CONCEPTUAL STORMWATER MANAGEMENT PLAN

Proposed Residential Subdivision

31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera

Lots 184-186 on SP173728, Lot 183 on RP156422, Lot 58 on SP191940, Lot 56 on RP162858 & Lot 57 on SP214370

For Norfolk Estates Pty Ltd

26 June 2025

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Synopsis:	This *Conceptual Stormwater Management Plan* describes the existing site characteristics, and corresponding stormwater quantity and quality management controls to be implemented during the construction and operational phase of the development.

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APPENDICES

Appendix A LandPartners, *Detail Survey* (Ref: BRJD8528-00-12-1)
Appendix B Saunders Havill Group, Proposal Plan (Ref: 11694 P 11)
Appendix C OSKA Consulting Group, Pre-Development Catchment Plan (Ref: OSK6521/P001/D)
Appendix D OSKA Consulting Group, Post-Development Catchment Plan (Ref: OSK6521/P002/D) & External Catchment Plan (Ref: OSK6521/P005/C)
Appendix E OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C)
Appendix F OSKA Consulting Group, Sediment and Erosion Control Plan – Sheet 1 of 2 (Ref: OSK6521/P050/C), Sediment and Erosion Control Plan – Sheet 2 of 2 (Ref: OSK6521/P051/C) & Sediment and Erosion Control Details (Ref: OSK6521/P052/C)
Appendix G OSKA Consulting Group, Response to Healthy Waters Code (Ref: OSK6521-0006)

1.0 INTRODUCTION

1.1 Background

OSKA Civil Consultants has been commissioned by Norfolk Estates Pty Ltd to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application for the proposed residential subdivision development situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera.

The subject site is described as Lots 184-186 on SP173728, Lot 183 on RP156422, Lot 58 on SP191940, Lot 56 on RP162858 & Lot 57 on SP214370 and has a total site area of 18.301ha.

This revision of the report (B) was issued for a new Development Application and in response to Council's Information Request dated 28 January 2025 for the previous Development Application (ROL/2024/116).

1.2 Scope

This CSWMP details the conceptual planning, layout and design of the stormwater management infrastructure for both the construction and operational phases of this development.

This CSWMP aims to:

- Establish the required performance criteria for the proposed stormwater quantity and quality improvement systems;
- Provide a conceptual design of stormwater infrastructure including stormwater quality improvement devices and stormwater quantity management controls;
- Demonstrate the modelled post-development stormwater quality discharging from the site does not adversely impact on the water quality and ecological values of downstream watercourses;
- Demonstrate stormwater runoff is conveyed through the site to a Lawful Point of Discharge (LPOD) in accordance with the Queensland Urban Drainage Manual (QUDM); and
- Provide reporting and monitoring mechanisms whereby the performance of this system can be measured enabling identification of corrective actions/alterations required to ensure the above mentioned objectives are maintained.

This CSWMP has been prepared in accordance with the IEAust *Australian Runoff Quality: Guide to Water Sensitive Urban Design, Queensland State Planning Policy 2017*, IPWEA *Queensland Urban Drainage Manual (QUDM) Fourth Edition (2017)* and City of Gold Coast (CoGC), *SC6.12 City Plan Policy – Land Development Guidelines.*

2.0 SITE DESCRIPTION

2.1 Location

The subject site is located at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The site fronts Courtney Drive to the north, Baileys Mountain Road to the east, Reserve Road and Richardson Crescent to the south and has existing residential properties to the north, east and west. The site covers a total combined area of 18.301ha, with details as summarised in Table 1 and as located in Figure 1.

Table 1: Site Description

Client	Lot and Property Description	Street Address
Norfolk Estates Pty Ltd	*Lots 184-186 on SP173728, Lot 183 on RP156422, Lot 58 on SP191940, Lot 56 on RP162858 & Lot 57 on SP214370*	*31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera*



Figure 1: Locality Plan (Source: Nearmap)

2.2 Site Topography

The site generally grades to the south/east either towards the existing waterway through the site or the existing swale along Baileys Mountain Road. The existing site is relatively steep with spot heights ranging from approximately RL 23.00m AHD to 49.50m AHD. Based on the provided survey and aerial information, any stormwater runoff from the site either drains to the existing waterway through the site or the existing swale along Baileys Mountain Road.

Further information of the site survey has been provided by LandPartners, Detail Survey (Ref: BRJD8528-00-12-1) included as Appendix A.

2.3 Vegetation and Land Use

The subject site currently consists of six residential properties and most of the lots contain a number of dwellings/structures typically consisting of a residential dwelling, detached garage and shed. The subject site contains a total of three dams and a waterway that runs through the site from the north-west and along the southern site boundary through the south-eastern corner of the site. The majority of the subject site is covered in grassed areas with multiple trees throughout the site. Access to each lot is gained via dirt driveways from the road fronting each lot.

An aerial photograph taken on the 22 December 2024 of the subject site is included in Figure 2.



Figure 2: Aerial Image of the Site (Source: Nearmap – Image taken 22 December 2024)

2.4 Proposed Development

The proposed development for the site consists of a 188 lot residential subdivision with lot areas ranging between 300-923m^2. Access to the proposed development will be gained via one of the number of new road connections from Courtney Drive, Baileys Mountain Road and Richardson Crescent which will provide access to all lots. The development will be completed through six stages of works, ranging from 20 – 46 lots per stage.

Refer to Appendix B for further proposed layout details prepared by Saunders Havill Group, Proposal Plan (Ref: 11694 P 11).

2.5 Proposed Conceptual Drainage

It is proposed that the site's captured stormwater be conveyed to proposed bio-retention basins located within each major catchment. The Stormwater Quality Improvement Devices (SQID) will treat the majority of the site's stormwater runoff with at minimum the Q3-month flow rate being treated by the SQID's. The basins proposed will look to treat stormwater quality as well as mitigate the site's post-development flow rates to those evident in the pre-development scenario (quantity).

The captured flows from the three basins in the western and southern parts of the site, are to discharge directly to the existing waterway through the site which will be the Lawful Point of Discharge (LPOD) for the respective catchments. The captured flows from the eastern basin will discharge directly to the existing swale along Baileys Mountain Road, the LPOD for the catchment. All runoff from undeveloped areas of the site will drain directly to the existing waterway through the site.

2.6 Rainfall Data

Rainfall intensity data has been obtained from the Australian Bureau of Meteorology's 2016 Design IFD Rainfall System. The data has been extracted for the nearest grid cell at Latitude 27.8625 (S) and Longitude 153.2875 (E). The IFD data and average rainfall intensities used in this report are in accordance with the procedures outlined in Geosciences Australia, Australian Rainfall and Runoff 2019.

3.0 DATA

Data which has been sourced or provided, in order to prepare this report for the site, was gathered from the following sources:

- Detailed site survey provided by LandPartners, Detail Survey (Ref: BRJD8528-00-12-1) included as Appendix A;
- Proposed site layout provided by Saunders Havill Group, Proposal Plan (Ref: 11694 P 11) included as Appendix B;
- LIDAR data for the subject site sourced from Australian Government Elevation and Depth Foundation Spatial Data (ELVIS), Date Source: 2014, DEM Data;
- Rainfall and Meteorological 2016 IFD Data by the Australian Bureau of Meteorology;
- Information Extracted from CoGC City Plan Interactive Mapping – Version 11;
- Aerial Imagery by Nearmap (Accessed on 31 March 2025); and
- MUSIC data sourced from Rainfall Station 40584, Hinze Dam.

4.0 SITE HYDROLOGY

4.1 Background

The following sections define the method and parameters utilised within the hydrologics of the site, in order to establish a simulation of the anticipated flow regime and peak discharge at the Lawful Point of Discharge (LPOD). A Rational Method calculation has been provided for comparison of the pre and post-development peak flow rates.

The Rational Method (Section 4.3 of the Queensland Urban Drainage Manual - QUDM 2017) is a suitable estimation technique, given its flexibility in its data requirements and is able to produce satisfactory estimates of peak site discharges based on the following data input:
specific intensity frequency duration (IFD) data;

- length/type of flow path;
- contributing catchment areas; and
- coefficient of discharge.

4.2 Pre-Development

4.2.1 Catchment Definition and Lawful Point of Discharge

The pre-development site has been analysed as three internal catchments with a total contributing area of 12.260ha.

The pre-development catchments have been defined based on the post-development catchments to ensure a like for like comparison and to only include the development extent. Any areas outside the development extent are to remain similar to existing (grass and vegetation) and as such have not been included within the peak flow rate assessment.

Pre A

- Total Catchment Area 2.464ha
- 0.114ha of impervious surfaces (4.62%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD A) within the western part of the site.

Pre B

- Total Catchment Area 5.914ha
- 0.350ha of impervious surface (5.91%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD B) within the south-eastern part of the site.

Pre C

- Total Catchment Area 2.777ha
- Fully Pervious
- Runoff is conveyed as sheet/overland flow towards the existing swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary.

Pre D

- Total Catchment Area 1.104ha
- 0.047ha of impervious surface (4.26%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD D) within the western part of the site.

The catchment area and LPOD for the subject site are shown on OSKA Consulting Group, Pre-Development Catchment Plan (Ref: OSK6521/P001/D) included as Appendix C.

4.2.2 Coefficient of Runoff

The pre-development coefficients of runoff (C year) were determined using the fraction impervious method as specified in QUDM and based on Table 4.5.4 in QUDM. Using a one hour, ten-year rainfall intensity ($^1I_{10}$) of 64.9 mm/hr and Table 4.5.4 in QUDM with good grass cover and medium permeability, the adopted C_{10} values for all the individual pre-development catchments have been shown in bold Table 2.

The following pre-development coefficients of runoff (as shown in Table 2) have been adopted in accordance with QUDM Table 4.5.2, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storms of 39%, 10%, 5% and 1% (corresponding to the 2, 10, 20 and 100 year Average Recurrence Interval (ARI) storms).

Table 2: Pre-Development Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
PRE A	0.57	**0.67**	0.71	0.81
PRE B	0.57	**0.67**	0.71	0.81
PRE C	0.56	**0.66**	0.69	0.79
PRE D	0.57	**0.67**	0.70	0.80

4.2.3 Time of Concentration

The Time of Concentration (TOC) for the pre-development catchments have been calculated in accordance with QUDM Section 4.6.6 – Overland Flow and 4.6.11 - Time of concentration for rural and creek catchments. Friend's Equation ($t = (107*n*L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and Bransby-Williams' ($t = (58 * L)/(A^{0.1} * S_e^{0.2})$ equation has been used to calculate the travel time using channel flow.

Refer to *Table 3* for the calculated time of concentration for the pre-developed catchments.

Table 3: Pre-Development Time of Concentration

Catchment	Catchment Area (ha)	Time of Concentration		
		Overland flow Friend's Equation	Concentrated Overland Flow Bransby-Williams	Total t_c
Pre-Development Catchment A	2.464	Horton's (n) = 0.040 L = 50m Slope = 10.50% t = 9.84 mins	Length (km) = 0.150 Area (ha) = 2.464 Slope = 4.41% t = 5.91 mins	16 mins
Pre-Development Catchment B	5.914	Horton's (n) = 0.040 L = 50m Slope = 5.00% t = 11.41 mins	Length (km) = 0.230 Area (ha) = 5.914 Slope = 6.68% t = 7.64 mins	19 mins
Pre-Development Catchment C	2.777	Horton's (n) = 0.040 L = 50m Slope = 11.00% t = 9.75 mins	Length (km) = 0.200 Area (ha) = 2.777 Slope = 7.41% t = 7.02 mins	17 mins
Pre-Development Catchment D	1.104	Horton's (n) = 0.040 L = 50m Slope = 12.00% t = 9.58 mins	Length (km) = 0.080 Area (ha) = 1.104 Slope = 9.49% t = 2.93 mins	13 mins

4.2.4 Design Flow Rates

Pre-development peak flow rates have been estimated for the adopted storms using design rainfall intensities from the Bureau of Meteorology IFD Data. The Rational Method (Q = 2.78 x 10^{-3} CIA) has been used to estimate the subject site's design peak flow rates. The pre-development peak flows for the subject site are presented in Tables 4-7.

Table 4: Pre-Development A Peak Flow Estimation – Rational Method

PRE A					
Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.57	0.67	0.71	0.81
Area of Catchment (ha)	**A**	2.464	2.464	2.464	2.464
Average Rainfall Intensity (mm/h)	**I**	94	135	154	196
Peak Flow Rate (m^3/s)	**Q**	**0.369**	**0.619**	**0.742**	**1.080**

Table 5: Pre-Development B Peak Flow Estimation – Rational Method

PRE B					
Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.57	0.67	0.71	0.81
Area of Catchment (ha)	**A**	5.914	5.914	5.914	5.914
Average Rainfall Intensity (mm/h)	**I**	87	124	141	181
Peak Flow Rate (m^3/s)	**Q**	**0.819**	**1.375**	**1.647**	**2.404**

Table 6: Pre-Development C Peak Flow Estimation – Rational Method

PRE C					
Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.56	0.66	0.69	0.79
Area of Catchment (ha)	**A**	2.777	2.777	2.777	2.777
Average Rainfall Intensity (mm/h)	**I**	92	131	149	190
Peak Flow Rate (m^3/s)	**Q**	**0.397**	**0.666**	**0.798**	**1.163**

Table 7: Pre-Development D Peak Flow Estimation – Rational Method

PRE D					
Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.57	0.67	0.70	0.80
Area of Catchment (ha)	**A**	1.104	1.104	1.104	1.104
Average Rainfall Intensity (mm/h)	**I**	104	148	169	215
Peak Flow Rate (m^3/s)	**Q**	**0.181**	**0.304**	**0.364**	**0.530**

4.3 Post-Development

4.3.1 Catchment Definition and Lawful Point of Discharge

The post-development scenario has been analysed as described in the pre-development scenario with three internal catchments with a total contributing area of 12.260ha.

The post-development catchments, which are consistent with the pre-development catchments, contain the majority of the lots to be developed. It is noted that some of the smaller lot groupings (less than 5 lots) are not included in the catchments that are conveyed to the basin which include Lots 524-527, 528-530, 643-644 and 645-646. Although this is the case, it is not practical to provide basins for these areas and these areas are not considered to cause any adverse impacts (quality or quantity) to the receiving system or downstream properties. Therefore, these areas have been excluded from the quantity and quality analysis within this report.

Further to the above, the bypass areas have been included within the Hydraulic Impact Assessment has been completed by Biome Consulting which demonstrated no impacts downstream of the development as a result of these bypass areas. For further information, refer to the Hydraulic Impact Assessment (Ref: BC-23170) completed by Biome Consulting.

Post A

- Total Catchment Area 2.464ha
- 1.590ha of impervious surfaces (64.53%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD A) within the western part of the site.

Post B

- Total Catchment Area 5.914ha
- 3.344ha of impervious surface (56.54%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD B) within the south-eastern part of the site.

Post C

- Total Catchment Area 2.777ha
- 1.636ha of impervious surfaces (58.92%)
- Runoff is conveyed as sheet/overland flow towards the existing swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary.

Post D

- Total Catchment Area 1.104ha
- 0.661ha of impervious surfaces (59.90%)
- Runoff is conveyed as sheet/overland flow towards the existing waterway through the site (LPOD D) within the western part of the site.

The post-development catchment area and LPOD are detailed on OSKA Consulting Group, Post-Development Catchment Plan (Ref: OSK6521/P002/D) included as Appendix D.

4.3.2 Coefficient of Runoff

The post-development coefficients of runoff (C year) were determined using the fraction impervious method as specified in QUDM. Based on the supplied layout plans, the post-development catchment has an approximate total of 7.232ha of impervious surfaces which equates to a fraction impervious (fi) of 0.59.

This report will adopt a fraction impervious value on 0.70 for all developable areas of the development which corresponds to the roof areas having a fraction impervious of 1.00, the ground areas (excluding basin areas/lots) having a fraction impervious of 0.30 and the road reserve areas having a fraction impervious of 0.75. This fraction impervious value has been adopted based on the recommended C_{10} value for areas zoned as Emerging Community in

Table 4.4: Runoff Coefficient vs development category of the City of Gold Coast City. The recommended C_{10} value of 0.80-0.85 correlates to a fraction impervious value of approximately 0.70 and as such will be adopted throughout this report for all developable areas.

Using a one-hour, ten-year rainfall intensity ($^1I_{10}$) of 64.9 mm/hr, the adopted C_{10} values for all the individual post-development catchments have been shown in bold Table 8.

The following post-development Coefficients of Runoff (as shown in *Table 8*) have been adopted in accordance with QUDM Table 4.5.2, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storms of 39%, 10%, 5% and 1% (corresponding to the 2, 10, 20 and 100-year ARI storms).

Table 8: Post-Development Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
POST A	0.69	**0.81**	0.85	0.97
POST B	0.67	**0.79**	0.83	0.95
POST C	0.68	**0.80**	0.84	0.96
POST D	0.68	**0.80**	0.84	0.96

4.3.3 Time of Concentration

The Time Of Concentration for the post-developed catchments have been calculated in accordance with QUDM Table 4.6.3 – Recommended roof drainage system travel times.
In accordance with Table 4.6.3 and Figure 4.5 of QUDM, the post-development time of concentration for each individual catchment has been shown in Table 9.

Table 9: Post-Development Time of Concentration

Catchment	Catchment Area (ha)	Time of Concentration		
		Roof to Downpipes (Table 4.06.2)	Pipe Flow (Figure 4.5)	Total t_c
Post-Development Catchment A	2.464	t = 5 mins	Length (m) = 200 Slope = 2% t = 3 mins	8 mins
Post-Development Catchment B	5.914	t = 5 mins	Length (m) = 480 Slope = 2% t = 5 mins	10 mins
Post-Development Catchment C	2.777	t = 5 mins	Length (m) = 280 Slope = 2% t = 4 mins	9 mins
Post-Development Catchment D	1.104	t = 5 mins	Length (m) = 100 Slope = 2% t = 2 mins	7 mins

4.3.4 Design Flow Rates

Post-development peak flow rates have been calculated for the adopted storms using design rainfall intensities from the Bureau of Meteorology 2016 IFD Data. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to estimate the required design peak flow rates for the subject site. The post-development peak flows for the subject site are presented in Tables 10-13.

Table 10: Post-Development A Peak Flow Estimation – Rational Method

POST A					
Annual Exceedance Probability	AEP	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.69	0.81	0.85	0.97
Area of Catchment (ha)	**A**	2.464	2.464	2.464	2.464
Average Rainfall Intensity (mm/h)	**I**	124	178	204	262
Peak Flow Rate (m^3/s)	**Q**	**0.586**	**0.989**	**1.188**	**1.748**

Table 11: Post-Development B Peak Flow Estimation – Rational Method

POST B					
Annual Exceedance Probability	AEP	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.67	0.79	0.83	0.95
Area of Catchment (ha)	**A**	5.914	5.914	5.914	5.914
Average Rainfall Intensity (mm/h)	**I**	115	164	188	240
Peak Flow Rate (m^3/s)	**Q**	**1.274**	**2.142**	**2.570**	**3.755**

Table 12: Post-Development C Peak Flow Estimation – Rational Method

POST C					
Annual Exceedance Probability	AEP	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.68	0.80	0.84	0.96
Area of Catchment (ha)	**A**	2.777	2.777	2.777	2.777
Average Rainfall Intensity (mm/h)	**I**	119	171	195	250
Peak Flow Rate (m^3/s)	**Q**	**0.624**	**1.052**	**1.263**	**1.851**

Table 13: Post-Development D Peak Flow Estimation – Rational Method

POST D					
Annual Exceedance Probability	AEP	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.68	0.80	0.84	0.96
Area of Catchment (ha)	**A**	1.104	1.104	1.104	1.104
Average Rainfall Intensity (mm/h)	**I**	129	186	213	275
Peak Flow Rate (m^3/s)	**Q**	**0.269**	**0.456**	**0.548**	**0.811**

4.4 Change in Flow Rates

The difference in peak flow rates calculated from the individual pre and post-developed catchments have been estimated via The Rational Method, with the results detailed in Tables 14-17.

Table 14: Change in Peak Flow Rates Estimation (Catchment A) – Rational Method

Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.369	0.619	0.742	1.080
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.586	0.989	1.188	1.748
Change in Peak Flow Rate (m^3/s)	**Q**	**+0.217**	**+0.370**	**+0.446**	**+0.668**

The Rational Method assessment has demonstrated that there is a potential increase in peak flow rates discharging to the existing waterway through the site (LPOD A) within the western part of the site. Therefore, on-site detention measures may be required to mitigate flows to pre-development conditions with a further hydraulic assessment undertaken using XP-SWMM in Section 5 to confirm the detention requirements.

Table 15: Change in Peak Flow Rates Estimation (Catchment B) – Rational Method

Annual Exceedance Probability	AEP	39%	10%	5%	1%
Pre-Developed Peak Flow Rate (m^3/s)	Q	0.819	1.375	1.647	2.404
Post-Developed Peak Flow Rate (m^3/s)	Q	1.274	2.142	2.570	3.755
Change in Peak Flow Rate (m^3/s)	**Q**	**+0.455**	**+0.767**	**+0.923**	**+1.351**

The Rational Method assessment has demonstrated that there is a potential increase in peak flow rates discharging to the existing waterway through the site (LPOD B) within the south-eastern part of the site. Therefore, on-site detention measures may be required to mitigate flows to pre-development conditions with a further hydraulic assessment undertaken using XP-SWMM in Section 5 to confirm the detention requirements.

Table 16: Change in Peak Flow Rates Estimation (Catchment C) – Rational Method

Annual Exceedance Probability	AEP	39%	10%	5%	1%
Pre-Developed Peak Flow Rate (m^3/s)	Q	0.397	0.666	0.798	1.163
Post-Developed Peak Flow Rate (m^3/s)	Q	0.624	1.052	1.263	1.851
Change in Peak Flow Rate (m^3/s)	**Q**	**+0.227**	**+0.386**	**+0.465**	**+0.688**

The Rational Method assessment has demonstrated that there is a potential increase in peak flow rates discharging to the existing swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary. Therefore, on-site detention measures may be required to mitigate flows to pre-development conditions with a further hydraulic assessment undertaken using XP-SWMM in Section 5 to confirm the detention requirements.

Table 17: Change in Peak Flow Rates Estimation (Catchment D) – Rational Method

Annual Exceedance Probability	AEP	39%	10%	5%	1%
Pre-Developed Peak Flow Rate (m^3/s)	Q	0.181	0.304	0.364	0.530
Post-Developed Peak Flow Rate (m^3/s)	Q	0.269	0.456	0.548	0.811
Change in Peak Flow Rate (m^3/s)	**Q**	**+0.088**	**+0.152**	**+0.184**	**+0.281**

The Rational Method assessment has demonstrated that there is a potential increase in peak flow rates discharging to the existing waterway through the site (LPOD D) within the western part of the site. Therefore, on-site detention measures may be required to mitigate flows to pre-development conditions with a further hydraulic assessment undertaken using XP-SWMM in Section 5 to confirm the detention requirements.

4.5 External Catchments

The subject site and the surrounding area were examined to determine if any localised external catchments will contribute to the subject site. The site was deemed to contain an influencing external catchment to the north of the subject site. The development will propose to capture and convey the flows from External Catchment A around the site via a swale along the northern and eastern boundaries. All captured flows within the swale are to be discharged into the existing swale along Baileys Mountain Road along the eastern site boundary (LPOD C).

Further information on the external catchment including area, flows and the proposed swale sizing will be undertaken in the sections below.

It is to be noted that there is an existing waterway that runs through the site and contains a number of influencing external catchments. These external catchments do not convey flows directly onto the developable area of the subject site and as such have not been included within this assessment or report. A Hydraulic Impact Assessment has been completed by Biome Consulting which provides a detailed assessment of the waterway and other influencing

external catchments that run through the site. Refer to the Hydraulic Impact Assessment (Ref: BC-23170) completed by Biome Consulting for further information.

4.5.1 Catchment Definition and Lawful Point of Discharge

The external catchment A has a total contributing area of 4.375ha and a breakdown of the external catchment has been shown below:

Ext A

- Total Catchment Area 4.375ha
- 0.656ha of impervious surface (15.00%) – conservative estimate
- Runoff is conveyed as sheet/overland flow to the south-east towards the proposed road reserve along the northern boundary.

The external catchments area and LPOD is detailed on OSKA Consulting Group, External Catchment Plan (Ref: OSK6521/P005/C) included as Appendix D.

4.5.2 Coefficient of Runoff

The coefficient of runoff (C year) was determined based on the fraction impervious (f_i) method as specified in QUDM and using the provided survey and latest aerial imagery of the site and surrounding area. Using a one-hour, ten-year rainfall intensity ($^1I_{10}$) of 64.9 mm/hr, the C_{10} value for external catchment A is 0.70 and has been shown in bold in Table 18.

The following external catchments Coefficients of Runoff (as shown in *Table 18*) have been adopted in accordance with QUDM Table 4.5.2, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storms of 39%, 10%, 5% and 1% (corresponding to the 2, 10, 20 and 100-year ARI storms).

Table 18: External Catchment Coefficient of Runoff

Catchment	C_2	C_{10}	C_{20}	C_{100}
EXT A	0.59	**0.70**	0.73	0.84

4.5.3 Time of Concentration

The Time of Concentration for the external catchment has been calculated in accordance with QUDM Section 4.6.6 – Overland Flow and 4.6.11 - Time of concentration for rural and creek catchments. Friend's Equation ($t = (107*n*L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and Bransby-Williams' ($t = (58 * L)/(A^{0.1} * S_e^{0.2})$) equation has been used to calculate the travel time using channel flow.

Refer to *Table 19* for the calculated time of concentration for the external catchment.

Table 19: External Catchment Time of Concentration

Sub-Catchment	Catchment Area (ha)	Time of Concentration		
		Overland flow Friend's Equation	Concentrated Overland Flow Bransby-Williams	Total t_c
External Catchment A	4.375	Horton's (n) = 0.040 L = 50m Slope = 15.00% t = 9.16 mins	Length (km) = 0.215 Area (ha) = 4.375 Slope = 15.00% t = 6.26 mins	15 mins

4.5.4 Design Flow Rates

Design storm flow rates have been calculated for standard storms for the external catchment using design rainfall intensities from the Bureau of Meteorology. The Rational Method (Q = 2.78 x 10^{-3} CIA) has been used to calculate the design flow rates. The peak flow rates for the external catchment are presented in Table 20.

Table 20: External Catchment A Peak Flow Rates

External Catchment A					
Annual Exceedance Probability	**AEP**	39%	10%	5%	1%
Coefficient of Runoff	**C**	0.59	0.70	0.73	0.84
Area of Catchment (ha)	**A**	4.375	4.375	4.375	4.375
Average Rainfall Intensity (mm/h)	**I**	97	139	158	201
Peak Flow Rate (m^3/s)	**Q**	**0.701**	**1.176**	**1.409**	**2.051**

4.5.5 External Catchment Conveyance

The external catchment A flows are to be conveyed by a swale along the northern and eastern boundaries of the site and discharged to the existing swale along Baileys Mountain Road.

To demonstrate that the proposed swale is capable of conveying the external catchments 1% AEP flow rates around the site, it has been sized utilising the Manning's equation (9.1), $Q = \frac{A}{n} \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}$, from QUDM to ensure that it is sized to an adequate capacity to accommodate and safely convey the external flows.

Refer to Table 21 for the calculated swales capacity.

Table 21: Swale Flow Capacity

Swale Parameters	**External Catchment A**
Swale ID	Swale 1
Swale Depth, d (m)	0.825
Freeboard (m)	0.300
Base Width, W (m)	1.50
Top Width (m)	6.45
Bank Slope (Ratio of V:H)	1:3
Manning's Roughness, n	0.032 (turf)
Longitudinal Grade, S	1.00% (0.010m/m)
Q - Flow Rate (m^3/s)	**2.430**
Design Flow Rate (m^3/s)	2.051

For further information on the external catchment stormwater network, refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) in *Appendix E.*

5.0 STORMWATER QUANTITY ASSESSMENT

5.1 Background

The following sections define the method and parameters utilised within the hydrologic assessment of the site, to establish a simulation of the anticipated flow regime and peak discharge at the Lawful Point of Discharge (LPOD).

The analysis of hydrology across the subject site was performed using the non-linear runoff routing program XP-SWMM.

5.2 Objective

The following objective has been set for post-development stormwater discharge from the site:

- No net increase in peak flows from the subject site (up to the 1% AEP event), for all design storm events, during the post-developed scenario.

This objective shall be demonstrated via a suitable hydrologic and hydraulic modelling package, by detaining site runoff from the subject site within proposed detention basins.

5.3 XP-SWMM Model

To assess the pre and post-development hydrographs, the industry standard modelling software XP-SWMM has been selected for the analysis. Details of the model set-up and results are summarised in the following sections for the sites LPOD's.

5.3.1 Model Set Up

Rainfall data for the subject site has been obtained from the Australian Bureau of Meteorology's 2016 Design IFD Rainfall System. The data has been extracted for the nearest grid cell at Latitude 27.8625 (S) and Longitude 153.2875 (E). The IFD data and average rainfall intensities used in this report are in accordance with the procedures outlined in IEAust, Australian Rainfall and Runoff (AR&R) 2019. Storm suites for a range of durations from 10 minutes to 360 minutes were simulated in the XP-SWMM model analysis to determine design flow estimations for all events up to and including the 1% AEP.

Initial Loss (IL) and Continuing Losses (CL) were applied to the XP-SWMM model in accordance with Australian Rainfall and Runoff (AR&R) 2019. These values are also varied for the impervious and pervious portions of the catchment. The following loss rates were adopted:

Table 22: Initial Loss (IL) and Continuing Losses (CL)

Storm Losses (XP-SWMM)		
Sub catchment Type	**Initial Loss (mm/hr)**	**Continuing Loss (mm/hr)**
Impervious	0.5	0
Pervious	25	2.3

Note: The loss rates were maintained for all design storm events up to the 1% AEP event.

5.3.2 Hydrologic Roughness

Hydrologic roughness in the form of Manning's n values was applied to represent the undeveloped and developed portions of the catchment. The following values were adopted:

- Impervious Catchment n = 0.015; and
- Pervious Catchment n = 0.040.

5.3.3 Catchment Set Up and Parameters

The XP-SWMM model has been set up to match the proposed earthworks (lot and road grading) and stormwater drainage for the development and also accounting for external catchments and bypass areas where applicable.

There will be no bypass areas for Catchment A with all flows (up to the 1% AEP event) from the catchment draining into the detention basin.

Catchment B has been set up to account for the proposed park area (1.070ha) to bypass the proposed detention basin and discharge directly to the existing waterway. There will also be a small amount of bypass from Lots 406 and 409 (0.149ha) with all flows to bypass and discharge directly to the existing waterway.

Catchment C will have a small amount of bypass which will account for the proposed swale along the northern and eastern boundaries (0.333ha) that conveys the flows (up to the 1% AEP event) from External Catchment A around the site and into the existing swale along Baileys Mountain Road with the remainder of the site to drain into the basin.

Catchment D will have a small amount of bypass which will account for a small amount of bypass from Lots 504 and 516-520 with only the major roof water flows to be conveyed into the detention basin with the remaining area of the lots (0.083ha) to bypass and discharge directly to the existing waterway.

The adopted sub-catchment areas for the site, slopes and fraction imperviousness, for the pre and post-development have been tabulated in *Table 23*.

Table 23: Adopted Sub-catchment Parameters

Pre-Development Sub-Catchments			
XP-SWMM Sub-Catchment ID	Total Area (ha)	Slope (%)	Fi (%)
Pre A	2.464	4.41%	4.62
Pre B	5.914	6.68%	5.91
Pre C	2.777	7.41%	0.00
Pre D	1.104	9.49%	4.26
Post-Development Sub-Catchments			
XP-SWMM Sub-Catchment ID	Total Area (ha)	Slope (%)	Fi (%)
Post A	2.464	2.50%	64.53
Post B	5.914	3.50%	56.54
Post C	2.777	4.00%	58.92
Post D	1.104	4.50%	59.90

Note: Slopes have been adopted based on detailed survey and aerial imagery for the pre-developed scenario and detailed survey and proposed bulk earthworks levels for the post-development scenario.

5.3.4 Hydrologic Modelling Results

A comparison of the peak median discharges from the site for the individual pre and post-developed catchments are detailed in Tables 24-27.

Catchment A

Table 24: Anticipated Peak Discharge Rate Catchment A – Extracted from XP-SWMM Model (m^3/s)

Scenario	63% AEP	39% AEP	18% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Pre-Development A	0.169	0.258	0.372	0.514	0.641	0.769	0.899
Storm Event	3hr_6	1.5hr_7	1hr_4	45min_7	45min_6	30min_1	30min_4
Post-Development A	0.470	0.590	0.739	0.831	0.961	1.109	1.243
Storm Event	10min_7	10min_7	10min_7	15min_1	15min_10	15min_2	15min_2
Change in Peak Flow Rate (m^3/s)	**+0.301**	**+0.332**	**+0.367**	**+0.317**	**+0.320**	**+0.340**	**+0.344**

The XP-SWMM analysis confirms the post-development flow rates discharging to the existing waterway through the site (LPOD A) within the western part of the site are higher than the pre-development flow rates and therefore formal detention structures will be required for Catchment A of the development.

Further details on the detention requirements for Catchment A has been provided in Section 5.3.6.

Catchment B

Table 25: Anticipated Peak Discharge Rate Catchment B – Extracted from XP-SWMM Model (m^3/s)

Scenario	63% AEP	39% AEP	18% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Pre-Development B	0.408	0.626	0.897	1.241	1.543	1.868	2.177
Storm Event	3hr_6	1.5hr_7	1hr_4	45min_7	45min_5	30min_1	30min_4
Post-Development B	0.991	1.242	1.554	1.762	2.034	2.375	2.666
Storm Event	10min_7	10min_8	10min_7	15min_1	15min_2	15min_2	15min_4
Change in Peak Flow Rate (m^3/s)	**+0.583**	**+0.616**	**+0.657**	**+0.521**	**+0.491**	**+0.507**	**+0.489**

The XP-SWMM analysis confirms the post-development flow rates discharging to the existing waterway through the site (LPOD B) within the south-eastern part of the site are higher than the pre-development flow rates and therefore formal detention structures will be required for Catchment B of the development.

Further details on the detention requirements for Catchment B has been provided in Section 5.3.7.

Catchment C

Table 26: Anticipated Peak Discharge Rate Catchment C – Extracted from XP-SWMM Model (m^3/s)

Scenario	63% AEP	39% AEP	18% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Pre-Development C	0.219	0.324	0.466	0.646	0.781	0.964	1.117
Storm Event	1.5hr_7	1.5hr_7	1hr_1	45min_5	30min_8	30min_1	25min_8
Post-Development C	0.494	0.622	0.772	0.875	1.005	1.191	1.333
Storm Event	10min_7	10min_7	10min_7	15min_1	15min_2	15min_2	15min_2
Change in Peak Flow Rate (m^3/s)	**+0.275**	**+0.298**	**+0.306**	**+0.229**	**+0.224**	**+0.227**	**+0.216**

The XP-SWMM analysis confirms the post-development flow rates discharging to the existing swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary are higher than the pre-development flow rates and therefore formal detention structures will be required for Catchment C of the development.

Further details on the detention requirements for Catchment C has been provided in Section 5.3.8.

Catchment D

Table 27: Anticipated Peak Discharge Rate Catchment D – Extracted from XP-SWMM Model (m^3/s)

Scenario	63% AEP	39% AEP	18% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Pre-Development C	0.110	0.149	0.217	0.286	0.337	0.433	0.497
Storm Event	1.5hr_7	1.5hr_7	30min_9	45min_5	30min_8	30min_7	25min_5
Post-Development C	0.199	0.249	0.308	0.349	0.402	0.495	0.562
Storm Event	10min_7	10min_7	10min_7	15min_2	15min_2	15min_5	15min_5
Change in Peak Flow Rate (m^3/s)	**+0.089**	**+0.100**	**+0.091**	**+0.063**	**+0.065**	**+0.062**	**+0.065**

The XP-SWMM analysis confirms the post-development flow rates discharging to the existing waterway through the site (LPOD D) within the western part of the site are higher than the pre-development flow rates and therefore formal detention structures will be required for Catchment D of the development.

Further details on the detention requirements for Catchment D has been provided in Section 5.3.9.

5.3.5 Flow Rate Result Variability

It is noted that throughout the prior calculation of peak flow rates using XP-SWMM, in comparison to the Rational Method calculation results provided in Section 4, there is a variable level of difference between the two. The majority of the pre and post-development results for both the Rational Method and XP-SWMM model are comparable, however the is some deviation in the results and his can be attributed to the methodology behind each form of assessment. The Rational Method is used to estimate the peak flow of a catchment only and is only typically used for a preliminary calculation and hydraulic model (XP-SWMM) verification to detect gross errors. The XP-SWMM calculation uses a non-linear runoff routing method to calculate actual temporal patterns across a multitude of different storm burst events and durations. As such, it is more accurate to utilise peak flow calculations from this method.

5.3.6 Catchment A Detention Basin Parameters & Results

5.3.6.1 Detention Basin Sizing

It is proposed to construct a combined bio-retention/detention basin to mitigate the post-developed discharge and provide water quality treatment for Catchment A.

The following have been utilised in the design of the detention basins:

- Design of basin to be undertaken using hydrological assessment model (XP-SWMM);
- Provide stormwater attenuation to ensure all total peak flows from Catchment A are not increased by the development for any storm event up to and including the 1% AEP (Q100);
- Allowance for the 0.30m extended detention depth for the water quality component (refer Section 6 for further details);
- Allowance for minimum 0.30m freeboard; and
- The combined bio-retention and detention basin is proposed to be located in the western part of the site;

The following table shows a summary of the basin's characteristics with details of the basin's stage/area relationship for the detention component below.

Table 28: Catchment A Detention Basin Characteristics

Low Level Outlet	Ø250mm low flow orifice at 1.00% grade at approximately RL 30.40m AHD. Orifice invert level coincides with the invert level of the 900mm x 900mm field inlet within the basin. The top of the 900mm x 900mm field inlet coincides with the top of the extended detention zone (at 0.30m above basin floor).
Intermediate Outlet	Ø375mm pipe at 1.00% grade at approximately RL 32.25m AHD, 0.35m above extended detention zone (at 0.65m above basin floor)
High Level Outlet	10m wide spillway weir at approximately RL 32.70m AHD, 0.80m above extended detention zone (1.10m above basin floor)
Dimensions	Base area (bottom of detention zone) = 611m^2 Base area (top of detention zone) = 1162m^2 Basin Depth = 1.20m
Maximum Water Depth within Detention Zone of Basin (m)	63% AEP (Q1) = 0.295 39% AEP (Q2) = 0.421 18% AEP (Q5) = 0.572 10% AEP (Q10) = 0.674 5% AEP (Q20) = 0.774 2% AEP (Q50) = 0.845 1% AEP (Q100) = 0.878

Table 29: Catchment A Detention Basin – Stage/Area Relationship

Stage (m)*	Detention Area (m^2)	Detention Storage (m^3)
0	611	0
0.1	657	63
0.2	703	131
0.3	749	204
0.4	795	281
0.5	841	363
0.6	887	449
0.7	932	540
0.8	978	636
0.9	1024	736
1	1070	841
1.1	1116	950
1.2	1162	1064

**Note: The stage is from the start of the detention zone and excludes the 0.3m extended detention depth of the water quality component of the basin.*

5.3.6.2 Mitigation Effect of Detention Basin A

A comparison of the peak median discharges for the pre and mitigated post-developed cases for Catchment A is detailed in Table 30.

Table 30: Comparison of Mitigated Flows at Outlet (Catchment A)

Outlet	Storm	Pre-Developed (m^3/s)	Post-Developed Mitigated (m^3/s)	Difference (m^3/s)	Difference (%)
Existing Waterway through the site (LPOD A) within the western part of the site.	63%	0.169	0.144	-0.025	-14.63
	39%	0.258	0.166	-0.092	-35.64
	18%	0.372	0.289	-0.083	-22.37
	10%	0.514	0.370	-0.144	-27.96
	5%	0.641	0.432	-0.209	-32.67
	2%	0.769	0.618	-0.151	-19.63
	1%	0.899	0.823	-0.076	-8.51

The above table demonstrates the proposed detention basin will ensure the post-development flows discharging from the Catchment A are attenuated to equal or below the pre-development rates.

The hydrograph for the critical duration of the Mitigated 1% AEP storm event compared against the pre and post-development is shown in *Figure 3.*

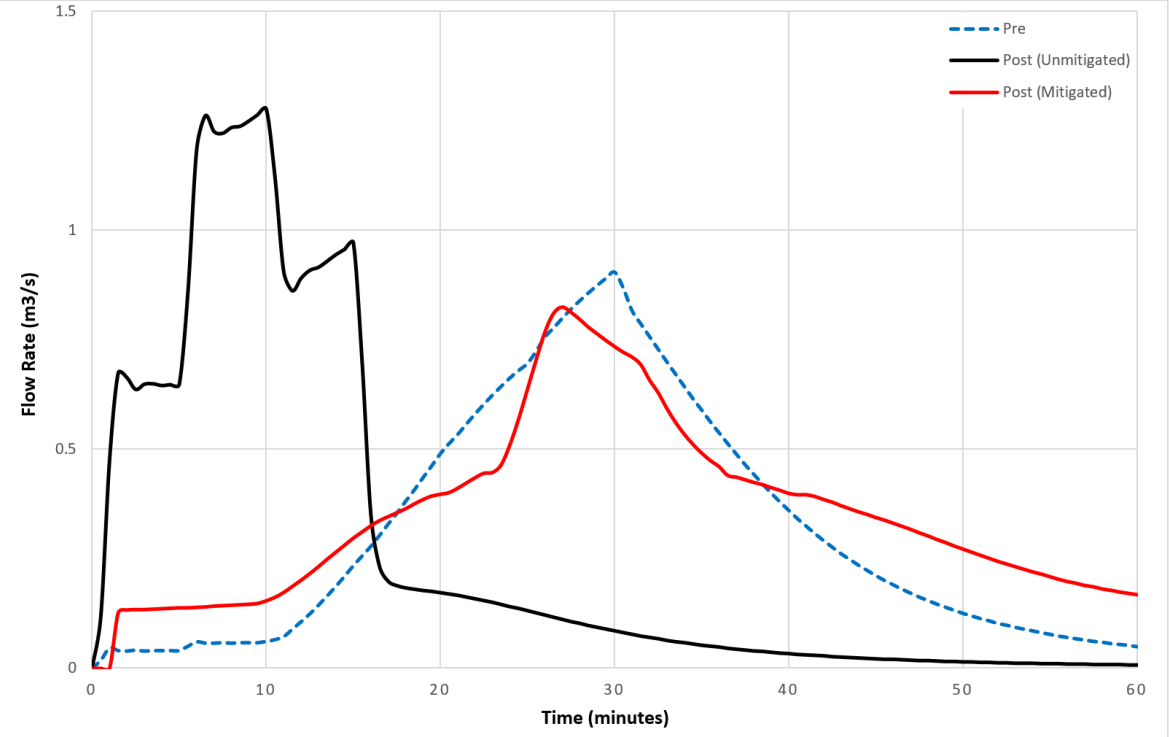


Figure 3: Pre, Post and Mitigated Flow Rates for the 1% AEP Design Storm Event (Catchment A)

The results in the tables and graphs above confirm that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for the full range of storms up to the 6hr event for Catchment A.

The hydraulic analysis using the XP-SWMM model has determined that a minimum detention basin volume of approximately 1064m^3 for the detention basin is required to mitigate the increase in stormwater flow rates due to the development in Catchment A. The detention basin is to be fitted with an outlet configuration as detailed in Table 28 to satisfy the mitigation requirements. It is concluded that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for all events up to the 1% AEP event for Catchment A.

Refer OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) within Appendix E for further details.

5.3.7 Catchment B Detention Basin Parameters & Results

5.3.7.1 Detention Basin Sizing

It is proposed to construct a combined bio-retention/detention basin to mitigate the post-developed discharge and provide water quality treatment for Catchment B.

The following have been utilised in the design of the detention basins:

- Design of basin to be undertaken using hydrological assessment model (XP-SWMM);
- Provide stormwater attenuation to ensure all total peak flows from Catchment B are not increased by the development for any storm event up to and including the 1% AEP (Q100);
- Allowance for the 0.30m extended detention depth for the water quality component (refer Section 6 for further details);
- Allowance for minimum 0.30m freeboard; and
- The combined bio-retention and detention basin is proposed to be located in the south-eastern part of the site;

The following table shows a summary of the basin's characteristics with details of the basin's stage/area relationship for the detention component below.

Table 31: Catchment B Detention Basin Characteristics

Low Level Outlet	Ø365mm low flow orifice at 1.10% grade at approximately RL 24.90m AHD. Orifice invert level coincides with the invert level of the 900mm x 900mm field inlet within the basin. The top of the 900mm x 900mm field inlet coincides with the top of the extended detention zone (at 0.30m above basin floor).
Intermediate Outlet	Ø525mm pipe at 1.50% grade at approximately RL 26.65m AHD, 0.25m above extended detention zone (at 0.55m above basin floor)
High Level Outlet	10m wide spillway weir at approximately RL 27.175m AHD, 0.775m above extended detention zone (1.075m above basin floor)
Dimensions	Base area (bottom of detention zone) = 1063m^2 Base area (top of detention zone) = 1778m^2 Basin Depth = 1.20m
Maximum Water Depth within Detention Zone of Basin (m)	63% AEP (Q1) = 0.314 39% AEP (Q2) = 0.418 18% AEP (Q5) = 0.529 10% AEP (Q10) = 0.629 5% AEP (Q20) = 0.734 2% AEP (Q50) = 0.830 1% AEP (Q100) = 0.881

Table 32: Catchment B Detention Basin – Stage/Area Relationship

Stage (m)*	Detention Area (m^2)	Detention Storage (m^3)
0	1063	0
0.1	1123	109
0.2	1182	225
0.3	1242	346
0.4	1301	473
0.5	1361	606
0.6	1421	745
0.7	1480	890
0.8	1540	1041
0.9	1599	1198
1	1659	1361
1.1	1718	1530
1.2	1778	1705

**Note: The stage is from the start of the detention zone and excludes the 0.3m extended detention depth of the water quality component of the basin.*

5.3.7.2 Mitigation Effect of Detention Basin B

A comparison of the peak median discharges for the pre and mitigated post-developed cases for Catchment B is detailed in Table 33.

Table 33: Comparison of Mitigated Flows at Outlet (Catchment B)

Outlet	Storm	Pre-Developed (m^3/s)	Post-Developed Mitigated (m^3/s)	Difference (m^3/s)	Difference (%)
Existing waterway through the site (LPOD B) within the south-eastern part of the site.	63%	0.408	0.403	-0.006	-1.37
	39%	0.626	0.548	-0.078	-12.42
	18%	0.897	0.867	-0.030	-3.29
	10%	1.241	1.119	-0.121	-9.78
	5%	1.543	1.298	-0.245	-15.86
	2%	1.868	1.676	-0.192	-10.25
	1%	2.177	2.136	-0.040	-1.85

The above table demonstrates the proposed detention basin will ensure the post-development flows discharging from the Catchment B are attenuated to equal or below the pre-development rates.

The hydrograph for the critical duration of the Mitigated 1% AEP storm event compared against the pre and post-development is shown in *Figure 4.*

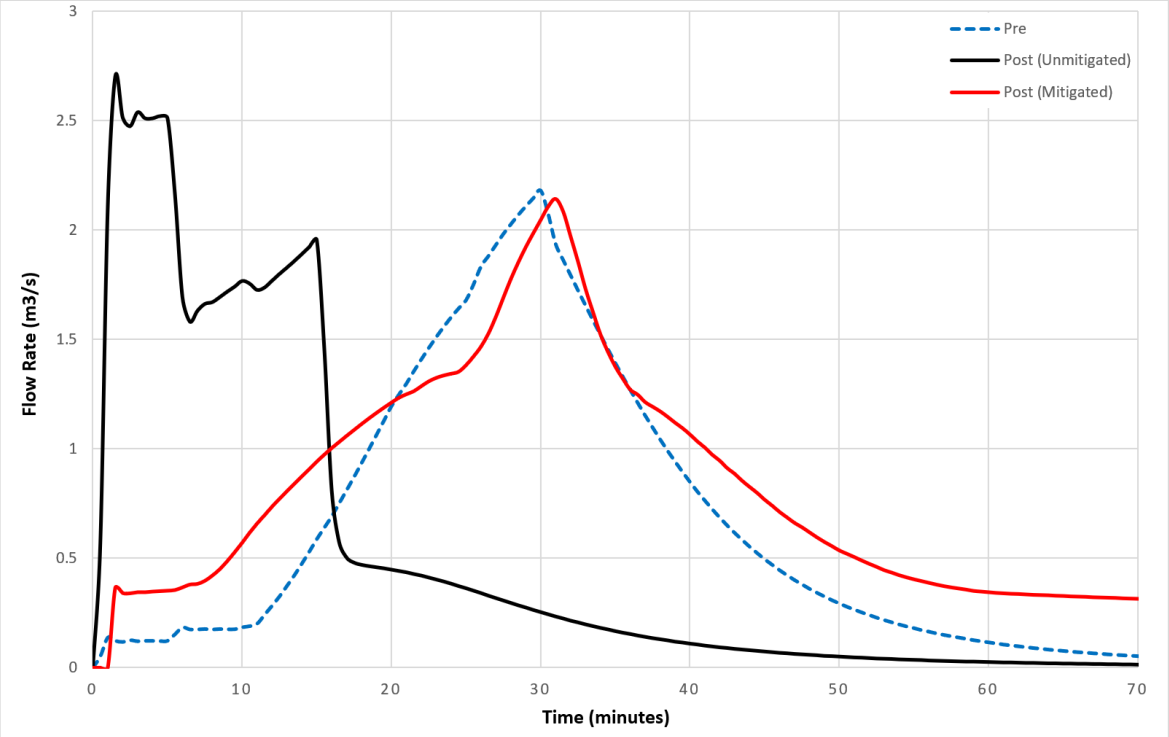


Figure 4: Pre, Post and Mitigated Flow Rates for the 1% AEP Design Storm Event (Catchment B)

The results in the tables and graphs above confirm that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for the full range of storms up to the 6hr event for Catchment B.

The hydraulic analysis using the XP-SWMM model has determined that a minimum detention basin volume of approximately 1705m^3 for the detention basin is required to mitigate the increase in stormwater flow rates due to the development in Catchment B. The detention basin is to be fitted with an outlet configuration as detailed in Table 31 to satisfy the mitigation requirements. It is concluded that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for all events up to the 1% AEP event for Catchment B

Refer OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) within Appendix E for further details.

5.3.8 Catchment C Detention Basin Parameters & Results

5.3.8.1 Detention Basin Sizing

It is proposed to construct a combined bio-retention/detention basin to mitigate the post-developed discharge and provide water quality treatment for Catchment C.

The following have been utilised in the design of the detention basins:

- Design of basin to be undertaken using hydrological assessment model (XP-SWMM);
- Provide stormwater attenuation to ensure all total peak flows from Catchment C are not increased by the development for any storm event up to and including the 1% AEP (Q100);

- Allowance for the 0.30m extended detention depth for the water quality component (refer Section 6 for further details);
- Allowance for minimum 0.30m freeboard; and
- The combined bio-retention and detention basin is proposed to be located in the eastern part of the site;

The following table shows a summary of the basin's characteristics with details of the basin's stage/area relationship for the detention component below.

Table 34: Catchment C Detention Basin Characteristics

Low Level Outlet	Ø275mm low flow orifice at 1.00% grade at approximately RL 26.70m AHD. Orifice invert level coincides with the invert level of the 900mm x 900mm field inlet within the basin. The top of the 900mm x 900mm field inlet coincides with the top of the extended detention zone (at 0.30m above basin floor).
Intermediate Outlet	Ø450mm pipe at 1.50% grade at approximately RL 28.525m AHD, 0.325m above extended detention zone (at 0.625m above basin floor)
High Level Outlet	10m wide spillway weir at approximately RL 29.00m AHD, 0.80m above extended detention zone (1.10m above basin floor)
Dimensions	Base area (bottom of detention zone) = 444m^2 Base area (top of detention zone) = 924m^2 Basin Depth = 1.20m
Maximum Water Depth within Detention Zone of Basin (m)	63% AEP (Q1) = 0.311 39% AEP (Q2) = 0.442 18% AEP (Q5) = 0.558 10% AEP (Q10) = 0.655 5% AEP (Q20) = 0.739 2% AEP (Q50) = 0.826 1% AEP (Q100) = 0.861

Table 35: Catchment C Detention Basin – Stage/Area Relationship

Stage (m)*	Detention Area (m^2)	Detention Storage (m^3)
0	444	0
0.1	484	46
0.2	524	97
0.3	564	151
0.4	604	210
0.5	644	272
0.6	684	338
0.7	724	409
0.8	764	483
0.9	804	562
1	844	644
1.1	884	730
1.2	924	821

**Note: The stage is from the start of the detention zone and excludes the 0.3m extended detention depth of the water quality component of the basin.*

5.3.8.2 Mitigation Effect of Detention Basin C

A comparison of the peak median discharges for the pre and mitigated post-developed cases for Catchment C is detailed in Table 36.

Table 36: Comparison of Mitigated Flows at Outlet (Catchment C)

Outlet	Storm	Pre-Developed (m^3/s)	Post-Developed Mitigated (m^3/s)	Difference (m^3/s)	Difference (%)
Existing Swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary.	63%	0.219	0.207	-0.012	-0.67
	39%	0.324	0.261	-0.066	-18.56
	18%	0.466	0.435	-0.038	-7.42
	10%	0.646	0.574	-0.090	-12.60
	5%	0.781	0.679	-0.148	-17.18
	2%	0.964	0.849	-0.123	-11.63
	1%	1.117	1.087	-0.033	-2.68

The above table demonstrates the proposed detention basin will ensure the post-development flows discharging from the Catchment C are attenuated to equal or below the pre-development rates.

The hydrograph for the critical duration of the Mitigated 1% AEP storm event compared against the pre and post-development is shown in *Figure 5*.

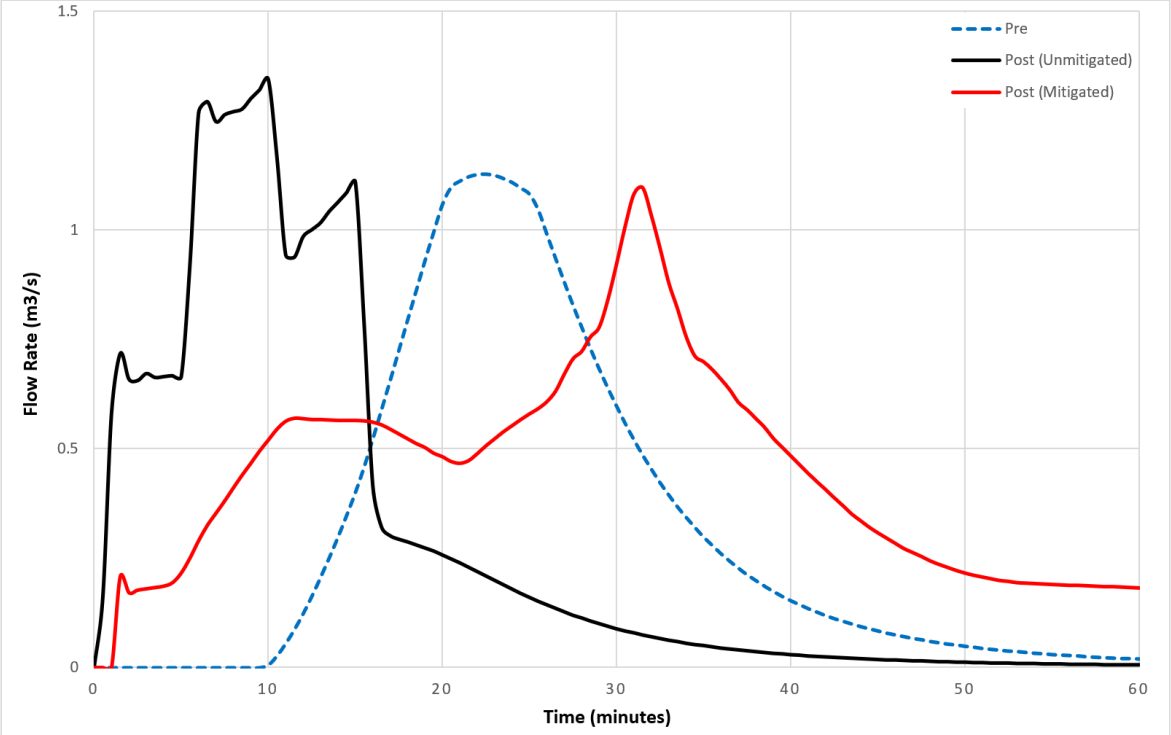


Figure 5: Pre, Post and Mitigated Flow Rates for the 1% AEP Design Storm Event (Catchment C)

The results in the tables and graphs above confirm that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for the full range of storms up to the 6hr event for Catchment C.

The hydraulic analysis using the XP-SWMM model has determined that a minimum detention basin volume of approximately $821m^3$ for the detention basin is required to mitigate the increase in stormwater flow rates due to the development in Catchment C. The detention basin is to be fitted with an outlet pipe configuration as detailed in Table 34 to satisfy the mitigation requirements. It is concluded that the proposed detention basin effectively mitigates the runoff

to equal or less than pre-developed flows for all events up to the 1% AEP event for Catchment C.

Refer OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) within Appendix E for further details.

A copy of the XP-SWMM model used in this report can be made available to Council upon request.

5.3.9 Catchment D Detention Basin Parameters & Results

5.3.9.1 Detention Basin Sizing

It is proposed to construct a combined bio-retention/detention basin to mitigate the post-developed discharge and provide water quality treatment for Catchment D.

The following have been utilised in the design of the detention basins:

- Design of basin to be undertaken using hydrological assessment model (XP-SWMM);
- Provide stormwater attenuation to ensure all total peak flows from Catchment D are not increased by the development for any storm event up to and including the 1% AEP (Q100);
- Allowance for the 0.30m extended detention depth for the water quality component (refer Section 6 for further details);
- Allowance for minimum 0.30m freeboard; and
- The combined bio-retention and detention basin is proposed to be located in the eastern part of the site;

The following table shows a summary of the basin's characteristics with details of the basin's stage/area relationship for the detention component below.

Table 37: Catchment D Detention Basin Characteristics

Low Level Outlet	Ø225mm low flow orifice at 1.00% grade at approximately RL 35.20m AHD. Orifice invert level coincides with the invert level of the 900mm x 900mm field inlet within the basin. The top of the 900mm x 900mm field inlet coincides with the top of the extended detention zone (at 0.30m above basin floor).
Intermediate Outlet	Ø375mm pipe at 1.50% grade at approximately RL 36.90m AHD, 0.20m above extended detention zone (at 0.50m above basin floor)
High Level Outlet	5m wide spillway weir at approximately RL 37.20m AHD, 0.50m above extended detention zone (0.80m above basin floor)
Dimensions	Base area (bottom of detention zone) = 267m^2 Base area (top of detention zone) = 643m^2 Basin Depth = 0.85m
Maximum Water Depth within Detention Zone of Basin (m)	63% AEP (Q1) = 0.154 39% AEP (Q2) = 0.230 18% AEP (Q5) = 0.322 10% AEP (Q10) = 0.391 5% AEP (Q20) = 0.438 2% AEP (Q50) = 0.499 1% AEP (Q100) = 0.530

Table 38: Catchment D Detention Basin – Stage/Area Relationship

Stage (m)*	Detention Area (m^2)	Detention Storage (m^3)
0	267	0
0.1	296	28
0.2	326	59
0.3	357	93
0.4	390	131
0.5	423	171
0.6	457	215
0.7	492	263
0.8	528	314
0.85	546	341

**Note: The stage is from the start of the detention zone and excludes the 0.3m extended detention depth of the water quality component of the basin.*

5.3.9.2 Mitigation Effect of Detention Basin D

A comparison of the peak median discharges for the pre and mitigated post-developed cases for Catchment D is detailed in Table 39.

Table 39: Comparison of Mitigated Flows at Outlet (Catchment D)

Outlet	Storm	Pre-Developed (m^3/s)	Post-Developed Mitigated (m^3/s)	Difference (m^3/s)	Difference (%)
Existing Swale along Baileys Mountain Road (LPOD C) along the site's eastern boundary.	63%	0.110	0.104	-0.006	-5.64
	39%	0.149	0.110	-0.038	-25.72
	18%	0.217	0.170	-0.047	-21.72
	10%	0.286	0.241	-0.046	-15.96
	5%	0.337	0.296	-0.041	-12.26
	2%	0.433	0.363	-0.071	-16.27
	1%	0.497	0.430	-0.067	-13.51

The above table demonstrates the proposed detention basin will ensure the post-development flows discharging from the Catchment D are attenuated to equal or below the pre-development rates.

The hydrograph for the critical duration of the Mitigated 1% AEP storm event compared against the pre and post-development is shown in *Figure 6.*

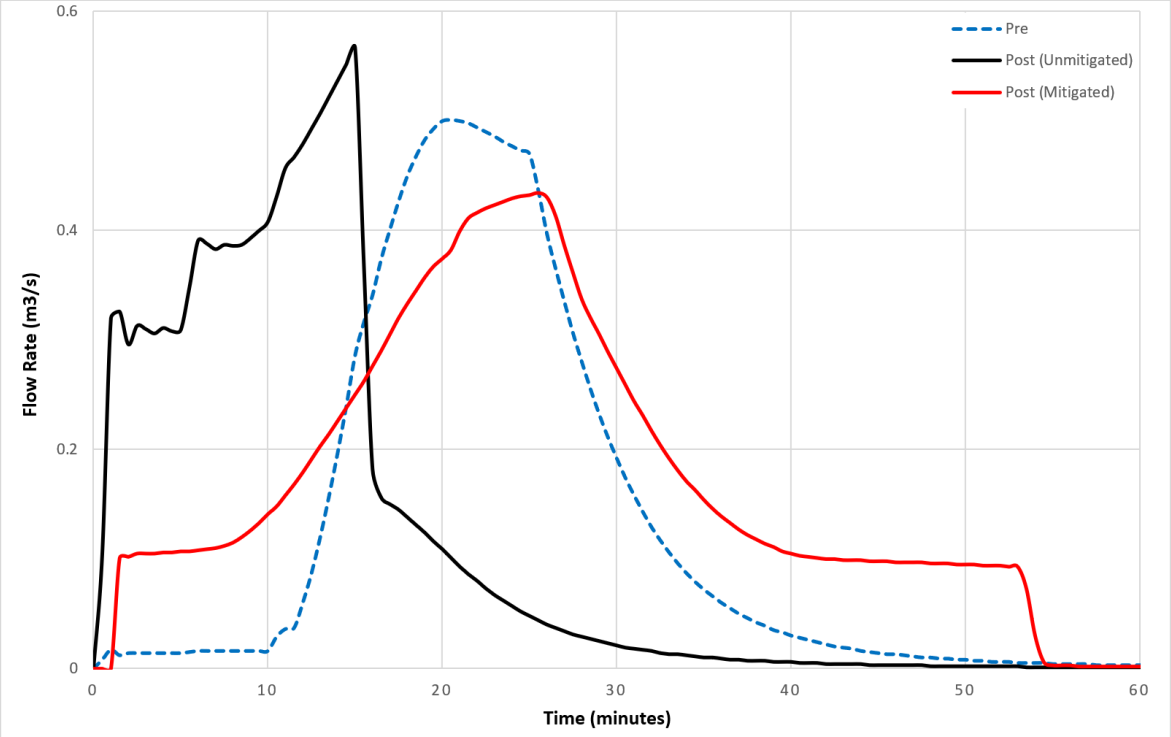


Figure 6: Pre, Post and Mitigated Flow Rates for the 1% AEP Design Storm Event (Catchment D)

The results in the tables and graphs above confirm that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for the full range of storms up to the 6hr event for Catchment D.

The hydraulic analysis using the XP-SWMM model has determined that a minimum detention basin volume of approximately 341m^3 for the detention basin is required to mitigate the increase in stormwater flow rates due to the development in Catchment D. The detention basin is to be fitted with an outlet pipe configuration as detailed in Table 37 to satisfy the mitigation requirements. It is concluded that the proposed detention basin effectively mitigates the runoff to equal or less than pre-developed flows for all events up to the 1% AEP event for Catchment D.

Refer OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) within Appendix E for further details.

6.0 STORMWATER QUALITY ASSESSMENT

6.1 Background

The development of the land has the potential to increase the pollutant loads within stormwater runoff and downstream watercourses. During the construction phase of the development, disturbances to the existing ground have the potential to significantly increase sediment loads entering downstream drainage systems and watercourses. The operational phase of the development will potentially increase the amount of sediments and nutrients washing from the site.

The following sections describe the construction and operational phase controls and water quality modelling of the proposed treatment train in compliance with Council guidelines.

6.2 Construction Phase

A high risk of stormwater pollution will occur from the site during the construction phase due to erosion and sediment transportation off-site to the receiving environment. The majority of this risk results from construction activities disturbing the site and exposing areas of soil to the direct erosive influence of the environment.

The following section outlines the procedures necessary to minimise erosion and control sediment during construction in accordance with the International Erosion Control Association (IECA) Best Practice ESC Document.

6.2.1 Key Pollutants

The key pollutants have been identified for the Construction Phase of this development.

Table 40: Key Pollutants, Construction Phase

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags, material offcuts.
Sediment	Exposed soils and stockpiles during earthworks and building works.
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary car park areas.
Toxic Materials	Cement slurry, asphalt primer, solvents, cleaning agents, and wash waters (e.g., from tile works).
Acids or Alkaline substances	Acid sulphate soils, cement slurry and wash waters.

6.2.2 Sediment and Erosion Controls

Sediment and Erosion Control devices (S&EC) employed on the site shall be designed and constructed in accordance with the International Erosion Control Association (IECA) Best Practice ESC Document as shown on OSKA Consulting Group, Sediment and Erosion Control Plan – Sheet 1 of 2 (Ref: OSK6521/P050/C), Sediment and Erosion Control Plan – Sheet 2 of 2 (Ref: OSK6521/P051/C) & Sediment and Erosion Control Details (Ref: OSK6521/P052/C) included as Appendix F.

Pre-Construction

- Stabilised site access/exit onto Courtney Drive to the north and Baileys Mountain Road to the east;
- Sediment fences to be located around the perimeter of the site;
- Sediment trap to be installed if required;
- Dust fencing to be installed if required; and
- Educate site personnel to the requirements of Erosion and Sediment Control Plan.

Initial Construction

- Maintain construction access/exit, sediment fencing, dust fences and all other existing controls as required;
- Construct diversion drains to convey disturbed site run-off to the temporary sediment traps; and
- Confine construction activities to stages to minimise areas of disturbance at any given time.

Second Stage Construction

- Maintain construction access/exit, sediment fencing, dust fences, diversion drain and all other existing controls as required;
- Progressively revegetate finished areas where applicable;
- Divert runoff from undisturbed areas around disturbed areas; and
- Drainage structure protection around field inlets and gully pits.

During construction, all areas of exposed soils allowing dust generation are to be suitably treated. Treatments will include covering the soil and watering. Road accesses are to be regularly cleaned to prevent the transmission of soil on vehicle wheels and eliminate any build-up of typical road dirt and tyre dust from delivery vehicles.

Adequate waste disposal facilities are to be provided and maintained on the site to cater for all waste materials such as litter, hydrocarbons, toxic materials, acids or alkaline substances.

6.2.3 Water Quality Monitoring and Inspections

To ensure that the water quality objectives are being met during the construction phase of the development, water quality monitoring shall be conducted. Water quality monitoring shall use a calibrated probe or sampling and testing at a NATA registered laboratory.

Location: Monitoring Stations shown on OSKA Consulting Group, *Sediment and Erosion Control Plan - Sheet 1 of 2* (Ref: OSK6521/P050/C) & OSKA Consulting Group, *Sediment and Erosion Control Plan - Sheet 2 of 2* (Ref: OSK6521/P051/C).

Parameters: Site discharge criteria.

Frequency: Following at least 10mm of rainfall in a 24-hour period.

The contractor shall be responsible for the inspection and maintenance of all sediment and erosion control devices. Additional controls and review of existing controls shall be undertaken in response to the results of the above-mentioned monitoring program.

6.2.4 Reporting

An inspection report shall be written by a suitably qualified and experienced scientist/engineer following each water quality monitoring episode. The report shall include at least the following information:

- Name, address and real property description for the development site;
- Council file reference number (if known);
- Monitoring locations;
- Performance criteria;
- Results for each monitoring location, identifying any breaches of performance criteria;
- Recommended corrective actions to be taken and additional sediment and erosion controls, if required; and
- Inspection reports shall be provided to the contractor for their action and compilation in an on-site register.

If the above-mentioned performance criteria are exceeded and results from the downstream monitoring stations show significant deterioration from upstream results (if applicable), the contractor shall implement all recommendation of the inspection report within one (1) working day of receipt of the report.

6.3 Operational Phase

The following sections provide details of the Stormwater Quality Improvement Devices (SQID's) proposed for the operational phase of the development. OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521/P003/E), Conceptual Stormwater Management Details (Ref: OSK6521/P006/C), Preliminary Services Layout Plan – Sheet 1 of 2 (Ref: OSK6521/P040/C) & Preliminary Services Layout Plan – Sheet 2 of 2 (Ref: OSK6521/P041/C) in Appendix E illustrates the size and location of the proposed SQID's.

6.3.1 Stormwater Quality Objectives

To protect the water quality of the downstream watercourses the following Water Quality Objectives (WQO's) have been applied to stormwater runoff from the site in accordance with CoGC SC6.12.4.5.4.2 Stormwater quality objectives (operational phase) and the criteria of the CoGC Healthy Waters Code as addressed in OSKA Consulting Group, Response to Healthy Waters Code (Ref: OSK6521-0006) included as Appendix G.

Best Management Practices (BMP) are required to be demonstrated for all Development Applications within the City of Gold Coast and are recommended to be implemented by the developer. Where practicable, methods such as first flush devices, and discharging stormwater to landscaped/grassed areas prior to discharge to the LPOD, are to be incorporated into the site's stormwater strategy, where the opportunity is available.

The following load reduction targets must be achieved when assessing the post-development treatment train (comparison of unmitigated developed case versus developed mitigated case).

- 80% reduction in Total Suspended Sediment (TSS).
- 60% reduction in Total Phosphorus (TP).
- 45% reduction in Total Nitrogen (TN).
- 90% reduction in litter (sized 5 mm or greater).

6.3.2 Post-Development MUSIC Modelling

To assess the potential quantities of pollutants anticipated to be discharged from the site, the water quality modelling package 'Model for Urban Stormwater Improvement Conceptualisation' (MUSIC) V6.3 by eWATER has been applied. MUSIC Modelling Parameters and delineated data have been sourced from Water by Design, MUSIC Modelling Guidelines, and where possible, via online MUSIC Link data.

Rainfall data has been sourced from Rainfall Station 40584, (Hinze Dam) using a date range from 1974 to 2010 and a 6 Minute Time Step, in accordance with CoGC requirements.

6.3.3 Stormwater Quality Improvement Devices

A Water Sensitive Urban Design (WSUD) approach has been adopted for the site with all stormwater runoff from the site being treated by four separate bio-retention basins located throughout the site. The bio-retention basins will treat runoff from the subject site as it is deemed more suitable for the proposed site use. To ensure there are no bypass areas from the development, rear allotment drainage has been proposed for Lots 406, 409, 504, 516-520, 601-606 and 629-633 to ensure all minor flows (up to Q3 month) are directed into the proposed basin with localised grading to occur directing all ground flows into the pits.

As previously mentioned, and in accordance with the stormwater quantity modelling in the sections above, only the larger developed areas have been included within the quantity and quality analysis within this report. Any small grouping of lots (less than 5) are not considered to cause any adverse impacts (quality or quantity) to the receiving system or downstream properties. As such, the four (4) smaller grouping of lots that includes Lots 524-527, 528-530, 643-644 and 645-646 have been excluded from the quantity and quality analysis within this report. All four of the smaller grouping of lots that have been excluded from the MUSIC modelling discharge into the existing waterway through the site at least 150m upstream from the site boundary and the existing waterway will assist in treating the bypass flows.

The proposed SQID's have been provided for modelling purposes only and is subject to Council approval. Accordingly, similar alternative devices may be adopted with Council review and approval.

The adopted MUSIC catchment areas for the subject site are as follows:

Table 41: Adopted MUSIC Catchment Areas

Catchment	Surface Type	Area (m^2)	% Impervious
A	Roof (Residential)	9,088	100
	Road (Residential)	5,680	75
	Ground (Residential)	9,876	24*
B	Roof (Residential)	18,510	100
	Road (Residential)	11,569	75
	Ground (Residential)	18,363	26*
	Roof Bypass (Residential)	500	100
	Ground Bypass (Residential)	999	30
C	Roof (Residential)	9,350	100
	Road (Residential)	5,844	75
	Ground (Residential)	9,309	26*
	Ground Bypass (Residential)	3,329	0
D	Roof (Residential)	3,637	100
	Road (Residential)	2,273	75
	Ground (Residential)	4,304	22*
	Ground Bypass (Residential)	825	30
	TOTAL Site	**113,456**	

*The ground area in the developable area of the site (e.g. excluding parks, swales and basins) has been assumed as 30% impervious with the park, swale and basin extents assumed to be 0% impervious.
Note all lots that grade to the rear will have rear allotment drainage that is to capture minor flows (up to Q3 month) and convey to the proposed basins.

All stormwater runoff captured from the developed area of the site will be conveyed to the proposed pit and pipe network and conveyed directly to one of the proposed bio-retention basins. The proposed park area (10,702m^2) within Catchment B has been excluded from the water quality analysis as the area is to be entirely pervious consisting of grassed areas and vegetation, similar to the existing scenario and as such is not anticipated to cause any adverse impacts to the receiving waterway.

An illustration of the MUSIC model of the adopted operational treatment train for the post-development site has been provided in Figure 7.

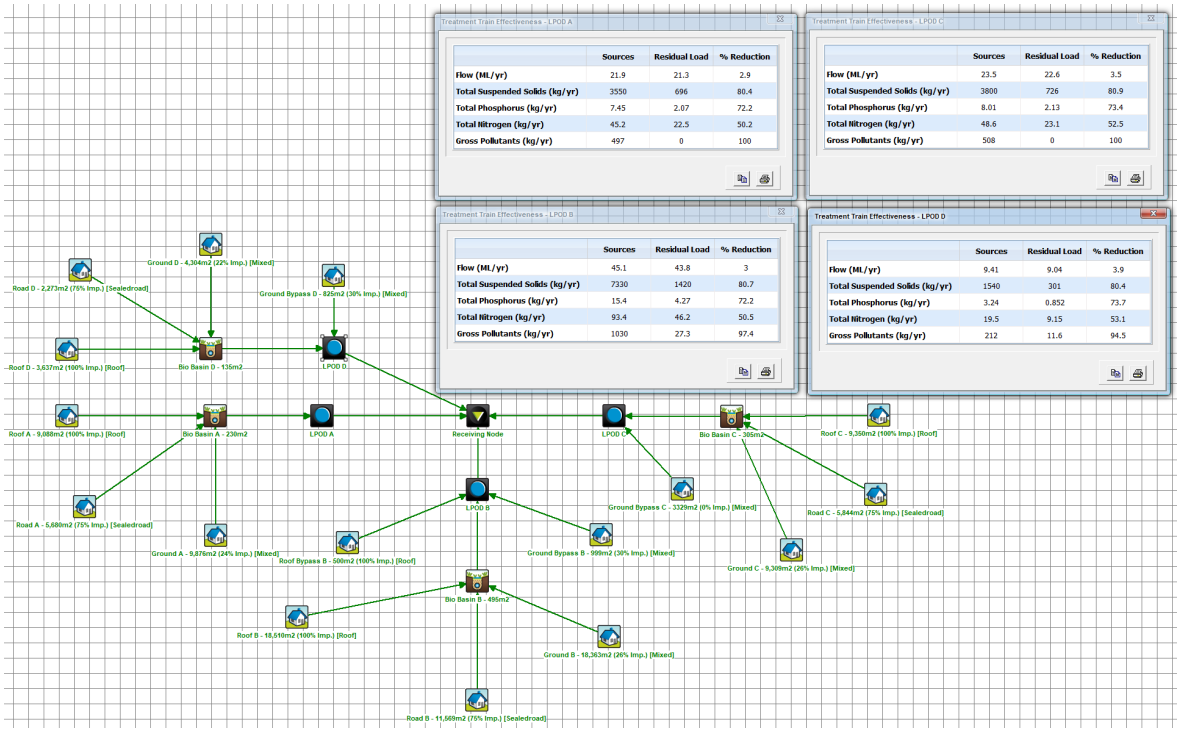


Figure 7: Operational Phase Treatment Train (Source: MUSIC Model)

6.3.4 Design Parameters of the Stormwater Quality Improvement System

Detailed design of the stormwater treatment train shall be in accordance with the Water Sensitive Urban Design (WSUD), Technical Design Guidelines for South East Queensland – Version 1 (June 2006).

BIO-RETENTION BASIN

A bio-retention basin is designed to pond stormwater allowing it to percolate through a layer of filter media, typically sandy loam. Runoff passing through the filter media is collected with a perforated pipe discharging to the downstream drainage infrastructure. The bio-retention basin shall be located to treat all stormwater from the development area. A bund will be constructed to separate the bio-retention system and the open detention basin. This will ensure that the filter and surface area relationship detailed below is achieved.

The bio-retention basins have been modelled with the following properties:

- Filter media — Sandy Loam;
  5 – 10% Organic Content in accordance with AS1289.4.1.1;
  Average D_{50} 0.45 mm;
  K_{sat} 200 mm/hr;
  TN Content = 400 mg/kg
  Orthophosphate Content = 30 mg/kg
- Filter media depth — 0.70 m
- Drainage layer — Varies (0.40-50m);
- Extended detention depth — 0.30 m;
- Seepage — 0 mm/hr;
- Filter Area — Varies (135-495m^2);
- Surface Area — Varies (150-535m^2).

6.3.5 Post-Development Modelling Results - Mitigated

The modelled Stormwater Quality Improvement Devices (SQID) have demonstrated a reduction in the amount of sediments and nutrients discharging from the proposed residential subdivision. Tables 42-45 illustrate the effectiveness of the SQID's in the treatment train for the individual catchments.

Table 42: Treatment Train Effectiveness at Receiving Node (Catchment A)

Parameter	Post	Post Mitigated	Reduction	Water Quality Objectives
Flow (ML/yr)	21.9	21.3	**2.9 %**	-
TSS (kg/yr)	3550	696	**80.4 %**	80 %
TP (kg/yr)	7.45	2.07	**72.2 %**	60 %
TN (kg/yr)	45.2	22.5	**50.2 %**	45 %
Gross Pollutants (kg/yr)	497	0	**100 %**	90 %

Table 43: Treatment Train Effectiveness at Receiving Node (Catchment B)

Parameter	Post	Post Mitigated	Reduction	Water Quality Objectives
Flow (ML/yr)	45.1	43.8	**3.0 %**	-
TSS (kg/yr)	7330	1420	**80.7 %**	80 %
TP (kg/yr)	15.4	4.27	**72.2 %**	60 %
TN (kg/yr)	93.4	46.2	**50.5 %**	45 %
Gross Pollutants (kg/yr)	1030	27.3	**97.4 %**	90 %

Table 44: Treatment Train Effectiveness at Receiving Node (Catchment C)

Parameter	Post	Post Mitigated	Reduction	Water Quality Objectives
Flow (ML/yr)	23.5	22.6	**3.5 %**	-
TSS (kg/yr)	3800	726	**80.9 %**	80 %
TP (kg/yr)	8.01	2.13	**73.4 %**	60 %
TN (kg/yr)	48.6	23.1	**52.5 %**	45 %
Gross Pollutants (kg/yr)	508	0	**100 %**	90 %

Table 45: Treatment Train Effectiveness at Receiving Node (Catchment D)

Parameter	Post	Post Mitigated	Reduction	Water Quality Objectives
Flow (ML/yr)	9.41	9.04	**3.9 %**	-
TSS (kg/yr)	1540	301	**80.4 %**	80 %
TP (kg/yr)	3.24	0.852	**73.7 %**	60 %
TN (kg/yr)	19.5	9.15	**53.1 %**	45 %
Gross Pollutants (kg/yr)	212	11.6	**94.5 %**	90 %

The results demonstrate that the proposed SQID's meet the intended Water Quality Objectives for Gross Pollutants, Suspended Solids, Phosphorous and Nitrogen levels, in accordance with the City of Gold Coast Requirements.

7.0 OPERATIONAL PHASE MAINTENANCE REQUIREMENTS

The proposed stormwater management devices will require maintenance and monitoring to ensure that they function as designed. The following section provides an outline of the necessary maintenance tasks for the proposed devices.

7.1 Bio-retention Basin Maintenance

The most intensive period of maintenance is during the plant establishment period (first two years) when weed removal and replanting may be required. It is also the time when large loads of sediments could impact on plant growth particularly in developing catchments with poor building controls.

Maintenance is primarily concerned with:

- Maintenance of flow to and through the bio-retention basin;
- Maintaining vegetation;
- Preventing undesired overgrowth vegetation from taking over the bio-retention basin;
- Removal of accumulated sediments; and
- Litter and debris removal.

Vegetation maintenance will include:

- Fertilising plants;
- Removal of noxious plants or weeds; and
- Re-establishment of plants that die.

Sediments accumulated at the inlets need to be monitored. Depending on the catchment activities the deposition of sediment can tend to smother plants and reduce the ponding volume available. Should excessive sediment build-up it will impact on the plant health and require removal before it reduces the infiltration rate of the filter media. The proposed SQID's will require regular maintenance and monitoring to ensure that it functions as designed.

Table 46: Bio-retention Basin Maintenance Schedule

Bio-retention Basin Maintenance Checklist			
Inspection Frequency: 3 Monthly	**Date of Visit:**		
Location:			
Description:			
Site Visibility:			
Inspection Items	**Yes**	**No**	**Action Required (Details)**
Sediment accumulation at inflow points?			
Litter basin?			
Erosion at inlet or other key structures (e.g. crossovers)?			
Traffic damage present?			
Evidence of dumping (Building waste, oils etc)?			
Vegetation condition satisfactory (density, weeds etc)?			
Replanting required?			
Mowing required?			
Clogging of drainage points (sediment or debris)?			
Evidence of ponding?			
Damage/vandalism to structures present?			
Surface clogging visible?			
Drainage system inspected?			
Resettling of system required?			
Comments:			

8.0 ASSET HANDOVER

The proposed stormwater management devices shall be dedicated to owner/body corporate/Council following the time of practical completion for the proposed development. An Asset Handover Checklist is provided as Table 47 as a guideline for the necessary steps to be taken prior to the end of the maintenance period.

Table 47: Asset Handover Checklist

Asset Location:		
Construction By:		
Maintenance Period:		
Treatment:	**Y**	**N**
Actual treatment performance equivalent to design:		
Maintenance:		
Maintenance Plans Provided:		
Inspection and maintenance undertaken as per maintenance plan:		
Inspection and maintenance forms provided:		
Asset inspected for defects:		
Asset Information:		
Design assessment checklist provided:		
As constructed plans provided:		
Copies of all permits provided:		
Digital files provided:		

9.0 CONCLUSIONS

OSKA Civil Consultants has been commissioned by Norfolk Estates Pty Ltd to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application (DA) to the City of Gold Coast (CoGC) for the proposed residential subdivision situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. This CSWMP intends to provide an optimised stormwater management system that would be compatible and readily integrated into the proposed site use.

This CSWMP details the conceptual planning, layout and design of the stormwater management infrastructure for both the construction and operational phases of this development and satisfies the requirements of the City of Gold Coast's Land Development Guidelines.

A hydrological analysis demonstrated that the anticipated post-development peak flow rates discharging from Catchments A, B, C and D are higher than the pre-development flow rates. A hydraulic model was built using the XP-SWMM software program, to estimate the required detention volume and arrangement. This report and stormwater management plan defined the layout of the proposed detention arrangement, which is to be provided in the form of four (4) combined bio-retention and detention basins with approximate detention volumes between 341-1705m^3 at depths at varying depths (0.85-1.20m) in conjunction with the water quality aspect of the basins. This strategy demonstrates no adverse or actionable nuisance associated with the increased runoff rate on surrounding properties and infrastructure.

OSKA Civil Consultants has adopted a Water Sensitive Urban Design (WSUD) approach, in accordance with the State Planning Policy, to managing the stormwater runoff from the proposed development by treating stormwater runoff within four (4) proposed bio-retention basins with filter areas between 135-495m^2. The SQID's utilised within the MUSIC model have been adopted to demonstrate a potential treatment system, pending Council approval.

A monitoring and maintenance plan for the proposed infrastructure has been included. A concept sediment and erosion control plan is provided for the construction phase of the development and shall be implemented by the contractor and developer.

This stormwater quality strategy has defined the preliminary requirements and layout of the proposed development to demonstrate compliance with the State Planning Policy 2017 and the CoGC Planning Scheme Stormwater Quality Management requirements.

APPENDIX

A

LandPartners, Detail Survey (Ref: BRJD8528-00-12-1)

COURTNEY DRIVE

BAILEYS MOUNTAIN ROAD

182
RP156422

183
RP156422

184
RP173727

185
RP173727

186
RP173728

187
RP173728

188
RP173728

58
SP191940

57
SP214370

56
RP162858

Emt A SP205586

Emt B SP205586

Emt C SP214374

RESERVE ROAD

75
SP174234

RICHARDSON CRES

900
SP205578

Emt A SP205578

Emt B SP205578

Emt C SP205578

1
SP205578

2
SP205578

3
SP205578

WRIGHT COURT

BRJD8528-000-12-1
Eden - Upper Coomera
Detail Survey
Contour Interval - 0.5m
10/09/2024

10 0 20 50 110m

SCALE BAR

APPENDIX

B

Saunders Havill Group, Proposal Plan (Ref: 11694 P 11)

CONCEPT PLAN

NOT TO BE USED FOR ENGINEERING DESIGN OR CONSTRUCTION

NOTES

This plan was prepared as a conceptual layout only. The information on this plan is not suitable for any other purpose.

Property dimensions, areas, numbers of lots and contours and other physical features shown have been compiled from existing information and may not have been verified by field survey. These may need verification if the development application is approved and development proceeds, and may change when a full survey is undertaken or in order to comply with development approval conditions.

No reliance should be placed on the information on this plan for detailed subdivision design or for any financial dealings involving the land.

Pavements and centrelines shown are indicative only and are subject to Engineering Design.

Saunders Havill Group therefore disclaims any liability for any loss or damage whatsoever or howsoever incurred, arising from any party using or relying upon this plan for any purpose other than as a document prepared for the sole purpose of accompanying a development application and which may be subject to alteration beyond the control of the Saunders Havill Group. Unless a development approval states otherwise, this is not an approved plan.

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Lidar Data © State of Queensland (Department of Natural Resources and Mines) 2016.

* This note is an integral part of this plan/data. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.

PROJECTION: GDA2020 MGA56

SUBJECT BOUNDARIES: LOT CALCULATIONS BY LANDPARTNERS DATED 25/11/2024

LEGEND

- Site Boundary
- Major Contour (1.0m interval)
- Minor Contour (0.5m interval)
- Vegetation Management
- Traffic Calming & Landscape Treatment
- Proposed Temporary Turnaround Easement
- Indicative Binpad Location
- Stage Boundary
- 1 Stage No.

DEVELOPMENT STATISTICS			
RESIDENTIAL ALLOTMENTS	**No. Lots**	**%**	**Net Area**
10.5m - 12.49m Frontage	64	34.0%	2.152 ha
12.5m - 13.99m Frontage	71	37.8%	2.851 ha
14m - 14.99m Frontage	29	15.4%	1.244 ha
> 15m Frontage	17	9.0%	0.866 ha
Irregular Frontage	7	3.7%	0.439 ha
Total Residential Allotments	**188**	**100.0%**	**7.552 ha**

Land Budget	**Area (Ha)**	**%**	
Area of Subject Site / Stage	18.266 ha		
Net Residential Area (no roads)	7.552 ha	41.3%	
Detention / Drainage	0.881 ha	4.8%	
Local Park	1.070 ha	5.9%	
Environmental Open Space	5.280 ha	28.9%	
Road Widening	0.025 ha	0.1%	
Road Areas	3.458 ha	18.9%	
Total	**18.266 ha**	**100.0%**	

RP DESCRIPTION: Lot 185 on RP173727, Lot 186 on RP173728, Lot 57 on SP214370 & Lot 56 on RP162858, Lot 58 on SP191940

SCALE @A1 1:1250 @A3 1:2500 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

saunders havill group

NORFOLK ESTATES PTY LTD ATF SOLANDER INVESTMENT UNIT TRUST

41 - 53 COURTNEY DRIVE , UPPER COOMERA ● 18/06/2025 ● 11694 P 11 Rev M - CON 01

APPENDIX

C

OSKA Consulting Group, Pre-Development Catchment Plan (Ref: OSK6521/P001/D)

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- (A) INTERNAL STORMWATER CATCHMENT I.D.
- [A] EXTERNAL STORMWATER CATCHMENT I.D.
- 80.0 EXISTING SURFACE CONTOURS
- ● LPOD LAWFUL POINT OF DISCHARGE
- FLOW DIRECTION
- SITE BOUNDARY

EXISTING SERVICES LEGEND

- S EXISTING SEWER MAIN
- W EXISTING WATER MAIN
- SWD EXISTING STORMWATER PIPE
- T EXISTING TELECOMMUNICATIONS CABLE
- E EXISTING ELECTRICAL CABLE

STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A	2.464
B	5.914
C	2.777
D	1.104
EXT A	4.375
TOTAL	16.634

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED



ISSUE No.	DATE	AMENDMENT
D	26-06-25	ISSUED FOR REPORT
C	11-12-24	ISSUED FOR APPROVAL
B	06-12-24	ISSUED FOR REPORT
A	20-11-23	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
BG	BG	DC

TITLE: PRE-DEVELOPMENT CATCHMENT PLAN

SCALE: 1:1250 AT A1, 1:2500 AT A3 (0, 50, 100m)

PROJECT NO.: OSK6521

DWG NO.: P001

ISSUE: D

APPENDIX

D

OSKA Consulting Group, Post-Development Catchment Plan (Ref: OSK6521/P002/D) & External Catchment Plan (Ref: OSK6521/P005/C)

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- (A) INTERNAL STORMWATER CATCHMENT I.D.
- [A] EXTERNAL STORMWATER CATCHMENT I.D.
- 80.0 FINISHED SURFACE CONTOURS
- 80.0 EXISTING SURFACE CONTOURS
- ● LPOD LAWFUL POINT OF DISCHARGE
- PROPOSED FLOW DIRECTION
- SITE BOUNDARY

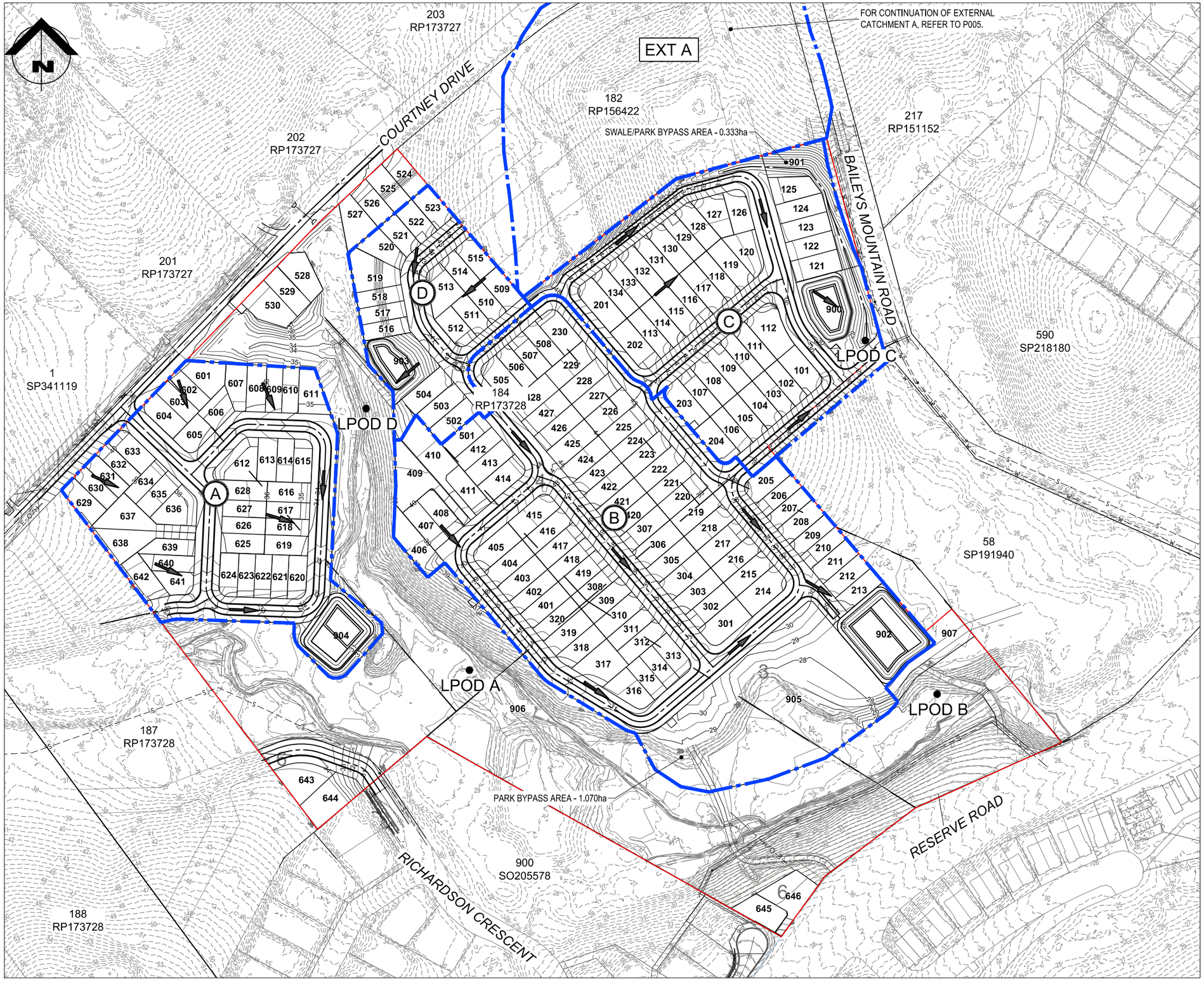
EXISTING SERVICES LEGEND

- EXISTING SEWER MAIN
- EXISTING WATER MAIN
- EXISTING STORMWATER PIPE
- EXISTING TELECOMMUNICATIONS CABLE
- EXISTING ELECTRICAL CABLE

STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A	2.464
B	5.914
C	2.777
D	1.104
EXT A	4.375
TOTAL	16.634

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED



ISSUE No.	DATE	AMENDMENT
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C	11-12-24	ISSUED FOR APPROVAL
B	06-12-24	ISSUED FOR INFORMATION
A	20-11-23	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
BG	BG	DC

TITLE: POST-DEVELOPMENT CATCHMENT PLAN

SCALE: 1:1250 AT A1, 1:2500 AT A3 (0, 50, 100m)

PROJECT NO.: OSK6521

DWG NO.: P002

ISSUE: D

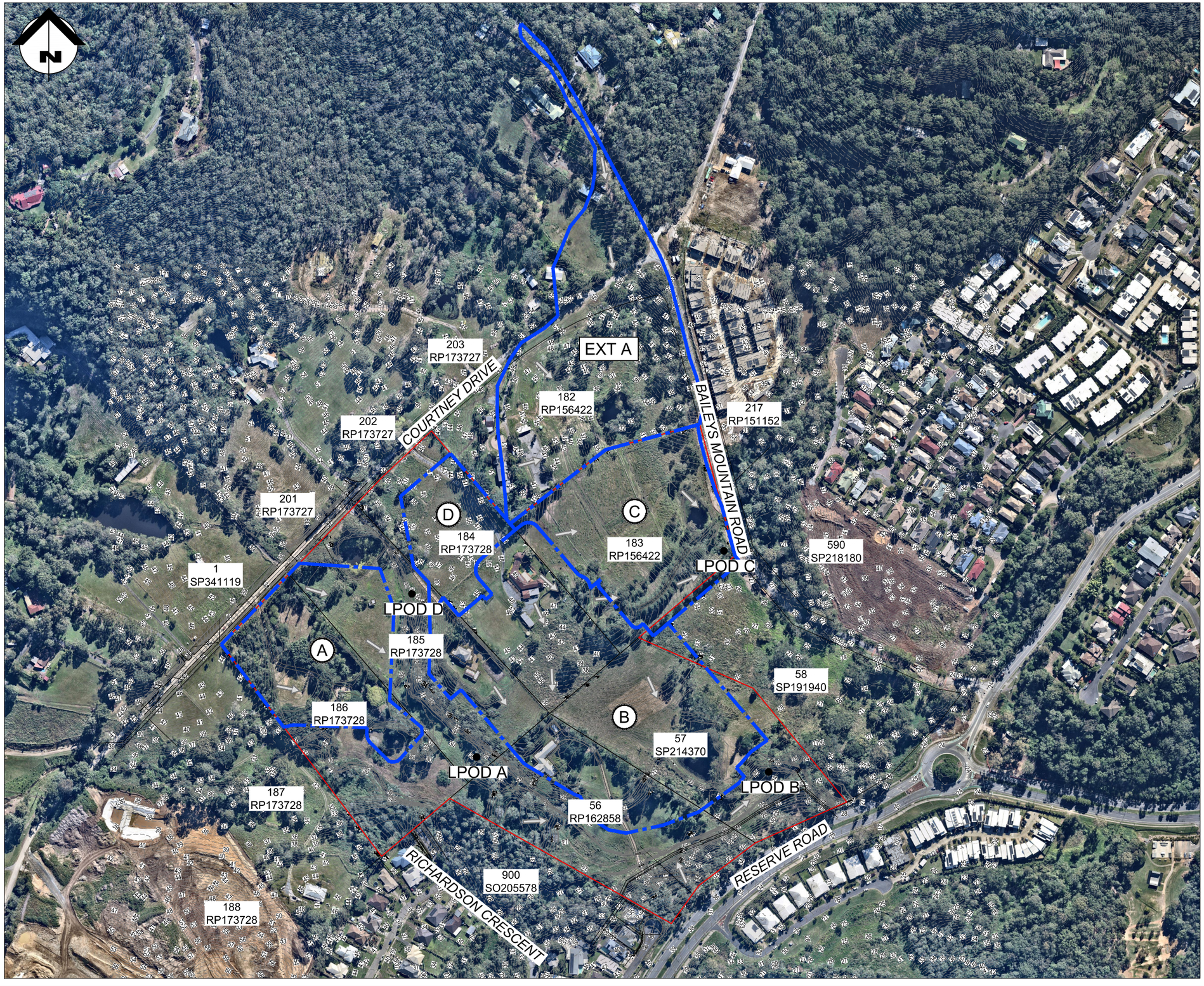
LEGEND

- STORMWATER CATCHMENT BOUNDARY
- (A) INTERNAL STORMWATER CATCHMENT I.D.
- [A] EXTERNAL STORMWATER CATCHMENT I.D.
- 80.0 EXISTING SURFACE CONTOURS
- ● LPOD LAWFUL POINT OF DISCHARGE
- FLOW DIRECTION
- SITE BOUNDARY

EXISTING SERVICES LEGEND

- S EXISTING SEWER MAIN
- W EXISTING WATER MAIN
- SWD EXISTING STORMWATER PIPE
- T EXISTING TELECOMMUNICATIONS CABLE
- E EXISTING ELECTRICAL CABLE

STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A	2.464
B	5.914
C	2.777
D	1.104
EXT A	4.375
TOTAL	16.634



CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

APPROVAL ISSUE
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ISSUE No.	DATE	AMENDMENT
C	26-06-25	ISSUED FOR REPORT
B	11-12-24	ISSUED FOR APPROVAL
A	06-12-24	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
BG	BG	DC

TITLE: EXTERNAL CATCHMENT PLAN

SCALE: 1:2000 AT A1, 1:4000 AT A3 (0, 50, 100, 150, 200m)

PROJECT NO.: OSK6521

DWG NO.: P005

ISSUE: C

APPENDIX

E

OSKA Consulting Group,
Conceptual Stormwater Management Plan
(Ref: OSK6521/P003/E),
Conceptual Stormwater Management Details
(Ref: OSK6521/P006/C),
Preliminary Services Layout Plan – Sheet 1 of 2
(Ref: OSK6521/P040/C) &
Preliminary Services Layout Plan – Sheet 2 of 2
(Ref: OSK6521/P041/C)

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- 80.0 — EXISTING SURFACE CONTOURS
- ● LPOD — LAWFUL POINT OF DISCHARGE
- SWD — PROPOSED STORMWATER DRAINAGE
- PROPOSED SWALE
- PROPOSED FLOW DIRECTION
- SITE BOUNDARY
- PROPOSED BIO-RETENTION & DETENTION BASIN
- PROPOSED BIO-RETENTION BASIN FILTER AREA
- PROPOSED BASIN MAINTENANCE ACCESS

NOTE:

ALL BASIN MAINTENANCE ACCESSES ARE TO BE CONSTRUCTED OUT OF CONCRETE AND DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH CITY OF GOLD COAST STANDARDS AND REQUIREMENTS. SEDIMENT FOREBAY'S WILL BE DESIGNED AND INCORPORATED INTO EACH BASIN (IF REQUIRED).

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

APPROVAL ISSUE
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ISSUE No.	DATE	AMENDMENT
E	26-06-25	ISSUED FOR REPORT
D	11-12-24	ISSUED FOR APPROVAL
C	06-12-24	ISSUED FOR INFORMATION
B	12-12-23	ISSUED FOR INFOMRATION
A	20-11-23	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
BG	BG	DC

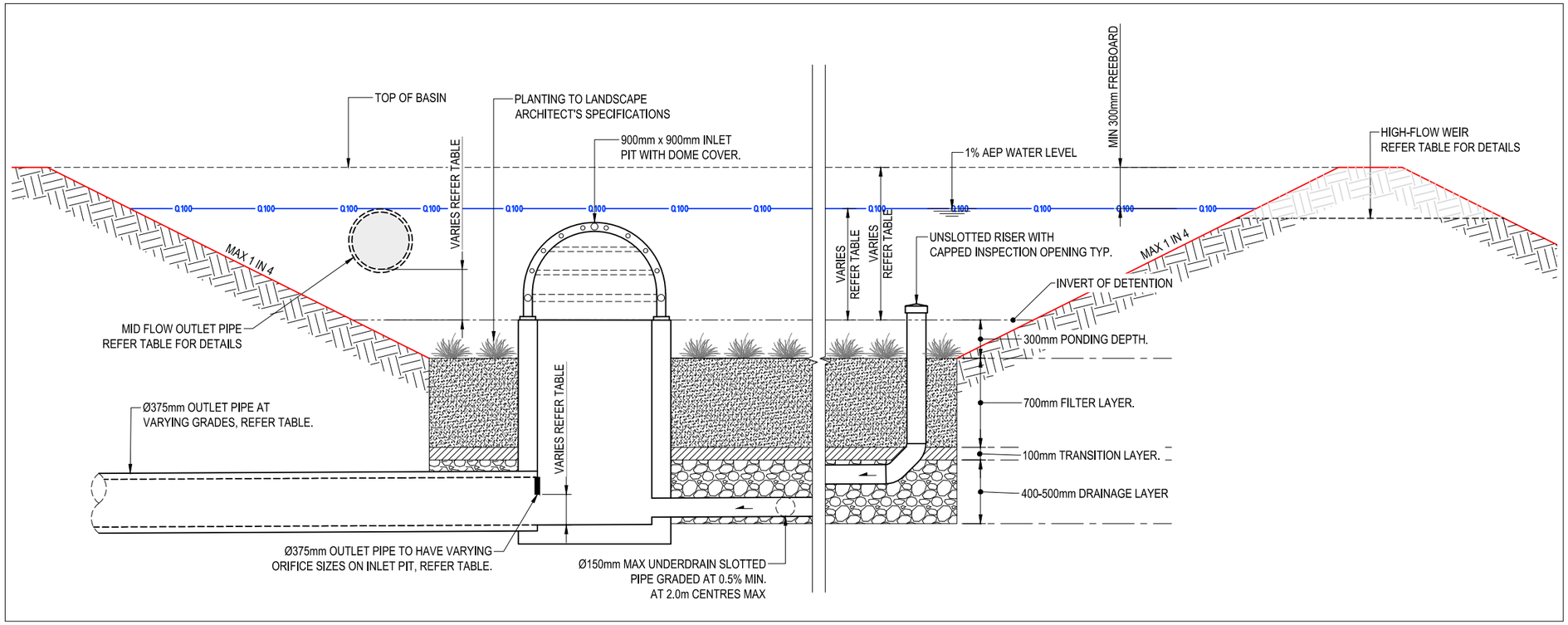
TITLE: CONCEPTUAL STORMWATER MANAGEMENT PLAN

SCALE: 1:1250 AT A1 / 1:2500 AT A3 (0, 50, 100m)

PROJECT NO.: OSK6521

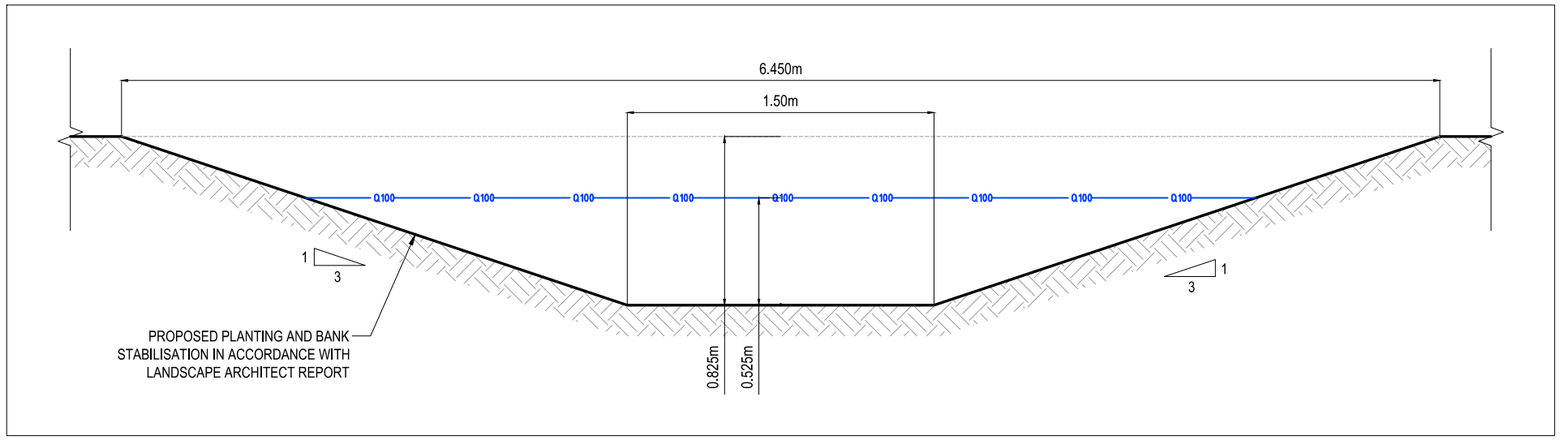
DWG NO.: P003

ISSUE: E



BIO-RETENTION BASIN - TYPICAL SECTION

NTS



PROPOSED SWALE 1 - TYPICAL DETAIL

SCALE 1:15 (A1)

STORMWATER OUTLET ARRANGEMENT	
STORMWATER OUTLET LOCATION	STORMWATER STRUCTURE
BIO-RETENTION & DETENTION BASIN A	
LOW FLOW OUTLET	Ø250mm ORIFICE ON Ø375mm OUTLET PIPE AT 1.00% GRADE AT INVERT OF INLET PIT
MID FLOW OUTLET	Ø375mm PIPE AT 1.00% GRADE AT 0.35m ABOVE DETENTION INVERT
HIGH FLOW OUTLET	10m WIDE WEIR at 0.80m ABOVE DETENTION INVERT
BASIN DEPTH	1.20m
1% AEP WATER LEVEL	0.878m
BIO-RETENTION & DETENTION BASIN B	
LOW FLOW OUTLET	Ø365mm ORIFICE ON Ø375mm OUTLET PIPE AT 1.10% GRADE AT INVERT OF INLET PIT
MID FLOW OUTLET	Ø525mm PIPE AT 1.50% GRADE AT 0.25m ABOVE DETENTION INVERT
HIGH FLOW OUTLET	10m WIDE WEIR at 0.775m ABOVE DETENTION INVERT
BASIN DEPTH	1.20m
1% AEP WATER LEVEL	0.881m
BIO-RETENTION & DETENTION BASIN C	
LOW FLOW OUTLET	Ø275mm ORIFICE ON Ø375mm OUTLET PIPE AT 1.00% GRADE AT INVERT OF INLET PIT
MID FLOW OUTLET	Ø450mm PIPE AT 1.50% GRADE AT 0.325m ABOVE DETENTION INVERT
HIGH FLOW OUTLET	10m WIDE WEIR at 0.80m ABOVE DETENTION INVERT
BASIN DEPTH	1.20m
1% AEP WATER LEVEL	0.861m
BIO-RETENTION & DETENTION BASIN D	
LOW FLOW OUTLET	Ø225mm ORIFICE ON Ø375mm OUTLET PIPE AT 1.00% GRADE AT INVERT OF INLET PIT
MID FLOW OUTLET	Ø375mm PIPE AT 1.50% GRADE AT 0.20m ABOVE DETENTION INVERT
HIGH FLOW OUTLET	5m WIDE WEIR at 0.50m ABOVE DETENTION INVERT
BASIN DEPTH	0.85m
1% AEP WATER LEVEL	0.530m

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

ISSUE No.	DATE	AMENDMENT
C	26-06-25	ISSUED FOR REPORT
B	11-12-24	ISSUED FOR APPROVAL
A	06-12-24	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
BG	BG	DC

TITLE: CONCEPTUAL STORMWATER MANAGEMENT DETAILS

SCALE: 1:15 AT A1, 1:30 AT A3 (0, 0.5m, 1.0m, 1.5m)

PROJECT NO.: OSK6521

DWG NO.: P006

ISSUE: C

LEGEND

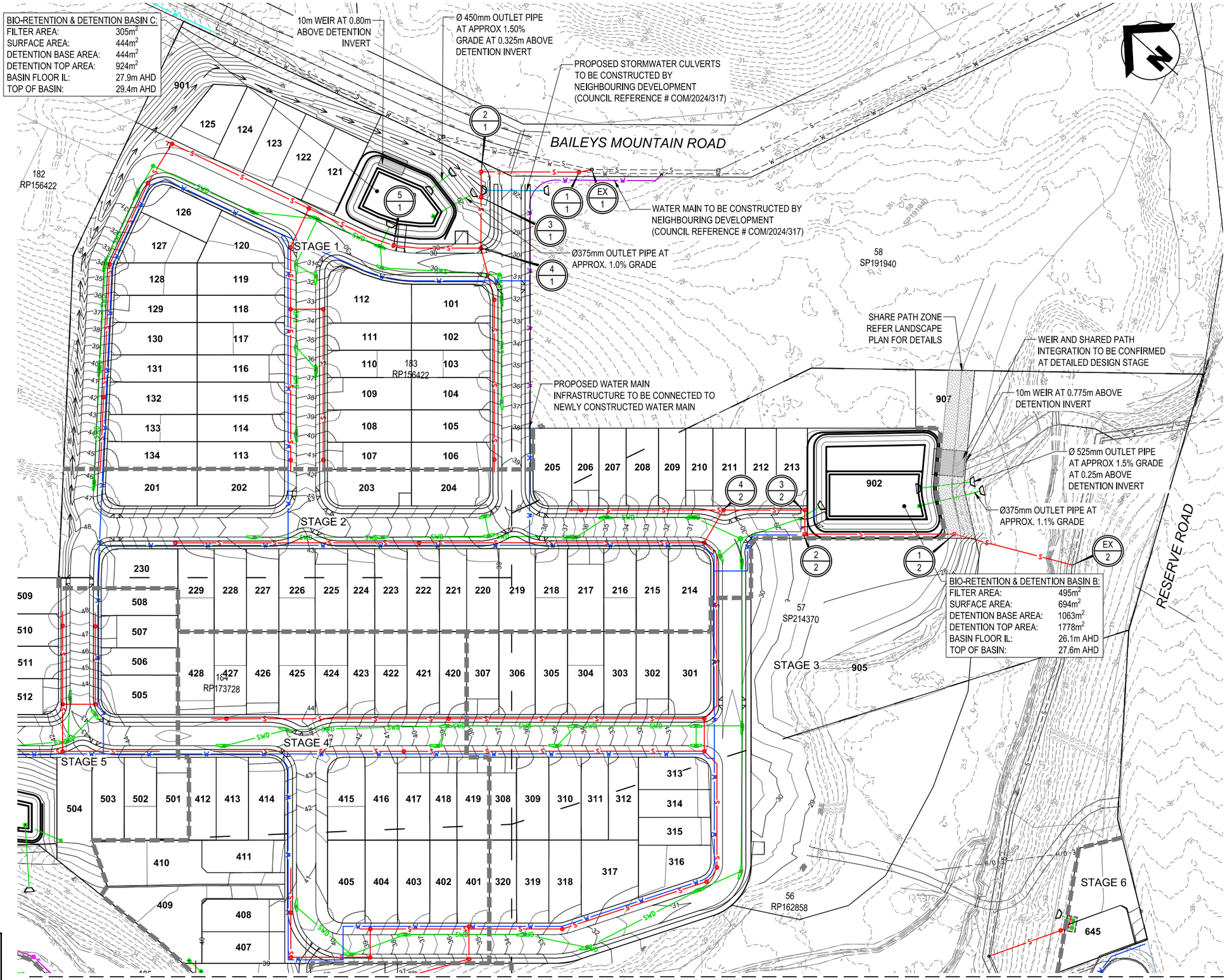
- PROPOSED SEWER MAIN
- PROPOSED TRUNK SEWER MAIN
- PROPOSED WATER MAIN
- PROPOSED TRUNK WATER MAIN
- PROPOSED STORMWATER DRAINAGE
- FINISHED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- STAGE BOUNDARY
- PROPOSED SEWER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED WATER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED STORMWATER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED SERVICE EASEMENTS
- MAINTENANCE HOLE NUMBER

EXISTING SERVICES LEGEND

- EXISTING SEWER MAIN
- EXISTING WATER MAIN
- EXISTING STORMWATER PIPE
- EXISTING TELECOMMUNICATIONS CABLE
- EXISTING ELECTRICAL CABLE

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS



ISSUE No.	DATE	AMENDMENT
C	26-06-25	ISSUED FOR REPORT
B	11-12-24	ISSUED FOR APPROVAL
A	06-12-24	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD	DESIGN: DR	DRAWN: MS	APPROVED: DC
PROJECT: PROPOSED RESIDENTIAL SUBDIVISION 31-53 COURTNEY DRIVE UPPER COOMERA, QLD, 4209			

TITLE: PRELIMINARY SERVICES LAYOUT PLAN - SHEET 1 OF 2

SCALE: 1:750 AT A1, 1:1500 AT A3 (0, 15, 30, 45, 60m)

PROJECT NO.: OSK6521

DWG NO.: P040

ISSUE: C

LEGEND

- PROPOSED SEWER MAIN
- PROPOSED TRUNK SEWER MAIN
- PROPOSED WATER MAIN
- PROPOSED TRUNK WATER MAIN
- PROPOSED STORMWATER DRAINAGE
- FINISHED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- STAGE BOUNDARY
- PROPOSED SEWER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED WATER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED STORMWATER MAIN (CONSTRUCTED BY OTHERS)
- PROPOSED SERVICE EASEMENTS
- MAINTENANCE HOLE NUMBER (MH1 / 1)

EXISTING SERVICES LEGEND

- EXISTING SEWER MAIN
- EXISTING WATER MAIN
- EXISTING STORMWATER PIPE
- EXISTING TELECOMMUNICATIONS CABLE
- EXISTING ELECTRICAL CABLE

FOR CONTINUATION REFER SHEET 1

REFER TO OSK6521-P045 FOR PROPOSED WATER MAIN EXTENSION ALONG COURTNEY DRIVE

BIO-RETENTION & DETENTION BASIN D:

FILTER AREA:	135m²
SURFACE AREA:	267m²
DETENTION BASE AREA:	267m²
DETENTION TOP AREA:	643m²
BASIN FLOOR IL:	36.4m AHD
TOP OF BASIN:	37.55m AHD

EXISTING CULVERT TO BE EXTENDED

5m WEIR AT 0.50m ABOVE DETENTION INVERT

Ø 375mm OUTLET PIPE AT 1.5% GRADE AT 0.20m ABOVE DETENTION INVERT

Ø 375mm OUTLET PIPE AT 1.0% GRADE

Ø 375mm OUTLET PIPE AT APPROX 1.0% GRADE AT 0.35m ABOVE DETENTION INVERT

Ø375mm OUTLET PIPE AT APPROX. 1.0% GRADE

BIO-RETENTION & DETENTION BASIN A:

FILTER AREA:	230m²
SURFACE AREA:	355m²
DETENTION BASE AREA:	611m²
DETENTION TOP AREA:	1162m²
BASIN FLOOR IL:	31.6m AHD
TOP OF BASIN:	33.1m AHD

10m WEIR AT 0.80m ABOVE DETENTION INVERT

Ø 225 TRUNK SEWER MAIN TO BE CONSTRUCTED BY NEIGHBOURING DEVELOPMENT (COUNCIL REFERENCE # OPW/2024/987)

TRUNK SEWER WORKS TO CONNECT INTO Ø225 STUB CONNECTION PROVIDE AS A PART OF THE ONGOING SEWER OPW APPLICATION (COUNCIL REFERENCE # OPW/2024/987)

MANHOLE TO BE CONSTRUCTED OVER EXISTING CULVERT AND REDIRECTED TO WATERWAY TO ACCOMODATE PROPOSED ROAD WIDENING AND LOT LAYOUT

PROPOSED WATER MAIN EXTENSION TO BE CONNECTED TO NEWLY CONSTRUCTED WATER MAIN

WATER MAIN TO BE CONSTRUCTED BY NEIGHBOURING DEVELOPMENT (COUNCIL REFERENCE # OPW/2023/1202)

INSET A
SCALE 1:750 AT A1

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

REFER INSET A

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

ISSUE No.	DATE	AMENDMENT
C	26-06-25	ISSUED FOR REPORT
B	11-12-24	ISSUED FOR APPROVAL
A	06-12-24	ISSUED FOR INFORMATION

OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
DR	MS	DC

TITLE: PRELIMINARY SERVICES LAYOUT PLAN - SHEET 2 OF 2

SCALE: 1:750 AT A1, 1:1500 AT A3 (0, 15, 30, 45, 60m)

PROJECT NO.: OSK6521

DWG NO.: P041

ISSUE: C

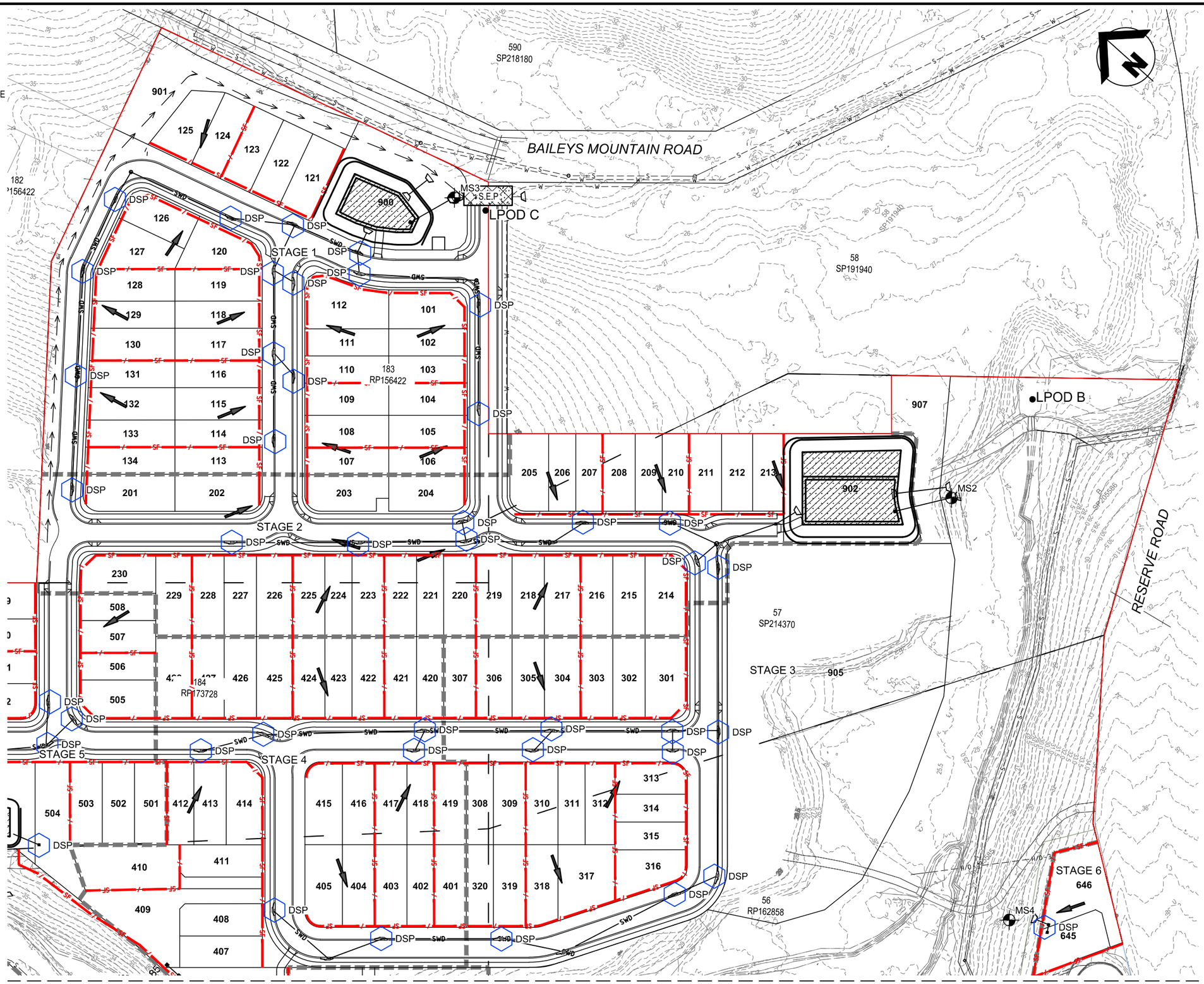
APPENDIX

F

OSKA Consulting Group,
Sediment and Erosion Control Plan – Sheet 1 of 2
(Ref: OSK6521/P050/C),
Sediment and Erosion Control Plan – Sheet 2 of 2
(Ref: OSK6521/P051/C) &
Sediment and Erosion Control Details
(Ref: OSK6521/P052/C)

SEDIMENT & EROSION CONTROL LEGEND

- SF — SEDIMENT FENCE
- TEMPORARY DIVERSION DRAIN
- TEMPORARY SEDIMENT PONDS WITHIN FUTURE BIO RETENTION BASINS
- S.E.P — LOCATION OF STABILISED ENTRY/EXIT POINT
- DSP — DRAINAGE STRUCTURE PROTECTION
- MS1 — WATER QUALITY MONITORING STATION
- FLOW ARROW
- LPOD — LAWFUL POINT OF DISCHARGE
- 80.0 — EXISTING SURFACE CONTOURS
- SWD — PROPOSED STORMWATER PIPE
- STAGE BOUNDARY



FOR CONTINUATION REFER SHEET 2

CONCEPT ONLY

IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN ADEQUATE SEDIMENT & EROSION CONTROL DURING ALL PHASES OF CONSTRUCTION TO THE SATISFACTION OF BOTH THE SUPERINTENDENT AND COUNCIL.

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

ISSUE No.	DATE	AMENDMENT
C	26-06-25	ISSUED FOR REPORT
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OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
DR	MS	DC

TITLE: SEDIMENT AND EROSION CONTROL PLAN - SHEET 1 OF 2

SCALE: 1:750 AT A1 / 1:1500 AT A3 (0 15 30 45 60m)

PROJECT NO.: OSK6521

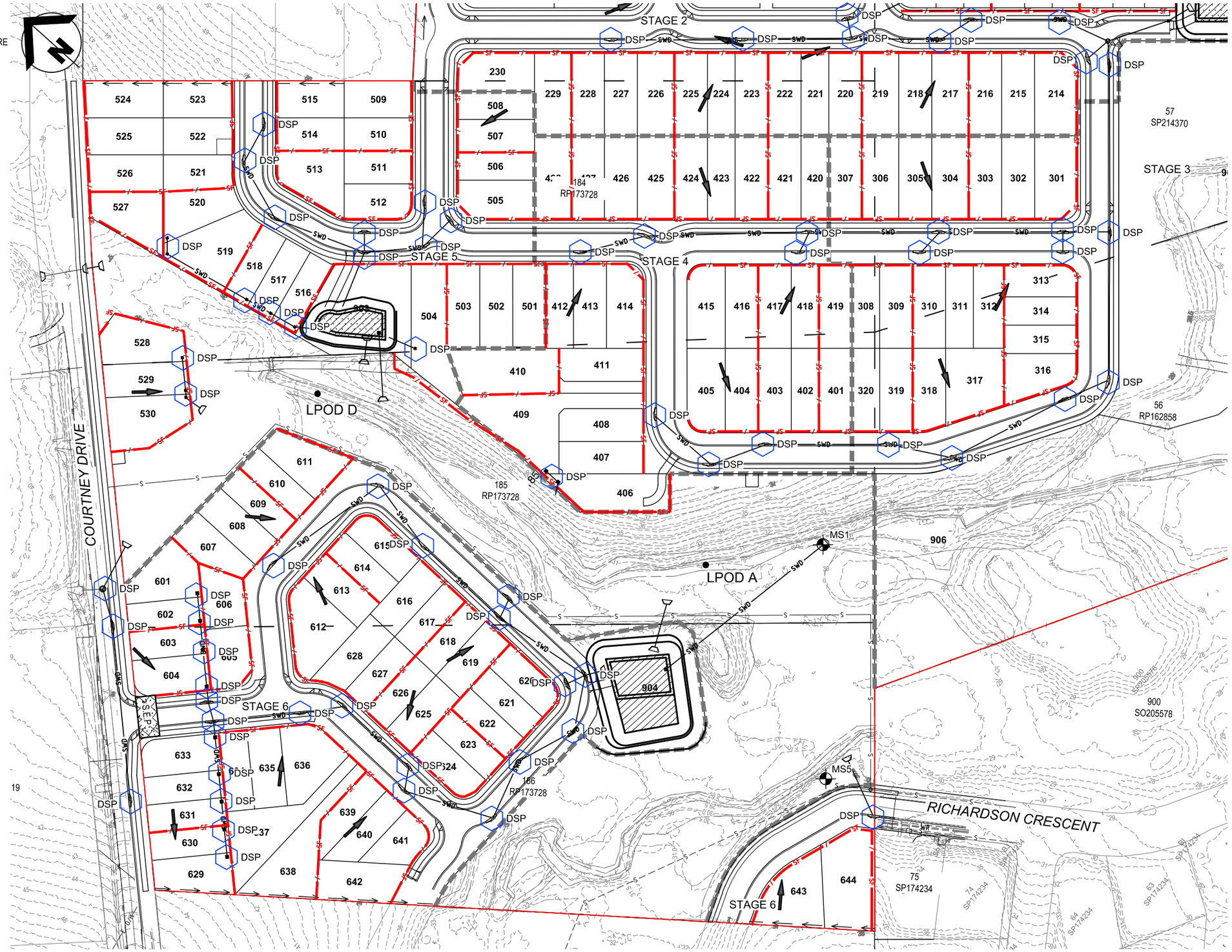
DWG NO.: P050

ISSUE: C

SEDIMENT & EROSION CONTROL LEGEND

- SEDIMENT FENCE
- TEMPORARY DIVERSION DRAIN
- TEMPORARY SEDIMENT PONDS WITHIN FUTURE BIO RETENTION BASINS
- S.E.P. — LOCATION OF STABILISED ENTRY/EXIT POINT
- DSP — DRAINAGE STRUCTURE PROTECTION
- MS1 — WATER QUALITY MONITORING STATION
- FLOW ARROW
- LPOD — LAWFUL POINT OF DISCHARGE
- 80.0 — EXISTING SURFACE CONTOURS
- SWD — PROPOSED STORMWATER PIPE
- STAGE BOUNDARY

FOR CONTINUATION REFER SHEET 1



CONCEPT ONLY

IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN ADEQUATE SEDIMENT & EROSION CONTROL DURING ALL PHASES OF CONSTRUCTION TO THE SATISFACTION OF BOTH THE SUPERINTENDENT AND COUNCIL.

APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

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OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
DR	MS	DC

TITLE: SEDIMENT AND EROSION CONTROL PLAN - SHEET 2 OF 2

SCALE: 1:750 AT A1 / 1:1500 AT A3 (0 15 30 45 60m)

PROJECT NO.: OSK6521

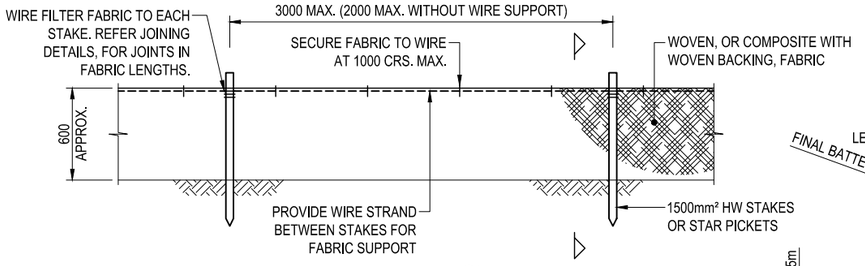
DWG NO.: P051

ISSUE: C

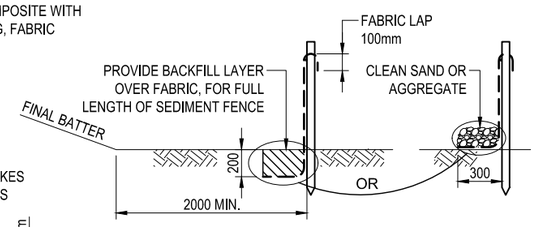
APPROVAL ISSUE
NOT FOR CONSTRUCTION UNLESS STAMPED

CONTRACTOR TO DETERMINE AND LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS

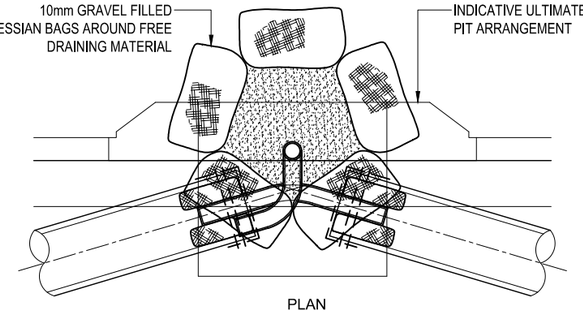
CONCEPT ONLY
IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN ADEQUATE SEDIMENT & EROSION CONTROL DURING ALL PHASES OF CONSTRUCTION TO THE SATISFACTION OF BOTH THE SUPERINTENDENT AND COUNCIL.



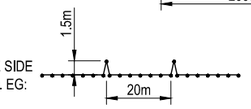
ELEVATION



SECTION



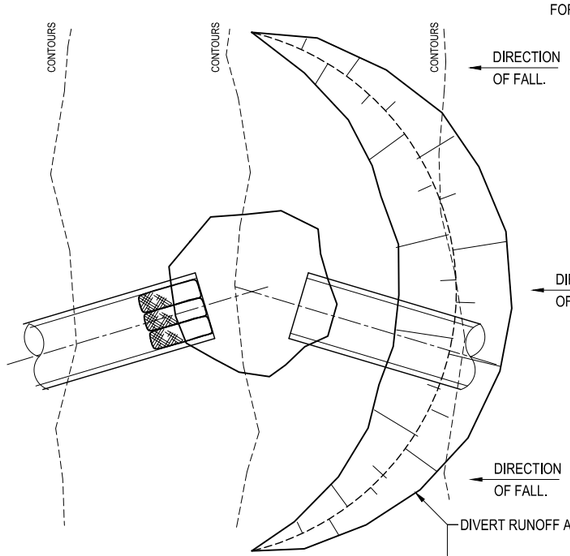
PLAN



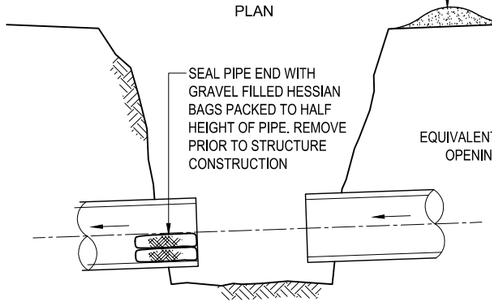
NOTE: INSTALL 1.5m (MIN.) DEEP 'RETURNS' AT 20m SPACING (MAX.) ON UPSLOPE SIDE OF FENCELINE (5-10m MAX SPACING IF FENCE ALIGNED AT ANGLE TO CONTOUR). EG:

SEDIMENT FENCE DETAILS

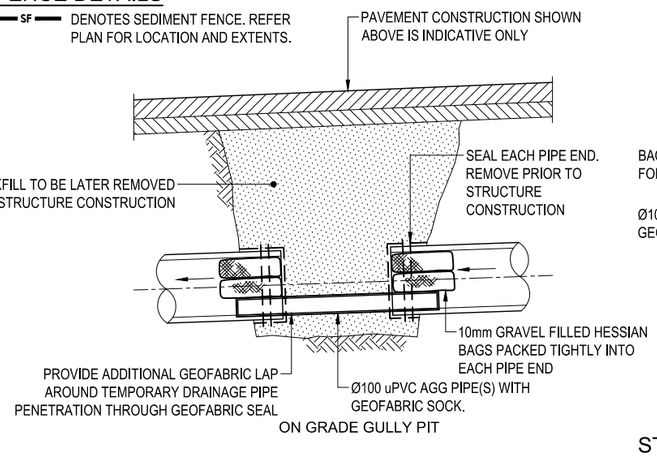
N.T.S. —— / —— SF —— DENOTES SEDIMENT FENCE. REFER PLAN FOR LOCATION AND EXTENTS.



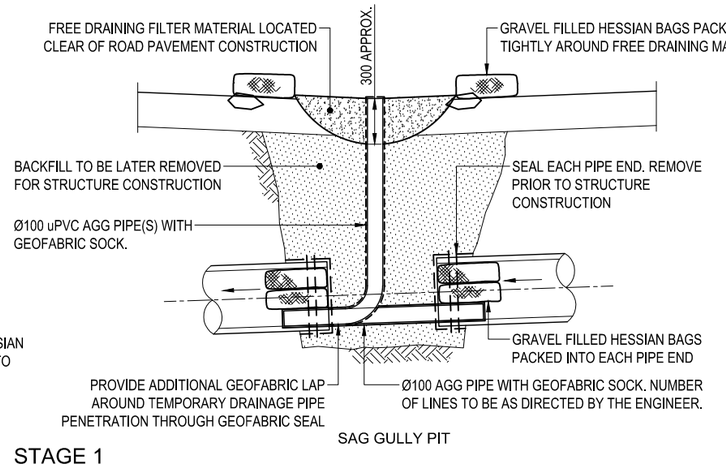
PLAN



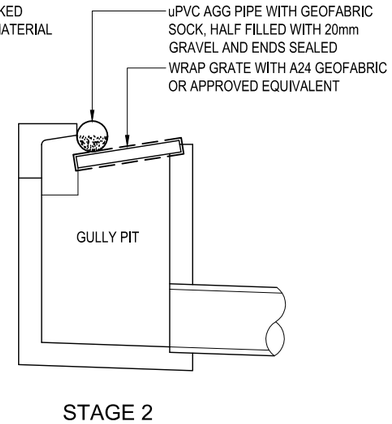
STAGE 1
EXCAVATION AND PIPE INSTALLATION



ON GRADE GULLY PIT



SAG GULLY PIT



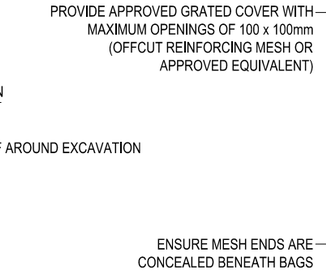
STAGE 2
STRUCTURE COMPLETE

STAGE 1
EXCAVATION, PIPE INSTALLATION AND INTERIM BACKFILLING

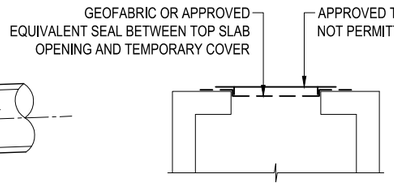
ROADWAY GULLY PIT

DSP DENOTES DRAINAGE STRUCTURE PROTECTION. REFER PLAN FOR LOCATION & EXTENTS.

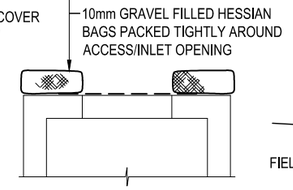
N.T.S.



PLAN

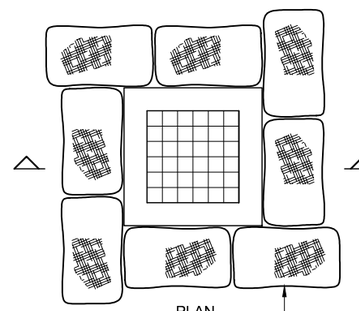


ACCESS CHAMBER



INLET STRUCTURE

STAGE 2

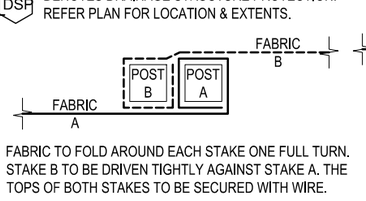


INLET STRUCTURE

STAGE 3

SEDIMENT FENCE FABRIC JOINING DETAILS

N.T.S.

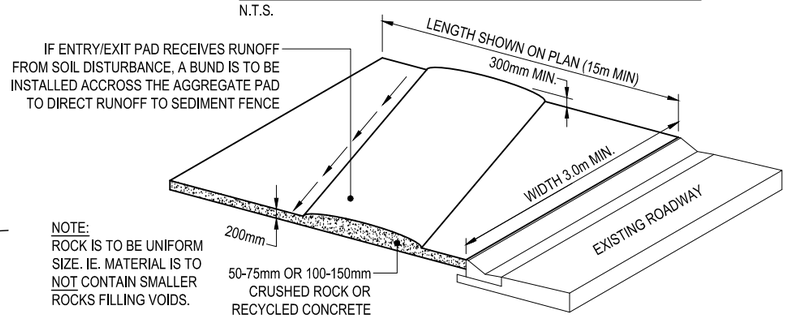


FABRIC TO FOLD AROUND EACH STAKE ONE FULL TURN. STAKE B TO BE DRIVEN TIGHTLY AGAINST STAKE A. THE TOPS OF BOTH STAKES TO BE SECURED WITH WIRE.

METHOD 1 METHOD 2

STABILISED ENTRY/EXIT POINT

N.T.S. OR APPROVED EQUIVALENT



NOTE: ROCK IS TO BE UNIFORM SIZE. IE. MATERIAL IS TO NOT CONTAIN SMALLER ROCKS FILLING VOIDS.

SEP DENOTES STABILISED ENTRY/EXIT POINT, REFER PLAN FOR LOCATIONS.

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OSKA CONSULTING GROUP

CLIENT: NORFOLK ESTATES PTY LTD

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
31-53 COURTNEY DRIVE
UPPER COOMERA, QLD, 4209

DESIGN	DRAWN	APPROVED
DR	MS	DC

TITLE: SEDIMENT AND EROSION CONTROL DETAILS

SCALE:

PROJECT NO. OSK6521

DWG NO. P052

ISSUE C

APPENDIX

G

OSKA Consulting Group, Response to Healthy Waters Code (Ref: OSK6521-0006)

City Plan code template

This code template supports the preparation of a development application against either the acceptable outcome(s) or performance outcome(s) contained in the code. Development assessment rules are outlined in **Section 5.3.3** of the City Plan.

Please note:

Note: In accordance with Section 2.1 of City Plan, an assessment against State interest - Water quality (policies 4 and 5) of the State Planning Policy 2017 is required as the Healthy water development code does not fully integrate this State interest. A response table for policies 4 and 5 have been included below.

For assessment against the overall outcomes, refer to the appropriate code.

Note: The whole of the planning scheme is identified as the assessment benchmark for impact assessable development. This specifically includes assessment of impact assessable development against this strategic framework. The strategic framework may contain intentions and requirements that are additional to and not necessarily repeated in zone, overlay or other codes. In particular, the performance outcomes in zone codes address only a limited number of aspects, predominantly related to built form. Development that is impact assessable must also be assessed against the overall outcomes of the code as well as the strategic framework.

9.4.5 Healthy waters code

9.4.5.3 Specific benchmarks for assessment

PART B – ASSESSABLE DEVELOPMENT BENCHMARKS

Table 9.4.5-3: Healthy waters code – for assessable development

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
Erosion and sediment control			
PO1 Stormwater discharge from a development site achieves the construction phase water quality objectives of **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards**.	**AO1** No acceptable outcome provided.	**PO** The stormwater discharge from the development extent achieves the construction phase water quality objectives of SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details on the proposed treatment system.	
PO2 Erosion, sediment and dust is appropriately managed during the construction phase.	**AO2** The level of risk for soil erosion and sediment pollution to the environment is determined by an erosion hazard assessment, completed by a suitably-qualified person in accordance with the criteria in **Table 9.4.5-4: Erosion hazard assessment**. Where the erosion hazard assessment has a risk score of: (a) less than or equal to 10: A deemed to comply report is prepared by a suitably qualified person for Council approval, including conceptual location and	**AO** An erosion hazard assessment was completed for the development in accordance with Table 9.4.5-4 and the proposed development totalled a risk score of 13. A sediment and erosion control plan is included in OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. A detailed sediment and erosion plan will be required as part of the detailed design phase to ensure the plan addresses devices and management measures to control erosion and sediment for the pre-construction, construction and post-construction phases of the development, in accordance with the Best Practice	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
	design drawings of each treatment measure in plan and section views, in accordance with the *Best Practice Erosion and Sediment Control: International Erosion Control Association, (IECA) 2008, Australasia Chapter 2008.* (b) greater than 10 or developments involving multiple stages of disturbance or more than 1.25 ha of land: (i) For material change of use or reconfiguring a lot, a conceptual erosion and sediment control plan (ESCP) is prepared by a suitably-qualified person for Council approval in accordance with **SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards**, and the *Best Practice Erosion and Sediment Control: International Erosion Control Association (IECA) 2008, Australasia Chapter 2008*.	Erosion and Sediment Control: International Erosion Control Association, (IECA) 2008.	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
	(ii) For operational work, a detailed ESCP is prepared by a suitably-qualified person in accordance with **SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards**, and *Best Practice Erosion and Sediment Control: International Erosion Control Association (IECA) 2008, Australasia Chapter 2008*. The ESCP is to detail appropriate treatment measures for the construction phase of development, demonstrating how the minimum design objectives in **Table 9.4.5-5: Stormwater design objectives** are achieved, including: (a) measures to ensure the release of sediment-laden stormwater for the nominated design storm are minimised when the design storm is exceeded; (b) detailed design, installation, construction, monitoring and maintenance requirements of all approved proprietary products in accordance with local conditions and manufacturer's recommendations; and (c) details of how the ESCP aligns with the approved development staging plan.		
Stormwater quality			
PO3	**AO3.1** For post developed sites, the following minimum pollutant reduction targets are	**AO**	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets <u>either</u> the performance outcome or overall outcome	Internal use
Development appropriately manages stormwater quality to: (a) protect natural ecosystems; (b) protect water quality; (c) reduce runoff and peak flows; and (d) meet the water quality objectives and environmental values for Queensland waters. **Note: Water quality objectives and environmental values for Queensland waters are contained within *Schedule 1* of the *Environmental Protection (Water) Policy 2009*. Water quality objectives are locally specific and vary between and within river catchments.** **Note: A stormwater quality management plan prepared by a suitably qualified person in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards, is Council's preferred method for addressing this performance outcome.**	achieved: (a) Gross pollutants (>5mm) – 90%; (b) Total Suspended Solids (TSS) – 80%, (c) Total Phosphorus (TP) – 60%; and (d) Total Nitrogen (TN) – 45%.	A Conceptual Stormwater Management Plan (CSWMP) has been prepared for the proposed Residential Subdivision situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The CSWMP details the proposed treatment measures to be implemented to ensure compliance with SC6.12 City Plan policy – Land development guidelines. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further information.	
	AO3.2 For development on land less than 1.25ha, a deemed to comply solution for stormwater quality is achieved in accordance with **Table 9.4.5-6: Stormwater quality deemed to comply solutions**.	**N/A**	
	AO3.3 For development on land greater than 1.25ha, a stormwater quality management plan is to be prepared by a suitably qualified person in accordance with **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards**, is required.	**AO** A Conceptual Stormwater Management Plan (CSWMP) has been prepared for the proposed Residential Subdivision situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The CSWMP details the proposed treatment measures to be implemented to ensure compliance with SC6.12 City Plan policy – Land development guidelines. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further information.	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets <u>either</u> the performance outcome or overall outcome	Internal use
Waterway stability			
PO4 In-stream erosion, downstream of urban development is prevented by controlling the rate (or magnitude) and duration of sediment transporting flows.	**AO4** Post-development peak 0.632 Annual Exceedance Probability (AEP) event discharge within receiving waterway is limited to pre-development peak 0.632 AEP event discharge and is in accordance with **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards.**	**AO** The development proposes detention basins to ensure post development flow rates are mitigated to pre-development rates for the 63.2% AEP event in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
Stormwater quantity control			
PO5 Stormwater quantity management outcomes demonstrate no adverse impact on stormwater flooding or the drainage of properties external to the subject site.	**AO5** The following is achieved external to the development site: (a) no increase in peak flood flow rate from the development site for all events up to and including the 1% AEP; (b) no increase in peak flood velocities from the development site for all events up to and including the 1% AEP; (c) no increase in peak flood level from the development site for all events up to and including the 1% AEP; and (d) stormwater outfalls or discharge is located to avoid conflict with existing usage of downstream land or impacts on existing watercourse or drainage.	**AO** The development proposes detention basins to ensure post development flow rates are mitigated to pre-development rates and that there is no increased runoff on downstream properties in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
Lawful point of discharge			

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
PO6 Development ensures the stormwater systems are designed to not cause actionable nuisance that would adversely affect adjoining (upstream or downstream) properties.	**AO6** A lawful point of discharge must be identified and demonstrated that all discharge point/s from the development are in accordance with **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards**.	**AO** The development proposed to discharge all flows to the existing waterway within the site which is a Lawful Point of Discharge in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
Overland flow paths			
PO7 Development must not obstruct free open surface flow of stormwater through a site.	**AO7** Overland flowing stormwater is allowed free open surface flow between the street and any waterway at the rear or sides of a property, in accordance with the provisions of the *Building Code of Australia*.	**N/A**	
Whole of life costs			
PO8 Stormwater infrastructure is designed and constructed to: (a) remain fit for purpose for the life of the development and maintains full functionality in the design flood event; (b) be cost effective to maintain; and (c) ensure no structural damage to existing stormwater infrastructure.	**AO8** No acceptable outcome provided.	**PO** The proposed stormwater infrastructure for the development has been designed to be fit for purpose for the development and is a cost effective solution. A Maintenance Management Plan will be required during the detailed design phase to ensure sufficient maintenance of the treatment system throughout the life of the development. Any damages that occur to the existing Council infrastructure during construction will be rectified. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
		Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
Landscape integration			
PO9 Stormwater treatment devices and stormwater infrastructure are designed to: (a) integrate with the urban design and landscape outcomes of the development; (b) complement natural environments, wetlands and watercourses; (c) protect environmental values; (d) enhance visual amenity; and (e) incorporate CPTED principles in accordance with **SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards**.	**AO9.1** Where stormwater treatment devices and stormwater infrastructure are integrated into public open space, a Statement of Landscape Intent is to be prepared by a suitably qualified person, for approval by Council. The plan is to demonstrate that the operation of stormwater infrastructure does not compromise the function of any co-located uses and reflect the design principles within **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards.** **Note: A Statement of landscape intent is to be prepared in accordance with SC6.13 City Plan policy – Landscape work.**	**PO** The proposed stormwater treatment devices and stormwater infrastructure have been designed to be incorporated within the landscape outcomes, enhance visual amenity and to protect the environment in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
	AO9.2 Stormwater treatment devices are located offline to any upstream catchment. **Note: This provision relates to the integration of stormwater treatment devices and stormwater infrastructure into the landscape. Development identified on the Environmental significance – wetlands and watercourse overlay map will still require assessment against the Environmental significance overlay code.**	**AO** The development has an existing waterway through the site which conveys external/upstream catchment flows however all proposed treatment devices will be located offline to the existing waterway. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
	AO9.3 All stormwater outlets that are located adjacent to watercourses, creeks and drainage paths are aligned at a maximum	**AO**	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
	of 45 degrees to the downstream direction of flow, and energy dissipation measures installed to minimise scour.	All stormwater outlets will be constructed to minimise scour on the receiving waterway. Further details will be provided at the detail design phase. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further information on the location of the stormwater outlets.	
Public safety			
PO10 Stormwater treatment devices and stormwater infrastructure minimise impacts on public health and safety.	**AO10** All stormwater quantity control measures are designed in accordance with **SC6.12 City Plan policy – Land development guidelines**, **Section 4 – Stormwater drainage and water sensitive urban design standards**.	**AO** The development proposes detention basins to ensure post development flow rates are mitigated to pre-development rates and that there is no increased runoff on downstream properties in accordance with SC6.12 City Plan policy – Land development guidelines, Section 4 – Stormwater drainage and water sensitive urban design standards. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further details.	
Maintenance access			
PO11 Maintenance access is provided for all stormwater management systems and considers:	**AO11.1** All weather vehicle access is to be provided to inlet zones of the stormwater treatment systems in accordance with **Table 9.4.5-7: Maintenance access requirements (slope).**	**AO**	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets <u>either</u> the performance outcome or overall outcome	Internal use
(a) the type of vehicle or machinery needed to service particular assets; and (b) the need to ensure a safe working environment for maintenance personnel and the public.		A Conceptual Stormwater Management Plan (CSWMP) has been prepared for the proposed Residential Subdivision situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The CSWMP details the proposed treatment measures to be implemented to ensure compliance with SC6.12 City Plan policy – Land development guidelines. Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further information.	
	AO11.2 Maintenance access is to be provided around the perimeter of all stormwater treatment systems in accordance with **Table 9.4.5-8: Maintenance access requirements (size).**	**AO** Maintenance access has been provided around the perimeter of all proposed basins in accordance with Table 9.4.5-8: Maintenance access requirements (size). Refer to the OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera for further information.	
	AO11.3 A maintenance buffer is provided around the perimeter of all stormwater treatment devices and adjoining private property equal to: (a) 1m in width; or (b) the width of a perimeter maintenance access, as delivered in AO11.2, plus 0.5m. The maintenance buffer is measured from the adjacent allotment boundary to the top	**N/A**	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets either the performance outcome or overall outcome	Internal use
	of batter around the treatment measure. The maximum slope on the maintenance buffer is 1 in 10.		
Fauna movement			
PO12 Stormwater conveyance structures and channels are designed to ensure the safe movement of native fauna and provide for terrestrial and aquatic passage.	**AO12.1** Stormwater drainage structures and channels minimise impacts on aquatic fauna and associated habitats and provide opportunities for beneficial habitat uses of structures in accordance with the *Department of Primary Industries and Fisheries – Fisheries guidelines for Fish-friendly structures (2006).*	**N/A**	
	AO12.2 Stormwater drainage structures allow for the safe movement of terrestrial fauna in accordance with: (a) the Queensland Government Fauna Sensitive Road Design Manual Volume 2: Preferred Practices; and (b) the Queensland Government Koala-Sensitive Design Guidelines.	**N/A**	

Performance outcomes	Acceptable outcomes	Does the proposal meet the acceptable outcome? If not, justify how the proposal meets <u>either</u> the performance outcome or overall outcome	Internal use
Wastewater management			
PO13 Development does not discharge wastewater to receiving waters or areas external to the site unless demonstrated to be the best-practice environmental management for that site and takes into consideration: (a) the applicable water quality objectives for the receiving waters; and (b) the potential adverse impact on ecosystem health of receiving waters.	**AO13** Where the development involves the discharge of wastewater, a Wastewater Management Plan (WWMP) is prepared, demonstrating compliance with the performance outcome, by a suitably qualified person and submitted to the Council, detailing all of the following: (a) wastewater type; (b) climatic conditions; (c) water quality objectives; (d) best-practice environmental management; (e) waste management hierarchy; and (f) the WWMP provides for the management of wastewater in accordance with a wastewater management hierarchy that: (i) avoids wastewater discharge to watercourses; or (ii) if wastewater discharge to the environment cannot practicably be avoided wastewater discharge to watercourses is minimised through re-use, recycling, recovery and treatment for disposal to sewer, surface water and groundwater.	**N/A** The proposed development does not propose to discharge wastewater into receiving waters. All wastewater will be discharged appropriately into Council's sewerage network.	
Dewatering management			
PO14 Dewatering occurs in accordance with an	**AO14** No acceptable outcome provided.	**N/A**	

approved Dewatering management plan.			
Woongoolba flood mitigation catchment area			
PO15 In the Woongoolba flood mitigation catchment area, shown on the **Water catchments and dual supply system area overlay map**, peak outflow and its timing for Q2, Q5 and Q10 for rainfall events up to 72 hours does not change as a result of development.	**AO15** No acceptable outcome provided.	**N/A**	

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Policies	Demonstrate how the proposal meets the policy?	Internal use
State interest – water quality		
ASSESSMENT BENCHMARK 4 (POLICY 4): At the construction phase, development achieves the applicable stormwater management design objectives in table A (appendix 2) of the State Planning Policy.	A sediment and erosion control plan is included in OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The plan addresses devices and management measures to control erosion and sediment for the pre-construction, construction and post-construction phases of the development, in accordance with the Best Practice Erosion and Sediment Control: International Erosion Control Association, (IECA) 2008 to ensure compliance with Assessment Benchmark 4 (Policy 4) of the State Planning Policy.	
ASSESSMENT BENCHMARK 5 (POLICY 5): (5) At the post-construction phase, development: a) achieves the applicable stormwater management design objectives on-site, as identified in table B (appendix 2) of the State Planning Policy; or b) achieves an alternative locally appropriate solution off-site that achieves an equivalent or improved water quality outcome to the relevant stormwater management design objectives in table B (appendix 2) of the State Planning Policy.	A Conceptual Stormwater Management Plan (CSWMP) has been prepared for the Proposed Residential Subdivision situated at 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera. The CSWMP details the proposed treatment measures to be implemented to ensure compliance with Assessment Benchmark (Policy 5) of the State Planning Policy. Refer to OSKA Consulting Group, Conceptual Stormwater Management Plan (Ref: OSK6521-0003) prepared for 31-53 Courtney Drive, 176 & 202 Baileys Mountain Road, Lot 57 & 288 Reserve Road, Upper Coomera.	

Table 9.4.5-3: Erosion hazard assessment

Controlling factor	Points	Score
Average slope of the whole site prior to operational works		
Slope less than 2%	0	
More than or equal to 2% but less than 5%	1	
More than or equal to 5% but less than 10%	2	2
More than or equal to 10% but less than 15%	4	
More than or equal to 15%	5	
Soil type (to be disturbed)		
Gravels and sandy soils	1	
Sandy loam	2	2
Clays on flood plains	3	
Shallow soils on slopes	4	
Clays on slopes greater than 5%/imported fill or untested fill	5	
Anticipated duration of site disturbance		
Duration less than 2 weeks	0	
More than 2 weeks but less than 3 months	2	
More than 3 months but less than 6 months	4	
More than 6 months	5	5
Anticipated erosive rainfall risk during site disturbance		
Low (monthly average rainfall less than 45 mm)	0	
Moderate (monthly average rainfall 46 - 100 mm)	1	
High (monthly average rainfall 101 - 225 mm)	2	2
Very high (monthly average rainfall 226 - 1500 mm)	4	
Extreme (monthly average rainfall more than 1500 mm)	5	

Off-site sediment control (down-slope of the soil disturbance)		
Score 1 point if there is no purpose-built sediment trap (e.g. sediment basin, gross pollutant trap or purpose-built wetland).	1	0
Run-off entering the site		
Score 1 point if stormwater run-off is not diverted from entering the site or away from soil disturbance.	1	0
Extent of site disturbance		
Score 2 points if the building works requires reshaping of the ground surface.	2	2
Total Score **Note: High erosion risk - if score 11 or greater, or five for any factor.**		13

This Erosion Hazard Assessment form is adapted from the *Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), IECA 2008 Appendix H - Building Sites, the Brisbane City Council Erosion Hazard Assessment Form* and *Attachment 2 to the QDC Draft Part 16 Erosion and Sediment Control*.