Stormwater Management Report

Westfield Shopping Centre Warringah Stage 2

80017026

Prepared for
Scentre Group Design & Construction

17 August 2018

Cardno
Shaping the Future

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7	17/08/18	Revised for DA	S.Brisbin	S.Brisbin

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Appendices

1 Introduction

1.1 Project Background

Cardno was engaged by Scentre Group Design & Construction to assist in the Development Application for Westfield Warringah Mall Stage 2 project for The Northern Beaches Council. The project is the second stage of the Westfield Warringah Mall Project comprising of the redevelopment and refurbishment of the existing Westfield shopping complex. The purpose of the project can be summarised as follows:

1) Stage 1 (not part of this scope) – Parallel Fashion Mall is an existing shopping centre with approximately 125,000m^2 Gross Leasable Area (GLA) over multiple storeys including 4,322 car spaces. This section has been completed under the previous develop application DA2008/1742 to add an additional:
   - 8,000m^2 GLA.
   - 328 car spaces.
2) Stage 2 – Hospitality, Lifestyle and Entertainment is the second stage of redevelopment for Westfield Warringah Mall. Scentre Group Design & Construction is seeking Development Application approval for modifications and additions to the mall including adjustments to the existing on grade car park that will facilitate:
   - Existing GLA: 136,220m^2 and Incremental GLA: 9,845m^2.
   - Cars will be provided in a Ratio 4:1 Car/100m^2 GLA ca. 400.
   - Rebuilt Cinema Complex.

1.2 Standards

The Concept Design Plans were prepared in accordance with the relevant Council Policies and Technical Specifications, Local Stormwater Management Plans and other relevant standards including but not limited to:

- Northern Beaches Council's Stormwater Management Plan.
- Northern Beaches Council's Water Management Policy.
- Warringah Council's Water Sensitive Urban Design Policy.
- Norther Beaches Council's Technical Specifications.
- Landcom: Managing Urban Stormwater – Soils and Construction.

1.3 Purpose of this Report

This Stormwater Management Report has been prepared on behalf of Scentre Group Design & Construction seeking Development Application Approval for Westfield Warringah Mall Project – Stage 2 Redevelopment.

This report is to be read in conjunction with Cardno's Concept Design drawings series for Westfield Warringah Stage 2 DA. The report outlines the proposed stormwater drainage network for the proposed on-grade car park, loading dock, water quality controls and the erosion and sediment control plan.

2 Site Description

2.1 Location

Westfield Warringah Stage 2 development is located on the eastern side of the existing Warringah Mall next to the intersection of Condamine Street and Pittwater Road, Brookvale. The development site is currently used as an on-grade carpark and businesses. Figure 2-1 shows the extent of works in Westfield Warringah Mall Stage 2.

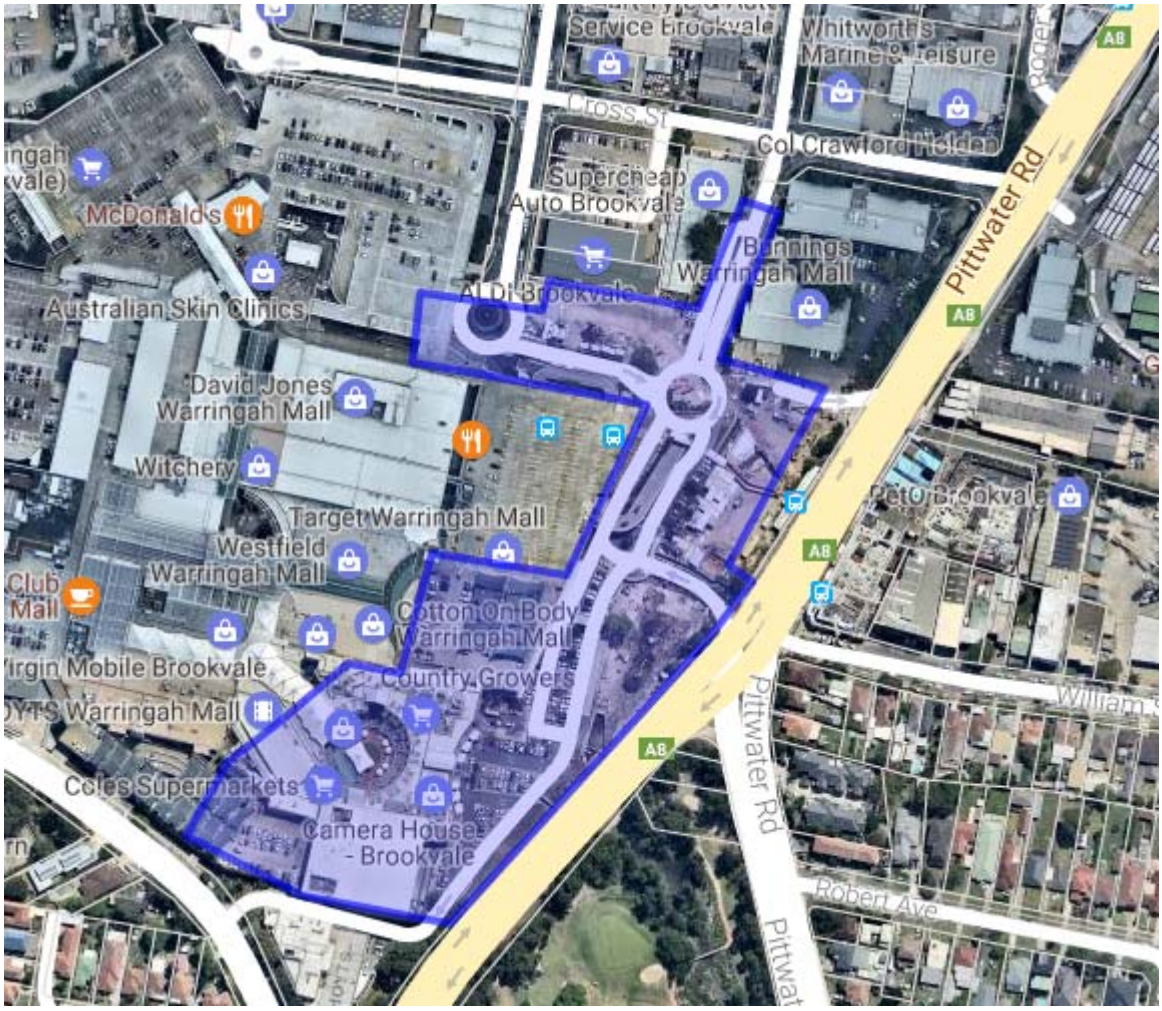


Figure 2-1 Westfield Warringah Stage 2

2.2 Proposed Development

Scentre Group Design & Construction is seeking Development Approval for an on-grade car park and development of facilities for additional Gross Leasable Area that connects into the existing mall, currently undergoing redevelopment, which will facilitate for the following:

1) Existing GLA: 136,220m^2 and Incremental GLA: 9,845m^2.

   GLA incremental break up:

   - Specialty 1,195 sqm
   - Food Shops 575 sqm
   - Restaurant 2,150 sqm
   - Mini Major 9,480 sqm
   - Major -2,010 sqm
   - Lifestyle, others -1,545 Sqm

2) Cars will be provided in a Ratio 4:1 Car/100m2 GLA ca. 400.

3) Rebuilt Cinema Complex.

2.3 Constraints

Site constraints include the following:

- The works is required to generally maintain the existing surface levels of the existing on-grade carpark while tying into the existing levels of the road and proposed development.
- The developed site is proposed to be predominantly impervious similar to existing which limits the opportunity for traditional water sensitive urban design treatments.
- The proposed development must adhere to the Northern Beaches Council's Water Management Policy and other relevant Technical Specifications that were not included in the previously approved development application DA2008/1742.

2.4 Existing Condition

2.4.1 Stormwater Drainage

The majority of the existing stormwater drainage systems will be maintained. There are numerous pipes and box culverts which exist within the development site including a 900dia, 1500dia, 3 x 1800dia, 2 x 1350dia and 4200 x 1800 RCBC which all connect to a large pit chamber junction Pit C6 which then discharges to 4 x 2800 x 1800. Two 3300 x 1800 RCBC has been completed and a triple grated high capacity inlet pit has been retained to accept overland flows from Dale Street and from the east of the site at Pittwater Road as part of Stage 1.

2.4.2 Soil Conditions

Currently, the development site is used as an on-grade carpark following redevelopment of Warringah Mall as part of Westfield Warringah Stormwater Augmentation Works – Stage 1 works. Under the existing carpark includes large twin 3300 x 1800 box culverts constructed as part of Westfield Warringah Stage 1.

3 Stormwater Management

3.1 Stormwater Management Requirements

The piped stormwater drainage network was sized for the minor storm event, identified as the 5% AEP storm for a commercial development in Section D5.04 of Council's Development Design Specification. For the minor storm event, the maximum HGL limit was set at 150mm below pit surface levels.

Stormwater will be collected from the proposed drainage network at the on-grade carpark that will be connected to the existing culverts. Inlet capacity will be suitable to collect and convey the 1% AEP storm event.

3.2 DRAINS Stormwater Model

A DRAINS model (Version 2017.03) was used to analyse the hydraulic performance of the proposed stormwater network in the minor (5% AEP) and major (1% AEP) design storm events.

AR&R 2016 IFD data and temporal pattern ensembles for the site were obtained from the Bureau of Meteorology and ARR Data Hub respectively.

An initial loss-continuing loss hydrological model will be used within the DRAINS model. For the purpose of the model, the entire development site was assumed to be impervious and thus the effective impervious area for catchments was set at 100%. The scattered soft landscaping is assumed to have a negligible hydrologic impact. Initial loss was set at 1mm and continuing loss was set at 0mm given the impervious nature of the site.

The total catchment area draining to the proposed stormwater drainage network is approximately 4.3ha.

3.3 Local Overland Drainage

As noted in the previous section, the incorporation of sealed lids for the number of pits that surcharge in the major storm event will prevent any overland flow in the ground level carpark. The remainder of pits in the network will have grated lids to accept water entering the carpark via car tyres and/or angled rainfall.

3.4 Buildings Over Drainage Infrastructure

3.4.1.1 Proposed Design

The Northern Beaches Council has identified that the proposed works are located over twin culverts that were approved under a previous development application DA2008/1742. In accordance with the Council's Water Policy and Technical Specification – Building over adjacent to Constructed Council Drainage systems and easements, The Northern Beaches Council has provided the following comments:

- Council does not favour structures over pipelines/culverts
- Council may permit structures over pipelines/culverts provided that they meet the minimum access/clearance requirements
- Structural clearances for footings including zone of influence

The twin culverts that were approved under the previous development application are assets owned by Scentre Group Design & Construction and is therefore not a Council asset governed by the Technical Specification – Building over adjacent to Constructed Council Drainage systems and easements. However, Scentre Group Design & Construction has acknowledged the comments and technical direction will be considered during the detailed design including access, maintenance and site inspections.

3.4.1.2 Access to Drainage Infrastructure

Condition 65 of the previous development application DA2008/1742 outlines that the land owners are responsible for the ongoing maintenance, structural inspections and renewal of the trunk drainage network

throughout the site. As per Council comments, Scentre Group Design & Construction will undertake regular maintenance and structural inspections of the drainage assets throughout the site.

3.5 On-site Stormwater Detention

Stormwater On-site Drainage Plans will not be provided as part of the development application for Westfield Warringah Stage 2 due to the existing site being 100% impervious and the site being located in a floodplain. This has been confirmed with Joe Di Cristo, Development Engineer from Northern Beaches Council, on February 28, 2017.

3.6 Water Quality

The Northern Beaches Council has stated that the Warringah Mall Stage 2 development must provide water quality control measures in accordance with the adopted Northern Beaches Stormwater Management Plan and Council's Water Sensitive Urban Design Policy. In response to the Northern Beaches requirements, Cardno has prepared a Water Quality Report included in Appendix D.

4 Sediment, Erosion and Drainage Control Measures

Earthworks are proposed to be undertaken and has the potential to result in erosion of the site soils, movement of sediment and therefore to impact on the environment beyond the site boundaries. The proposed control measures to be implemented on site will minimise these potential impacts, and are summarised below. All measures are to be installed in accordance with Managing Urban Stormwater: Soils and Construction.[1] References to standard drawings from that publication (The Blue Book) are included.

Where practical, the soil erosion hazard on the site will be kept as low as possible and as recommended in Table 5-1 below.

Table 4-1 Limitations to Access

Land Use	Limitation	Comments
Construction areas	Disturbance to be no further than five metres from the edge of any essential engineering activity shown on the plans	All workers will clearly recognise these zones that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones on site. All workers are to clearly recognise these zones.
Remaining lands	Entry prohibited	Barrier fencing shall be used to prevent access to these areas.

4.1 Work Schedule Conditions

4.1.1 Staging of Works

Bulk earthworks will be stage one of the works including stripping of the existing pavement. Stage 2 of development will involve construction of the proposed stormwater drainage networks along with the major works.

4.1.2 Sequence of Works

The sequence of works for the earthworks operation has been outlined below.

1) Site establishment and installation of erosion and sediment control measures for stage one
2) Existing pavement stripped and removed from site.
3) Cut to fill earthworks operations.
4) Topsoil spread over earthworks area and stabilisation with hydro-seed.
5) Installation of erosion and sediment control measures for stage two.
6) Construction of stormwater drainage.
7) Construction of pavement and building pads.
8) Perimeter diversion drains and sediment basin to remain in operation until completion of proposed development works. Long term maintenance required as noted in Section 4.9

[1] Landcom, 2004. Commonly known as The Blue Book.

4.2 Site Preparation

All erosion and sediment control measures as outlined below and documented on Cardno's Erosion and Sediment Control Plan drawings for the works are to be implemented prior to the commencement of earthworks on the site.

A stabilised site access shall be constructed at the commencement of construction in accordance with Section 4.3 below. Vehicle access is to be limited to that essential for construction work and entry shall only be obtained through the stabilised site access points.

Barrier fencing and sediment fencing shall be installed as indicated on the Erosion and Sediment Control Plan drawings, in order to minimise soil erosion hazard.

Works are to comply with the land disturbance conditions outlined in Table 4-1 above.

4.3 Site Access and Haul Routes

The proposed site access will be located at Dale Street near the existing roundabout. The contractor must ensure that the sight access will not adversely affect the access road to the Bunnings located just before the proposed site access.

The stabilised site access shall be designed to capture any soil materials collected on vehicles such that they are not deposited on public roads. Should soil material be spilled on public roads or transported from the site onto a public road, the soil shall be removed within the same working day.

Loads to and from the site shall be covered at all times.

4.4 Topsoil Management

The remaining existing pavement is to be stripped from the site after the establishment of erosion and sediment controls, and removed from site. Areas with topsoil is to be stripped and removed from site where possible.

4.5 Wind Erosion Management

Progressive covering of exposed areas is required as soon as possible after filling/regrading. Cover is to be bitumen emulsion and seed, and watering as required to create instant cover and reduce dust issues.

Revegetation and stabilisation of disturbed areas should be undertaken within 10 days of earthworks completion.

4.6 Revegetation of Earthworks

All areas of completed earthworks are to be stabilised within ten days of completion. All erosion and sediment controls are to remain in place until stabilisation / revegetation of earthworks is established. All stabilised areas are to be free of vehicle and pedestrian traffic to prevent disturbance of stabilisation measures.

Stabilisation options include mulch covers, latex-type sprays, bitumen emulsion sprays, tarp covers (stockpiles) and grass-seeding. Stabilisation is to be undertaken in accordance with Council's requirements for suitable landscape treatments.

Maintenance and inspection of revegetation will be required to ensure that the site is stabilised and future erosion is prevented. For areas stabilised with grass–seeding, regular watering will be required until an

effective ground cover has been established and plants are growing vigorously. Re-seeding may be required in areas of inadequate coverage.

4.7 Sediment Basin

The site catchment of the development is required to have a sediment basin. A temporary Sediment Basin shall be constructed as indicated on the Erosion and Sediment Control Plan drawings. The sediment basin is to be designed using the Landcom: Managing Urban Stormwater (Blue Book).

4.8 Sediment Traps

Sediment traps shall be used to protect stormwater pits during construction. The large pits on site shall be protected appropriately using straw bale sediment filter, geotextile filter filled with gravel and sediment fences. Where it is not indicated on the Erosion and Sediment Control Plan drawings, the contractor shall identify any existing pits that require protection from sediments and install appropriate protection.

4.9 Maintenance of Controls

All erosion and sediment measures will require regular inspection and maintenance by the Contractor – the nature of the site requires that daily checks of control measures prior to site closure be undertaken, and within 24 hours of each rainfall event. The Contractor shall nominate a person to be responsible for the daily checks and after rainfall checks, including on RDOs, weekends and holiday periods.

The daily site inspection shall be recorded on a check sheet that includes the following information –

- The condition of each measure noted on the Concept Soil and Water Management Plan drawing series,
- Maintenance requirements of each measure,
- Volumes of sediment removed where applicable,
- Disposal locations.

A copy of the check sheets shall be provided to the Superintendent on a weekly basis.

Drains shall be checked to ensure they are operating effectively, are not blocked, and are not eroding due to higher than allowable velocities. Linings shall be repaired immediately if required, and check dams installed where required.

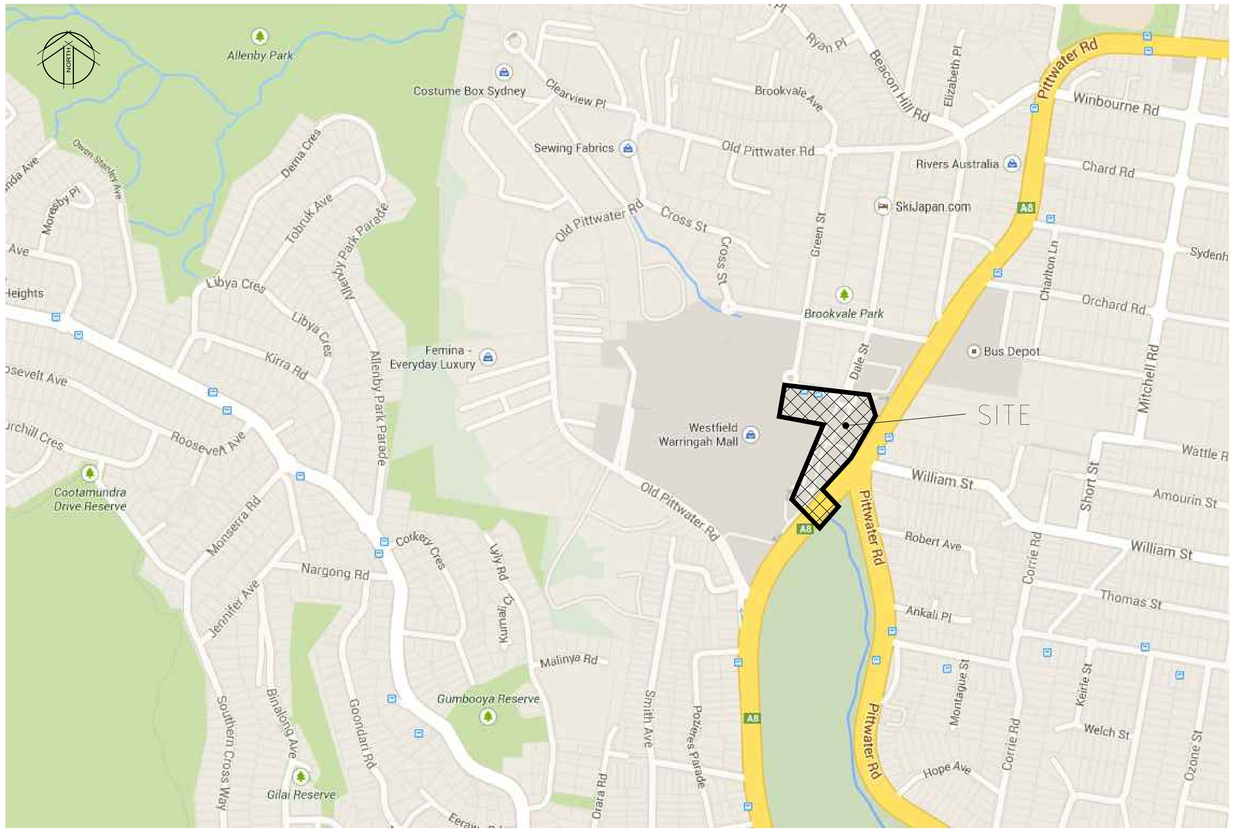
Trapped sediment shall be removed from sediment fences. Dispose to an approved landfill location or waste treatment facility in accordance with Council requirements.

Ensure revegetation works are established and maintained to prevent future erosion of the earthworks areas.

Appendix A – Drawings List

WESTFIELD WARRINGAH MALL
STAGE 2
CONCEPT DESIGN
WESTFIELD PROJECT REFERENCE No: D11754

DRAWING INDEX	
NUMBER	TITLE
CAR-070101	COVER SHEET AND DRAWING INDEX - SHEET 1 OF 1
CAR-070110	SITE PLAN - SHEET 1 OF 1
CAR-070111	GENERAL ARRANGEMENT AND STORMWATER MANAGEMENT PLAN - SHEET 1 OF 3
CAR-070112	GENERAL ARRANGEMENT AND STORMWATER MANAGEMENT PLAN - SHEET 2 OF 3
CAR-070113	GENERAL ARRANGEMENT AND STORMWATER MANAGEMENT PLAN - SHEET 3 OF 3
CAR-070115	TYPICAL SECTIONS - SHEET 1 OF 1
CAR-070121	EROSION AND SEDIMENTATION PLAN - SHEET 1 OF 3
CAR-070122	EROSION AND SEDIMENTATION PLAN - SHEET 2 OF 3
CAR-070123	EROSION AND SEDIMENTATION PLAN - SHEET 3 OF 3
CAR-070125	EROSION AND SEDIMENTATION DETAILS - SHEET 1 OF 1
CAR-070131	BULK EARTHWORKS PLAN - SHEET 1 OF 3
CAR-070132	BULK EARTHWORKS PLAN - SHEET 2 OF 3
CAR-070133	BULK EARTHWORKS PLAN - SHEET 3 OF 3
CAR-070141	TYPICAL DETAILS - SHEET 1 OF 2
CAR-070142	TYPICAL DETAILS - SHEET 2 OF 2

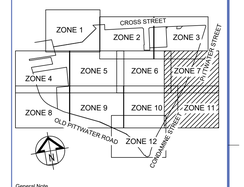


LOCALITY SKETCH

NOT TO SCALE

Rev	Date	By	Ch	Description
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	29/06/2018	CM	DNA	ISSUE FOR REVIEW
B	25/05/2017	CM	DNA	ISSUE FOR REVIEW
A	31/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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GPO Box 4004 Sydney NSW 2001

Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

COVER SHEET & INDEX
SHEET 1 OF 1

Drawing Scale	Scale Bar 1:1	
Drawn By: S.P.	CAD Filename: CAR-070101.DWG	Plot Date: 13/8/2018 4:38pm
Project No.: D11754	Drawing No.: CAR-070101	Revision: E

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Appendix B – Concept Stormwater Plans

NORTH

SHEET CAR-070111

CROSS STREET

AREA OF POTENTIAL LAND ACQUISITION FOR ROAD WIDENING OUTSIDE THE SCOPE OF CURRENT PROJECT

PALM TREE CARPARK

GREEN STREET

WOOLWORTHS

ALDI

BUNNINGS

SHEET CAR-070112

PROPOSED LOADING DOCK

B-LINE BUS STOP

PITTWATER ROAD

WARRINGAH MALL

DAVID JONES

CAR PARK

LOADING DOCK

SHEET CAR-070113

MYER

WILLIAM STREET

PITTWATER ROAD

LANDSCAPED AREA

PLANT ROOM

PLANT ROOM

COLES

OLD PITTWATER ROAD

EXISTING EXIT LANE

EXISTING CAR PARK

LEGEND

PROPOSED

- CAR PARK
- LOADING DOCK
- B-LINE BUS STOP
- LANDSCAPED AREA

0 10 20 30 40 50m

SCALE 1:500 @A0

Rev	Date	By	Chk	Description
F	17/08/2018	CM	DNA	ISSUE FOR REVIEW
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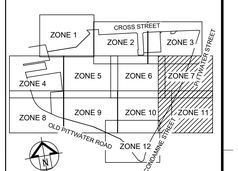
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

SITE PLAN
SHEET 1 OF 1

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070110.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070110	Revision: F

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NORTH

CROSS STREET

RETAIN EXISTING SIGNALS

PROPOSED MODIFICATION TO EXISTING SIGNALISED INTERSECTION - REFER TO TCS DRAWINGS

PALM TREE CAR PARK

GREEN STREET

DALE STREET

ALDI

PROVIDE BREAK IN MEDIAN

K.O. KERB

K&G KERB

FIT ENVIROPOD LITTER BASKETS TO PITS INLETS (TYP)

CONNECT TO EXISTING CULVERT

PROVIDE GRATED DRAIN

PROVIDE HEAVY DUTY CONCRETE CROSSOVER TO NORTHERN BEACHES COUNCIL SPECIFICATION

PROVIDE BREAK IN MEDIAN

PROVIDE GRATED DRAIN

CONNECT TO EXISTING CULVERT

EXISTING 1500ø

03

NEW RAMP UP to L1 &L2 G1:8

NEW RAMP DN fr L1 G1:8

450ø SEWER

ONLY R2-14 A

JOINS CAR-070112

EXISTING 450ø SEWER

LINE OF BUILDING ABOVE

MK KERB

EXISTING 3300 x 1800 RCBC

EXISTING 3300 x 1500 RCBC

EXISTING 1800 x 3300 RCBC

EXISTING 3300 x 1500 RCP

PROVIDE SKID RESISTANT COATING OVER GRATES

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
- STORMWATER DRAINAGE PIPE
- JELLY FISH FILTER SEE NOTE 2.
- SS — SUBSOIL DRAINAGE LINE
- ASPHALTIC CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- B-LINE BUS STOP
- LANDSCAPED AREA. REFER TO LANDSCAPE DRAWINGS

KERBS

- FK KERB — FK FLUSH KERB
- K&G KERB — KERB AND GUTTER
- MK KERB — TYPE 'MK' KERB
- KO KERB — TYPE 'KO' KERB
- SB KERB — TYPE 'SB' KERB
- PROPOSED BUS LANE
- PROPOSED CONCRETE FOOTPATH

NOTES

1. ENVIROPOD LITTER BASKETS TO BE FITTED TO ALL PIT INLETS. SPECIFICATION SUBJECT TO DETAILED DESIGN.
2. JELLYFISH JF2250-7-2 OR APPROVED EQUIVALENT SECONDARY TREATMENT DEVICE. UNIT SIZING AND SPECIFICATION SUBJECT TO DETAILED DESIGN.

0 5 10 15 20m

SCALE 1:200 @A0

Rev.	Date	By	Ch	Description
F	17/08/2018	CM	DNA	ISSUE FOR REVIEW
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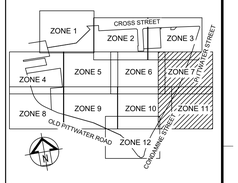

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Title

WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

GENERAL ARRANGEMENT PLAN
SHEET 1 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070111.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070111	Revision: F

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NORTH

ALDI

ONLY

DALE STREET DISCHARGES TO CHAMBER B6

DISCHARGE LOADING DOCK SURFACE DRAINAGE TO B6

2 070115

1 070115

RL 8.80

RL 9.00

RL10.0

LINE OF BUILDING ABOVE

EXISTING 1500ø

EXISTING 1800ø

EXISTING 1800ø

EXISTING 1800ø

STORAGE

RL 8.85

KO KERB

K&G KERB

RL 8.80

RL 8.75

RL 8.70

BREAK IN AND CONSTRUCT GOOD CONNECTION TO EXISTING CULVERT

PROVIDE SLIP RESISTANT YELLOW STRIPS TO EXISTING GRATE.

TROLLEY STORAGE

EXISTING RAMP

DALE STREET

HIGH CAPACITY INLET PIT B6

EXISTING 1350ø

EXISTING 4200 x 1800 RCBC DP

JOINS CAR-070111

JOINS CAR-070113

EXISTING CHAMBER B6.

GRATED DRAIN

EXISTING 450ø SEWER

EXISTING 375ø RCP

WATER QUALITY TREATMENT DEVICES (REFER TO LEGEND)

EXISTING 1350ø

EXISTING 1200ø SEWER

EXISTING 750ø

EXISTING 1350ø

EXISTING 375ø RCP

RL11.35

RL11.50

EXISTING 5.5m SEWER EASEMENT

FUTURE 4m ROAD WIDENING

EXISTING K&G

EXISTING TWIN 3300 X 1800 RCBC

EXISTING 5.5m SEWER EASEMENT

EXISTING B-LINE BUS STOP

EXISTING B-LINE BUS STOP

AREA TO LANDSCAPE DESIGN DRAWINGS

EXISTING TREES

EXISTING MEDIAN

PITTWATER ROAD

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
- STORMWATER DRAINAGE PIPE
- JELLY FISH FILTER SEE NOTE 2.
- SS — SUBSOIL DRAINAGE LINE
- ASPHALTIC CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- B-LINE BUS STOP
- LANDSCAPED AREA. REFER TO LANDSCAPE DRAWINGS

KERBS

- FK KERB — FK FLUSH KERB
- K&G KERB — KERB AND GUTTER
- MK KERB — TYPE 'MK' KERB
- KO KERB — TYPE 'KO' KERB
- SB KERB — TYPE 'SB' KERB
- PROPOSED BUS LANE
- PROPOSED CONCRETE FOOTPATH

NOTES

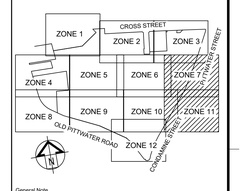
1. ENVIROPOD LITTER BASKETS TO BE FITTED TO ALL PIT INLETS. SPECIFICATION SUBJECT TO DETAILED DESIGN.
2. JELLYFISH JF2250-7-2 OR APPROVED EQUIVALENT SECONDARY TREATMENT DEVICE. UNIT SIZING AND SPECIFICATION SUBJECT TO DETAILED DESIGN.

0 5 10 15 20m

SCALE 1:200 @A0

Rev	Date	By	Chk	Description
F	17/08/2018	CM	DNA	ISSUE FOR REVIEW
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	27/06/2018	CM	DNA	ISSUE FOR REVIEW
B	25/05/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Westfield

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GPO Box 4004 Sydney NSW 2001

Title

WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

GENERAL ARRANGEMENT PLAN
SHEET 2 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070112.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070112	Revision: F

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NORTH

COLES

JOINS INSET A

RETAINING WALL 1.5m HIGH AS PART OF FUTURE STRUCTURE

SEAL EXISTING SURCHARGE PIT

LANDSCAPED AREA

RL 10.0

EXISTING 2x1350 RCP

EXISTING Ø1350 RCP

EXISTING Ø1350 RCP

PROVIDE KERB RAMP

Ø906 SNLSTING

Ø1050 EXISTING

Ø1080 EXISTING

Ø1080 EXISTING

Ø1080 SNLSTING

Ø1050 EXISTING

STORAGE

STORAGE

KO KERB

K&G KERB

EXISTING 1350Ø

EXISTING 4200 x 1800 RCBC

EXISTING CHAMBER C6

LINE OF BUILDING ABOVE

DROP OFF

FK KERB

PLANT ROOM

PLANT ROOM

PLANT

RETAINING WALL 1.5m HIGH

5.5m SEWER EASEMENT

PROPOSED SAG PIT AND CONNECT TO EXISTING STORMWATER

EXISTING CONCRETE FOOTPATH

FUTURE 4m ROAD WIDENING

EXISTING K&G

EXISTING 1200 SEWER

PROVIDE BREAK MEDIAN

WATER QUALITY TREATMENT DEVICES (REFER TO LEGEND)

BREAK IN AND MAKE GOOD CONNECTION TO CHAMBER C6

EXISTING CONCRETE FOOTPATH

RAISE ACCESS COVERS TO SUIT NEW SURFACE LEVELS

EXISTING 2x3.3x1.8 TWIN CULVERTS

CULVERT 1

CULVERT 2

CONDAMINE STREET

EXISTING 2x1.8x1.8 RCBC
2x1.8x2.8 RCBC

EXISTING MEDIAN

EXISTING 2.15x1.50 RCBC

PROPOSED SIGNALISED INTERSECTION MODIFICATIONS REFER TCS DRAWINGS

JOINS CAR-070111

PITTWATER ROAD

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
- STORMWATER DRAINAGE PIPE
- JELLY FISH FILTER SEE NOTE 2.
- SS — SUBSOIL DRAINAGE LINE
- ASPHALTIC CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- B-LINE BUS STOP
- LANDSCAPED AREA. REFER TO LANDSCAPE DRAWINGS

KERBS

- FK KERB — FK FLUSH KERB
- K&G KERB — KERB AND GUTTER
- MK KERB — TYPE 'MK' KERB
- KO KERB — TYPE 'KO' KERB
- SB KERB — TYPE 'SB' KERB
- PROPOSED BUS LANE
- PROPOSED CONCRETE FOOTPATH

INSET A
SCALE 1:200

EXISTING CAR PARK

3
070115

SA KERB

PROPOSED 34m DECELERATION LANE

NOTES

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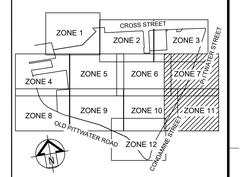
0 5 10 15 20m
SCALE 1:200 @A0

Rev	Date	By	Chk	Description
F	17/08/2018	CM	DNA	ISSUE FOR REVIEW
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	29/05/2017	CM	DNA	ISSUE FOR REVIEW
B	22/03/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

GENERAL ARRANGEMENT PLAN
SHEET 3 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070113.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070113	Revision: F

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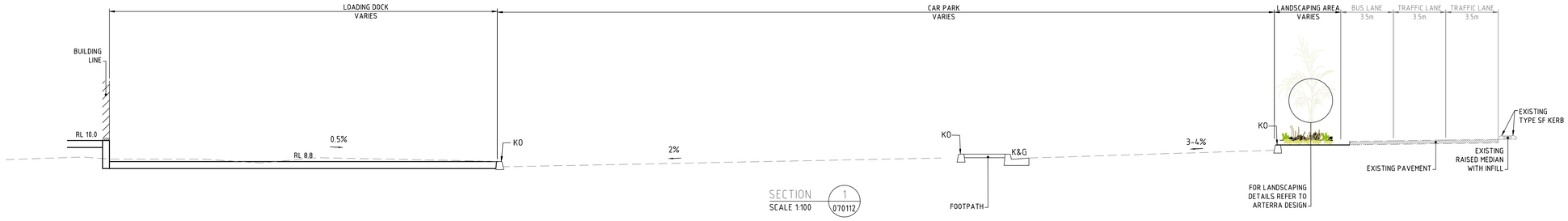
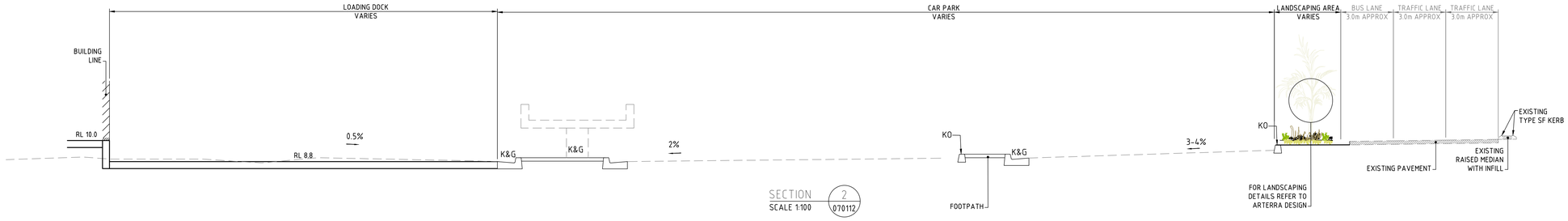


SECTION 1
SCALE 1:100 070112



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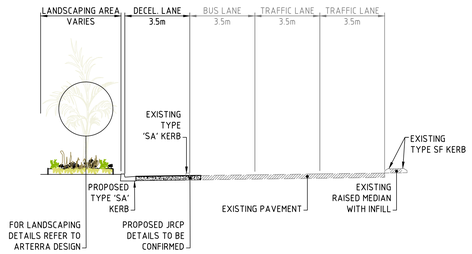
SCALE 1:100 070112

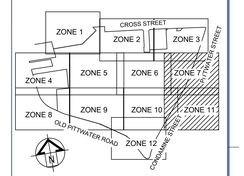


SECTION 3
SCALE 1:100 070113

0 1 2 4 6 8 10m
SCALE 1:100 @A0

Rev.	Date	By	Chk	Description
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	20/06/2018	CM	DNA	ISSUE FOR REVIEW
B	22/03/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

TYPICAL SECTIONS
SHEET 1 OF 1

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070115.DWG	Plot Date: 13/8/2018 4:39pm
Project No.: D11754	Drawing No.: CAR-070115	Revision: E

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NORTH

Surface Analysis: CUT and FILL depths			
Number	Color	Minimum Elevation (m)	Maximum Elevation (m)
1		1.50	9999
2		1.25	1.50
3		1.0	1.25
4		0.75	1
5		0.50	0.75
6		0.25	0.50
7		0	0.25
8		0	-0.25
9		-0.25	-0.50
10		-0.50	-0.75
11		-0.75	-1.0
12		-1.0	-1.25
13		-1.25	-1.50
14		-1.50	9999

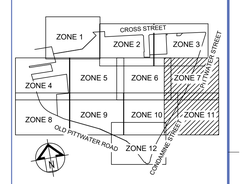
JOINS CAR-070132

0 5 10 15 20m
SCALE 1:200 @A0

C 13/08/2018 CM DNA ISSUE FOR REVIEW
B 24/07/2018 CM DNA ISSUE FOR REVIEW
A 22/06/2018 CM DNA ISSUE FOR REVIEW

Rev.	Date	By	Ch	Description

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

BULK EARTHWORKS PLAN
SHEET 1 OF 2

Drawing Scale:	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070131.DWG	Plot Date: 13/8/2018 4:40pm
Project No.: D11754	Drawing No.: CAR-070131	Revision: C

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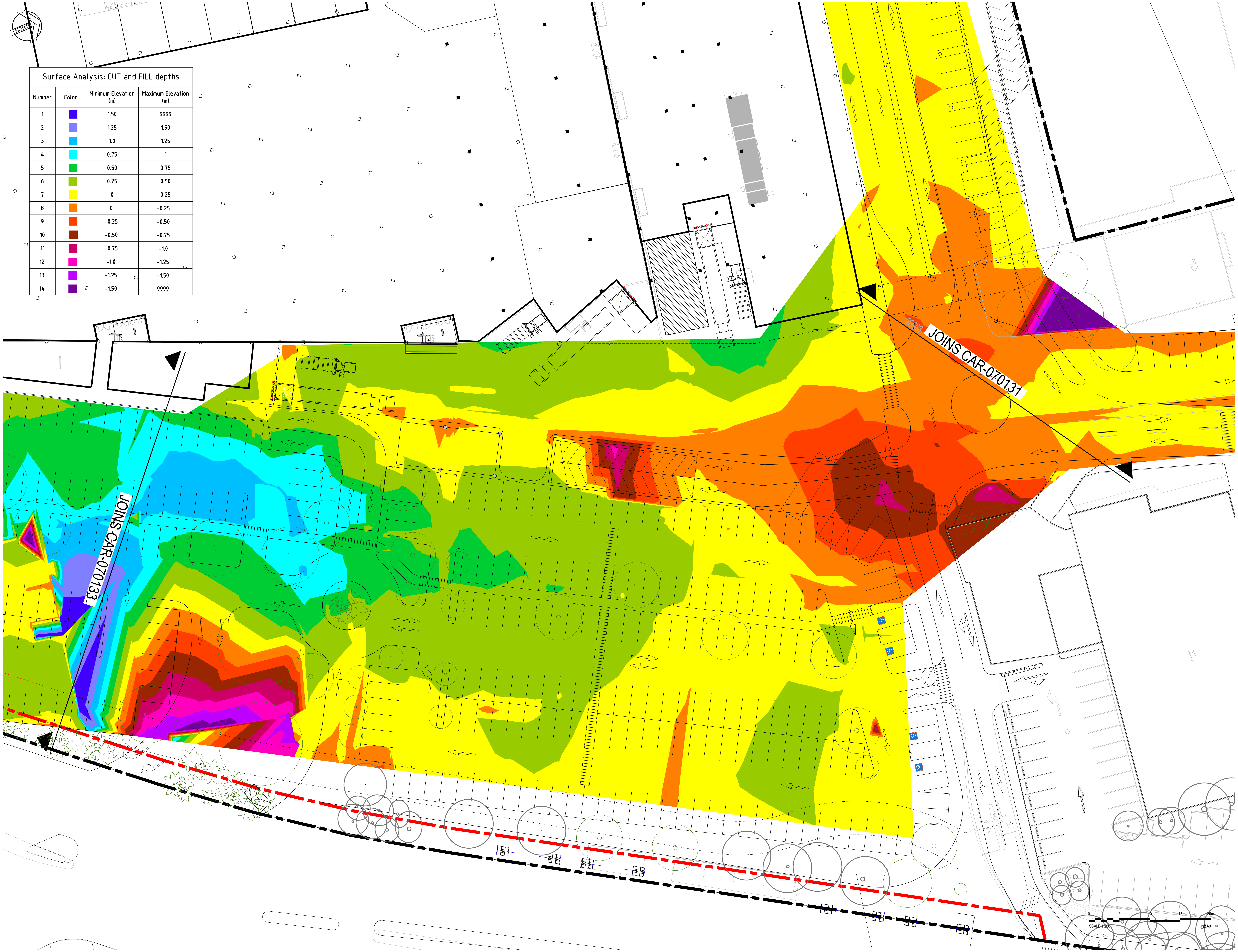

Surface Analysis: CUT and FILL depths

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)
1		1.50	9999
2		1.25	1.50
3		1.0	1.25
4		0.75	1
5		0.50	0.75
6		0.25	0.50
7		0	0.25
8		0	-0.25
9		-0.25	-0.50
10		-0.50	-0.75
11		-0.75	-1.0
12		-1.0	-1.25
13		-1.25	-1.50
14		-1.50	9999

Rev	Date	By	Chk	Description
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
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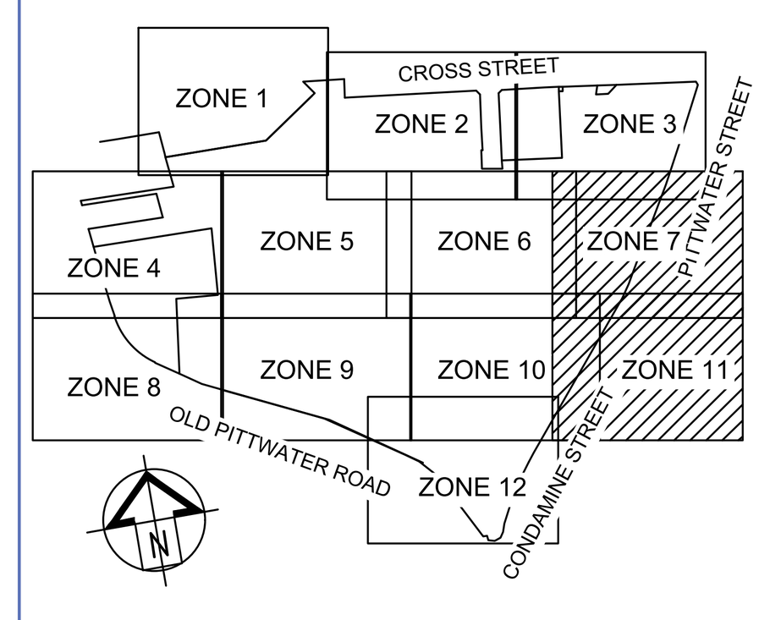
Key Plan



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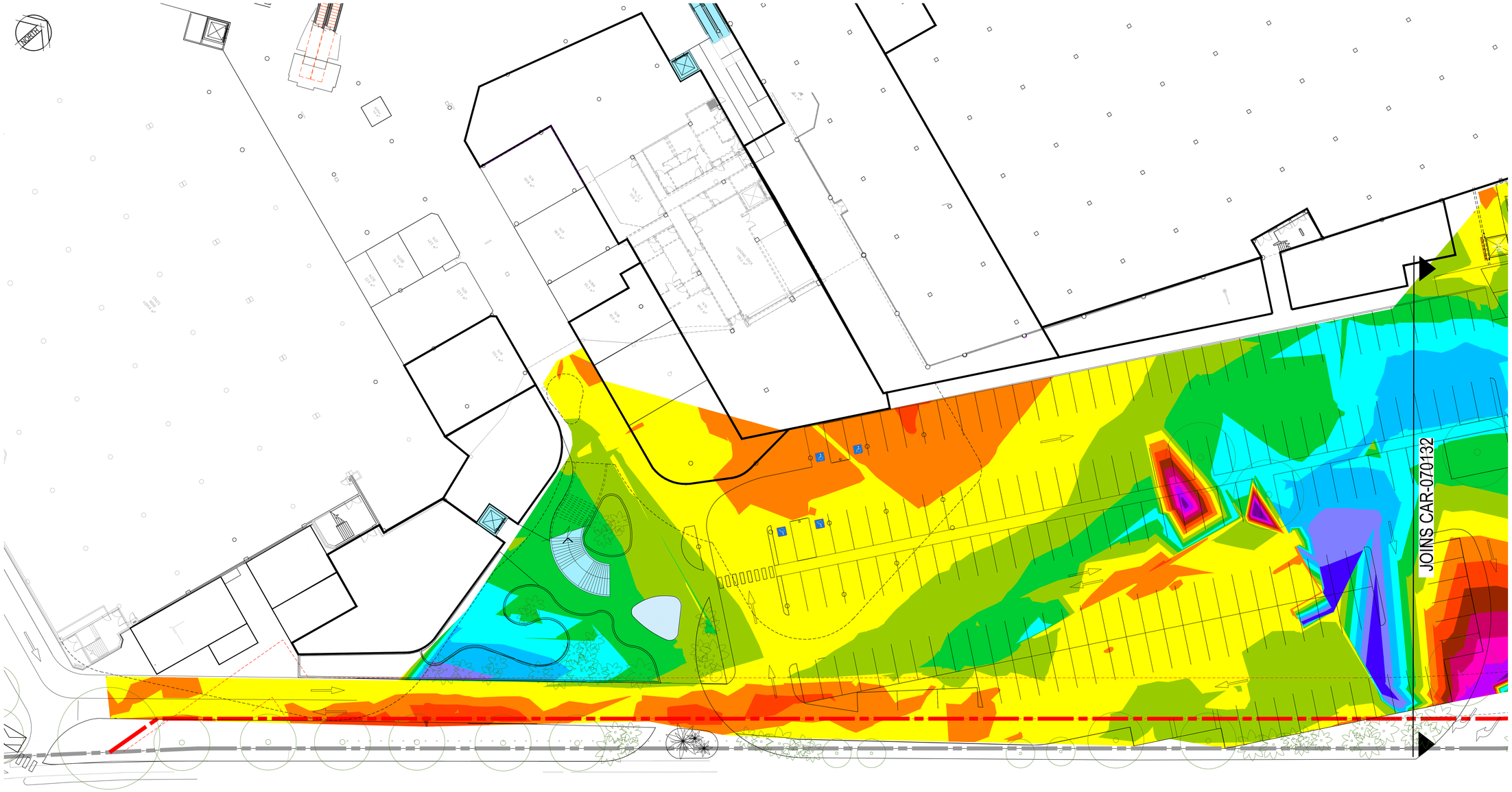
Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

BULK EARTHWORKS PLAN
SHEET 1 OF 2

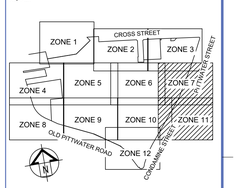
Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070132.DWG	Plot Date: 13/8/2018 4:41pm
Project No.: D11754	Drawing No.: CAR-070132	Revision: E



Surface Analysis: CUT and FILL depths			
Number	Color	Minimum Elevation (m)	Maximum Elevation (m)
1		1.50	9999
2		1.25	1.50
3		1.0	1.25
4		0.75	1
5		0.50	0.75
6		0.25	0.50
7		0	0.25
8		0	-0.25
9		-0.25	-0.50
10		-0.50	-0.75
11		-0.75	-1.0
12		-1.0	-1.25
13		-1.25	-1.50
14		-1.50	9999

Rev	Date	By	Ch	Description
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	27/06/2018	CM	DNA	ISSUE FOR REVIEW
B	22/05/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

BULK EARTHWORKS PLAN
SHEET 2 OF 2

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070133.DWG	Plot Date: 13/8/2018 4:41pm
Project No.: D11754	Drawing No.: CAR-070133	Revision: E

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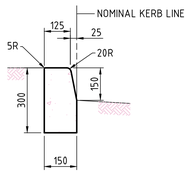
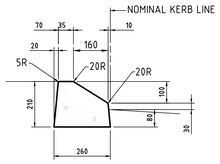
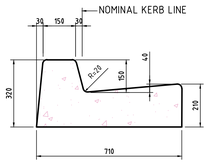


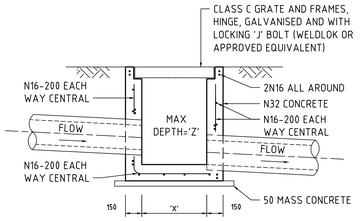
KERB ONLY (KO)
SCALE 1:10



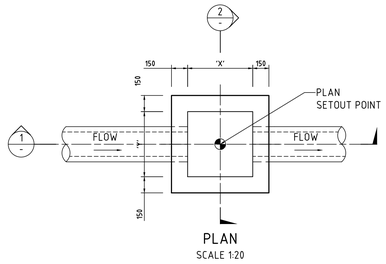
MOUNTABLE KERB (MK)
SCALE 1:10



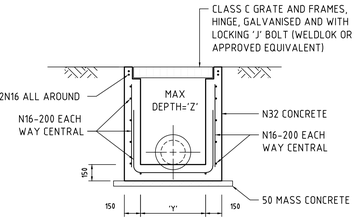
KERB AND GUTTER
SCALE 1:10



SECTION 1
SCALE 1:20



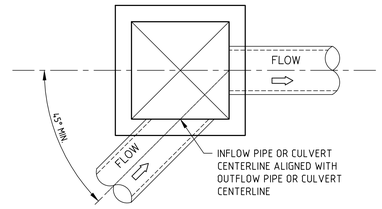
PLAN
SCALE 1:20



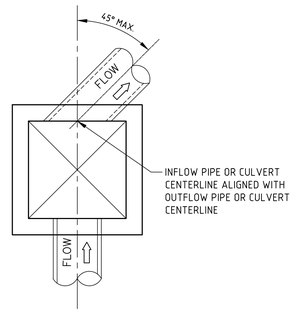
SECTION 2
SCALE 1:20

TYPICAL PIT DETAIL

DEPTH TO INVERT OF OUTLET	'X' (mm)	'Y' (mm)	'Z' (mm)
≤ 600	450	450	600
> 600 ≤ 900	600	600	900
> 900 & ≤ 1200	600	900	1200
> 1200	900	900	> 1200



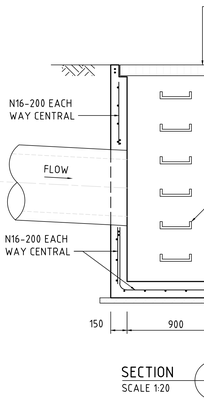
DEFLECTION ANGLE GREATER THAN 45° (SIDE OF PIT)
N.T.S



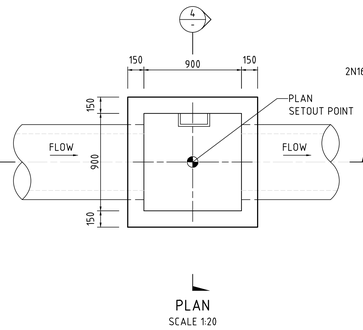
DEFLECTION ANGLE UP TO 45° (REAR OF PIT)
N.T.S

PIT ALIGNMENT REQUIREMENTS

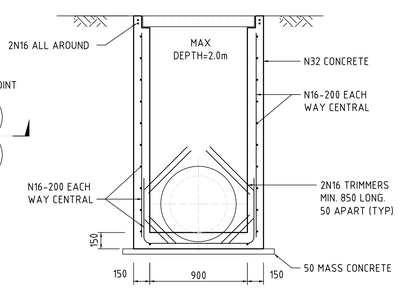
TYPICAL DETAILS OF STORMWATER PIPE OR CULVERT ALIGNMENTS THROUGH STORMWATER PITS. STORMWATER PIPE OR CULVERT ALIGNMENTS NOT SHOWN SHOULD BE CONSTRUCTED SIMILARLY IN ORDER TO STREAMLINE FLOWS FROM UPSTREAM TO DOWNSTREAM AND MINIMISE HEADLOSS.



SECTION 3
SCALE 1:20

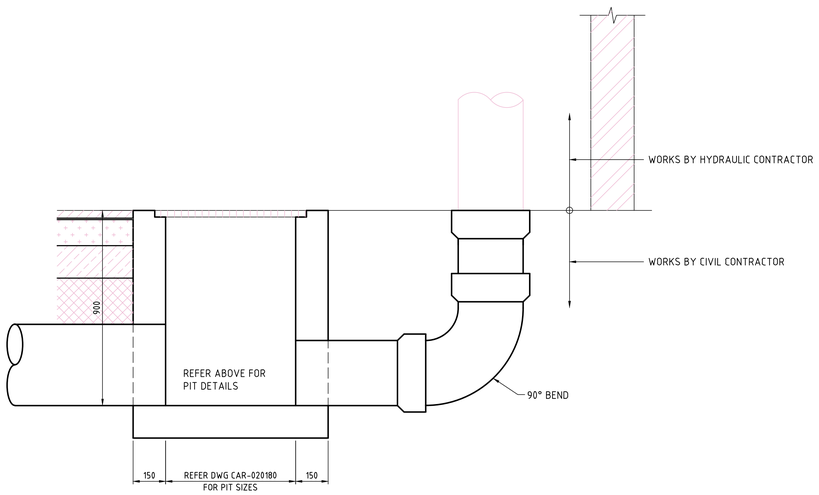


PLAN
SCALE 1:20

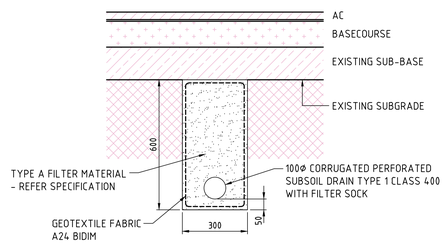


SECTION 4
SCALE 1:20

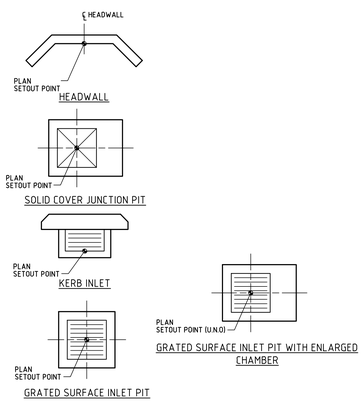
900X900 PIT DETAILS
(>1200 DEEP & MAX 2000 DEEP)
NOTE: STEP IRONS REQUIRED FOR PITS >1200 DEEP



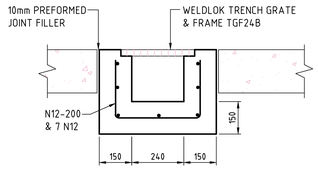
TYPICAL DOWNPIPE TO PIT DETAIL
SCALE 1:10



SUBSOIL DRAINAGE DETAIL
SCALE 1:10



SETOUT DETAILS
N.T.S



GRATED TRENCH GRATE - CARPARK
SCALE 1:10

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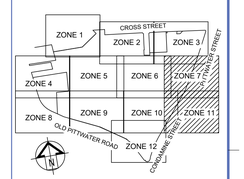
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	20/06/2018	CM	DNA	ISSUE FOR REVIEW
B	22/03/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

TYPICAL DETAILS
SHEET 1 OF 2

Drawing Scale	Scale Bar 1:1	
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Drawn By: B.A.F.	CAD Filename: CAR-070141.DWG	Plot Date: 13/8/2018 4:41pm
Project No.: D11754	Drawing No.: CAR-070141	Revision: E

0 200 400 600 800 1000mm
SCALE 1:10 @A0

0 500 1000 1500 2000mm
SCALE 1:20 @A0

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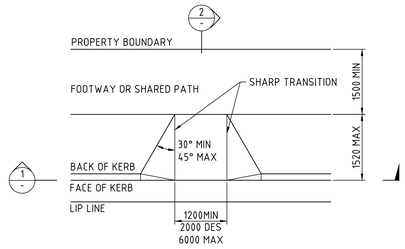
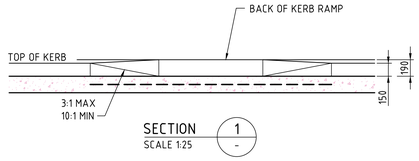
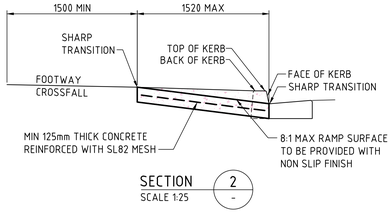


KERB RAMP PLAN
SCALE 1:50



SECTION 1 -
SCALE 1:25



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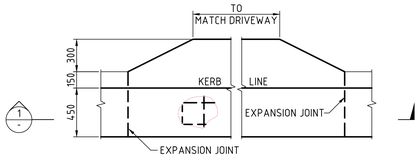
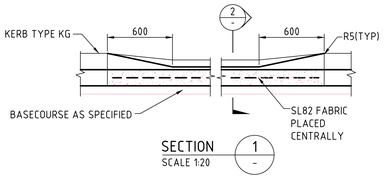
SCALE 1:25



PLAN
VEHICULAR CROSSING
SCALE 1:20



SECTION 1 -
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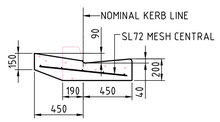
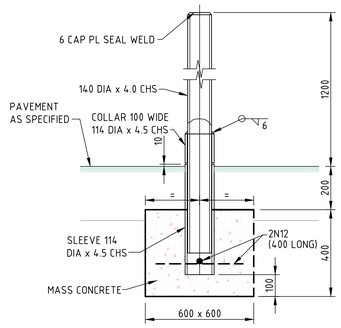
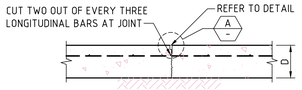


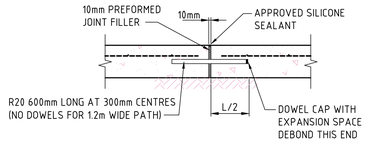
SECTION 2 -
SCALE 1:20



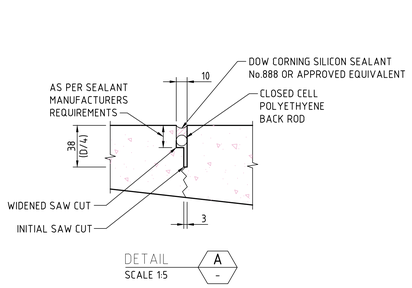
NON REMOVABLE BOLLARD TO FLEXIBLE PAVEMENT
SCALE 1:10
FINISH: HOT DIP GALVANISED 600gm / m²



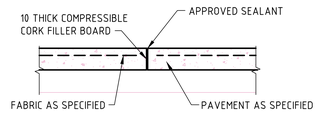
TRANSVERSE CONTRACTION JOINT (TCJ)
SCALE 1:10



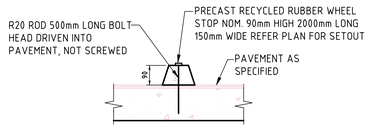
EXPANSION JOINT (EJ)
SCALE 1:10



SCALE 1:5



EXPANSION JOINT (EJ)
FOOTPATHS & MEDIANS/ISLANDS
SCALE 1:10



PRECAST WHEEL STOP (PWS)
SCALE 1:10

0 200 400 600 800 1000mm
SCALE 1:10 @A0

0 500 1000 1500 2000mm
SCALE 1:20 @A0

Rev.	Date	By	Chk	Description
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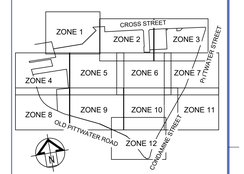
B	22/03/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

TYPICAL DETAILS
SHEET 2 OF 2

Drawing Scale	Scale Bar 1:1	
	0 500 1000 1500	
Drawn By: B.A.F.	CAD Filename: CAR-070142.DWG	Plot Date: 13/8/2018 4:41pm
Project No.: D11754	Drawing No.: CAR-070142	Revision: E

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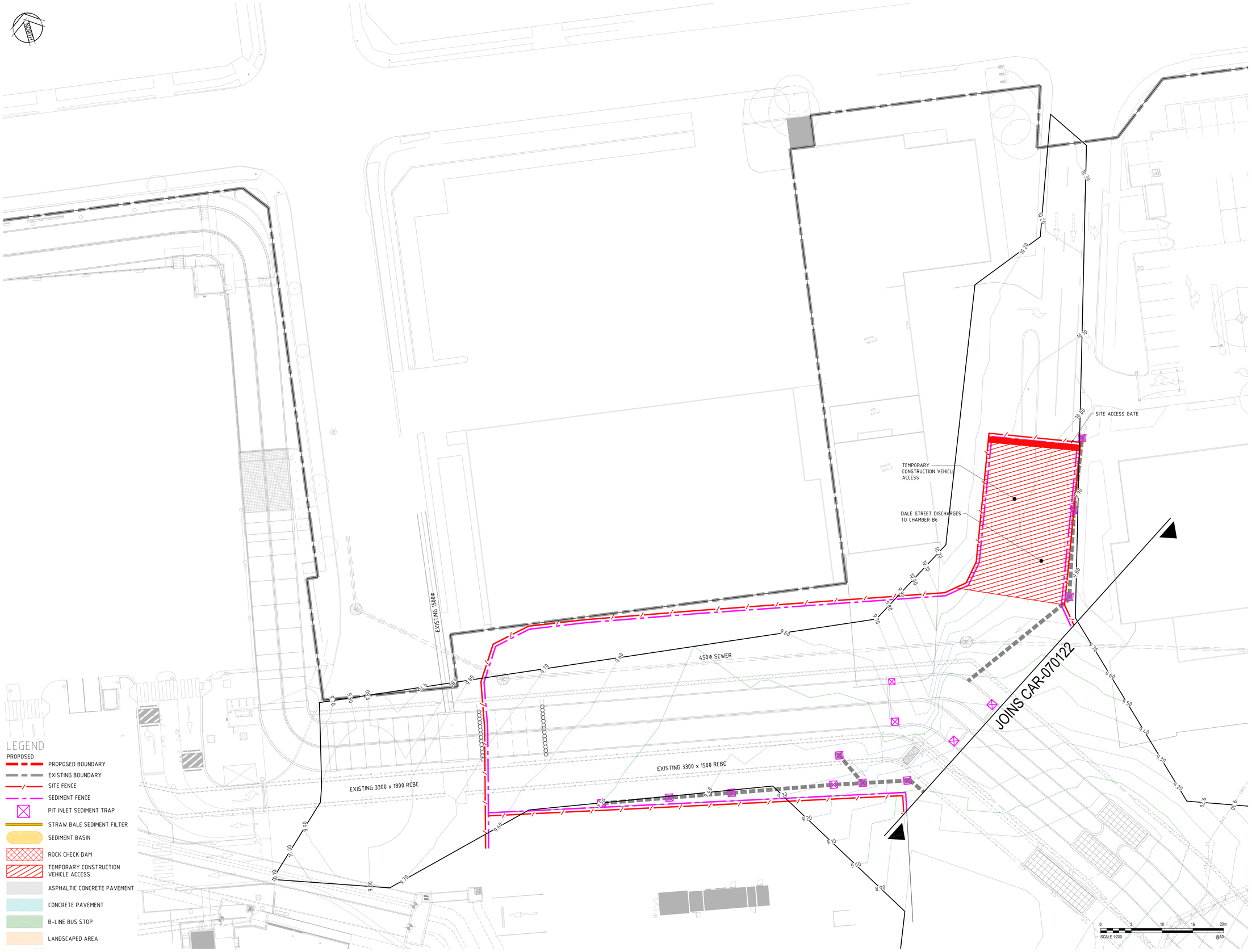
Appendix C – Erosion and Sediment Control Plans



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C	27/06/2018	CM	DNA	ISSUE FOR REVIEW
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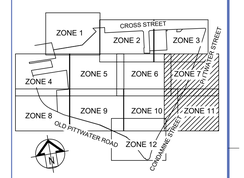
Key Plan



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Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

EROSION AND SEDIMENTATION PLAN
SHEET 1 OF 3

Drawing Scale:	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070121.DWG	Plot Date: 13/8/2018 4:39pm
Project No.: D11754	Drawing No.: CAR-070121	Revision: E

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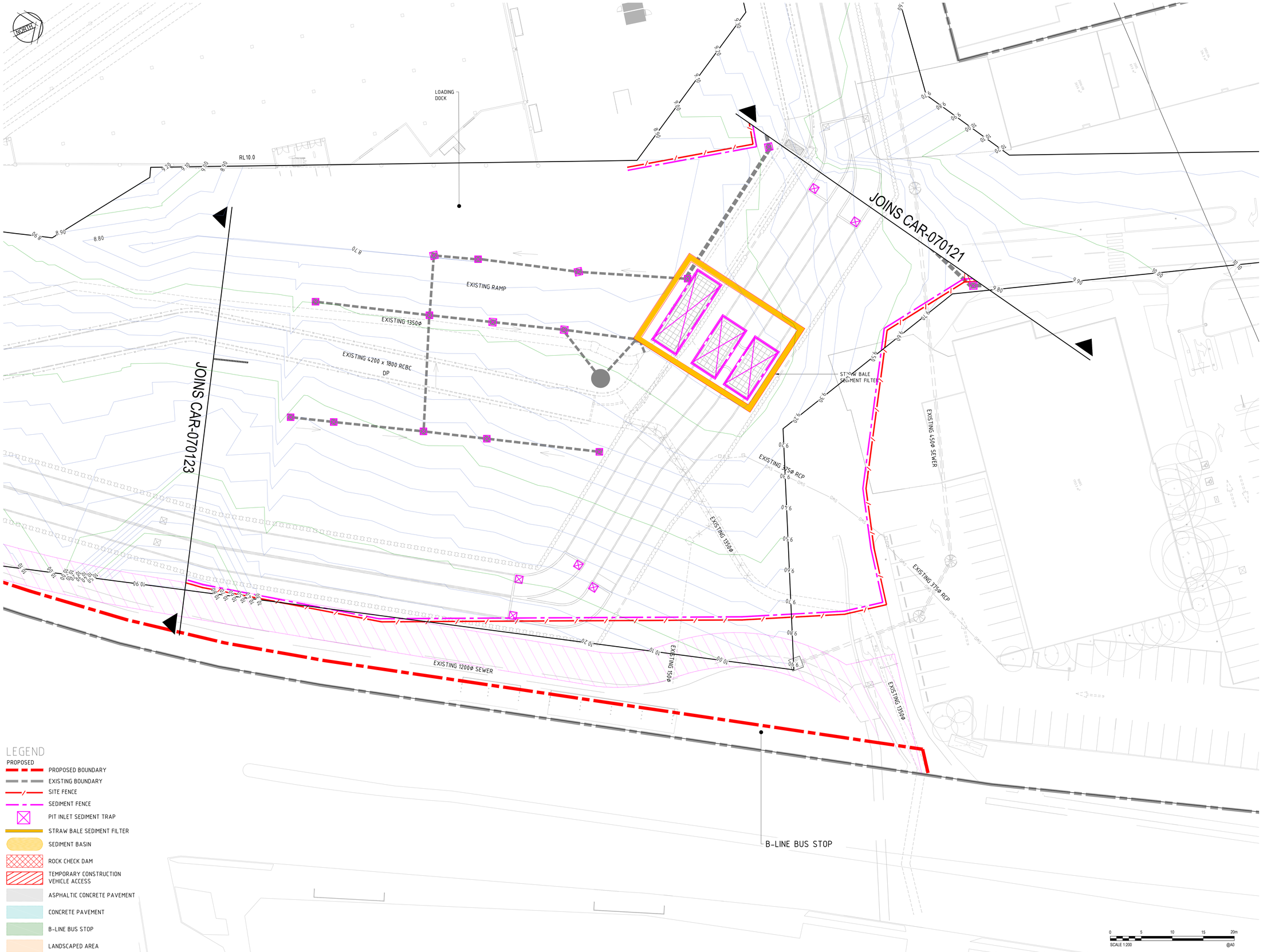

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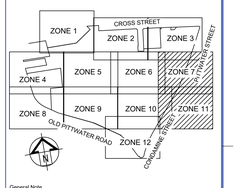
Key Plan



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WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

EROSION AND SEDIMENTATION PLAN
SHEET 2 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070122.DWG	Plot Date: 13/8/2018 4:40pm
Project No.: D11754	Drawing No.: CAR-070122	Revision: E

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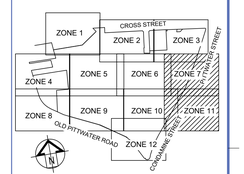
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



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SHEET 3 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070123.DWG	Plot Date: 13/8/2018 4:40pm
Project No.: D11754	Drawing No.: CAR-070123	Revision: E

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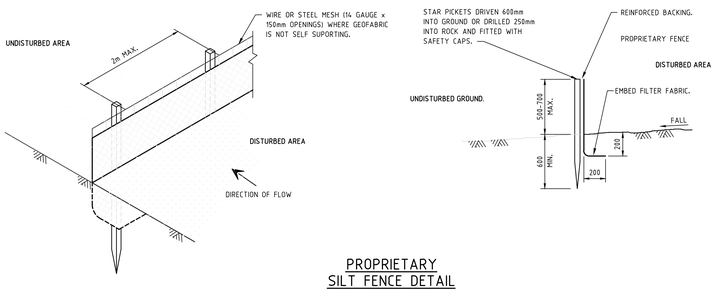

PROPRIETARY SILT FENCE DETAIL

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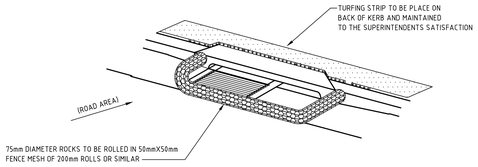
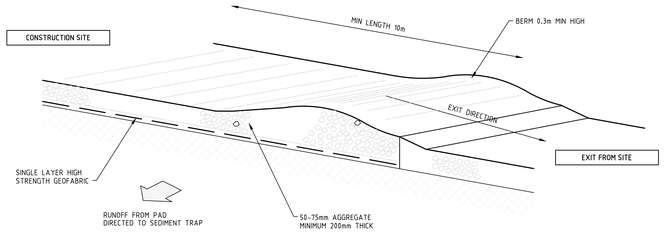


DETAIL OF MESH AND GRAVEL INLET SEDIMENT TRAP

NOT TO SCALE



TEMPORARY CONSTRUCTION VEHICLE EXIT

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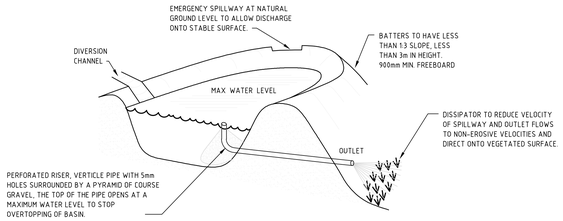
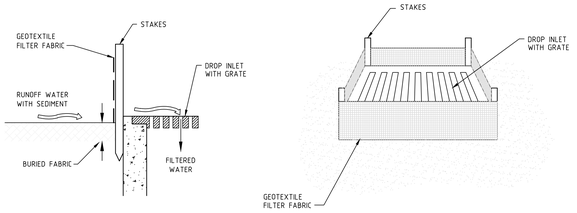


SEDIMENT BASIN

NOT TO SCALE



GEOTEXTILE FILTER SEDIMENT TRAP

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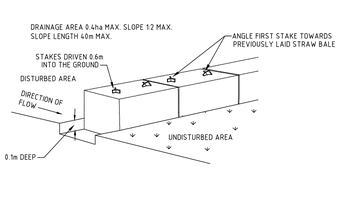
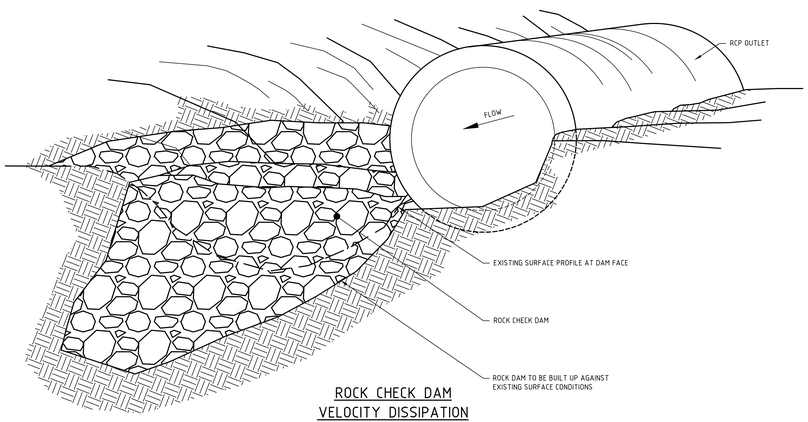


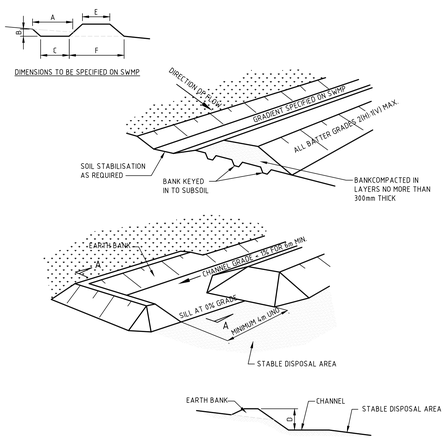
STRAW BALE SEDIMENT FILTER

NOT TO SCALE



ROCK CHECK DAM VELOCITY DISSIPATION

NOT TO SCALE



DIVERSION BUND & LEVEL SPREADER

NOT TO SCALE

NOTE: THESE "DETAILED CALCULATION" SPREADSHEETS RELATE ONLY TO HIGH EROSION HAZARD LANDS AS IDENTIFIED IN FIGURE 4.6 OR WHERE THE DESIGNER CHOOSES TO USE THE RUSLE TO SIZE SEDIMENT BASINS. THE "STANDARD CALCULATION" SPREADSHEETS SHOULD BE USED ON LOW EROSION HAZARD LANDS AS IDENTIFIED BY FIGURE 4.6 AND WHERE THE DESIGNER CHOOSES NOT TO RUN THE RUSLE IN CALCULATIONS

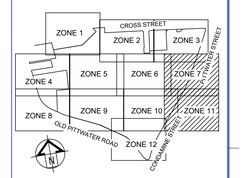
1. SITE DATA SHEET

SITE NAME:	WESTFIELD WARRINGAH						
SITE LOCATION:	BROOKVALE						
PRECINCT:	STAGE 2						
DESCRIPTION OF SITE:							
SITE AREA:	SITE						REMARKS:
TOTAL CATCHMENT AREA (HA)	2.1	-	-	-	-	-	
DISTURBED CATCHMENT AREA (HA)	2.1	-	-	-	-	-	
SOIL ANALYSIS:							
% SAND (FACTION 0.02 TO 2.00 MM	-	-	-	-	-	-	SOIL TEXTURE SHOULD BE ASSESSED THROUGH MECHANICAL DISPERSION ONLY. DISPERSING AGENTS (E.G. CALGON) SHOULD NOT BE USED
% SILT (FRACTION 0.002 TO 0.02 MM)	-	-	-	-	-	-	-
% CLAY (FRACTION FINER THAN 0.002 MM)	-	-	-	-	-	-	-
DISPERSION PERCENTAGE	-	-	-	-	-	-	E.G. ENTER 10 FOR DISPERSION OF 10%
% OF WHOLE SOIL DISPERSIBLE	-	-	-	-	-	-	SEE SECTION 6.3.3(E)
SOIL TEXTURE GROUP:	-	-	-	-	-	-	SEE SECTION 6.3.3(C), (D) AND (E)
RAINFALL DATA:							
DESIGN RAINFALL DEPTH (DAYS)	5	-	-	-	-	-	SEE SECTIONS 6.3.4 (D) AND (E)
DESIGN RAINFALL DEPTH (PERCENTILE)	75	-	-	-	-	-	SEE SECTIONS 6.3.4 (F) AND (G)
X-DAY, Y-PERCENTILE RAINFALL EVENT	2/9	-	-	-	-	-	SEE SECTION 6.3.4 (H)
RAINFALL INTENSITY 2-YEAR, 6-HOUR STORM	10.8	-	-	-	-	-	SEE IFD CHART FOR THE SITE
RUSLE FACTORS:							
RAINFALL EROSIVITY (R-FACTOR)	254	-	-	-	-	-	AUTOMATIC CALCULATION FROM ABOVE DATA
SOIL ERODIBILITY (K-FACTOR)	0.05	-	-	-	-	-	RUSLE DATA CAN BE OBTAINED FROM APPENDIXES A, B AND C
SLOPE LENGTH (M)	250	-	-	-	-	-	
SLOPE GRADIENT (%)	-	-	-	-	-	-	
LENGTH/GRADIENT (LS-FACTOR)	0.26	-	-	-	-	-	
EROSION CONTROL PRACTICE (P-FACTOR)	1.3	-	2.3	3.3	4.3	5.3	6.3
GROUND COVER (C-FACTOR)	-	-	-	-	-	-	-
CALCULATIONS:							
SOIL LOSS (T/HA/YR)	42	-	-	-	-	-	
SOIL LOSS CLASS	-	-	-	-	-	-	SEE SECTION 6.4.2(B)
SOIL LOSS (M3/HA/YR)	33	-	-	-	-	-	
SEDIMENT BASIN STORAGE VOLUME, M3	42	-	-	-	-	-	SEE SECTIONS 6.3.4(I) AND 6.3.5 (E)

E 13/08/2018 CM DNA ISSUE FOR REVIEW
D 24/07/2018 CM DNA ISSUE FOR REVIEW
C 20/06/2018 CM DNA ISSUE FOR REVIEW
B 22/03/2017 CM DNA ISSUE FOR REVIEW
A 17/03/2017 CM DNA ISSUE FOR REVIEW

Rev.	Date	By	Ch	Description

Key Plan



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SCENTRE GROUP
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Westfield
WARRINGAH

Scentre Design & Construction Pty Limited
85 Castlereagh Street. Sydney NSW 2011
Phone (02) 9058 7000 Fax (02) 9028 8500
GPO Box 4004 Sydney NSW 2001

Title
WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

EROSION AND SEDIMENTATION DETAILS
SHEET 1 OF 1

Drawing Scale:	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070125.DWG	Plot Date: 13/8/2018 4:40pm
Project No.: D11754	Drawing No.: CAR-070125	Revision: E

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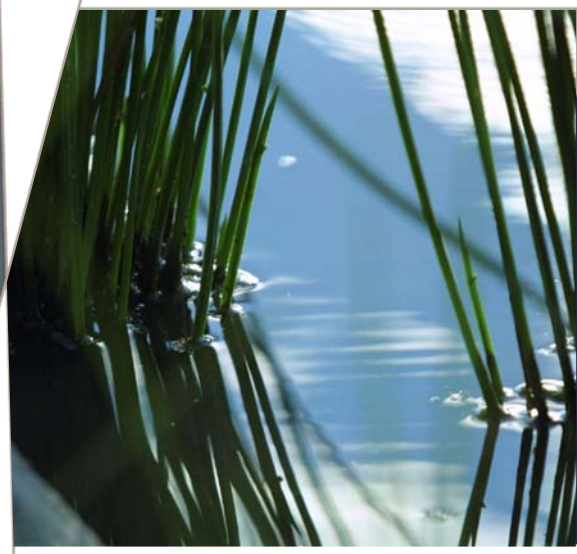
Appendix D – Water Quality Report

Water Quality Report

Westfield Shopping Centre, Warringah – Stage 2

80017026



Prepared for
Scentre Group Design and Construction Pty Ltd

August 2018

Cardno
Shaping the Future

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Civil Design Manager

Document Information

Prepared for	Scentre Group Design and Construction Pty Ltd
Project Name	Westfield Shopping Centre, Warringah – Stage 2
Job Reference	80017026
Date	17 August 2018
Version Number	6
Effective Date	13 August 2018
Date Approved:	13 August 2018

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	7 Mar 17	Initial Issue	Jason Stewart	Scott Brisbin
2	15 Mar 17	For DA	Jason Stewart	Scott Brisbin
3	10 Jul 18	For DA	Jason Stewart	Scott Brisbin
4	7 Aug 18	For DA	Jason Stewart	Scott Brisbin
5	13 Aug 18	For DA	Jason Stewart	Scott Brisbin
5	13 Aug 18	For DA	Jason Stewart	Scott Brisbin

Table of Contents

Appendices

Tables

Figures

1 Introduction

Cardno (NSW/ACT) Pty Ltd has been engaged by Scentre Group Design and Construction Pty Ltd to undertake the stormwater system design for the proposed Stage 2 upgrades to the Westfield shopping centre. The proposed works consist of car park upgrades and additional shopping facilities. Water quality management is required for the proposed development to meet Northern Beaches Council's stormwater quality performance targets specified in the Draft Water Management Policy (2015). This report details the management measures to be employed to meet these targets.

2 Site Description

The proposed development area of the site is currently the eastern portion of the Westfield Shopping Centre, Warringah. The existing site is entirely impervious with the exception of scattered soft landscaping. The site falls generally towards the south-east with a gentle grade of approximately 0.5%. The site area is approximately 3.92ha. The existing site is presented in Figure 2-1 below (subject site shaded blue).

Figure 2-1 Satellite Image Showing Site Location (Nearmap 2017)

2.1 Natural Watercourses

Brookvale creek enters the Warringah Westfield site in the north-western corner of the shopping centre. Brookvale Creek flow is conveyed through the site via box culverts that discharge back into Brookvale Creek in the south-eastern corner of the site before passing under Condamine Street and discharging to the existing gross pollutant trap located adjacent to the golf course.

2.2 Stormwater Discharge Points

Site stormwater runoff currently discharges into the Brookvale Creek box culverts that run underneath the shopping centre and discharge under Condamine Street.

2.3 Flooding

2.3.1 Mainstream Flooding

The subject site is impacted by the flooding of Brookvale Creek. Refer to Cardno's Flood Impact Assessment (ref: 80017026-L01:BCP/bcp) for details.

High Capacity inlet pits are located at the Dale Street roundabout (Chamber B6) and opposite the Condamine Street box culverts (Chamber C6).

2.3.2 Overland Flow

The subject site is impacted by upstream overland flows. Refer to Cardno's Flood Impact Assessment (ref: 80017026-L01:BCP/bcp) for details.

High Capacity inlet pits are located at the Dale Street roundabout (Chamber B6) and opposite the Condamine Street box culverts (Chamber C6).

2.3.3 Water Quality

The subject site does not contain any known water quality devices.

3 Proposed Development

3.1 Development Description

The development is proposed to consist of car park upgrades and additional retail space. Details are included on the architectural drawings prepared by Scentre Group.

3.2 Stormwater Drainage

Stormwater runoff from the proposed development site will be collected and conveyed in pit and pipe networks that discharge into the Brookvale Creek box culverts at three locations. Refer to Cardno's CAR-070100 series drawings for details.

4 Water Quality

4.1 Water Quality Targets

Table 4 in Section 8.1.3 of Council's Draft Water Management Policy (2015) specifies minimum pollutant reduction targets for different catchment classes within the Northern Beaches Council LGA compared to untreated runoff from the developed site. The subject site is located in a Class C catchment area and thus the stormwater quality targets in Table 4-1 below have been adopted.

Table 4-1 Minimum Pollutant Reduction Targets

Pollutant	Minimum Reduction
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%
Gross Pollutants (GP)	90%

It is to be noted that Table 4 of Council's Draft Water Management Policy (2015) also requires that post-development peak site discharge must not exceed pre-development levels for all storm events up to and including the 50% AEP event, a requirement which is typically met with stormwater retention and/or infiltration. Considering the existing site is completely impervious and does not contain any stormwater retention or infiltration measures, this requirement can be met without the inclusion of additional measures.

4.2 Base Information

A MUSIC model (Version 6.2.1) was prepared for the development site in order to demonstrate compliance with Table 4 in Section 8.1.3 of Council's Draft Water Management Policy (2015).

Meteorological stations near the subject site were reviewed in reference to distance from the site, completeness of data record, dates of data record and type of data record.

Historical pluviograph data was taken from Meteorology Station Number 066062 at Observatory Hill, Sydney. The station is approximately 12km from the development site with the rainfall record approximately 91% complete.

20 years of historical rainfall data was analysed in 6 minute time steps from 22 December 1972 to 22 December 1992. The average annual rainfall over this period was 1,325mm.

Average monthly evapotranspiration data for Sydney, converted to a daily time step, was analysed over the same 20 year time period noted above.

4.3 Source Nodes

Source nodes were characterised according to surface types specified in Table 3-2 of BMT WBM's Draft NSW MUSIC Modelling Guidelines (2010). Source node surface types and hydrologic parameters are summarised in Table 4-2 below.

Table 4-2 Source Nodes

Land Use	Surface Type	Area (ha)	Effective Impervious Area (%)	Rainfall Threshold (mm/day)
Car Parks/ Roads	Sealed Roads	2.010	100	1.5
Roofs	Roof	1.296	100	0.3
Landscaping/Footpaths	Commercial	0.616	100	1.5

Pollutant loads for source nodes were adopted from Table 3-9 and 3-10 of the Draft NSW MUSIC Modelling Guidelines (2010) and are summarised in Table 4-3 below. Stochastic pollutant generation was selected.

Table 4-3 Storm Flow Pollutant Loads

Land Use	Concentration (mg/ L – log10					
	TSS		**TP**		**TN**	
	mean	**std.dev**	**mean**	**std.dev**	**mean**	**std.dev**
Car Parks/ Roads	2.43	0.32	-0.3	0.25	0.34	0.19
Roofs	1.3	0.32	-0.89	0.25	0.3	0.19
Landscaping	2.15	0.32	-0.6	0.25	0.3	0.19

It is to be noted that as the development site is 100% impervious, base flow pollutant parameters have not been included.

4.4 Treatment Nodes

Three treatment nodes are proposed as part of the stormwater treatment train

1. Primary Treatment – 43 x Stormwater 360 Enviropod Litter Baskets (or approved equivalent devices)
2. Tertiary Treatment – 2 x Stormwater 360 Jellyfish Membrane Filtration Devices (or approved equivalent devices)
3. Rainwater Tank

Runoff from a 0.236ha parcel of access road and carpark towards the north of the development area will bypass tertiary treatment. Runoff from the remaining 3.684ha of development area will pass through the proposed JellyFish devices.

The proposed treatment train is shown in Figure 4-1.

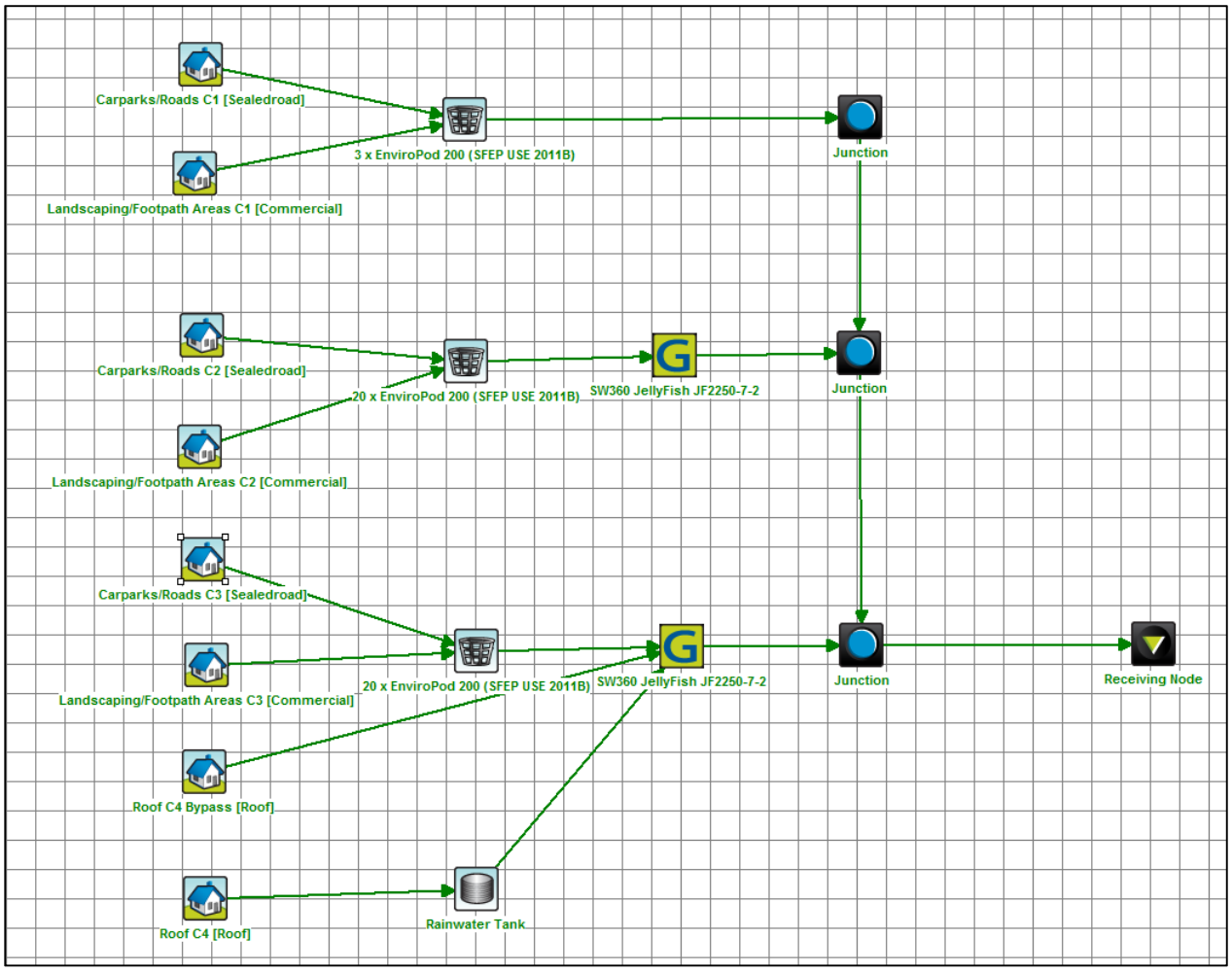

Figure 4-1 MUSIC Treatment Train

4.4.1 EnviroPod Litter Baskets

Litter baskets equivalent to Stormwater360 EnviroPods are to be fitted to all inlet pits to remove gross pollutants and coarse sediments from stormwater runoff. Preliminary sizing indicates approximately forty three (43) EnviroPod 200 units are required. Selection of the appropriate EnviroPod models and number of units will be confirmed during detailed design.

The EnviroPod MUSIC nodes were provided by Stormwater360 with pollutant removal efficiencies presented in Table 4-4 below.

Table 4-4 Stormwater360 Enviropod Pollutant Removal Efficiency

Pollutant	Removal Efficiency
Gross Pollutants	100%
Total Suspended Solids (TSS)	75%
Total Phosphorus (TP)	30%
Total Nitrogen (TN)	21%

The EnviroPod's may be substituted with approved equivalent devices.

4.4.2 Jellyfish Filter

Two Stormwater 360 'JellyFish' or equivalent stormwater membrane filtration devices are proposed to target finer suspended solids and nutrients in the site's stormwater runoff. The JellyFish product provides effective treatment over a very small footprint and is available in a number of configurations. Preliminary sizing indicates two (2) JellyFish model SW360 JF2250-7-2 devices will be required to provide suitable treatment of

stormwater with reasonable maintenance requirements. Final sizes and configurations of the JellyFish devices will be confirmed during detailed design.

The JellyFish treatment node within the MUSIC model was provided by Stormwater360 with pollutant removal efficiencies presented in Table 4-5 below.

Table 4-5 Jellyfish Filter Pollutant Removal Efficiency

Pollutant	Removal Efficiency
Gross Pollutants	99%
Total Suspended Solids (TSS)	89%
Total Phosphorus (TP)	65%
Total Nitrogen (TN)	54%

The Jellyfish may be substituted with approved equivalent devices.

4.4.3 Rainwater Tank

The proposed stormwater retention tank was modelled as a 'rainwater tank' in the MUSIC model with a of 50kL storage capacity.

Stormwater reuse is to be used for commercial toilets with the assumed toilet flushing rates as follows:

- Toilets – 30 toilets x 4.5L/flush/toilet x 80 flushes/day (assumed 10 flushes/hr x 8 hrs) = 10.8kL/day
- Urinals – 15 urinals x 3.0L/flush/urinal x 80 flushes/day (assumed 10 flushes/hr x 8 hrs) = 3.6kL/day
- Total daily water usage for the commercial toilets is therefore estimated at 14.4kL/day.

Runoff from approximately 0.2ha of roof area will drain to the proposed rainwater tank. Runoff from the remaining 1.096ha of roof area will bypass the rainwater tank.

4.5 Results

Results of the MUSIC model show the nominated treatment train meets the pollutant removal targets outlined in Council's Draft Water Management Policy (2015). Table 4-6 presents a summary of the MUSIC model results.

Table 4-6 Summary of MUSIC Model Results

Pollutant	Minimum Reduction	Achieved Reduction	Comments
Total Suspended Solids (TSS)	80%	91.7%	Treatment exceeds minimum
Total Phosphorus (TP)	45%	60.4%	Treatment exceeds minimum
Total Nitrogen (TN)	45%	48.9%	Treatment exceeds minimum
Gross Pollutants	90%	96.2%	Treatment exceeds minimum

The above results demonstrate compliance with the minimum pollutant reduction specified in Table 4 of Council's Draft Water Management Policy (2015).

4.6 Maintenance

All operation and maintenance works on proprietary devices, such as the EnviroPod and Jellyfish Filter will be undertaken in accordance with the manufacturer's recommendations.

It is expected that all operation and maintenance works will be undertaken at regular intervals and following significant rainfall events.

5 Conclusion

A water quality management plan has been developed for the proposed additions and alterations to the Westfield Shopping Centre, Warringah.

MUSIC modelling has confirmed that the proposed water quality treatment train consisting of a rainwater tank, forty three (43) EnviroPod litter baskets and two (2) Jellyfish membrane filtration devices (or approved equivalent treatment devices) meets Council's minimum pollutant reduction targets specified in Table 4 of the Draft Water Management Policy (2015).

6 References

Draft Water Management Policy, Northern Beaches Council (2015)

Creek Management Study, Warringah Council (March 2004)

Draft NSW MUSIC Modelling Guidelines, BMT WBM (August 2010)

JellyFish Filter Brochure, Stormwater 360 (2017)

Gross Pollutant Removal Brochure, Stormwater 360 (2012)

Westfield Shopping Centre,
Warringah – Stage 2

APPENDIX A

CONCEPT STORMWATER MANAGEMENT PLANS

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NORTH

CROSS STREET

RETAIN EXISTING SIGNALS

PROPOSED MODIFICATION TO EXISTING SIGNALISED INTERSECTION - REFER TO TCS DRAWINGS

PALM TREE CAR PARK

GREEN STREET

DALE STREET

ALDI

PROVIDE BREAK IN MEDIAN

K.O. KERB

K&G KERB

FIT ENVIROPOD LITTER BASKETS TO PITS INLETS (TYP)

CONNECT TO EXISTING CULVERT

PROVIDE GRATED DRAIN

PROVIDE HEAVY DUTY CONCRETE CROSSOVER TO NORTHERN BEACHES COUNCIL SPECIFICATION

PROVIDE BREAK IN MEDIAN

PROVIDE GRATED DRAIN

CONNECT TO EXISTING CULVERT

EXISTING 1500ø

03

NEW RAMP UP to L1 &L2 G1:8

NEW RAMP DN fr L1 G1:8

450ø SEWER

ONLY R2-14 A

JOINS CAR-070112

EXISTING 450ø SEWER

LINE OF BUILDING ABOVE

MK KERB

EXISTING 3300 x 1800 RCBC

EXISTING 3300 x 1500 RCBC

EXISTING 1800 x 3300 RCBC

EXISTING 3300 x 1500 RCP

PROVIDE SKID RESISTANT COATING OVER GRATES

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
- STORMWATER DRAINAGE PIPE
- JELLY FISH FILTER SEE NOTE 2.
- SS — SUBSOIL DRAINAGE LINE
- ASPHALTIC CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- B-LINE BUS STOP
- LANDSCAPED AREA. REFER TO LANDSCAPE DRAWINGS

KERBS

- FK KERB — FK FLUSH KERB
- K&G KERB — KERB AND GUTTER
- MK KERB — TYPE 'MK' KERB
- KO KERB — TYPE 'KO' KERB
- SB KERB — TYPE 'SB' KERB
- PROPOSED BUS LANE
- PROPOSED CONCRETE FOOTPATH

NOTES

1. ENVIROPOD LITTER BASKETS TO BE FITTED TO ALL PIT INLETS. SPECIFICATION SUBJECT TO DETAILED DESIGN.
2. JELLYFISH JF2250-7-2 OR APPROVED EQUIVALENT SECONDARY TREATMENT DEVICE. UNIT SIZING AND SPECIFICATION SUBJECT TO DETAILED DESIGN.

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SCALE 1:200 @A0

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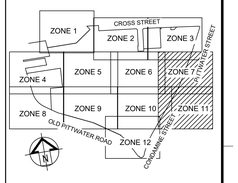

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Title

WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

GENERAL ARRANGEMENT PLAN
SHEET 1 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070111.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070111	Revision: F

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NORTH

ALDI

ONLY

DALE STREET DISCHARGES TO CHAMBER B6

DISCHARGE LOADING DOCK SURFACE DRAINAGE TO B6

2 070115

1 070115

RL 8.80

RL 9.00

RL10.0

LINE OF BUILDING ABOVE

EXISTING 1500ø

EXISTING 1800ø

EXISTING 1800ø

EXISTING 1800ø

STORAGE

RL 8.85

KO KERB

K&G KERB

RL 8.80

RL 8.75

RL 8.70

BREAK IN AND CONSTRUCT GOOD CONNECTION TO EXISTING CULVERT

PROVIDE SLIP RESISTANT YELLOW STRIPS TO EXISTING GRATE.

TROLLEY STORAGE

EXISTING RAMP

DALE STREET

HIGH CAPACITY INLET PIT B6

EXISTING 1350ø

EXISTING 4200 x 1800 RCBC DP

JOINS CAR-070111

JOINS CAR-070113

EXISTING CHAMBER B6.

GRATED DRAIN

EXISTING 450ø SEWER

EXISTING 375ø RCP

WATER QUALITY TREATMENT DEVICES (REFER TO LEGEND)

EXISTING 1350ø

EXISTING 1200ø SEWER

EXISTING 750ø

EXISTING 1350ø

EXISTING 375ø RCP

RL11.35

RL11.50

EXISTING 5.5m SEWER EASEMENT

FUTURE 4m ROAD WIDENING

EXISTING K&G

EXISTING TWIN 3300 X 1800 RCBC

EXISTING 5.5m SEWER EASEMENT

EXISTING B-LINE BUS STOP

EXISTING B-LINE BUS STOP

AREA TO LANDSCAPE DESIGN DRAWINGS

EXISTING TREES

EXISTING MEDIAN

PITTWATER ROAD

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
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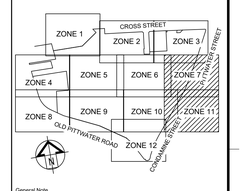

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SCENTRE GROUP

Owner and Operator of Westfield in Australia and New Zealand

Westfield

WARRINGAH

Scentre Design & Construction Pty Limited
85 Castlereagh Street. Sydney NSW 2011
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Title

WARRINGAH STAGE 2 WORKS
CONCEPT CIVIL DESIGN

GENERAL ARRANGEMENT PLAN
SHEET 2 OF 3

Drawing Scale	Scale Bar 1:1	
Drawn By: B.A.F.	CAD Filename: CAR-070112.DWG	Plot Date: 17/8/2018 9:16am
Project No.: D11754	Drawing No.: CAR-070112	Revision: F

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NORTH

COLES

JOINS INSET A

RETAINING WALL 1.5m HIGH AS PART OF FUTURE STRUCTURE

SEAL EXISTING SURCHARGE PIT

LANDSCAPED AREA

RL 10.0

EXISTING 2x1350 RCP

EXISTING Ø1350 RCP

EXISTING Ø1350 RCP

PROVIDE KERB RAMP

Ø906 SNLSTING

Ø1050 EXISTING

Ø1080 EXISTING

Ø1080 EXISTING

Ø1080 SNLSTING

Ø1050 EXISTING

STORAGE

STORAGE

KO KERB

K&G KERB

EXISTING 1350Ø

EXISTING 4200 x 1800 RCBC

EXISTING CHAMBER C6

LINE OF BUILDING ABOVE

DROP OFF

FK KERB

PLANT ROOM

PLANT ROOM

PLANT

RETAINING WALL 1.5m HIGH

5.5m SEWER EASEMENT

PROPOSED SAG PIT AND CONNECT TO EXISTING STORMWATER

EXISTING CONCRETE FOOTPATH

FUTURE 4m ROAD WIDENING

EXISTING K&G

EXISTING 1200 SEWER

PROVIDE BREAK MEDIAN

WATER QUALITY TREATMENT DEVICES (REFER TO LEGEND)

BREAK IN AND MAKE GOOD CONNECTION TO CHAMBER C6

EXISTING CONCRETE FOOTPATH

RAISE ACCESS COVERS TO SUIT NEW SURFACE LEVELS

EXISTING 2x3.3x1.8 TWIN CULVERTS

CULVERT 1

CULVERT 2

CONDAMINE STREET

EXISTING 2x1.8x1.8 RCBC
2x1.8x2.8 RCBC

EXISTING MEDIAN

EXISTING 2.15x1.50 RCBC

PROPOSED SIGNALISED INTERSECTION MODIFICATIONS REFER TCS DRAWINGS

JOINS CAR-070111

PITTWATER ROAD

LEGEND

PROPOSED

- FUTURE BOUNDARY
- EXISTING BOUNDARY
- STORMWATER DOWN PIPE
- PIT ID LABEL
- 900 x 900 STORMWATER PIT
- 1500 x 1000 STORMWATER PIT
- STORMWATER DRAINAGE PIPE
- JELLY FISH FILTER SEE NOTE 2.
- SS — SUBSOIL DRAINAGE LINE
- ASPHALTIC CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- B-LINE BUS STOP
- LANDSCAPED AREA. REFER TO LANDSCAPE DRAWINGS

KERBS

- FK KERB — FK FLUSH KERB
- K&G KERB — KERB AND GUTTER
- MK KERB — TYPE 'MK' KERB
- KO KERB — TYPE 'KO' KERB
- SB KERB — TYPE 'SB' KERB
- PROPOSED BUS LANE
- PROPOSED CONCRETE FOOTPATH

INSET A
SCALE 1:200

EXISTING CAR PARK

3
070115

SA KERB

PROPOSED 34m DECELERATION LANE

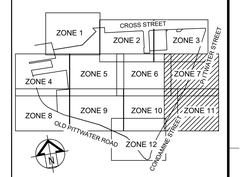
NOTES

1. ENVIROPOD LITTER BASKETS TO BE FITTED TO ALL PIT INLETS. SPECIFICATION SUBJECT TO DETAILED DESIGN.
2. JELLYFISH JF2250-7-2 OR APPROVED EQUIVALENT SECONDARY TREATMENT DEVICE. UNIT SIZING AND SPECIFICATION SUBJECT TO DETAILED DESIGN.

0 5 10 15 20m
SCALE 1:200 @A0

Rev	Date	By	Chk	Description
F	17/08/2018	CM	DNA	ISSUE FOR REVIEW
E	13/08/2018	CM	DNA	ISSUE FOR REVIEW
D	24/07/2018	CM	DNA	ISSUE FOR REVIEW
C	29/05/2017	CM	DNA	ISSUE FOR REVIEW
B	22/03/2017	CM	DNA	ISSUE FOR REVIEW
A	17/03/2017	CM	DNA	ISSUE FOR REVIEW

Key Plan



General Note

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About Cardno

Cardno is an ASX200 professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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