mean annual rainfall for this period corresponds exactly to the mean annual rainfall over the entire rainfall data period.

Monthly evapotranspiration data for the 10 year period was sourced from the Bureau of *Meteorology's Climatic Atlas of Australia - Evapotranspiration* (2001) and then entered into the MUSIC model. The mean annual evapotranspiration for the modelled period is 1,621mm.

4.3.2 Source Nodes

Source nodes represent sub catchment areas within the MUSIC model. The split catchment approach in accordance the *MUSIC Modelling Guidelines* (2010) has been adopted. The site was divided into four sub-catchment areas within the MUSIC model. Three types of surfaces have been modelled: Roof, Road and Ground. The three node types have been set up with the following total impervious percentages:

- Industrial Roof – 100% impervious
- Industrial Ground – 20% impervious (depending on ground configuration
- Industrial Road (Including Reserve) – 60% impervious

Base and Storm flow pollutant concentrations have been adopted from Table 3.7 & 3.8 of the MUSIC Modelling Guidelines (2010) and soil characteristics have been adopted from the *Music Guidelines* (Mackay Regional Council 2008). Soil characteristics have been adopted from MRC 2008, as they as considered to better reflect the soil conditions at the site, compared to the Water by Design (2010) which were prepared based on South East Queensland conditions.

The overall percentage impervious for the MUSIC model is 72% which is consistent with the hydrological modelling described in **Section 3**.

Stochastic generation estimation and serial autocorrelation set to zero has also been adopted. Refer to **Appendix D** for detailed MUSIC model set up details.

4.3.3 Drainage Links

No routing has been adopted for all drainage links within each model. It is believed this assumption will produce results that are more conservative.

4.4 Stormwater Quality Management Strategy

To mitigate the increase in pollutants generated by the proposed development a treatment train of suitable Stormwater Quality Improvement Devices (SQIDs) is proposed. Refer to Drawing No. **B13313.W-SK01** in **Appendix E** shows the location of the proposed SQIDs. The subsequent sections detail the proposed treatment devices for the development.

4.4.1 Lot Scale Bio-Retention Basins

Lot scale bio-retention basins are proposed to treat runoff from all lots excluding Lot 1 (Toll site) and General Industrial allotments, before they discharge to the proposed stormwater drainage network. These bio-retention basins will treat runoff by storing and discharging it through a permeable soil based filter media providing significant sediment and nutrient removal. **Table 4.2** below shows the modelled lot scale bio-retention basin parameters.

Table 4.2: Lot Scale Bio-Retention Basin Parameters

Parameter	Value
Extended Detention Depth (mm)	300
Filter Depth (mm)	600
Filter Type	Sandy Loam
Filter Area	1.5% of lot area
Average Surface Area	1.5% of lot area
Saturated Hydraulic Conductivity (mm/hr)	200
Filter Median Particle Diameter (mm)	0.45

Due to the varying uses for the high and medium impact allotments and their relatively large areas, it is considered appropriate that each incorporates their own lot scale bio-retention basin to achieve the required WQO's. The general industry and estate road will be treated with the other SQID's proposed.

4.4.2 Bio-Retention Swales

Bio-retention swales are proposed with the channel along the western boundary of the development and adjacent to the southern boundary of Lot 2 to treat runoff from Stage 4 of the development and road within the northern part of the site. These bio-retention swales will provide sediment and nutrient removal by treating runoff through infiltration through a permeable filter media. **Table 4.3** below shows the modelled bio-retention swale parameters for the two SQID's.

Table 4.3: Bio-Retention Swale Parameters

Parameter	Western Bio-Retention Swale	Lot 2 Bio-Retention Swale[2]
Modelled Length	390	100
Base Width	2[1]	2
Longitudinal Grade	1%	0.3%
Extended Detention Depth (mm)	0	0
Filter Depth (mm)	400	400
Filter Type	Sandy Loam	Sandy Loam
Filter Area (m^2)	690	200
Average Surface Area (m^2)	690	200
Saturated Hydraulic Conductivity (mm/hr)	200	200
Filter Median Particle Diameter (mm)	0.45	0.45

[1]- Total base width of channel 11m. Base width of bio-retention filter is less.

[2]- Depth and side slope of swale to be confirmed at detailed design.

4.4.3 Swale

A swale is proposed through the site to convey flows from the upstream catchment. This swale will also convey and treat flows from the southern part of the site (General Industry allotments and road). **Table 4.4** below shows the modelled swale properties.

Table 4.4: Swale Properties

Parameter	Value
Modelled Length*	200
Minimum Base Width (m)	3
Depth of Swale (m)*	0.8
Longitudinal Grade	1%
Vegetation Height (mm)	100

*- Depth and side slope of swale to be confirmed at detailed design.

4.5 MUSIC Results

MUSIC results of the proposed treatment train are shown in **Table 4.5**.

Table 4.5: MUSIC Model Results

Details	TSS	TP	TN	GP
WQO (% Reduction)	85%	60%	45%	90%
% Reduction Achieved	87%	60%	49%	100%
Objective Achieved	YES	YES	YES	YES

As shown above the proposed SQID's achieve all the water quality objectives applicable to the proposed developed as required by the SPP (2013).

5. Conclusion

Brown Consulting (Qld) Pty Ltd has prepared the Stormwater Management Plan for the Gracemere Industrial Area, east of the Gracemere Overpass and to address Item 1 of RRC's information request dated 12 November 2013 regarding the 245 Somerset Road development. This SMP has demonstrated the following:

- The developed of the subject site does not result in a perceivable change in peak flow the Capricorn Highway;
- The development of the industrial sites east of Somerset Connection Road do not result in a perceivable change in peak flow at Capricorn Highway;
- The culverts under Somerset Connection Road have sufficient capacity to convey the 100 year ARI from the fully developed industrial catchments east of Somerset Connection Road, however this road is not trafficable in a 100 year event due to backwater flooding from the Capricorn Highway; and
- The proposed stormwater treatment train provides adequate pollutant removal and incorporates the following:
  - Lot scale bioretention basins with the filter area sized at 1.5% for all lots excluding Lot 1 (Toll Site) and the General Industry allotments;
  - Bioretention swale with a filter area of 690m² along the western site boundary; and
  - Bioretention swale along the southern boundary of Lot 2.

6. Recommendations

It is recommended that the Stormwater Management Plan be approved and incorporated into the final design. Furthermore detailed design and construction drawings for the proposed works are to be undertaken and submitted with the Operational Works application. Detailed design may result in changes to this stormwater management proposal but the design objectives will be maintained.

7. References

- WBNM User Guide (2007);
- Healthy Waterways (2010), Construction and Establishment Guidelines: Swales, Bio-Retention systems and Wetlands;
- Healthy Waterways (2012), *Interim MUSIC Bioretention Treatment Node;*
- Department of Environment and Heritage Protection (2010), State Planning Policy 4/10 Healthy Waters Guideline;
- Water by Design (2010), *MUSIC Modelling Guidelines – Version 1.*
- Institution of Engineers, Australia (1987) Australian Rainfall and Runoff;
- Natural Resources and Water (2013), Queensland Urban Drainage Manual

8. Disclaimer

This report has been prepared on behalf of and for the exclusive use of Gracemere Industry Park Developments Pty Ltd and is subject to and issued in accordance with the agreement between Brown Consulting (QLD) Pty Ltd.

Our investigation and analysis has been specifically catered for the particular requirements of Gracemere Industry Park Developments Pty Ltd and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from Brown Consulting (QLD) Pty Ltd.

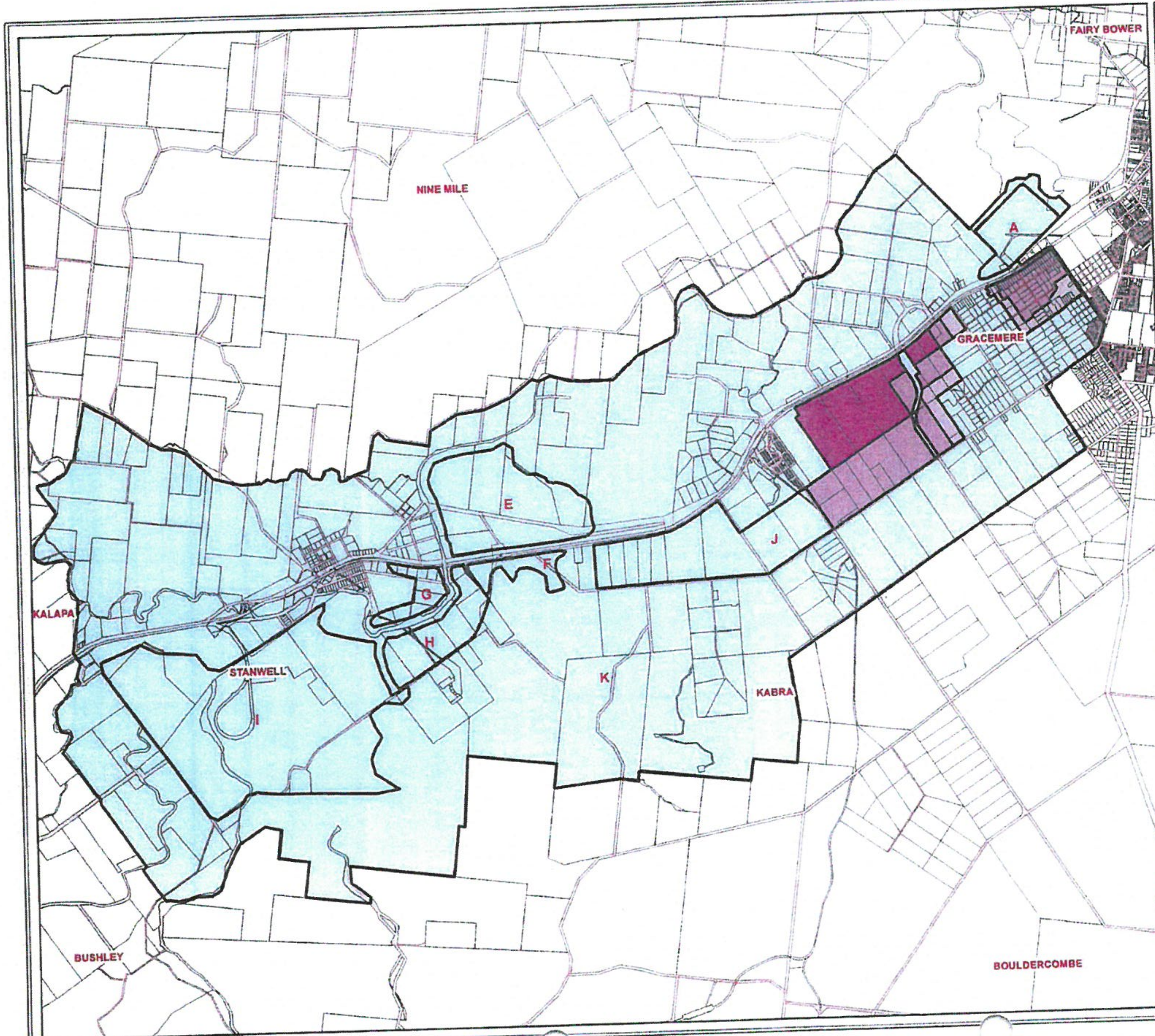
Brown Consulting (QLD) Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon this report by any third party.

The investigation and analysis has relied on information provided by others. We accept no responsibility for accuracy of material supplied by others. The accuracy of the investigation, analysis and report is dependent upon the accuracy of this information.

Appendix A:

Site Layout Plan

Gracemere-Stanwell Zone Precincts



Fitzroy Shire Council

THE BIG RIVER SHIRE

Fitzroy Shire Council

Zoning Map - A17
Gracemere - Stanwell Zone

80% Percentage Impervious.

LEGEND

Gracemere-Stanwell Zone Precincts

80%	Low Impact Industry Precinct
50%	Medium Impact Industry Precinct
30%	High Impact Industry Precinct
A	General Industry Precinct A
E	Special Industry Precinct E
F	General Industry Precinct F
G	General Industry Precinct G
H	Special Industry Precinct H
I	Special Industry Precinct I
J	General Industry Precinct J
K	Rural/Village Balance Precinct K

Appendix B:

B13313.W-F001 – Existing Catchment Plan

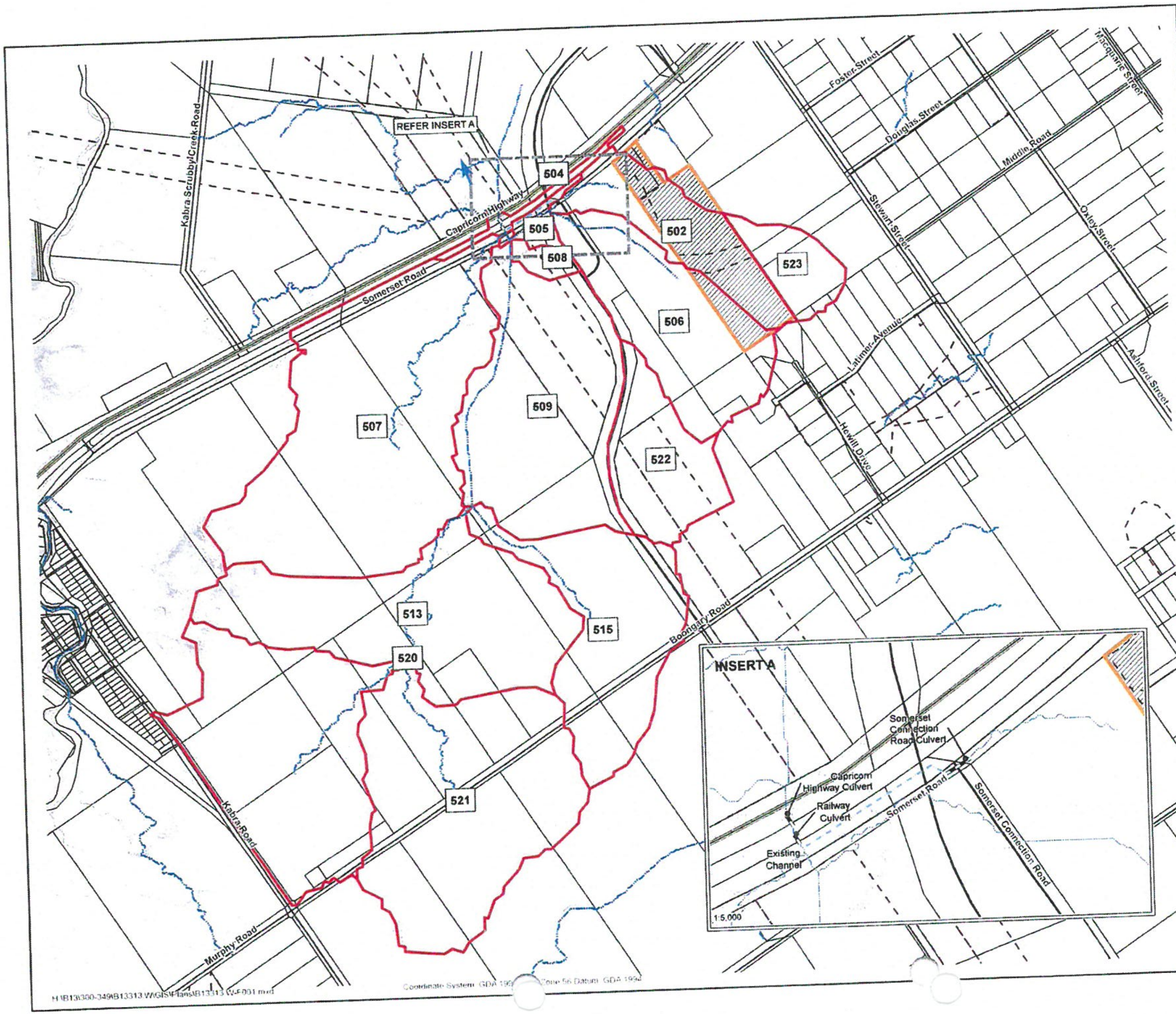
B13313.W-F002 – Developed Catchment Plan

Developed Catchment Plan

Queensland Rational Method Calculations

WBNM Catchment Parameters

WBNM Multi Storm Summary



BROWN *Smart Water*

LEGEND

- Existing Culvert
- Existing Channel
- Flowpath
- Existing Catchment Boundary
- Subject Site
- Easement
- DCDB
- 1m Contour

NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH REPORT B13313.W-01D

0 105 210 420 m
1:14,000 (A3)
N

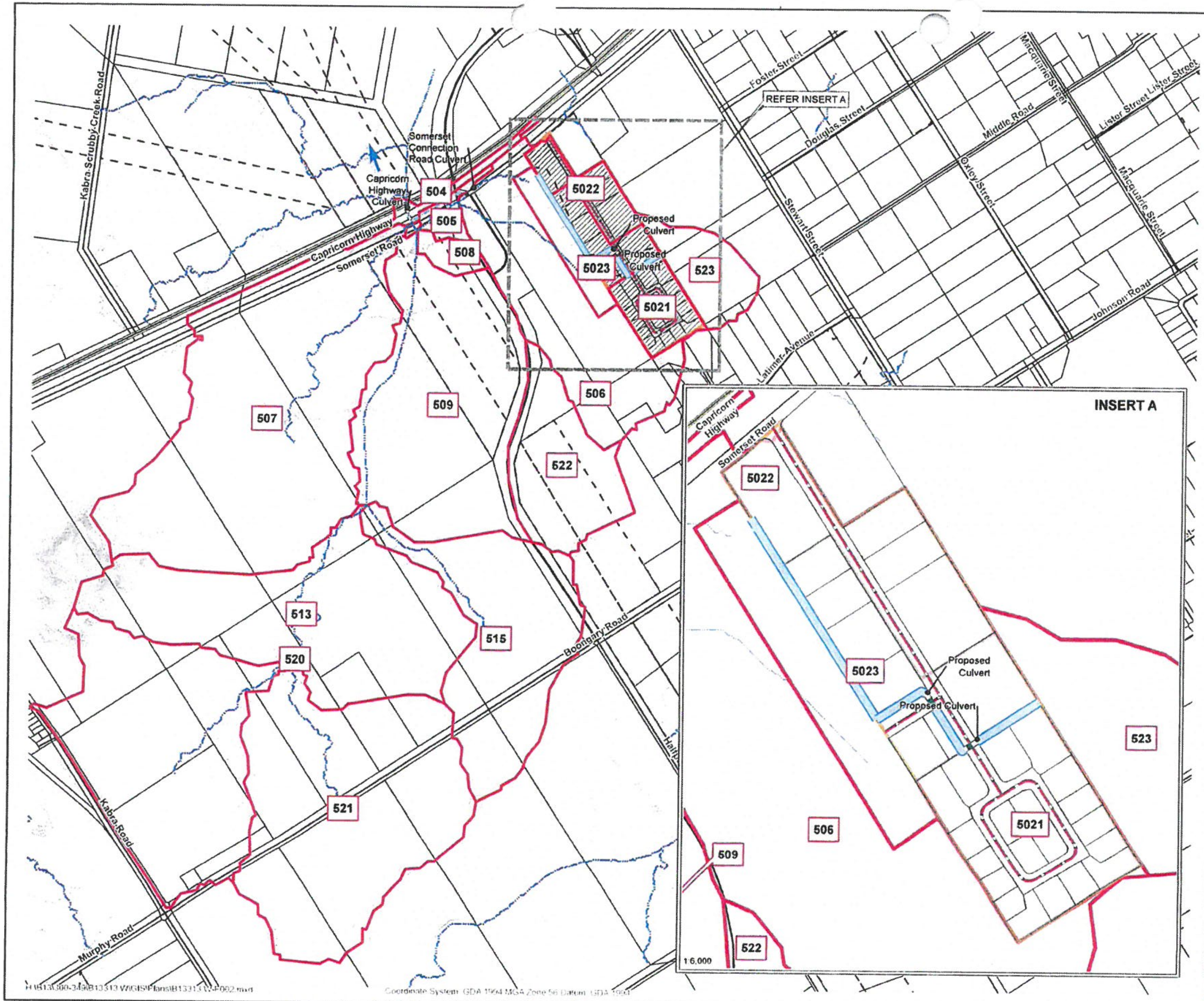
PROJECT
GRACEMERE INDUSTRIAL AREA - EAST OF GRACEMERE OVERPASS

CLIENT
GRACEMERE INDUSTRY PARK DEVELOPMENTS PTY LTD

DRAWING TITLE:
EXISTING CATCHMENT PLAN

DRAWING NO: **B13313.W-F001**
ISSUE: **C**

ISS	BY	CHK	DATE	DETAILS
A	AH	AH	19.11.13	ORIGINAL
B	AH	AH	23.01.14	REPORT REVISION UPDATED
C	AH	AH	13.03.14	REPORT REVISION UPDATED



BROWN *Smart Water*

LEGEND

- Existing Culvert
- Existing Channel
- Proposed Channel
- Flowpath
- Developed Catchment Boundary
- Subject Site
- Easement
- DCDB
- 1m Contour
- Proposed Road
- Proposed Lot

NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH REPORT B13313.W-01D

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1:14,000 (A3)
N

PROJECT
GRACEMERE INDUSTRIAL AREA - EAST OF GRACEMERE OVERPASS

CLIENT
GRACEMERE INDUSTRY PARK DEVELOPMENTS PTY LTD

DRAWING TITLE
DEVELOPED CATCHMENT PLAN

DRAWING NO: **B13313.W-F002** ISSUE: **C**

ISS	BY	CHK	DATE	DETAILS
A	AH	AH	19.12.13	ORIGINAL ISSUE
B	AH	AH	23.01.14	REPORT REVISION UPDATED
C	AH	AH	13.03.14	REPORT REVISION UPDATED

WBNM Catchment Configuration

Existing

Subarea Name	D/S Subarea	Area (ha)	% Impervious	C	Imp Lag	Type	Value	IL (mm)	CL (mm/hr)	Imp IL (mm)
521	513	77.359	5	1.8	0.1			30	2.5	0.1
520	513	64.67	5	1.8	0.1			30	2.5	0.1
513	509	65.126	0	1.8	0.1	R	1	30	2.5	0.1
522	509	23.835	2	1.8	0.1			30	2.5	0.1
515	509	45.041	2	1.8	0.1			30	2.5	0.1
509	508	62.027	2	1.8	0.1	R	1	30	2.5	0.1
506	505	40.798	5	1.8	0.1			30	2.5	0.1
523	502	10.955	5	1.8	0.1			30	2.5	0.1
502	505	23.5	5	1.8	0.1	R	1	30	2.5	0.1
505	508	2.932	10	1.8	0.1	R	1	30	2.5	0.1
508	504	3.317	5	1.8	0.1	R	1	30	2.5	0.1
507	504	96.659	5	1.8	0.1			30	2.5	0.1
504	OUT	3.1	20	1.8	0.1	R	1	30	2.5	0.1
OUT	SINK	0	0	1.8	0.1	R	1	30	2.5	0.1

Scenario A - WBNM Configuration

Subarea Name	D/S Subarea	Area (ha)	% Impervious	C	Imp Lag	Type	Value	IL (mm)	CL (mm/hr)	Imp IL (mm)
521	513	77.359	5	1.8	0.1			30	2.5	0.1
520	513	64.67	5	1.8	0.1			30	2.5	0.1
513	509	65.126	0	1.8	0.1	R	1	30	2.5	0.1
5022	DUMMY	9.04	70	1.8	0.1			30	2.5	0.1
522	509	23.835	2	1.8	0.1			30	2.5	0.1
515	509	45.041	2	1.8	0.1			30	2.5	0.1
509	508	62.027	2	1.8	0.1	R	1	30	2.5	0.1
506	505	38.52	5	1.8	0.1			30	2.5	0.1
523	5021	10.955	5	1.8	0.1			30	2.5	0.1
5021	5023	8.389	70	1.8	0.1	R	0.5	30	2.5	0.1
5023	DUMMY	10.32	70	1.8	0.1	R	0.5	30	2.5	0.1
DUMMY	505	0.001	0	1.8	0.1	R	0.5	30	2.5	0.1
505	508	2.932	10	1.8	0.1	R	0.5	30	2.5	0.1
508	504	3.317	5	1.8	0.1	R	1	30	2.5	0.1
507	504	96.659	5	1.8	0.1			30	2.5	0.1
504	OUT	3.1	20	1.8	0.1	R	1	30	2.5	0.1
OUT	SINK	0	0	1.8	0.1	R	1	30	2.5	0.1

Scenario B - WBNM Configuration

Subarea Name	D/S Subarea	Area (ha)	% Impervious	C	Imp Lag	Type	Value	IL (mm)	CL (mm/hr)	Imp IL (mm)
521	513	77.359	5	1.8	0.1			30	2.5	0.1
520	513	64.67	5	1.8	0.1			30	2.5	0.1
513	509	65.126	0	1.8	0.1	R	1	30	2.5	0.1
5022	DUMMY	9.04	70	1.8	0.1			30	2.5	0.1
522	509	23.835	2	1.8	0.1			30	2.5	0.1
515	509	45.041	2	1.8	0.1			30	2.5	0.1
509	508	62.027	2	1.8	0.1	R	1	30	2.5	0.1
506	505	38.52	70	1.8	0.1			30	2.5	0.1
523	5021	10.955	5	1.8	0.1			30	2.5	0.1
5021	5023	8.389	70	1.8	0.1	R	0.5	30	2.5	0.1
5023	DUMMY	10.32	70	1.8	0.1	R	0.5	30	2.5	0.1
DUMMY	505	0.001	0	1.8	0.1	R	0.5	30	2.5	0.1
505	508	2.932	10	1.8	0.1	R	0.5	30	2.5	0.1
508	504	3.317	5	1.8	0.1	R	1	30	2.5	0.1
507	504	96.659	5	1.8	0.1			30	2.5	0.1
504	OUT	3.1	20	1.8	0.1	R	1	30	2.5	0.1
OUT	SINK	0	0	1.8	0.1	R	1	30	2.5	0.1

Capricorn Highway QRM

File:	H:\B13\300-349\B13313.W\Stormwater\[B13313.W QRM.xlsx]Out504
Date:	19/12/2013
Job:	B13313.W
By:	AH
Locality:	RRC
IFD Ref:	IFD_RRC
IFD Source:	Capricorn Municipal Development Guidelines

Time of Concentration Calculations

Reference	Equation Type / Method	Area (ha)	Length (m)	Av. Slope (%)	Pipe Diameter (mm)	Velocity (m/s)	Wetted Area (m^2)	Wetted Perimeter (m)	Hydraulic Radius R	Roughness (Mannings/Hortons)	Sub Total (mins)	tc (min)
4.06.11 (a) QUDM	Bransby Williams Equation	519.3	4.04	0.4							151	151
											Adopted tc	151

C10 VALUE

Enter Fraction Impervious	Development Category	f_i	$1I_{10}$ (mm/hr)
Table 5.04.2 QUDM	Average Lot >450 m2 < 600 m2 (including roads)	0.037	64

	C10
	0.601
Adopted	0.601

Flow Calculations (QUDM 4.03.1)

tc (min) 151

ARI	Cy	$^{tc}I_y$	A (ha)	Q (m3/s)
1	0.48	19	519.32	13.12
2	0.51	25	519.32	18.06
5	0.57	32	519.32	26.09
10	0.60	36	519.32	31.27
20	0.63	42	519.32	38.28
50	0.69	50	519.32	49.69
100	0.72	57	519.32	59.10

Existing 1-5 year

#####START_MULTIPLE_STORM_SUMMARY##

STORM	---BURST----- ARI (year)	DURATION (minutes)	---EVENT----- ARI (year)	DURATION (minutes)	RAINFALL (mm)	EXCESS RAINFALL (mm)	PEAK DISCHARGE (m3/s)
1	1	45	0	0	30.60	1.60	1.24
2	1	60	0	0	35.07	5.30	1.95
3	1	90	0	0	40.63	9.90	4.41
4	1	120	0	0	44.94	13.21	6.18
5	1	180	0	0	51.65	18.07	7.98
6	1	270	0	0	59.26	22.44	8.74
7	2	45	0	0	38.81	9.21	4.14
8	2	60	0	0	44.29	14.09	7.18
9	2	90	0	0	51.39	20.26	11.06
10	2	120	0	0	56.89	24.72	13.11
11	2	180	0	0	65.47	31.49	14.72
12	2	270	0	0	75.22	37.75	14.44
13	5	45	0	0	49.81	19.88	11.43
14	5	60	0	0	56.71	26.30	16.17
15	5	90	0	0	66.05	34.76	21.54
16	5	120	0	0	73.34	40.97	23.54
17	5	180	0	0	84.74	50.52	24.70
18	5	270	0	0	97.77	59.98	22.24

#####END_MULTIPLE_STORM_SUMMARY##

Existing 10-100 Year

#####START_MULTIPLE_STORM_SUMMARY##

STORM	---BURST----- ARI (year)	DURATION (minutes)	---EVENT----- ARI (year)	DURATION (minutes)	RAINFALL (mm)	EXCESS RAINFALL (mm)	PEAK DISCHARGE (m3/s)
1	10	60	0	0	64.36	33.91	22.39
2	10	90	0	0	75.12	43.71	28.42
3	10	120	0	0	83.55	51.10	30.44
4	10	180	0	0	96.76	62.39	31.07
5	10	270	0	0	111.88	73.97	27.01
6	20	60	0	0	74.70	44.21	31.31
7	20	90	0	0	87.35	55.82	38.03
8	20	120	0	0	97.28	64.71	40.15
9	20	180	0	0	112.87	78.29	40.46
10	20	270	0	0	130.76	92.70	35.91
11	50	60	0	0	88.73	58.12	44.05
12	50	90	0	0	103.98	72.33	51.70
13	50	120	0	0	115.98	83.25	53.33
14	50	180	0	0	134.87	100.09	51.43
15	50	270	0	0	156.59	118.40	44.55
16	100	60	0	0	99.79	69.14	54.63
17	100	90	0	0	117.12	85.43	62.73
18	100	120	0	0	130.77	97.95	64.09
19	100	180	0	0	152.30	117.36	61.78
20	100	270	0	0	177.10	138.79	54.15

#####END_MULTIPLE_STORM_SUMMARY##

Scenario A 1-5 Year

#####START_MULTIPLE_STORM_SUMMARY###

STORM	---BURST-----		---EVENT-----		RAINFALL	EXCESS	PEAK
	ARI	DURATION	ARI	DURATION		RAINFALL	DISCHARGE
	(year)	(minutes)	(year)	(minutes)	(mm)	(mm)	(m3/s)
1	1	45	0	0	30.60	2.64	3.67
2	1	60	0	0	35.07	6.37	4.08
3	1	90	0	0	40.63	11.00	4.87
4	1	120	0	0	44.94	14.35	6.41
5	1	180	0	0	51.65	19.28	8.11
6	1	270	0	0	59.26	23.76	8.93
7	2	45	0	0	38.81	10.27	6.10
8	2	60	0	0	44.29	15.17	8.21
9	2	90	0	0	51.39	21.37	11.44
10	2	120	0	0	56.89	25.88	13.23
11	2	180	0	0	65.47	32.71	14.83
12	2	270	0	0	75.22	39.10	14.68
13	5	45	0	0	49.81	20.95	13.37
14	5	60	0	0	56.71	27.39	17.12
15	5	90	0	0	66.05	35.88	21.76
16	5	120	0	0	73.34	42.13	23.59
17	5	180	0	0	84.74	51.75	24.74
18	5	270	0	0	97.77	61.33	22.58

#####END_MULTIPLE_STORM_SUMMARY###

Scenario A 10-100 Year

#####START_MULTIPLE_STORM_SUMMARY###

STORM	---BURST-----		---EVENT-----		RAINFALL	EXCESS	PEAK
	ARI	DURATION	ARI	DURATION		RAINFALL	DISCHARGE
	(year)	(minutes)	(year)	(minutes)	(mm)	(mm)	(m3/s)
1	10	45	0	0	56.60	27.67	18.72
2	10	60	0	0	64.36	35.00	23.31
3	10	90	0	0	75.12	44.84	28.57
4	10	120	0	0	83.55	52.26	30.53
5	10	180	0	0	96.76	63.62	30.98
6	20	45	0	0	65.76	36.75	26.58
7	20	60	0	0	74.70	45.30	32.15
8	20	90	0	0	87.35	56.95	38.08
9	20	120	0	0	97.28	65.87	40.13
10	20	180	0	0	112.87	79.54	40.50
11	50	45	0	0	78.21	49.16	38.19
12	50	60	0	0	88.73	59.22	44.83
13	50	90	0	0	103.98	73.47	51.75
14	50	120	0	0	115.98	84.42	53.36
15	50	180	0	0	134.87	101.34	51.47
16	100	45	0	0	88.04	58.95	47.86
17	100	60	0	0	99.79	70.24	55.30
18	100	90	0	0	117.12	86.57	62.70
19	100	120	0	0	130.77	99.13	64.01
20	100	180	0	0	152.30	118.61	61.78

#####END_MULTIPLE_STORM_SUMMARY###

Scenario B 1-5 Year

#####START_MULTIPLE_STORM_SUMMARY###

STORM	---BURST----- ARI (year)	DURATION (minutes)	---EVENT----- ARI (year)	DURATION (minutes)	RAINFALL (mm)	EXCESS RAINFALL (mm)	PEAK DISCHARGE (m3/s)
1	1	45	0	0	30.60	4.08	7.22
2	1	60	0	0	35.07	7.85	8.02
3	1	90	0	0	40.63	12.53	7.21
4	1	120	0	0	44.94	15.93	6.91
5	1	180	0	0	51.65	20.95	8.29
6	1	270	0	0	59.26	25.59	9.19
7	2	45	0	0	38.81	11.74	9.74
8	2	60	0	0	44.29	16.67	11.69
9	2	90	0	0	51.39	22.92	11.91
10	2	120	0	0	56.89	27.48	13.37
11	2	180	0	0	65.47	34.40	14.96
12	2	270	0	0	75.22	40.96	14.96
13	5	45	0	0	49.81	22.44	16.84
14	5	60	0	0	56.71	28.90	19.88
15	5	90	0	0	66.05	37.44	22.03
16	5	120	0	0	73.34	43.74	23.75
17	5	180	0	0	84.74	53.46	24.74
18	5	270	0	0	97.77	63.21	22.91

#####END_MULTIPLE_STORM_SUMMARY###

Scenario B 10-100 Year

#####START_MULTIPLE_STORM_SUMMARY###

STORM	---BURST----- ARI (year)	DURATION (minutes)	---EVENT----- ARI (year)	DURATION (minutes)	RAINFALL (mm)	EXCESS RAINFALL (mm)	PEAK DISCHARGE (m3/s)
1	10	45	0	0	56.60	29.16	22.16
2	10	60	0	0	64.36	36.52	25.78
3	10	90	0	0	75.12	46.40	28.73
4	10	120	0	0	83.55	53.87	30.59
5	10	180	0	0	96.76	65.33	31.01
6	20	45	0	0	65.76	38.25	29.99
7	20	60	0	0	74.70	46.82	34.39
8	20	90	0	0	87.35	58.52	38.13
9	20	120	0	0	97.28	67.49	40.05
10	20	180	0	0	112.87	81.26	40.50
11	50	45	0	0	78.21	50.66	41.53
12	50	60	0	0	88.73	60.74	46.14
13	50	90	0	0	103.98	75.04	51.77
14	50	120	0	0	115.98	86.05	53.29
15	50	180	0	0	134.87	103.07	51.46
16	100	45	0	0	88.04	60.45	51.20
17	100	60	0	0	99.79	71.77	56.56
18	100	90	0	0	117.12	88.14	62.60
19	100	120	0	0	130.77	100.76	63.82
20	100	180	0	0	152.30	120.35	61.67

#####END_MULTIPLE_STORM_SUMMARY###

Appendix C:

Manning's Calculations

Weir and Culvert Flow Calculations

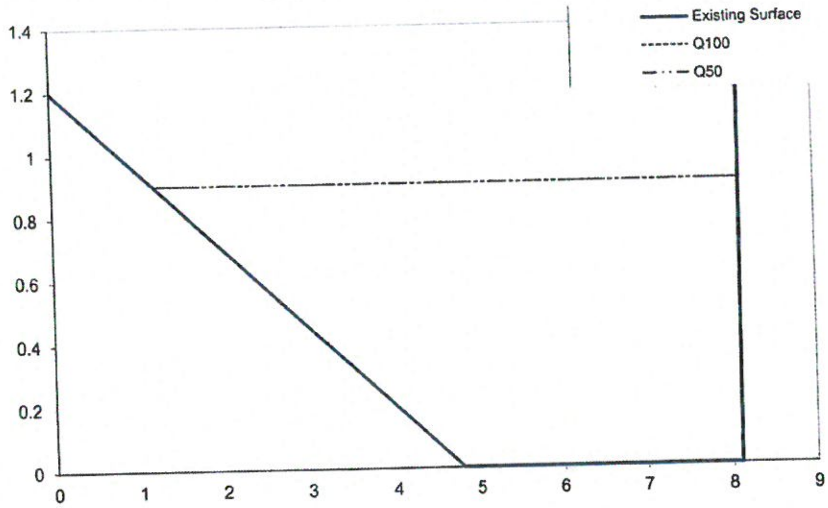
MANNING'S WATER SURFACE EXTENT CALCULATION

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W Manning's Calcs.xls]Section 3 (5023 ds)
Date: 19/12/2013
By: AH

Manning's calculation as per Equation 4.2.3 of Australian Rainfall and Runoff (1987)

Cunningham Highway
SECTION A

CROSS SECTION DETAILS				Q100			Q50		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0	1.2	0.060						
2	4.8	0	0.060	1.62	3.71	0.10	1.62	3.71	0.10
3	8.1	0	0.030	2.97	3.30	0.09	2.97	3.30	0.09
4	8.124	1.2	0.030	0.01	0.90	0.00	0.01	0.90	0.00
5									
				wA	wP	n x wA	wA	wP	n x wA
			TOTAL	4.5981	7.910975	0.186543	4.5981	7.910975	0.186543
	S			R	n	Q	R	n	Q
	0.01			0.581231	0.041	7.89	0.581231	0.041	7.89
			523 Flow		6.93			1.97	
			WSL		0.9			0.9	
			Calculated by Manning's Equation		7.89			7.89	
			Vel (m/s)		1.72			1.72	



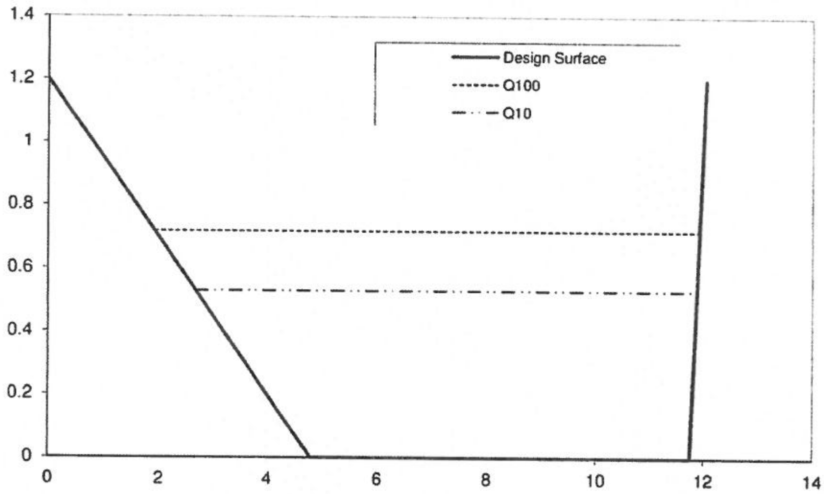
MANNING'S WATER SURFACE EXTENT CALCULATION

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W Manning's Calcs.xls]Section1 INT (5023 ds) (140227)
Date: 13/03/2014
By: AH

Manning's calculation as per Equation 4.2.3 of Australian Rainfall and Runoff (1987)

SECTION 1 - INTERIM

CROSS SECTION DETAILS				Q100			Q10		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0	1.2							
2	4.8	0	0.040	1.04	2.97	0.04	0.56	2.19	0.02
3	11.75	0	0.050	5.00	6.95	0.25	3.68	6.95	0.18
4	12.05	1.2	0.040	0.06	0.74	0.00	0.04	0.55	0.00
				wA	wP	n x wA	wA	wP	n x wA
			TOTAL	6.1056	10.6608	0.294264	4.280413	9.681557	0.208052
	S			R	n	Q	R	n	Q
	0.01			0.572715	0.048	8.74	0.44212	0.049	5.11
			502 Flow		8.4			4.9	
			WSL		0.72			0.53	
			Calculated by Manning's Equation		8.7			5.1	
			Vel (m/s)		1.43			1.19	



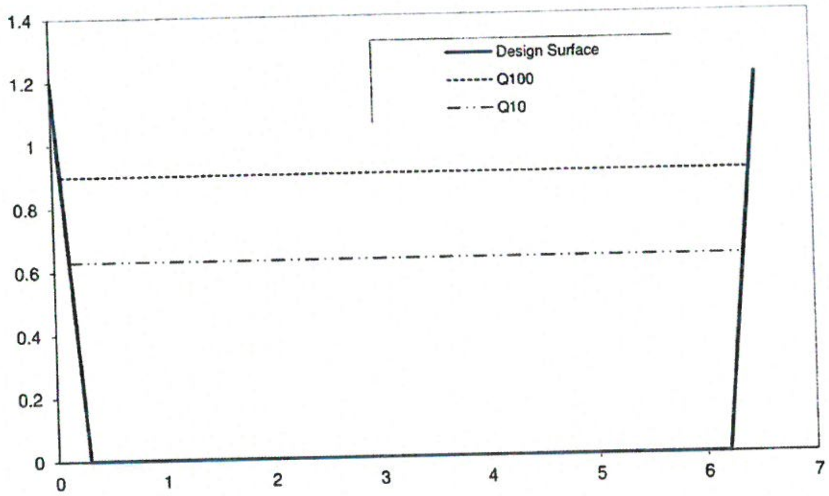
MANNING'S WATER SURFACE EXTENT CALCULATION

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W Manning's Calcs.xls]Section1 ULT (5023 ds) (140227)
Date: 13/03/2014
By: AH

Manning's calculation as per Equation 4.2.3 of Australian Rainfall and Runoff (1987)

SECTION 1 - ULTIMATE

CROSS SECTION DETAILS				Q100			Q10		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0	1.2							
2	0.3	0	0.040	0.10	0.93	0.00	0.05	0.65	0.00
3	6.2	0	0.050	5.31	5.90	0.27	3.72	5.90	0.19
4	6.5	1.2	0.040	0.10	0.93	0.00	0.05	0.65	0.00
				wA	wP	n x wA	wA	wP	n x wA
			TOTAL	5.5125	7.755398	0.2736	3.816225	7.198778	0.189819
	S			R	n	Q	R	n	Q
	0.01			0.710795	0.050	8.85	0.530121	0.050	5.03
			502 Flow		8.4			4.9	
			WSL		0.90			0.63	
			Calculated by Manning's Equation		8.8			5.0	
			Vel (m/s)		1.60			1.32	



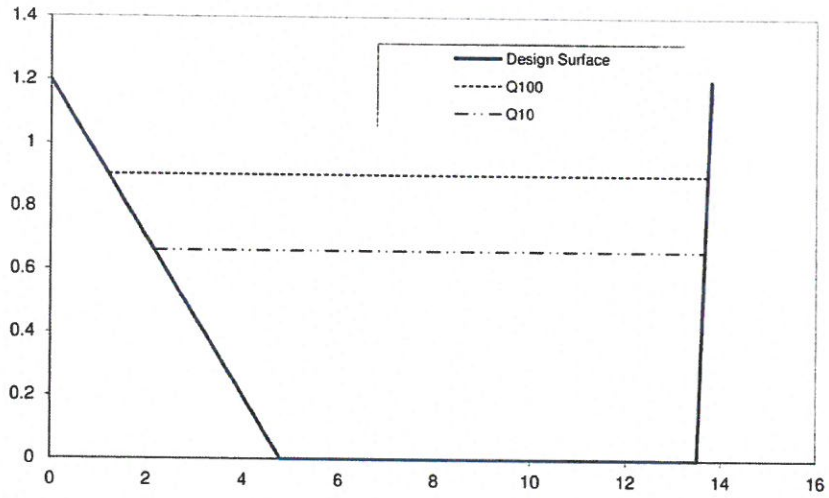
MANNING'S WATER SURFACE EXTENT CALCULATION

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W Manning's Calcs.xls]Section 2 (5023 ds) (140227)
Date: 13/03/2014
By: AH

Manning's calculation as per Equation 4.2.3 of Australian Rainfall and Runoff (1987)

SECTION 2

CROSS SECTION DETAILS				Q100			Q10		
POINT	CH	Z	n	wA	wP	n x wA	wA	wP	n x wA
1	0	1.2							
2	4.8	0	0.040	1.62	3.71	0.06	0.87	2.72	0.03
3	8	0	0.040	2.88	3.20	0.12	2.11	3.20	0.08
4	13.5	0	0.040	4.95	5.50	0.20	3.63	5.50	0.15
5	13.8	1.2	0.040	0.10	0.93	0.00	0.05	0.68	0.00
				wA	wP	n x wA	wA	wP	n x wA
			TOTAL	9.55125	13.33849	0.38205	6.66765	12.10156	0.266706
	S			R	n	Q	R	n	Q
	0.005			0.716067	0.040	13.51	0.550974	0.040	7.92
			502 Flow		12.7			7.7	
			WSL		0.90			0.66	
			Calculated by Manning's Equation		13.5			7.9	
			Vel (m/s)		1.4			1.2	



SOMERSET CONNECTION ROAD - CULVERT FLOW CALCULATIONS

Scenario A - No Blockage

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W WBNM Results.xlsx]Somerset Cnct Rd Cul (Scen B 50
Date: 19/12/2013
By: AH

Somerset Road Culverts

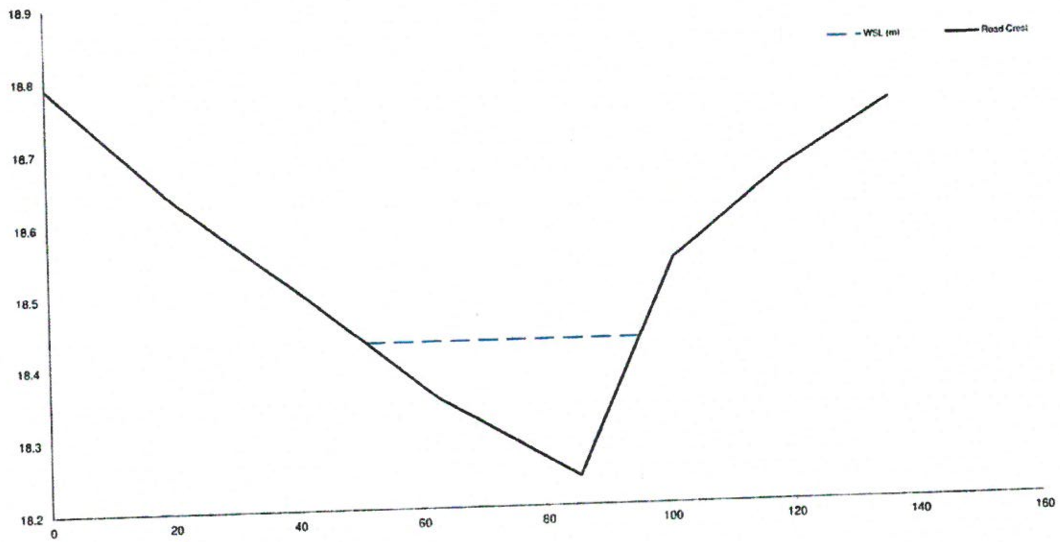
100 Y ARI

WSL (m)	18.43
Pipe Details	
U/S WSL (m)	18.43
TW (m)	
H (m)	18.43
L (m)	
No. Cells	
Dia (m)	
A (m2)	0.000
U/S IL	
D/S IL	
n	
ke	
g (m/s2)	9.81
Q Inlet (m3/s)	
Q Outlet (m3/s)	
Pipe Flow (m3/s)	0.00
Box Details	
L (m)	22
TW (m)	17.88
Width	1.8
Height (m)	0.60
No.	6
Area (m²)	1.080
K	1
Invert Level (R.L)	17.28
Inflow Level (R.L)	17.28
Box Inlet Flow (m3/s)	16.41
Box Outlet Flow (m3/s)	17.19
Box Flow (m3/s)	16.41
Weir Flow (m3/s)	2.51

Results	
Total Flow (m3/s)	18.92
Actual Flow (m3/s)	18.88
% Difference	0.22%

Weir Coefficient: 1.67

	Weir Details Chainage	RL (m)	P (m)	D (m)	Q (m3/s)	wA (m2)	V (m/s)	V.D (m2/s)
1	0	18.79						
2	19.259	18.64						
3	40.921	18.5						
4	62.721	18.35	11.63	0.04	0.155	0.47	0.33	0.01
5	85.331	18.24	22.61	0.13	1.873	3.05	0.61	0.08
6	100.851	18.54	9.83	0.09	0.481	0.93	0.51	0.05
7	118.612	18.66						
8	136	18.75						
9								



SOMERSET CONNECTION ROAD - CULVERT FLOW CALCULATIONS

Scenario A - 50% Blockage

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W WBNM Results.xlsx]Somerset Cnct Rd Cul (Scen B 50
Date: 19/12/2013
By: AH

Somerset Road Culverts

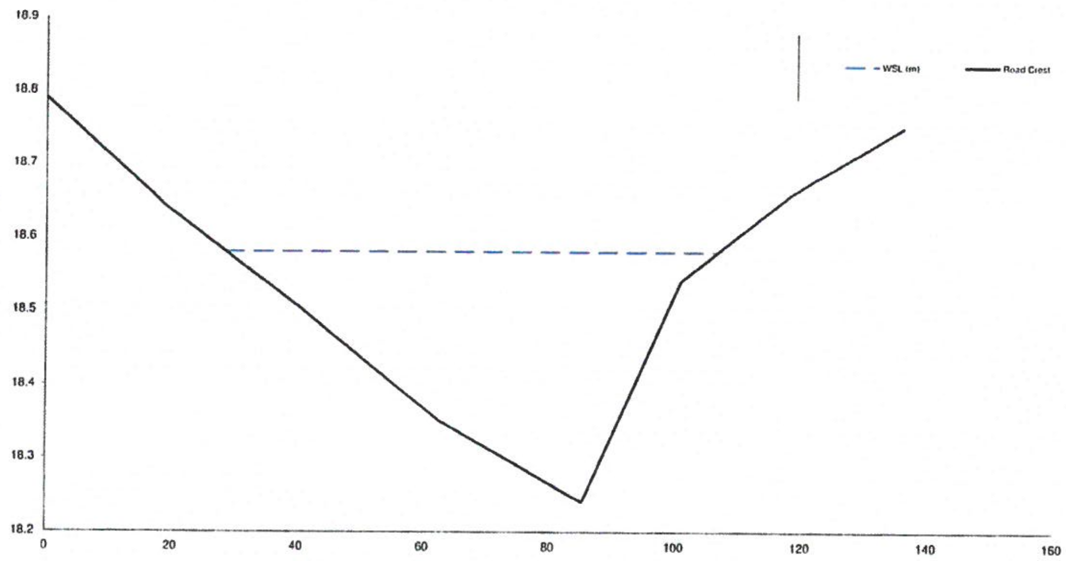
100 Y ARI

WSL (m)	18.58
Pipe Details	
U/S WSL (m)	18.58
TW (m)	
H (m)	18.58
L (m)	
No. Cells	
Dia (m)	
A (m2)	0.000
U/S IL	
D/S IL	
n	
ke	
g (m/s2)	9.81
Q Inlet (m3/s)	
Q Outlet (m3/s)	
Pipe Flow (m3/s)	0.00
Box Details	
L (m)	22
TW (m)	17.88
Width	1.8
Height (m)	0.60
No.	3
Area (m^2)	1.080
K	1
Invert Level (R.L)	17.28
Inflow Level (R.L)	17.28
Box Inlet Flow (m3/s)	8.84
Box Outlet Flow (m3/s)	9.70
Box Flow (m3/s)	8.84
Weir Flow (m3/s)	10.31

Results	
Total Flow (m3/s)	19.15
Actual Flow (m3/s)	18.88
% Difference	1.43%

Weir Details — Weir Coefficient 1.67

Chainage	RL (m)	P (m)	D (m)	Q (m3/s)	wA (m2)	V (m/s)	V.D (m2/s)
0	18.79						
19.259	18.64						
40.921	18.5	12.38	0.04	0.165	0.50	0.33	0.01
62.721	18.35	21.80	0.15	2.222	3.38	0.66	0.10
85.331	18.24	22.61	0.28	5.745	6.44	0.89	0.25
100.851	18.54	15.52	0.19	2.147	2.95	0.73	0.14
118.612	18.66	5.92	0.02	0.028	0.12	0.24	0.00
136	18.75						



SOMERSET CONNECTION ROAD - CULVERT FLOW CALCULATIONS

Scenario B - No Blockage

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W WBNM Results.xlsx]Somerset Cnct Rd Cul (Scen B 50
Date: 19/12/2013
By: AH

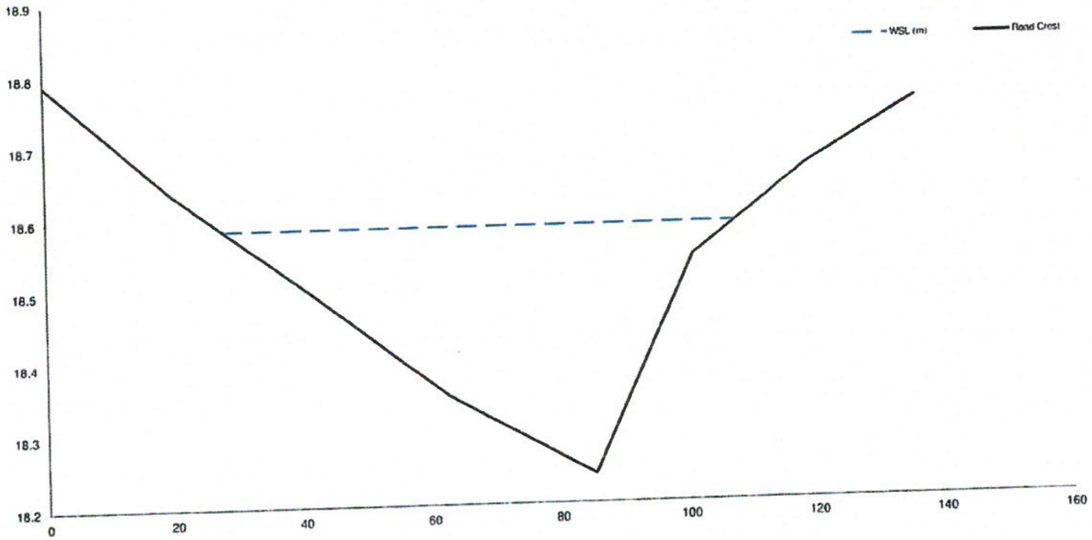
Somerset Road Culverts

100 Y ARI

WSL (m)	18.59
Pipe Details	
U/S WSL (m)	18.59
TW (m)	
H (m)	18.59
L (m)	
No. Cells	
Dia (m)	
A (m2)	0.000
U/S IL	
D/S IL	
n	
ke	
g (m/s2)	9.81
Q Inlet (m3/s)	
Q Outlet (m3/s)	
Pipe Flow (m3/s)	0.00
Box Details	
L (m)	22
TW (m)	17.88
Width	1.8
Height (m)	0.60
No.	6
Area (m²)	1.080
K	1
Invert Level (R.L)	17.28
Inflow Level (R.L)	17.28
Box Inlet Flow (m3/s)	17.73
Box Outlet Flow (m3/s)	19.46
Box Flow (m3/s)	17.73
Weir Flow (m3/s)	10.69

Results	
Total Flow (m3/s)	28.42
Actual Flow (m3/s)	28.414
% Difference	0.01%

Weir Details		Weir Coefficient		1.67			
Chainage	RL (m)	P (m)	D (m)	Q (m3/s)	wA (m2)	V (m/s)	V.D (m2/s)
0	18.79						
19.259	18.64	13.15	0.04	0.192	0.56	0.34	0.01
40.921	18.5	21.80	0.16	2.330	3.49	0.67	0.11
62.721	18.35	22.61	0.29	5.897	6.56	0.90	0.26
85.331	18.24	15.52	0.20	2.232	3.03	0.74	0.14
100.851	18.54	6.66	0.02	0.038	0.15	0.25	0.01
118.612	18.66						
136	18.75						



SOMERSET CONNECTION ROAD - CULVERT FLOW CALCULATIONS

Scenario B - 50% Blockage

Filename: H:\B13\300-349\B13313.W\Stormwater\[B13313.W WBNM Results.xlsx]Somerset Cnct Rd Cul (Scen B 50
Date: 19/12/2013
By: AH

Somerset Road Culverts

100 Y ARI

WSL (m)	18.68

Pipe Details

U/S WSL (m)	18.68
TW (m)	
H (m)	18.68
L (m)	
No. Cells	
Dia (m)	
A (m2)	0.000
U/S IL	
D/S IL	
n	
ke	
g (m/s2)	
Q Inlet (m3/s)	
Q Outlet (m3/s)	
Pipe Flow (m3/s)	0.00

Box Details

L (m)	22
TW (m)	17.88
Width	1.8
Height (m)	0.60
No.	3
Area (m²)	1.080
K	1
Invert Level (R.L)	17.28
Inflow Level (R.L)	17.28
Box Inlet Flow (m3/s)	9.23
Box Outlet Flow (m3/s)	10.33
Box Flow (m3/s)	9.23
Weir Flow (m3/s)	19.20

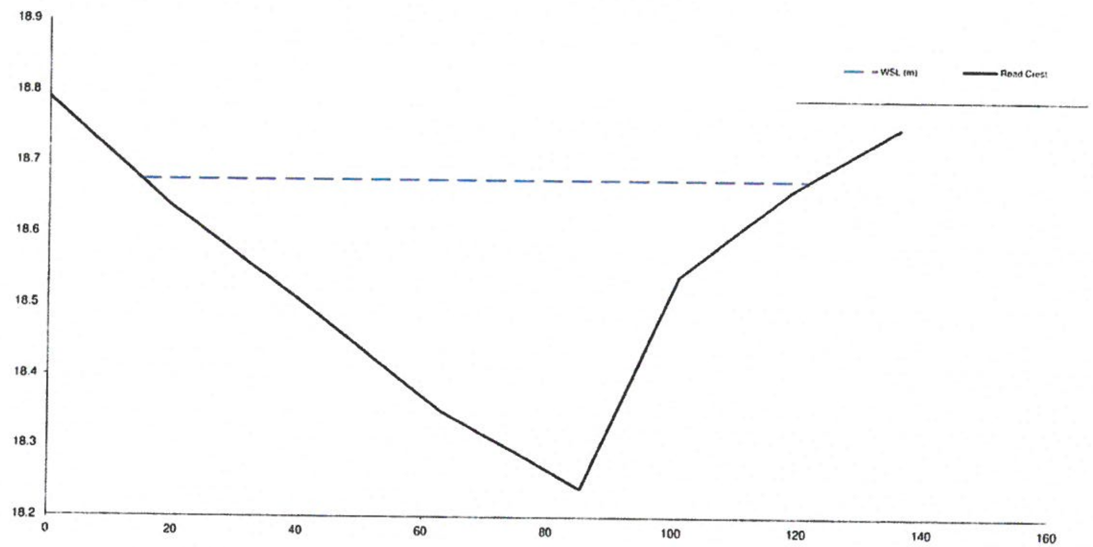
Results	
Total Flow (m3/s)	28.43
Actual Flow (m3/s)	28.414
% Difference	0.06%

W.A	Q
14.9	11.8
21.6	18.63
	6.83

Weir Details — Weir Coefficient 1.67

Chainage	RL (m)	P (m)	D (m)	Q (m3/s)	wA (m2)	V (m/s)	V.D (m2/s)
0	18.79						
19.259	18.64	4.49	0.02	0.017	0.08	0.22	0.00
40.921	18.5	21.66	0.11	1.231	2.27	0.54	0.06
62.721	18.35	21.80	0.25	4.551	5.45	0.84	0.21
85.331	18.24	22.61	0.38	8.845	8.59	1.03	0.39
100.851	18.54	15.52	0.29	3.943	4.42	0.89	0.25
118.612	18.66	17.76	0.07	0.609	1.33	0.46	0.03
136	18.75	2.90	0.01	0.003	0.02	0.14	0.00

18.79	18.89
18.64	18.74
18.5	18.6
18.35	18.45
18.24	18.34
18.54	18.64
18.66	18.76
18.75	18.85



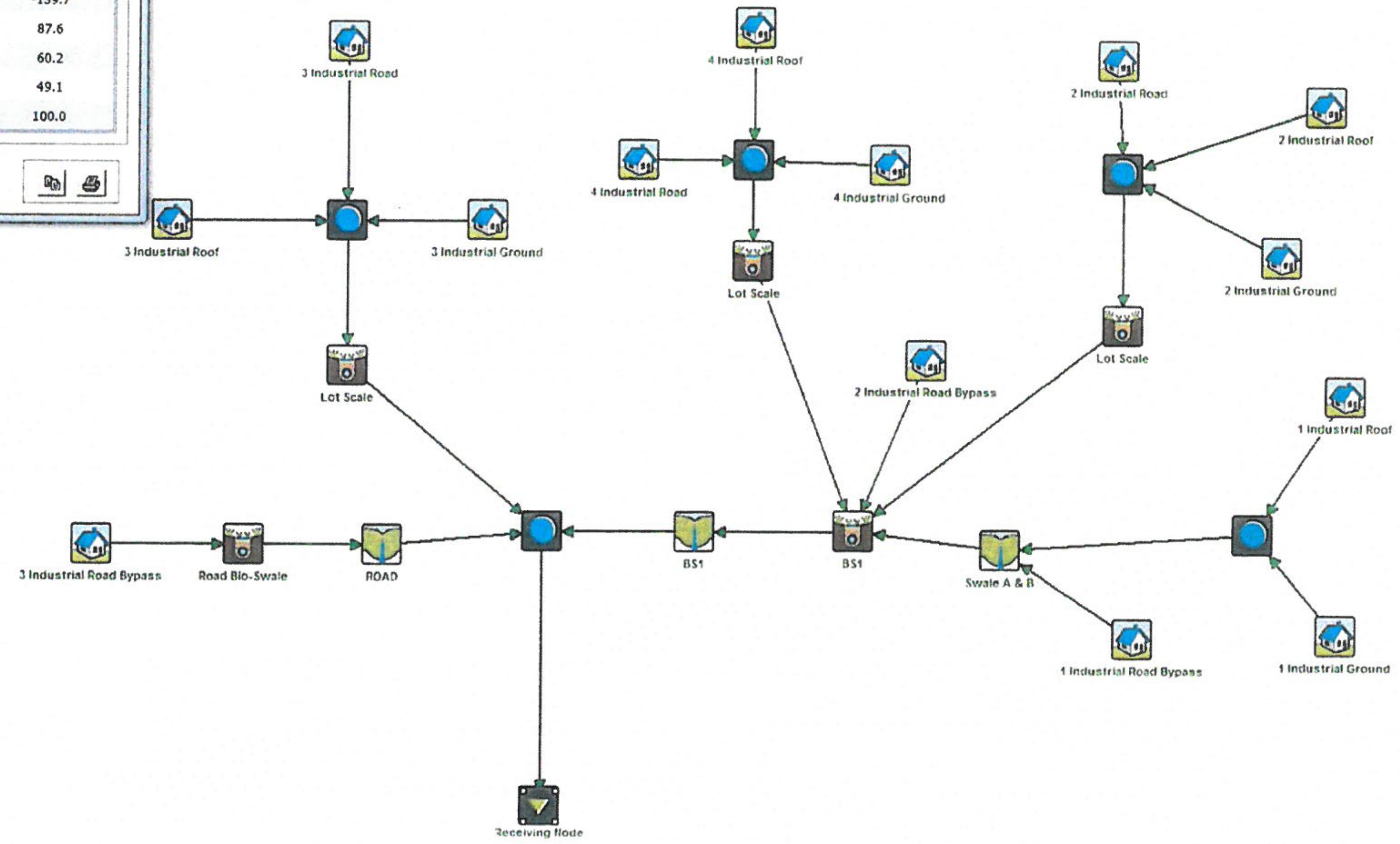
Appendix D:

MUSIC Model Layout

MUSIC Summary

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	123	117	4.7
Peak Flow (m3/s)	1.70	4.07	-139.7
Total Suspended Solids (kg/yr)	17.5E3	2.17E3	87.6
Total Phosphorus (kg/yr)	39.7	15.8	60.2
Total Nitrogen (kg/yr)	283	144	49.1
Gross Pollutants (kg/yr)	3.01E3	0.00	100.0



Source Node Configuration

Location	1 Industrial Roof	1 Industrial Road Bypass	1 Industrial Ground	2 Industrial Roof	2 Industrial Road	2 Industrial Ground	3 Industrial Roof
Total Area (ha)	4.155	2.493	1.662	1.665	0.339	0.666	3.465
Area Impervious (ha)	4.155	1.491056	0.337691	1.665	0.202755	0.13532	3.465
Area Pervious (ha)	0	1.001944	1.324309	0	0.136245	0.53068	0
Field Capacity (mm)	100	100	100	100	100	100	100
Pervious Area Infiltration Capacity coefficient - a	200	200	200	200	200	200	200
Pervious Area Infiltration Capacity exponent - b	1	1	1	1	1	1	1
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1	1	1	1
Pervious Area Soil Storage Capacity (mm)	250	250	250	250	250	250	250
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	30	30	30	30
Groundwater Initial Depth (mm)	10	40	10	10	40	10	10
Groundwater Daily Recharge Rate (%)	4	4	4	4	4	4	4
Groundwater Daily Baseflow Rate (%)	2	2	2	2	2	2	2
Groundwater Daily Deep Seepage Rate (%)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Stormflow Total Suspended Solids Mean (log mg/L)	1.3	2.43	1.92	1.3	2.43	1.92	1.3
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.3	-0.59	-0.89	-0.3	-0.59	-0.89
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0
Stormflow Total Nitrogen Mean (log mg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.32	0.32	0.32	0.32	0.32	0.32	0.32

Source Node Configuration Cont.

Location	3 Industrial Road	3 Industrial Ground	4 Industrial Roof	4 Industrial Road	4 Industrial Ground	2 Industrial Road Bypass	3 Industrial Road Bypass
Total Area (ha)	0.819	1.386	1.63	0.978	0.652	0.66	1.26
Area Impervious (ha)	0.489841	0.281612	1.63	0.584939	0.132476	0.394744	0.753602
Area Pervious (ha)	0.329159	1.104388	0	0.393061	0.519524	0.265256	0.506398
Field Capacity (mm)	100	100	100	100	100	100	100
Pervious Area Infiltration Capacity coefficient - a	200	200	200	200	200	200	200
Pervious Area Infiltration Capacity exponent - b	1	1	1	1	1	1	1
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1	1	1	1
Pervious Area Soil Storage Capacity (mm)	250	250	250	250	250	250	250
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	30	30	30	30
Groundwater Initial Depth (mm)	40	10	10	40	10	40	40
Groundwater Daily Recharge Rate (%)	4	4	4	4	4	4	4
Groundwater Daily Baseflow Rate (%)	2	2	2	2	2	2	2
Groundwater Daily Deep Seepage Rate (%)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Stormflow Total Suspended Solids Mean (log mg/L)	2.43	1.92	1.3	2.43	1.92	2.43	2.43
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.59	-0.89	-0.3	-0.59	-0.3	-0.3
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0
Stormflow Total Nitrogen Mean (log mg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.32	0.32	0.32	0.32	0.32	0.32	0.32

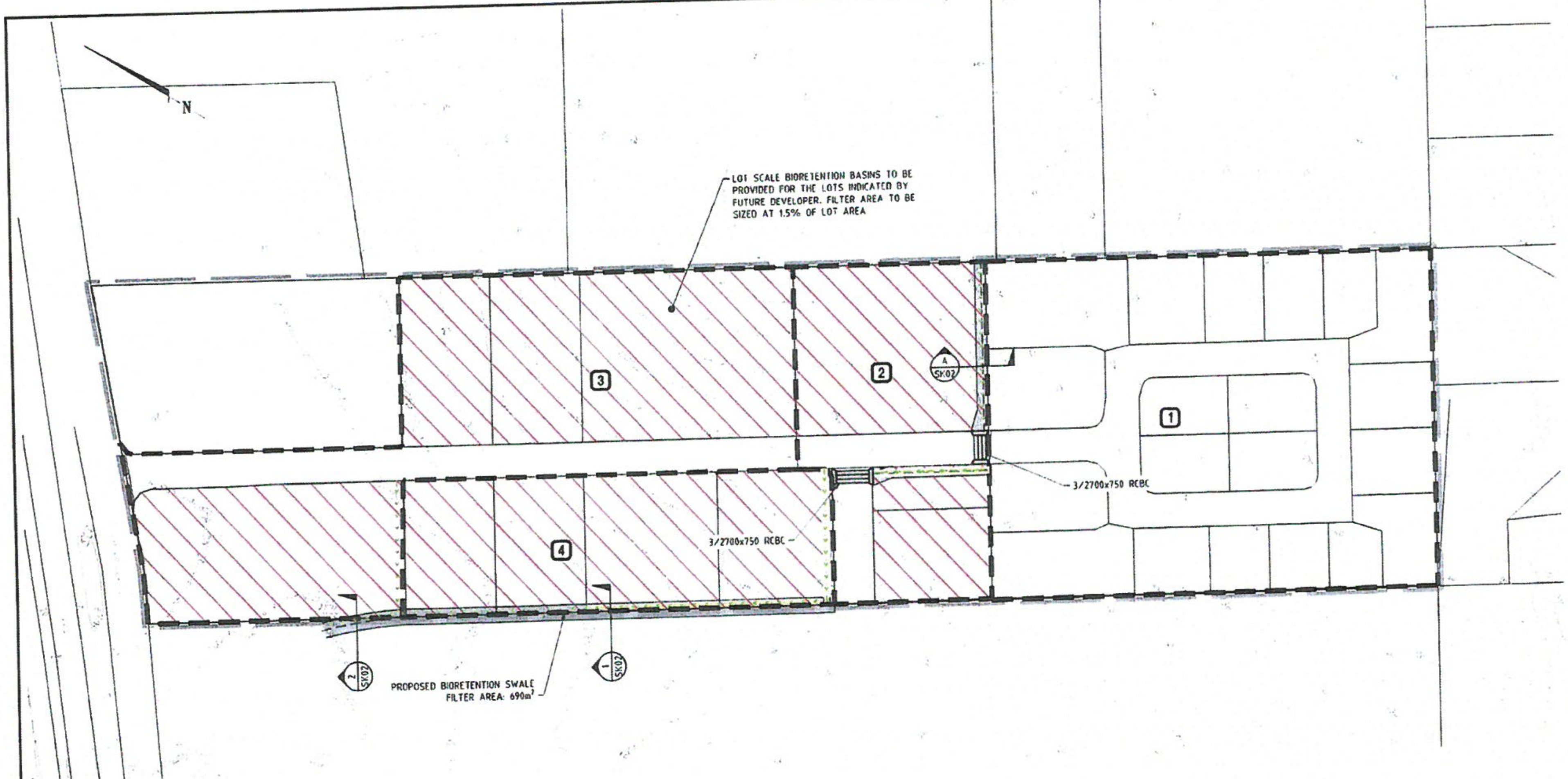
Treatment Node Configuration

Location	BS1	BS1	Lot Scale	Lot Scale	Lot Scale	Lot Scale	Lot Scale	ROAD	Road Bio-Swale	Swale A & B
Lo-flow bypass rate (cum/sec)	0	0.087	0	0	0	0	0	0.01	0	0
Hi-flow bypass rate (cum/sec)	100		100	100	100	100	100		1000	
Area (sqm)	690		400	490	850	2035	130		200	
Extended detention depth (m)	0	1.3	0.3	0.3	0.3	0.3	0.2	0.5	0	0.8
Overflow weir width (m)	156		80	98	170	203.5	13		4	
Weir Coefficient	1.7		1.7	1.7	1.7	1.7	1.7		1.7	
Number of CSTR Cells	3	10	3	3	3	3	3	10	3	10
Total Suspended Solids - k (m/yr)	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
Total Suspended Solids - C* (mg/L)	20	20	20	20	20	20	20	20	20	20
Total Phosphorus - k (m/yr)	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
Total Phosphorus - C* (mg/L)	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Total Nitrogen - k (m/yr)	500	500	500	500	500	500	500	500	500	500
Total Nitrogen - C* (mg/L)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Filter area (sqm)	690		400	490	850	2035	130		200	
Filter depth (m)	0.4		0.6	0.6	0.6	0.6	0.6		0.4	
Filter Median Particle Diameter (mm)										
Saturated Hydraulic Conductivity (mm/hr)	200		200	200	200	200	200		200	

Appendix E:

B13313.W-SK01

B13313.W-SK02



LEGEND

- EXISTING CONTOURS
- APPROXIMATE SITE BOUNDARY
- MUSIC CATCHMENT BOUNDARY
- 1 — MUSIC CATCHMENT LABEL
- PROPOSED SWALE
- PROPOSED BIORETENTION SWALE
- STORMWATER FLOW DIRECTION
- LOTS TO PROVIDE OWN STORMWATER QUALITY CONTROLS

NOTES:

1. LAYOUT OF THE PRELIMINARY STORMWATER QUALITY IMPROVEMENT DEVICES IS CONCEPTUAL ONLY AND PROVIDED AS A GUIDE FOR THE TREATMENT TRAIN AND IS SUBJECT TO DETAILED DESIGN.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH BROWN CONSULTING REPORT NO. B13313.W-01D.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

ISSUE	CALC	DESIGN	DATE	AMENDMENT DETAILS
A	AR	AR	23.01.14	REPORT REVISION UPDATED
B	AR	DT	13.03.14	CHANNEL SECTIONS AND REPORT REVISION UPDATED

SCALE (METRES) 1:1500 A1 / 1:3000 A3

FOR & ON BEHALF OF BROWN CONSULTING (QLD) PTY LTD

CLIENT: GRACEMERE INDUSTRY PARK DEVELOPMENTS PTY LTD

PROJECT: INDUSTRIAL DEVELOPMENT 245 SOMERSET ROAD, GRACEMERE

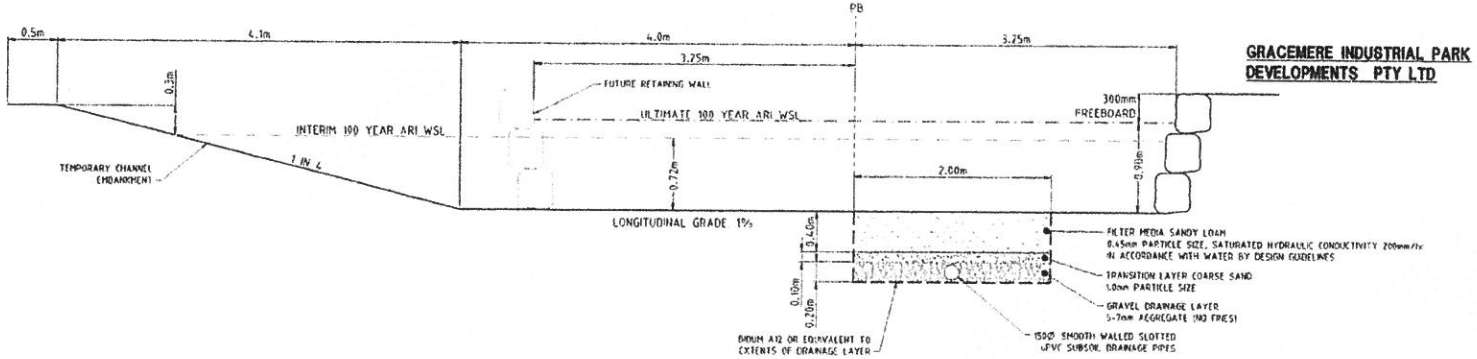
BROWN *Smart Consulting*

DRAWING TITLE: STORMWATER MANAGEMENT PLAN

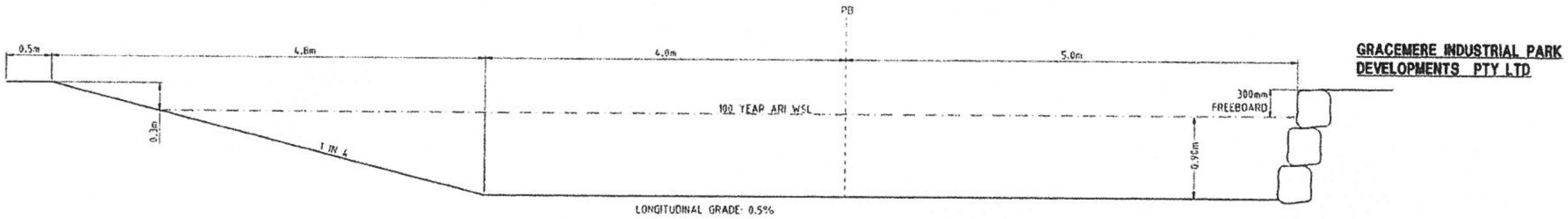
DRAWING NUMBER: B13313.W-SK01

ISSUE: B

SECTION A / SK07



SECTION 1 / SK07



SECTION 2 / SK07

NOTES:

1. LAYOUT OF THE PRELIMINARY STORMWATER QUALITY IMPROVEMENT DEVICES IS CONCEPTUAL ONLY AND PROVIDED AS A GUIDE FOR THE TREATMENT TRAIN AND IS SUBJECT TO DETAILED DESIGN.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH BROWN CONSULTING REPORT NO. B13313.W-01D.

CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
A	AH	AH	21.12.16	REPORT REVISION UPDATED
B	AH	PF	13.03.16	CHANNEL SECTIONS AND REPORT REVISION UPDATED
C				
D				
E				
F				

CLIENT: GRACEMERE INDUSTRY PARK DEVELOPMENTS PTY LTD

PROJECT: INDUSTRIAL DEVELOPMENT, 245 SOMERSET ROAD, GRACEMERE

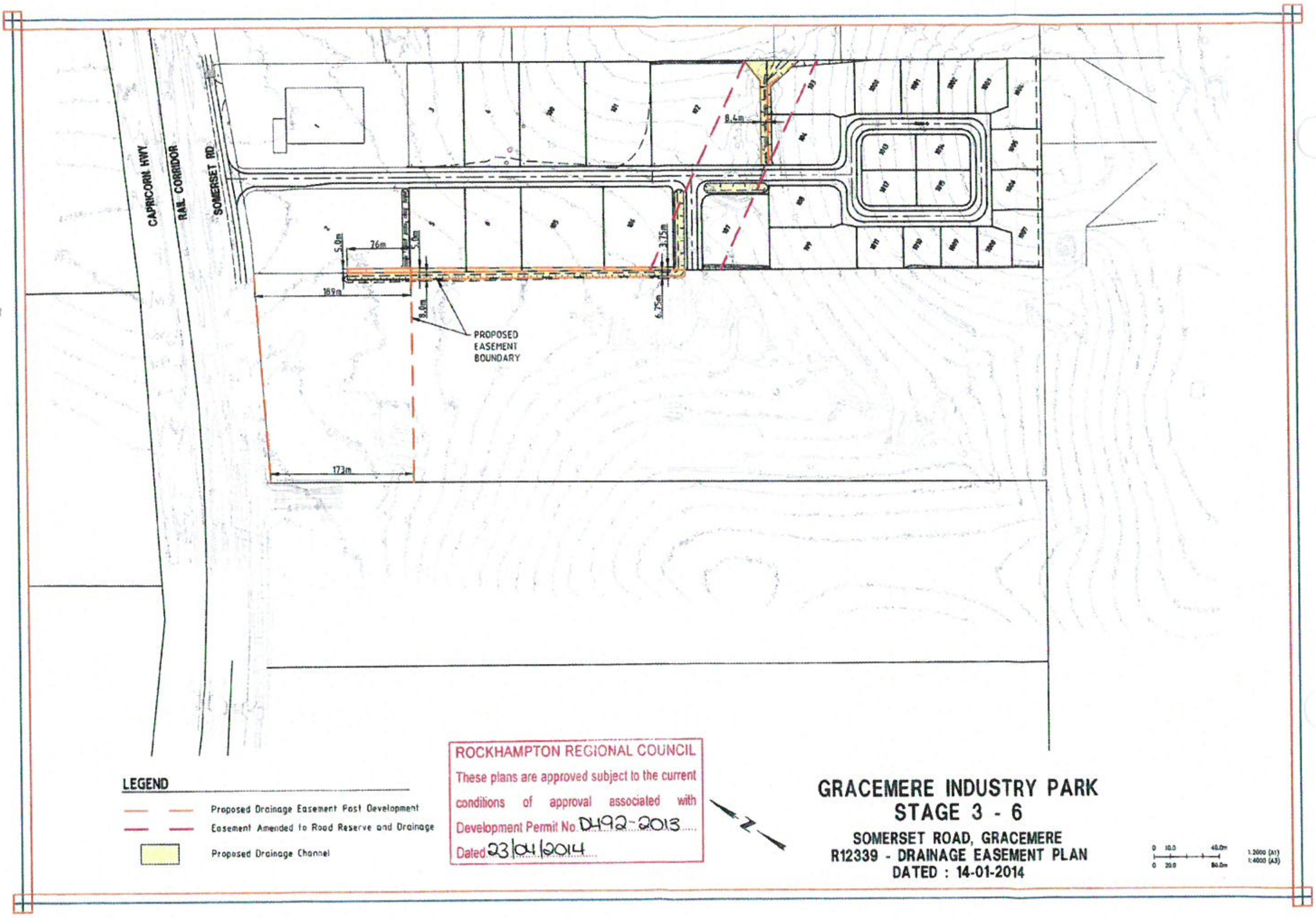
FOR & ON BEHALF OF BROWN CONSULTING (QLD) PTY LTD

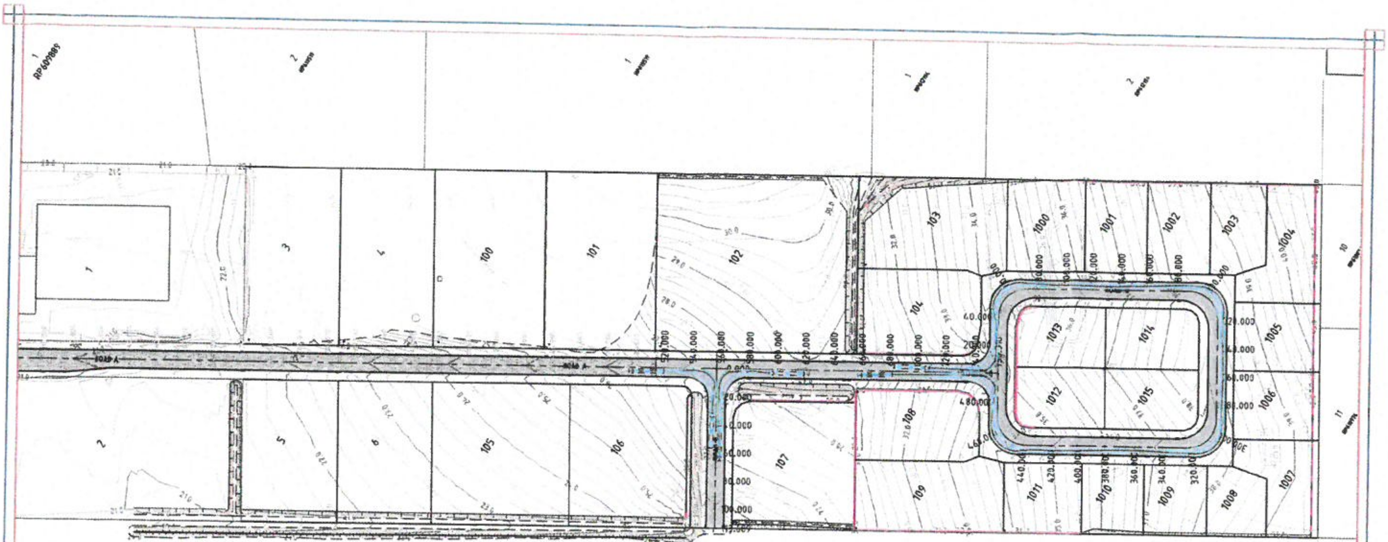
BROWN *Smart Consulting*

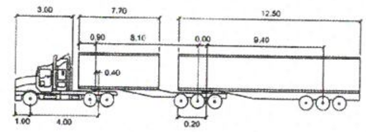
DRAWING TITLE: SECTIONS PLAN

DRAWING NUMBER: B13313.W-SK02

ISSUE: B


CAPRICORN HWY
RAIL CORRIDOR
SOMERSET RD
8.4m
5.0m
26m
5.0m
189m
8.0m
3.75m
6.75m
PROPOSED
EASEMENT
BOUNDARY
173m
LEGEND
Proposed Drainage Easement Post Development
Easement Amended to Road Reserve and Drainage
Proposed Drainage Channel
ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with
Development Permit No. D492-2013
Dated 23/04/2014
N
GRACEMERE INDUSTRY PARK
STAGE 3 - 6
SOMERSET ROAD, GRACEMERE
R12339 - DRAINAGE EASEMENT PLAN
DATED : 14-01-2014





B-DOUBLE 25M

	meters		
Tractor Width	: 2.50	Lock to Lock Time	: 6.0
Trailer Width	: 2.50	Steering Angle	: 20.6
Tractor Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

NOTE: Refer to the R12292-ROADWORKS INTERSECTION DETAILS plan for road details.

LEGEND

- New Roadwork
- Existing Roadwork
- Proposed Barrier Kerb and Channel
- Existing Contours
- Finished Surface Contours

GRACEMERE INDUSTRY PARK
STAGE 3 - 6

SOMERSET ROAD, GRACEMERE
R12339 - ROADWORKS LAYOUT

0 6.25 25.0m 1:1250 (A1)
0 12.5 50.0m 1:2500 (A3)

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D492-2013
Dated 23/04/2014

ROCKHAMPTON
P.O. Box 1580
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Rockhampton Q 4700

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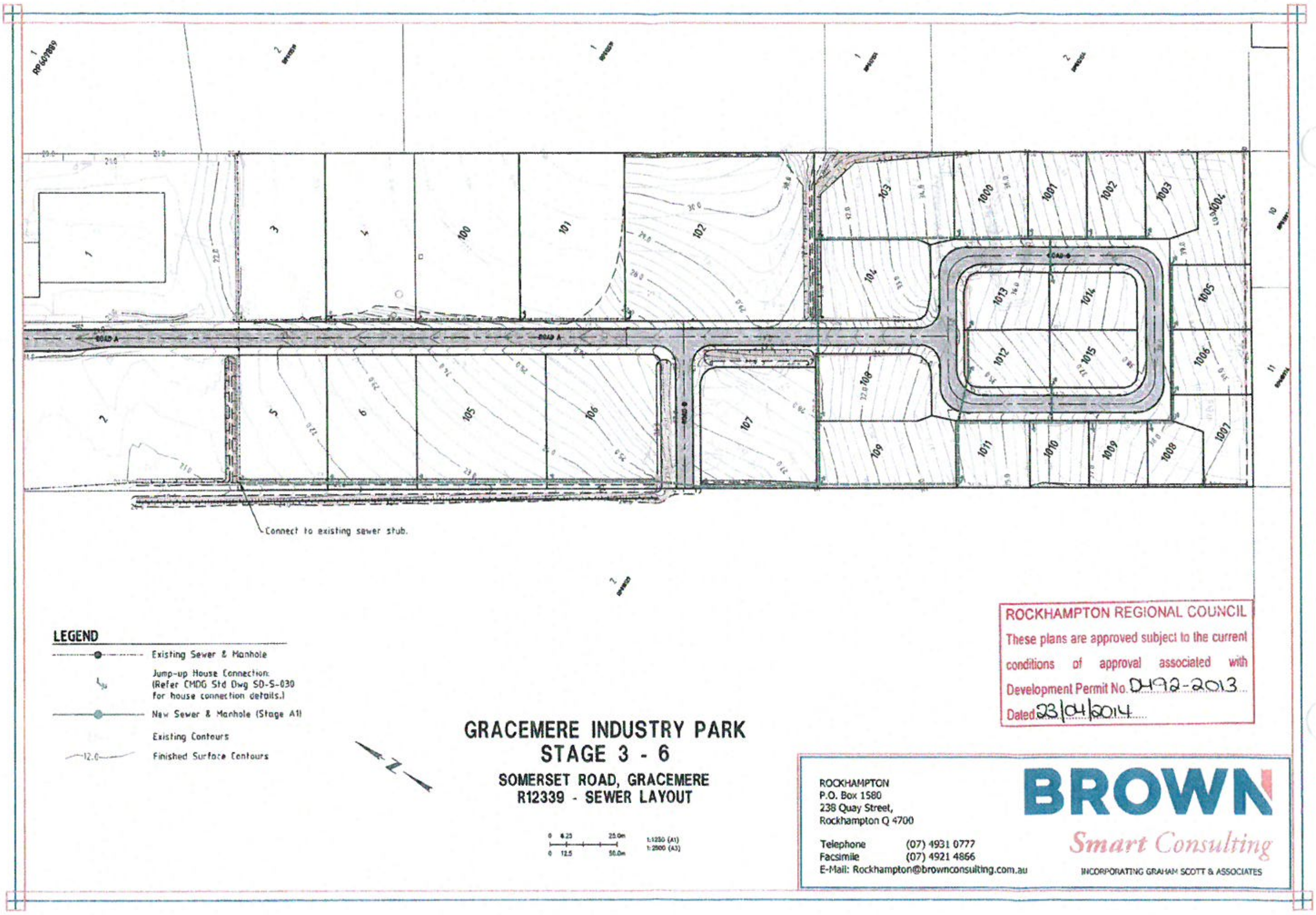
Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES



Connect to existing sewer stub.
LEGEND
Existing Sewer & Manhole
Jump-up House Connection: (Refer CMDG Std Dwg SD-S-030 for house connection details.)
New Sewer & Manhole (Stage A1)
Existing Contours
Finished Surface Contours
GRACEMERE INDUSTRY PARK
STAGE 3 - 6
SOMERSET ROAD, GRACEMERE
R12339 - SEWER LAYOUT
ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D492-2013
Dated 23/04/2014
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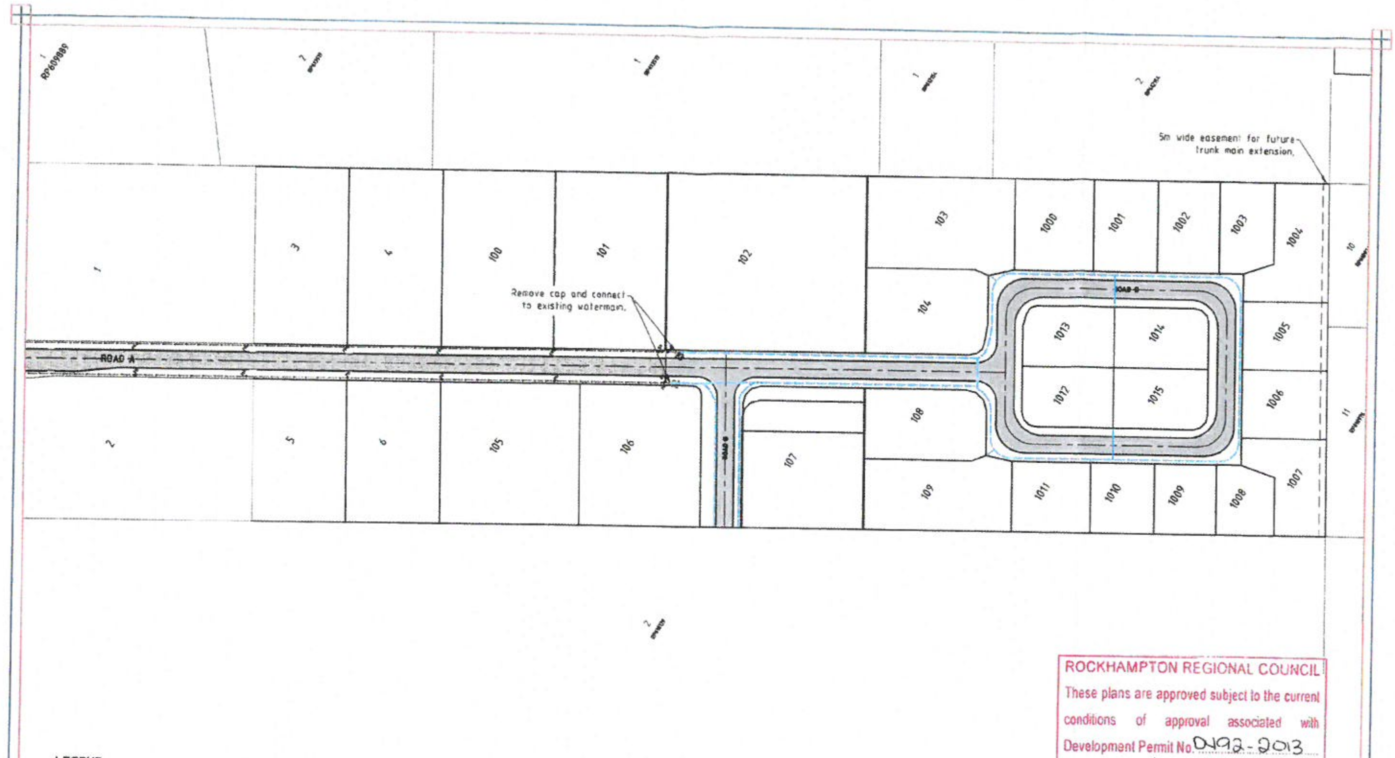

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No D492-2013
Dated 23/04/2014

GRACEMERE INDUSTRY PARK
STAGE 3 - 6
SOMERSET ROAD, GRACEMERE
R12339 - WATER RETICULATION PLAN

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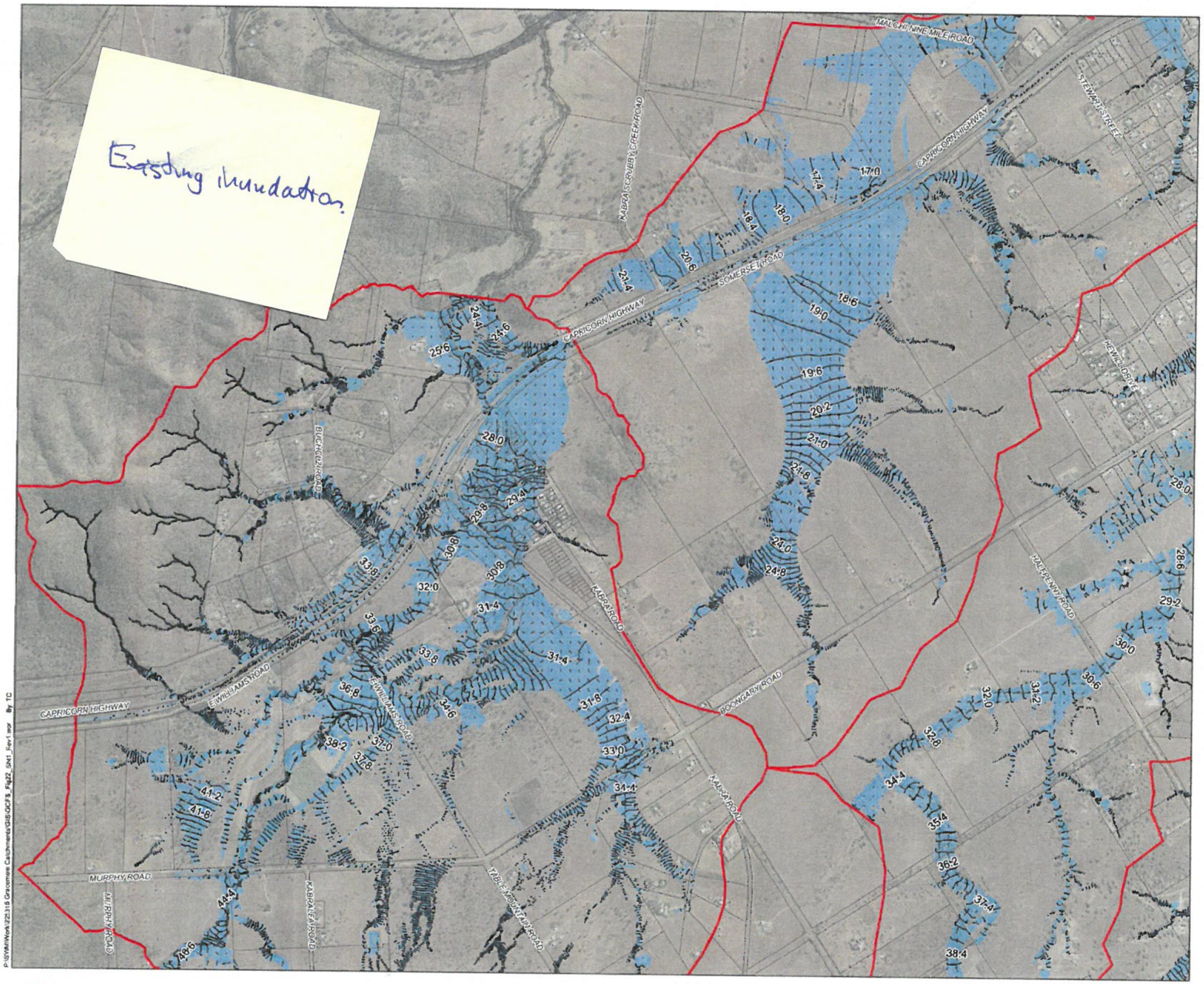
APPENDIX P Q100 INUNDATION PLANS



aurecon

Legend

- Cadastre
- TUFLOW Model Extents
- Inundation Extents
- 0.2m (AHD) Peak Water Surface Elevation Contour
- Velocity Vector
  - represents velocity at time of peak water level
  - reference vector = 9 m/s

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

0 — 1000 (m)

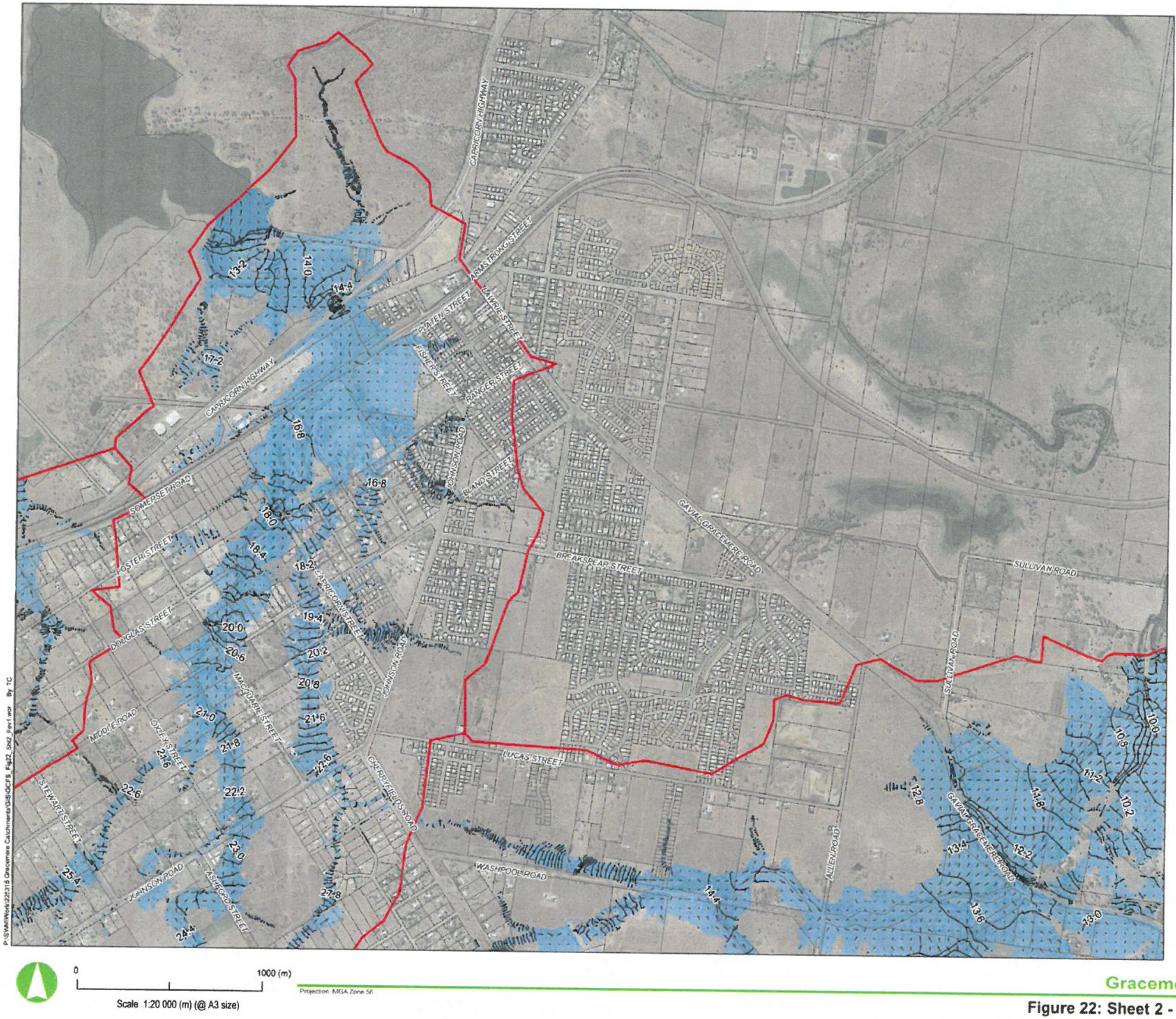
Scale 1:20 000 (m) (@ A3 size)

Projection: MGA Zone 56

P:\WM\Work\225316 Gracemere Catchments\GIS\GCFS_Fig22_SM1_Rev1.wor By TC

Gracemere Catchments Flood Study

Figure 22: Sheet 1 - 100 Year ARI Inundation Extents, Peak Water Surface Elevations and Velocities



aurecon

Legend

- Cadastre
- TUFLOW Model Extents
- Inundation Extents
- 0.2m (AHD) Peak Water Surface Elevation Contour
- Velocity Vector
  - represents velocity at time of peak water level
  - reference vector = 9 m/s

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012 Version: 1

Gracemere Catchments Flood Study

Figure 22: Sheet 2 - 100 Year ARI Inundation Extents, Peak Water Surface Elevations and Velocities

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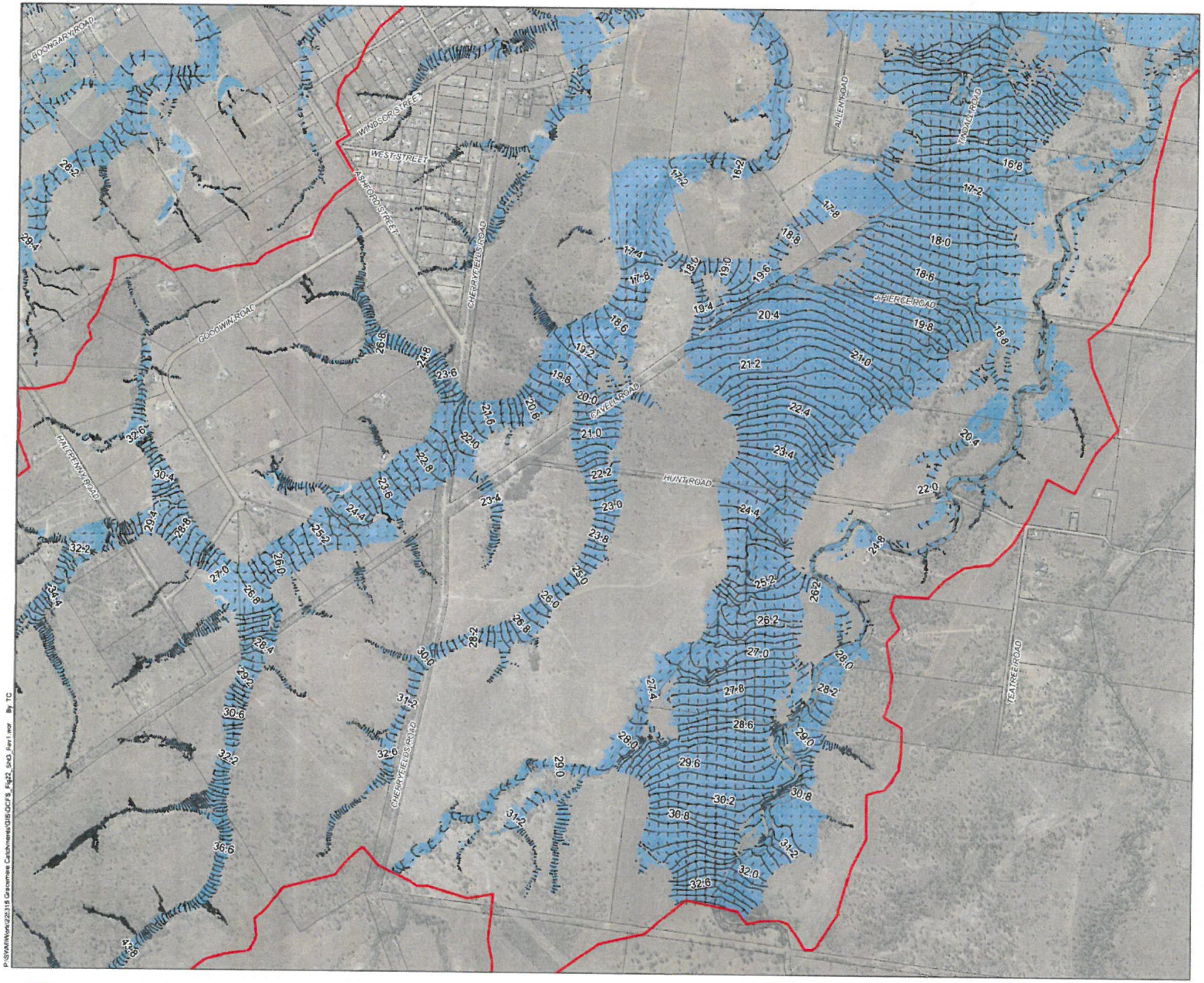

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0 — 1000 (m)

Scale 1:20 000 (m) (@ A3 size)

Projection: MGA Zone 56

Legend

- Cadastre
- TUFLOW Model Extents
- Inundation Extents
- 0.2m (AHD) Peak Water Surface Elevation Contour
- Velocity Vector
  - represents velocity at time of peak water level
  - reference vector = 9 m/s

Notes:

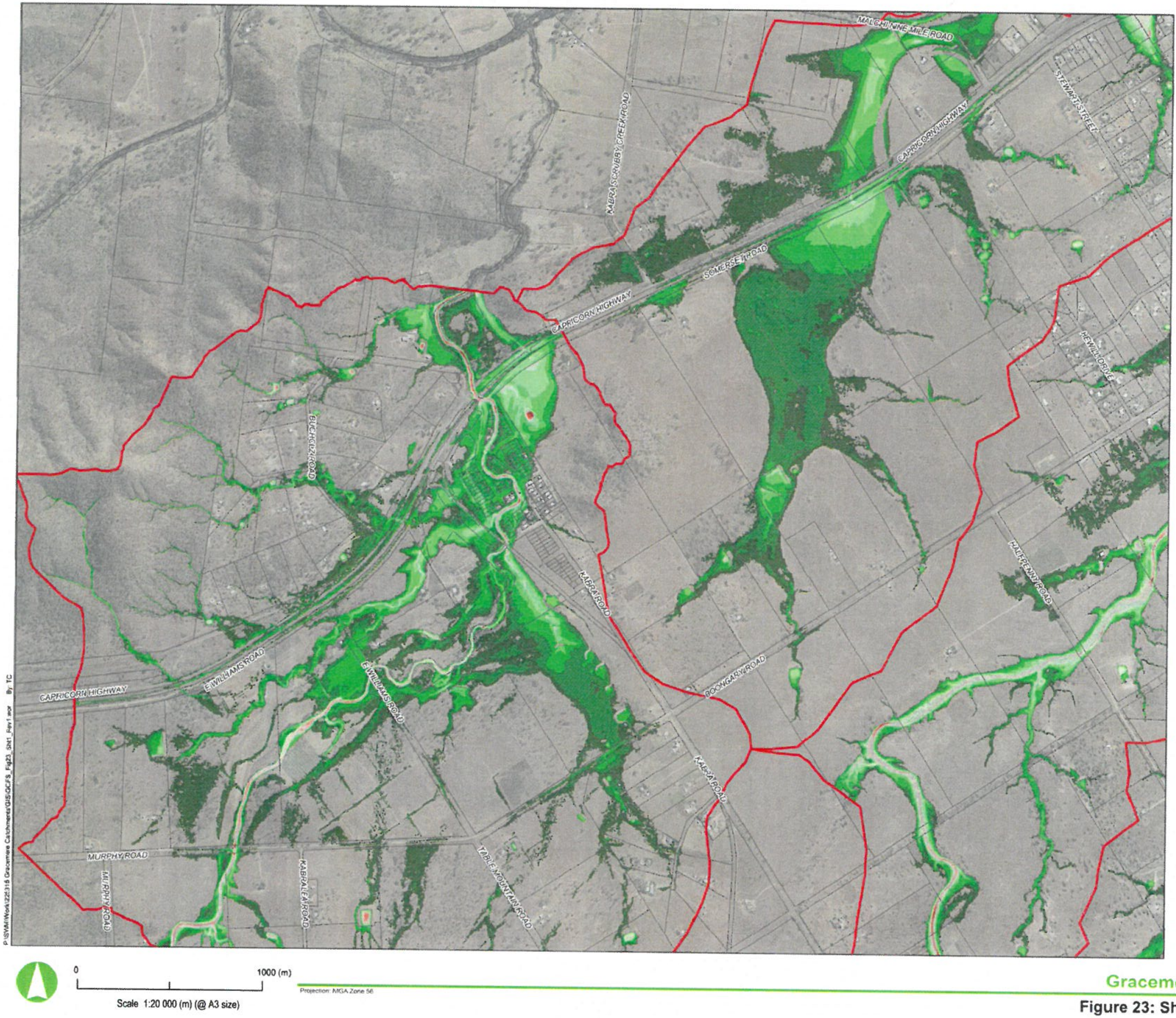
1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

Gracemere Catchments Flood Study

Figure 22: Sheet 3 - 100 Year ARI Inundation Extents, Peak Water Surface Elevations and Velocities



aurecon

Legend

Cadastre

TUFLOW Model Extents

Depth (m)

- 0.0 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

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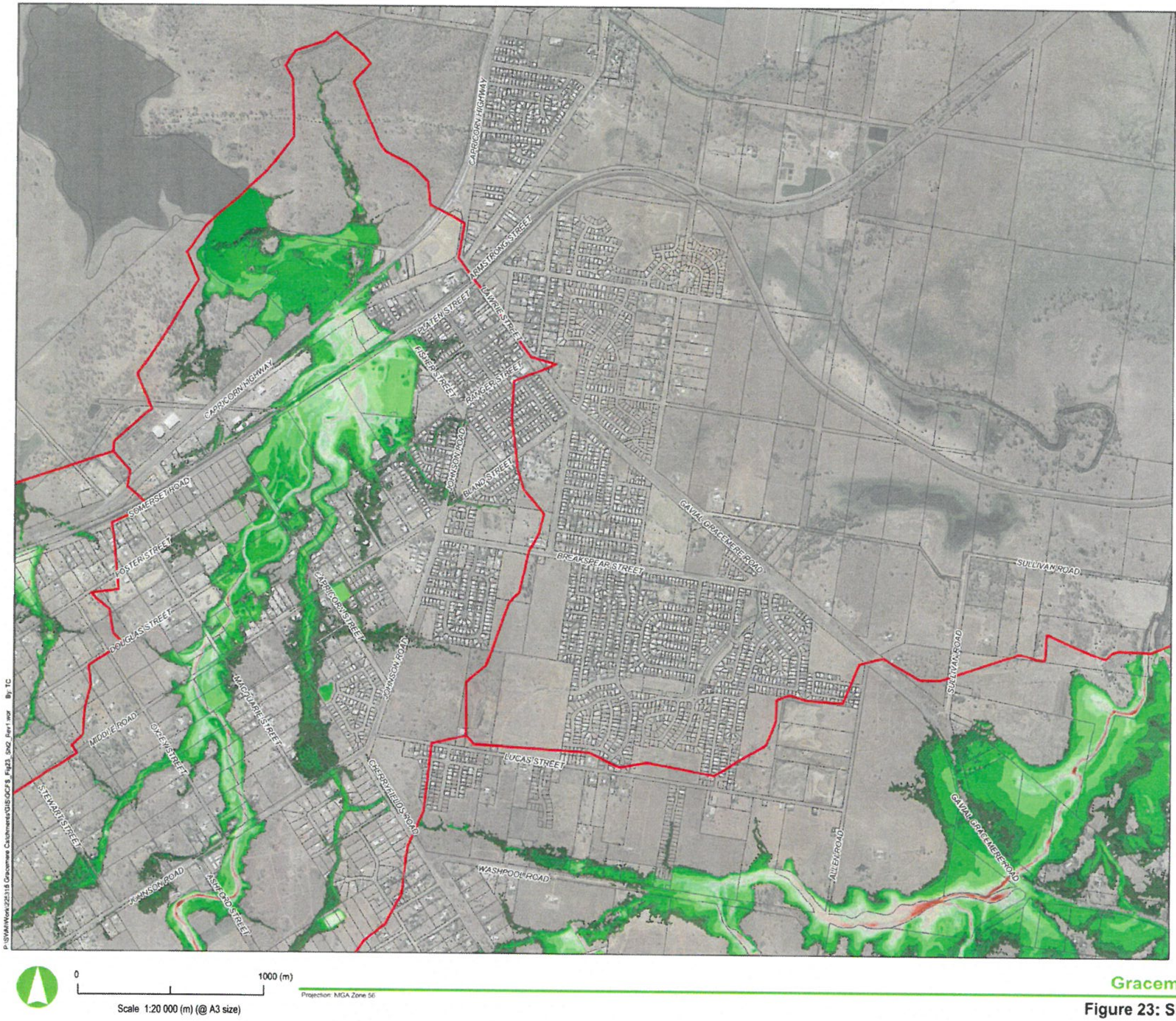
Gracemere Catchments Flood Study

Figure 23: Sheet 1 - 100 Year ARI Peak Depths



aurecon

Legend

- Cadastre
- TUFLOW Model Extents

Depth (m)

- 0.0 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

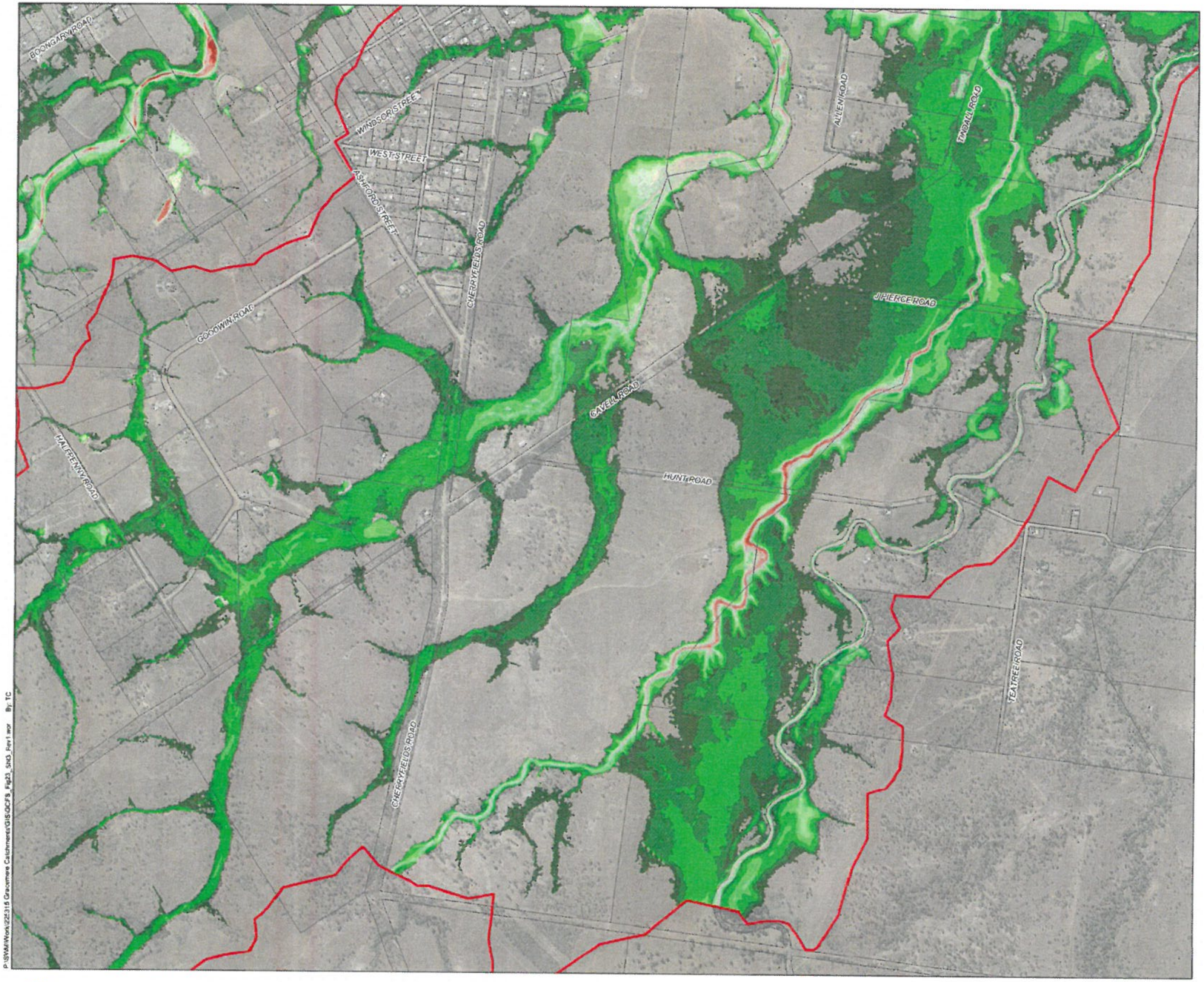
1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

Gracemere Catchments Flood Study

Figure 23: Sheet 2 - 100 Year ARI Peak Depths



aurecon

Legend

- Cadastre
- TUFLOW Model Extents

Depth (m)

- 0.0 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- 4.5 to 5.0
- > 5.0

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012 Version: 1

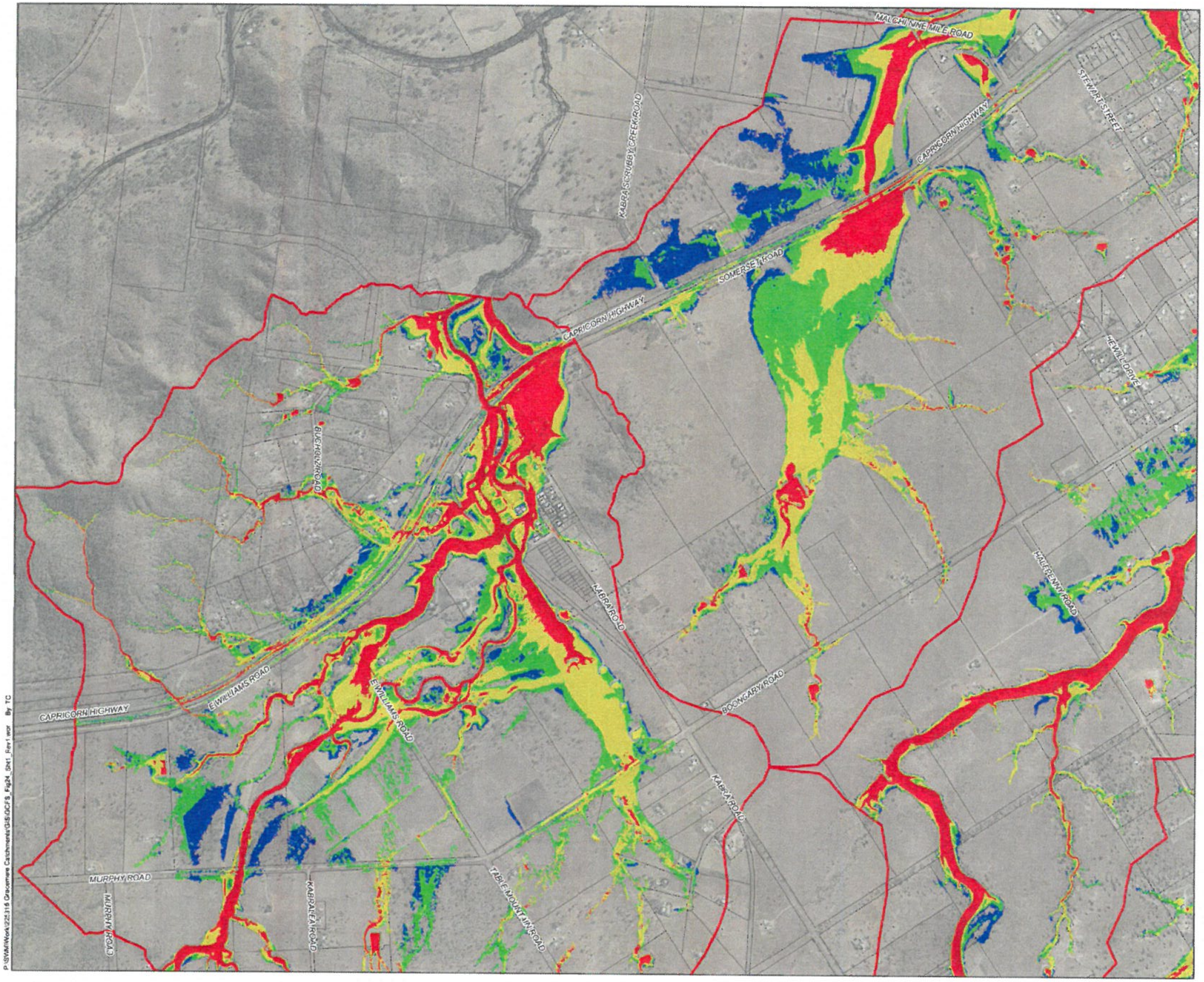
0 1000 (m)

Scale 1:20 000 (m) (@ A3 size)

Projection: MGA Zone 56

Gracemere Catchments Flood Study

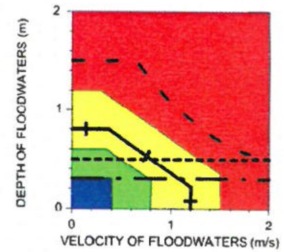
Figure 23: Sheet 3 - 100 Year ARI Peak Depths



Legend

Cadastre

TUFLOW Model Extents



Hazard Categories	Hazard Thresholds
Extreme	Safe to Use Small Cars
High	Safe to Use 4WDs
Medium	Wading Limit - Children
Low	Wading Limit - Adults

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

0 — 1000 (m)

Scale 1:20 000 (m) (@ A3 size)

Projection: MGA Zone 56

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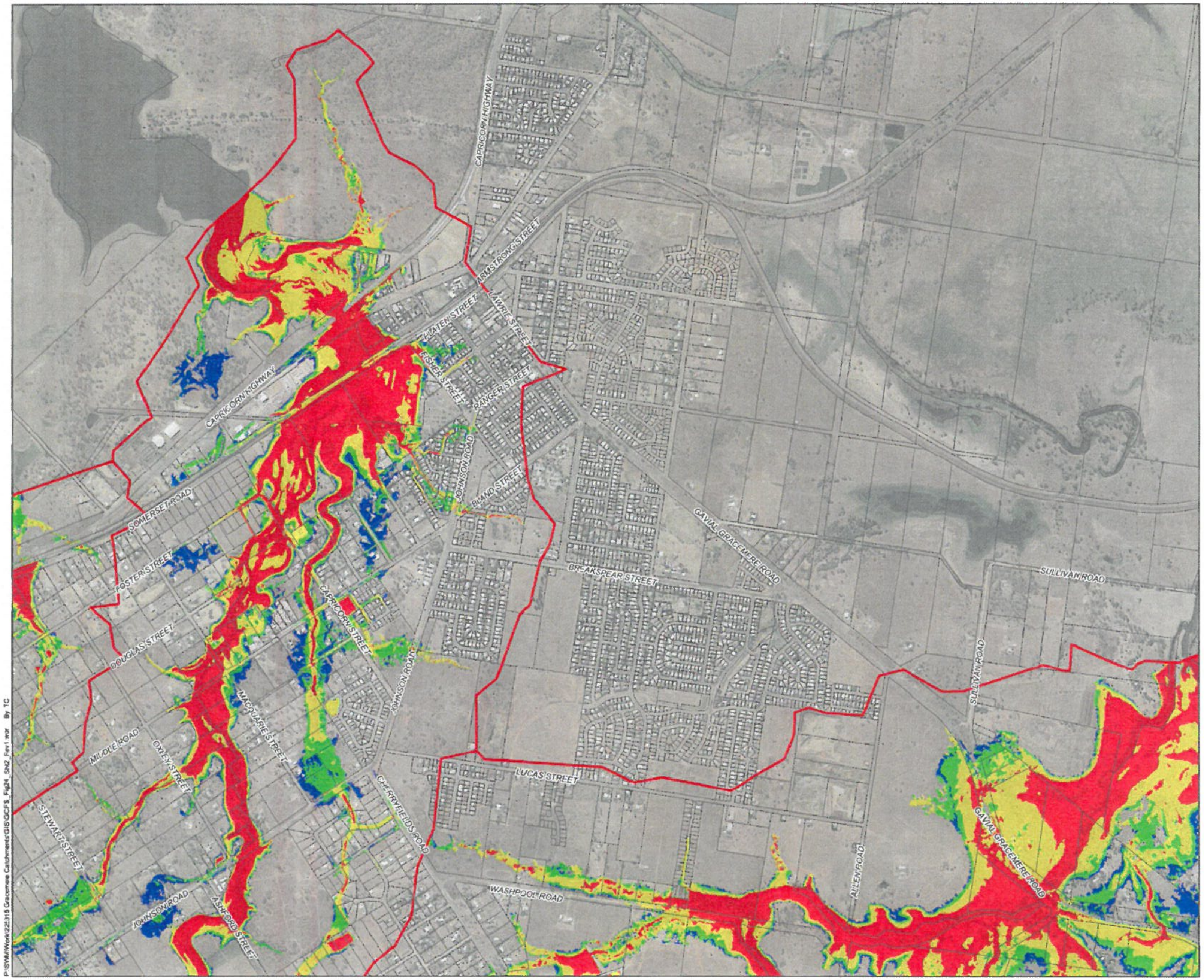
Gracemere Catchments Flood Study

Figure 24: Sheet 1 - 100 Year ARI Peak Hazards

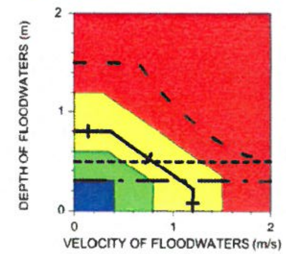


aurecon

Legend

Cadastre

TUFLOW Model Extents



Hazard Categories	Hazard Thresholds
Extreme	Safe to Use Small Cars
High	Safe to Use 4WDs
Medium	Wading Limit - Children
Low	Wading Limit - Adults

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

0 1000 (m)

Scale 1:20 000 (m) (@ A3 size)

Projection: MGA Zone 56

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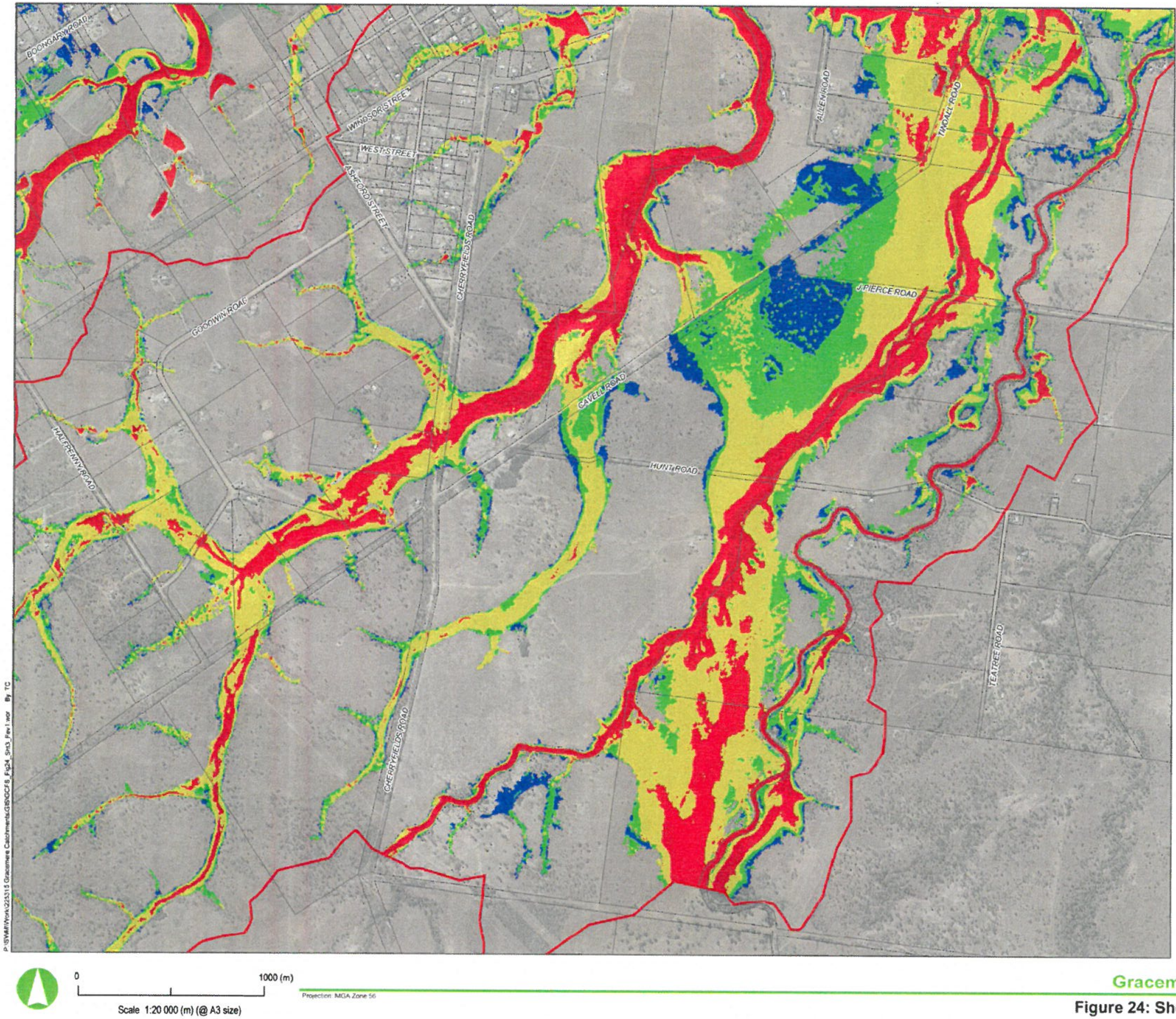
Gracemere Catchments Flood Study

Figure 24: Sheet 2 - 100 Year ARI Peak Hazards

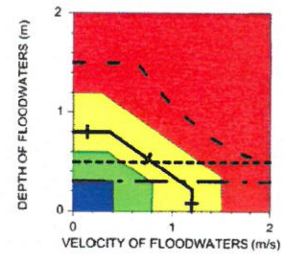


aurecon

Legend

Cadastre

TUFLOW Model Extents



Hazard Categories		Hazard Thresholds	
	Extreme		Safe to Use Small Cars
	High		Safe to Use 4WDs
	Medium		Wading Limit - Children
	Low		Wading Limit - Adults

Notes:

1. This map must not be used without consideration of, or reference to, the Explanatory Notes and Disclaimers which are provided on the Gracemere Catchments Flood Study Figure 25 so as to understand the important limitations and conditions on such use.
2. This mapping considers local catchment flooding only. No consideration of Neerkol Creek or Padgoe Lagoon flooding has been made.
3. This mapping shows inundation within the Gracemere Catchments Flood Study TUFLOW model extents only. Flood inundation continues beyond the downstream extents of this mapping.

Date: 31/03/2012

Version: 1

Gracemere Catchments Flood Study

Figure 24: Sheet 3 - 100 Year ARI Peak Hazards

APPENDIX R WATER NETWORK ANALYSIS

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/55-2015

Dated: 12 November 2018

Rockhampton Office
232 Bolsover St, Rockhampton

Gracemere Office
1 Ranger St, Gracemere

Mount Morgan Office
32 Hall St, Mount Morgan

DATE	13/07/15
INITIALS	SO
JOB NO.	R14205
FILED	

13 July 2015

Our Ref: 1335
Enquiries: Peter Wheelhouse
Telephone: 1300 22 55 77
Fax: 1300 22 55 79
Email: peter.wheelhouse@rrc.qld.gov.au

Ron and Tracey Bowes
C/- Calibre Consulting
PO Box 1580
ROCKHAMPTON QLD 4700

ATTENTION: Ken Laughton

Dear Ken

WATER NETWORK ANALYSIS
ZEBRA INDUSTRIAL ESTATE STAGES 1 to 10

I refer to your request for the above work; please find enclosed the water network analysis.

An invoice in the amount $1,476.00 will be forwarded in the near future.

Should you have any queries or require any further information please contact Peter Wheelhouse on telephone number 4936 8403.

Yours sincerely

Martin Crow
Manager Engineering
Regional Services

Enc Water Network Analysis Report

Water Network Analysis

Client:	Ron and Tracey Bowes	
Address:	C/-	Calibre Consulting PO Box 1580 ROCKHAMPTON QLD 4700
Site Address:	Lot2 SP259555 265 Somerset Road GRACEMERE, 4702	

Description of Analysis:

Investigate the capacity of the water reticulation network to accommodate the proposed 10 Stages of the Zebra Industrial Estate subdivision. The proposed stages are comprised of 53 industrial allotments of various sizes ranging from 0.14ha to 1.29ha located off Somerset Road, Gracemere, as detailed in the attached staging plan and preliminary water reticulation layout prepared by Calibre Consulting.

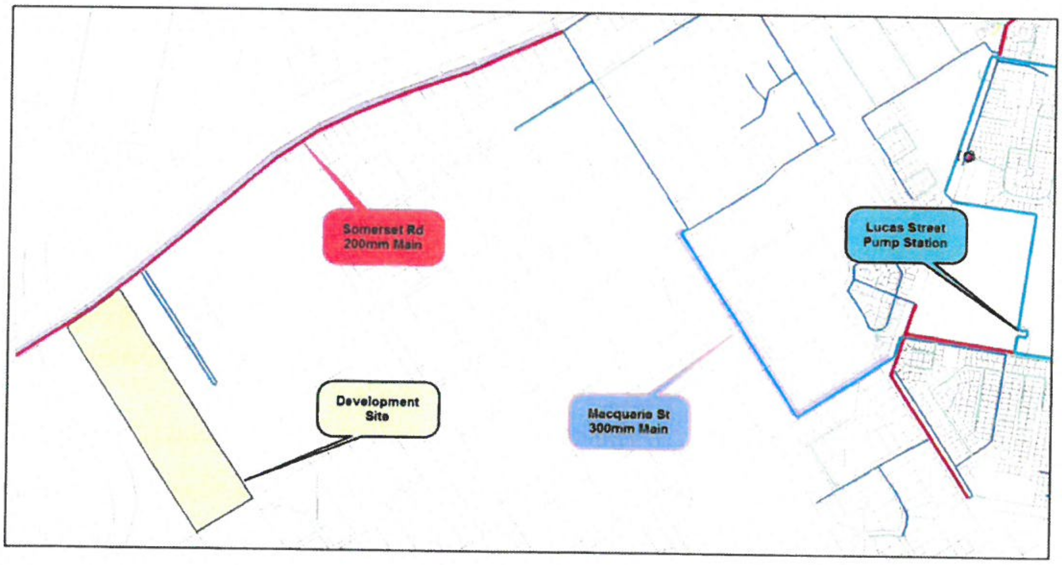
Refer Attachment A

Staging Plan

Network Analysis

Existing Reticulation

The subject site is located at the western extremity of the Lucas Street pump station supply zone. The site is serviced via a 200mm main in Somerset Road. This main is supplemented via a 300mm main in Macquarie St linking Middle road and Cherryfield Road. These two mains were constructed in 2013 with the primary purpose of servicing initial development within the Gracemere Industrial Area.



It is proposed to service the proposed development via 2 x 150mm connections to the 200mm main in Somerset Road. 150mm mains are to be located on either side of the proposed roadways as shown in the attached preliminary water reticulation layout prepared by Calibre Consulting.

Refer Attachment B

Preliminary Water Reticulation Layout Plan

The Lucas Street pump station is currently in the process of receiving a substantial upgrade that will include new pumps, switchboard and the provision of pipework to accommodate the future duplication of the Lucas St reservoir and delivery main.

These upgrades are scheduled for completion in 2015 and will ensure the Lucas St pump station has sufficient capacity to maintain service over the next fifteen years.

Estimated Demands

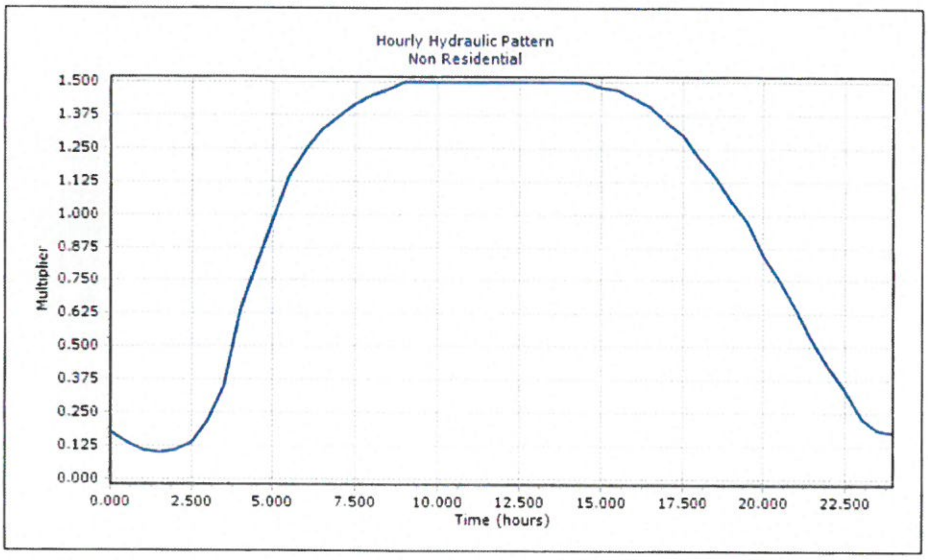
The demands for the proposed development have been calculated based on the following assumptions.

- Industrial Area Design EP 56 EP per ha
- Maximum Day Base Demand per EP = 0.01 L/s

Refer Attachment C

Base Loading Calculations

Using these assumptions, the base demand has been calculated for the ten proposed development stages and apportioned amongst the respective nodes within the network model using the following non-residential diurnal pattern



Fire Fighting

For an industrial development the following fire-fighting requirement is applicable as per the Capricorn Municipal Development Guidelines (CMDG).

- Design criteria of 30L/s @ 120kPa residual pressure

Scenarios

The following scenarios have been analysed to demonstrate the capacity of the existing and future network to service the proposed development.

Scenario 1	Stages 1 to 5
Scenario 2	Stages 1 to 6
Scenario 3	Stages 1 to 7
Scenario 4	Stages 1 to 10

Scenarios 1 to 3 analyse the existing network and scenario 4 analyses the future network augmentation.

Results:

These results are theoretical and based on the use of the water model (WaterGEMs V8i), which has been developed by Council based on the best information available. Errors in the model may occur due to a range of factors. The results should not be taken to represent measured values in the pipe network, as the condition at the time of measuring may be different to those modeled.

Refer Attachment D

Residual Pressure and Fire-Fighting Capacity Results

The maximum pressure to the development site is the same for all scenarios as this occurs during periods of low demand with the Lucas Street pump station hold a constant set point of 550kPa.

Scenario	**Residual Pressure (kPa)**		
	Residential Demand		**Fire Flow @ 30 L/s**
	Min	**Max**	
1	570	730	180
2	564	730	120
3	558	730	**60**
4	480	730	280

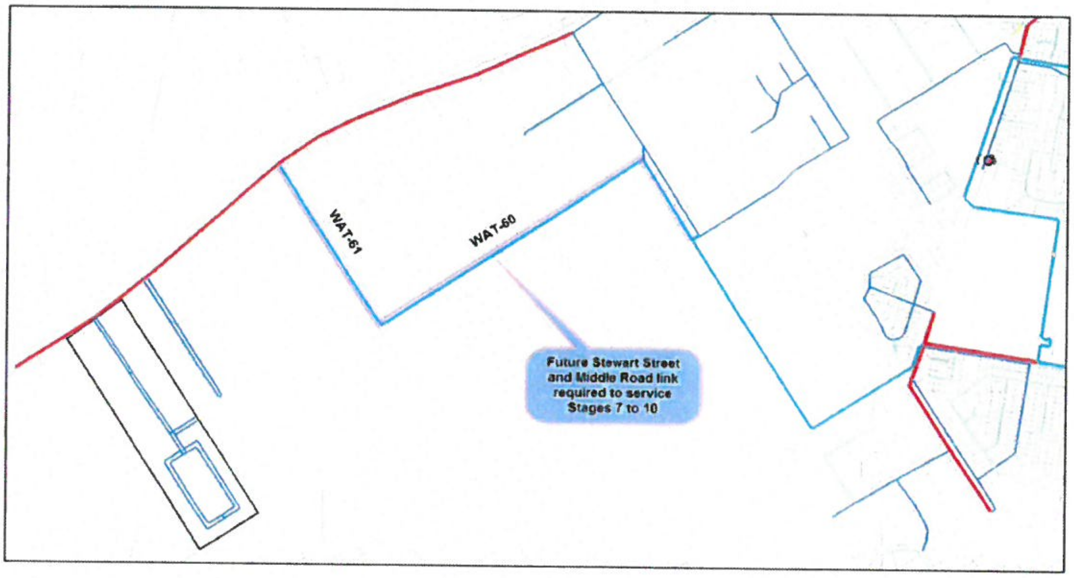
Summary of Residual Pressure Results

Discussion:

The analysis shows the existing network only has capacity to service up to the sixth stage. The existing network is unable to provide the minimum fire- fighting capacity of 30L/s at 120kPa for stages 7 to 10.

The 200mm Somerset Road main would need to be at least partially duplicated in order to provide the minimum required fire-fighting capacity.

Priority future trunk infrastructure projects (PFTI's) have been identified in Middle Road (WAT-60) and Stewart St (WAT61).



The Scenario 4 analysis shows the augmentation of these two PFTI projects provides a significant boost to the available fire-fighting capacity of the Somerset road main enabling stages 7 to 10 to be well serviced.

These PFTI projects are currently scheduled for construction in 2021.

Recommendations:

It is recommended that the development be serviced by the proposed two 150mm connections to the 200mm Somerset Road main.

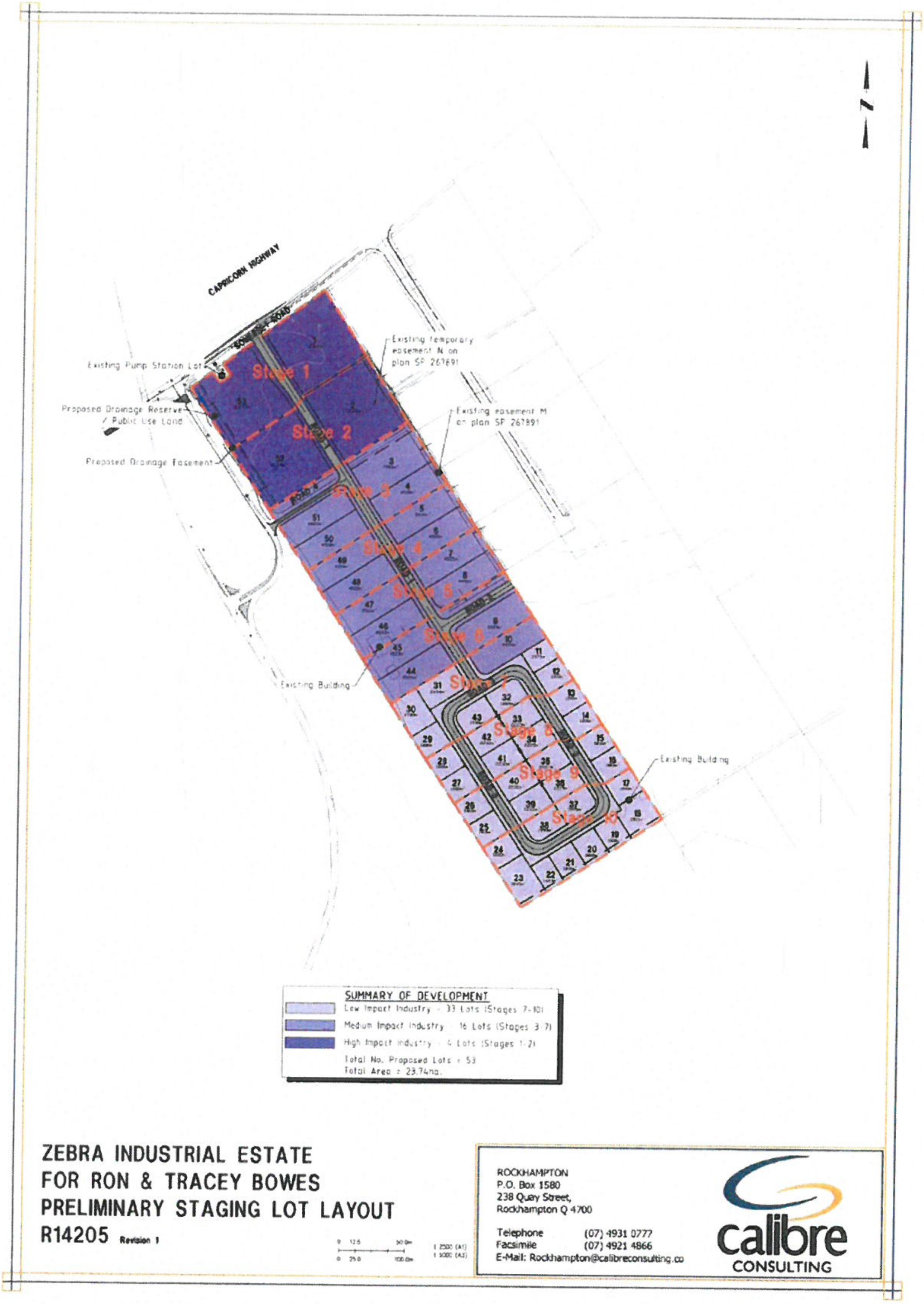
The existing network has capacity to service the first six stages of the proposed development. Stages 7 to 10 would require the augmentation of PFTI projects WAT-60 and WAT-61 in order to receive adequate service.

The two 150mm mains to be located on either side of the proposed roadways are to be interconnected at various locations as indicated in the "Stages 1-10" analysis provided in Attachment D.

End of Report

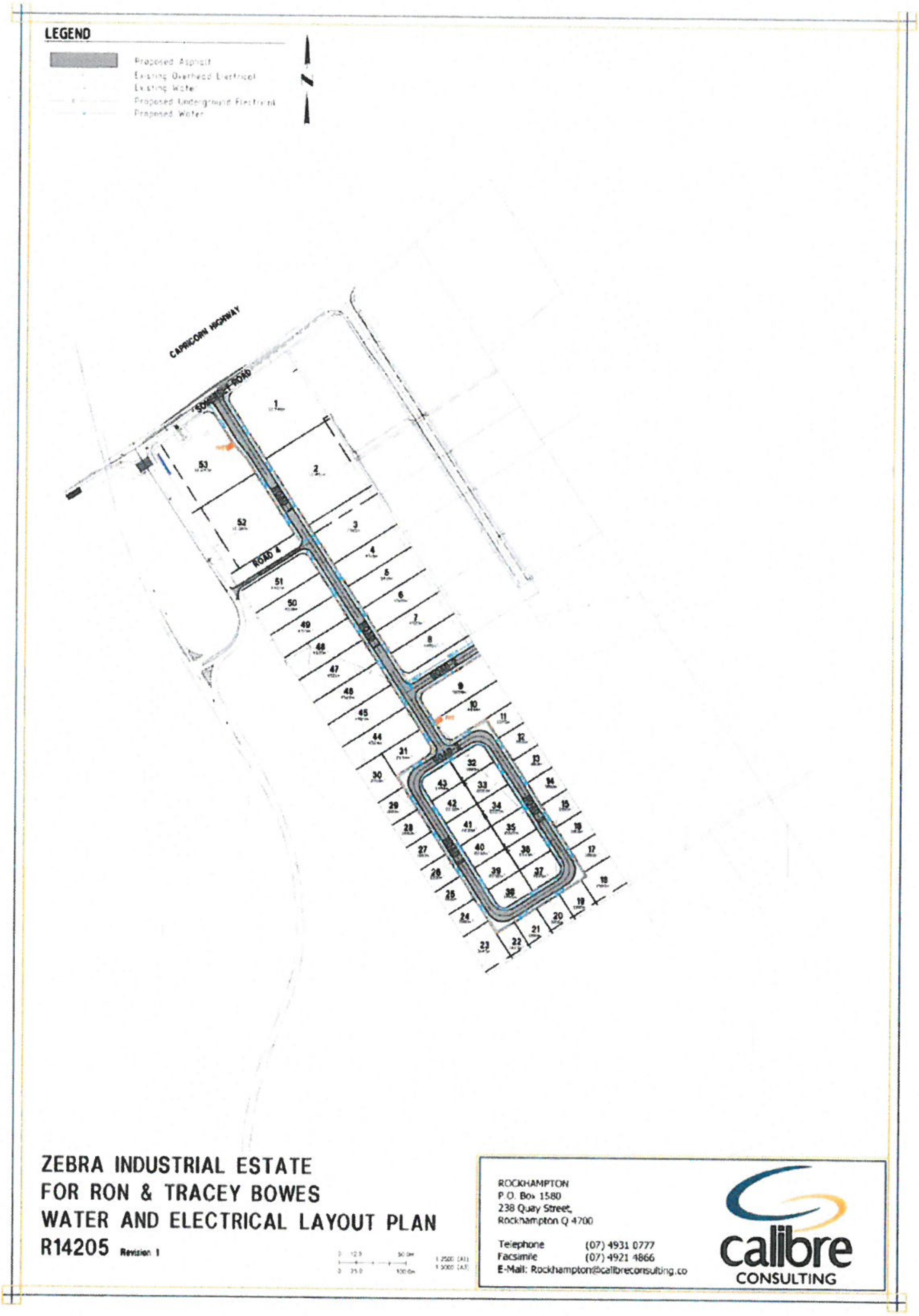
Attachment A

Ultimate Staging Plan



Attachment B

Preliminary Water Reticulation Plan



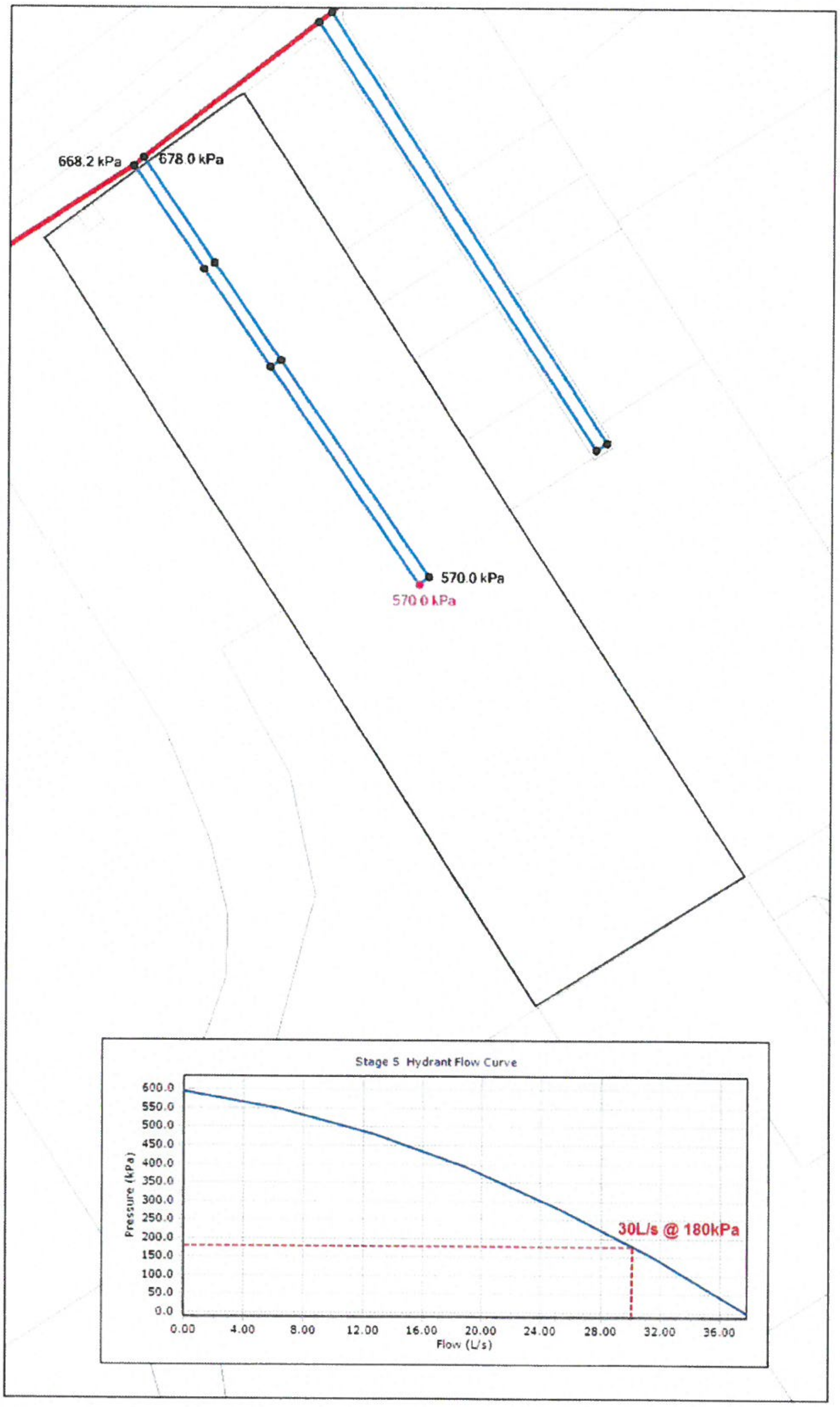
Attachment C

Base Loading Calculations

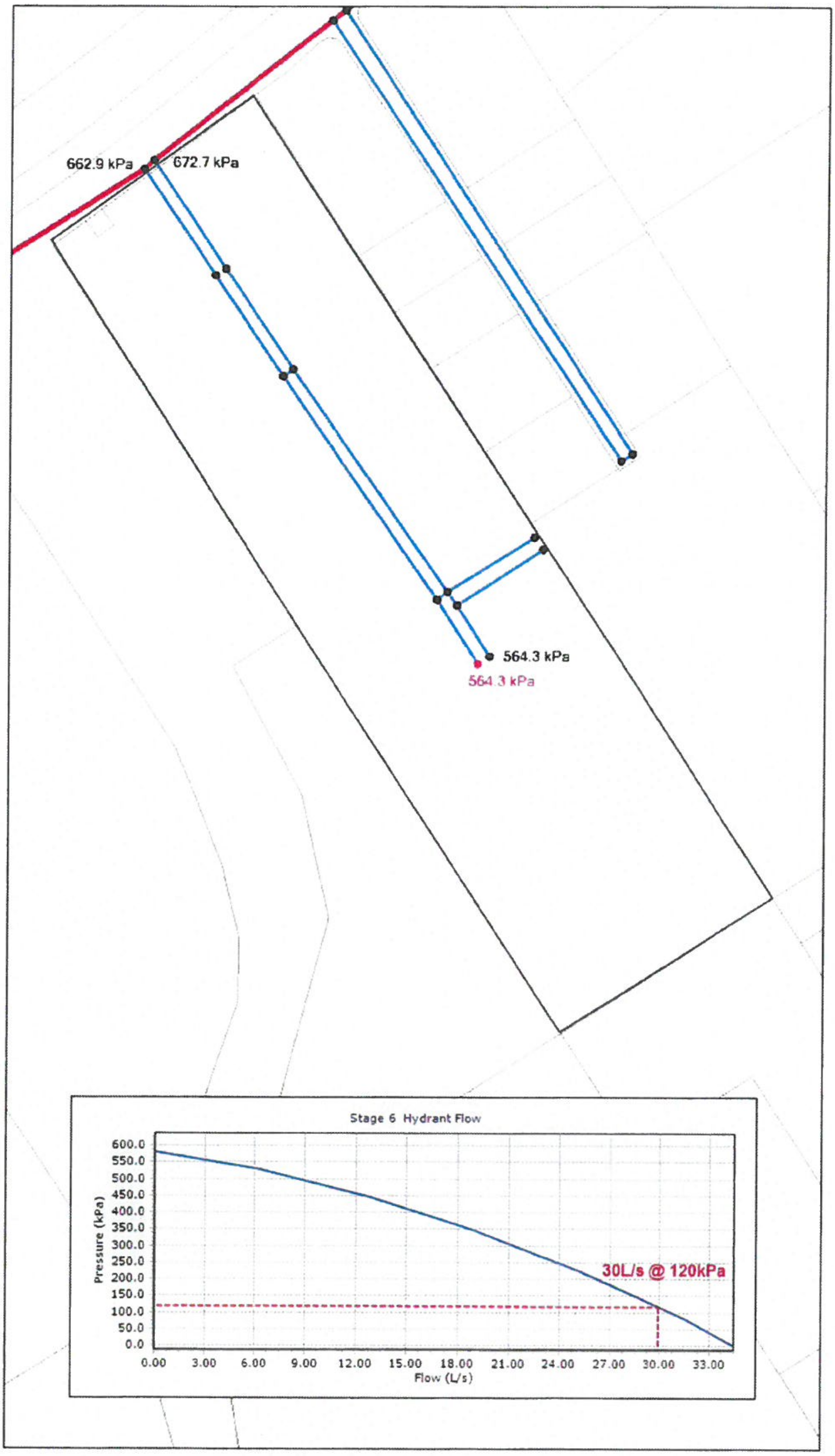
Stage	Lot	(ha)	EP (56/ha)	Base Load (0.01L/s/ep)
1	1	1.30	72.80	0.73
	53	1.20	67.20	0.67
				1.41
2	2	1.30	72.80	0.73
	52	1.20	67.20	0.67
				1.40
3	3	0.79	44.24	0.44
	4	0.45	25.20	0.25
	50	0.45	25.20	0.25
	51	0.49	27.44	0.27
				1.22
4	5	0.54	30.24	0.30
	6	0.45	25.20	0.25
	48	0.45	25.20	0.25
	49	0.45	25.20	0.25
				1.06
5	7	0.45	25.20	0.25
	8	0.45	25.20	0.25
	46	0.45	25.20	0.25
	47	0.45	25.20	0.25
				1.01
6	9	0.51	28.56	0.29
	44	0.45	25.20	0.25
	45	0.45	25.20	0.25
				0.79
7	10	0.44	24.64	0.25
	11	0.16	8.96	0.09
	12	0.18	10.08	0.10
	29	0.18	10.08	0.10
	31	0.27	15.12	0.15
	32	0.19	10.64	0.11
	43	0.20	11.20	0.11
				0.91
8	13	0.18	10.08	0.10
	14	0.18	10.08	0.10
	27	0.18	10.08	0.10
	28	0.18	10.08	0.10
	33	0.22	12.32	0.12
	34	0.22	12.32	0.12
	41	0.22	12.32	0.12
	42	0.22	12.32	0.12
				0.90
9	15	0.18	10.08	0.10
	16	0.18	10.08	0.10
	25	0.18	10.08	0.10
	26	0.18	10.08	0.10
	35	0.22	12.32	0.12
	36	0.22	12.32	0.12
	39	0.22	12.32	0.12
	40	0.22	12.32	0.12
				0.90
10	17	0.18	10.08	0.10
	18	0.28	15.68	0.16
	19	0.18	10.08	0.10
	20	0.18	10.08	0.10
	21	0.18	10.08	0.10
	22	0.14	7.84	0.08
	23	0.30	16.80	0.17
	24	0.18	10.08	0.10
				0.91

Attachment D

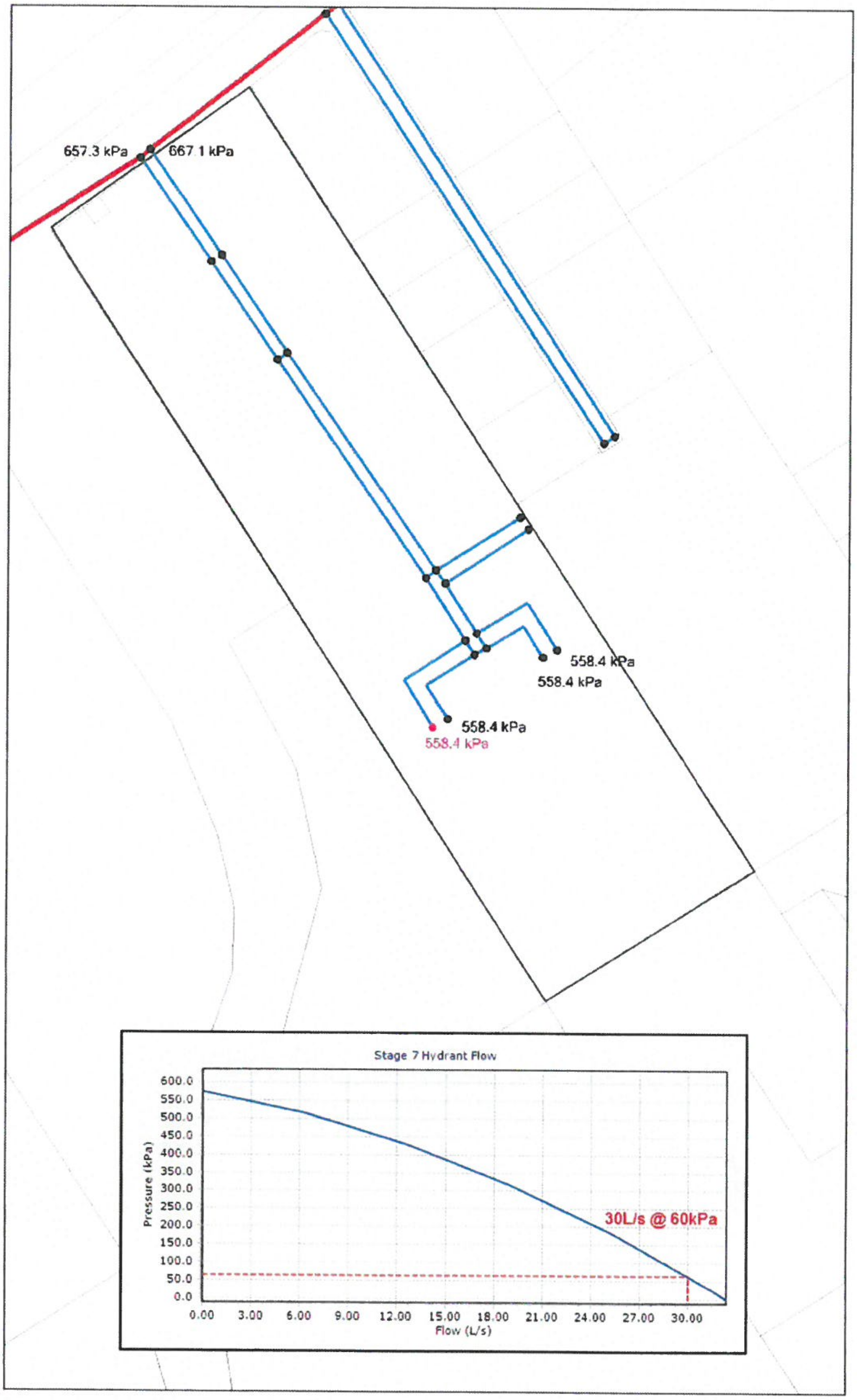
Stages 1-5



Stages 1-6

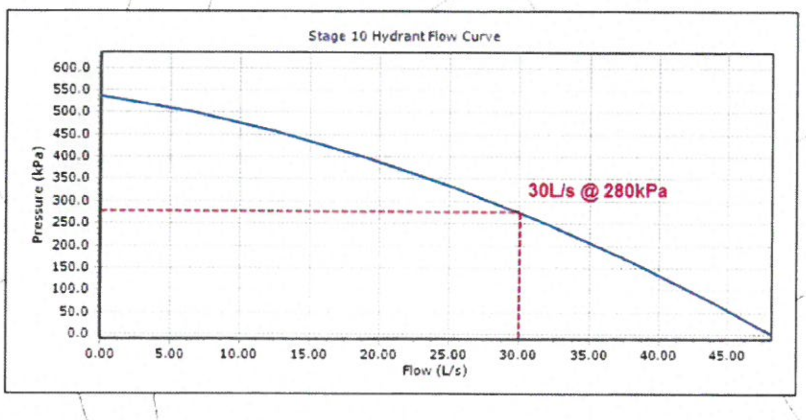

662.9 kPa
672.7 kPa
564.3 kPa
564.3 kPa
Stage 6 Hydrant Flow
Pressure (kPa)
Flow (L/s)
30L/s @ 120kPa

Stage 1-7


657.3 kPa
667.1 kPa
558.4 kPa
558.4 kPa
558.4 kPa
558.4 kPa
Stage 7 Hydrant Flow
Pressure (kPa)
Flow (L/s)
30L/s @ 60kPa

Stage 1-10


632.3 kPa
642.1 kPa
480.5 kPa
480.5 kPa


Stage 10 Hydrant Flow Curve
Pressure (kPa)
Flow (L/s)
30L/s @ 280kPa
600.0
550.0
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00