CONCEPTUAL STORMWATER MANAGEMENT PLAN

Proposed Rural Residential Subdivision

253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar

Lots 100-101,103-104 in DP1049845, Lot 4 in DP252388; Lot 2 in DP1076610, Lots 14 and 22 in DP238401

For Tea Garden Farms Pty Ltd

12 May 2025

File No: OSK6866-0003-B

DOCUMENT CONTROL SHEET

Title:	Conceptual Stormwater Management Plan
Document No:	OSK6866-0003-B
Original Date of Issue:	14 February 2025
Project Manager:	Trent Purdon
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Client:	Tea Garden Farms Pty Ltd
Client Contact:	Tea Garden Farms Pty Ltd
Client Reference:	253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar
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.

Reviewed by NER	Signed	Date
Trent Purdon		12 May 2025

Revision/Checking History			
Revision No	**Date**	**Checked By**	**Issued By**
A	14 February 2025	Thomas Watt	Matthew Fradgley
B	12 May 2025	Thomas Watt	Matthew Fradgley

Distribution		
Recipient	**No of Copies**	**Method**
Tea Garden Farms Pty Ltd	1	PDF

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1.0 INTRODUCTION

1.1 Background

OSKA Civil Consultants has been commissioned by Tea Garden Farms Pty Ltd to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application (DA) to MidCoast Council (MCC) for the proposed Rural Residential Subdivision situated at 253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar.

The site comprises of the following lots (including four lots which are to be subdivided in **bold**) and is accessible via 253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar:

- Lot 100 in DP1049845 No. 251 Bundabah Road, Bundabah – 10.1ha
- **Lot 101 in DP1049845 No. 253 Bundabah Road, Bundabah – 66.8ha**
- **Lot 104 in DP1049845 Bundabah Road, Bundabah – 100.7ha**
- **Lot 2 in DP1076610 Bundabah Road, Bundabah – 104.7ha**
- **Lot 103 in DP1049845 Bundabah Road, Pindimar – 129.4ha**
- Lot 4 in DP252388 No. 207 Bundabah Road, Bundabah – 10.08ha
- Lot 14 in DP238401 No. 120 Clarke Street, Pindimar – 10.89ha
- Lot 22 in DP238401 No. 120 Clarke Street, Pindimar – 13.93ha

The four lots within the site that are to be subdivide occupy an area of 401.6ha.

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:

- Provide a conceptual design of stormwater infrastructure including the details of the driveway drainage;
- Provide a conceptual design of stormwater infrastructure including stormwater quality improvement devices and stormwater quantity management controls (if required);
- 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 MidCoast Council standards and requirements; 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*, AR&R Guidebook Version 4.2 - 2019, Austroads – Guide to Road Design (AGRD) Part 5, 5A & 5B, MidCoast Council – *Development Control Plan (DCP) and MidCoast Council – Site Stormwater Drainage Guidelines.*

2.0 SITE DESCRIPTION

2.1 Location

The subject site is located off 253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar and Clarke Street, Pindimar. The site fronts Bundabah Road to the north and Clarke Street to the east and generally is surrounded by water to the west and south. The site is surrounded by RU2 - Rural Landscape lots to the east, RU5 – Village properties to the north-west.

The site is owned by Tea Garden Farms Pty Ltd comprising of the following lots (including four lots which are to be subdivide in **bold**) and is accessible via 253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar (*Figure 1*):

- Lot 100 in DP1049845 No. 251 Bundabah Road, Bundabah – 10.1ha
- **Lot 101 in DP1049845 No. 253 Bundabah Road, Bundabah – 66.8ha**
- **Lot 104 in DP1049845 Bundabah Road, Bundabah – 100.7ha**
- **Lot 2 in DP1076610 Bundabah Road, Bundabah – 104.7ha**
- **Lot 103 in DP1049845 Bundabah Road, Pindimar – 129.4ha**
- Lot 4 in DP252388 No. 207 Bundabah Road, Bundabah – 10.08ha
- Lot 14 in DP238401 No. 120 Clarke Street, Pindimar – 10.89ha
- Lot 22 in DP238401 No. 120 Clarke Street, Pindimar – 13.93ha

The four lots within the site to be subdivide occupy an area of 401.6ha.

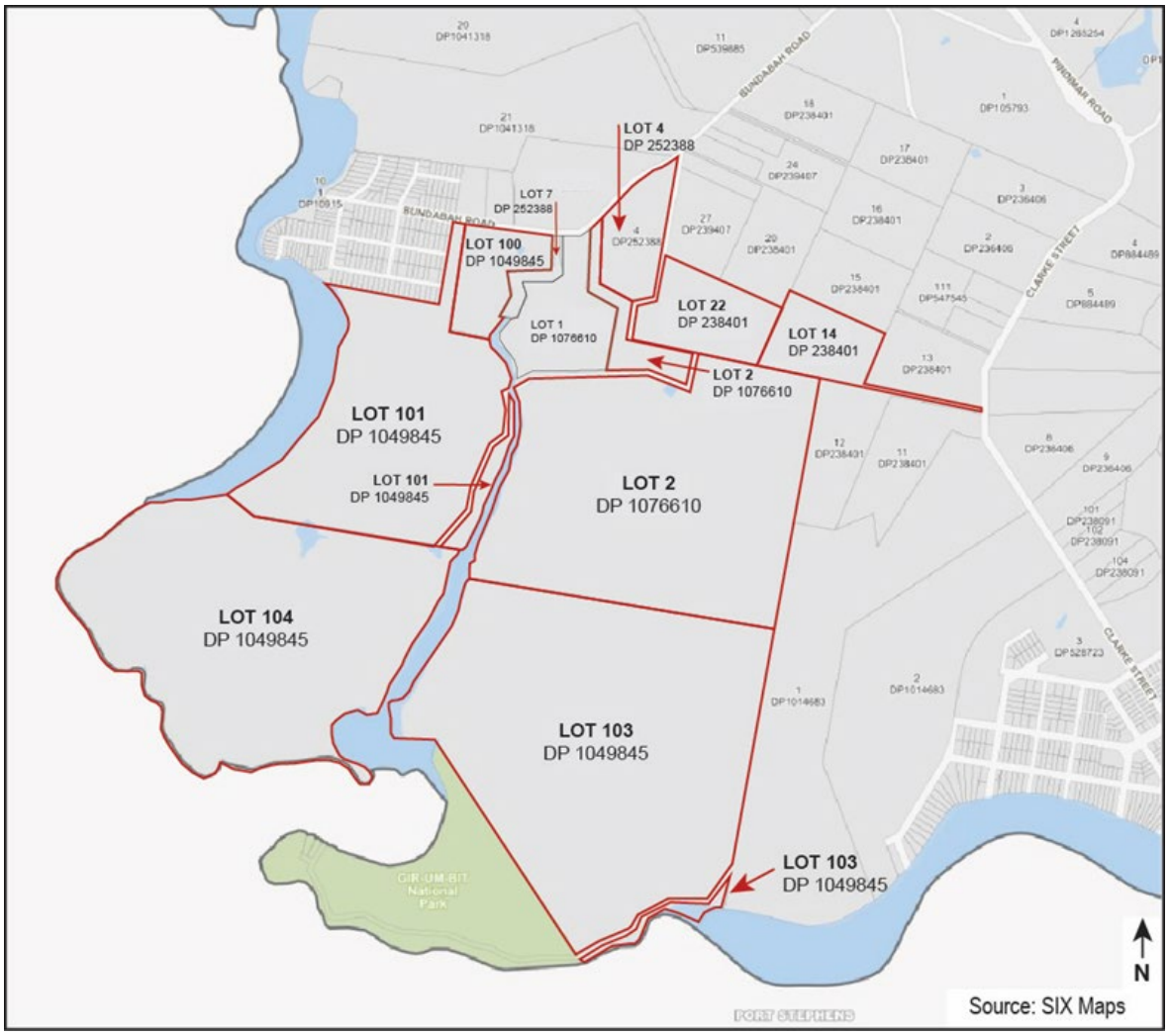


Figure 1: Locality Plan

2.2 Site Topography

The existing site is large and consists of flat areas ranging to very steep areas. Spot heights range from approximately RL 0.0m AHD to 140m AHD. The site has multiple peaks, ridges and valleys. Water generally discharges off the site towards North Arm Cove to the west and Karuah River to the south.

Further information of the site has been provided in the Barry Hunt Associates; Detail and Contour Survey & Proposed Subdivision of Lots 101, 103 & 104 DP 1049845 & Lot 2 DP 1076610 (Ref: 57511 DSUB10) included as Appendix A.

2.3 Vegetation and Land Use

The subject site currently consists of existing vegetation and rural access tracks. The site is generally covered by vegetation ranging from grassed areas to densely tree vegetation areas. Access to the site is gained from the north via Bundabah Road and east via Clarke Street.

An aerial photograph of the subject site is included in *Figure 2*.

Figure 2: Aerial Image of the Site

2.4 Proposed Development

Four lots comprising of 401.6ha are proposed to be subdivided into 9 lots with primary and secondary access options via Bundabah Road and Clarke Street servicing eastern and

western peninsulas that are naturally separated by an upper tributary of Fame Cove. The lots are large rural style lots ranging in size from 40.1ha to 55.8ha.

Refer to Appendix B for further proposed layout details prepared by Barry Hunt Associates; Proposed Subdivision of Lots 101, 103 & 104 DP1049845 & Lot 2 DP1076610 and Right of Access (Ref: 57511 DSUB8).

2.5 Proposed Conceptual Drainage

The development will not propose any formal stormwater quantity or quality devices however, will propose a number of culverts and swales along and under the new driveways to capture and convey stormwater.

Due to the minimal increase in impervious areas as a result of the proposed development, with the minimum lot size of 40ha it is anticipated that there will be a negligible change to flows (quantity and quality) discharging from the subject site and as such no permanent stormwater quantity or quality treatment devices have been proposed. Despite no formal stormwater quantity or quality devices being proposed, the dense vegetation downstream of the proposed driveways and future dwellings, is anticipated to assist in treating the runoff from the proposed development prior to ultimately discharging into Karuah Creek. The subject site is also located in close proximity to the ocean where it is proposed to discharge all runoff directly to the receiving waterways which are connected and discharge to Karuah Creek and the ocean. It is anticipated that by discharging all the site's flows directly to the receiving waterways that it can allow peak flows from the site to be discharged prior to the wider catchment/regional flood peak.

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 -32.6875 (S) and Longitude 152.0625 (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 Barry Hunt Associates; Detail and Contour Survey & Proposed Subdivision of Lots 101, 103 & 104 DP 1049845 & Lot 2 DP 1076610 (Ref: 57511 DSUB10) included as Appendix A;
- Proposed subdivision layout provided by Barry Hunt Associates; Proposed Subdivision of Lots 101, 103 & 104 DP1049845 & Lot 2 DP1076610 and Right of Access (Ref: 57511 DSUB8) included as Appendix B;
- LIDAR data for the subject site sourced from Australian Government Elevation and Depth Foundation Spatial Data (ELVIS), Date Source: 2012, DEM Data;
- Rainfall and Meteorological 2016 IFD Data by the Australian Bureau of Meteorology;
- Information Extracted from MidCoast Public GIS Maps;
- Aerial Imagery extracted from Googlemaps and SIXmaps.

4.0 DRIVEWAY SWALE DESIGN

4.1 Background

The following sections define the method and parameters used within the hydrologics of the site, to establish a simulation of the anticipated flow regime and peak discharge of the swale catchments. A Rational Method calculation has been provided to determine the peak flow rates of the swale catchments.

The Rational Method (*Appendix D – AGRD – Part 5*) 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 Swale Catchment

4.2.1 Catchment Definition and Lawful Point of Discharge

In the analysis of the driveway swales, it was determined that there is a total of 45 contributing catchments. Any stormwater on ground surfaces is conveyed via one of the proposed swales and ultimately conveyed to one of the proposed culverts under the new driveways.

The swale catchments and locations are shown on the Barry Hunt Associates; Proposed Subdivision of Lots 101, 103 & 104 DP1049845 & Lot 2 DP1076610 and Right of Access (Ref: 57511 DSUB10) as Appendix C.

4.2.2 Coefficient of Runoff

The swale catchment's coefficient of runoff (C year) was determined based on the fraction impervious method. The swale catchment's, based on the provided survey information, all have 0m^2 of impervious surfaces, which equates to fraction impervious (fi) of 0. Using a one hour, ten-year rainfall intensity ($^1I_{10}$) of 58.3 mm/hr, a C_{10} value of 0.53 has been adopted for all the swale catchments.

The swale catchment's coefficients of runoff (as shown in *Table 1*) have been adopted in accordance with *AGRD Table 6.24*, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storm for the 1% AEP event (corresponding to 100-year Average Recurrence Interval (ARI) storm).

Table 1: Swale Catchment Coefficient of Runoff

Swale Catchment ID	C_{100}	Swale Catchment ID	C_{100}
1a	0.64	8a2	0.64
1b	0.64	8b1	0.64
1c	0.64	8b2	0.64
2a1	0.64	8c1	0.64
2a2	0.64	8c2	0.64
2b1	0.64	8d1	0.64
2b2	0.64	8d2	0.64
2c1	0.64	8d3	0.64
2c2	0.64	8e	0.64
3b1	0.64	9a	0.64
3b2	0.64	9b	0.64
3c1	0.64	9c	0.64
3c2	0.64	10a	0.64
5a	0.64	10b	0.64
5b	0.64	11	0.64
7a1	0.64	12a	0.64
7a2	0.64	12b	0.64
7b	0.64	13a	0.64
7c1	0.64	13b	0.64
7c2	0.64	14a	0.64
7d1	0.64	14b	0.64
7d2	0.64	15	0.64
8a1	0.64		

4.2.3 Time of Concentration

The Time of Concentration for the swale catchment's has been calculated in accordance with Austroads – Guide to Road Design Part 5 and Part 5A. Friend's Equation ($t = (107n*L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and AGRD Part *5 Figure 6.69: Flow Travel time in pipes and channels* has been used to calculate the travel time in channels via concentrated flow. Refer to *Table 2* for the calculated Time of Concentration for the swale catchment's.

Table 2: Swale Catchment's Time of Concentration

Swale Catchment ID	Catchment Area (ha)	Total tc	Swale Catchment ID	Catchment Area (ha)	Total tc
1a	0.81	11 mins	8a2	2.28	10 mins
1b	1.01	11 mins	8b1	0.63	21 mins
1c	0.31	10 mins	8b2	1.52	27 mins
2a1	4.92	11 mins	8c1	0.44	10 mins
2a2	0.80	10 mins	8c2	0.37	10 mins
2b1	1.24	9 mins	8d1	1.13	16 mins
2b2	1.43	10 mins	8d2	0.43	14 mins
2c1	0.50	10 mins	8d3	2.55	12 mins
2c2	0.98	10 mins	8e	0.98	18 mins
3b1	1.09	11 mins	9a	1.59	11 mins
3b2	0.22	10 mins	9b	0.27	20 mins
3c1	1.33	9 mins	9c	3.25	27 mins
3c2	0.67	10 mins	10a	0.36	11 mins
5a	1.46	11 mins	10b	0.28	15 mins
5b	0.70	10 mins	11	1.44	22 mins
7a1	0.67	10 mins	12a	0.49	21 mins
7a2	1.15	10 mins	12b	0.70	24 mins
7b	0.35	11 mins	13a	1.55	25 mins
7c1	1.08	9 mins	13b	2.03	24 mins
7c2	1.68	11 mins	14a	0.77	22 mins
7d1	0.74	10 mins	14b	1.20	20 mins
7d2	0.69	11 mins	15	0.63	22 mins
8a1	**0.95**	11 mins			

4.2.4 Design Flow Rates

The swale catchment's peak flow rates have been estimated for the 1% AEP storm event using design rainfall intensities from the Bureau of Meteorology IFD Data. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to estimate each of the individual swale catchments peak flow rates for the 1% AEP event. The individual swale catchment peak flow rates are presented in *Table 3.*

It is to be noted that only the 1% AEP event peak flow rates have been calculated for each catchment as this will form the critical flow rate in designing the proposed driveway swales.

Table 3: Swale Catchment's Peak Flow Rate Estimation – Rational Method

Swale Catchment ID	Area of Catchment (ha)	Time of Concentration (min)	Average Rainfall Intensity (mm/h)	Coefficient of Runoff	Annual Exceedance Probability- 1% AEP (m^3/s)
1a	0.81	11	251.02	0.64	**0.360**
1b	1.01	11	251.02	0.64	**0.448**
1c	0.31	10	260.85	0.64	**0.143**
2a1	4.92	11	251.02	0.64	**2.184**
2a2	0.80	10	260.85	0.64	**0.369**
2b1	1.24	9	271.58	0.64	**0.595**
2b2	1.43	10	260.85	0.64	**0.660**
2c1	0.50	10	260.85	0.64	**0.231**
2c2	0.98	10	260.85	0.64	**0.450**
3b1	1.09	11	251.02	0.64	**0.484**
3b2	0.22	10	260.85	0.64	**0.099**
3c1	1.33	9	271.58	0.64	**0.639**
3c2	0.67	10	260.85	0.64	**0.311**
5a	1.46	11	251.02	0.64	**0.648**
5b	0.70	10	260.85	0.64	**0.323**
7a1	0.67	10	260.85	0.64	**0.309**
7a2	1.15	10	260.85	0.64	**0.530**
7b	0.35	11	251.02	0.64	**0.153**
7c1	1.08	9	271.58	0.64	**0.519**
7c2	1.68	11	251.02	0.64	**0.746**
7d1	0.74	10	260.85	0.64	**0.341**
7d2	0.69	11	251.02	0.64	**0.306**
8a1	**0.95**	11	251.02	0.64	**0.422**
8a2	2.28	10	260.85	0.64	**1.052**
8b1	0.63	21	184.66	0.64	**0.206**
8b2	1.52	27	160.70	0.64	**0.432**
8c1	0.44	10	260.85	0.64	**0.201**
8c2	0.37	10	260.85	0.64	**0.169**
8d1	1.13	16	212.11	0.64	**0.424**
8d2	0.43	14	225.94	0.64	**0.172**
8d3	2.55	12	241.99	0.64	**1.091**
8e	0.98	18	200.07	0.64	**0.347**
9a	1.59	11	251.02	0.64	**0.706**
9b	0.27	20	189.49	0.64	**0.090**
9c	3.25	27	160.70	0.64	**0.923**
10a	0.36	11	251.02	0.64	**0.160**
10b	0.28	15	218.78	0.64	**0.108**
11	1.44	22	180.10	0.64	**0.459**
12a	0.49	21	184.66	0.64	**0.160**
12b	0.70	24	171.72	0.64	**0.213**
13a	1.55	25	167.85	0.64	**0.460**
13b	2.03	24	171.72	0.64	**0.616**
14a	0.77	22	180.10	0.64	**0.123**
14b	1.20	20	189.49	0.64	**0.402**
15	0.63	22	180.10	0.64	**0.201**

4.3 Proposed Swale Sizing

There are a total of 45 swales proposed to convey and direct stormwater flows along the driveways and to the proposed culverts. The proposed swales have been sized utilising the Manning's equation (9.1), $Q = \frac{A}{n} \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}$, from AGRD – Part 5B to ensure that the swales are sized to an adequate capacity to accommodate the swale catchment flows. All swales have been designed as grass lined swales with a Manning's 'n' value of 0.035 (grass). All driveway swales have been designed based on the minimum longitudinal grade achieved along the length of each swale as this will be the critical grade to ensure each swale can sufficiently convey the 1% AEP flows of the respective contributing catchment. It is to be noted that the longitudinal grade and velocities vary along the length of the swales and as such may be required to be lined from different materials. Further confirmation on the lining material of each channel/swale will be determined in the detailed design phase. Refer to *Table 4* for details on the proposed swales for each catchment.

The swale catchment details and locations for the subject site are shown on the Barry Hunt Associates; Proposed Subdivision of Lots 101, 103 & 104 DP1049845 & Lot 2 DP1076610 and Right of Access (Ref: 57511 DSUB10) included as Appendix C.

Table 4: Swale Channel Capacity and Details

Swale Catchment ID	Base Width (m)	Swale Depth (m)	Flow Depth (m)	Longitudinal Slope (%)	Side Slope	Swale Capacity (m^3/s)	Swale Velocity (m^3/s)
1a	-	0.500	0.410	1.50	1 in 2	**0.379**	1.129
1b	0.50	0.550	0.430	0.50	1 in 2	**0.458**	0.783
1c	-	0.450	0.325	0.85	1 in 2	**0.154**	0.728
2a1	1.00	0.600	0.550	2.00	1 in 2	**2.245**	1.944
2a2	-	0.550	0.400	1.75	1 in 2	**0.384**	1.199
2b1	0.50	0.550	0.450	0.75	1 in 2	**0.620**	0.983
2b2	0.75	0.550	0.475	0.50	1 in 2	**0.699**	0.866
2c1	-	0.550	0.425	0.50	1 in 2	**0.241**	0.667
2c2	-	0.600	0.500	0.80	1 in 2	**0.470**	0.941
3b1	-	0.550	0.410	2.50	1 in 2	**0.490**	1.457
3b2	-	0.450	0.325	0.50	1 in 2	**0.118**	0.558
3c1	-	0.500	0.375	7.00	1 in 2	**0.646**	2.297
3c2	-	0.550	0.450	0.65	1 in 2	**0.320**	0.791
5a	-	0.550	0.410	4.90	1 in 2	**0.686**	2.040
5b	-	0.450	0.320	4.25	1 in 2	**0.330**	1.610
7a1	-	0.500	0.350	2.75	1 in 2	**0.337**	1.375
7a2	-	0.550	0.450	2.00	1 in 2	**0.562**	1.387
7b	-	0.350	0.210	9.50	1 in 2	**0.160**	1.818
7c1	0.50	0.550	0.460	0.50	1 in 2	**0.531**	0.813
7c2	-	0.500	0.375	9.50	1 in 2	**0.753**	2.676
7d1	-	0.550	0.440	0.90	1 in 2	**0.355**	0.916
7d2	-	0.450	0.340	3.00	1 in 2	**0.326**	1.409
8a1	-	0.450	0.300	10.00	1 in 2	**0.426**	2.366
8a2	0.75	0.550	0.460	1.30	1 in 2	**1.054**	1.373
8b1	-	0.400	0.265	5.00	1 in 2	**0.216**	1.540
8b2	-	0.500	0.375	3.20	1 in 2	**0.437**	1.553
8c1	-	0.450	0.310	2.00	1 in 2	**0.208**	1.082
8c2	-	0.500	0.375	0.50	1 in 2	**0.173**	0.614
8d1	-	0.450	0.350	5.00	1 in 2	**0.454**	1.854
8d2	-	0.450	0.350	0.85	1 in 2	**0.187**	0.765
8d3	-	0.550	0.475	6.00	1 in 2	**1.124**	2.490
8e	-	0.550	0.490	0.50	1 in 2	**0.352**	0.734
9a	-	0.600	0.540	1.20	1 in 2	**0.708**	1.213
9b	-	0.300	0.200	4.50	1 in 2	**0.097**	1.211
9c	0.50	0.550	0.405	2.75	1 in 2	**0.942**	1.775
10a	-	0.350	0.210	10.00	1 in 2	**0.165**	1.865
10b	-	0.350	0.190	9.00	1 in 2	**0.120**	1.655
11	-	0.550	0.425	2.00	1 in 2	**0.482**	1.335
12a	-	0.350	0.230	6.00	1 in 2	**0.162**	1.535
12b	-	0.450	0.340	1.50	1 in 2	**0.230**	0.996
13a	-	0.500	0.420	2.00	1 in 2	**0.467**	1.324
13b	-	0.550	0.440	3.00	1 in 2	**0.648**	1.673
14a	-	0.450	0.340	0.50	1 in 2	**0.133**	0.575
14b	-	0.500	0.375	3.00	1 in 2	**0.423**	1.504
15	-	0.400	0.325	1.70	1 in 2	**0.217**	1.029

5.0 DRIVEWAY CULVERT SIZING

5.1 Background

The proposed development proposes to construct new driveways that will be located over existing natural drainage channels. Accordingly, the following section provides preliminary details of the proposed culverts to convey flows from the natural drainage channels and upstream catchments under the proposed new driveways.

5.2 Objective

In accordance with MidCoast Council's requirements and typical industry-standard practices, the following objective has been set for the stormwater culvert design for the development:

- All flows from the upstream catchments of the proposed driveways will be conveyed through culverts with a maximum of 600mm ponding above the obvert of the upstream ends of the culverts.

This will ensure all upstream flows are entirely contained within the culvert structures and do not overtop the driveways up to the 1% AEP event (with the exception of major blockage events).

This objective shall be demonstrated via a suitable hydrologic and hydraulic modelling package, by collected site runoff from the subject site via the proposed culvert.

5.3 XP-SWMM Model

An estimation of the culvert's sizes to capture flow from upstream catchments has been undertaken using the XP-SWMM software program.

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 to Latitude -32.6875 (S) and Longitude 152.0625 (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 180 minutes were simulated in the XP-SWMM model analysis to determine design flow estimations for the 1% AEP event.

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 culvert sub-catchment. The following loss rates were adopted:

Table 5: Initial Loss (IL) and Continuing Losses (CL)

Storm Losses (XP-SWMM)		
Sub catchment Type	**Initial Loss (mm/hr)**	**Continuing Loss (mm/hr)**
Impervious	0	0
Pervious	9	0.84

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 catchments. The following values were adopted:

- Impervious Catchment n = 0.015; and
- Pervious Catchment n = 0.075.

5.3.3 Catchment Parameters

The adopted sub-catchment areas, slopes and fraction imperviousness, for the culvert catchments have been tabulated in *Table 6.*

Table 6: Adopted Culvert Catchment Parameters

Culvert Sub-Catchments			
XP-SWMM Sub-Catchment ID	Total Area (ha)	Slope (%)	Fi (%)
C1a	3.827	18.5	5
C1b	1.009	14.0	16
C2a	5.719	25.4	13
C2b	4.760	15.7	10
C2c	1.720	15.7	10
C3a	4.290	24.9	3
C3b	4.262	27.1	4
C3c	2.018	21.0	8
C5	12.00	24.8	5
C7a	4.630	35.6	2
C7b	2.550	28.7	2
C7c	6.780	26.3	3
C7d	1.430	30.0	5
C8a	17.000	28.1	4
C8b	33.747	6.1	3
C8c	0.800	28.1	4
C8d	7.766	9.7	8
C9	4.654	10.8	6
C10	3.014	12.3	4
C11	0.895	10.7	25
C12	3.067	4.3	3
C13	3.614	5.5	3
C14	1.968	5.6	7
C15	0.936	6.6	15

5.3.4 Culvert Sizing

The following have been utilised in the design of the proposed culverts:

- Design of culvert to be undertaken using hydrological assessment model (XP-SWMM);
- Ensure all total flows are conveyed by the culverts up to the 1% AEP event (Q100);
- Allowance for maximum 0.60m ponding depth over the obvert of the upstream ends of the culverts;
- Allowance of 20% blockage in line with typical industry standard modelling practices; and
- All culverts were modelled with a minimum 2% longitudinal grade.

The following table shows a summary of the culvert's characteristics for each catchment. The culvert sub-catchment areas and locations are detailed on OSKA Consulting Group, Stormwater Catchment & Management Plan – Culverts (Ref: OSK6866/P101/C) included respectively as *Appendix D.*

Table 7: Culvert Characteristics

Culvert ID	Culvert Diameter (mm)	Number of Culverts	Depth Over Top of Culvert (m)
C1a	750	2	0.265
C1b	600	1	0.107
C2a	1,200	1	0.382
C2b	750	2	0.592
C2c	750	1	0.132
C3a	750	2	0.536
C3b	750	2	0.567
C3c	750	1	0.492
C5	1,200	2	0.324
C7a	1,200	1	0.086
C7b	900	1	0.166
C7c	900	2	0.575
C7d	750	1	0.065
C8a	1,200	3	0.135
C8b	1,500	3	0.262
C8c	525	1	0.381
C8d	1,200	1	0.369
C9	750	2	0.315
C10	900	1	0.195
C11	525	1	0.428
C12	750	1	0.355
C13	900	1	0.029
C14	750	1	-
C15	525	1	0.344

6.0 STORMWATER QUANTITY, QUALITY AND MANAGEMENT

6.1 Stormwater Quantity and Quality

In accordance with the MidCoast Council Site Stormwater Drainage Guidelines, due to the minimal increase in impervious area for the development and the site's location in close proximity to Karuah Creek and the ocean, it is proposed to not provide any stormwater quantity or quality devices.

It is anticipated that due to the small amount of impervious area proposed for the subject site with a minimum 40ha lot size, there will be a negligible change to flows (quantity and quality) discharging from the subject site and as such no permanent stormwater quantity or quality treatment devices have been proposed. Due to the heavy vegetation downstream of the new driveways and future dwellings that extend at least 50-150m before crossing the subject site boundary, no formal stormwater quality devices are proposed. It is anticipated that any minor pollutants from the new driveways and future dwellings will be treated by the heavy vegetation downstream and when the runoff crosses the site boundary it is not anticipated to cause any adverse effects to the receiving environment (ultimately discharging into Karuah Creek).

The subject site is also located in close proximity to the ocean where it is proposed to discharge all runoff directly to the receiving waterways which are connected and discharge to Karuah Creek and the ocean. It is anticipated that by discharging all the site's flows directly to the receiving waterways that it can allow peak flows from the site to be discharged prior to the wider catchment/regional flood peak.

6.2 Stormwater Management

Clause 7.5 of *Great Lakes Local Environmental Plan 2014* pertains to Stormwater Management as follows:

1. *The objective of this clause is to minimise the impacts of stormwater on land to which this clause applies and on adjoining properties, native bushland, groundwater, wetlands and receiving waters.*
2. *Development consent must not be granted to development on any land unless the consent authority is satisfied that the development:*
    a) *is designed to maximise the use of water permeable surfaces on the land having regard to the soil characteristics affecting on-site infiltration of water, and*
    b) *is designed to minimise the use of impervious surfaces on the land, directing run off to piped drainage systems and waterways, and*
    c) *is designed to integrate water sensitive design measures, including stormwater, groundwater and waste water management, to minimise environmental degradation and to improve the aesthetic and recreational appeal of the development, and*
    d) *incorporates an appropriately managed and maintained stormwater management system that will maintain or improve the quality of stormwater discharged from the land, and*
    e) *includes, if practicable, on-site stormwater retention for use as an alternative supply to mains water, groundwater or river water, and*
    f) *avoids any significant adverse impacts of stormwater runoff on adjoining properties, native bushland, groundwater, wetlands and receiving waters, or if that impact cannot be reasonably avoided, minimises and mitigates the impact.*

The proposal responds to clause 7.5 of *Great Lakes Local Environmental Plan 2014* pertains to Stormwater Management as follows:

- All runoff upstream of the proposed driveways is to be directed to one of a number of culverts via swales before being conveyed through the culverts. The culverts have been designed to ensure all upstream flows are entirely contained within the culvert structures and do not overtop the driveways up to the 1% AEP event (with the exception of major blockage events).
- Due to the minimum lot size being 40ha, it is anticipated that there will only be a small increase in impervious area resulting in a negligible change to flows (quantity and quality) discharging from the subject site. The subject site is also located in close proximity to the ocean where it is proposed to discharge all runoff directly to the receiving waterways which are connected and discharge to Karuah Creek and the ocean. It is anticipated that by discharging all the site's flows directly to the receiving waterways that it can allow peak flows from the site to be discharged prior to the wider catchment/regional flood peak. Therefore, the development will not propose any formal stormwater quantity or quality devices.
- Due to the heavy vegetation downstream of the new driveways and future dwellings that extend at least 50-150m before crossing the subject site boundary, no formal stormwater quality devices are proposed. It is anticipated that any minor pollutants from the new driveways and future dwellings will be treated by the heavy vegetation downstream and when the runoff crosses the site boundary it is not anticipated to cause any adverse effects to the receiving environment (ultimately discharging into Karuah Creek).

Consequently, the proposal is satisfactory having regard to clause 7.5 of *Great Lakes Local Environmental Plan 2014* with respect to Stormwater Management.

7.0 CONCLUSIONS

OSKA Civil Consultants has been commissioned by Tea Garden Farms Pty Ltd to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application (DA) to the MidCoast Council (MCC) for the proposed subdivision development situated at 253 Bundabah Road, Bundabah and 120 Clarke Street, Pindimar.

Four lots comprising of 401.6ha are proposed to be subdivided into 9 large rural style lots ranging in size from 40.1ha to 55.8ha with primary and secondary access options via Bundabah Road and Clarke Street.

This CSWMP intends to provide an optimised stormwater drainage system that would be compatible and readily integrated into the proposed use of the site.

The development will not propose any formal stormwater quantity or quality devices however, will propose a number of culverts and swales along and under the new driveways to capture and convey stormwater. Due to the minimal increase in impervious areas as a result of the proposed development, with the minimum lot size of 40ha it is anticipated that there will be a negligible change to flows (quantity and quality) discharging from the subject site and as such no permanent stormwater quantity or quality treatment devices have been proposed. Despite no formal stormwater quantity or quality devices being proposed, the dense vegetation downstream of the proposed driveways and future dwellings, is anticipated to assist in treating the runoff from the proposed development prior to ultimately discharging into Karuah Creek. The subject site is also located in close proximity to the ocean where it is proposed to discharge all runoff directly to the receiving waterways which are connected and discharge to Karuah Creek and the ocean. It is anticipated that by discharging all the site's flows directly to the receiving waterways that it can allow peak flows from the site to be discharged prior to the wider catchment/regional flood peak.

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 MidCoast Council's stormwater controls.

A Rational Method calculation has been provided to estimate the swale catchment flows with a Manning's calculation also to ensure that the channels are sized to an adequate capacity. A hydraulic model was built using the XP-SWMM software program, to estimate the required culvert sizing and arrangement.

The report and stormwater management plan define the preliminary size and layout of the proposed culverts and swales to ensure all flows (up to 1% AEP event) are conveyed within the proposed culverts and swales. The proposal is satisfactory having regard to Stormwater Management in *Great Lakes Local Environmental Plan 2014*.

APPENDIX

A

Barry Hunt Associates; Detail and Contour Survey & Proposed Subdivision of Lots 101, 103 & 104 DP 1049845 & Lot 2 DP 1076610 (Ref: 57511 DSUB10)

DETAIL AND CONTOUR SURVEY

BUNDABAH

ROAD

FAME POINT ROAD

CONC CULVERT

LOT 100
DP 1049845
10.12ha

LOT Z DP 252388

LOT 4
DP 2852388

LOT 27
DP 237407

LOT 20
DP 238401

LOT 15
DP 238401

LOT 22
DP 238401

LOT 14
DP 238401

LOT 13
DP 238401

LOT 12
DP 238401

LOT 17
DP 238401

LOT 3
DP 236406

LOT 1
DP 1076610

NORTH ARM COVE

CLARKE STREET

0.58m CONTOUR

DA125-2018

DA126-2019

DA-8/2019/A

DA821-2002

DA825-2002

DA-218-2016-A

DA228-2014 &
DA218-2016

APPROXIMATE LOCATION
OF CONCRETE FOOTINGS

EXISTING BOUNDARY

1 40ha
2 42.2ha
3 42ha
4 43.3ha
5 55.4ha
6 54.9ha
7 43.8ha
8 40ha
9 40ha

1A 2A 3A 4A 5A 6A 7A 8A 9A

FAME COVE

LOT 1
DP 1014683

SOUTH PINDAMAR BEACH

LOT 9
DP 659980

KARUAH RIVER PORT STEPHENS

PIGGY BEACH

(A) RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1229396)

(B) RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1229396)

(C) RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1258800)

DENOTES EXISTING ACCESS TRACKS

CONTOUR INTERVAL 5m
MEAN HIGH WATER MARK DEFINED BY MANLY HYDROLICS LABORATORY AT 0.58m A.H.D.

20x20m POTENTIAL HOUSE SITE
EXCEPT 3A (EXISTING APPROVAL 20x35m)

NOTE: AREAS AND DIMENSIONS SUBJECT TO FINAL SURVEY

0 40 80 160 240 320 1: 4000(A0)

	AMENDMENTS	DATE
D	EXISTING TRACKS DENOTED	9/5/25
C	AREAS AMENDED	20/3/25
B	LOT AMENDMENTS	11/2/25
A	ORIGINAL ISSUE	4/11/24

REGISTERED SURVEYOR

DRAWN JRCH DATE 4/11/24

SURVEYED MR DATE OCT 24

Barry Hunt Associates

REGISTERED SURVEYORS AND
LAND DEVELOPMENT CONSULTANTS
SUITE 4, 1 BOUNTY CL, TUGGERAH 2259
P.O. BOX 4144, BAY VILLAGE, 2261
PHONE (02) 43539644 FAX (02) 43533858
Email ~admin@surveyors.com.au

LOCALITY: 253 BUNDABAH ROAD, BUNDABAH AND 120 CLARKE STREET, PINDIMAR L.G.A. MID COAST

CLIENT: TEA GARDENS FARMS

PROJECT: DEVELOPMENT

PLAN: DETAIL AND CONTOUR SURVEY AND PROPOSED SUBDIVISION OF LOTS 101, 103 & 104 DP 1049845 + LOT 2 DP 1076610 AND RIGHT OF ACCESS WITHIN LOTS 14 & 22 DP 238401 + LOT 100 DP 1049845

DATUM: GDA 1994 AUSTRALIAN HEIGHT DATUM

SCALE: 1:4000(A0)

CAD REF: 57511DSUB10

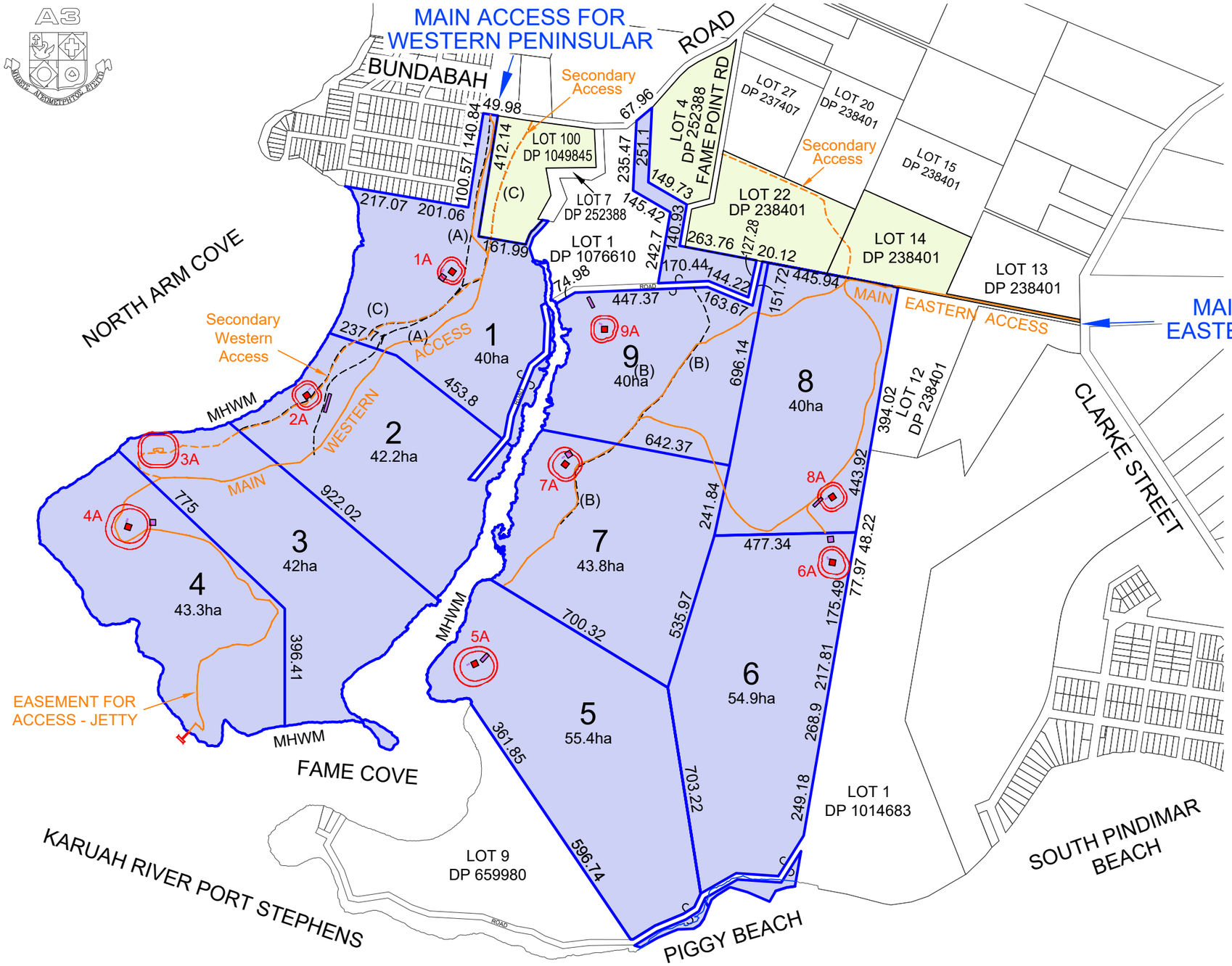
SHEET 3 OF 12

APPENDIX

B

Barry Hunt Associates; Proposed Subdivision of Lots 101, 103 & 104 DP1049845 & Lot 2 DP1076610 and Right of Access (Ref: 57511 DSUB10)

PROPOSED LOT LAYOUT



LEGEND

MHWM	DENOTES MEAN HIGH WATER MARK
■	20x20m INDICATIVE BUILDING FOOTPRINT EXCEPT 3A (EXISTING APPROVAL 20x35m) SEE SHEETS 4-12 FOR DETAILS
○	ASSET PROTECTION ZONES (APZs) (19kW) IPA: INNER PROTECTION AREA OPA: OUTER PROTECTION AREA SEE SHEETS 4-12 FOR DETAILS
▭	DENOTES PROPOSED SUBDIVISION LOTS
▭	DENOTES COMMON OWNERSHIP WITH SUBJECT SITE BUT NOT PROPOSED TO BE SUBDIVIDED.
———	PROPOSED RIGHT OF ACCESS (PRIMARY)
- - - -	PROPOSED RIGHT OF ACCESS (SECONDARY)
(A) - - - -	RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1229396) TO BE REMOVED
(B) - - - -	RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1229396) TO BE REMOVED
(C) - - - -	RIGHT OF CARRIAGEWAY OVER TRACK IN USE APPROXIMATE POSITION (DP 1258800) TO BE REMOVED

NOTE: AREAS AND DIMENSIONS SUBJECT TO FINAL SURVEY

Mark Rolls
REGISTERED SURVEYOR

DRAWN	JRCH	DATE	9/05/25
SURVEYED	MR	DATE	OCT 24

Barry Hunt Associates
REGISTERED SURVEYORS AND
LAND DEVELOPMENT CONSULTANTS
SUITE 4, 1 BOUNTY CL., TUGGERAH 2259
P.O. BOX 4144, BAY VILLAGE. 2261
PHONE (02) 43539644 FAX (02) 43533855
Email ~admin@surveyors.com.au

LOCALITY : 253 BUNDABAH ROAD, BUNDABAH AND 120 CLARKE STREET, PINDIMAR L.G.A. MID COAST		PLAN : PROPOSED SUBDIVISION OF LOTS 101, 103 & 104 DP 1049845 + LOT 2 DP 1076610 AND RIGHT OF ACCESS WITHIN LOTS 14 & 22 DP 238401 + LOT 100 DP 1049845	
CLIENT :	TEA GARDENS FARMS	DATUM GDA 1994 AUSTRALIAN HEIGHT DATUM	SCALE 1:15,000 (A3)
PROJECT :	DEVELOPMENT	CAD REF: 57511 DSUB10	SHEET 2 OF 12

APPENDIX

C

OSKA Consulting Group, Stormwater Catchment & Management Plan - Swales (Ref: OSK6866/P102/C)

LEGEND

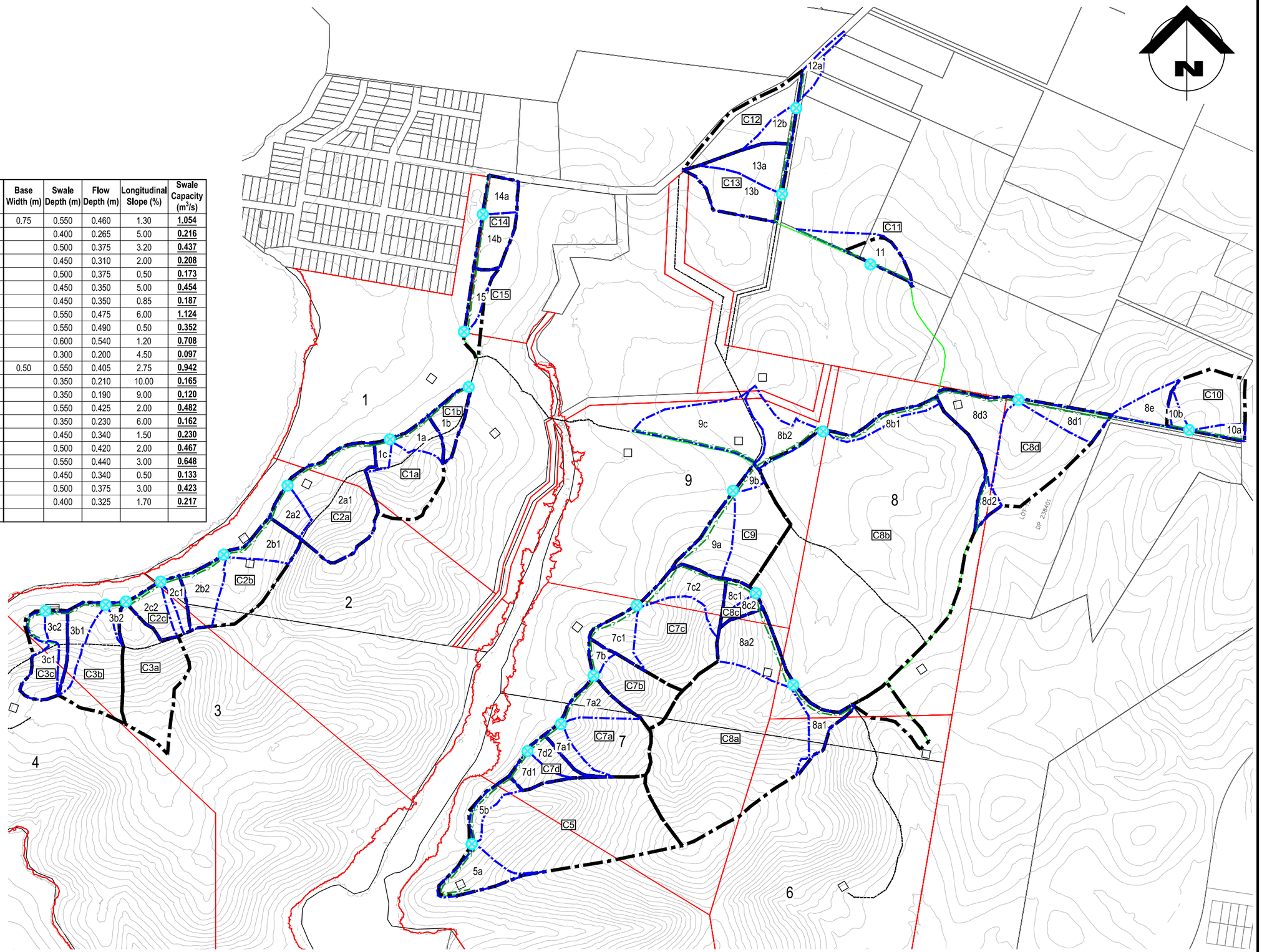
- CULVERT CATCHMENT BOUNDARY
- SWALE CATCHMENT BOUNDARY
- PROPOSED DRIVEWAY
- EXISTING ACCESS TRACKS
- PROPOSED LOT BOUNDARIES
- C1 — CULVERT CATCHMENT I.D.
- 14b — SWALE CATCHMENT I.D.
- PROPOSED SWALE
- PROPOSED CULVERT

ID	Base Width (m)	Swale Depth (m)	Flow Depth (m)	Longitudinal Slope (%)	Swale Capacity (m^3/s)	ID	Base Width (m)	Swale Depth (m)	Flow Depth (m)	Longitudinal Slope (%)	Swale Capacity (m^3/s)
1a		0.500	0.410	1.50	0.379	8a2	0.75	0.550	0.460	1.30	1.054
1b	0.50	0.550	0.430	0.50	0.458	8b1		0.400	0.265	5.00	0.216
1c		0.450	0.325	0.85	0.154	8b2		0.500	0.375	3.20	0.437
2a1	1.00	0.600	0.550	2.00	2.245	8c1		0.450	0.310	2.00	0.208
2a2		0.550	0.400	1.75	0.384	8c2		0.500	0.375	0.50	0.173
2b1	0.50	0.550	0.450	0.75	0.620	8d1		0.450	0.350	5.00	0.454
2b2	0.75	0.550	0.475	0.50	0.699	8d2		0.450	0.350	0.85	0.187
2c1		0.550	0.425	0.50	0.241	8d3		0.550	0.475	6.00	1.124
2c2		0.600	0.500	0.80	0.470	8e		0.550	0.490	0.50	0.352
3b1		0.550	0.410	2.50	0.490	9a		0.600	0.540	1.20	0.708
3b2		0.450	0.325	0.50	0.118	9b		0.300	0.200	4.50	0.097
3c1		0.500	0.375	7.00	0.646	9c	0.50	0.550	0.405	2.75	0.942
3c2		0.550	0.450	0.65	0.320	10a		0.350	0.210	10.00	0.165
5a		0.550	0.410	4.90	0.686	10b		0.350	0.190	9.00	0.120
5b		0.450	0.320	4.25	0.330	11		0.550	0.425	2.00	0.482
7a1		0.500	0.350	2.75	0.337	12a		0.350	0.230	6.00	0.162
7a2		0.550	0.450	2.00	0.562	12b		0.450	0.340	1.50	0.230
7b		0.350	0.210	9.50	0.160	13a		0.500	0.420	2.00	0.467
7c1	0.50	0.550	0.460	0.50	0.531	13b		0.550	0.440	3.00	0.648
7c2		0.500	0.375	9.50	0.753	14a		0.450	0.340	0.50	0.133
7d1		0.550	0.440	0.90	0.355	14b		0.500	0.375	3.00	0.423
7d2		0.450	0.340	3.00	0.326	15		0.400	0.325	1.70	0.217
8a1		0.450	0.300	10.00	0.426						

NOTE:

THE CHANNELS/SWALES HAVE ALL BEEN DESIGNED AS GRASS LINED WITH A MANNING'S 'n' VALUE OF 0.035.

THE LONGITUDINAL GRADES AND VELOCITIES OF THE CHANNELS/SWALES VARY ALONG THE ENTIRE LENGTH AND MAY BE REQUIRED TO BE LINED OUT OF DIFFERENT MATERIAL (E.G. GRASS, ROCK, CONCRETE ETC). CONFIRMATION ON THE LINING OF EACH CHANNEL/SWALE WILL BE DETERMINED IN THE DETAILED DESIGN PHASE.



REV	DESCRIPTION	DRAWN	DATE
C	ISSUED FOR REPORT	MS	30-04-25
B	ISSUED FOR REPORT	BG	14-02-25
A	ISSUED FOR REPORT	BG	17-01-25

DRAWN: BG | DESIGN: AWE | APPROVED: TP

SIGNED

DATE

OSKA CONSULTING GROUP

DRAWING IS NOT TO BE SCALED

SCALE

1:5000 AT A1
1:10000 AT A3

0 100 200m

CLIENT

TEA GARDEN FARMS PTY LTD

PROJECT

PROPOSED DEVELOPMENT
253 BUNDABAH ROAD, BUNDABAH
AND 120 CLARKE STREET, PINDIMAR

STAGE / PHASE

FOR INFORMATION ONLY NOT FOR CONSTRUCTION

TITLE

STORMWATER CATCHMENT & MANAGEMENT PLAN - SWALES

DRAWING NUMBER: OSK6866-P102

REVISION: C

APPENDIX

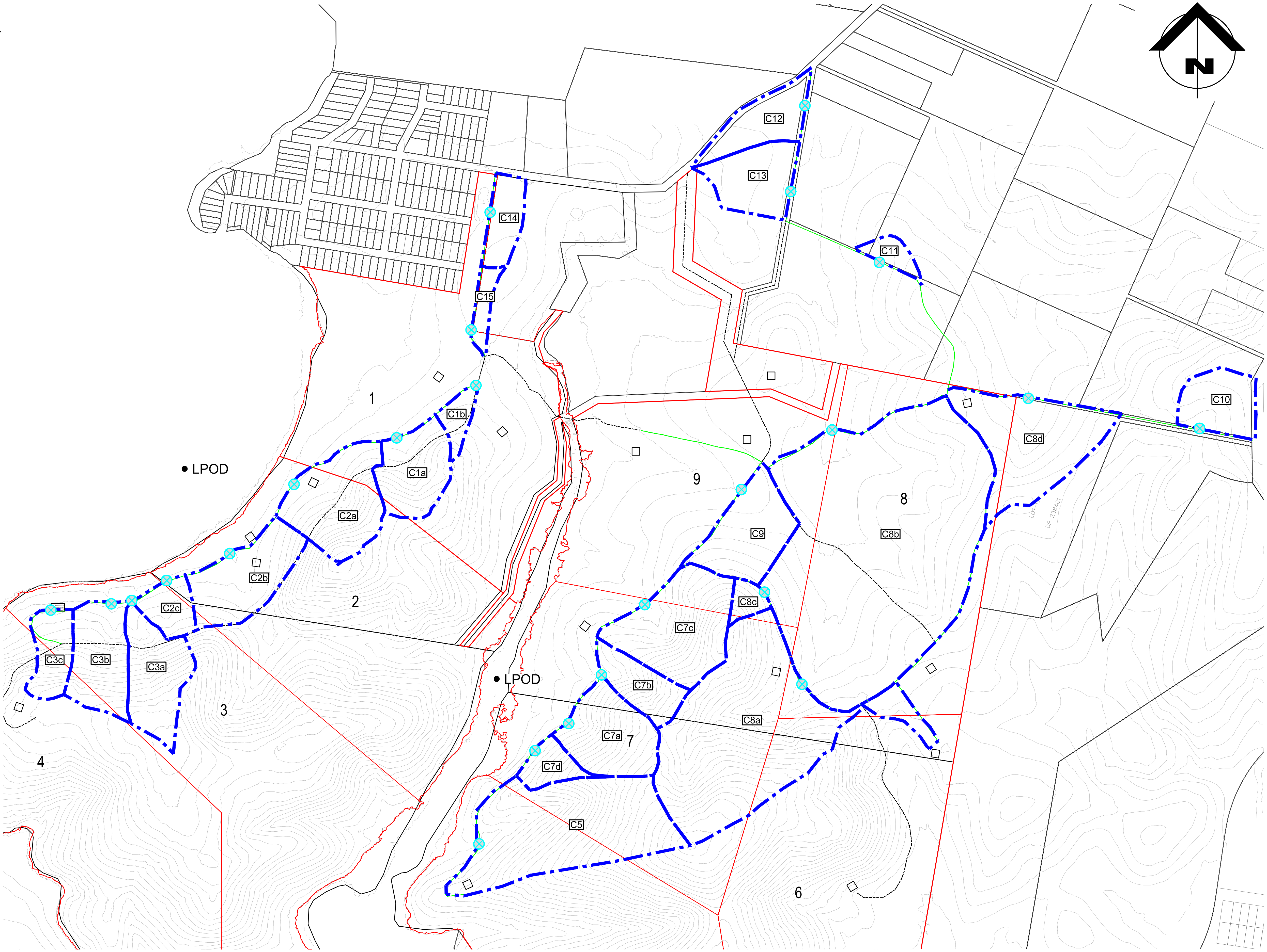
D

OSKA Consulting Group, Stormwater Catchment & Management Plan – Culverts (Ref: OSK6866/P101/C)

LEGEND

- CULVERT CATCHMENT BOUNDARY
- PROPOSED DRIVEWAY
- EXISTING ACCESS TRACKS
- PROPOSED LOT BOUNDARIES
- C1 — CULVERT CATCHMENT I.D.
- PROPOSED CULVERT
- ● LPOD — LAWFUL POINT OF DISCHARGE

ID	Catchment Area (ha)	Culvert dia (mm)	Number of Culvert's
C1a	3.827	750	2
C1b	1.009	600	1
C2a	5.719	1,200	1
C2b	4.760	750	2
C2c	1.720	750	1
C3a	4.290	750	2
C3b	4.262	750	2
C3c	2.018	750	1
C5	12.000	1,200	2
C7a	4.630	1,200	1
C7b	2.550	900	1
C7c	6.780	900	2
C7d	1.430	750	1
C8a	17.000	1,200	3
C8b	33.747	1,500	3
C8c	0.800	525	1
C8d	7.766	1,200	1
C9	4.654	750	2
C10	3.014	900	1
C11	0.895	525	1
C12	3.067	750	1
C13	3.614	900	1
C14	1.968	750	1
C15	0.936	525	1



REV	DESCRIPTION	DRAWN	DATE
C	ISSUED FOR REPORT	MS	30-04-25
B	ISSUED FOR REPORT	BG	14-02-25
A	ISSUED FOR REPORT	BG	17-01-25

DRAWN: BG DESIGN: AWE APPROVED: TP

SIGNED

DATE

OSKA CONSULTING GROUP

DRAWING IS NOT TO BE SCALED

SCALE 1:5000 AT A1 1:10000 AT A3 — 0 100 200m

CLIENT: TEA GARDEN FARMS PTY LTD

PROJECT: PROPOSED DEVELOPMENT 253 BUNDABAH ROAD, BUNDABAH AND 120 CLARKE STREET, PINDIMAR

STAGE / PHASE: FOR INFORMATION ONLY — NOT FOR CONSTRUCTION

TITLE: STORMWATER CATCHMENT & MANAGEMENT PLAN - CULVERTS

DRAWING NUMBER: OSK6866-P101

REVISION: C