osgood civil resource engineering

OCRE

McLeods Creek, GUNDAROO

FLOOD STUDY

CLIENT	Paul Carmody
PROJECT No	1407
DATE	05 May 2014
REVISION	0

Produced by Van Osgood
Rev: 0 Date: 05 May 2014
C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\2_Docs\Flood Report Rev0 2014 05 05.docx

Contents

Executive Summary

The McLeods Creek flood study was prepared to enable the Yass Valley Council to progress the rezoning of land (PP-2012-03) north of the Village of Gundaroo, namely Lots 1 & 2 DP850916 “Kyeema”, Gundaroo Rd, for the purposes of development of the land to permit subdivision into residential allotments.

The peak ARI100 flood event in the McLeods Creek corridor as illustrated in drawing 1407-SWMP001 (Appendix B) has insignificant impact on the development area. The ARI100 flood extents do not encroach onto any land proposed to be developed for residential purposes or do not encroach onto any existing residential properties along the McLeods Creek corridor within the subject area.

It has been prepared in accordance with the principles and guidelines of the Floodplain Development Manual 2005 by modelling numerous ARI100 and Probable Maximum Flood events. The results illustrate *consistency* with *Section 117(2) of the Environmental Planning and Assessment Act, Direction 4.3 Flood Prone Land*, in particular clause (6) points a & b, i.e.:

a) **there are no residential properties proposed within the peak ARI100 flood extents and**
b) **there are no existing properties effected by the peak ARI100 flood event.**

Hence it would be suitable to rezone the subject land to permit development of the residential properties.

The ARI100 flood extents are suitable to be used for setting planning controls for the subject land under consideration and are recommended to be used for this purpose, in future development applications.

The report also illustrates the Probable Maximum Flood extents within the subject area providing a reasonable understanding of this rare event for the residential development area along McLeods Creek, north of Gundaroo.

1 Introduction

Osgood CRE Pty Ltd was engaged by Diverse Project Solutions for Mr Paul Carmody to undertake a study of the flood impacts on land adjacent to McLeods Creek at Gundaroo. The flood study was required to enable the Yass Valley Council to progress the rezoning of land (PP-2012-03) north of the Village of Gundaroo, namely Lots 1 & 2 DP850916 "Kyeema", Gundaroo Rd, for the purposes of development of the land to permit subdivision into residential allotments.

To date there has not been any such review of the impacts of flooding in this area to satisfy the Yass Valley Council as required by The Office of Environment and Heritage, namely Section 117(2) of the Environmental Planning and Assessment Act, Direction 4.3 Flood Prone Land.

This report details the results of the flood study to support the rezoning of the land and subsequent development of residential allotments. The report will detail the peak design ARI100 flood extents which are to be used to determine acceptable development areas and floor levels of future dwellings and will present a reasonable estimate of the design Probable Maximum Flood limits to understand the impacts of flooding that currently exist within the proposed development area along McLeods Creek.

1.1 Background

It is understood that Yass Valley Council (YVC) have not undertaken any form of review of flood impacts on McLeods Creek for the village area of Gundaroo. However in order to permit the land to be rezoned for residential purposes, an understanding of the impacts of flooding, namely the flood level and other subsequent flood criteria (flow rate and velocity), is to be determined for the subject land.

Accordingly to gain an understanding of the impacts of the flooding in McLeods Creek the Floodplain Development Manual, the Management of Flood Liable Land, April 2005, NSW Government is the reference document for which the review has been undertaken and the study will demonstrate consistency with Section 117(2) of the Environmental Planning and Assessment Act, Direction 4.3 Flood Prone Land.

The proposed development area is illustrated in Appendix A.

2 Data

2.1 Site

Lot 1 & 2 DP850916 "Kyeema" is located north of the village of Gundaroo, NSW, 32kms north north east of Canberra and 50km south west of Goulburn, NSW (refer dwg 1407-SWMP000, Appendix B). The property is bounded by Gundaroo Road to the west, farm land to the north and east (Lot 6 DP708530, Lots 3 & 4 DP850916) and existing residential properties on the northern edge of Gundaroo which front onto Rosamel St (refer dwg 1407-SWMP001, Appendix B).

McLeods Creek drains in a westerly direction through the southern half of the subject property passing through culverts in Marked Tree Road and exiting the property via a triple cell reinforced concrete box culvert (RCBC) in Gundaroo Road. There is an online surface water storage reservoir in the middle of the property providing stock and domestic water.

The existing reservoir is (when full) roughly rectangular in shape with dimensions 180m x 140m. The volume of the surface water storage has not been determined. Overflow facilities for the reservoir include a 30-40m wide spillway with 4 x 300mm dia pipe culvert. The dam embankment is located on the western and southern side of the reservoir and includes a gravel track permitting access from the dwelling on Lot 1 DP850916 to Rosamel St on the Lute St alignment.

It should be noted that the existing dam was assumed to be full at the commencement of storm events and thus did not provide any temporal storage of runoff, thus providing a conservative runoff routing result.

2.2 McLeods Creek

Discussion about the subject water course will generally be restricted to the portion of the creek within the boundary of the subject parcel of land, i.e. Lots 1 & 2 DP850916. As stated above McLeods Creek passes beneath Marked Tree Road via concrete culverts flowing toward the existing dam. The channel appears to be reasonably smooth and only illustrating some incised channel sections immediately upstream of the dam and upstream of the Gundaroo Rd RCBC.

Downstream of the Gundaroo Rd RCBC the creek is more incised and meanders to meet the Yass River approximately 400m west of Gundaroo Rd.

Some erosion is evident midway between the spillway of the dam and Gundaroo Rd. A significant amount of sediment (approximately 0.6m deep) was observed in the Gundaroo Rd RCBC. The water course is generally free of trees apart from the lower reaches immediately upstream of the Gundaroo Rd RCBC.

Survey of the water course highlighted significant (thick) vegetation within the banks and aerial photography illustrates slashed grasslands outside of the top of banks. Accordingly the Manning's 'n' coefficients used in the flood models were generally adopted as 0.045 within the creek and 0.035 for the floodplain areas outside the creek.

2.3 Catchment

The five catchments analysed in this flood review are presented in dwg 1407-SWMP002 (Appendix A) with the total catchment area draining to the Gundaroo Rd RCBC outlet totalling 1,008ha. The overall catchment commences at elevations of 790-800m AHD located east of the site and drains to the lower elevations of 573 AHD at the Gundaroo Rd RCBC. The catchment is 7.0km in length and approximately 2.5km wide. Grades range from 15% to less than 1% in the lower portions within the subject property.

The catchment includes the McLeods Creek Nature Reserve. Aerial photographic images illustrate the catchment is dominated by grassland with sparse trees, however there are some pockets of native woodland, particularly at higher elevations.

2.4 Topography/Survey

Topographical information illustrated in the drawings was obtained by detailed survey of the creek corridor within the confines of the subject property. Thus this data set is of sufficient accuracy to define the water course channel. Outside of the surveyed area, generally outside of the subject land, the topographical information was obtained from Google Earth Imagery, the LPMA Six Viewer website including the 1:25,000 topographic map series and 10m interval contour data from YVC.

The detailed survey extended to beyond the ARI100 flood limits (as shown by the results) however was limited to the property boundaries which has shown to be somewhat limiting in the extent of the PMF limits.

2.5 Layout

Subdivision of Lot 1 & 2 DP850916 is proposed to comprise 65 residential lots ranging in area of 2,000m^2 to 12,000m^2 (refer dwg Proposed Plan of Subdivision Lots 1 & 2 DP850916 4056-4078 Gundaroo Road, Gundaroo, Appendix A). The proposed subdivision layout includes six roads with two roads intersecting Gundaroo Rd and one road intersecting Rosamel St on the Lute St alignment (refer dwg 1407-SWMP001, Appendix B). It is this latter road (Road 1) that crosses the McLeods Creek at the upper fringes of the existing surface water storage.

2.6 Hydrology

In accordance with the Floodplain Development Manual, the Management of Flood Liable Land, April 2005, NSW Government, the flood review concentrated on the ARI100 and the Probable Maximum Flood (PMF) events. The ARI100 and the PMF events utilise different rainfall depths and temporal distribution over the catchment. Hence the data used in each of the events is described separately below.

2.6.1 ARI100

Rainfall used in the ARI100 event model was based on the rainfall data presented for Zone 2 in ARR1987 Volume 2. That being the 60min 100 year rainfall with a 5 minute interval. Storms modelled included the 30min, 1hr, 2hr, 3hr, 6hr, 9hr and 12hr events using the hyetographs from ARR1987 Vol 2.

Infiltration or the loss method adopted in both the ARI100 and PMF models included a Uniform Loss method with the following depths:

Catchment Component	Initial Loss [mm]	Continuing Loss Absolute [mm]	Depression Storage [mm]
Pervious	15	2.5	0
Impervious	2	0	0

Routing method utilised in both ARI100 and PMF models was Laurenson's Routing Method.

Total simulation time for the storm events was set at 24 hours.

2.6.2 PMF

Rainfall used in the PMF event model, or the Probable Maximum Precipitation (PMP) was determined in accordance with The Estimation of the Probable Maximum Precipitation in Australia: Generalised Short-Duration Method, Commonwealth Bureau of Meteorology, June 2003. In accordance with the Generalised Short-Duration Method (GSDM) the duration limit for this catchment was 5 hours, thus storms modelled included the 30min, 45min, 1hr, 1.5hr, 2hr, 2.5hr, 3hr, 4hr, and 5hr events using the

design temporal distribution of the PMP as presented in Table 1 of the GSDM document referred above.

PMP Parameters for the subject catchment were as follows:

Portion Smooth S – 1.0, Portion Rough R – 0.0

Mean Elevation – 690m, EAF – 1.00

GSDM MAF – 0.66

ELIPSE AREAS – A – 2.6km^2, B – 5.5km^2, C – 2.0km^2

2.7 Hydraulic

Given a 1-D model was utilised for the flood routing calculations, the detailed survey permitted the open channel sections of the creek to be assumed between node points within the watercourse, thus mimicking a constant channel section downstream of each node.

In accordance with the YVC Drainage Design Specification, V1.3 June 2007, the starting HGL for both the ARI100 and PMF models was set at the obvert level of the RCBC at Gundaroo Rd with a fixed backwater parameter, i.e. 572.159AHD. This being the top of the outlet pipe for the design 100 year ARI event and the PMF event in the absence of any better data.

Manning's Open Channel Flow methodology was then utilised to ascertain the stage of each flood event.

3 Methodology

The methodology used in the determination of the ARI100 flood and PMF limits for the McLeods Creek was as follows:

1. Import detailed survey of creek corridor into 12D civil engineering software and produce a DTM of the watercourse. Obtain creek channel sections at various node/positions in the creek (refer dwg 1407-SWMP003, Appendix B).
2. Create a hydrologic and hydraulic model in XP Storm software of the subject section of McLeods Creek by importing catchment nodes and setting channel sections to convey the runoff down the system.
3. Undertake a variety of storm events (durations) for the ARI100 and PMF models.
4. Export the water surface levels at each section back to the DTM and document.
5. Produce a Flood Limit Plan illustrating the ARI100 Flood and PMF Extents (refer dwg 1407-SWMP003, Appendix B).

4 Results

4.1 ARI100

The maximum ARI100 flood extents are presented in dwg 1407-SWMP001 (Appendix B) illustrating the extent of the McLeods Creek floodplain which is inundated by the maximum flow

from the ARI100 events. The critical storm duration that causes the maximum event is generally the 2hr storm. The following results are describing the 2 hour ARI100 storm event and the resulting flood extents.

4.1.1 Flows

Drawing 1407-SWMP003 (Appendix B) presents the maximum runoff flow rates from the catchments and hence the maximum flow rates at each section modelled. Generally the maximum flow rate entering the subject land is 42.6m^3/s, increasing to 53.4m^3/s discharging through the Gundaroo Rd RCBC.

4.1.2 Water Depths

The peak ARI100 flood event maximum water depths are illustrated on each individual section presented in drawings 1407-SWMP004-007 (Appendix B). It is shown that the peak ARI100 event produces a water depth at the upstream (eastern) end of McLeods Creek of 2.57m (above creek invert) or a water elevation of 580.94m AHD.

In the central area of the site (section E) the maximum water depth appears to be 0.66m or a water elevation of 576.94m AHD, this representing the shallowest section of water, due to the steeper slope of the land in this area.

At the lower end of the system and where the Creek departs the subject property and enters the Gundaroo Road Reserve, the ARI100 maximum water depth is 2.74m or water elevation 573.85m AHD. This being the deepest in the system as Section G (dwg 1407-SWMP007 Appendix B) is the most incised creek section within the water course.

4.1.3 Inundation

The area inundated by the peak ARI100 event is presented in drawing 1407-SWMP001 (Appendix A) noted by the blue hatched area. The ARI100 flood extents do not encroach onto any existing or proposed residential properties, however the said flood does appear to encroach onto the proposed Road 6 Road Reserve. This inundated area is essentially covering the existing topography and thus any formation construction for Road 6 would create an embankment between the proposed Lots 19-21 and the ARI100 flood waters, thus providing an increased level of protection to the proposed properties nearest the ARI100 flood limits.

4.1.4 Dam & Spillway Performance

As illustrated in Sections C & D (Drawing 1407-SWMP005, Appendix B) the peak ARI100 flood stage does not breach the dam wall in the surface water storage or the spillway. Thus the maximum ARI100 flood is contained and conveyed within the dam infrastructure. Therefore it is acceptable to consider that the existing surface water storage has the capacity to convey the ARI100 event safely. It should be reiterated that the surface water storage is assumed to be full and no storage or detention facility has been utilised in the flood models, thus providing a conservative result.

4.2 PMF

The maximum flows and hence greatest depths from the PMF models appeared to be produced in the 1 hr. event of the PMP. That is for all nodes or sub catchments apart from sub catchment G-02 which is offsite due to that catchment being relatively smaller in size and therefore quicker to produce a peak runoff. The peak flow rates calculated in the PMF model are tabled on drawing 1407-SWMP003 (Appendix B). The drawings also indicate the PMF limits and stage depths (with the ARI100 results for comparative purposes).

4.2.1 Flows

The runoff flow rates calculated from the PMP appear to be greater that the ARI100 peak runoff flow rates by at least an order of magnitude of 10. The PMF flow rate within McLeods Creek entering the subject site (Section A) was calculated at 525m^3/s (the peak ARI100 flow rate at the same section was 42.6m^3/s). The peak discharge from the site within this watercourse was calculated to be 645m^3/s.

4.2.2 Water Depths

Accordingly, when comparing the ARI100 flow depths to the PMF flow depths, the difference is considerable. Drawings 1407-SWMP004-007 illustrate the PMF water depths at the respective sections along the Creek. At the eastern end of the subject property (Section A) the PMF depths appear to be 4.79m or water elevation of 583.16m AHD or 2.22m higher than the ARI100 flood depth at the corresponding location.

Section F, in the middle section of the site, downstream of the dam and between proposed Roads 2 & 6, the PMF depth is 3.5m or water elevation 576.23m AHD (2.20m above the ARI100 flood stage).

The deepest location of the PMF is also at Section G (as per the ARI100 event) illustrating a depth of 4.7m or water elevation of 575.76m AHD, 1.96m above the ARI100 flood level at the same location.

4.2.3 Inundation

Given the increased runoff and greater water depths, the area inundated by the PMF is also greater than the peak ARI100 flood event as illustrated by drawings 1407-SWMP003 (Appendix B). Where the PMF is shown to encroach onto existing or proposed properties, it does not inundate the entire property, confirming that any built form on such properties may be clear of the PMF.

The detailed survey did not extend past the alignment of proposed Road 2 and therefore the full extent of the PMF flood that may impact on the western allotments (#46-51, 55-65) is less certain. However as for Road 6, any road formation construction for Road 2 should include a suitably designed embankment that could act as a levee directing flow downstream instead of laterally across the land, thus providing an increased level of protection to the properties behind.

Proposed Lot 17 appears to illustrate the most (on property) inundation in the PMF event, however not all the property would be inundated. This level of inundation from the PMF is attributed to the boundary condition within the model, i.e. the RCBC in Gundaroo Road and does not take into consideration of any future Road 6 construction.

4.2.4 Dam & Spillway Performance

As can be observed in Sections B, C & D, the PMF is not contained within the dam embankment and as such will skirt around the southern arm (east-west running) of the embankment and flow in a westerly direction and reconverge with the original watercourse below the dam embankment. This level of inundation illustrates that the dam and spillway cannot accommodate the PMF and hence would be breached. Being a rural dam it was never intended to convey the PMF and breaching of the dam embankment and spillway is to be expected in the PMF conditions.

4.2.5 Velocities

The greater flow in the PMF accordingly increases the velocity of flow and the greatest velocity of flow is contained within the deeper channel areas. Thus the fringes of the PMF extents illustrate the lowest velocities within the water column. Therefore the

velocities given below are indicative, are provided for comparative purposes only and should not be taken as absolute for any one position in the section or watercourse.

Stream Section	LHS Floodplain Velocity [m/s]	Main Channel Velocity [m/s]	RHS Floodplain Velocity [m/s]
A > B	2.5	3.4	2.5
E > F	2.6	4.2	0.0
F > G	1.7	3.1	1.8
G > H	3.0	5.1	4.4

5 Interpretation of Results

5.1 ARI100 Flood

The peak ARI100 flood event in the McLeods Creek corridor as illustrated in drawing 1407-SWMP001 (Appendix B) has little impact on the proposed development area. This is observed by no inundation evident on either a proposed or existing residential allotment.

It has been shown that the ARI100 flood will encroach onto the proposed road reserve (Road 6), however this is based on the current topography which would be modified in detailed design of the road formation to provide further protection from the design peak event.

The existing online infrastructure, i.e. the stock and domestic surface water storage centrally located within the proposed development, has the capacity to permit the peak ARI100 flow through the asset without breaching the embankment or spillway batters.

5.2 PMF

In accordance with the Section 2.4 of the Floodplain Development Manual the PMF was considered in this study. The results of the PMF provide understanding of the worst case design flood event that could occur in this watercourse at this specific location in the catchment and an indicative representation of the areas impacted by the rare event.

The PMF extents as presented on drawing 1407-SWMP003 (Appendix B) illustrate the land areas that will be impacted by the PMF. It appears that only a minor portion of the proposed development area is certain to be impacted by the PMF (i.e. Lot 17) however this does not consider the future Road 6 has the capacity to reduce the impact of the event on that particular proposed property.

5.3 Planning Controls

This Flood Study provides a quantitative representation of the peak ARI 100 flood event that can be used for input into planning controls in the future development, i.e. to determine what is flood liable land, defining suitable building envelopes and furthermore setting finished floor levels for residential dwellings (with freeboard).

Whilst it may be economically unwise to set deck levels or culvert capacities for a future Road 1 McLeods Creek crossing to accommodate the full ARI100 flows, any structure/embankment

combination should be reviewed with the peak ARI100 flow passing through/beneath it. Hence review the effect the structure may have on ARI100 flood extents.

The PMF presented in this report merely provides an initial understanding of the flooding potential within this section of the McLeods Creek corridor and could be added to a wider Flood Study for the village of Gundaroo. The PMF is an extreme event and as such should be considered/reviewed in the planning of developed land but used with extreme caution for setting planning controls given the rare occurrence of such events.

5.4 Consistency – Floodplain Development Manual 2005

The Flood Study clearly demonstrates consistency with the Section 117(2) of the Environmental Planning and Assessment Act, Direction 4.3 Flood Prone Land as it has been prepared in line with the principles and guidelines of the Floodplain Development Manual 2005. Further clause (6) of the above mentioned Directions states:

6) A planning proposal must not contain provisions that apply to the flood planning areas which:

a) permit development in floodway areas,

b) permit development that will result in significant flood impacts to other properties,……

The peak ARI100 flood extents as illustrated on drawing 1407-SWMP001 (Appendix B) clearly demonstrate that the above two clauses are satisfied, i.e.:

c) there are no residential properties proposed within the peak ARI100 flood extents and
d) there are no existing properties effected by the peak ARI100 flood event.

Hence it would be suitable to rezone the subject land to permit development of the residential properties.

6 Conclusion & Recommendations

This report presents to the YVC the ARI100 flood and PMF extents within the proposed development area of Lots 1 & 2 DP850916 “Kyeema” Gundaroo along the existing McLeods Creek corridor. It has been prepared in line with the principles and guidelines of the Floodplain Development Manual 2005 and has illustrated consistency with Section 117(2) of the Environmental Planning and Assessment Act, Direction 4.3 Flood Prone Land, in particular clause (6) points a & b.

The ARI100 flood extents do not encroach onto any land proposed to be developed for residential purposes or for that matter do not encroach onto any existing residential properties along the McLeods Creek corridor within the Village of Gundaroo.

The ARI100 flood extents are suitable to be used for setting planning controls for the subject land under consideration and are recommended to be used for this purpose, in future development applications.

As the existing online surface water storage has been shown to safely convey the peak ARI100 flood event as it possesses sufficient capacity, it is considered acceptable to retain this infrastructure.

A reasonable understanding of the PMF has been determined in this study and has been illustrated to inundate a wider area of the floodplain than the peak ARI100 flood event, as was expected. It should not be used to set planning controls, however may be used as an input into a broader Gundaroo Flood Prone land review and subsequent floodplain risk management plan.

It is recommended that the concept design of proposed Roads 2, 6 and Road 1 (including culvert or creek crossing) be completed in future Development Applications and should consider the effect on the ARI100 flood and PMF events.

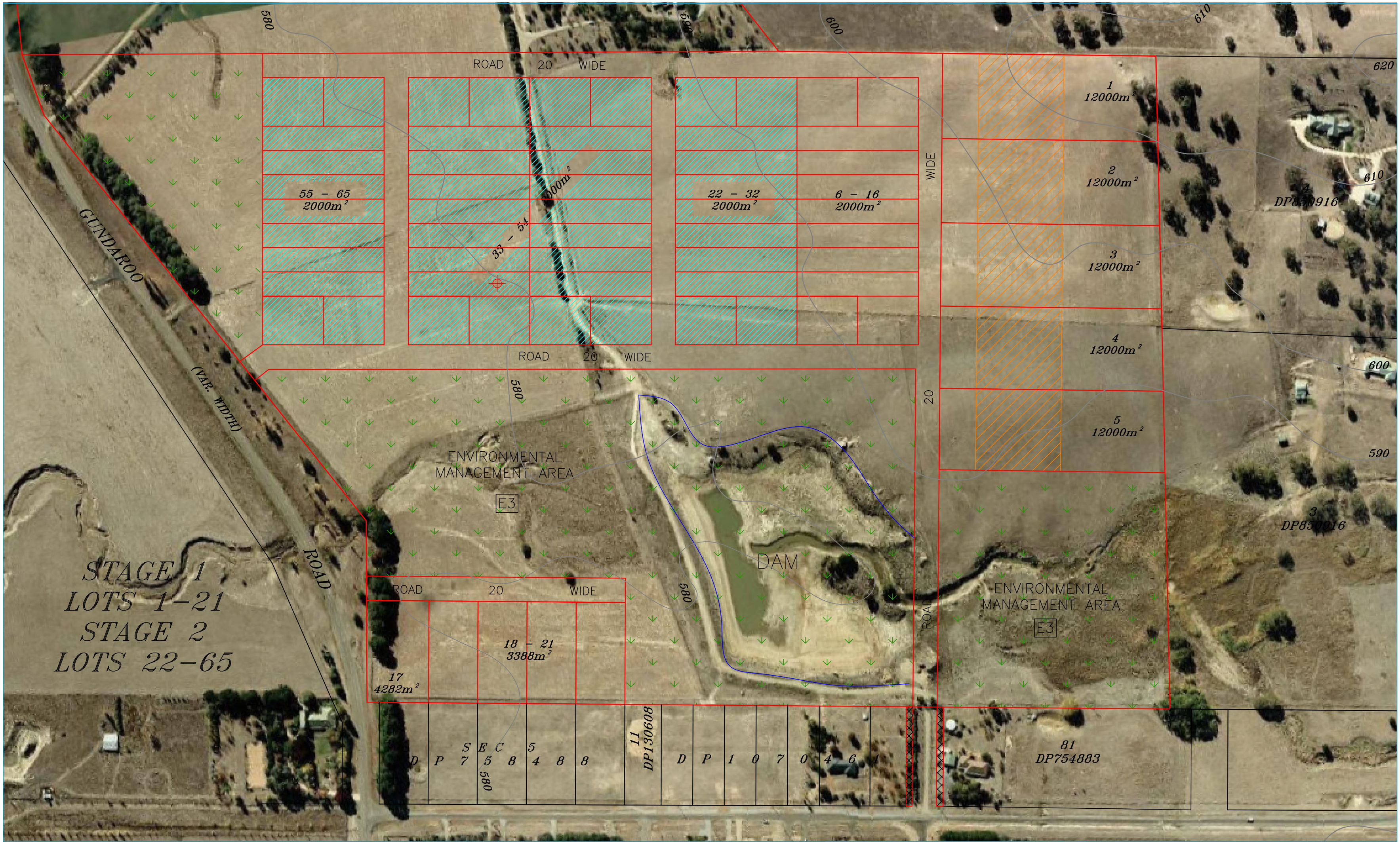
Van Osgood
Osgood CRE Pty Ltd
05 May 2014

Appendix A

Vekta Subdivision Layout

254436 1 of 1 Proposed Plan of Subdivision Lots 1 & 2 DP850916

4056-4078 Gundaroo Road, Gundaroo



PROPOSED PLAN OF SUBDIVISION
LOTS 1 & 2 DP850916
4056–4078 GUNDAROO ROAD
GUNDAROO

CLIENT:
PAUL CARMODY

A2 SHEET	1 OF 1
DATE OF SURVEY	21 OCT 2013
JOB REFERENCE	254436
COMPUTER REFERENCE	254436_PPS1C.dwg
LEVEL DATUM	
ORIGINS OF LEVEL	
CONTOUR INTERVAL	10M

NOTES:
THIS PLAN WAS PREPARED FOR MR. PAUL CARMODY, AS A PROPOSED SUBDIVISION TO ACCOMPANY A DEVELOPMENT APPLICATION TO YASS VALLEY COUNCIL AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE. THE DIMENSIONS AND AREAS SHOWN HEREON ARE SUBJECT TO SURVEY AND ALSO TO THE REQUIREMENTS OF COUNCIL AND ANY OTHER RELEVANT AUTHORITY WHICH MAY HAVE REQUIREMENTS UNDER ANY RELEVANT LEGISLATION. THE DETAIL INFORMATION SHOWN IS APPROXIMATE ONLY. IN PARTICULAR, NO RELIANCE SHOULD BE PLACED ON THE INFORMATION ON THIS PLAN FOR FINANCIAL DEALINGS INVOLVING THIS LAND. THIS NOTE IS AN INTEGRAL PART OF THIS PLAN.

NOTE:

CONTOURS TAKEN FROM SIX PORTAL AND HAVE NOT BEEN VERIFIED BY SURVEY AND ARE APPROXIMATE ONLY.

REDUCTION RATIO:
1:2000 @ A2

0 50 100 150
ALL DISTANCES IN METRES

LEGEND:
- YASS VALLEY COUNCIL ROAD PROPOSED TO BE CLOSED AND DISPOSED OF
- STAGE 2
- E3 ENVIRONMENT MANAGEMENT AREA
- PROPOSED BUILDING ZONE
- EXISTING RESIDENCE

VEKTA
The benchmark for survey and spatial solutions

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D: NM

22/10/2013 9:21AM

Appendix B

OCRE Drawings

1407-SWMP000	Title Sheet
1407-SWMP001	General Arrangement
1407-SWMP002	Catchment Plan
1407-SWMP003	Site Detail – ARI100 & PMF Limits
1407-SWMP004	Sections A & B
1407-SWMP005	Sections C, D & E
1407-SWMP006	Sections F & G
1407-SWMP007	Sections H & I

"KYEEMA" GUNDAROO - LOTS 1 & 2 DP850916
STORMWATER MASTER PLAN & McLEODS CREEK FLOOD LEVELS

CLIENT: PAUL CARMODY

LGA: YASS VALLEY COUNCIL

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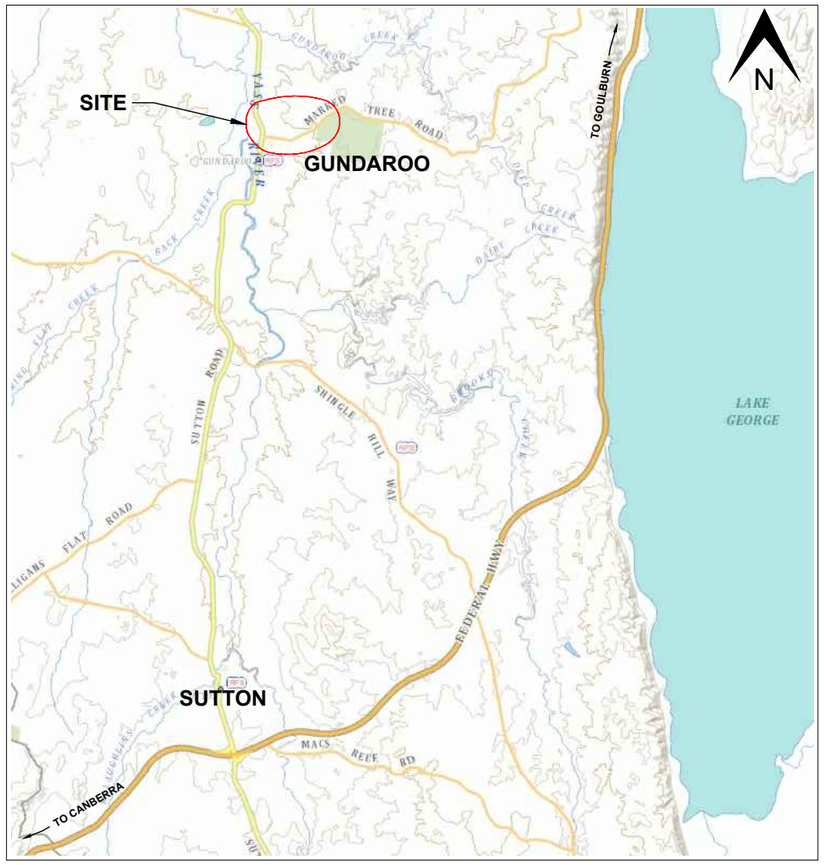
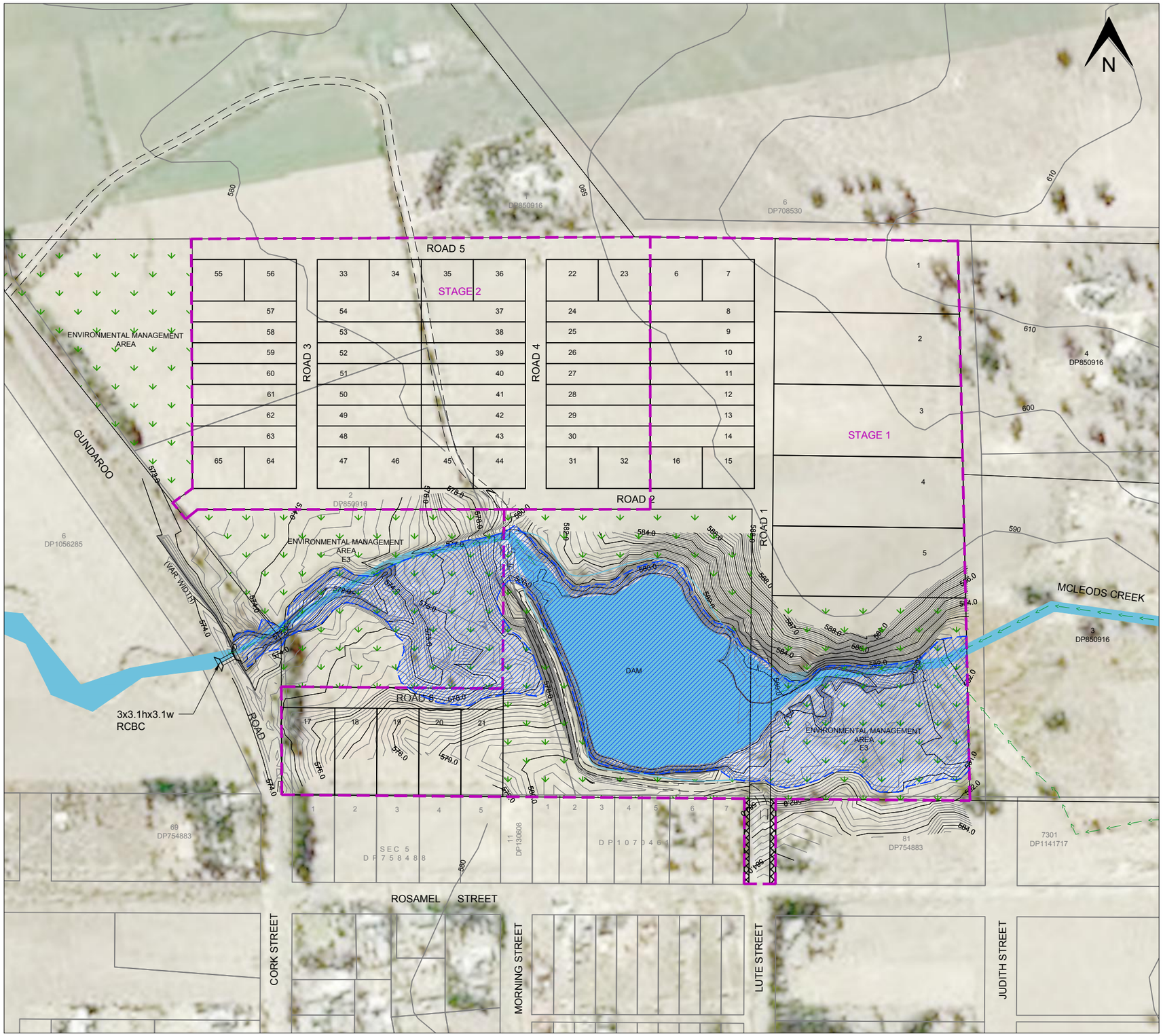


LOCALITY PLAN
N.T.S

DRAWING SCHEDULE



LEGEND

- EXISTING SEWER MAIN, FLOW DIRECTION, MANHOLES
- EXISTING WATER MAIN, HYDRANT,
- EXISTING STORMWATER, SUMPS, MANHOLES
- EXISTING CONTOUR (INTERVAL AS SHOWN)
- EXISTING BOUNDARY
- PROPOSED BOUNDARY
- FUTURE BOUNDARY
- STAGE BOUNDARY
- TREE
- BRIDGE
- BUILDING
- TRACK
- ARI100 FLOOD EXTENTS

NOTES:

1. CADASTRE INFORMATION PROVIDED BY DPS, PROPOSED PLAN OF SUBDIVISION LOT 1 & 2, DP850916 4056-4078 GUNDAROO RD, GUNDAROO, SHEET 1 OF 1 254436 PPS1CJ.DWG
2. PROPOSED CADASTRE PROVIDED BY DPS, PROPOSED PLAN OF SUBDIVISION LOT 1 & 2, DP850916 4056-4078 GUNDAROO RD, GUNDAROO, SHEET 1 OF 1 254436 PPS1CJ.DWG
3. CONTOUR INFORMATION PROVIDED BY DPS, PROPOSED PLAN OF SUBDIVISION LOT 1 & 2, DP850916 4056-4078 GUNDAROO RD, GUNDAROO, SHEET 1 OF 1 254436 PPS1CJ.DWG LEVEL DATUM - AHD, COORDINATE SYSTEM - ASSUMED ORIENTATED DP AZIMUTH.

D						
C						
B						
A	AR100 LIMITS ADDED	VAO	TJL	VAO	VAO	30/04/14
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14
No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE

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m 0408 361 612

CLIENT P. CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
GENERAL ARRANGEMENT

DRAWING NUMBER 1407-SWMP001 AMENDMENT: A

Date: Wednesday, 30 April 2014 2:36:29 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP001.dwg

LEGEND

- NATURAL STORMWATER FLOW
- 1 — CATCHMENT NODES
- CATCHMENT BOUNDARY
- 520 — EXISTING CONTOUR (INTERVAL AS SHOWN)
- DAM

GUNNING
YASS RIVER
MARKED TREE ROAD
MCLEODS CREEK NATURE RESERVE
G-05
G-04
G-03
G-01
G-02
ROSAMEL STREET
CORK STREET
LUTE STREET
DAVID STREET
YASS RIVER
GUNDAROO
MCLEODS CREEK
MORNING ST
LOT STREET
FAITHFUL STREET
SUTTON ROAD
N

D						
C						
B						
A						
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14
No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE

SCALE IN METRES
100 50 0 100 200 300 400 500
1:10000 SCALE AT A1
1:20000 SCALE AT A3

DO NOT SCALE

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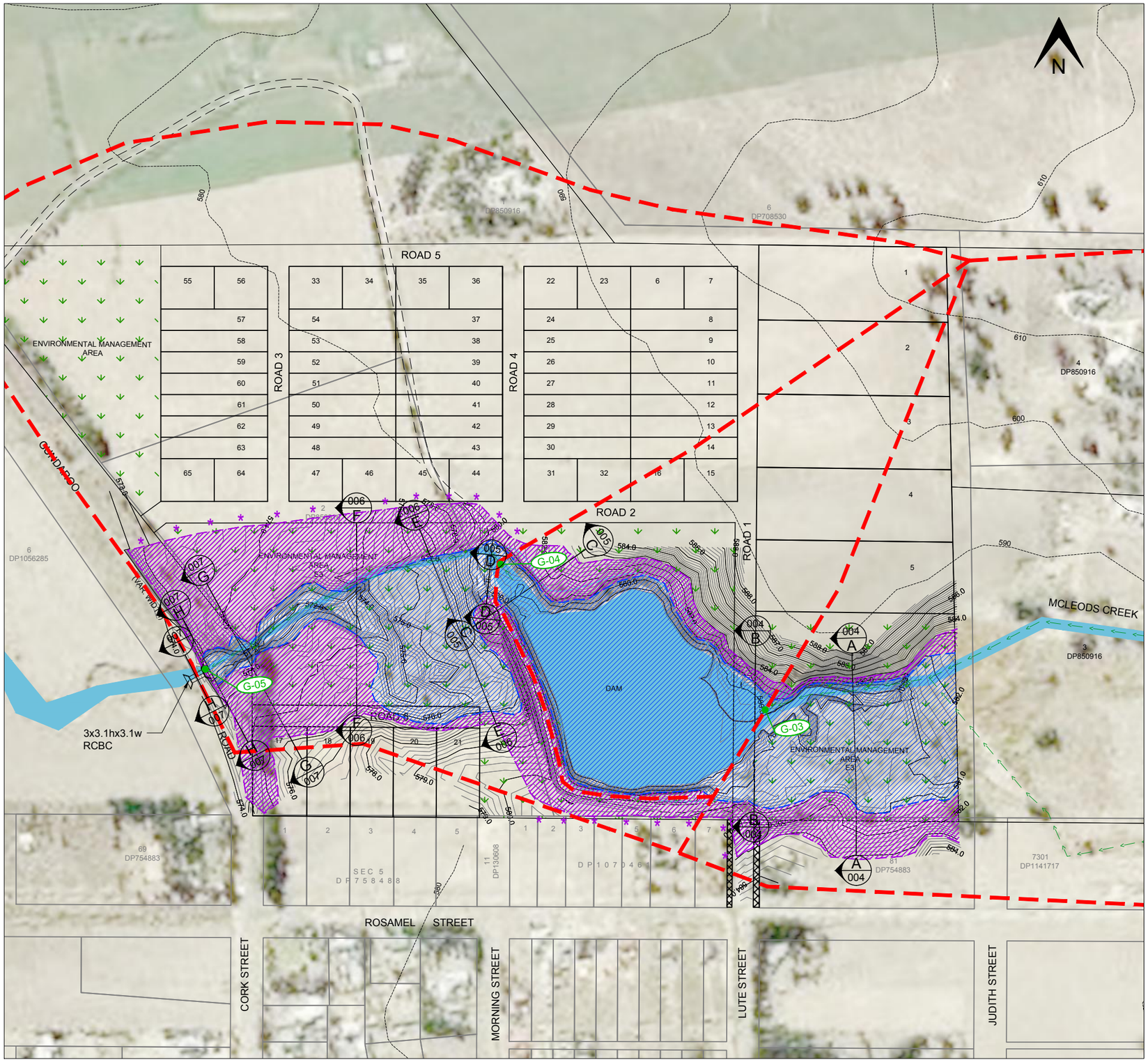
m 0408 361 612

CLIENT P. CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
CATCHMENT PLAN

DRAWING NUMBER 1407-SWMP002
AMENDMENT:

Date: Wednesday, 16 April 2014 11:42:40 AM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP002.dwg



LEGEND

- NATURAL STORMWATER FLOW
- 1 — CATCHMENT NODES
- CATCHMENT BOUNDARY
- Q100 FLOOD EXTENTS
- PMF EXTENTS
- LIMITS OF SURVEY - UNKNOWN EXTENT OF FLOOD

NOTES:

1. REFER TO 1407-SWMP001 FOR NOTES & LEGEND.
2. PEAK STORMWATER RUNOFF RATES WERE CALCULATED USING XP STORM SOFTWARE.
3. ROUTING METHOD - LAURENSON.
4. STORMS MODELLED INCLUDE:
   100 YR - 30MIN, 1HR, 2HR, 3HR, 6HR, 9HR, 12HR - ZONE 2 (YASS) ARR 1987 HYETOGRAPHS
   PMP - 30 MIN, 45 MIN, 1HR, 1.5HR, 2HR, 2.5HR, 3HR, 4HR, 5HR (MAX DURATION)
5. RAINFALL - ARI 100 YASS ZONE 2 60MIN 100 YEAR, 5 MINUTE INTERVAL.
   PMP - DETERMINED IN ACCORDANCE WITH THE ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION IN AUSTRALIA: GENERALISED SHORT-DURATION METHOD, GSDM, COMMONWEALTH BUREAU OF METEOROLOGY, JUNE 2003.
6. PMP PARAMETERS
   PORTION SMOOTH S - 1.0, PORTION ROUGH R - 0.0
   MEAN ELEVATION - 690M, EAF - 1.00
   GSDM MAF - 0.66
   ELLIPSE AREAS - A - 2.6km², B - 5.5km², C - 2.0km²
7. INFILTRATION/LOSS METHOD - UNIFORM LOSS:
   PERVIOUS - INITIAL 15mm, CONTINUING (ABSOLUTE) 2.5mm,
   IMPERVIOUS - INITIAL 2mm, CONTINUING (ABSOLUTE) 0mm,
   DEPRESSION STORAGE - PERVIOUS & IMPERVIOUS 0.0mm.
8. TOTAL SIMULATION TIME - 24 HOURS.
8. EXISTING SURFACE WATER STORAGES ARE EXCLUDED FROM MODEL. EXISTING DAM ASSUMED TO BE FULL DURING ARI100 AND PMF MODELS.
9. CONTOUR INFORMATION OUTSIDE OF DETAILED SURVEY EXTENTS OBTAINED FROM LPMA SIX VIEWER 1:25,000 TOPOGRAPHIC SERIES, DEC 2013
10. FLOOD ROUTING UNDERTAKEN USING XP STORM SOFTWARE - MANNINGS OPEN CHANNEL FLOW
11. MANNINGS 'n'
    NATURAL CHANNEL 0.045
    FLOOD PLAIN (above top of banks) 0.035
13. STARTING HGL CRITERIA
    OUTFALL GUNDAROO RD 3xRCBC, FIXED BACKWATER, HGL = OBVERT LEVEL OF RCBC (572.159m),
14. FLOW CONDUITS UPSTREAM OF SECTION A-A ASSUMED TO BE EQUAL TO SECTION A-A.

					ARI 100					PMF				
Node	Section	Subcatchment Area	Total Catchment Area	Impervious Fraction	Subcatchment Peak Runoff	Existing Peak Flow	Critical Storm	Max Stage	Max Depth	Subcatchment Peak Runoff	Existing Peak Flow	Critical Storm	Max Stage	Max Depth
		[ha]	[ha]	[%]	[m3/s]	[m3/s]		[RL]	[m]	[m3/s]	[m3/s]		[RL]	[m]
G-01		696.3		0	35.3	35.3	2hr			442	438	1hr		
G-02		122.5		0	9.8	9.8	1hr			109	109	45min		
	AA		818.8			42.6	2hr	580.94	2.57		525	1hr	583.16	4.79
G-03	BB	145.7	964.5	0	11.9	51.3	2hr	580.69	1.39	129	623	1hr	582.96	3.63
	CC					51.6	2hr	580.48	1.18		625	1hr	582.75	3.44
G-04	DD	9.8	974.3	0	1.5	51.7	1hr	580.28	0.99	10.6	626	1hr	582.15	2.85
	EE					51.7	2hr	576.94	0.66		626	1hr	577.92	1.42
	FF					51.7	2hr	574.03	1.30		626	1hr	576.23	3.50
	GG					51.7	2hr	573.85	2.74		626	1hr	575.76	4.70
G-05	HH	34.1	1008.4	0	3.7	53.4	2hr	572.70	2.48	33	645	1hr	574.30	3.32

No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
D						
C						
B						
A	ROAD 3 & 4	VAO	TJL	VAO	VAO	30/04/14
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14

SCALE IN METRES
1:2000 (A1) 1:4000 (A3)
0 10 20 40 60 80 100 120

DO NOT SCALE

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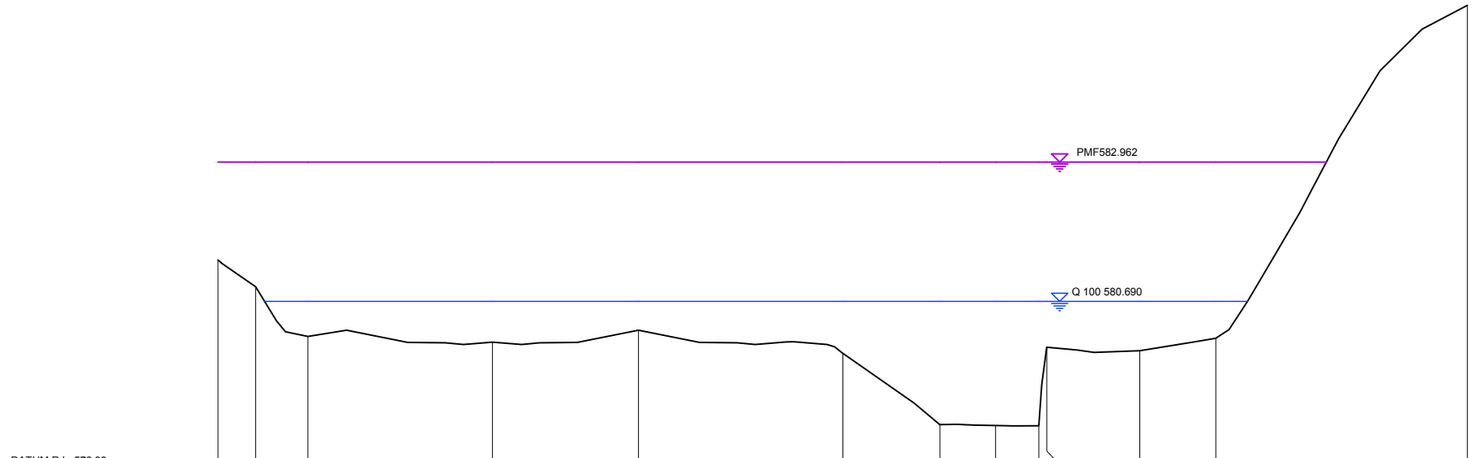
CLIENT P. CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
SITE DETAIL - ARI 100 & PMF LIMITS

DRAWING NUMBER 1407-SWMP003 AMENDMENT: A

Date: Wednesday, 30 April 2014 2:35:11 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP003.dwg

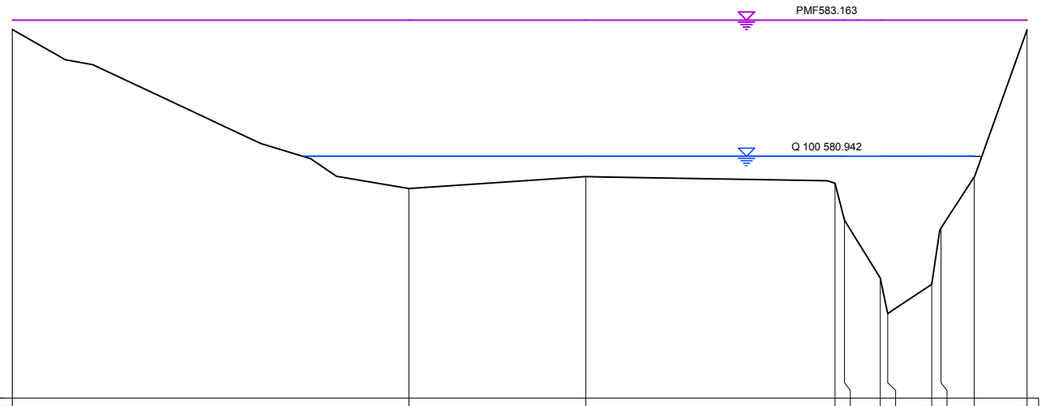


DATUM R.L. 578.00

NATURAL SURFACE	581.365	580.930	580.119	580.027	580.222	579.844	578.883	578.667	578.663	579.943	579.887	580.090	585.518
CHAINAGE	0.000	6.155	14.686	44.781	68.581	101.920	117.762	126.827	133.876	135.206	150.349	162.752	203.775

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

B 003 SECTION



DATUM R.L. 577.00

NATURAL SURFACE	583.010	580.417	580.612	580.504	579.901	578.956	578.377	578.855	579.773	580.607	583.006		
CHAINAGE	0.000	64.692	93.546	134.196	135.737	141.578	142.792	149.954	151.492	156.909	165.515		

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

A 003 SECTION

No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
D						
C						
B						
A						
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14

SCALE IN METRES
1:500 (A1) 0 5 10 20 30 1:1000 (A3)

DO NOT SCALE

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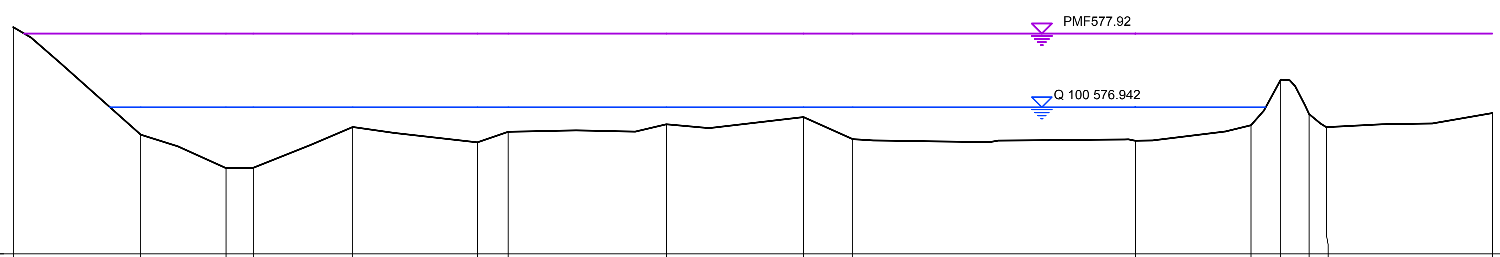
m 0408 361 612

CLIENT P.CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
SECTIONS A & B

DRAWING NUMBER 1407-SWMP004

AMENDMENT:

Date: Wednesday, 16 April 2014 3:03:22 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP004.dwg

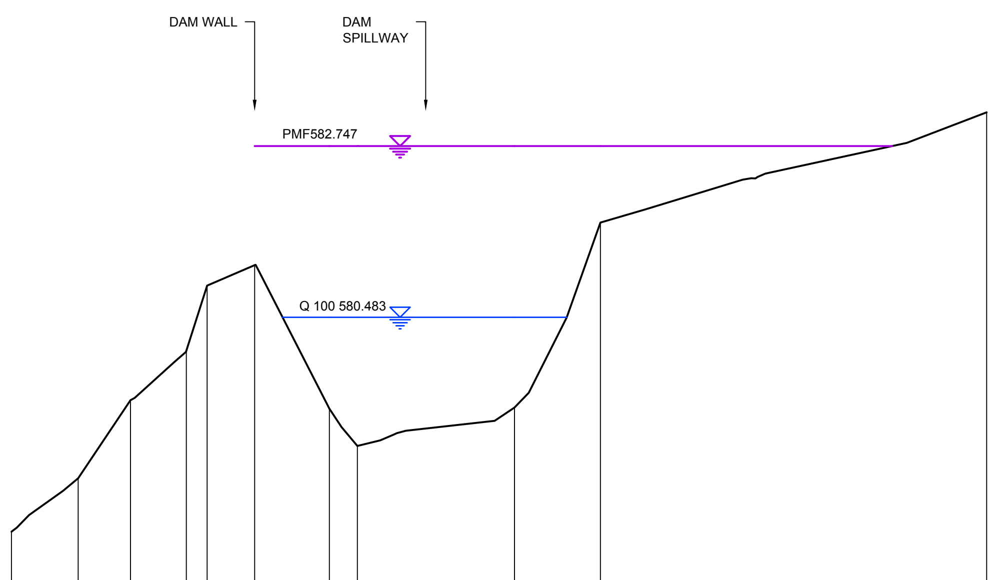


DATUM R.L. 575.00

NATURAL SURFACE	577.999	576.575	576.134	576.138	576.678	576.475	576.614	576.715	576.809	576.517	576.496	576.700	577.305	576.849	576.675	576.862
CHAINAGE	0.000	16.890	28.152	31.759	44.936	61.410	65.482	86.411	104.561	111.079	148.450	163.760	167.703	171.449	173.730	195.666

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

E/003 SECTION

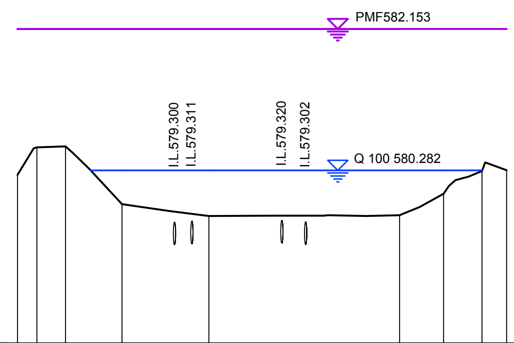


DATUM R.L. 577.00

NATURAL SURFACE	577.648	578.353	579.386	580.041	580.903	581.173	579.274	578.782	579.288	581.736	583.194
CHAINAGE	0.000	8.823	15.747	23.137	25.890	32.170	42.057	45.760	66.542	77.902	129.004

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

C/003 SECTION



DATUM R.L. 578.00

NATURAL SURFACE	580.223	580.587	580.600	579.835	579.679	579.690	579.972	580.273	580.284
CHAINAGE	0.000	2.545	6.350	13.808	25.309	50.530	56.367	61.435	64.702

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

D/003 SECTION 4 x 300Ø RCP CULVERT DAM SPILLWAY

No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
D						
C						
B						
A						
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14

SCALE IN METRES
1:500 (A1) 0 5 10 20 30 1:1000 (A3)

DO NOT SCALE

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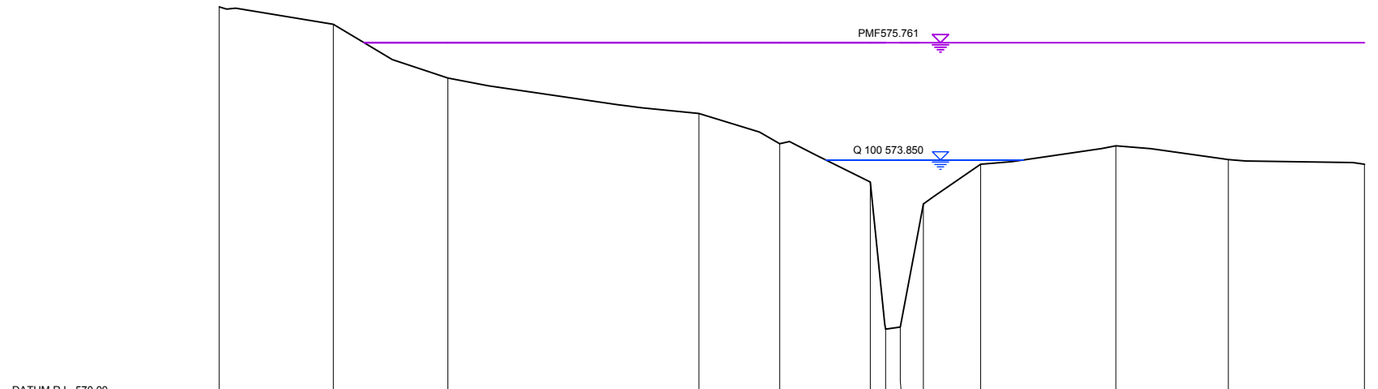
m 0408 361 612

CLIENT **P.CARMODY**
PROJECT **McLEODS CREEK FLOOD LEVELS**
TITLE **STORMWATER MASTER PLAN SECTIONS C, D & E**

DRAWING NUMBER **1407-SWMP005**
AMENDMENT:

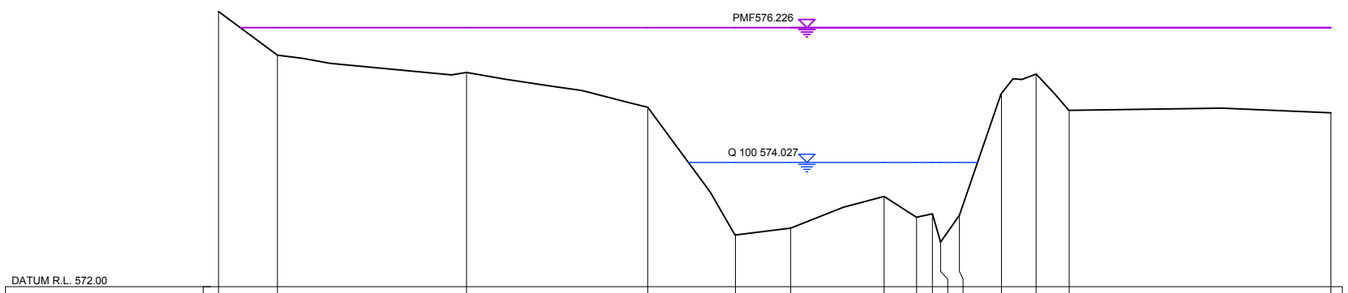
Date: Wednesday, 16 April 2014 12:31:57 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP005.dwg



DATUM R.L. 570.00												
NATURAL SURFACE	576.345	576.061	575.187	574.608	574.115	573.491	571.092	571.125	573.133	573.781	574.081	573.857	573.781
CHAINAGE	0.000	18.609	37.303	78.237	91.417	106.188	108.684	111.077	114.852	124.178	146.225	164.593	186.789

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

G SECTION 003



DATUM R.L. 572.00															
NATURAL SURFACE	576.484	575.773	575.493	574.925	572.841	572.954	573.472	573.132	573.187	572.726	573.164	575.150	575.465	574.875	574.833
CHAINAGE	0.000	9.610	40.443	69.982	84.304	93.312	108.558	113.838	116.418	117.763	120.826	127.678	133.345	138.735	181.418

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

F SECTION 003

No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
D						
C						
B						
A						
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14

SCALE IN METRES
1:500 (A1) 0 5 10 20 30 1:1000 (A3)

DO NOT SCALE

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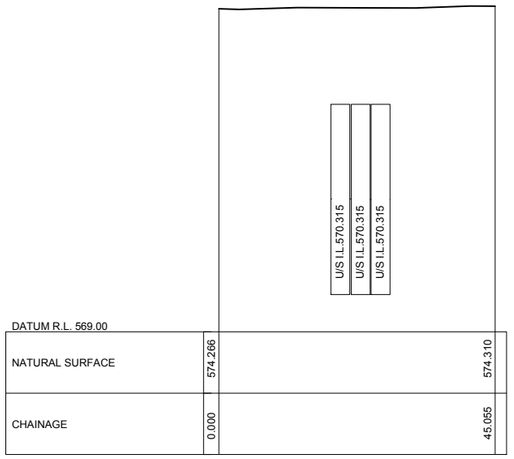
m 0408 361 612

CLIENT P.CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
SECTIONS F & G

DRAWING NUMBER 1407-SWMP006

AMENDMENT:

Date: Wednesday, 16 April 2014 12:32:24 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP006.dwg

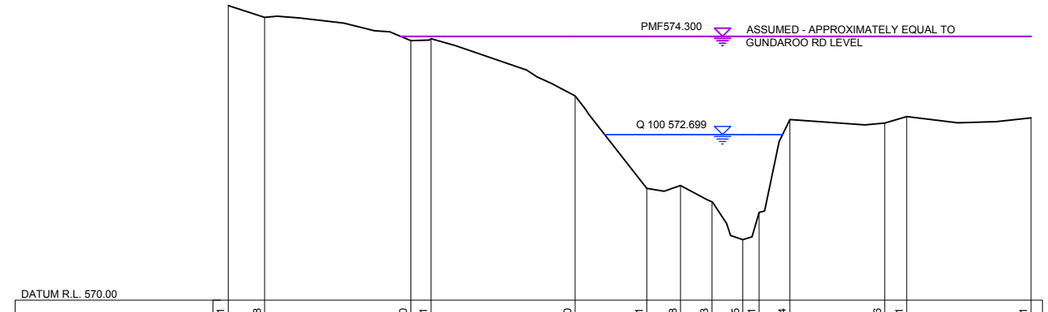


DATUM R.L. 569.00		
NATURAL SURFACE	574.266	574.310
CHAINAGE	0.000	45.055

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

I 003 SECTION

GUNDAROO RD
3 x 3.1h x 3.1w RCBC



DATUM R.L. 570.00													
NATURAL SURFACE	574.801	574.608	574.230	574.261	573.330	571.821	571.868	571.603	570.985	571.431	572.944	572.886	572.991	572.971
CHAINAGE	0.000	5.921	29.769	33.053	56.567	68.250	73.750	78.898	83.920	86.584	91.591	107.071	110.650	130.914

SCALE: HORZ 1:500 (A1) 1:1000 (A3)
VERT 1:50(A1) 1:100 (A3)

H 003 SECTION

No.	REVISION	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
D						
C						
B						
A						
-	INITIAL ISSUE	VAO	TJL	VAO	VAO	16/04/14

SCALE IN METRES
1:500 (A1) 0 5 10 20 30 1:1000 (A3)

DO NOT SCALE

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m 0408 361 612

CLIENT P.CARMODY
PROJECT McLEODS CREEK FLOOD LEVELS
TITLE STORMWATER MASTER PLAN
SECTIONS H & I

DRAWING NUMBER 1407-SWMP007

AMENDMENT:

Date: Wednesday, 16 April 2014 3:07:34 PM User: Tegan File: C:\1_OCRE\1_Projects\2014\1407 Gundaroo McLeods Ck\060_Deliverables\1_Dwgs\1407-SWMP007.dwg