PROJECT NO: 1189/01B

CONCEPTUAL STORMWATER QUALITY MANAGEMENT PLAN

PROPOSED RECONFIGURATION OF LOT 14 ON RP 113406 STARKEY STREET WELLINGTON POINT

FOR

COLLIN PARK PTY LTD

1189/01B R-GRB0006

31 July 2006

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1.0 INTRODUCTION

The purpose of this Conceptual Stormwater Quality Management Plan is to demonstrate that the quality of stormwater discharged into downstream waterways from the proposed development of Lot 14 on RP113406, is able to meet Council's required objectives in relation to Total Nitrogen, Total Phosphorus and Total Suspended Solids.

2.0 STORMWATER QUALITY PRINCIPLES

Redlands Shire Council has in place "Part 11 – Planning Scheme Policy 9 – Infrastructure Works - Chapter 6 "Stormwater Management". The purpose of this chapter of the policy is to:

a) set out the requirements for the preparation and submission of plans and technical reports for the design of stormwater management systems associated with development applications under the planning scheme;
b) ensure stormwater run-off does not adversely impact the quality of receiving waters, including waterways, wetlands, Moreton Bay and the marine environment;
c) provide an efficient and effective stormwater management system that provides adequate protection for people and property from the effects of overland flow or flooding;
d) maintain the natural flow regime of the site;
e) identify the requirements for the implementation of Water Sensitive Urban Design (WSUD)

In general Water Sensitive Urban Design Principles include:

a) minimise the contamination of waters by stormwater;
b) maximise the infiltration of water into the ground;
c) reduce the velocity of stormwater;
d) remove contaminants from the stormwater.

Measures to achieve these principles include -

a) flow rate mitigation;
b) erosion control;
c) infiltration areas;
d) grassed or vegetated drainage lines;
e) vegetated waterway buffers;
f) conservation or restoration of riparian vegetation;
g) artificial wetlands;
h) gross pollutant traps;
i) retention basins;
j) trash racks.

This approach minimises stormwater pollution by in-transit measures and maximises the performance of individual components through correct placement in the 'treatment train'. As no single treatment measure is capable of treating the full spectrum of pollutants, it is therefore essential to ensure that a number of treatments are used to meet water quality objectives.

3.0 STORMWATER QUALITY OBJECTIVES

The Stormwater Quality Management Plan seeks to achieve the following Redland Shire Council objectives in relation to the quality of stormwater discharged from the site into downstream waterways.

Turbidity : < 20 NTU
Total nitrogen : < 650 mg/L
Total phosphorus : < 70 mg/L
Total suspended solids : 15 mg/L, 90 percentile <100 mg/L for wet weather flows
Copper : < 5 mg/L
Lead : < 5 mg/L
Nickel : < 15 mg/L
Zinc : < 50 mg/L
Total oil and grease : No visible film or odour

4.0 CHANGES TO THE NATURAL SYSTEM

Possible sources of pollution

The possible sources of pollution at this proposed subdivision are similar to any other subdivision in south east Queensland. This source could be either during or after development.

During development, potentially pollution could emanate from, for example:

- Erosion from disturbed areas and sedimentation during and immediately after construction.
- Potential oil spills from construction machinery.

After the initial development phase, pollution could be as a result of:

- Stormwater run-off, both sediment and chemical pollutants, from individual building sites.
- High levels of dissolved nutrients from over fertilising and watering of gardens and lawn areas.
- General contaminants from roadways (oils, brake dust, coolants etc)
- Contaminants from households, eg. Sewer overflows, pets, paints, swimming pools, lawn clippings and other organic matter etc.

Soil erosion

As in any construction site where the vegetative soil cover has been removed, there is the potential for soil erosion. As it is inevitable that some vegetation will be removed during construction, this will be kept to a minimum and in these areas the time between removal and replacement of topsoil and vegetative cover will be minimised to limit the potential for erosion. Erosion and sediment control will be addressed during and post construction. An Erosion and Sediment Control Strategy (ESCS) detailing management practices and strategies to ensure erosion and sediment control during the construction period is to be prepared and submitted for Council approval with the Operational Works drawings.

A plan will be required to be developed by the contractor to provide a level of assurance that the risk of soil erosion and sediment loss as a result of the construction activity is minimised.

All urban subdivisions have the potential to deposit nutrients into the downstream waterways via stormwater runoff. The increased levels of nitrogen and phosphorus are usually the major concern, with their capacity to produce environmental harm in the form of algal blooms, for example. The source of these dissolved nutrients most commonly is, fertiliser flushed from lawns and gardens coupled with other contaminants such as decaying organic matter, animal faeces etc. The management of these nutrients will be addressed in the Plan.

Effects of required filling

The extent of filling required has been reduced considerably from that which the initial flood modelling was based. The filling required to a number of the eastern lots within the proposed subdivision to afford immunity from the 1:100 year flows is minimal and will not produce any detrimental effects on flow widths, depths etc to either upstream or downstream areas.

The material to be used for filling will be suitable for 'engineered fill' and uncontaminated. Consequently there will be no leachate produced from the introduced fill to the site.

5.0 STORMWATER QUALITY IMPROVEMENT DEVICES

Stormwater quality improvement devices can generally be subdivided into two categories. The first is to facilitate the removal of large waterborne debris from stormwater flows (litter, and other floating debris) generally referred to as gross pollution traps (GPT) and the latter being devices to remove/reduce dissolved solids and nutrients from stormwater flows.

GPTs are generally hard 'engineering structures' designed to be installed in-line with the stormwater flow. They should be installed in locations that are readily accessible and hence easy to maintain in the future by maintenance crews. The debris collected in the GPTs can be easily removed and either recycled or placed in landfill.

Devices to remove dissolved solids (nutrients) and facilitate deposition of sediment from stormwater can take the form of: constructed wetlands open flat swales, ditches, flood plains, in fact any area where the stormwater flow can 'slow down' and permit sedimentation.

The sediment could have heavy metals 'attached' and this will allow their removal from the stormwater system. In addition, this secondary treatment area should be planted heavily with either appropriate grasses, or in the case of a constructed wetland, appropriate water plants, usually emerging macrophytes, to assist in storing/removing the dissolved nutrients from the stormwater.

In addition, constructed wetlands provide other opportunities, for example:

- enhanced amenity
- increases in biological diversity,
- recreational opportunities and
- opportunities to raise environmental awareness within the local community.

6.0 PROPOSED STRATEGIES TO MEET OBJECTIVES

The proposed strategy to meet the stormwater quality objectives seeks to address potential impacts on the stormwater quality as close to the source of the impact as practical. This strategy enables the quantity of stormwater run-off to be more manageable as it involves managing smaller volumes of water during a storm event and enables tracing of any possible future stormwater contaminants easier.

As previously stated, no single treatment measure is capable of treating the full spectrum of pollutants, it is therefore essential to ensure that a number of treatments are used to meet water quality objectives and work towards water sensitive urban design. These include flow rate mitigation, erosion control, infiltration areas, grassed drainage lines, artificial wetlands, gross pollutant traps.

This approach minimises stormwater pollution by in-transit measures and maximises the performance of individual components, through correct placement in the 'treatment train'.

It is proposed to install measures to intercept stormwater flowing from the site as close as possible to its source.

This involves the installation of an underground stormwater pipe network to collect stormwater run-off flowing from the subdivision. The stormwater will pass through a Gross Pollutant Trap followed by flowing through a constructed wetlands and 'nutrient removal' areas. Please refer to **Appendix A** 'Conceptual Stormwater Quality Management Plan' 1189-SK45 for locations of proposed stormwater quality management devices.

Nutrient removal is to be affected by two small constructed wetlands located at the downstream end of both sections of the new subdivision. These, two cell, constructed wetlands are to capture the 'trickle flows' and 'first flush' from the two developed areas.

Flows emanating from the two areas during a major flood event will bypass the wetlands in order not to destabilise the processes within them. Protection from the 1:100 flows for the wetlands will be afforded by a low levee. The flat grassed areas immediately downstream of the two wetlands, over which the outfall will flow will further assist in nutrient removal and will assist in deposition of sediments.

The grass swales and vegetation filtration zones, falls within the flow area for a 1:100 year flood event. Should this 1:100 year flood event occur, the flow velocities occurring will not be sufficient to dislodge or remove sediments and any possible contaminants from the local area as the grasses and vegetation proposed for that area will have taken up and stored any nutrients from the low flows.

Detailed designs of facilities to address stormwater quality objectives, taking into account the flows and volumes etc., will be provided as part of the application for Operational Works Approval.

7.0 TIMING

It is essential that stormwater quality management occurs before during and following the construction phase of the development.

Prior to construction commencing, erosion and sediment control measures must be installed and maintained during the construction and maintenance period.

The management, including the required ongoing maintenance of the stormwater quality enhancement devices must continue on an ongoing basis to ensure that the objectives in relation to stormwater quality discharged from the site into downstream waterways are maintained.

8.0 MONITORING, REPORTING, CORRECTIVE ACTION

Constructed wetlands are monitored for various reasons including: water quality performance (research and/or compliance), biological/habitat status, accumulation of toxic substances (sediment), to ensure optimal operation standards and condition of maintenance. Measuring a variety of parameters is recommended in EPA Water Quality Guidelines and national monitoring protocols, including heavy metals, nutrients and hydrocarbons. These measures provide an indication of potential impact to the environment and can be directly compared to other studies.

Monitoring can be performed on base flows (inter-event) and/or storm events at sample locations above and below each constructed wetland. Sampling can be grab (concentration) or auto-sampled (load monitoring). The type and extent of monitoring will depend upon what questions you are trying to answer and budget. Sampling 'first flush' runoff waters could be carried out, as these generally involve the majority of nutrients, contaminants and suspended sediments. Subsequent rainfall involves clean surfaces and contaminant levels are typically lower.

Protocols

- Water quality monitoring:

Physical and Chemical parameters using in-situ probes, auto-samplers, or manually.
General: Turb., pH, DO, Temp, Conductivity, REDOX, SS, Nuts, FCols, flow rate

- Biological monitoring:

Macro-invertebrates, periphytons (diatoms/blue greens/filamentous greens), fish, amphibians, macrophyte colonisation, pest species (weeds and fauna eg. gambusia) and riparian vegetation.

- Sediment monitoring:

Particle size analysis, TOC, Nuts, Metals, PAH's.

9.0 CONCLUSIONS

This Conceptual Stormwater Quality Management Plan demonstrates that the quality of stormwater discharged into downstream waterways from the proposed development of Lot 14 on RP113406, is able to meet Council's required objectives in relation to Total Nitrogen, Total Phosphorus and Total Suspended Solids.

This Conceptual Plan also complies with Redland Shire Council's "Part 11 – Planning Scheme Policy 9 – Infrastructure Works - Chapter 6 "Stormwater Management". By incorporating a combination of a number of proven measures in the final design to achieve the required objectives, including installation of gross pollutant traps, artificial wetlands, grassed or vegetated areas for drainage lines, coupled with an Erosion and Sediment Control Plan during the construction phase, it ensures that the objectives of the Redland Shire Council are able to be met.

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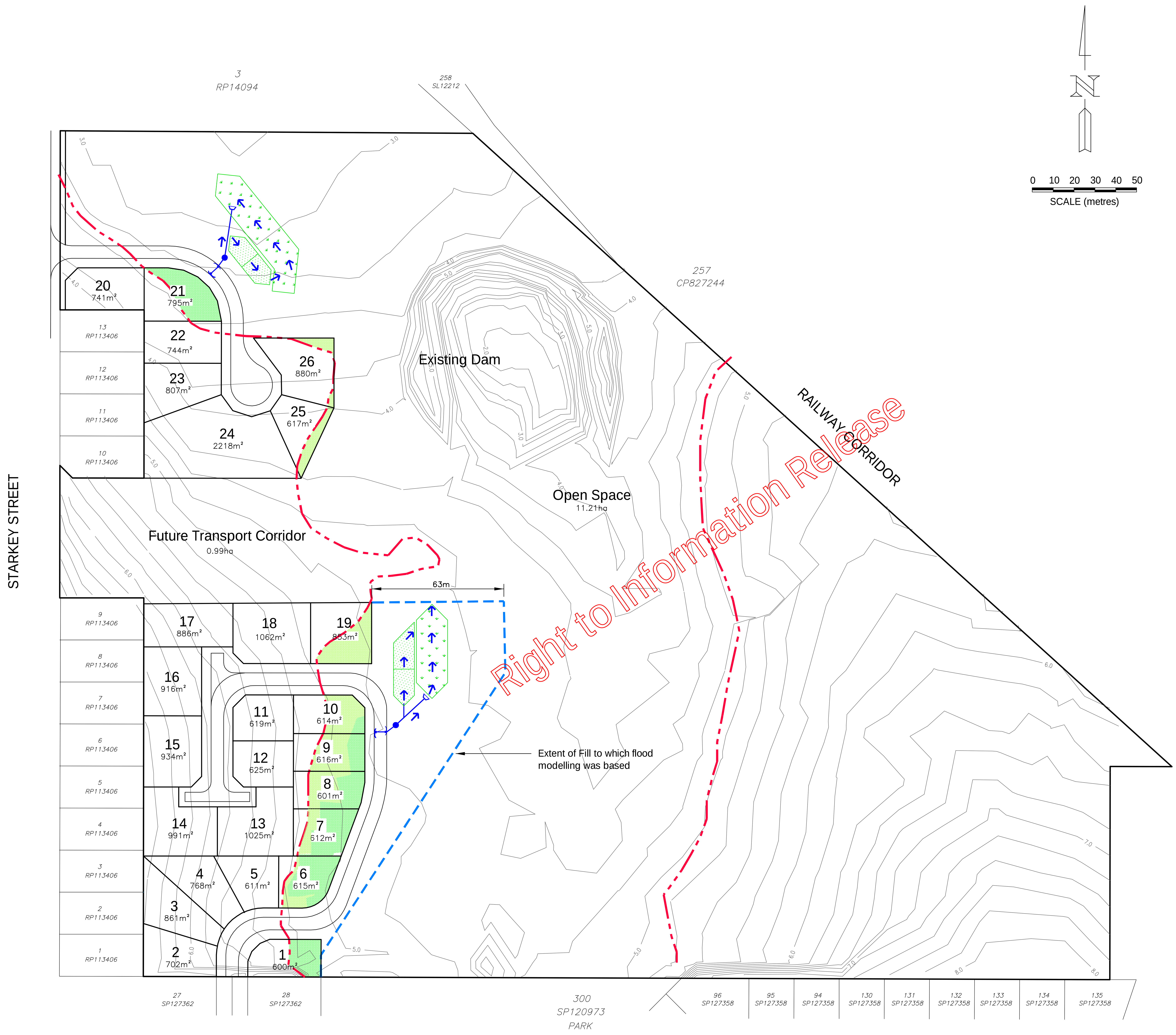
APPENDIX A



Allotment Data

Total Site Area	- 15.13 ha
Open Space	- 11.10 ha (73.4%)
Transport Corridor	- 0.99 ha (6.5%)
Number of Lots	- 26
Minimum Lot Size	- 600 m²

Note

Development limited to areas requiring <200mm fill to achieve 100 year ARI flood immunity.

Legend

- Q_{100} Flood line
- Extent of Fill to which flood modelling was based
- Constructed Wetlands
- Grassed Swale Vegetation Filtration
- Water Flow Direction
- Gross Pollutant Trap
- Kerb Inlet Pit

Fill Extents (m)

- 0.10 - 0.20
- 0.00 0.10

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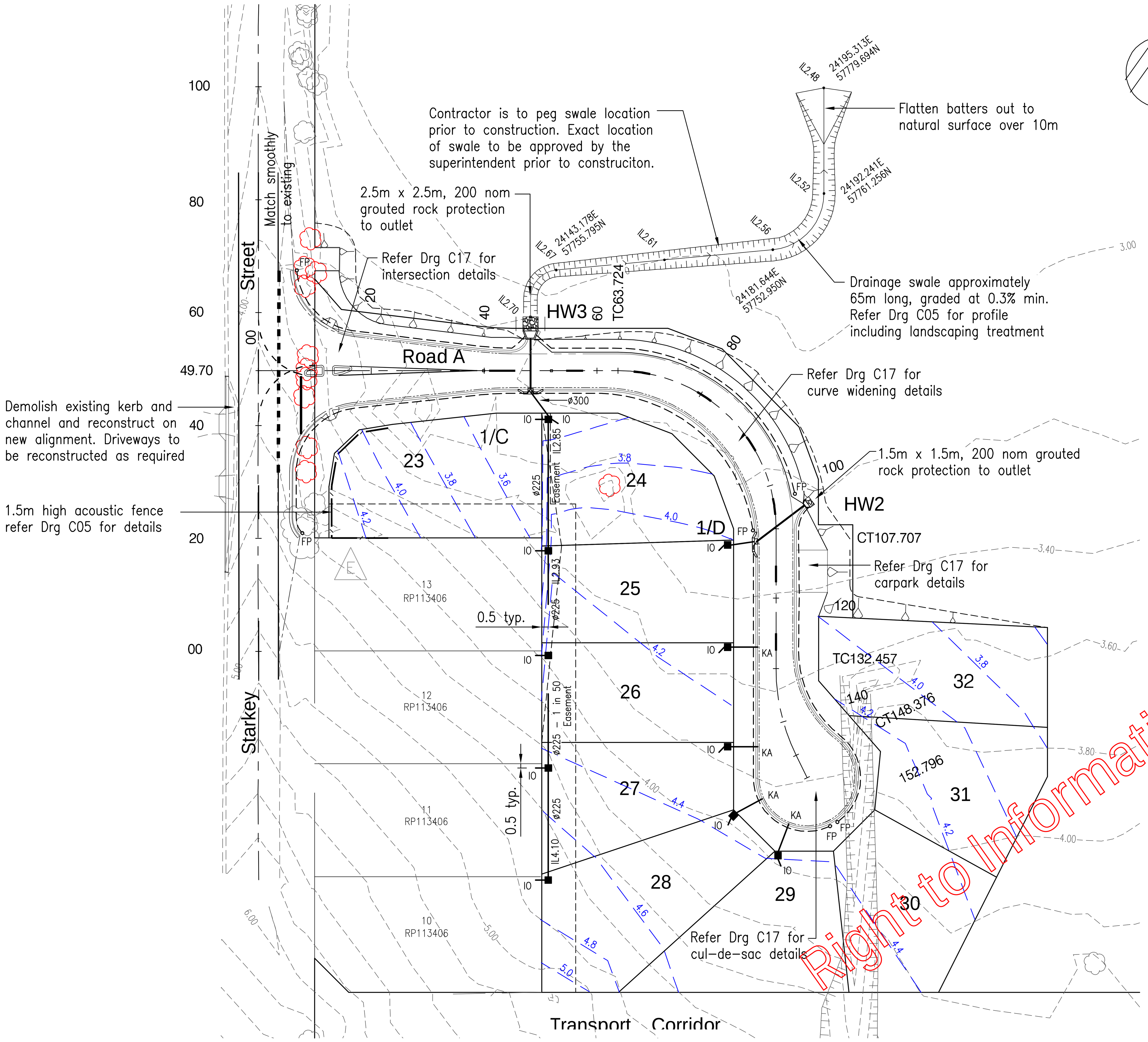
Starkey Street Subdivision
Lot 14 on RP113406
Conceptual Stormwater Quality Management Plan

1189-SK45 — 1:1000, A1 Full Size

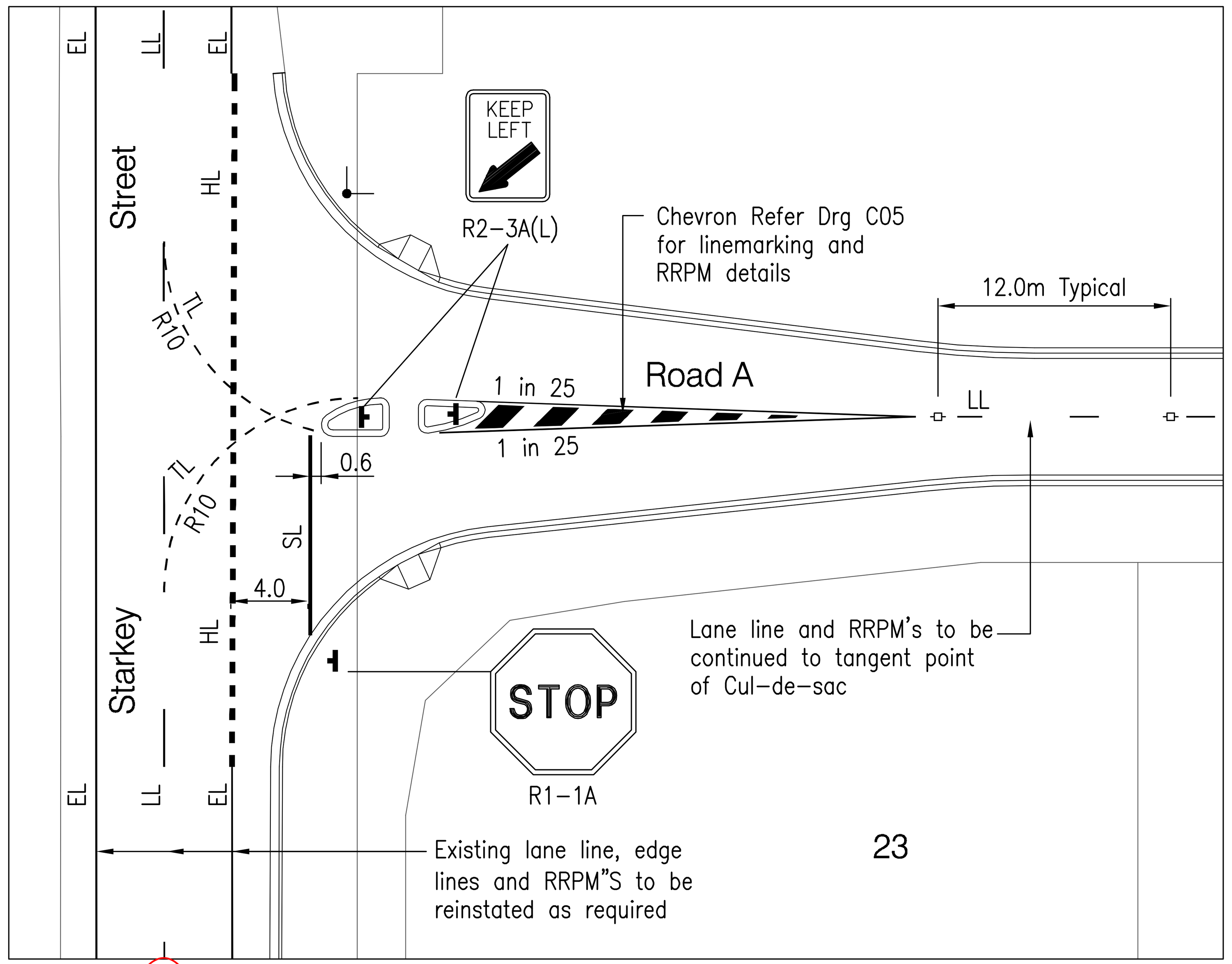
Acad No. 1189SK45 — 20 July 2006

DO NOT SCALE



ROADWORK AND STORMWATER PLAN

1:500



STARKEY STREET / ROAD A INTERSECTION LINEMARKING AND SIGNAGE

1:250

LEGEND

- Kerb Ramp
- KA — Kerb Adaptor Refer RSC Std Drg R-RSC-7(B)
- 300sq HDPE roofwater collection pit with galvanised grate (Class A)
- IO — 150 x 150 dia PVC-U Inspection Opening
- Type B1 Kerb and Channel
- Type M1 Kerb and Channel
- Edge Restraint RSC-1(D)
- Street Name Sign
- Traffic Control Sign
- R19 — Radius
- Pavement Markers – Bi Directional
- Tree to be Removed
- FP — Subsoil Drain with Flushing Point

Linemarking Legend

Edge line	EL	80
Lane Line	LL	3m / 9m; 80
Hold Line	HL	600/600 Paint/Gap; 300
Turn Line	TL	600/600 Paint/Gap; 80
Stop Line	SL	300

NOTES

1. For kerb ramp detail refer IPWEAQ Std Drg R-0084(C). Width of ramp to be 2.0m u.n.o.
2. For stormwater long sections refer Drg C06.
3. For kerb adaptor details refer RSC Std Drg R-RSC-7(B).
4. For details of kerb inlet pits refer RSC Std Drg's D-RSC-2(B), D-RSC-3(C) and Drg C05.
5. For box culvert bedding & backfill details refer IPWEAQ Std Drg D-0031(A). For pipe bedding & backfill details refer RSC Std Drg D-RSC-11(A).
6. Cast insitu Headwalls (HW2 and HW3) to be constructed in accordance with detail on Drg C05.
7. Roofwater connection to kerb and channel to be ø100 PVC-U unless noted otherwise on plan.
8. Roofwater allotment drains to be generally located 0.5m from property boundary and in accordance with Redland Shire Council's standards.
9. All Island kerbs to be painted white and impregnated with glass beads.
10. All pavement marking and traffic signs to be in accordance with Department of Main Roads "Manual of Uniform Traffic Control Devices"
11. For street sign and traffic signs to be installed in accordance with RSC Std Drg R-RSC-11(B) and IPWEAQ Std Drg R-0131(C) respectively.

DRAINAGE STRUCTURE SETOUT COORDINATES

STRUCTURE	EASTING	NORTHING
1/C	24134.970	57735.776
HW2	24136.445	57744.502
1/D	24170.224	57702.464
HW3	24179.590	57706.204

ROAD A CONTROL LINE SETOUT

Chainage	Easting	Northing	Bearing	Rad/Spiral	A.Length	D.Angle
0.000	24088.187	57747.005				
TC 63.724	24151.020	57736.385	99°35'35"			
				-28.000	43.982	89°59'60"
CT 107.707	24173.963	57704.110	189°35'35"			
TC 132.457	24169.838	57679.706	189°35'35"			
				35.000	-15.919	26°03'32"
CT 148.376	24170.784	57663.953	163°32'02"			
152.796	24172.037	57659.713				

REV	DESCRIPTION	TASK MAN.	APPROVED	RPEQ No.	DATE
E	SOBSOIL DRAINS ADDED	PVF	PVF	2170	07/12/07
D	ADDITIONAL SETOUT PROVIDED	PVF	PVF	2170	01/11/07
C	AMENDMENTS AS PER COUNCIL MARKUPS	PVF	PVF	2170	03/10/07
B	STARKEY STREET INTERSECTION AMENDED	PVF	PVF	2170	04/09/07
A	ORIGINAL ISSUE	PVF	PVF	2170	29/06/07

ASSOCIATED CONSULTANTS

CLIENT / PROJECT

Park Lake Estate
Collin Park Pty Ltd
Redland Shire Council
Application No. EC005.202.1

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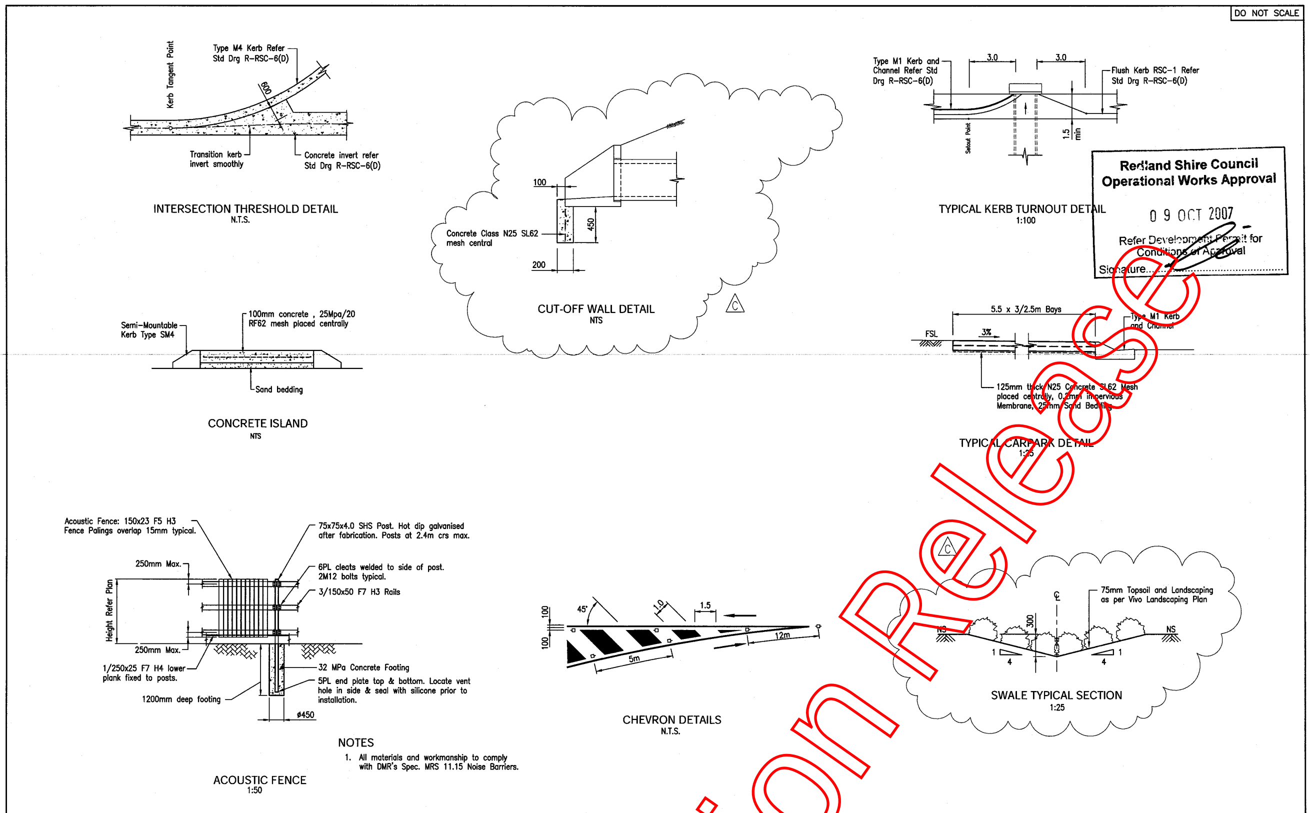
DESIGNED MM | DRAWN MM | ACAD No. 1189C02E | SCALE 1:500

TITLE: ROAD A ROADWORKS, LINEMARKING AND DRAINAGE PLAN

A1 FULL SIZE | DRAWING No. 1189-C02 | REVISION E

SHEET 2 OF 26 SHEETS



NOTES

1. All materials and workmanship to comply with DMR's Spec. MRS 11.15 Noise Barriers.

REV	DESCRIPTION	TASK MAN.	APPROVED	RPEQ No.	DATE
C	HEADWALL DELETED CUT-OFF WALL ADDED	PVF		2170	03/10/07
B	GENERAL REVISIONS	PVF	PVF	2170	04/09/07
A	ORIGINAL ISSUE	PVF	PVF	2170	29/06/07

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DESIGNED MM
DRAWN MM
ACAD No. 1189C05C
SCALE AS SHOWN
TITLE MISCELLANEOUS DETAILS
A1 FULL SIZE
DRAWING No. 1189-C05
SHEET 5 OF 26 SHEETS
REVISION C

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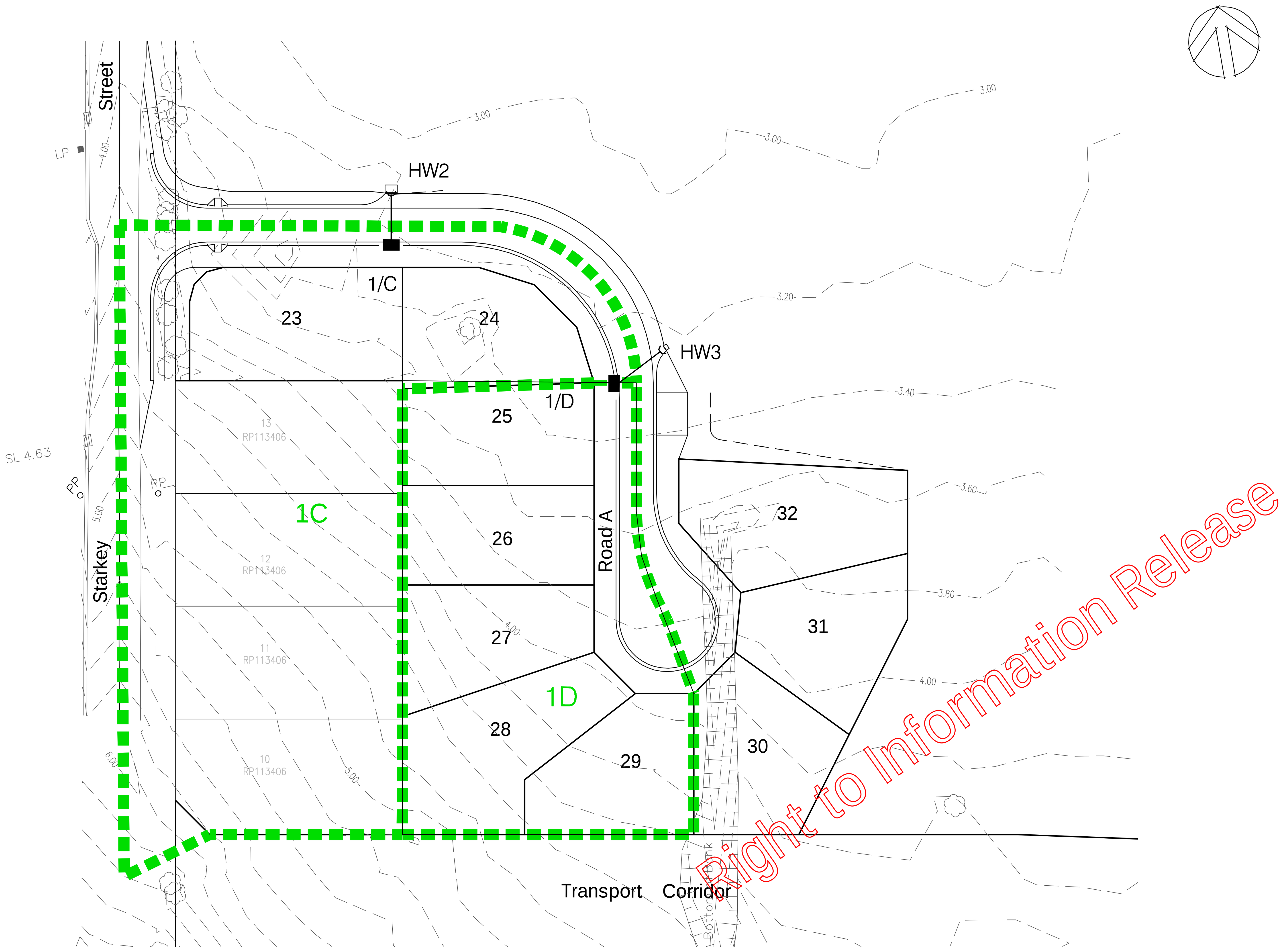
APPENDIX D

DO NOT SCALE



Plan
1:500

LEGEND

- Catchment Boundary
- 4/A — Catchment Name
- 1/A — Inlet Pit No.
- 5.8 — Design Contours
- 6.00 — Existing Contours

CATCHMENT AREAS

SURFACE CATCHMENT	AREA(ha)	ROOFWATER CATCHMENT	AREA(ha)
1/C	0.481	1/C	0.163
1/D	0.372	1/D	-

REV	DESCRIPTION	TASK MAN.	APPROVED	RPEQ No.	DATE
A	ORIGINAL ISSUE	PF	PF	2170	29/06/07

ASSOCIATED CONSULTANTS

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Park Lake Estate
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Application No. SB005202

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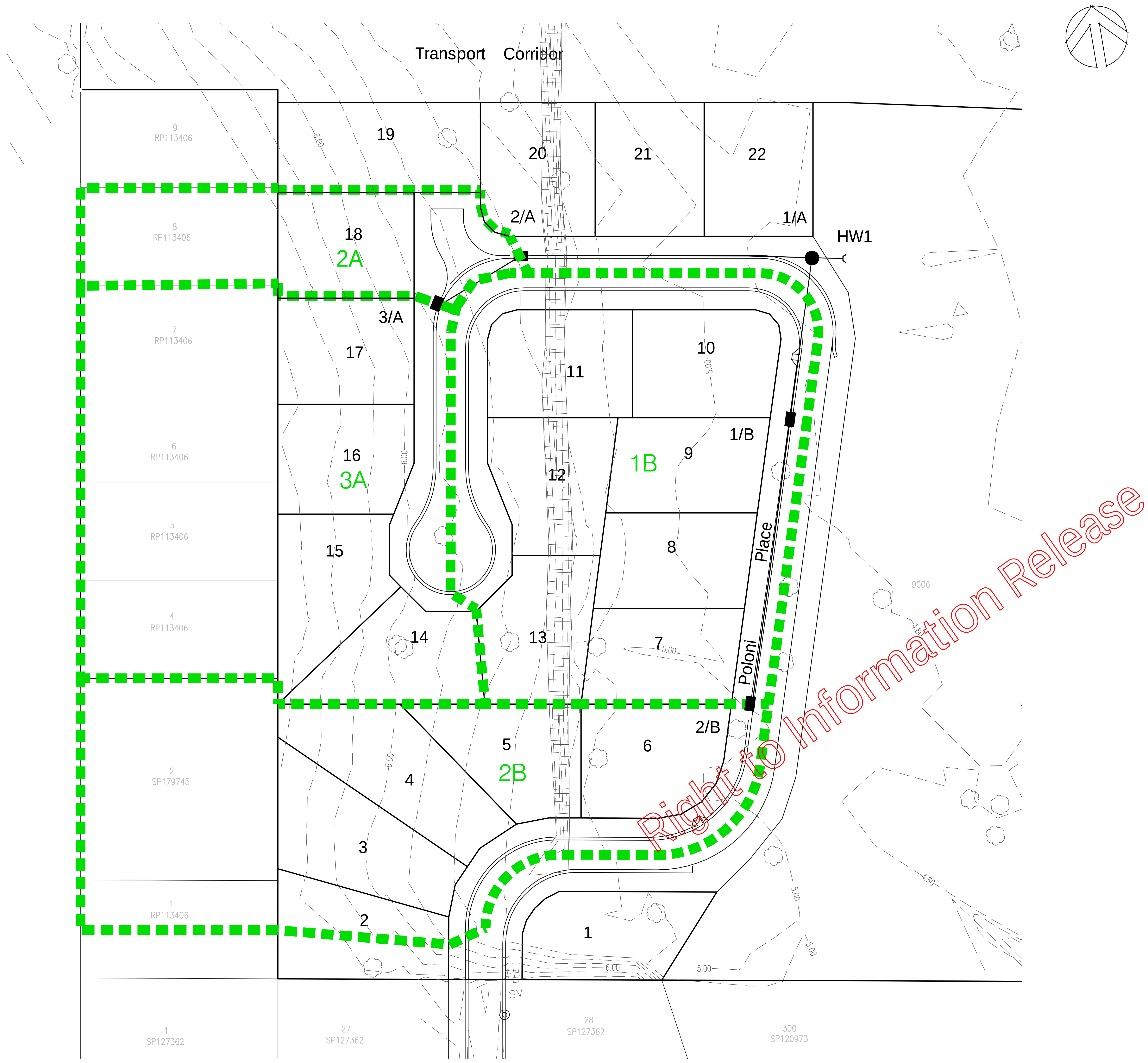
DESIGNED MM
DRAWN AF
ACAD No. 1189R02A
SCALE 1:500

TITLE
Q2 STORMWATER CATCHMENT PLAN
SHEET 1 OF 2

A1 FULL SIZE
DRAWING No. 1189-R02
REVISION A
SHEET 1 OF 2 SHEETS

DO NOT SCALE



Plan
1:500

LEGEND

- Catchment Boundary
- 4/A — Catchment Name
- 1/A — Inlet Pit No.
- 5.8 — Design Contours
- 6.00 — Existing Contours

CATCHMENT AREAS

SURFACE CATCHMENT	AREA(ha)	ROOFWATER CATCHMENT	AREA(ha)
2/A	0.098	2/A	-
3/A	0.307	3/A	0.127
1/B	0.317	1/B	0.094
2/B	0.579	2/B	-

REV	DESCRIPTION	TASK MAN.	APPROVED	RPEQ No.	DATE
A	ORIGINAL ISSUE	PF	PF	2170	29/06/07

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ACAD No. 1189R03A
SCALE 1:500

TITLE
Q2 STORMWATER CATCHMENT PLAN
SHEET 2 OF 2

A1 FULL SIZE
DRAWING No. 1189-R03
REVISION A
SHEET 2 OF 3 SHEETS

DO NOT SCALE

LOCATION				TIME		SUB-CATCHMENT RUNOFF							INLET DESIGN										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
					tc	I	C	A	(CxA)	+(CxA)	Q					Wf	dg	Vg				Qg	
DESIGN A.R.I.	STRUCTURE NO.	DRAIN SECTION	SUB-CATCHMENTS CONTRIBUTING	SLOPE OF CATCHMENT	SUB-CATCHMENT TIME OF CONCENTRATION	RAINFALL INTENSITY	COEFFICIENT OF RUNOFF	SUB-CATCHMENT AREA	EQUIVALENT AREA	SUM OF CONTRIBUTING EQUIVALENT AREAS	SUB-CATCHMENT DISCHARGE	FLOW PAST PREVIOUS GULLIES	FLOW IN K&C (INCLUDING BYPASS)	ROAD GRADE AT INLET	K – K WIDTH	FLOW WIDTH	FLOW DEPTH AT INVERT	GUTTER FLOW VELOCITY	dg x Vg	INLET NUMBER	INLET TYPE	FLOW INTO INLET	BYPASS FLOW
						From intensity Chart			8 x 9	sum 10	(7x11)/360	sum 24	12 + 13						18 x 19		From Std. Drg.	From Charts	14 – 23
years				%	min	mm/h		ha	ha	ha	cumec	cumec	cumec	%	m	m	m	m/s	m2/s			cumec	cumec
2 100	2/B	2/B to 1/B	2B		15.00 15.00	97 200	0.66 0.94	0.579 0.579	0.382 0.544	0.382 0.544	0.103 0.302	0.000	0.103	0.50						2/B	STD RSC ONGRADE GULLY 2.4m Lintel; Type S	0.075	0.028 1/B
2 100	1/B	1/B to 1/A	2B;1B		15.00 15.00	97 200	0.66 0.94	0.317 0.317	0.209 0.298	0.209 0.298	0.056 0.166	0.028	0.084	0.00		0.047Dp				1/B	STD RSC SINGLE SAG GULLY TWO DIRECTION APPROACH	0.084	0.000
2 100	3/A	3/A to 2/A	3A		15.00 15.00	97 200	0.66 0.94	0.307 0.307	0.203 0.289	0.203 0.289	0.055 0.160	0.000	0.055	0.50						3/A	STD RSC ONGRADE GULLY 2.4m Lintel Type 'S'	0.043	0.012 2/A
2 100	2/A	2/A to 1/A	3A;2A		10.00 10.00	116 236	0.66 0.94	0.098 0.098	0.065 0.092	0.065 0.092	0.021 0.060	0.012	0.033	0.50						2/A	STD RSC ONGRADE GULLY 2.4m Lintel Type 'S'	0.027	0.006
2 100	1/A	1/A to HW1	2B;1B;3A;2A																	1/A	STD RSC MANHOLE 1500mm DIAMETER		
2 100	1/C	1/C to HW2	1C		15.00 15.00	97 200	0.66 0.94	0.481 0.481	0.317 0.452	0.317 0.452	0.085 0.251	0.015	0.100	0.00		0.058Dp				1/C	STD RSC Type S SAG GULLY TWO DIRECTION APPROACH	0.100	0.000
2 100	1/D	1/D to HW3	1D		15.00 15.00	97 200	0.66 0.94	0.372 0.372	0.246 0.350	0.246 0.350	0.066 0.194	0.000	0.066	0.87						1/D	STD RSC GULLY 2.4m Lintel Type 'S'	0.051	0.015 1/C

STRUCTURE NO.	DRAIN DESIGN											
2	25	26	27	28	29	30	31	32	33	34	35	36
	tc	I	+(CxA)	Qt	Qm	Qs	Qo	L	S		V	T
STRUCTURE NO.	CRITICAL TIME OF CONCENTRATION	RAINFALL INTENSITY	TOTAL CONTRIBUTING EQUIVALENT AREA	MAJOR TOTAL FLOW	MAJOR SURFACE FLOW CAPACITY	MAJOR SURFACE FLOW	FLOW IN PIPE	REACH LENGTH	PIPE GRADE	PIPE / BOX DIMENSIONS	FLOW VELOCITY FULL (PIPE GRADE VELOCITY)	TIME OF FLOW IN REACH
		From Intensity Chart	sum of U/S 11								31/Sec Area	32/(35x60)
	min	mm/h	ha	cumec	cumec	cumec	cumec	m	%	mm	m/s	min
2/B	15.00 15.00	97 200	0.382 0.544	0.302		(Pipe flow= Grate flow)	0.075	58.669	0.40	450 x 300 (RCBC)	0.56 (0.98)	0.98
1/B	15.98 15.98	95 195	0.591 0.873	0.473		Additional flow: 0.026 cumecs (Pipe flow= Sum upstr atten flows)	0.182	33.654	0.40	900 x 300 (RCBC)	0.67 (1.13)	0.56
3/A	15.00 15.00	97 200	0.203 0.331	0.184		Additional flow: 0.036 cumecs (Pipe flow= Sum upstr atten flows)	0.079	19.227	0.50	375(3)	0.72 (1.12)	0.32
2/A	15.32 15.32	97 199	0.268 0.423	0.234		(Pipe flow= Sum upstr atten flows)	0.102	58.854	0.50	375(3)	0.92 (1.12)	0.98
1/A	16.54 16.54	93 192	0.859 1.296	0.691		(Pipe flow= Sum upstr atten flows)	0.275	5.121	0.40	525(2)	1.23 (1.27)	0.07
1/C	15.00 15.00	97 200	0.317 0.506	0.281		Additional flow: 0.046 cumecs (Pipe flow= Sum upstr atten flows)	0.146	8.850	0.50	1200 x 300 (RCBC)	0.41 (1.32)	0.15
1/D	15.00 15.00	97 200	0.246 0.350	0.194		(Pipe flow= Grate flow)	0.051	10.085	0.50	450 x 300 (RCBC)	0.38 (1.09)	0.17

STRUCTURE NO.	HEADLOSSES										PART FULL								
2	37 – 38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
		V2/2g	Ku	hu	Kl	hl	Kw	hw	Sf	hf		Vp							
STRUCTURE NO.	STRUCTURE RATIOS FOR 'K' VALUE CALCULATIONS	VELOCITY HEAD	U/S HEADLOSS COEFFICIENT	U/S PIPE STRUCTURE HEADLOSS	LATERAL HEADLOSS COEFFICIENT	LATERAL PIPE STRUCTURE HEADLOSS	W.S.E COEFFICIENT	CHANGE IN W.S.E	FRICTION SLOPE	PIPE FRICTION HEADLOSS	DEPTH	VELOCITY	INVERT LEVELS	DRAIN SECTION H.G.L	U/S H.G.L	W.S.E.	SURFACE OR K&C INVERT LEVEL	FREEBOARD	STRUCTURE No.
	FROM Q.U.D.M. CHARTS VOLUME 2	35x35/2g	From Q.U.D.M. Volume 2	39 x 40	From Q.U.D.M. Volume 2		From Q.U.D.M. Volume 2		From Sect. 14.5.7 A.R.R. Vol. 1 1987	46 x 32/100			U/S RL D/S RL	U/S RL D/S RL					
		m		m		m		m	%	m	m	m/s	m	m	m	m	m	m	
2/B	Qg 0.075 Qo 0.075 Do 360 CHRT 32: Vo2/2gDo 0.05 H/Do Kg side flow 8.10 end flow 6.02	0.016	8.10	0.129			8.10	0.129	0.13	0.076			4.730 4.495	5.118 5.042	5.247	5.247	5.462	0.215	2/B
1/B	Qg 0.108 Qo 0.182 Do 450 CHART 33 Angle 0 S/Do 2.5 Du/Do 0.80 Qg/Qo 0.60 K 1.61 S/Do 1.89 cor 0.33 Ku 1.94 Kw 1.94	0.023	1.94	0.044			1.94	0.044	0.14	0.047			4.475 4.340	4.997 4.950	5.042	5.042	5.194	0.152	1/B
3/A	Qg 0.079 Qo 0.079 Do 375 CHRT 32: Vo2/2gDo 0.07 H/Do Kg side flow 7.44 end flow 5.62	0.026	7.44	0.197			7.44	0.197	0.20	0.039			4.751 4.655	5.262 5.223	5.459	5.459	5.703	0.244	3/A
2/A	Qg 0.023 Qo 0.102 Do 375 Angle 29 Chart 36 S/Do 2.5 chart Du/Do 1.00 K0 1.51 K0.5 1.86 Qu/Qo 0.78 Cg 0.53 K 1.69 S/Do 2.0 K0 1.79 K0.5 2.07 K 1.94 S/Do 1.5 K0 2.11 K0.5 2.54 K 2.33	0.043	1.74	0.075	Interp val for S/Do 1.62 Kw 2.23 CHART 35 S/Do 2.0 K0 1.55 K0.5 1.74 K 1.65 S/Do 1.5 K0 1.75 K0.5 1.80 K 1.78 Interp val for S/Do 1.62 Ku 1.74		2.23	0.096	0.34	0.198			4.635 4.340	5.148 4.950	5.223	5.244	5.618	0.374	2/A
1/A	Qo 0.275 Do 525 Routine 2.2 Combined pipes in line case Join Pipes: 1/B and 2/A Vel1 0.882 Vel2 1.117	0.077	1.35	0.104	Eq Dia 582 Angle 130 Flow 0.275 CHART 50 Du/Do1.11 alpha 0 K'w 0.05 Vu 1.03 WSE 0.05 Ku 0.66 Kw 0.70 Interpolated Ku= 1.35 Kw= 1.36		1.36	0.105	0.37	0.019	0.423	1.45	4.320 4.300	4.845 4.825	4.950	4.950	5.387	0.437	1/A
1/C	Qg 0.146 Qo 0.146 Do 480 CHRT 32: Vo2/2gDo 0.03 H/Do Kg side flow 10.00 end flow 7.12 Part full downstream pipe	0.009	1.00	0.009	Upstream HGL 3.015 below outlet pipe obv 3.045 Set Kp to 1		1.00	0.009	0.05	0.004	0.109	1.11	2.744 2.700	3.004 3.000	3.015	3.015	3.249	0.234	1/C
1/D	Qg 0.051 Qo 0.051 Do 360 CHRT 32: Vo2/2gDo 0.02 H/Do Kg side flow 10.12 end flow 7.19 Part full downstream pipe	0.007	1.00	0.007	Upstream HGL 3.416 below outlet pipe obv 3.450 Set Kp to 1		1.00	0.007	0.06	0.006	0.116	0.98	3.150 3.100	3.406 3.400	3.416	3.416	3.748	0.332	1/D

REV	DESCRIPTION	TASK MAN.	APPROVED	RPEQ No.	DATE
A	ORIGINAL ISSUE	PF	PF	2170	29/06/07

ASSOCIATED CONSULTANTS

CLIENT / PROJECT

Park lake Estate

Collin Park Pty Ltd

Redland Shire Council

Application No. SB005202

FLANAGAN
CONSULTING GROUP
1st FLOOR 138–142 SPENCE STREET
P.O. BOX 5820 CAIRNS, QLD, 4870
PHONE: 07 4031 3199 FAX: 07 4051 0089
EMAIL: cairns@fcgroup.com.au
WEB: www.fcgroup.com.au

DESIGNED MM

DRAWN MM

ACAD No. 1189R04A

SCALE -

TITLE

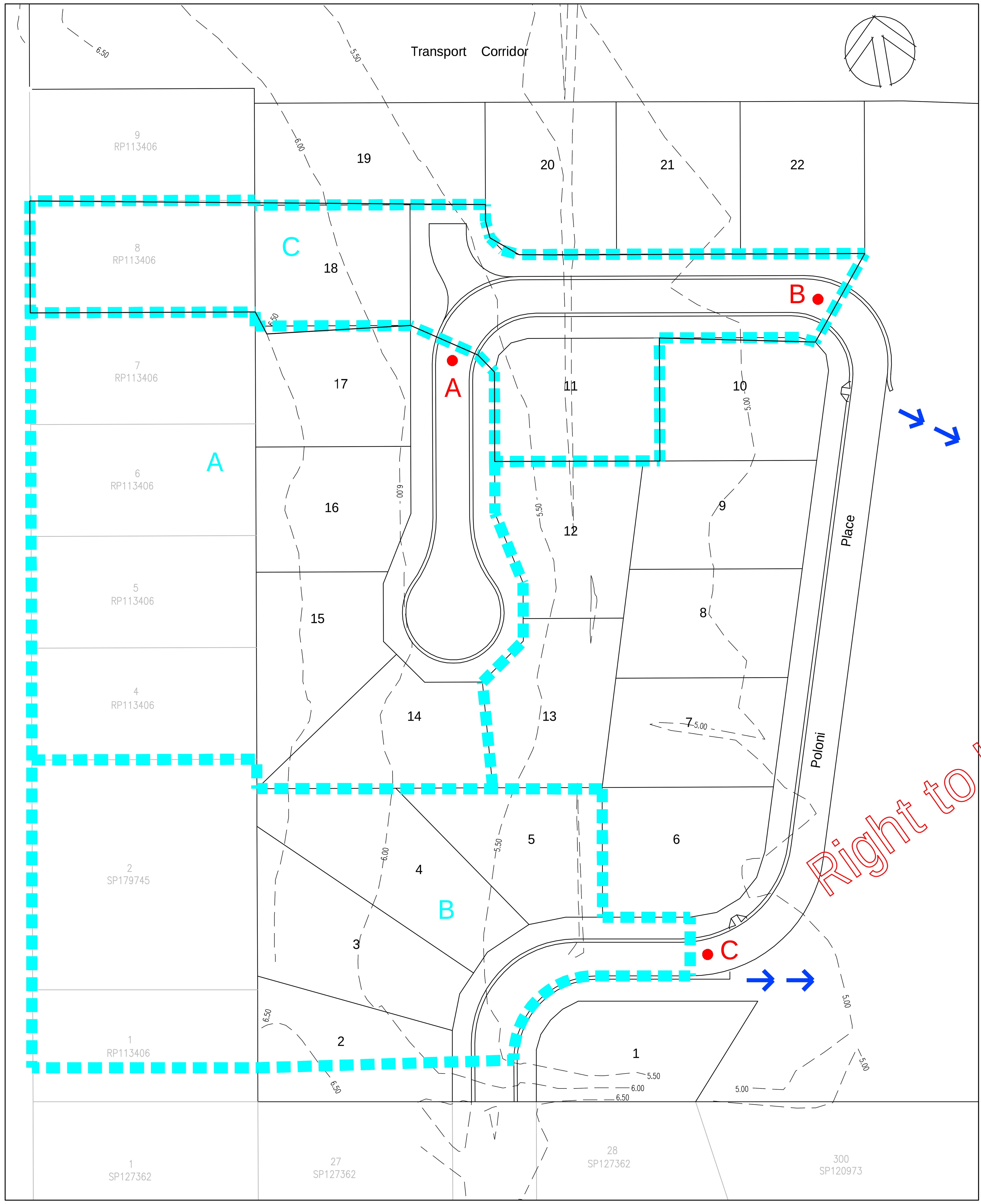
Q2 STORMWATER CALCULATION TABLES

A1 FULL SIZE

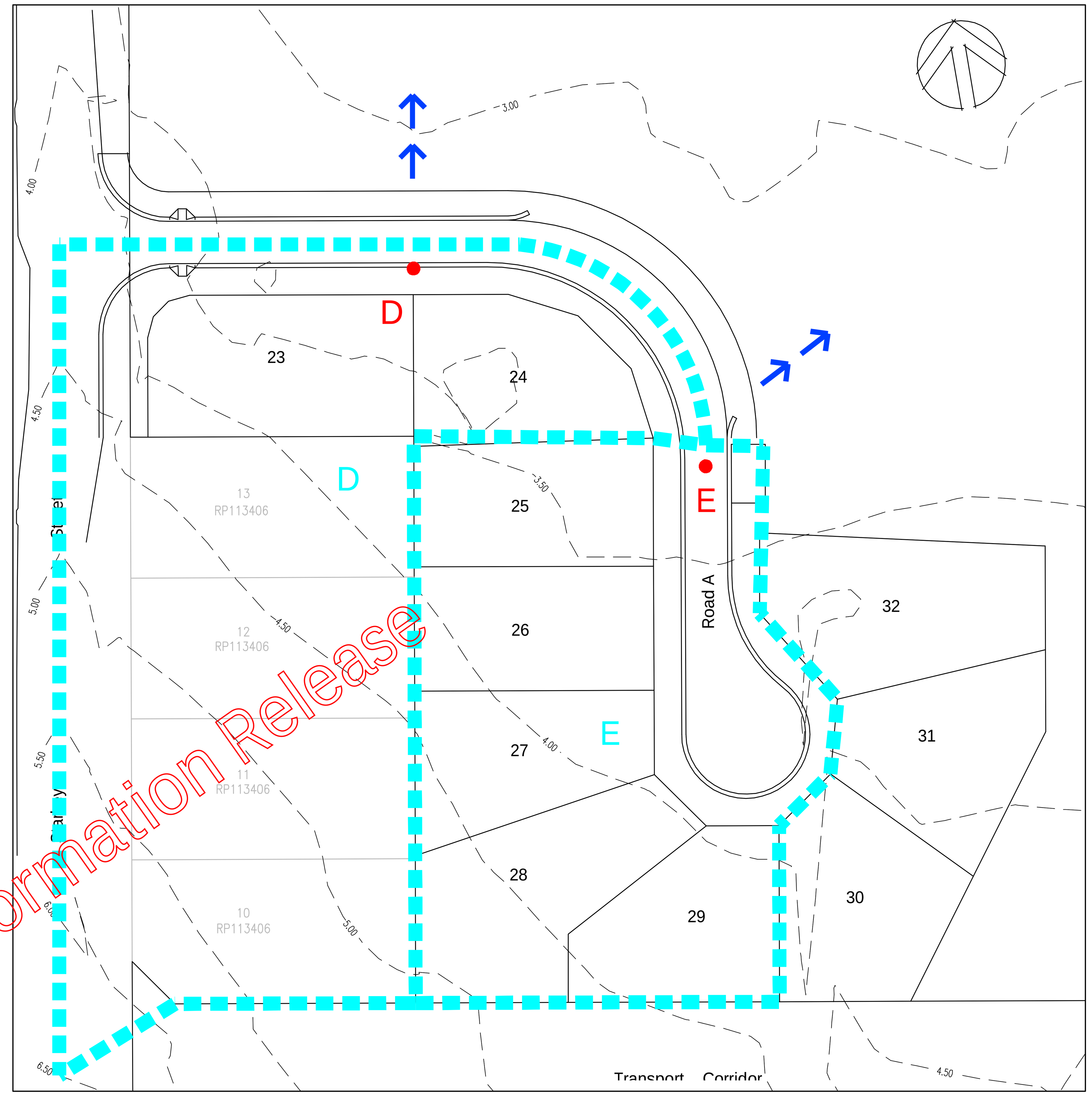
DRAWING No. 1189-R04

REVISION A

SHEET 3 OF 3 SHEETS



Plan
1:500



Plan
1:500

LEGEND

- Catchment Boundary
- A — Catchment Name
- Outlet
- Existing Contours
- Design Contours

CATCHMENT AREAS

CATCHMENT	AREA(ha)	Q100 Flow	Road Capacity
A	0.670	0.346m³/s	1.88m³/s
B	0.522	0.270m³/s	2.52m³/s
C	0.339	0.175m³/s	1.88m³/s
D	0.481	0.249m³/s	1.88m³/s
E	0.422	0.128m³/s	1.88m³/s

FLANAGAN CONSULTING GROUP
DEVELOPMENT CONSULTANTS · MANAGERS · ENGINEERS
138 –142 SPENCE STREET CAIRNS
P.O. BOX 5820 CAIRNS, QLD, 4870
PHONE 07 4031 3199
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Collin Park Pty Ltd
75 - 79 Starkey Street
Lot 14 on RP113406

Overland Flow Catchments

1189-SK50 — 1:500, A1 Full Size

Acad No. 1189SK50 — 23 May 2007

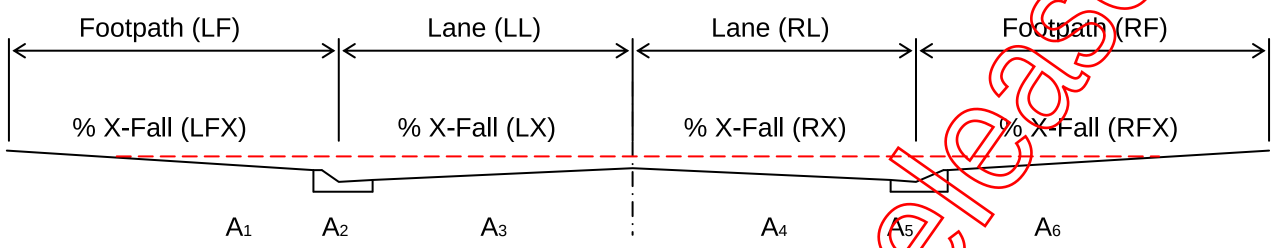
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Q100 Overland Flow Capacity 0.5% Grade



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.167
A_2	0.111
A_3	0.494

Wetted Perimeters (m)

P_1	3.335
P_2	0.633
P_3	2.996

Hydraulic Radius (A/P)

R_1	0.0500
R_2	0.1755
R_3	0.1650

Capacities (Cumecs)

Q_1	0.047
Q_2	0.189
Q_3	0.701

Outputs

Cross Sectional Areas (m^2)

A_6	0.167
A_5	0.111
A_4	0.494

Wetted Perimeters (m)

P_6	3.335
P_5	0.633
P_4	2.996

Hydraulic Radius (A/P)

R_6	0.0500
R_5	0.1755
R_4	0.1650

Capacities (Cumecs)

Q_6	0.047
Q_5	0.189
Q_4	0.701

Parameters

Mannings 'n'

Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.005
Depth of Flow	0.230

Capacity (m^3)	1.875
Velocity (m/s)	1.214
dg*Vave (m^2/s)	0.279

WARNING !! - FLOW OVERTOPS ROAD CROWN

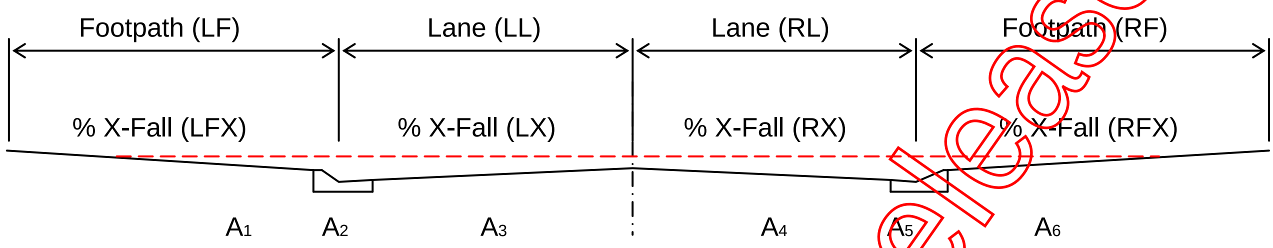
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Q100 Overland Flow Capacity 0.9% Grade



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.167	A_6	0.167
A_2	0.111	A_5	0.111
A_3	0.494	A_4	0.494

Wetted Perimeters (m)

P_1	3.335	P_6	3.335
P_2	0.633	P_5	0.633
P_3	2.996	P_4	2.996

Hydraulic Radius (A/P)

R_1	0.0500	R_6	0.0500
R_2	0.1755	R_5	0.1755
R_3	0.1650	R_4	0.1650

Capacities (Cumecs)

Q_1	0.063	Q_6	0.063
Q_2	0.254	Q_5	0.254
Q_3	0.941	Q_4	0.941

Parameters

Mannings 'n'	
Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.009
Depth of Flow	0.230

Capacity m^3

2.516

Velocity m/s

1.629

dg*Vave m^2/s

0.375

WARNING !! - FLOW OVERTOPS ROAD CROWN

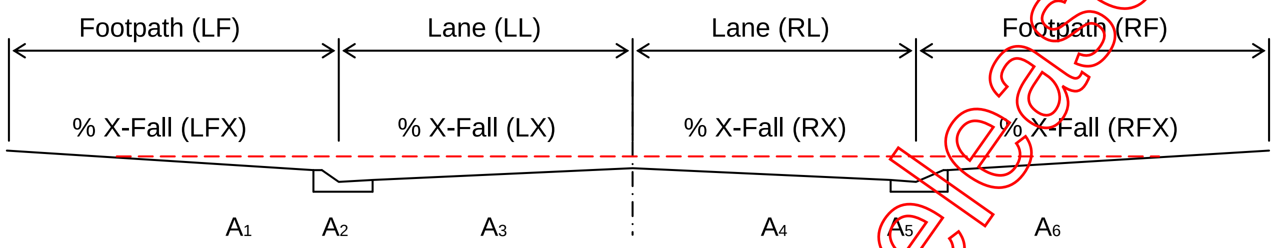
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Road A Q100 Overland Flow Capacity Point A



Dimensions (All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.000	A_6	0.000
A_2	0.048	A_5	0.048
A_3	0.180	A_4	0.180

Wetted Perimeters (m)

P_1	0.000	P_6	0.000
P_2	0.571	P_5	0.569
P_3	2.996	P_4	2.996

Hydraulic Radius (A/P)

R_1	0.0000	R_6	0.0000
R_2	0.0848	R_5	0.0851
R_3	0.0600	R_4	0.0600

Capacities (Cumecs)

Q_1	0.000	Q_6	0.000
Q_2	0.051	Q_5	0.051
Q_3	0.130	Q_4	0.130

Parameters

Mannings 'n'	
Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.005
Depth of Flow	0.125

Capacity	m^3	**0.362**
Velocity	m/s	**0.792**
dg*Vave	m^2/s	**0.099**

WARNING !! - FLOW OVERTOPS ROAD CROWN

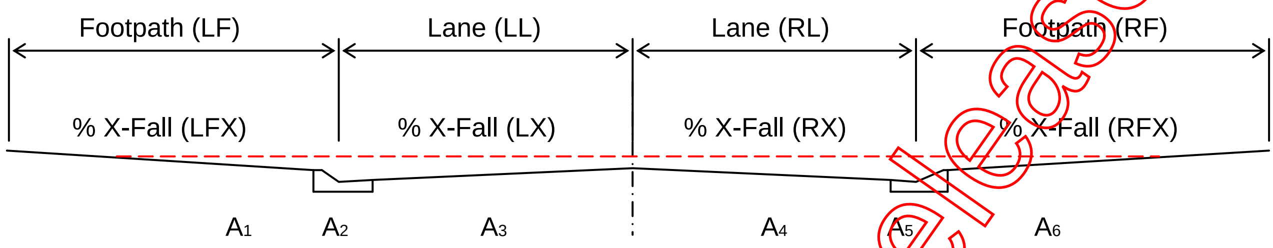
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Road A Q100 Overland Flow Capacity Point B



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.000
A_2	0.043
A_3	0.150

Wetted Perimeters (m)

P_1	0.000
P_2	0.548
P_3	2.996

Hydraulic Radius (A/P)

R_1	0.0000
R_2	0.0787
R_3	0.0501

Capacities (Cumecs)

Q_1	0.000
Q_2	0.043
Q_3	0.096

Outputs

Cross Sectional Areas (m^2)

A_6	0.000
A_5	0.043
A_4	0.150

Wetted Perimeters (m)

P_6	0.000
P_5	0.546
P_4	2.996

Hydraulic Radius (A/P)

R_6	0.0000
R_5	0.0790
R_4	0.0501

Capacities (Cumecs)

Q_6	0.000
Q_5	0.043
Q_4	0.096

Parameters

Mannings 'n' Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.005
Depth of Flow	0.115

Capacity	m^3	**0.278**
Velocity	m/s	**0.721**
dg*Vave	m^2/s	**0.083**

WARNING !! - FLOW OVERTOPS ROAD CROWN

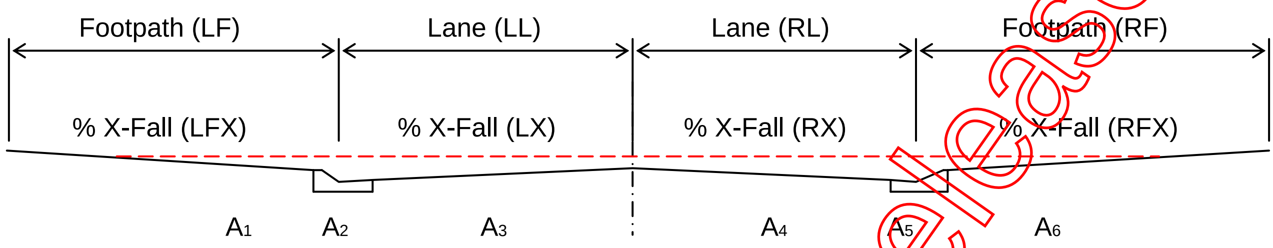
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Road A Q100 Overland Flow Capacity Point C



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.000
A_2	0.036
A_3	0.107

Wetted Perimeters (m)

P_1	0.000
P_2	0.514
P_3	2.668

Hydraulic Radius (A/P)

R_1	0.0000
R_2	0.0693
R_3	0.0400

Capacities (Cumecs)

Q_1	0.000
Q_2	0.033
Q_3	0.059

Outputs

Cross Sectional Areas (m^2)

A_6	0.000
A_5	0.036
A_4	0.107

Wetted Perimeters (m)

P_6	0.000
P_5	0.512
P_4	2.668

Hydraulic Radius (A/P)

R_6	0.0000
R_5	0.0696
R_4	0.0400

Capacities (Cumecs)

Q_6	0.000
Q_5	0.033
Q_4	0.059

Parameters

Mannings 'n'

Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.005
Depth of Flow	0.100

Capacity m^3

0.183

Velocity m/s

0.643

dg*Vave m^2/s

0.064

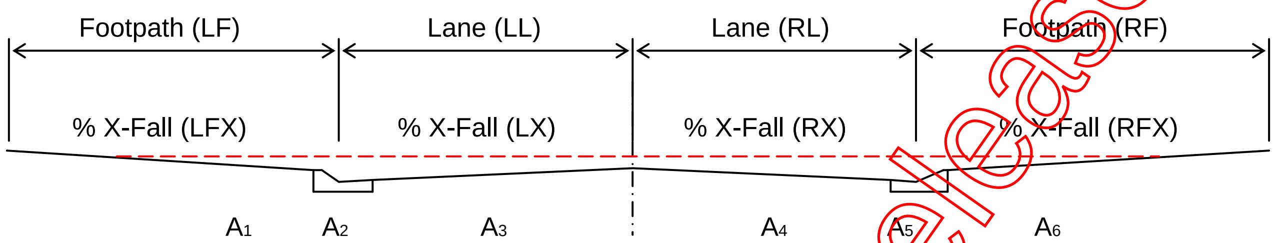
FLANAGAN CONSULTING GROUP

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Location Road A Q100 Overland Flow Capacity Point D



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.000
A_2	0.036
A_3	0.107

Wetted Perimeters (m)

P_1	0.000
P_2	0.514
P_3	2.668

Hydraulic Radius (A/P)

R_1	0.0000
R_2	0.0693
R_3	0.0400

Capacities (Cumecs)

Q_1	0.000
Q_2	0.044
Q_3	0.079

Outputs

Cross Sectional Areas (m^2)

A_6	0.000
A_5	0.036
A_4	0.107

Wetted Perimeters (m)

P_6	0.000
P_5	0.512
P_4	2.668

Hydraulic Radius (A/P)

R_6	0.0000
R_5	0.0696
R_4	0.0400

Capacities (Cumecs)

Q_6	0.000
Q_5	0.044
Q_4	0.079

Parameters

Mannings 'n'

Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.009
Depth of Flow	0.100

Capacity m^3

0.245

Velocity m/s

0.863

dg*Vave m^2/s

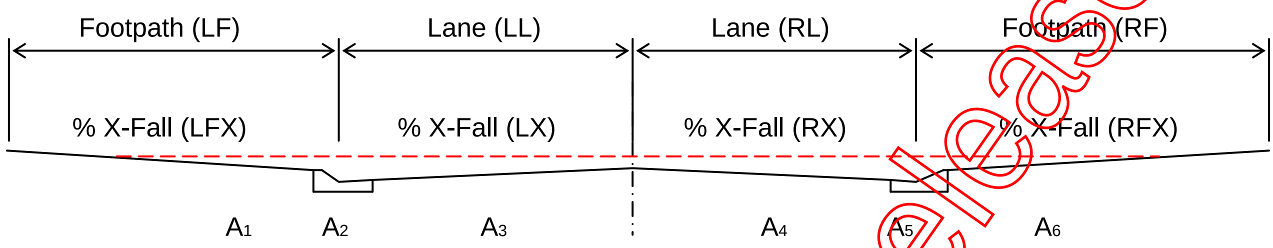
0.086

Roadway Flow Capacity

(Two Way Crossfall with Layback Kerb & Channel)

Project No.	1189/03
Calc's By	MM 29/06/07
Checked By	

Location Road A Q100 Overland Flow Capacity Point E



Dimensions

(All Dimensions to be in metres)

4.225	Footpath Width (LF)	4.225	Footpath Width (RF)
3.0	Footpath % X-Fall (LFX)	3.0	Footpath % X-Fall (RFX)
3.275	Lane Width (LL)	3.275	Lane Width (RL)
3.0	Lane % X-Fall (LX)	3.0	Lane % X-Fall (RX)

Outputs

Cross Sectional Areas (m^2)

A_1	0.000	A_6	0.000
A_2	0.026	A_5	0.026
A_3	0.060	A_4	0.060

Wetted Perimeters (m)

P_1	0.000	P_6	0.000
P_2	0.467	P_5	0.465
P_3	2.001	P_4	2.001

Hydraulic Radius (A/P)

R_1	0.0000	R_6	0.0000
R_2	0.0562	R_5	0.0564
R_3	0.0300	R_4	0.0300

Capacities (Cumecs)

Q_1	0.000	Q_6	0.000
Q_2	0.028	Q_5	0.028
Q_3	0.037	Q_4	0.037

Parameters

Mannings 'n' Footpath	0.034
Kerb	0.013
Roadway	0.015
Slope (m/m)	0.009
Depth of Flow	0.080

Capacity m^3

0.130

Velocity m/s

0.751

dg*Vave m^2/s

0.060

Customer Request Enquiry 97-111 Starkey Street, Wellington Point

Application ID	Received On	Primary Address	Full Details	Company/Surname	Given Name	Responsible Officer	Completion Date
CRWS258998	4/10/01	97-111 Starkey Street, Wellington Point QLD 4160	relocate water service	Council Officer			27/7/03
CRCI014339	10/11/14	97-111 Starkey Street, Wellington Point QLD 4160	Customer is requesting a new footpath on the bush side of Starkey street running from Duncan to Anhs place.				28/10/15
CRCI024489	8/6/16	97-111 Starkey Street, Wellington Point QLD 4160	Request for extension to existing footpath that ends along Starkey St . To Belford drive. The road reserve is often very overgrown, so you cant walk along that stretch meaning you need to walk on the road, which is very dangerous, particularly by the traffic island.			Ebrahim Ibrahim	7/10/16
CRCI024610	15/6/16	97-111 Starkey Street, Wellington Point QLD 4160	COUNCILLOR REQUEST Dear Wendy, Just a friendly reminder, we were wondering what was happening with the footpath at the end of Duncan Street (where the bridge is) continuing up Starky Street. Last time we spoke to you re this, about 18 months ago, we were just wondering what was the latest. Hope this email finds you well and happy. Kind regards, Note from Councillor - "Can I please ask for confirmation that it is indeed in the works program and approx delivery time" please ensure an outcome is forwarded to the resident and the elected member			Ebrahim Ibrahim	4/8/16

Contrary to Public Interest, Irrelevant Information

Pages 32 through 33 redacted for the following reasons:
- -
Irrelevant Information