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CIVIL ENGINEERING REPORT FOR DEVELOPMENT APPLICATION

128 ANDREWS ROAD PENRITH NSW

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1 INTRODUCTION

1.1 Background

This civil engineering report has been prepared by Costin Roe Consulting Pty Ltd as part of a Development Application submission to the Penrith City Council for the development of an industrial warehouse/ distribution type facility.

The proposed development comprises a single level warehouse, truck circulation and loading areas, dedicated container storage area, ancillary office space and parking areas.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by Cadence Property to prepare this Engineering Report in support of the proposed application for development on the site.

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Earthworks & Retaining Walls;
- Stormwater Management including stormwater quantity and quality;
- Flooding; and
- Erosion & Sediment Control.

The engineering objectives for the development are to create a site which, based on the proposed architectural layout, responds to the topography and site constraints to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design consistent with the requirements of council's water quality objectives.

A set of drawings have been prepared to show the proposed finished levels, retaining walls, stormwater drainage layout and water quantity and quality requirements for the development. These drawings are for development approval and subject to change through design progression in detail design and construction certificate, ensuring strategies and objectives set out in this document are maintained in the design.

1.3 Authority Jurisdiction

The consent authority is Penrith City Council and the engineering requirements of Penrith City Council (PCC) have been addressed.

It is noted that a pre-development application meeting was completed 6 September 2018 and subsequent meeting minutes provided on 11 September 2018. The engineering design considers items raised in the meeting and subsequent meeting minutes. Refer **Appendix E** for the council minutes.

1.4 Proposed Development

The proposed development is for the construction of an industrial facility comprising a 50,000m^2 single level warehouse building. The indicative layout for the site has been included in **Figure 1.1**.

The indicative layout comprises a single level warehouse building with ancillary office space on the south-east corner of the building. Truck loading areas and circulation hardstand is located on the southern sides of the building, parking is on the east of the building and fire brigade access for the full perimeter of the building. Access is proposed from Andrews Road. Allowances for flooding and flow paths around the development have also been made.

Civil works will include filling earthworks, construction of detention and flood mitigation ponds, bio-retention water quality features and drainage structures. Works will also include in-ground stormwater drainage system, stormwater management system and pavements.

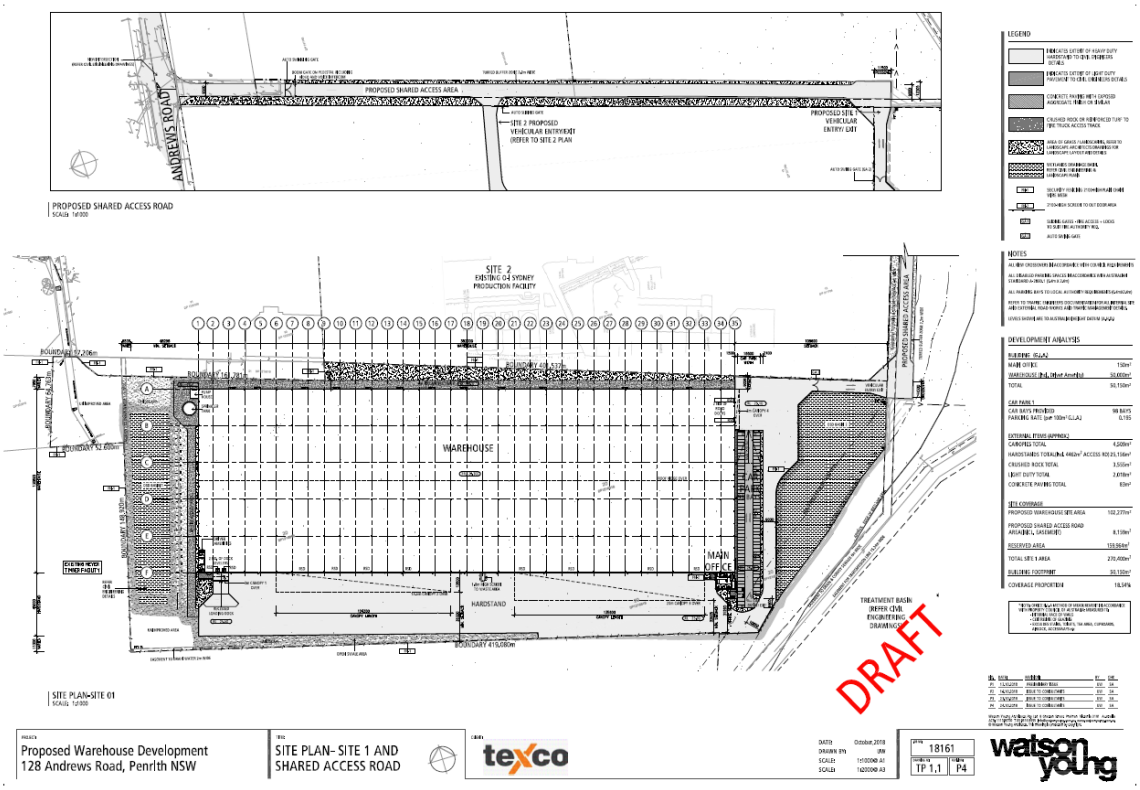

Figure 1.1. Proposed Development

2 SITE CHARACTERISTICS

2.1 Location

The proposed development is in the suburb of Penrith and the site is located on the southern side of Andrews Road. The site is undeveloped however is located within an established area comprising industrial development. The site is bounded by Capral land to the south, undeveloped and the Meyer Timber Facility to the west and existing O/I Glass Facility to the north.

A wetland/ environmental conservation area is located throughout the eastern portion of the overall site, however remains clear of the proposed development footprint referenced in **Figure 1.1**.

The site and location is shown in **Figure 2.1**.

Figure 2.1. Locality Map (Source: Sixmap Viewer 2018)

2.2 Topography & Description

The existing site is undeveloped. The Site, being Lot 20 in DP1216618, is irregular in shape and has an area of approximately 26 Ha. Development is proposed over the 9.97 Ha western part of the land which is clear of the E2 Zoned wetland and conservation area.

The site comprises gently undulating land with levels around RL 25.0m AHD. Existing site falls to the north-east and north-west, with the majority of the site draining toward the wetland area. The maximum level of the site is RL 25.5m AHD and the lowest is 24.1m AHD.

There is an existing drainage path on the west of the site whereby a 600mm RCP discharges from the Capral Land onto the site and into a small dam. Overflow from the small dam are conveyed to an existing box culvert system and ultimately to Lambridge Place.

2.3 Existing Stormwater Drainage & Estate Drainage System

There is no formal drainage on the site. As noted above site runoff generally drains to the north and east to the wetland as overland/ sheet flow. A small portion of the site drains to the west, to a formalised easement and box culvert system. Discharge from Capral land to the south drains through the property to the noted box culvert system. This system, although not previously formalised, has been incorporated into the design and will become formalised as part of the new drainage system.

2.4 Proposed Stormwater Drainage System

The proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The minor system will consist of a piped drainage system designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. The major system has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). This major system employs overland flow paths to safely convey excess run-off from the site.

The design of the stormwater system for this site is based on the following:

- Runoff from the canopy will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.
- Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1988 Edition), Volumes 1 and 2 (AR&R).
- Design recurrence intervals for major and minor storms will be in accordance with Part C3 of PCC DCP2014.
- On-site detention, water quality measures and flooding requirements will be in accordance with Part C3 of PCC DCP2014.
- Stormwater harvesting is based on the requirement of PCC DCP2014 Part C3 and the NSW Department of Environment and Conservation Document *Managing Urban Stormwater: Harvesting and Reuse*.

Water quality has been considered in the design, throughout new paved areas, ensuring that any increase in the detrimental effects of pollution are mitigated and PCC Water Quality Objectives are met

Plans of the proposed stormwater drainage layout can be found on drawing **Co13620.00-DA40** in **Appendix A**.

The objectives for the management of stormwater quantity and quality for the proposed application are consistent with PCC requirements. **Section 5** of this report discusses the proposed water quantity management and **Section 6** discusses the proposed water quality management. The means by which these objectives are achieved are as follows through a stormwater management basin consisting of an on-site detention basin combined with a bioretention basin.

- *Water Quantity* –
  An on-site detention system is proposed for the site. The objective for water quantity is to attenuate the post development flows to less than or equal to the pre-development flows from the site.
- *Water Quality* –
  Treatment of stormwater flows will be performed by a treatment train which comprises of pit inserts and bioretention.

There are two existing catchments on the site and the proposed legal points of discharge for the site will generally match existing catchment breakdown. The majority of the site will be drained to the eastern wetland, and a smaller portion to the Lambridge Place Culvert. Existing pre-developed flows will be maintained for the post-development conditions as noted above.

2.5 Sewer Main

Dial Before You Dig (DBYD) information shows an existing sewer line that runs through the eastern portion of the site within a dedicated easement. Works are proposed to remain clear of the existing asset.

3 SITE WORKS

3.1 Bulk Earthworks

The existing earthworks and geotechnical considerations for the site are set out in an investigation by JK Geotechnics completed during July 2018.

The JK report describes the existing conditions over the site. The geotechnical profile includes alluvial profile with silty sands of 1-2m depth over silty sandy gravels. The silty sands exhibit CBR's of 10-14%, however it is noted that silts are difficult to work with and need a tight control of moisture content during the works. Noting that if the moisture content is slightly off optimum the material can become unworkable. The earthworks are recommended to be carried out by a earthworks contractor experienced with such soils.

It is further noted that filling of the site will be required. The objective for the levels and earthworks over the site will be to provide a pad for the proposed building, to facilitate site access, to drain the site stormwater via gravity, keep building levels above the 1% AEP (1 in 100 year ARI flood level) - with appropriate freeboards- , to maintain floodway during the 0.5% AEP (1 in 200 year ARI) event and to maximise efficiency in the retaining wall design for the development.

As filling will be required, it is proposed to ensure a minimum 500mm layer of sandstone (min CBR = 25%) is included in the filling exercise. The sandstone layer will assist in providing a more homogenous foundation for the proposed warehouse pavements, bridging the more variable underlying alluvial soils.

Earthworks drawings and sections are included as drawings **Co13620.00-DA30** and **DA31** and the estimated earthworks volumes are as follows:

Cut:	*-12,700 m^3*
Fill:	*+54,400 m^3*
Detail Ex.	*-4,900 m^3*
Difference	*+36,800 m^3 (import)*

Allowing for the structural zone for the facility floor and falls in external levels some earthworks will be required to the existing pad levels. Detailed assessment of the earthworks level will be completed during detailed design stage.

Imported fill will need to comprise ENM or VENM with suitable certification as such prior to placement or importation to the development site. A formal fill management plan prepared by the contractor is recommended to form part of the Construction Certificate approval stage of the development.

3.2 Embankment Stability

To assist in maintaining embankment stability permanent batter slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in **Section 8**.

3.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

3.4 Erosion and Sediment Control

Soil Erosion and Sediment Control measures will be provided for the development during the construction phase of the project. All Soil and Sediment Control measures will be performed in accordance with Penrith City Council requirements and recommendations set out in the Landcom document *Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book*.

Measures will include sediment basins, construction entry/ truck shakers, sediment fences, diversion drains and drainage pit protection.

Refer **Section 8** of this report for details.

4 STORMWATER HYDROLOGICAL MODELLING AND ANALYSIS

4.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Penrith City Council and accepted engineering practice as discussed in **Section 2.4** of this report.

Storm events for the 2 to 100 Year ARI events have been assessed.

4.2 Minor/ Major System Design

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

4.3 Rainfall Data

Rainfall Intensity Frequency Duration (IFD) data used as a basis for Drains modelling for the 2 to 100 Year ARI events was taken from *The Bureau of Meteorology Online IFD Tool*.

4.4 Runoff Models

Calculation of the runoff from storms of the design ARI have been calculated with the catchment modelling software DRAINS.

At this stage, the modelling performed is to calculate OSD requirements. Detailed hydraulic assessment of the internal drainage system will be calculated at detail/ construction certificate stage.

The design parameters for the Drains model are to be based on typical values and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Minor Storm Pit Freeboard	150	mm

Table 4.1: DRAINS ILSAX Parameters

4.5 Hydraulics

4.5.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems meet or exceed the required standard.

4.5.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard is not required.

4.5.3 Public Safety

For all areas subject to pedestrian traffic, the Depth-Velocity product (dV) of the depth of flow, d (in metres), and the velocity of flow, V (in metres per second), will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

4.5.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the major system design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

4.5.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the detention systems prior to discharge.

4.6 Site Discharge

The site has two main catchments and subsequent discharge points.

Western Catchment

The eastern catchment drains via a box culvert system to council drainage infrastructure in Lambridge Place.

Costin Roe Consulting prepared the design of the box culvert system which was constructed as part of the nearby Meyer Timber development to carry discharge from Meyer Timber and existing surrounding undeveloped catchments including the land described as Lot 20 on DP1216618 & Lot 2 DP787827. This system has a capacity in the order of 1.05m^3/s during the 1 in 20-year ARI event.

We have designed the drainage system for the proposed development allowing for an on-site detention system which limits the site discharge post development to that of pre-development. This system on-site detention system also includes allowance for runoff from Lot 2 DP787827 such that the design flow rate that enters the box culvert system is less than the existing flow rate currently entering the box culvert system during the 1 in 20-year ARI event.

We understand at the time the box culvert system was constructed, that the agreement reached, between Meyer Timber and the landowner of the inter-allotment drain, was for the system to cater for the outfall from Meyer Timber (0.45m^3/s) and existing catchments which currently drained to the area (ie in Lot 20 swales and overland from the Capral land to the south to 0.60m^3/s) in the 1 in 20-year ARI event.

It is noted the design flow from the Lot 20 development is 0.49m^3/s being less than the 0.6m^3/s available in the box culverts.

Eastern Catchment

The eastern catchment drains to the wetland area, designated as Wetland 158.

The design of the proposed outlet structure has been provided based on the NSW Office of Water document *Controlled Activities: Guidelines for Outlet Structures.*

The stormwater outlet consists of one 525mm diameter pipe and 'natural' energy dissipater in the location shown on **Co13620.00-DA41**. The outlet is aligned with the wetland to remove the potential for bank scour and shall include rip rap energy dissipaters

constructed in accordance with the *Outlet Structures Guidelines* and The Blue Book, ensuring that flows are spread and velocity is reduced to a limit which will ensure no scour or limited potential for loss of habitiat or ecological amenity (as confirmed by the Ecological Consultant). The arrangement of the outlet is shown figuratively below in **Figure 2.2** below. Further construction details regarding the configuration of dimensions, rock size and scour protection can be seen on drawing **Co13620.00-DA46**.

It is further noted that post-developed flows have been attenuated to pre-development, and that appropriate water quality and WSUD design has been employed to ensure acceptable water quality and flow rates to the Wetland 158. Further detail on water quantity and quality can be found in **Section 5** and **6** of this report.

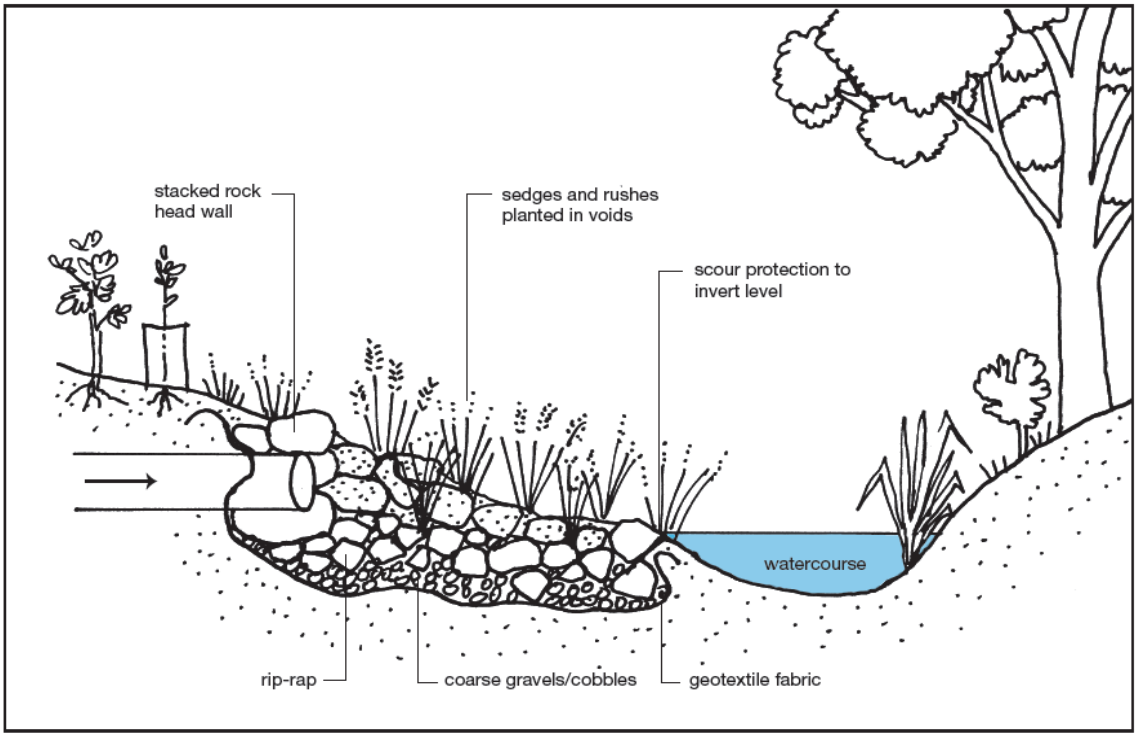

Figure 2.2. Outlet Structure Components

5 WATER QUANTITY MANAGEMENT

5.1 General Design Principles

Penrith City Council adopts the principles of water quantity management, also known as "On-site Detention (OSD)", to ensure the cumulative effect of development does not have a detrimental effect on the existing stormwater infrastructure and watercourses located within their LGA downstream from the particular site.

Section 3.3.3 of Councils draft stormwater management policy requires that "*it will be necessary to demonstrate that there will be no increase in runoff from the site as a result of the development for all storms up to and including the 100-year Average Recurrence Interval (ARI) event for all storm durations*".

5.2 Methodology

A hydrological analysis was undertaken to estimate the impact of the development of the site on peak flows at the downstream extent of the site. Modelling of stormwater runoff quantity was considered for the pre-existing case and for the operational phase of the development.

As the site is greater than 5000m^2, the simplified PSD/SSR method contained in Section 3.3 of the Penrith Council Document *Stormwater Drainage for Building Developments* has not been used in calculating the storage and discharge relationship for the site. Council's preferred modelling software, DRAINS has been used to assess the site detention discharge and storage relationship.

In order to assess the existing and operational phase peak discharges from the development site, a DRAINS hydrological model was used to estimate peak flows from catchments on the site for various storm durations for Q2 year ARI to Q100 year ARI events for the two adopted catchments. It is also noted that consideration to flows from Capral land are required to be considered in the western catchment.

5.3 Existing & Post Development Peak Flows

Tables 5.2 & **5.3** shows the existing and developed flows at the downstream boundaries for the western and eastern catchments respectively.

As noted in the council pre-development application minutes, peak flows are to match pre-development and flows are to be dissipated prior to entering the wetland on the eastern property catchment.

ARI	**Design Storm Duration**	**Peak Flow (m3/s)**		
		Undeveloped	**Developed**	
		Site	Site (no atten.)	**Site (+ atten.)**
2	30	0.565	0.128	**0.171**
	60	0.797	1.360	**0.226**
	120	0.770	1.310	**0.304**
20	30	1.770	2.340	**0.414**
	60	1.970	2.450	**0.467**
	120	2.070	2.440	**0.493**
100	30	2.530	2.990	**0.483**
	60	2.690	3.130	**0.754**
	120	2.780	3.110	**0.955**

Table 5.2. Western Catchment - Q2, Q20 & Q100 ARI Peak Flows

ARI	Design Storm Duration	Peak Flow (m3/s)		
		Undeveloped	**Developed**	
		Site	Site (no atten.)	**Site (+ atten.)**
2	30	0.441	1.460	**0.464**
	60	0.621	1.270	**0.474**
	120	0.600	1.470	**0.467**
20	30	1.380	2.710	**0.508**
	60	1.540	2.270	**0.525**
	120	1.610	2.670	**0.525**
100	30	1.970	3.340	**0.544**
	60	2.100	2.880	**0.895**
	120	2.170	3.280	**0.854**

Table 5.3. Eastern Catchment - Q2, Q20 & Q100 ARI Peak Flows

The post development (with site attenuation) flows can be seen to be lower than the pre-developed flows. The required detention storage for the development site is discussed in the following section.

5.4 Proposed Water Quantity Management

As previously discussed, detention storage on the development site is required to reduce local outflows. The proposed site layout allows for provision of two OSD system which will be located within the site boundaries. An above ground open basin is proposed in the western portion of the site to attenuate the western portion of site catchment, and the existing land to the south known as 'Capral' land. The existing discharge point from the Capral land is to an existing un-formed wetland on the subject site. The Capral land discharge point is to be maintained and attenuated within the western basin. The discharge location for the western basin will be to an existing drainage easement located to the north-west of the proposed warehouse. Basin outflow will be limited to allow discharge into the existing easement without overloading the easement capacity.

A secondary basin is proposed to attenuate the eastern portion of the site. The discharge location from the eastern basin will be made via an outlet pipe to the adjacent wetlands.

The proposed eastern OSD system is an above ground basin located in the south-east corner of the site, outside of the defined wetlands setback zone.

A number of combinations of storages and outlet arrangements have been modelled for the two catchments. The adopted arrangement models the open basin configuration shown in **Tables 5.4 and 5.5** and the proposed layout can also be observed on drawing **Co13620.00-DA40** and **DA41**, with details on **DA45** and **DA46**.

ARI	Duration (mins)	Peak Flow (m3/s)					Depth (mm)	Storage (m3)
		No Atten.	With attenuation					
			Low	High	Bypass	Total		
2	60	1.36	0.22	0	0	0.22	450	2200
20	120	2.45	0.43	0	0	0.49	900	4250
100	120	3.13	0.54	0.41	0	0.93	1100	5100

Table 5.4. Western Catchment - OSD Characteristics (Post Developed)

ARI	Duration (mins)	Peak Flow (m3/s)					Depth (mm)	Storage (m3)
		No Atten.	With attenuation					
			Low	High	Bypass	Total		
2	60	1.27	0.47	0	0	0.47	110	690
20	120	2.71	0.52	0	0	0.52	320	2000
100	120	3.34	0.56	0.33	0	0.89	450	2700

Table 5.5. Eastern Catchment - OSD Characteristics (Post Developed)

The hydrologic analysis shows that, with the provision of the on-site detention system detailed above, the post development peak flows from the site will be attenuated to less than pre-development; hence the requirements of PCC have been met.

A positive covenant over the stormwater management system will need to be provided in accordance with Penrith City Council requirements.

6 STORMWATER QUALITY CONTROLS

6.1 Regional Parameters

There is a need to provide a design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by PCC.

PCC has nominated, in Section C3 of their *DCP2014*, the requirements for stormwater quality to be performed on a catchment wide basis. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%
Free Oil and Grease	90%

6.2 Proposed Stormwater Treatment System

Roof, hardstand and other extensive paved areas are required to be treated by the Stormwater Treatment Measures (STM). The STM shall be sized according to the whole catchment area of the Site. The STM's for the development are based on a treatment train approach as discussed in the NSW EPA document *Managing Urban Stormwater: Treatment Techniques* to ensure that all the objectives above are met.

Components of the treatment train for the development are as follows:

- Primary treatment to hardstand areas is via Enviropod pit inserts;
- Secondary treatment (overflow event only) is via trash screens and a sediment sump within the OSD system; and
- Tertiary treatment of site water will be via a 250m^2 & 1000m^2 of bioretention system situated within the western and eastern on-site detention basins respectively.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

The MUSIC model was chosen to model water quality. This model, released by the Cooperative Research Centre for Catchment Hydrology (CRCCH), is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km^2 and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if the proposed systems and changes to land use are appropriate for their catchments and capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC, of relevance to this report, include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part C3 of PCC's DCP and nominated in Section 6.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*13620.00_Andrews Road Rev 5.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if PCC requirements have been achieved. The layout of the MUSIC model is presented in **Appendix B**.

6.3.2 Rainfall Data

Six-minute pluviographic data for the nearby Penrith Lakes AWS weather station was sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	**Data Used**
Rainfall Station	67113 Penrith Lakes AWS
Rainfall Period	1999 – 2008 (10 years)
Mean Annual Rainfall (mm)	712
Evapo- transpiration	Sydney Monthly Areal PET
Model Time step	6 minutes

6.3.3 Rainfall Runoff Parameters

Parameter	**Value**
Rainfall Threshold	1.40
Soil Storage Capacity (mm)	105
Initial Storage (% capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient a	150
Infiltration Capacity exponent b	3.5
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	10
Daily Seepage Rate (%)	0

6.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are as per **Table 6.1**:

Flow Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow	2.15	0.32	-0.60	0.25	0.30	0.19

Table 6.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 6.1** above.

6.3.5 Treatment Nodes

Bioretention and SW360 Enviropod nodes have been used in the modelling of the development.

There are two bioretention basins proposed which will be provided in accordance with industry best practice and the guidelines of the Monash University Facility for Advancing Water Biofiltration with the following parameters:

Bioretention West

Parameter	**Value**	
Storage Properties		
Extended Detention Depth	300	mm
Storage Surface Area	250	m^2 (minimum)
Filter and Media Properties		
Filtration Area	250	m^2
Saturated Hydraulic Conductivity	100	mm/hr
Filter Depth	500	mm

Bioretention East

Parameter	**Value**	
Storage Properties		
Extended Detention Depth	300	mm
Storage Surface Area	1000	m^2 (minimum)
Filter and Media Properties		
Filtration Area	1000	m^2
Saturated Hydraulic Conductivity	100	mm/hr
Filter Depth	500	mm

6.3.6 Results

Table 6.2 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	Residual Load	% Reduction
Flow (ML/yr)	52.6	46.7	11.3
Total Suspended Solids (kg/yr)	7850	1040	86.8
Total Phosphorus (kg/yr)	16.7	5.31	68.3
Total Nitrogen (kg/yr)	119	53.7	55.0
Gross Pollutants (kg/yr)	1480	93.2	93.7

Table 6.2. MUSIC analysis results

The model results indicate that, through the use of the STM in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of C3 of PCC's DCP2014 on an overall catchment basis.

6.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of C3 of PCC's DCP2014 have been met.

The MUSIC modelling has shown that the proposed treatment train of STM will provide stormwater treatment which will meet PCC requirements in an effective and economical manner.

Hydrocarbon and oil & grease removal cannot be modelled with MUSIC software. As a warehouse and distribution centre, the facility is expected to have low source loadings of hydrocarbons. Potential sources of hydrocarbons and/or oil & grease which drain to the stormwater system would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (car parking only). The potential for these pollutants is low and published data from the CSIRO indicates that average concentrations from industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration. Hydrocarbon pollution would also be limited to surface areas which will be treated via bioretention which is known to be effective in the treatment of hydrocarbons in stormwater.

Given the expected low source loadings of hydrocarbons and oil/grease and removal efficiencies of the treatment devices we consider the DGR's and PCC requirements have been met.

6.4 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater, where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

Rainwater harvesting will be required for the development site for re-use in non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The requirements as per Penrith Council C3 of DCP2014 is to reduce the water demand and provide a minimum 100kL rainwater tank.

In general terms, the rainwater harvesting system is expected to comprise and in-line tank for the collection and storage of rainwater. At times when the rainwater storage tank is full, rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non- potable water reticulation system.

Rainwater tanks have been designed, using a water balance analysis to balance the supply and demand, based on the below base water demands, to provide a reduction in non-potable water demand.

6.4.1 Internal Base Water Demand

Indoor water demand has been based on each provided toilet using 100 litres of potable water per day for flushing which is typical of an office environment which uses energy efficient flushing devices.

These rates give the following internal non-potable demands:

7 Toilets 0.7 kL/day

6.4.2 External Base Water Demand

External water consumption within each landscaping system varies depending upon the nature of the irrigation system, species of planting, and the prevailing climate. For this development, the base case outdoor potable water demand has been modelled using a simple rainwater balance. The proposed irrigation system will be a drip-fed system with application rates varying between 5 to 15 l/m^2. For the purposes of our analysis an application rate of 10 l/m2 has been used, in conjunction with the following application regime, to determine the total yearly demand. Irrigation to gardens and landscaped areas fronting the office and carparking areas have only been assumed in external base water demand. All other areas such as above ground basins & swales have been assumed to be irrigated via rainfall only.

Month	No. of Applications
January	12
February	12
March	10
April	9
May	8
June	4
July	4
August	4
September	8
October	9
November	10
December	12
Total	102

Table 6.3. External Irrigation Application Schedule

The above regime for the landscaped area for the site gives the following outdoor water demands:

Area=600 m2	6	kL/application
	612	kL/year

6.4.3 Rainwater Tank Sizing

The use of rainwater reduces the mains water demand and the amount of stormwater runoff. By collecting the rainwater run-off from roof areas, rainwater tanks provide a valuable water source suitable for flushing toilets and landscape irrigation.

A water balance calculation was performed to assess the resource potential of rainwater harvesting within the development. Details of the water balance calculation, which incorporate statistical rainfall data for the region sourced from the Australian Bureau of Meteorology, the above nominated base demands, and the low flow volume from the roof catchment areas to the tank.

Roof Catchment to Rainwater Tank (m2)	Tank Size (kL)
6200	100

Table 6.4. Rainwater Reuse Requirements

The water balance analysis, results summarised in Table 6.4, predicts that a reduction in non-potable water use will be made for the development with the provision a 100kL rainwater tank.

6.5 Maintenance and Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 6.5** below).

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the maintenance requirements below it is also recommended that inspections are made following heavy rainfall or major storm events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at Prospect Dam Weather Station No. 67019.

Table 6.5. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
BIO-RETENTION BASINS/ BIORETENTION SWALES			

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Check for sediment accumulation at inflow points	Six monthly/ After Major Storm	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements.
Check for erosion at inlet or other key structures.	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed profile is maintained
Check for evidence of dumping (litter, building waste or other).	Six monthly	Maintenance Contractor	Remove waste and litter and dispose in accordance with local authorities' requirements.
Check condition of vegetation is satisfactory (density, weeds, watering, replating, mowing/ slashing etc)	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Check for evidence of prolonged ponding, surface clogging or clogging of drainage structures	Six monthly/ After Major Storm 5-10 years	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements. Replace filter media & planting – refer to appropriately qualified engineer or stormwater specialist
Check stormwater pipes and pits	Six monthly/ After Major Storm	Maintenance Contractor	Refer to INLET/ JUNCTION PIT section below.
INLET & JUNCTION PITS			
Inside Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			Remove any collected sediment, debris, litter.
Outside of Pit	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.
OSD SYSTEM			
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc. likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.
ENVIROPOD PIT INSERTS			
As per manufacturer's Operation and Maintenance Manual	Six Monthly & after major storm events As per manufacturer's Operation and Maintenance Manual	Maintenance Contractor	As per manufacturer's Operation and Maintenance Manual

7 FLOODING

The site has been identified by Penrith City Council as being flood affected during the 1% AEP and 0.5% AEP flood events. These events are associated with overbank flooding from the Nepean River which is approximately 1km west of the development site. Reference to the *Nepean River Flood Study, Exhibition Draft Report* (16 August 2017) completed for Penrith City Council by Advisian, has been made and consultation with Councils flooding engineer Mr Myl Senthilvasan (refer **Appendix G**) regarding the localised assessment relating to this project. We understand the study will be adopted by Council toward the end of 2018 following minor technical updates to the hydraulic output.

Council has requested (as part of the pre-application minutes) the following to be included in the development application documents:

- *Any development shall require the submission of a flood study to assess the impact of the proposed development upon flood flow conveyance through the site for the 1% AEP and 0.5% AEP Nepean River flood events. Assessment of local overland flows is also to be undertaken. The study shall include flood level difference mapping and an assessment of safe velocity / depth ratios through the site and along the access handle.*
- *Flood safe evacuation access for the 1% AEP flood is to be provided from the development site.*
- *The development shall not have any adverse flood impacts upon adjoining properties.*
- *The application must demonstrate that the proposal is compatible with the State Government Floodplain Development Manual and Council's Local Environmental*
- *Plan and Development Control Plan for Flood Liable Lands.*
- *All habitable floor levels shall be a minimum of 0.5m above the 1% AEP flood event.*

An analysis of the impact of the development on existing flooding has been completed to confirm no affectation on upstream, downstream and adjoining properties in both the 1% AEP and 0.5% AEP events and to confirm the proposed building will meet flood immunity and flood planning requirements as noted above.

Reference to **Appendix F** should be made for the assessment in full. **Appendix F** contains detailed technical information including hydrological and hydraulic assessment, and results of the assessments.

Modelling has been completed using council preferred TUFLOW modelling engine. The model output shows that the 1% AEP level is RL25.3m AHD and the 0.5% AEP flood level is 25.8m AHD. Refer to Figure 7.1 and 7.2 for the post development flood extents and levels.

The assessment shows that sufficient flood-ways are available during the 0.5% AEP event. Further that flood afflux is negligible during the 1% AEP event, and within council recommendations during the 0.5% AEP event. The modelling output also shows a minor afflux in flood levels of 98mm during the 0.5% AEP post developed flooding events locally within the site boundaries. This would be considered acceptable in terms of the requirements of Councils Part C3 DCP.

Refer to **Figures F1 to F16** for the flood model output and results.

8 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co13620.00-DA20, DA25** and **DA26**. These plans show the works can proceed without polluting receiving waters. A detailed plan will be prepared after development consent is granted and before works commence.

8.1 General Conditions

1. The ESCP is to be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued by the site manager, council inspector or other authorised representative in relation to development at the subject site.
2. Contractors will ensure that all soil and water management works are undertaken as instructed in this report and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and PCC's specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

8.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 8.1**.

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Temporary construction access	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. All site workers will comply with these restrictions.
Remaining lands	Entry prohibited except for essential management works	

Table 8.1 Limitations to access

8.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co13620.00-DA20** and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils (landscaped areas only) remain on the surface at the completion of works.
3. The construction program should be scheduled so that period of time from starting land disturbance to stabilisation is minimised.
4. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.
5. Where practical, foot and vehicular traffic will be kept away from all recently established areas
6. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as low a gradient as practical but not steeper than:
    - 2H:1V where slope length is less than 7 metres
    - 2.5H:1V where slope length is between 7 and 10 metres
    - 3H:1V where slope length is between 10 and 12 metres
    - 4H:1V where slope length is between 12 and 18 metres
    - 5H:1V where slope length is between 18 and 27 metres
    - 6H:1V where slope length is greater than 27 metres
7. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event of 1 in 2 year ARI (Q2).
8. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

8.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 metres of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.
2. Sediment fences will:
   a) Be installed where shown on the drawings and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.
   b) Have a catchment area not exceeding 720 square metres, a storage depth (including both settling and settled zones) of at least 0.6 metres, and internal dimensions that provide maximum surface area for settling, and
   c) Provide a return of 1 metre upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_c discharge.
3. Sediment removed from any trapping device will be disposed of in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.
4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.
5. Temporary soil and water management structures will be removed only after the lands they are protecting are fully stabilised.

8.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance services are to be provided by the respective contractors at least weekly.

8.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a check sheet (refer **Appendix D**). A site inspection using the check sheet will be made by the site manager:
   - At least weekly;
   - Immediately before site closure; and
   - Immediately following rainfall events in excess of 5mm in any 24-hour period.

The self- audit will include:

- Recording the condition of every sediment control device;
- Recording maintenance requirements (if any) for each sediment control device;

- Recording the volumes of sediment removed from sediment retention systems, where applicable;
- Recording the site where sediment is disposed; and
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their recording.

2. In addition, the site manager will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report to the superintendent. The responsible person will ensure that:
   - The plan is being implemented correctly;
   - Repairs are undertaken as required; and
   - Essential modifications are made to the plan if and when necessary.

   The report shall include a certificate that works have been carried out in accordance with the plan.
3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.
4. Proper drainage will be maintained. To this end, drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that:
   - No low points exist that can fill and overtop in a large storm event;
   - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams and installing additional diversion upslope; and
   - Blockages are cleared (these night occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
5. Sand/soil/spoil materials placed closer than 2 metres from hazard areas will be removed. Such hazard areas include areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.
6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.
7. Excessive vegetation growth will be controlled through mowing or slashing.
8. All sediment detention systems will be kept in good working condition. In particular, attention will be given to:
   a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them;
   b) Degradable products to ensure they are replaced as required; and
   c) Sediment removal, to ensure the design capacity remains in the settling zone.
9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.

10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.
11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site fully stabilised.
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

9 CONCLUSION

This Civil Engineering Report has been prepared to support a development application for a proposed industrial facility at 128 Andrews Road, Penrith.

A civil engineering strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform and proposed development layout. Within this strategy a stormwater quantity and quality management strategy has been developed to reduce both peak flows and pollutant loads in stormwater leaving this site. The stormwater management for the development has been designed in accordance with Penrith City Council's Section C3 of DCP2014.

The hydrological assessment proves local post development flows from the site will be less than pre-development flows and demonstrates that the site discharge will not adversely affect any land, drainage system or watercourse as a result of the development.

Further flooding assessment, completed using TUFLOW modelling, confirms the building can be sited above the 1% AEP with appropriate freeboard and maintaining floodways during the 0.5% AEP event as required by council.

During the construction phase, a Sediment and Erosion Control Plan will be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

During the operational phase of the development, a treatment train incorporating the use of a bioretention system is proposed to mitigate any increase in stormwater pollutant load generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads in stormwater discharging from the site and meet the requirements of Council's pollution reduction targets. Best management practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

It is recommended the management strategies in this report be approved and incorporated into the future detailed design.

10 REFERENCES

- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004 (LANDCOM);
- Penrith City Council – DCP 2014 (Part C3); and
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

PROPOSED WAREHOUSE FACILITY

128 ANDREWS ROAD, PENRITH NSW

CONCEPT CIVIL DRAWINGS FOR DEVELOPMENT APPLICATION

DRAWING LIST:

DRAWING NO.	DRAWING TITLE
C013620.00-DA10	DRAWING LIST & GENERAL NOTES
C013620.00-DA20	EROSION & SEDIMENT CONTROL PLAN - SHEET 1
C013620.00-DA21	EROSION & SEDIMENT CONTROL PLAN - SHEET 2
C013620.00-DA30	BULK EARTHWORKS PLAN - SHEET 1
C013620.00-DA31	BULK EARTHWORKS PLAN - SHEET 2
C013620.00-DA40	STORMWATER DRAINAGE PLAN - SHEET 1
C013620.00-DA41	STORMWATER DRAINAGE PLAN - SHEET 2
C013620.00-DA41	STORMWATER TREATMENT CATCHMENT PLAN
C013620.00-DA45	STORMWATER DRAINAGE DETAILS - SHEET 1
C013620.00-DA46	STORMWATER DRAINAGE DETAILS - SHEET 2
C013620.00-DA50	FINISHED LEVELS PLAN - SHEET 1
C013620.00-DA51	FINISHED LEVELS PLAN - SHEET 2
C013620.00-DA52	ACCESS DRIVEWAY LONGSECTION

PAVEMENT MAINTENANCE NOTES:

DURING THE LIFE OF THE PAVEMENT, DAMAGE IN VARIOUS FORMS IS LIKELY TO OCCUR. GOOD MAINTENANCE WILL KEEP PROBLEMS TO A MINIMUM AND EXTEND THE LIFE OF PAVEMENTS. THE FOLLOWING LIKELY AREAS OF DAMAGE MAY OR MAY NOT OCCUR DURING THE LIFE OF THE PAVEMENTS:

SLAB PAVEMENTS:

1. DAMAGE TO JOINTS SUCH AS FRETTING OR BREAKING AWAY OF PIECES SHOULD BE REPAIRED USING CONCRETE REPAIR PRODUCTS AND THE JOINTING MATERIAL MADE GOOD.
2. CRACKING OF SLABS WHICH MAY OCCUR OVER THE LIFE OF THE SLAB SHOULD BE REPAIRED BY EPOXY GROUTING AS SOON AS POSSIBLE TO PREVENT LOCAL FRETTING AND BREAKING AWAY. THE DEFINITION OF A CRACK WHICH MAY BECOME DETRIMENTAL IS ONE WHICH IS GREATER THAN 0.3mm.
3. LOCAL DAMAGE DUE TO MECHANICAL PROCESSES OR PALLETS (WITH PROTRUDING NAILS) SHOULD BE REPAIRED AS SOON AS POSSIBLE WITH AN EPOXY CONCRETE REPAIR PRODUCT.
4. LOCAL MOVEMENT OF SLABS CAUSED BY EXTERNAL SOURCES SUCH AS INGRESS OF WATER SHOULD BE REFERRED TO THE ENGINEER TO DETERMINE THE BEST METHOD OF REPAIR.
5. JOINT SEALANTS WILL GENERALLY BREAKDOWN AND NEED REPLACEMENT AFTER 12 MONTHS WHEN MOST OF THE SLAB SHRINKAGE HAS TAKEN PLACE. RESEALING NEEDS TO BE CARRIED OUT TO ENSURE ONGOING SUPPORT TO SLAB EDGES.

ASPHALT PAVEMENTS:

1. UNLESS NOTED, FLEXIBLE PAVEMENTS SHOWN ON THESE DRAWINGS ARE THE MINIMUM NECESSARY TO SUPPORT LIGHT CAR PARKING FOR A MINIMUM DESIGN LIFETIME.
2. CRACKING OF THE ASPHALT SURFACE AND OTHER DEFECTS SHOULD BE REPAIRED QUICKLY TO PREVENT INGRESS OF WATER TO THE SUBGRADE, WHICH WILL ACCELERATE DETERIORATION OF PAVEMENTS.
3. DRAINAGE GRADES SHOULD BE MAINTAINED TO AVOID PONDING OF SURFACE WATER WHICH MAY CONTRIBUTE TO DETERIORATION.

GENERAL NOTES:

G1 THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

G2 ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE RELEVANT AND CURRENT STANDARDS AUSTRALIA CODES AND WITH THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE PROJECT SPECIFICATION.

G3 ALL DIMENSIONS SHOWN SHALL BE VERIFIED BY THE BUILDER ON SITE.
ENGINEER'S DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS.
ENGINEER'S DRAWINGS ISSUED IN ANY ELECTRONIC FORMAT MUST NOT BE USED FOR DIMENSIONAL SETOUT.
REFER TO THE ARCHITECT'S DRAWINGS FOR ALL DIMENSIONAL SETOUT INFORMATION.

G4 DURING CONSTRUCTION THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED. TEMPORARY BRACING SHALL BE PROVIDED BY THE BUILDER TO KEEP THE WORKS AND EXCAVATIONS STABLE AT ALL TIMES.

G5 UNLESS NOTED OTHERWISE ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES.

G6 ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ACCEPTABLE SAFETY STANDARDS & APPROPRIATE SAFETY SIGNS SHALL BE INSTALLED AT ALL TIMES DURING THE PROGRESS OF THE JOB.

ELECTRONIC INFORMATION NOTES:

1. THE ISSUED DRAWINGS IN HARD COPY OR PDF FORMAT TAKE PRECEDENCE OVER ANY ELECTRONICALLY ISSUED INFORMATION, LAYOUTS OR DESIGN MODELS.

2. THE CONTRACTOR'S DIRECT AMENDMENT OR MANIPULATION OF THE DATA OR INFORMATION THAT MIGHT BE CONTAINED WITHIN AN ENGINEER-SUPPLIED DIGITAL TERRAIN MODEL AND ITS SUBSEQUENT USE TO UNDERTAKE THE WORKS WILL BE SOLELY AT THE DISCRETION OF AND THE RISK OF THE CONTRACTOR.

3. THE CONTRACTOR IS REQUIRED TO HIGHLIGHT ANY DISCREPANCIES BETWEEN THE DIGITAL TERRAIN MODEL AND INFORMATION PROVIDED IN THE CONTRACT AND/OR DRAWINGS AND IS REQUIRED TO SEEK CLARIFICATION FROM THE SUPERINTENDENT.

4. THE ENGINEER WILL NOT BE LIABLE OR RESPONSIBLE FOR THE POSSIBLE ON-GOING NEED TO UPDATE THE DIGITAL TERRAIN MODEL, SHOULD THERE BE ANY AMENDMENTS OR CHANGES TO THE DRAWINGS OR CONTRACT INITIATED BY THE CONTRACTOR.

EROSION CONTROL NOTES

ALL CONTROL WORK INCLUDING DIVERSION BANKS AND CATCH DRAINS, V-DRAINS AND SILT FENCES SHALL BE COMPLETED DIRECTLY FOLLOWING THE COMPLETION OF THE EARTHWORKS.

1. SILT FENCES AND SILT FENCE RETURNS SHALL BE ERECTED CONVEX TO THE CONTOUR TO POND WATER.
2. HAY BALE BARRIERS AND GEOFABRIC FENCES ARE TO BE CONSTRUCTED TO TOE OF BATTER, PRIOR TO COMMENCEMENT OF EARTHWORKS, IMMEDIATELY AFTER CLEARING OF VEGETATION AND BEFORE REMOVAL OF TOP SOIL.
3. ALL TEMPORARY EARTH BERMS, DIVERSION AND SILT DAM EMBANKMENTS ARE TO BE MACHINE COMPACTED, SEEDED AND MULCHED FOR TEMPORARY VEGETATION COVER AS SOON AS THEY HAVE BEEN FORMED.
4. CLEAR WATER IS TO BE DIVERTED AWAY FROM DISTURBED GROUND AND INTO THE DRAINAGE SYSTEM.
5. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING AND PROVIDING ON GOING ADJUSTMENT TO EROSION CONTROL MEASURES AS REQUIRED DURING CONSTRUCTION.
6. ALL SEDIMENT TRAPPING STRUCTURES AND DEVICES ARE TO BE INSPECTED AFTER STORMS FOR STRUCTURAL DAMAGE OR CLOGGING, TRAPPED MATERIAL IS TO BE REMOVED TO A SAFE, APPROVED LOCATION.
7. ALL FINAL EROSION PREVENTION MEASURES INCLUDING THE ESTABLISHMENT OF GRASSING ARE TO BE MAINTAINED UNTIL THE END OF THE DEFECTS LIABILITY PERIOD.
8. ALL EARTHWORKS AREAS SHALL BE ROLLED ON A REGULAR BASIS TO SEAL THE EARTHWORKS.
9. ALL FILL AREAS ARE TO BE LEFT WITH A BUND AT THE TOP OF THE SLOPE AT THE END OF EACH DAYS EARTHWORKS. THE HEIGHT OF THE BUND SHALL BE A MINIMUM OF 200MM.
10. ALL CUT AND FILL SLOPES ARE TO BE SEEDED AND HYDROMULCHED WITHIN 10 DAYS OF COMPLETION OF FORMATION.
11. AFTER REVEGETATION OF THE SITE IS COMPLETE AND THE SITE IS STABLE IN THE OPINION OF A SUITABLY QUALIFIED PERSON ALL TEMPORARY WORK SUCH AS SILT FENCE, DIVERSION DRAINS ETC SHALL BE REMOVED.
12. ALL TOPSOIL STOCKPILES ARE TO BE SUITABLY COVERED TO THE SATISFACTION OF THE CONTRACT ADMINISTRATOR TO PREVENT WIND AND WATER EROSION.
13. ANY AREA THAT IS NOT APPROVED BY THE CONTRACT ADMINISTRATOR FOR CLEARING OR DISTURBANCE BY THE CONTRACTOR'S ACTIVITIES SHALL BE CLEARLY MARKED AND SIGN POSTED, FENCED OFF OR OTHERWISE APPROPRIATELY PROTECTED AGAINST ANY SUCH DISTURBANCE.
14. ALL STOCKPILE SITES SHALL BE SITUATED IN AREAS APPROVED FOR SUCH USE BY THE CONTRACT ADMINISTRATOR. A 6m BUFFER ZONE SHALL EXIST BETWEEN STOCKPILE SITES AND ANY STREAM OR FLOW PATH. ALL STOCKPILES SHALL BE ADEQUATELY PROTECTED FROM EROSION AND CONTAMINATION OF THE SURROUNDING AREA BY USE OF THE MEASURES APPROVED IN THE EROSION AND SEDIMENTATION CONTROL PLAN.
15. ACCESS AND EXIT AREAS SHALL INCLUDE SHAKE-DOWN OR OTHER METHODS APPROVED BY THE CONTRACT ADMINISTRATOR FOR THE REMOVAL OF SOIL MATERIALS FORM MOTOR VEHICLES.
16. THE CONTRACTOR IS TO ENSURE RUNOFF FROM ALL AREAS WHERE THE NATURAL SURFACE IS DISTURBED BY CONSTRUCTION, INCLUDING ACCESS ROADS, DEPOT AND STOCKPILE SITES, SHALL BE FREE OF POLLUTANTS BEFORE IT IS EITHER DISPERSED TO STABLE AREAS OR DIRECTED TO NATURAL WATERCOURSES.
17. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN SLOPES, CROWNS AND DRAINS ON ALL EXCAVATIONS AND EMBANKMENTS TO ENSURE SATISFACTORY DRAINAGE AT ALL TIMES WATER SHALL NOT BE ALLOWED TO POND ON THE WORKS UNLESS SUCH PONDING IS PART OF AN APPROVED ESCP / SWMP.

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
DRAWING DAS2 ADDED	31.01.19	D
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR REVIEW	05.09.18	A

AMENDMENTS	DATE	ISSUE

AMENDMENTS	DATE	ISSUE

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA10

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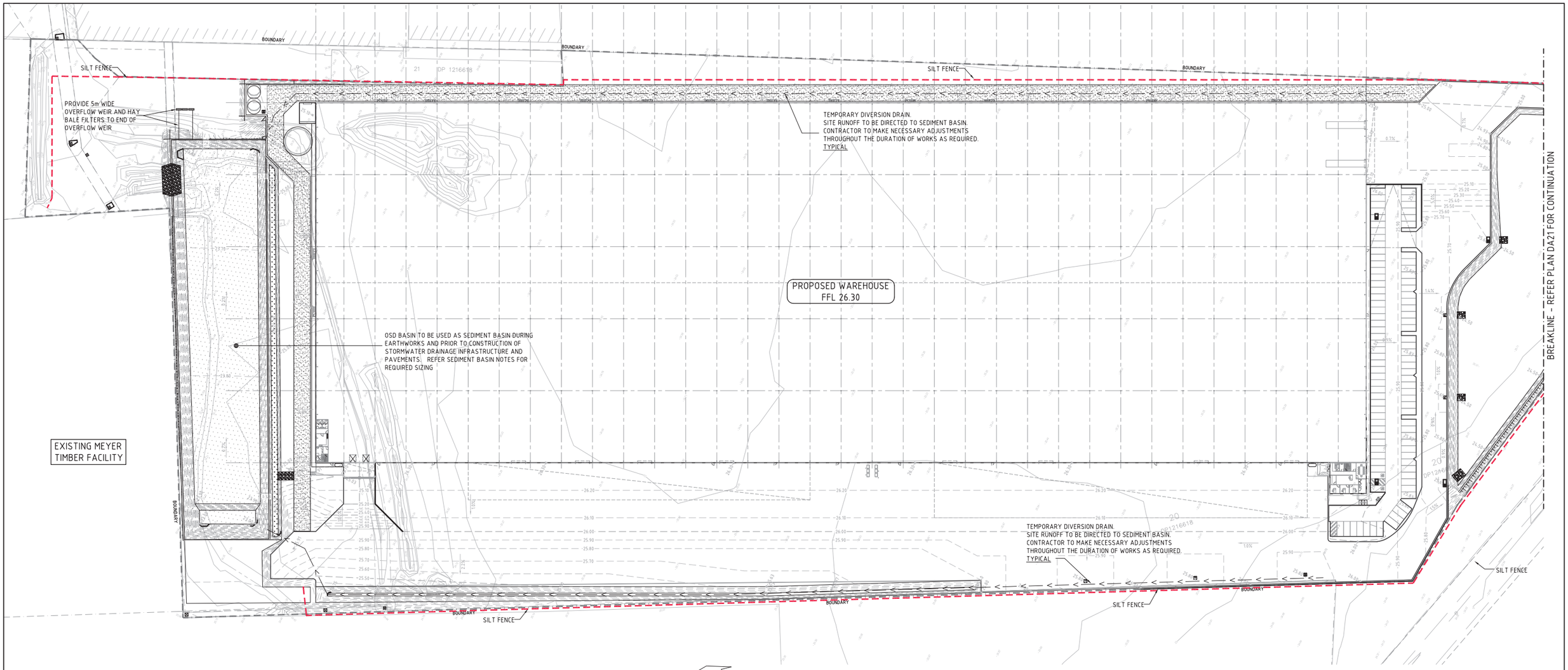
DRAWING TITLE
DRAWING LIST AND GENERAL NOTES

DRAWING No. C013620.00-DA10 ISSUE D



EROSION AND SEDIMENT CONTROL PLAN - SHEET 1
1:500 SCALE

SEDIMENTATION BASIN NOTE:

FOR SEDIMENT & EROSION CONTROL DETAILS REFER TO DRAWING C013620.00-DA20&DA21.

SEDIMENTATION BASIN SIZING BASED ON RECOMMENDATIONS OF 'SOILS AND CONSTRUCTION, MANAGING URBAN STORMWATER-THE BLUE BOOK'. CAPACITY BASED UPON 5 DAY RAINFALL DEPTH AT 85th PERCENTILE INTENSITY (32.2mm).

APPROXIMATE AREA OF DISTURBED SITE = 10.0Ha

SEDIMENTATION BASINS TO COLLECT RUN-OFF IN EXTREME RAINFALL EVENTS. COLLECTED RUN-OFF TO BE ASSESSED BY A QUALIFIED LABORATORY FOR DOUSING RATES OF ALUM OR GYPSUM TO ENSURE COAGULATION OF SEDIMENTS PRIOR TO WATER BEING DISCHARGED TO COUNCIL STORMWATER SYSTEM.

EACH BASIN IS TO HAVE A MARKER PLACED AS PER THE DETAIL TO INDICATE WHEN SEDIMENT IS TO BE REMOVED. REMOVED SEDIMENT IS TO BE CLASSED AND DEWATERED PRIOR TO REMOVAL FROM SITE.

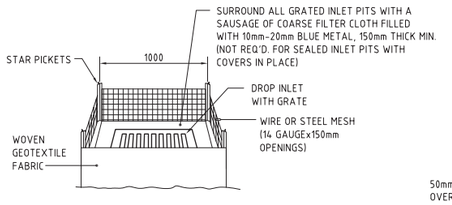
ALLOWANCE TO BE MADE DURING BENCHING OF SITE TO ENSURE RUN-OFF IS DIRECTED TO SEDIMENTATION BASINS.

NOTES:
1. ASSUME TYPE D SOIL (CLAY/SILTY CLAY)
2. ASSUME GROUP D SOIL (HIGH PLASTICITY AND SHRINK/SWELL PROPERTIES)

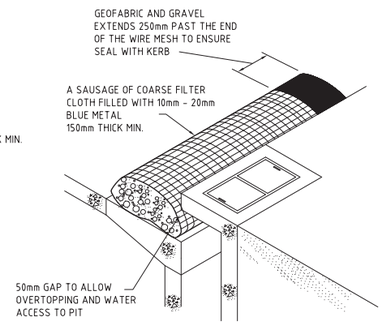
SOIL TYPE ASSESSED FROM GEOTECHNICAL REPORT.

SEDIMENT BASIN:

CATCHMENT AREA	= 10.0Ha
REQUIRED BASIN VOLUME	= 241.5m³
BASE DIMENSION (LxB)	= 138m x 25m
TOP DIMENSION (LxB)	= 31m x 144m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.0m
PROVIDED BASIN VOLUME	= 394.6m³

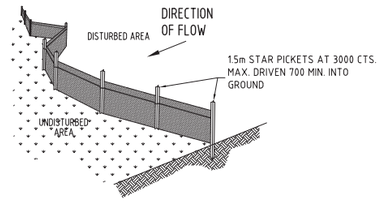


GRATED INLET PIT FILTER DETAIL
N.T.S

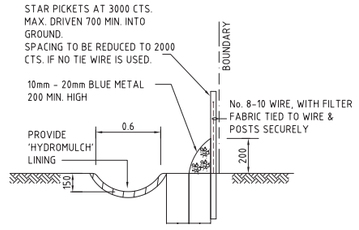


KERB INLET PIT CONTROL
N.T.S

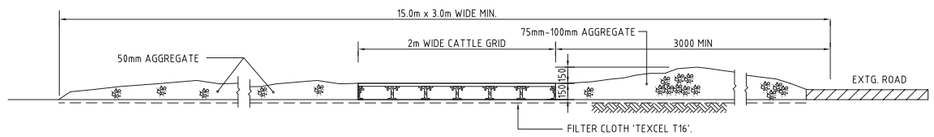
NOTE : ADOPT ABOVE DETAILS AROUND ALL PITS WITHIN AREA ENCOMPASSED BY SILT FENCE & TO PITS ON THE ROAD ADJACENT TO SITE BOUNDARY.



TYPICAL SILT FENCE DETAIL
N.T.S.
PROVIDE 1m RETURNS AT 30m INTERVALS.
TYPICAL



TYPICAL OPEN DRAIN & SILT FENCE
SCALE 1:20



SECTION 1:20 1 DA21 : STABILISED CONSTRUCTION ENTRANCE 'TRUCK SHAKER'

EROSION CONTROL NOTES:

REFER TO DRAWING DA10 FOR EROSION CONTROL NOTES

LEGEND:
PROVIDE 1m RETURNS TO SILT FENCE AT 30m MAX. INTERVALS.
TYPICAL (N.S.O.P.)

- SILT FENCE WITH CATCH DRAIN
- SILT FENCE ONLY
- DIVERSION DRAIN

200mm 0 500 1000 1500 2000mm
1:20 SCALE AT A0 SHEET SIZE

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR REVIEW	06.09.18	A

CLIENT
CADENCE
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PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA20

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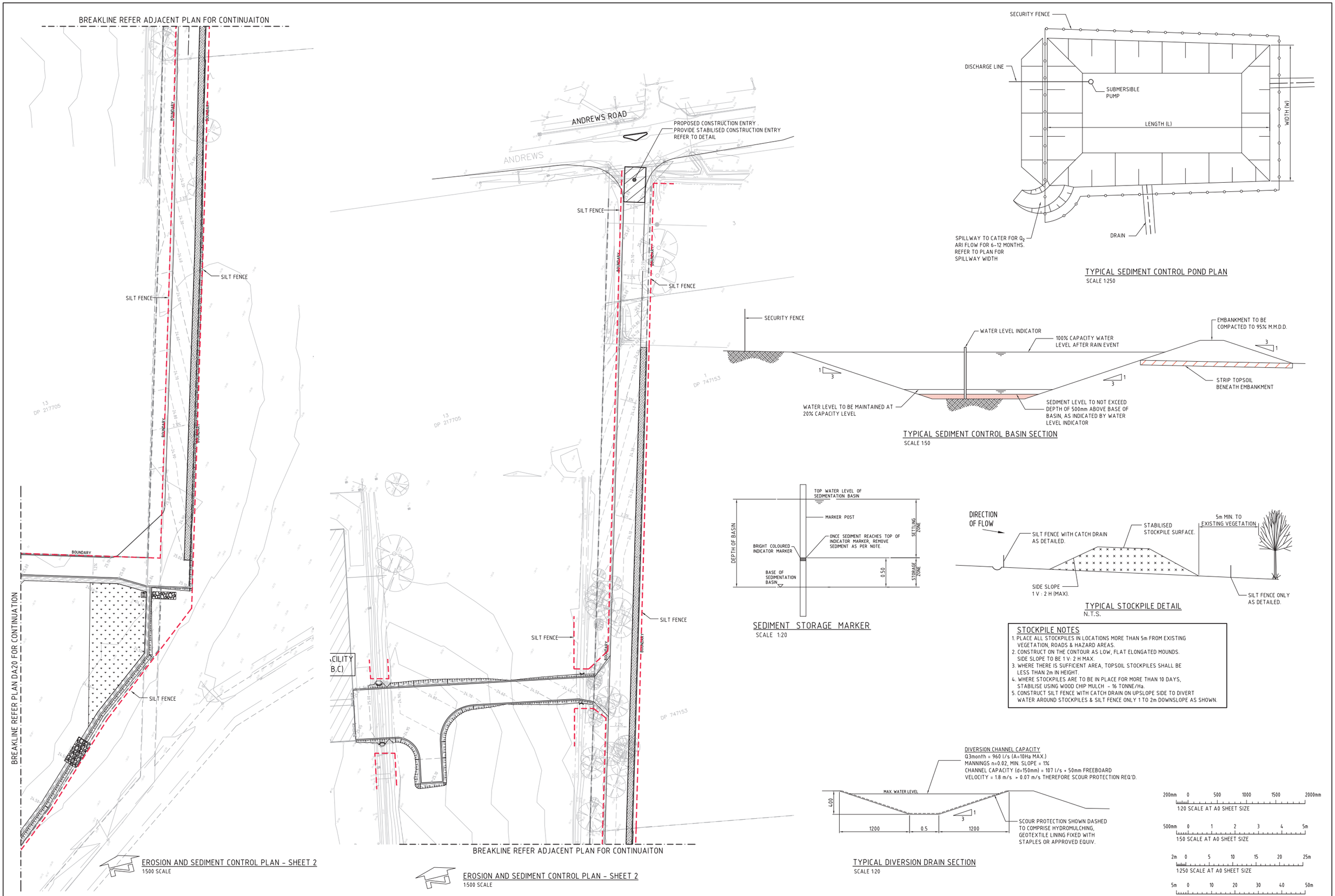
DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN - SHEET 1

DRAWING No C013620.00-DA20 ISSUE C



EROSION AND SEDIMENT CONTROL PLAN - SHEET 2
1:500 SCALE

EROSION AND SEDIMENT CONTROL PLAN - SHEET 2
1:500 SCALE

TYPICAL SEDIMENT CONTROL POND PLAN
SCALE 1:250

TYPICAL SEDIMENT CONTROL BASIN SECTION
SCALE 1:50

SEDIMENT STORAGE MARKER
SCALE 1:20

TYPICAL STOCKPILE DETAIL
N.T.S.

STOCKPILE NOTES
1. PLACE ALL STOCKPILES IN LOCATIONS MORE THAN 5m FROM EXISTING VEGETATION, ROADS & HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT ELONGATED MOUNDS. SIDE SLOPE TO BE 1 V: 2 H MAX.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE STOCKPILES ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE USING WOOD CHIP MULCH - 16 TONNE/Ha.
5. CONSTRUCT SILT FENCE WITH CATCH DRAIN ON UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES & SILT FENCE ONLY 1 TO 2m DOWNSLOPE AS SHOWN.

TYPICAL DIVERSION DRAIN SECTION
SCALE 1:20

200mm 0 500 1000 1500 2000mm
1:20 SCALE AT A0 SHEET SIZE

500mm 0 1 2 3 4 5m
1:50 SCALE AT A0 SHEET SIZE

2m 0 5 10 15 20 25m
1:250 SCALE AT A0 SHEET SIZE

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR ENGINEERING	06.09.18	A

AMENDMENTS | DATE | ISSUE | AMENDMENTS | DATE | ISSUE

CLIENT
CADENCE
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PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA21

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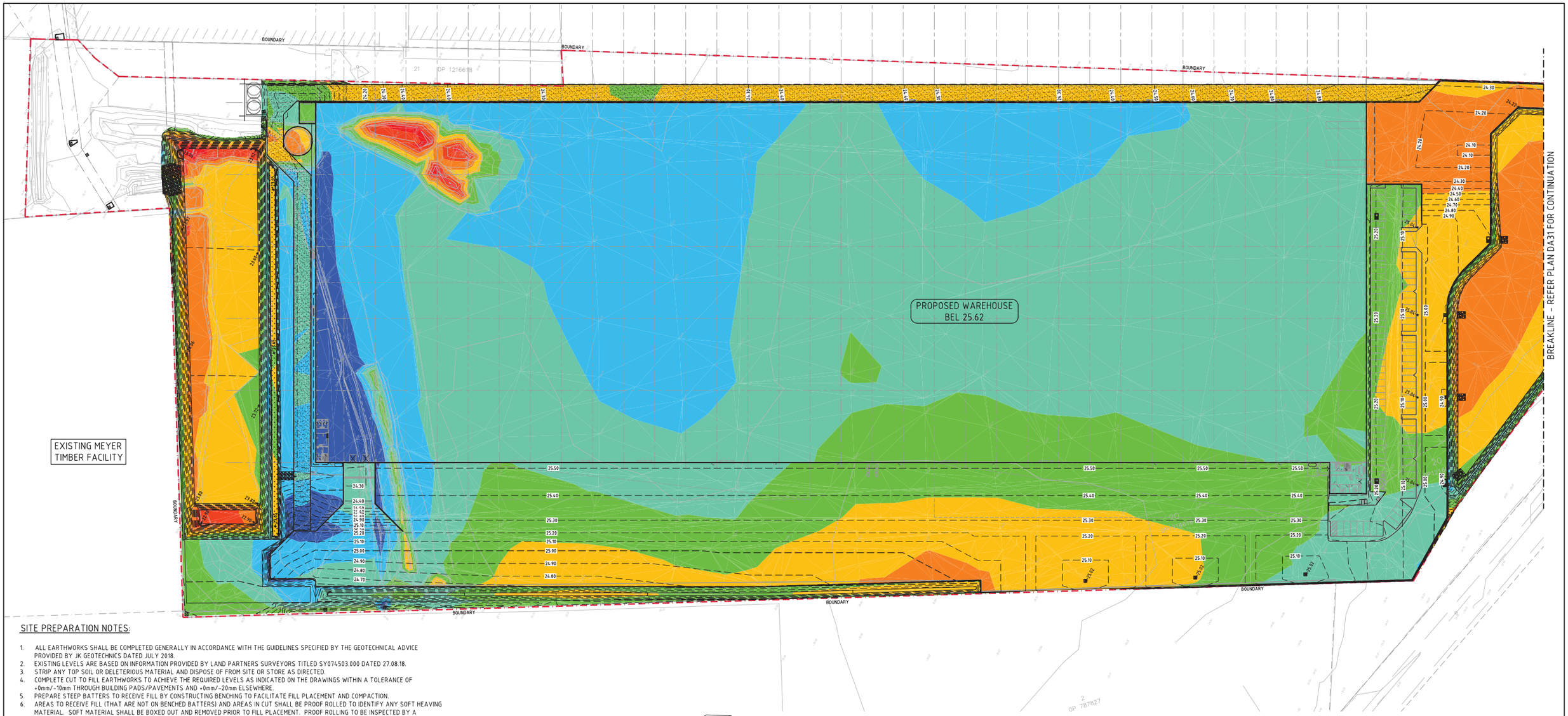
DRAWING TITLE
EROSION AND SEIMENT CONTROL PLAN - SHEET 2

DRAWING No C013620.00-DA21 | ISSUE C



SITE PREPARATION NOTES:

1. ALL EARTHWORKS SHALL BE COMPLETED GENERALLY IN ACCORDANCE WITH THE GUIDELINES SPECIFIED BY THE GEOTECHNICAL ADVICE PROVIDED BY JK GEOTECHNICS DATED JULY 2018.
2. EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY LAND PARTNERS SURVEYORS TITLED SY074503.000 DATED 27.08.18.
3. STRIP ANY TOP SOIL OR DELETERIOUS MATERIAL AND DISPOSE OF FROM SITE OR STORE AS DIRECTED.
4. COMPLETE CUT TO FILL EARTHWORKS TO ACHIEVE THE REQUIRED LEVELS AS INDICATED ON THE DRAWINGS WITHIN A TOLERANCE OF +0mm/-10mm THROUGH BUILDING PADS/PAVEMENTS AND +0mm/-20mm ELSEWHERE.
5. PREPARE STEEP BATTERS TO RECEIVE FILL BY CONSTRUCTING BENCHING TO FACILITATE FILL PLACEMENT AND COMPACTION.
6. AREAS TO RECEIVE FILL (THAT ARE NOT ON BENCHED BATTERS) AND AREAS IN CUT SHALL BE PROOF ROLLED TO IDENTIFY ANY SOFT HEAVING MATERIAL. SOFT MATERIAL SHALL BE BOXED OUT AND REMOVED PRIOR TO FILL PLACEMENT. PROOF ROLLING TO BE INSPECTED BY A GEOTECHNICAL ENGINEER OR THE EARTHWORKS DESIGNER.
7. SITE WON FILL SHALL BE COMPACTED IN MAXIMUM 300mm LAYERS AND TO DRY OR HILF DENSITY RATIOS (STANDARD COMPACTION) OF BETWEEN 98% AND 103%. THE PLACEMENT MOISTURE VARIATION OR HILF MOISTURE VARIATION SHALL BE CONTROLLED TO BE BETWEEN 2% DRY AND 2% WET.
8. IMPORTED FILL SHALL BE COMPACTED IN MAXIMUM 300mm LAYERS AND TO DRY OR HILF DENSITY RATIOS (STANDARD COMPACTION) OF BETWEEN 98% AND 103%. THE PLACEMENT MOISTURE VARIATION OR HILF MOISTURE VARIATION SHALL BE CONTROLLED TO BE BETWEEN 2% DRY AND 2% WET.
9. ALL ENGINEERED FILL PARTICLES SHALL BE ABLE TO BE INCORPORATED WITHIN A SINGLE LAYER. FURTHER, LESS THAN 30% OF PARTICLES SHALL BE RETAINED ON THE 37.5 MM SIEVE. ENGINEERED FILL SHALL BE ABLE TO BE TESTED IN ACCORDANCE WITH THE STANDARD COMPACTION METHOD (AS1289.5.4.1) OR HILF TEST METHOD (AS1289.5.7.1). THESE METHODS REQUIRE LESS THAN 20% RETAINED ON THE 37.5 MM SIEVE. WHERE BETWEEN 20% AND 30% OF PARTICLES ARE RETAINED ON THE 37.5 MM SIEVE THE ABOVE TEST METHODS SHALL STILL BE ADOPTED AND TEST REPORTS ANNOTATED APPROPRIATELY. THESE REQUIREMENTS SHOULD BE MET BY THE MATERIAL AFTER PLACEMENT AND COMPACTION
10. ALL THE EARTHWORKS UNDERTAKEN AND THE SUBGRADE CONDITION IN THE CUT AREAS (IN THE STATED PERIOD) ARE DOCUMENTED IN THE REPORTS AND HAVE BEEN UNDERTAKEN IN ACCORDANCE WITH THE SPECIFICATION.
11. PRIOR TO ANY EARTHWORKS, EROSION CONTROL AS OUTLINED IN THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE COMPLETED.
12. EXISTING ROCK, IF ANY, SHALL BE REMOVED BY HEAVY ROCK BREAKING OR RIPPING.
13. MATCH EXISTING LEVELS AT BATTER INTERFACE.
14. CONTRACTOR TO MATCH EXISTING LEVELS AT THE INTERFACE OF EARTHWORKS AND EXISTING SURFACE AT BATTER LOCATIONS OR WHERE NO RETAINING WALLS ARE PRESENT. ANY DISCREPANCY BETWEEN DESIGN AND EXISTING LEVELS TO BE REFERRED TO THE ENGINEER FOR DIRECTION OR ADJUSTMENTS TO DESIGN LEVELS.
15. SITE PREPARATION TO BE PERFORMED AS FOLLOWS:

a. PRIOR TO PLACEMENT OF ANY FILL, STRIP TOPSOIL/ORGANIC MATERIAL AND ANY DELETERIOUS OR CONTAMINATED EXISTING FILL (200MM DEEP TBC ON SITE OVER NATURAL AREAS) AND DISPOSE AS AGREED. TOP SOIL MAY BE RETAINED FOR LANDSCAPING REUSE AS REQUIRED AND AS DIRECT BY LANDSCAPE ARCHITECT AND THE CLIENT.

b. THE EXPOSED SUBGRADE, IN AREAS PROPOSED TO BE FILLED, ARE TO BE PROOF ROLLED WITH A MINIMUM OF TEN PASSES WITH A 10 TONNE SMOOTH DRUM ROLLER TO IDENTIFY ANY SOFT HEAVING AREAS.
ANY SOFT AREAS SHALL BE BOXED OUT TO FIRM MATERIAL AND FILLED AND COMPACTED WITH SITE OR IMPORTED MATERIAL (IN ACCRODANCE WITH THE GEOTECHNICAL ENGINEERS ADVICE).

c. FILL PLACEMENT IS TO BE IN 200-300MM THICK (LOOSE) LAYERS AND COMPACTED TO 100% RELATIVE COMPACTION WITHIN 2% OF OMC AS SET OUT IN ITEM 8.

d. AREAS WHERE NO FILL IS REQUIRED, OR WHERE CUTTING HAS BEEN PERFORMED, ARE TO BE TYNED (300-400MM) & MOISTURE CONDITIONED TO WITHIN 2% OF OMC AND RE-COMPACTED IN ACCORDANCE WITH THE GEOTECHNICAL ENGINEERS ADVICE.

e. A MINIMUM 500MM LAYER OF SITE WON SANDSTONE IS TO BE PROVIDED THROUGHOUT THE CARPARK PAVEMENT ZONES, HARDSTAND AREAS AND THE BUILDING FOOTPRINT. THE CONTRACTOR IS TO ALLOW FOR CUT TO FILL WORKS NECESSARY TO ENSURE THE MINIMUM SANDSTONE LAYER REQUIREMENT HAS BEEN MET. REFER PLAN AND LEGEND FOR ZONING OF SANDSTONE PLACEMENT AND ADJUSTMENT

BULK EARTHWORKS PLAN - SHEET 1
1:500 SCALE

EARTHWORKS VOLUMES

EARTHWORKS VOLUMES:

CUT	= -12 700 m^3
FILL	= +54 400 m^3
DETAILED EXCAVATION (500 m^3/Ha) (STORMWATER & OTHER SERVICES)	= -4 900 m^3
BALANCE	= +36 800 m^3 (IMPORT REQUIRED)

EARTHWORK VOLUMES ARE APPROXIMATE ONLY & ARE CALCULATED ASSUMING A 200mm TOPSOIL STRIP. NO ALLOWANCE HAS BEEN MADE FOR EROSION AND SEDIMENT CONTROL, BULKING, COMPACTION OF FILLED SOILS. VOLUMES ARE RAW CUT AND FILL VOLUMES AND DO NOT INCLUDE 500mm SANDSTONE CAPPING LAYER. CAPPING LAYER INCLUDED IN PAVEMENT ALLOWANCES.

REFER TO DRAWING DA20 FOR EROSION AND SEDIMENT CONTROL PLAN.

THE EXISTING SURFACE IS BASED THE SURVEY INFORMATION PROVIDED. THIS SURFACED USED IS MOST CURRENT HOWEVER IT MAY NOT ACCURATELY REFLECT ACTUAL GROUND LEVELS OR STOCKPILES ETC ON SITE. IT IS THE CONTRACTORS RESPONSIBILITY TO CONFIRM VOLUMES AND ALLOWANCES FOR EARTHWORKS.

PAVEMENT STRUCTURAL ALLOWANCES

WAREHOUSE PAVEMENT	
(180mm SLAB+20mm SAND+500mm CAPPING)	680mm
TRUCK HARDSTAND PAVEMENT	780mm
CARPARK PAVEMENT	780mm
FOOTPATH/OUTDOOR AREAS	125mm
FIRE TRAIL	360mm
LANDSCAPE	100mm

NOTE: PAVEMENT THICKNESS QUOTED INCLUDE 500mm SANDSTONE CAPPING LAYER

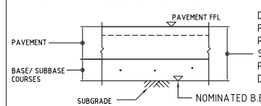
DEPTH RANGE

No.	FROM DEPTH	TO DEPTH	COLOUR
1	-2.000	-1.500	
2	-1.500	-1.000	
3	-1.000	-0.500	
4	-0.500	0.000	
5	0.000	0.500	
6	0.500	1.000	
7	1.000	1.500	
8	1.500	2.000	
9	2.000	2.500	

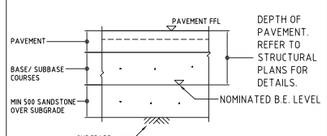
LEGEND

LEVELS DATUM IS AHD.

- 16.50 - EXISTING CONTOUR
- —73.00— — B.E.L. CONTOUR (MAJOR 0.5m)
- —73.10— — B.E.L. CONTOUR (MINOR 0.1m)



NOMINATED B.E.L. DETAIL (FOOTPATHS/FIRETRAIL)
N.T.S.



NOMINATED B.E.L. DETAIL (BUILDING & TRAFFICABLE PAVEMENTS)
N.T.S.

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	D
ISSUED FOR DEVELOPMENT APPLICATION	29.10.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR REVIEW	05.09.18	A

AMENDMENTS | DATE | ISSUE | AMENDMENTS | DATE | ISSUE

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HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
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128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA30

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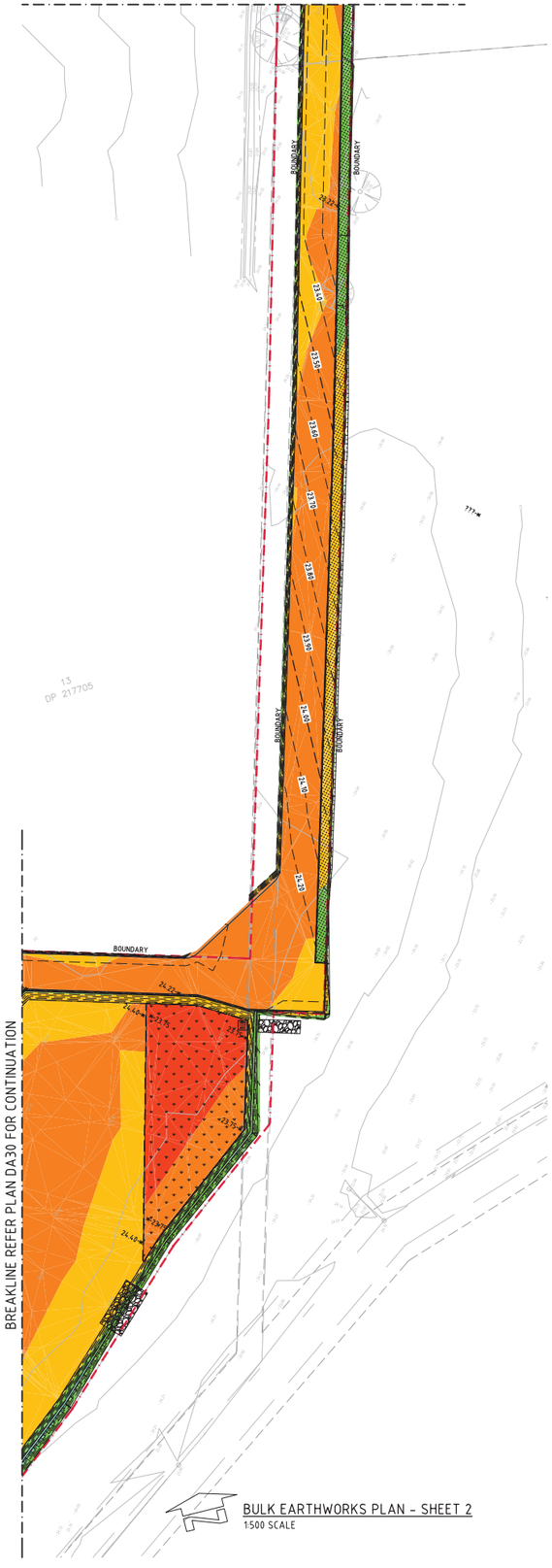
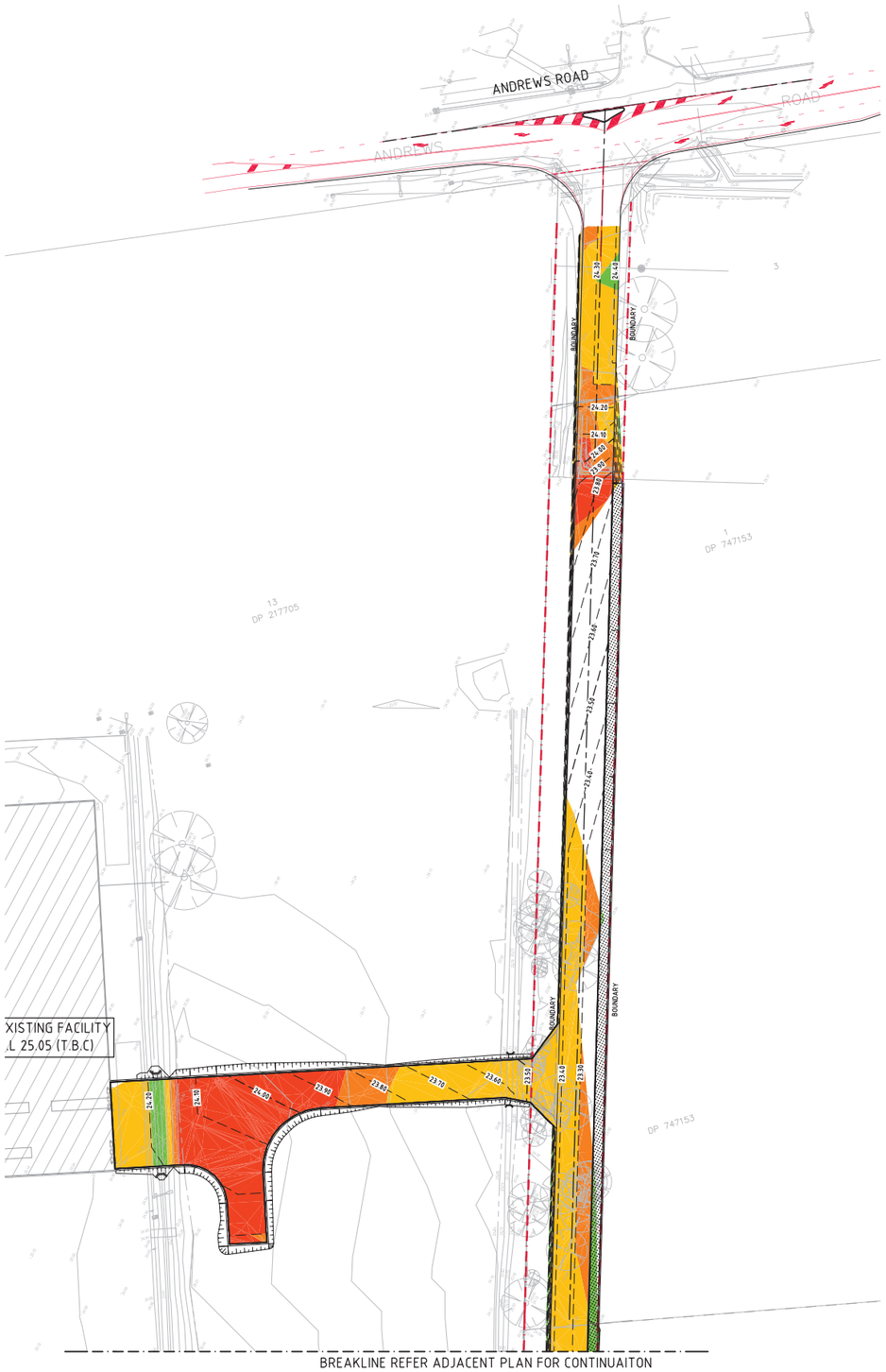
DRAWING TITLE
BULK EARTHWORKS PLAN
SHEET 1

DRAWING No C013620.00-DA30 | ISSUE D

BREAKLINE REFER ADJACENT PLAN FOR CONTINUAITON





BULK EARTHWORKS PLAN - SHEET 2
1:500 SCALE

BULK EARTHWORKS PLAN - SHEET 2
1:500 SCALE

PAVEMENT STRUCTURAL ALLOWANCES

WAREHOUSE PAVEMENT	
(180mm SLAB+20mm SAND+500mm CAPPING)	680mm
TRUCK HARDSTAND PAVEMENT	780mm
CARPARK PAVEMENT	780mm
FOOTPATH/OUTDOOR AREAS	125mm
FIRE TRAIL	360mm
LANDSCAPE	100mm

NOTE: PAVEMENT THICKNESS QUOTED INCLUDE 500mm SANDSTONE CAPPING LAYER

DEPTH RANGE

No.	FROM DEPTH	TO DEPTH	COLOUR
1	-2.000	-1.500	
2	-1.500	-1.000	
3	-1.000	-0.500	
4	-0.500	0.000	
5	0.000	0.500	
6	0.500	1.000	
7	1.000	1.500	
8	1.500	2.000	
9	2.000	2.500	

LEGEND

LEVELS DATUM IS AHD.

- 76.95 - EXISTING CONTOUR
- 73.00 - B.E.L. CONTOUR (MAJOR 0.5m)
- 73.10 - B.E.L. CONTOUR (MINOR 0.1m)

NOMINATED B.E.L. DETAIL (FOOTPATHS/FIRETRAIL)
N.T.S.

NOMINATED B.E.L. DETAIL (BUILDING & TRAFFICABLE PAVEMENTS)
N.T.S.

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

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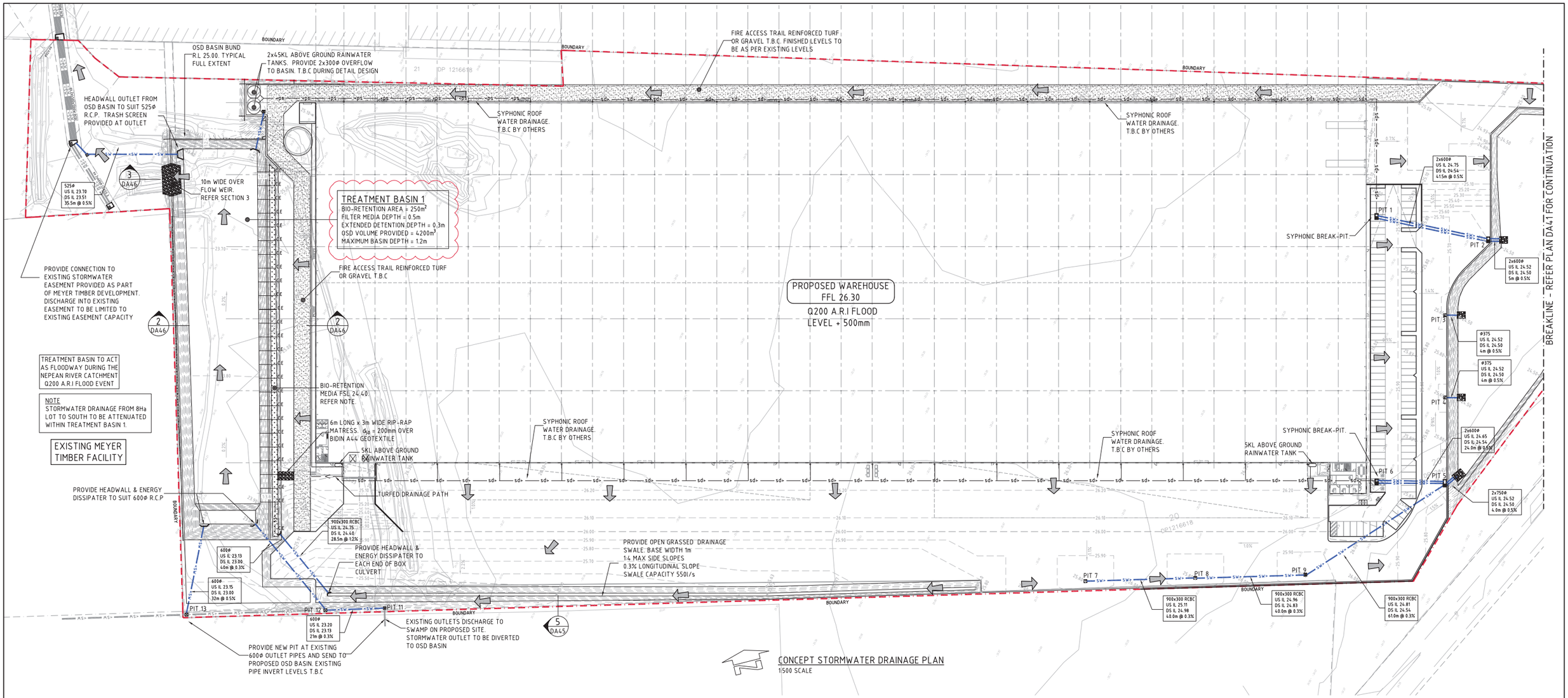
DRAWING TITLE
BULK EARTHWORKS PLAN
SHEET 2

DRAWING No C013620.00-DA31 ISSUE D



CONCEPT STORMWATER DRAINAGE PLAN
1:500 SCALE

STORMWATER DRAINAGE NOTES:

1. ALL STORMWATER WORKS TO BE COMPLETED IN ACCORDANCE WITH AUSTRALIAN STANDARD AS3500.3:2003 PLUMBING AND DRAINAGE, PART 3: STORMWATER DRAINAGE.
2. THE MINOR (PIPED) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 20 YEAR ARI STORM EVENT AND THE MAJOR (OVERLAND) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 100 YEAR ARI STORM EVENT.
3. ALL FINISHED PAVEMENT LEVELS SHALL BE AS INDICATED ON FINISHED LEVELS PLANS DA50.
4. PIT SIZES SHALL BE AS INDICATED IN THE SCHEDULE WHILE PIPE SIZES AND DETAILS ARE PROVIDED ON PLAN.
5. EXISTING STORMWATER PIT LOCATIONS AND INVERT LEVELS TO BE CONFIRMED BY SURVEY PRIOR TO COMMENCING WORKS ON SITE.
6. ALL STORMWATER PIPES ø375 OR GREATER SHALL BE CLASS 2 (WITH HS2 SUPPORT) REINFORCED CONCRETE WITH RUBBER RING JOINTS UNLESS NOTED OTHERWISE.
7. ALL PIPES UP TO AND INCLUDING ø300 TO BE uPVC GRADE SN8 UNO.
8. PIPE CLASS NOMINATED ARE FOR IN-SERVICE LOADING CONDITIONS ONLY. CONTRACTOR IS TO MAKE ANY NECESSARY ADJUSTMENTS REQUIRED FOR CONSTRUCTION CONDITIONS.
9. ALL CONCRETE PITS GREATER THAN 1000mm DEEP SHALL BE REINFORCED USING N12-200 EACH WAY CENTERED IN WALL AND BASE. LAP MINIMUM 300mm WHERE REQUIRED. ALL CONCRETE FOR PITS SHALL BE F'c 32 MPA. PRECAST PITS MAY BE USED WITH THE APPROVAL OF THE ENGINEER.
10. IN ADDITION TO ITEM 6 ABOVE, ALL CONCRETE PITS GREATER THAN 3000mm DEEP SHALL HAVE WALLS AND BASE THICKNESS INCREASED TO 200mm.
11. PIPES SHALL BE LAID AS PER PIPE LAYING DETAILS. PARTICULAR CARE SHALL BE TAKEN TO ENSURE THAT THE PIPE IS FULLY AND EVENLY SUPPORTED. RAM AND PACK FILLING AROUND AND UNDER BACK OF PIPES AND PIPE FAUCETS, WITH NARROW EDGED RAMMERS OR OTHER SUITABLE TAMPING DETAILS.
12. CONCRETE PIPES UNDER, OR WITHIN THE ZONE OF INFLUENCE OF PAVED AREAS SHALL BE LAID USING HS2 TYPE SUPPORT, AS A MINIMUM, IN ACCORDANCE WITH AS 3725. AGGREGATE BACKFILL SHALL NOT BE USED FOR PIPE BEDDING AND OR HAUNCH/SIDE SUPPORT.
13. WHERE PIPE LINES ENTER PITS, PROVIDE 2m LENGTH OF STOCKING WRAPPED SLOTTED ø100 uPVC TO EACH SIDE OF PIPE.
14. ALL SUBSOIL DRAINAGE LINES SHALL BE ø100 SLOTTED uPVC WITH APPROVED FILTER WRAP LAID IN 300mm WIDE GRANULAR FILTER UNLESS NOTED OTHERWISE. LAY SUBSOIL LINES TO MATCH FALLS OF LAND AND/OR 1 IN 200 MINIMUM. PROVIDE CAPPED CLEANING EYE (RODDING POINT) AT UPSTREAM END OF LINE AND AT 30m MAX. CTS. PROVIDE SUBSOIL LINES TO ALL PAVEMENT/ LANDSCAPED INTERFACES, TO REAR OF RETAINING WALLS (AS NOMINATED BY STRUCTURAL ENGINEER) AND AS SHOWN ON PLAN.
15. ALL PIPE GRADES 1 IN 100 MINIMUM UNO.
16. PROVIDE STEP IRONS IN PITS DEEPER THAN 1000mm.
17. MIN. 600 COVER TO PIPE OBVERT BENEATH ROADS & MIN. 400 COVER BENEATH LANDSCAPED AND PEDESTRIAN AREAS.
18. PIT COVERS IN TRAFFICABLE PAVEMENT SHALL BE CLASS D 'HEAVY DUTY', THOSE LOCATED IN NON-TRAFFICABLE AREAS SHALL BE CLASS B 'MEDIUM DUTY' U.N.O.
19. PROVIDE CLEANING EYES (RODDING POINTS) TO PIPES AT ALL CORNERS AND T-JUNCTIONS WHERE NO PITS ARE PRESENT.
20. DOWN PIPES (DP) TO BE AS PER HYDRAULIC ENGINEERS DETAILS WITH CONNECTOR TO MATCH DP SIZE U.N.O. ON PLAN. PROVIDE CLEANING EYE AT GROUND LEVEL.
21. PIPE LENGTHS NOMINATED ON PLAN OR LONGSECTIONS ARE MEASURED FROM CENTER OF PITS TO THE NEAREST 0.5m AND DO NOT REPRESENT ACTUAL LENGTH. THE CONTRACTOR IS TO ALLOW FOR THIS.

PIT SCHEDULE

PIT No.	GRATE RL	DEPTH	TYPE	SIZE	COMMENT
PIT 1	25.98	1230	SGGP	1800x1200	⊕
PIT 2	25.60	1100	SGGP	1800x1200	⊕
PIT 3	25.65	1130	SGGP	900x900	⊕
PIT 4	25.65	1130	SGGP	900x900	⊕
PIT 5	25.65	1130	SGGP	2400x900	⊕
PIT 6	25.98	1330	SGGP	1800x1200	⊕
PIT 7	25.80	690	SGGP	1200x1200	⊕
PIT 8	25.80	840	SGGP	1200x1200	⊕
PIT 9	25.80	990	SGGP	1200x1200	⊕
PIT 10	24.70	1050	BIP	1500x1500	⊕
PIT 11	25.20	2000	SJP	900x900	
PIT 12	25.20	2070	SJP	900x900	
PIT 13	25.10	1950	SJP	900x900	

NOTE:
⊕ DENOTES PITS TO BE PROVIDED WITH STORMWATER 360 ENVIROPOD PIT INSERT

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY MATTHEW FREEBURN SURVEYOR DATED 08.01.13

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- GD, GRATED DRAIN (300W x 225D UNO)
- PROPOSED DRAINAGE LINE
- EXISTING DRAINAGE LINE
- SYPHONIC ROOFWATER LINE
- SUBSOIL LINE
- OVERLAND FLOW DIRECTION
- FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR REVIEW	18.10.18	F
ISSUED FOR INFORMATION	04.10.18	E
ISSUED FOR INFORMATION	05.09.18	D
ISSUED FOR INFORMATION	29.08.18	C
ISSUED FOR INFORMATION	24.08.18	B
ISSUED FOR DEVELOPMENT APPLICATION	21.08.18	A

AMENDMENTS	DATE	ISSUE
TYPO AMENDED	31.01.19	H
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	G

AMENDMENTS	DATE	ISSUE

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA40

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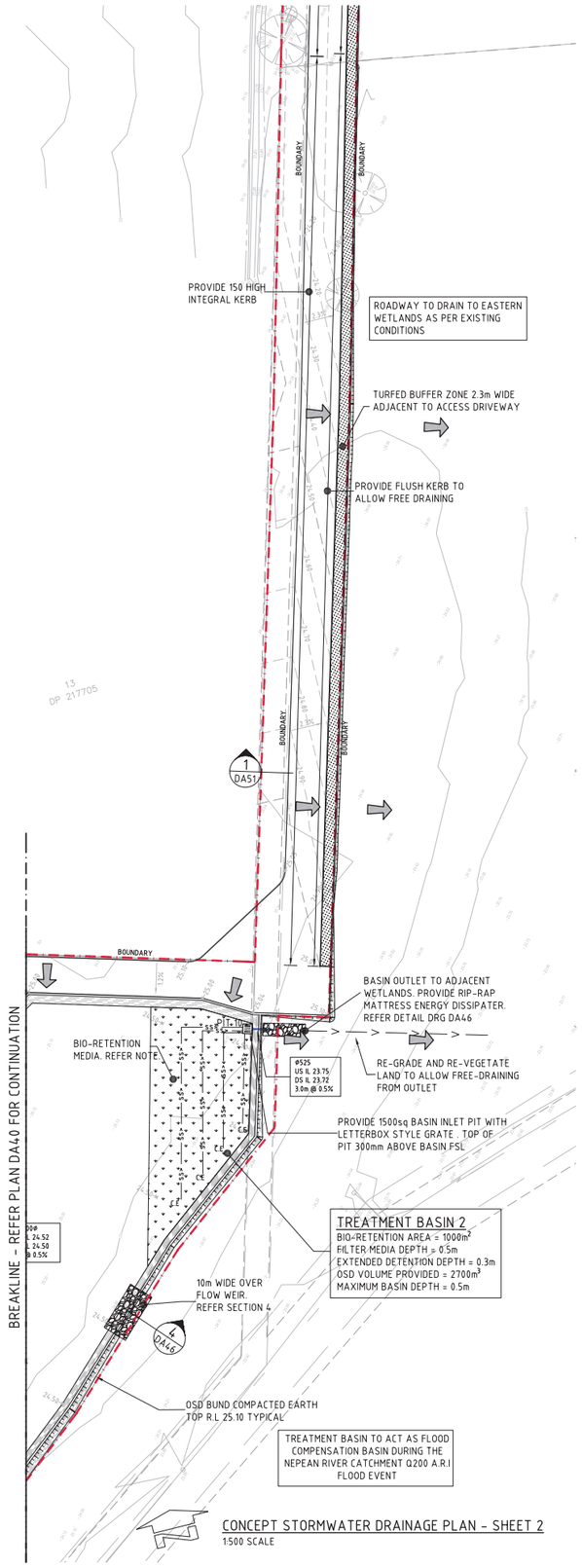
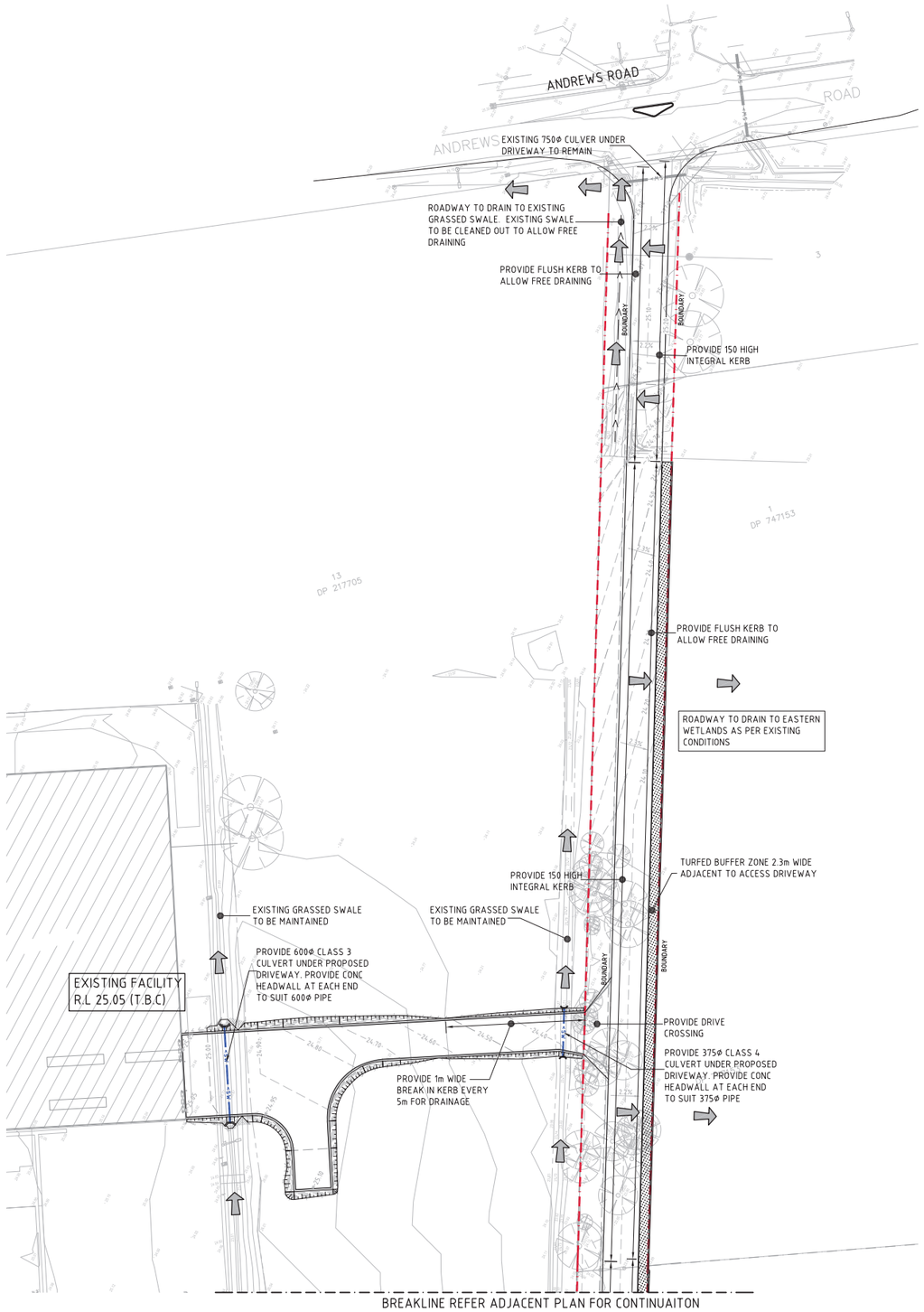
DRAWING TITLE
CONCEPT STORMWATER DRAINAGE PLAN - SHEET 1

DRAWING No C013620.00-DA40 ISSUE H



CONCEPT STORMWATER DRAINAGE PLAN - SHEET 2
1:500 SCALE



CONCEPT STORMWATER DRAINAGE PLAN - SHEET 2
1:500 SCALE

LEGEND:
LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYOR DATED 27.08.18

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- GD, GRATED DRAIN (300W x 225D UNO)
- PROPOSED DRAINAGE LINE
- EXISTING DRAINAGE LINE
- SYPHONIC ROOFWATER LINE
- SUBSOIL LINE
- OVERLAND FLOW DIRECTION
- FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	D
ISSUED FOR REVIEW	18.10.18	C
ISSUED FOR INFORMATION	04.10.18	B
ISSUED FOR REVIEW	05.09.18	A

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA41

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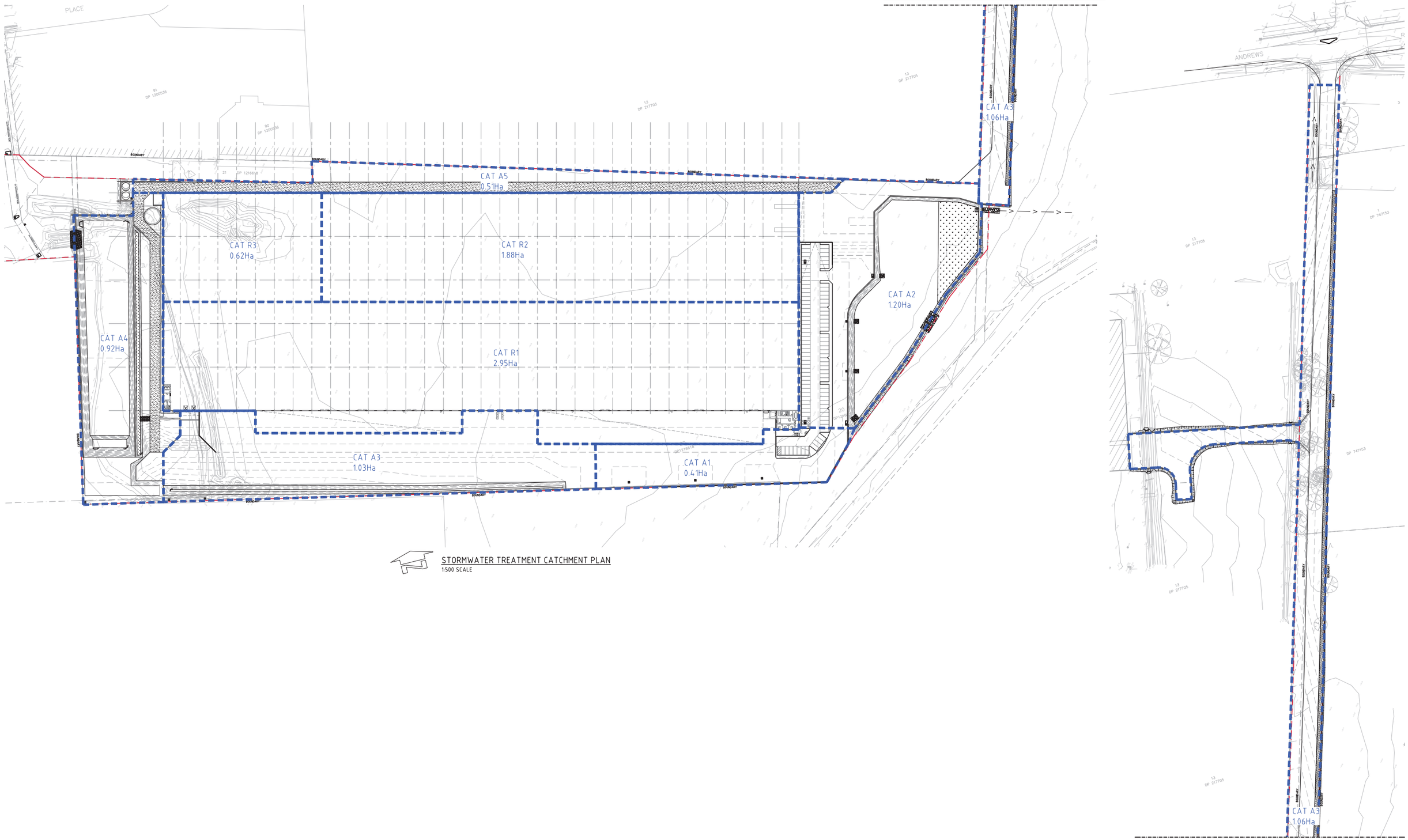
DRAWING TITLE
CONCEPT STORMWATER DRAINAGE PLAN - SHEET 2

DRAWING No C013620.00-DA41 ISSUE D



STORMWATER TREATMENT CATCHMENT PLAN
1:500 SCALE

STORMWATER TREATMENT CATCHMENT PLAN
1:500 SCALE

6m 0 15 30 45 60 75m
1:750 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	A
AMENDMENTS	DATE	ISSUE

AMENDMENTS	DATE	ISSUE

AMENDMENTS	DATE	ISSUE

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
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PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA42

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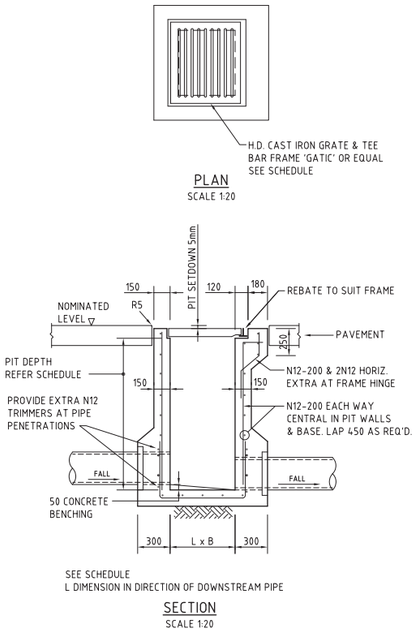
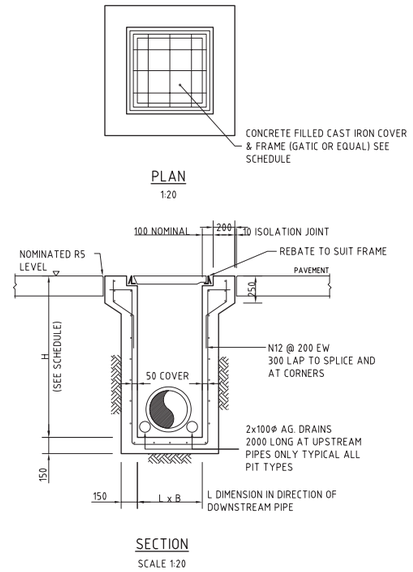
DRAWING TITLE
STORMWATER TREATMENT CATCHMENT PLAN

DRAWING No C013620.00-DA42 | ISSUE A



SINGLE GRATED GULLY PIT - SGGP

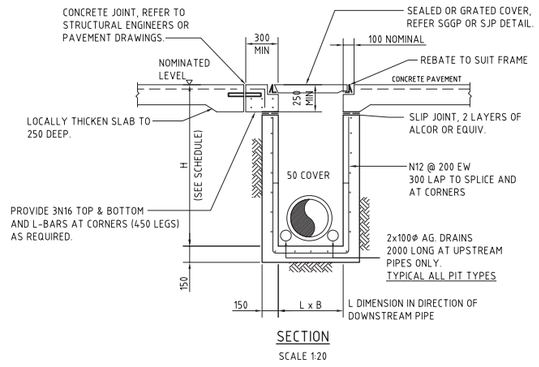


SEALED PIT - SP

CONCRETE QUALITY					
ELEMENT	SLUMP	AGGREGATE (MAX. SIZE)	CEMENT TYPE	ADMIXTURE	f'c (MPa)
PIT	80	20	GP	NIL	32

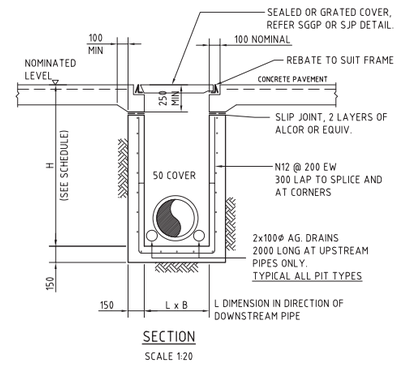
NOTES:

1. WHERE GULLY PIT IS LOCATED ON KERB RETURNS OR BULB OF CUL-DE-SACS PROVIDE CURVED PRECAST CONCRETE LINTELS.
2. SAG PITS SHALL HAVE LINTEL PLACED CENTRALLY ABOUT THE GRATE.
3. ALL REINFORCING TO HAVE 30 MIN. CLAER CONCRETE COVER.
4. FOR PITS DEEPER THAN 1200mm CLIMB RAILS SHALL BE PROVIDED.



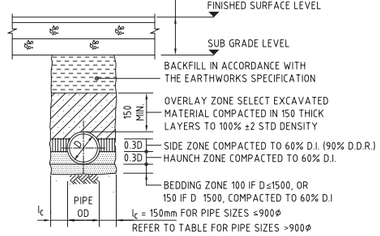
SJP/CIS & SGGP/CIS (CAST IN SLAB) PIT DETAIL GRATE/COVER SUPPORT CAST-INTO PAVEMENT SLAB

(ADOPT IN CONCRETE PAVEMENT FOR SGGP's & SJP's, WHERE PITS ARE LOCATED IN THE CORNER OF SLAB PANELS OR ADJACENT TO SLAB PANEL JOINTS)



SJP/CIS & SGGP/CIS (CAST IN SLAB) PIT DETAIL GRATE/COVER SUPPORT CAST-INTO PAVEMENT SLAB

(ADOPT IN CONCRETE PAVEMENTS FOR SGGP's & SJP's, WHERE JOINTS ARE NOT LOCATED WITHIN PROXIMITY OF THE GRATE)



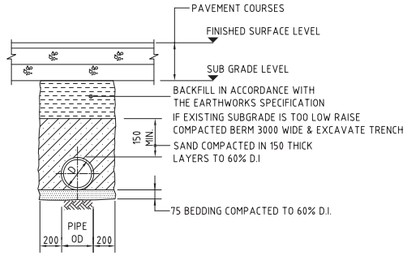
TYPE HS2 SUPPORT TO CONCRETE PIPES UNDER PAVEMENT

SCALE 1:20

BEDDING & HAUNCH MATERIAL GRADING	
SIEVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
2.36	100 TO 50
0.60	90 TO 50
0.30	60 TO 10
0.15	25 TO 0
0.075	10 TO 0

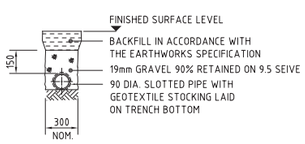
SIDE ZONE MATERIAL GRADING	
SIEVE SIZE (mm)	WEIGHT PASSING (%)
75.0	100
9.5	100 TO 50
2.36	100 TO 50
0.60	50 TO 15
0.075	25 TO 0

SELECT FILL MATERIAL IN ACCORDANCE WITH TABLE 1 AS 3725



SUPPORT TO uPVC PIPES

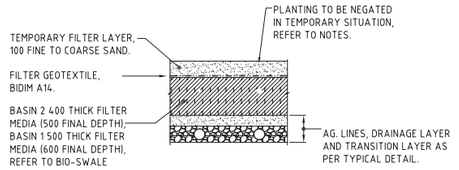
SCALE 1:20



SUPPORT TO AGRICULTURAL DRAIN

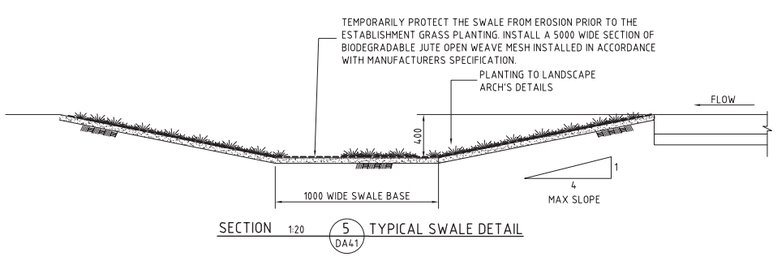
SCALE 1:20

SIDE ZONE MATERIAL GRADING	
SIEVE SIZE (mm)	WEIGHT PASSING (%)
19.0	100
9.5	100 TO 50
2.6	100 TO 30
0.60	50 TO 15
0.075	25 TO 0

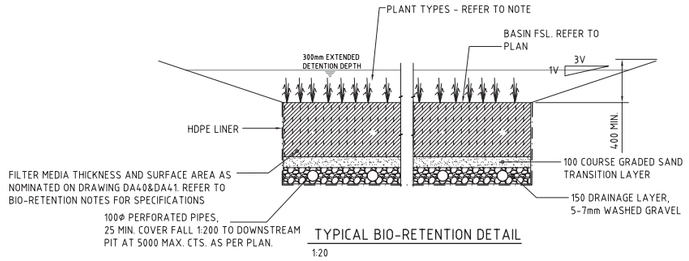


BIO-RETENTION CONSTRUCTION DETAIL

SCALE 1:20
TEMPORARY DETAIL FOR USE DURING CONSTRUCTION & SITE STABILISATION PERIOD - REFER TO NOTES FOR IMPLIMENTATION PERIODS.

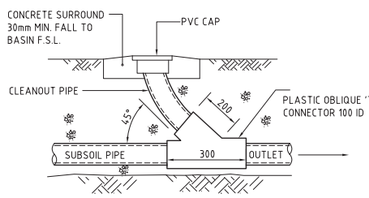


SECTION 1:20 (5 / DA41) TYPICAL SWALE DETAIL



TYPICAL BIO-RETENTION DETAIL

1:20



CLEANOUT EYE ELEVATION

SCALE 1:20
DENOTED C.E. ON PLAN

BIO-RETENTION NOTES:

FILTER MEDIA TO BE LOAMY SAND WITH A PERMEABILITY NOT LESS THAN 200mm/hr. FILTER MEDIA TO BE FREE OF RUBBISH, DELETERIOUS MATERIAL, TOXICANTS, DECLARED PLANTS AND LOCAL WEEDS, AND IS TO NOT BE HYDROPHOBIC.

FILTER MEDIA TO HAVE THE FOLLOWING COMPOSITION RANGE:

CLAY & SILT (<0.05mm)	<3%
VERY FINE SAND (0.05-0.15mm)	5-30%
FINE SAND (0.15-0.25mm)	10-30%
MEDIUM TO COARSE SAND (0.25-1.00mm)	40-60%
COARSE SAND (1.0-2.0mm)	7-10%
FINE GRAVEL (2.0-3.4mm)	<3%

FILTER MEDIA THAT DOES NOT MEET THE FOLLOWING CRITERIA SHALL BE REJECTED:

a. ORGANIC MATTER CONTENT TO BE IDEALLY WITHIN 1% TO 3% (W/W) AND TO BE NO GREATER THAN 5%(W/W).
b. PH TO BE BETWEEN 5.5 AND 7.5
c. PHOSPHOROUS CONTENT TO BE NO GREATER THAN 35mg/kg

FILTER MEDIA TO BE ASSESSED BY QUALIFIED HORTICULTURALIST TO ENSURE CAPABILITY OF SUPPORTING PLANT LIFE.

DRAINAGE LAYER TO BE CLEAN GRAVEL 5-7mm.

PROVIDE 100mm TOPSOIL AND TEMPORARY EROSION PROTECTION (JUTEMASTER OR EQUIV) TO SWALE BATTER SLOPES AND ADJACENT LANDSCAPED AREAS. NOTE THAT NO TOPSOIL IS TO BE PLACED OVER FILTRATION MEDIA. PROVIDE SILT FENCE TO TOP OF BANK UNTIL SUCH TIME AS THIS STABILISING AND VEGETATION HAS BEEN COMPLETED.

BIO-RETENTION TO BE PARTIALLY INSTALLED, FOLLOWING COMPLETION OF THE ROAD, WITH THE TOP 75-100mm OF FILTER MEDIA REPLACED WITH A FINE TO COARSE SAND UNDERLAIN WITH A GEOTEXTILE LAYER (REFER TO DETAIL). FOLLOWING COMPLETION OF THE UPSTREAM DEVELOPMENT AND SITE STABILISATION, THE SAND IS TO BE REMOVED, REPLACED WITH FILTER MATERIAL AND PLANTED OUT. REFER TO TEMPORARY BIO-BASIN DETAIL

PRIOR TO PLANTING, THE TOP 100mm OF THE BIORETENTION FILTER MEDIA IS TO BE AMELIORATED WITH APPROPRIATE ORGANIC MATTER, FERTILISER AND TRACE ELEMENTS TO AID PLANT ESTABLISHMENT AS PER THE TABLE BELOW:

TABLE: RECIPE FOR AMELIORATING TOP 100mm OF BIORETENTION FILTER MEDIA

CONSTITUENT	QUANTITY (kg/m2 OF FILTER AREA)
GRANULATED POULTRY MANURE FINES	50
SUPERPHOSPHATE	2
MAGNESIUM SULPHATE	3
POTASSIUM SULPHATE	2
TRACE ELEMENT MIX	1
FERTILISER NPK (16.4.14)	4
LIME	20

200mm 0 500 1000 1500 2000mm
1:20 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR CONSULTATION	05.09.18	A

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA45

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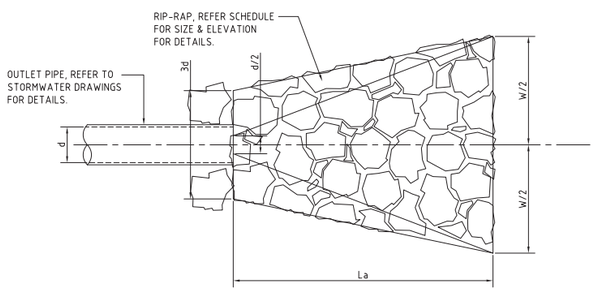
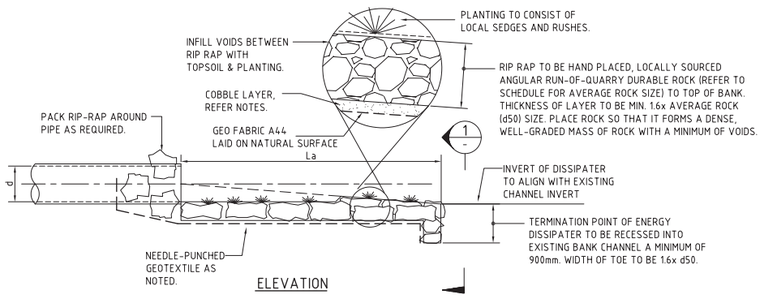
DRAWING TITLE
STORMWATER DRAINAGE DETAILS SHEET 1

DRAWING No C013620.00-DA45 ISSUE C



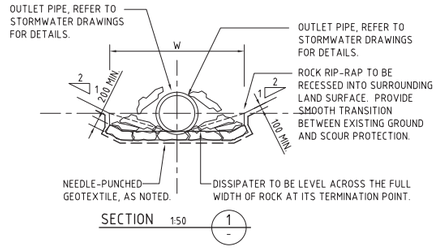
PLAN VIEW



ELEVATION

STORMWATER OUTLET DISSIPATER

SCALE 1:50



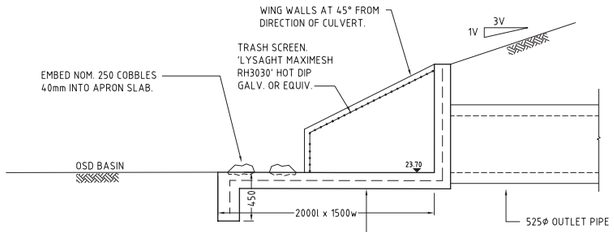
SECTION 1:50 (1 / -)

DISSIPATER NOTES:

1. ALIGN STRUCTURE EVENLY WITH BANK.
2. LOCATE STRUCTURE AT INVERT LEVEL OF STREAM AND POINT IN A DOWNSTREAM DIRECTION.
3. PIPE TO REST ON, AND BE PACKED IN, BY RIP-RAP (SIZE AS NOTED).
4. DISCHARGE INTO STREAM WHERE BEDROCK IS PRESENT, OTHERWISE SCOUR PROTECT AS REQUIRED.
5. SCOUR PROTECT THE OPPOSITE BANK AS REQUIRED. SCOUR PROTECTION TO BE PROVIDED WHERE OPPOSITE BANK IS WITHIN 12-14 TIMES THE PIPE DIAMETER.
6. RIP-RAP TO CONSIST OF ANGULAR RUN-OF-QUARRY ROCK (d50= 300mm MINIMUM) AS NOTED IN THE SCHEDULE. RIP-RAP TO BE MINIMUM THICKNESS OF RIP-RAP LAYER TO BE 1.6x AVERAGE ROCK SIZE (d50).
7. RIP-RAP IS TO BE PLACED OVER A 200mm LAYER OF 140mm COBBLES OVER NEEDLE-PUNCHED GEOFAB A44.
8. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS. THE FINISHED RIP-RAP SURFACE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS.
9. GAPS IN RIP-RAP TO BE HAND PACKED WITH TOPSOIL & PLANTED WITH NATIVE SEDGES & RUSHES TO PROVIDE. THE INTENT IS FOR THERE TO BE NO VOIDS BETWEEN RIP-RAP BOULDERS.
10. ENSURE THE FINISHED ROCK SURFACE BLENDS WITH THE SURROUNDING GROUND LEVELS. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.
11. ENSURE THAT STORMWATER FROM SURROUNDING GROUND IS FREE TO ENTER THE STRUCTURE WITHOUT CAUSING UNDESIRABLE PONDING OR SCOUR.

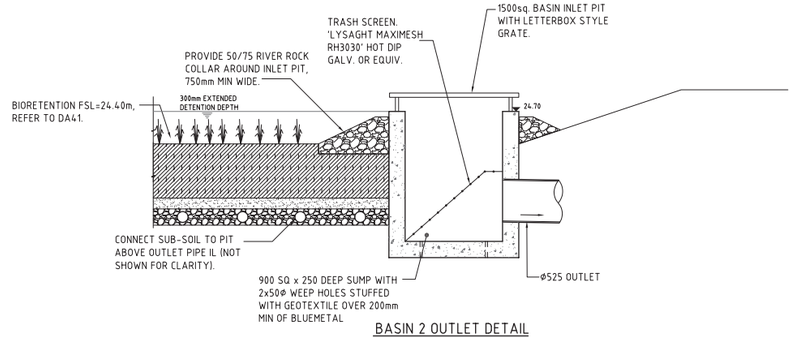
DISSIPATER SCHEDULE

DISCHARGE POINT	d	La	W	RIP-RAP
OUTLET TYPE 1	900/825	4000	3000	400
OUTLET TYPE 2	600	3000	2000	300
OUTLET TYPE 3	375	2000	1000	150
BASIN 2 OUTLET	525	10000	3000	300



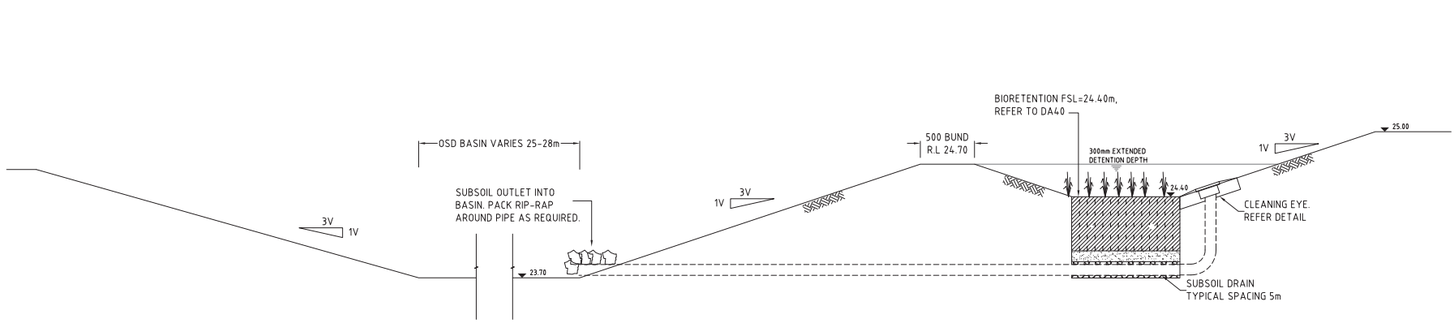
BASIN 1 OUTLET DETAIL

1:20

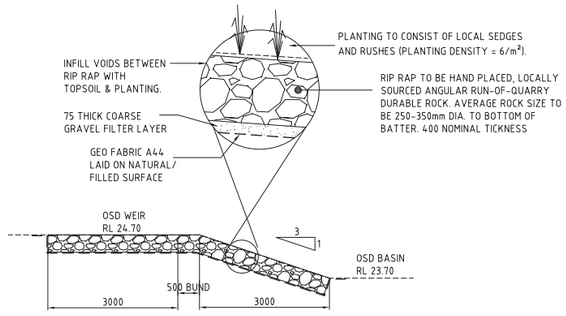


BASIN 2 OUTLET DETAIL

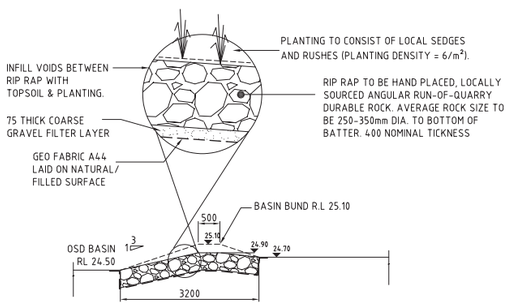
1:20



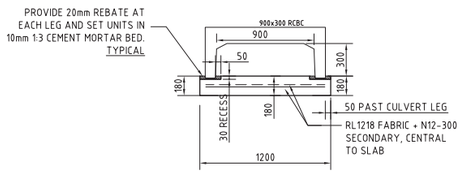
SECTION 1:20 (2 / DA41) TYPICAL THROUGH BASIN 1



SECTION 1:50 (3 / DA41) TYPICAL THROUGH BASIN 1 WEIR



SECTION 1:50 (4 / DA41) TYPICAL THROUGH BASIN 1 WEIR



BOX CULVERT BASE DETAIL

SCALE 1:20

500mm 0 1 2 3 4 5m
1:50 SCALE AT A0 SHEET SIZE

200mm 0 500 1000 1500 2000mm
1:20 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

ISSUE	DATE	AMENDMENTS	ISSUE	DATE	AMENDMENTS	ISSUE	DATE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C					
ISSUED FOR REVIEW	18.10.18	B					
ISSUED FOR REVIEW	05.09.18	A					

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA46

Costin Roe Consulting Pty Ltd.
Consulting Engineers
Level 1, 8 Windmill Street
Walsh Bay, Sydney NSW 2000
Tel: (02) 9251-7600 Fax: (02) 9241-3721
email: mail@costinroe.com.au ©

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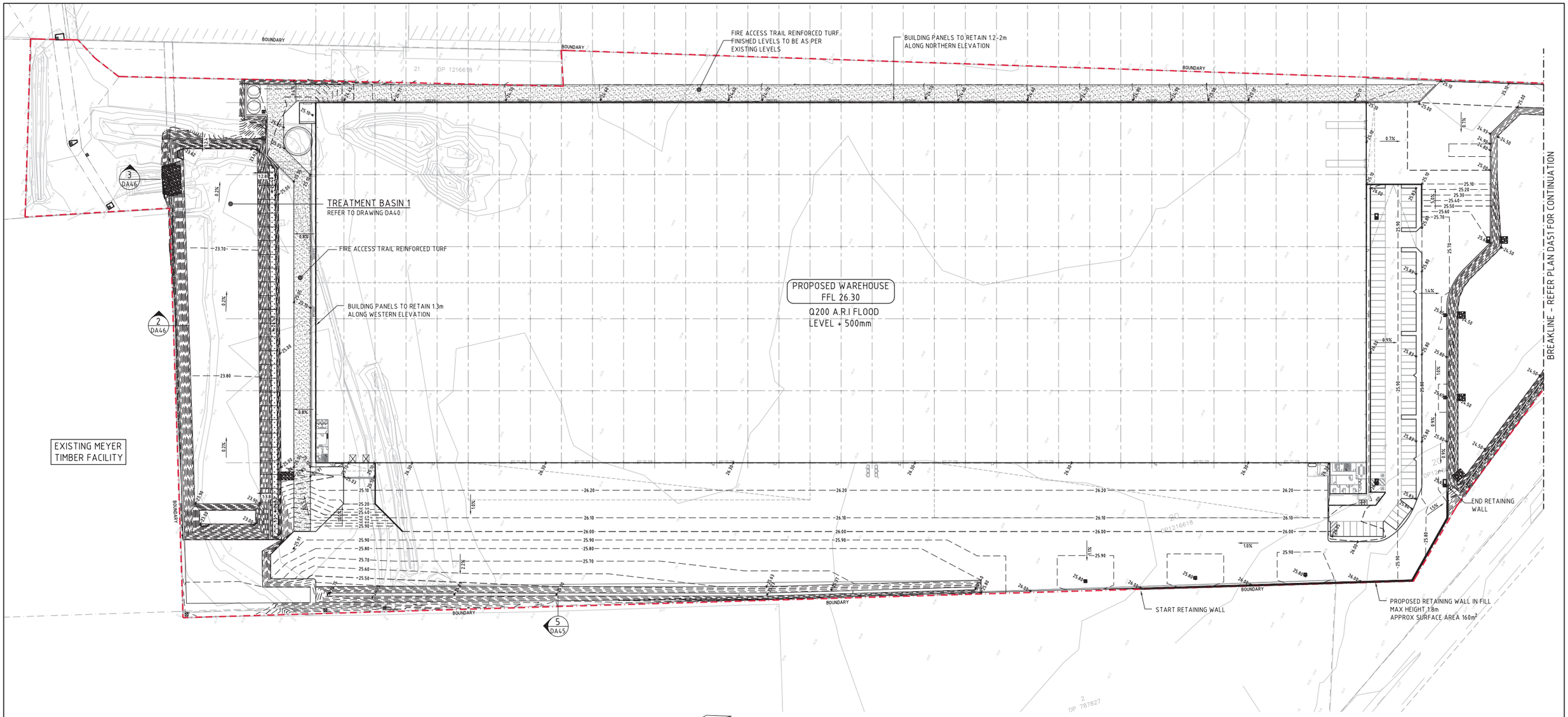
DRAWING TITLE
STORMWATER DRAINAGE DETAILS SHEET 2

DRAWING No C013620.00-DA46 ISSUE C



FINISHED LEVELS PLAN - SHEET 1
1:500 SCALE

FINISHED LEVELS PLAN NOTES:

1. LEVELS DATUM IS A.H.D.
2. ALL CONTOUR LINES & SPOT LEVELS INDICATE FINISHED PAVEMENT LEVELS U.N.O. ON PLAN.
3. THE MAJOR CONTOUR INTERVAL IS 0.5m
4. THE MINOR CONTOUR INTERVAL IS 0.1m.
5. MINIMUM PAVEMENT GRADE IS TO BE 1:100 (1%).
6. MAXIMUM PAVEMENT GRADE IS TO BE 1:20 (5%) IN CARPARKING AREAS AND 1:25 (4%) ELSEWHERE.
7. MAXIMUM RAMP GRADES ARE TO BE 1:12 (8.3%) U.N.O. ON PLAN
8. PROVIDE MINIMUM 3.0m LONG TRANSITION WHERE CHANGES GRADE EXCEDE 1:20 (5%).
9. PERMANENT BATTER SLOPES ARE TO HAVE A MAXIMUM GRADE OF 1V:3H.
10. ALL BATTER SLOPE WITH GRADES AT OR EXCEDING 1V:6H ARE TO BE TURFED IMMEDIATELY OR APPROPRIATE EROSION CONTROL IS TO BE PROVIDED TO THE SATISFACTION OF THE ENGINEER.
11. THE ACCESS ROAD TO THE HARDSTAND AREA IS TO HAVE A CROSSFALL OF 2% AS INDICATED ON PLAN.
12. ALL FOOTPATHS ARE TO FALL AWAY FROM THE BUILDING AT 2.5% NOMINAL. GRADE.
13. ALL PAVEMENTS ARE TO BE SET AT 50mm BELOW THE FINISHED FLOOR LEVEL OF THE WAREHOUSE AND OFFICE AREAS.

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYOR DATED 27.08.18

- ▤ - SGGP, SINGLE GRATED GULLY PIT
- ⊠ - SJP, SEALED JUNCTION PIT
- —50.00— - FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- —50.10— - FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS
- +50.10 - FINISHED SPOT HEIGHT

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	F
ISSUED FOR REVIEW	18.10.18	E
ISSUED FOR INFORMATION	05.09.18	D
ISSUED FOR INFORMATION	29.08.18	C
ISSUED FOR INFORMATION	24.08.18	B
ISSUED FOR INFORMATION	21.08.18	A

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA50

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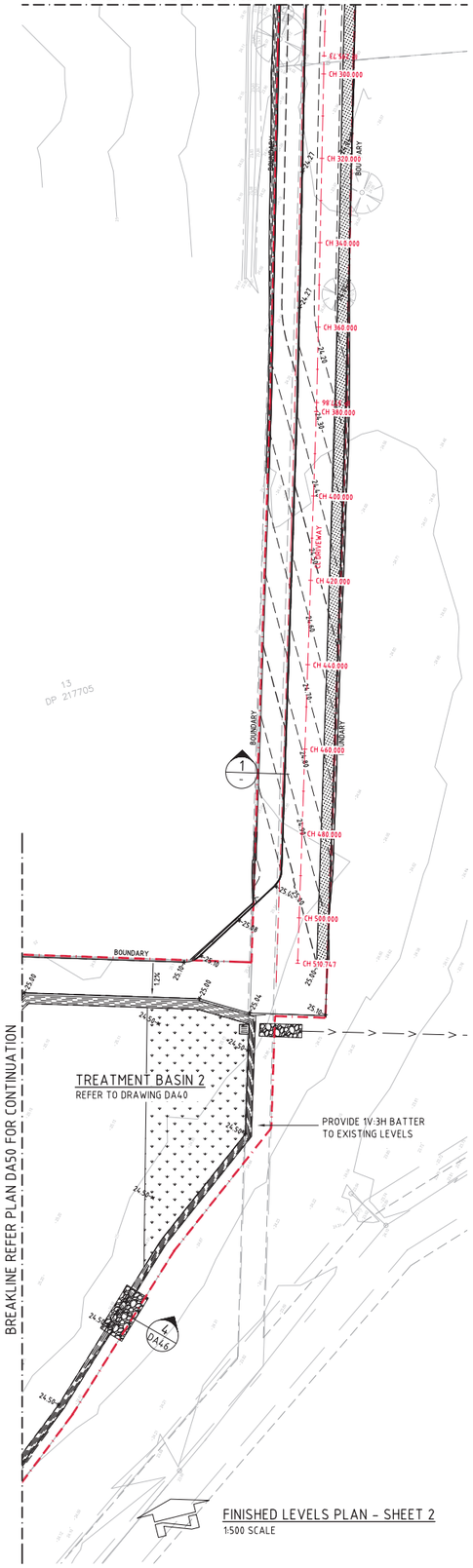
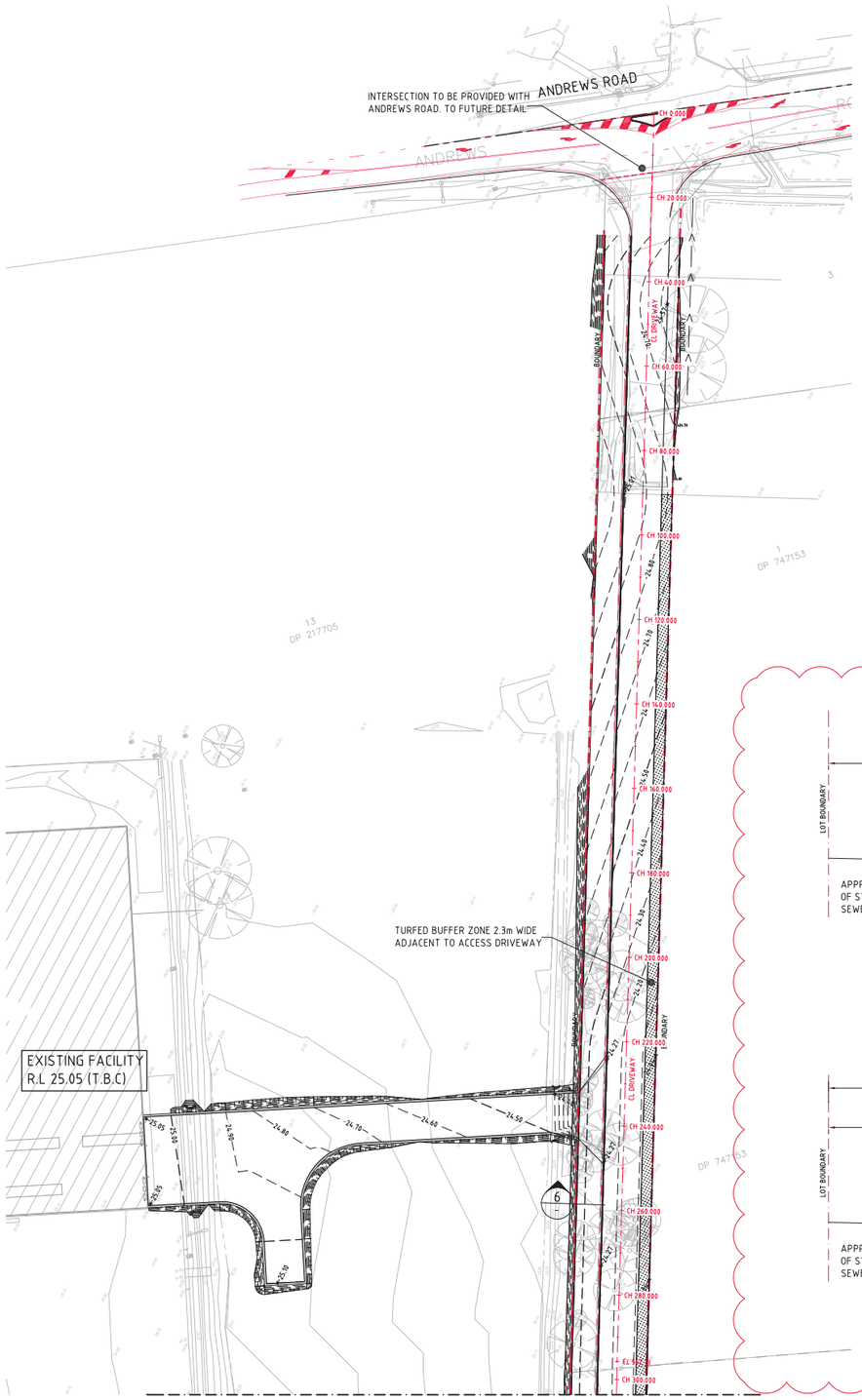
DRAWING TITLE
FINISHED LEVELS PLAN

DRAWING No C013620.00-DA50 ISSUE F

BREAKLINE REFER ADJACENT PLAN FOR CONTINUAITON



FINISHED LEVELS PLAN - SHEET 2
1:500 SCALE



BREAKLINE REFER ADJACENT PLAN FOR CONTINUAITON

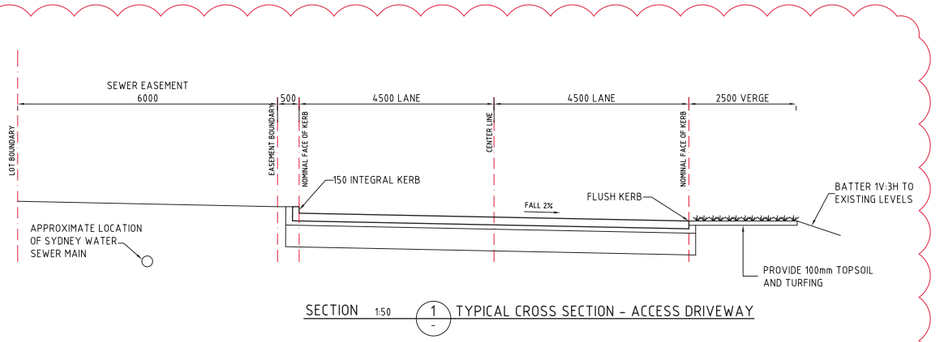
FINISHED LEVELS PLAN - SHEET 2
1:500 SCALE

LEGEND:

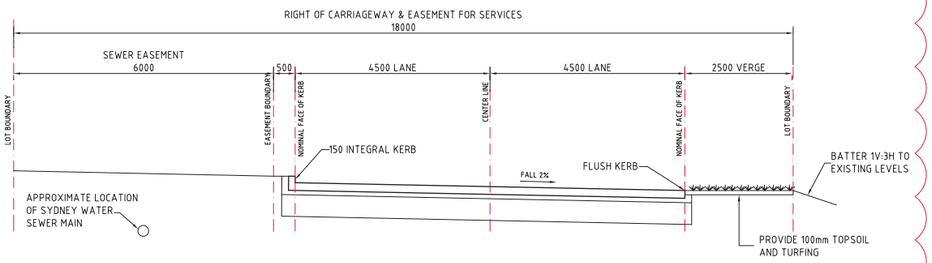
LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYOR DATED 27.08.18

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- 50.00 - FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- 50.10 - FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS
- +50.10 - FINISHED SPOT HEIGHT



SECTION 1:50 1 - TYPICAL CROSS SECTION - ACCESS DRIVEWAY



SECTION 1:50 6 - TYPICAL CROSS SECTION - ACCESS DRIVEWAY

500mm 0 1 2 3 4 5m
1:50 SCALE AT A0 SHEET SIZE

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
TYPICAL SECTION UPDATED	05.02.18	F
TYPICAL SECTION ADDED	01.02.19	E
TYPICAL SECTION UPDATED	31.01.19	D
ISSUED FOR DEVELOPMENT APPLICATION	02.11.18	C
ISSUED FOR REVIEW	18.10.18	B
ISSUED FOR INFORMATION	05.09.18	A

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA51

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DRAWING TITLE
FINISHED LEVELS PLAN
SHEET 2

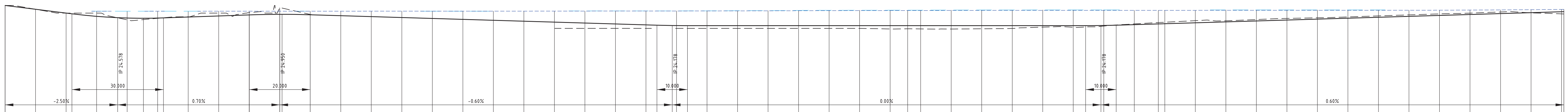
DRAWING No C013620.00-DA51 | ISSUE F

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LAND PARTNERS SURVEYOR DATED 27.08.18

- EXISTING SURFACE PROFILE
- FINISHED SURFACE PROFILE
- Q100 PRE-DEVELOPMENT FLOOD SURFACE PROFILE
- Q100 POST DEVELOPMENT FLOOD SURFACE PROFILE



DATUM 18.000

HORIZONTAL GEOMETRY: 295.734 / 198°27'50" — 82.129 / 197°59'22" — 132.884 / 198°42'40"

CHAINAGE	Q100 ARI POST DEVELOPMENT FLOOD LEVEL	Q100 ARI PRE-DEVELOPMENT FLOOD LEVEL	CUT/FILL DEPTH	DESIGN LEVEL	EXISTING LEVEL
0.000			0.000	25.500	25.50
10.000			0.003	25.250	25.25
20.000			0.000	25.000	25.00
21.900			-0.047	24.953	25.00
30.000	25.119	25.120	-0.214	24.786	25.00
36.900		25.120	0.009	24.698	24.69
40.000		25.120	0.118	24.675	24.56
45.333		25.120	0.087	24.660	24.57
50.000	25.120	25.120	0.014	24.672	24.66
51.900	25.119	25.120	-0.010	24.683	24.69
60.000		25.120	-0.018	24.740	24.76
70.000	25.120		-0.190	24.810	25.00
80.000	25.121		-0.147	24.880	25.03
90.000	25.121		-0.432	24.918	25.35
90.769	25.121		-0.411	24.918	25.33
100.000	25.122		-0.021	24.890	24.91
110.000	25.123			24.830	
120.000	25.124			24.770	
130.000	25.124			24.710	
140.000	25.125	25.122		24.650	
150.000	25.125	25.122		24.590	
160.000	25.125			24.530	
170.000	25.127			24.470	
180.000	25.130			24.410	
190.000	25.132	25.140	0.350	24.350	24.00
200.000	25.132	25.140	0.290	24.290	24.00
210.000	25.133	25.139	0.230	24.230	24.00
213.600	25.134	25.139		24.208	
218.600	25.134	25.139		24.186	
220.000	25.135	25.140	0.182	24.182	24.00
223.600	25.136	25.141	0.178	24.178	24.00
230.000	25.138	25.145	0.178	24.178	24.00
240.000	25.143	25.155	0.178	24.178	24.00
250.000	25.148	25.160	0.178	24.178	24.00
260.000	25.154	25.172	0.178	24.178	24.00
270.000	25.159	25.181	0.178	24.178	24.00
280.000	25.163	25.184	0.179	24.178	24.00
290.000	25.166	25.187	0.216	24.178	23.96
295.734			0.205	24.178	23.97
300.000	25.168	25.190	0.214	24.178	23.96
310.000	25.171	25.195	0.222	24.178	23.96
320.000	25.174	25.201	0.205	24.178	23.97
330.000	25.177	25.203	0.181	24.178	24.00
340.000	25.178	25.204	0.098	24.178	24.08
350.000	25.178	25.204	0.107	24.178	24.07
354.064	25.178	25.204	0.088	24.178	24.09
359.064	25.178	25.204	0.055	24.186	24.13
360.000	25.178	25.204	0.038	24.189	24.15
364.064	25.178	25.204	-0.014	24.208	24.22
370.000	25.178		-0.047	24.244	24.29
377.863			-0.089	24.291	24.38
380.000	25.178		-0.098	24.304	24.40
390.000	25.178		-0.141	24.364	24.50
400.000	25.179	25.204	-0.073	24.424	24.50
410.000	25.179	25.205	-0.092	24.485	24.58
420.000	25.179	25.204	-0.107	24.545	24.65
430.000	25.180	25.204	-0.085	24.605	24.69
440.000	25.181	25.205	-0.083	24.665	24.75
450.000	25.182	25.206	-0.090	24.725	24.81
460.000	25.184		-0.097	24.785	24.88
470.000	25.188		-0.100	24.845	24.95
480.000	25.196		-0.093	24.905	25.00
490.000	25.207		-0.106	24.965	25.07
500.000	25.222		0.012	25.025	25.01
510.000	25.241		0.137	25.086	24.95
510.747	25.243		0.146	25.090	24.94

LONGITUDINAL SECTION - CL DRIVEWAY

HORIZONAL SCALE 1:500
VERTICAL SCALE 1:100

1m 0 1 2 3 4 5 6 7 8 9 10m
1:100 SCALE AT A0 SHEET SIZE

5m 0 10 20 30 40 50m
1:500 SCALE AT A0 SHEET SIZE

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	31.01.19	A

CLIENT
CADENCE
SUITE 2.02 785 TOORAK ROAD
HAWTHORN EAST VIC 3123
P: 03 9038 8686 F: 03 9888 1118

PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	MC	JULY '18		A0	AS SHOWN	C013620.00-DA52

Costin Roe Consulting Pty Ltd.
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Walsh Bay, Sydney NSW 2000
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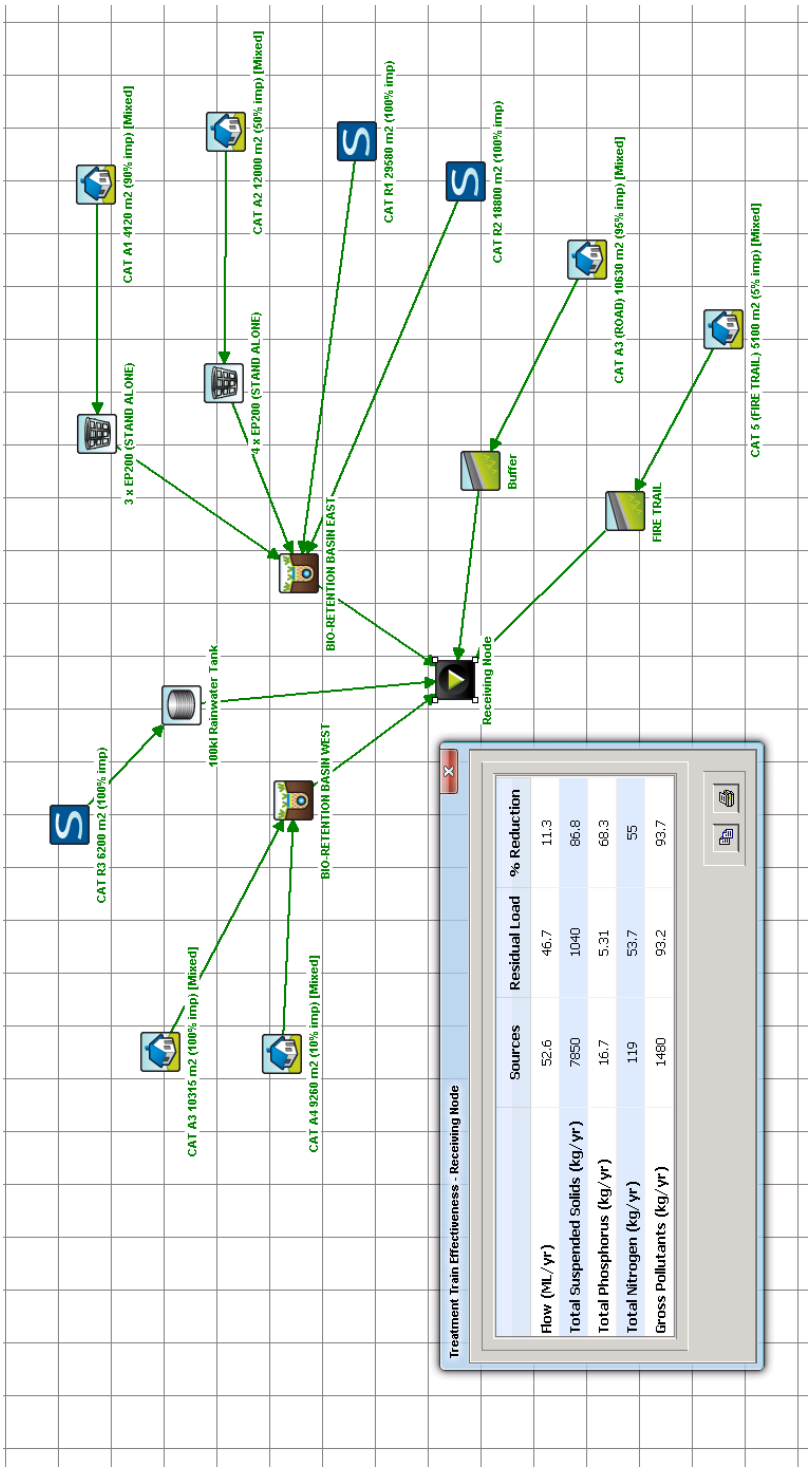
DRAWING TITLE
ACCESS DRIVEWAY
LONG SECTION

DRAWING No C013620.00-DA52 ISSUE A

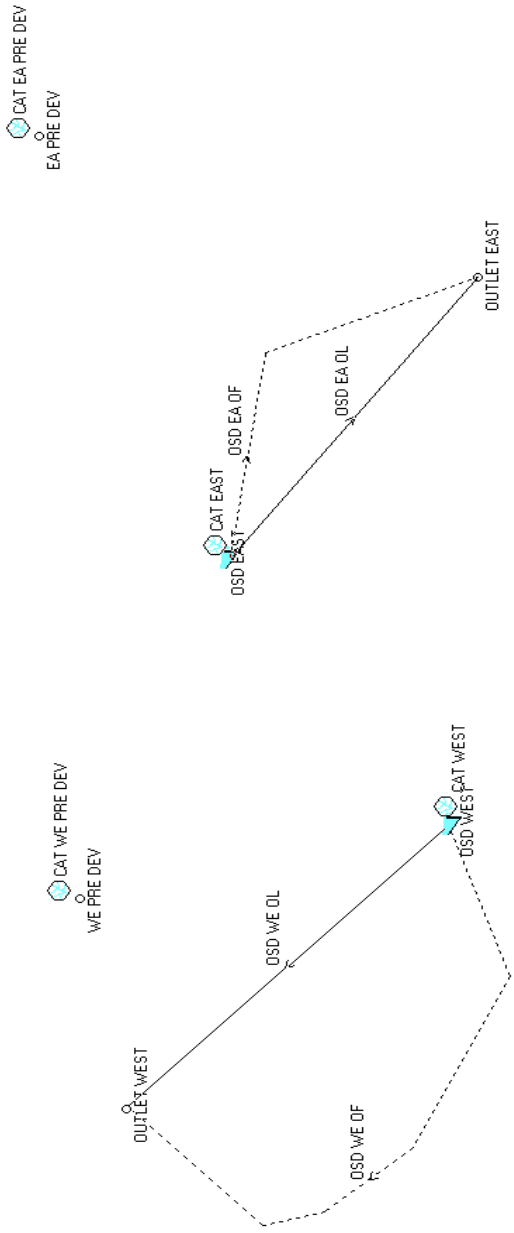
Appendix B

MUSIC MODEL CONFIGURATION & MUSIC LINK REPORT



Appendix C

DRAINS MODEL CONFIGURATION



Appendix D

EROSION CONTROL CHECK SHEET

EROSION AND SEDIMENT CONTROL

WEEKLY SITE INSPECTION SHEET

LOCATION . . . . . .

INSPECTION OFFICER . . . . . **DATE** . . . . . .

SIGNATURE . . . . . .

Legend: □ OK □ Not OK N/A Not applicable

Item	Consideration	Assessment
1	Public roadways clear of sediment.	. . . . .
2	Entry/exit pads clear of excessive sediment deposition.	. . . . .
3	Entry/exit pads have adequate void spacing to trap sediment.	. . . . .
4	The construction site is clear of litter and unconfined rubbish.	. . . . .
5	Adequate stockpiles of emergency ESC materials exist on site.	. . . . .
6	Site dust is being adequately controlled.	. . . . .
7	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	. . . . .
8	Up-slope "clean" water is being appropriately diverted around/through the site.	. . . . .
9	Drainage lines are free of soil scour and sediment deposition.	. . . . .
10	No areas of exposed soil are in need of erosion control.	. . . . .
11	Earth batters are free of "rill" erosion.	. . . . .
12	Erosion control mulch is not being displaced by wind or water.	. . . . .
13	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	. . . . .
14	Sediment fences are free from damage.	. . . . .
15	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	. . . . .
16	Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.	. . . . .
17	All sediment traps are free of excessive sediment deposition.	. . . . .
18	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	. . . . .
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	. . . . .
20	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	. . . . .
21	Stabilised surfaces have a minimum 70% soil coverage.	. . . . .
22	The site is adequately prepared for imminent storms.	. . . . .
23	All ESC measures are in proper working order.	. . . . .

Appendix E

Pre-Application Meeting Minutes

11 September 2018

Our Ref: PL18/0070
Contact: Wendy Connell
Telephone: (02) 4732 7908

11 September 2018

Willowtree Planning
100 Walker Street
NORTH SYDNEY NSW 2060

Dear Andrew

Pre-lodgement Advice
Proposed Warehouse & Distribution Facility & Related Subdivision & Bulk Earthworks
Lot 21 DP 1216618 & Lot 2 DP 787827, 15a Lambridge Place PENRITH NSW 2750

We welcome your initiative to undertake a project in the Penrith Area.

Thank you for taking part in Council's pre-lodgement meeting on 6 September 2018**.** The meeting was useful for Council in gaining an understanding of your proposal.

You are advised that should the items in the attached information be addressed, your application should be suitable for submission and consideration.

As I am sure you are aware, Council's full assessment and determination can only be made after you lodge an application.

If we can help you any further regarding the attached advice, please feel free to contact me on (02) 4732 7908.

Yours sincerely

Wendy Connell
Senior Development Assessment Planner

PROPERTY AND PLANNING INFORMATION	
Attendees	**Proponent** Andrew Cowan- Willowtree Planning Travis Lythall- Willowtree Planning Mark Wilson- Costin Rae Danielle Adams-Bennett – Eco Logical Australia Tim Lewis- Ason Group **Penrith City Council** Wendy Connell – Senior Environmental Planner Abby Younan- Planning Administration Officer Joshua Romeo – Senior Waste Planning Officer Craig Squires – Supervisor Fire Safety Stephen Masters – Senior Development Engineer Graham Green – Senior Traffic Engineer Paul Reynolds – Team Leader Environmental Health
Proposal	Warehouse & Distribution Facility & Related Subdivision & Bulk Earthworks
Address	Lot 21 DP 1216618 & Lot 2 DP 787827 15a Lambridge Place PENRITH NSW 2750
Zoning and permissibility	IN1 General Industrial - General Industrial under Penrith LEP 2010.
Site constraints	Flooding Easements Covenant/s Bushfire Prone Land (entirely)
Development type	Local Planning Panel

KEY ISSUES AND OUTCOMES

The proposal is to address the following issues:

RELEVANT EPI's POLICIES AND GUIDELINES

Planning provisions applying to the site, the provisions of all plans and policies are contained in **Appendix A**.

PLANNING

Warehouse & Distribution Centre (Lot 21 DP 1216618)

- The maximum height permitted under Clause 4.3 Height of buildings of Penrith

LEP is 12m.The current proposal exceeds this height limit and therefore would need to seek a Clause 4.6 Exceptions to development standards. The site is identified as having scenic and landscape values under clause 7.5 of Penrith LEP.

- The subject site is identified as 'land with Scenic and Landscape Values' under Clause 7.5 Protection of scenic character and landscape values. This proposal should be designed to minimise its visual impact from major roads and other public places. Design considerations should also consider external finishes and colour. A Visual Impact Analysis should support any development application.
- The external elevations need to be broken up by the use of building articulation, fenestration or other architectural treatments, varied materials and finishes for all external walls.
- The office space and entrance should be located near to the carpark.
- Signage should be integrated into the building design.
- A landscape plan prepared by a suitability qualified and experienced landscape professional is required.
- An operational management plan is required to support the 24 hour operation.
- The car parking controls in Penrith DCP 2014 is 1 space per 100 square metres. If a variation to this control is to be sought it will need to be addressed in the SOEE and justified in the Traffic and Parking Assessment.
- The SOEE will need to address how the development will minimise the visual impact of the development from major roads and public places as per clause 7.5 of Penrith LEP 2010.
- A Landscape Plan should support a development application and include tree planning in the car parking area.

Subdivision (Lot 2 DP 787827)

- The proposed subdivision of 1 lot into 21 (accessed via Castlereagh Road) would need to demonstrate that the lot sizes proposed would be able to support the permissible land uses in the IN1zone. This would need to include the built form requirements, turn paths for vehicles, setbacks and landscape areas.

ENVIRONMENTAL MANAGEMENT

Contamination

- The application will need to be accompanied by a contamination investigation report to demonstrate that the land is suitable for the proposed use. The report will need to be prepared by a suitably qualified and experienced consultant in accordance with relevant NSW EPA guidelines and NEPM 2013. I note that the Crane-Enfield site has plume of contaminated groundwater moving off-site and may impact on the proposed development, particularly the subdivision aspect of the proposal.
- Should remediation be required to make the suite suitable for the proposed use, a remediation action plan will also need to be submitted. This applies to the single building aspect and future subdivision.

Acoustics

- An acoustic assessment of the proposal needs to be provided to demonstrate that the proposed development complies with the NSW EPA's *Noise Policy for Industry* and NSW EPA's *Road Noise Policy*. This applies to both the single building and future subdivision aspects of the proposed development.

Fill Importation

- Given the amount of fill proposed to be imported as part of the development, a Fill Management Protocol will need to be provided. The FMP must detail the practices and procedures that will be implemented to ensure that only fill from suitable sources will be sourced, delivered to, and accepted at the site. This will be required for both the single building and future subdivision aspects of the proposed development if fill is going to be imported.

Hazardous Building Materials Assessment

- A HBMA will need to be submitted with the subdivision development application given that there will be a number of structures that will be demolished. As a minimum, the HBMA will need to identify where the types of hazardous materials found in the structures, where they are located, and how they will be managed to ensure the environment and community are protected from adverse impacts.

Odour

- I note the proximity of the proposal to the Sydney Water sewage treatment plant. Given this the site may be exposed to offensive odours. Table 2.1 of the NSW EPA's *Technical Framework: assessment and management of odour from stationary sources in NSW* requires that new developments take into account odour from existing sources. In addition, section 5.2 talks about the need to include potential odour impact assessment as part of subdivisions, where the land to be subdivided is likely to be affected by odour.

  As such, an odour assessment prepared in accordance with the NSW EPA's *Technical Framework: assessment and management of odour from stationary sources in NSW* needs to be submitted for both the single building and subdivision proposals.

Biodiversity

- A full flora and fauna assessment will be required to be undertaken for the site including an Assessment of Significance. If submitted to Council after 24th November, 2018 then the application will need to be in accordance with the requirements of the *Biodiversity Conservation Act 2016*.
- The applicant will need to consider any potential impacts on the Regionally Significant Wetland and associated flora and fauna including (but not limited to):
  - Stormwater runoff and Nutrients
  - Altered hydrological regime (including during floods)
  - Weed incursion
  - Noise
  - Light pollution
  - Groundwater impacts
- Preference is for access to the (Stage 1) site to be via Lambridge Pl as this would result in significantly reduced impacts on the native vegetation.
- A minimum buffer distance of 40m from the outer edge of the wetland (including any ephemeral areas) to any development activity.
- As this is a wetland that has been identified as Regionally Significant under SREP 20, a full assessment of the proposal against the objectives and requirements of SREP 20 is required.
- The 'moderated condition' wetland at the west of the site is proposed to be fully removed. This is contrary to the Penrith DCP and is not supported. I note the previous DA for this site did not propose removing this wetland.
- Lots 14,13 and 12 of the proposed future subdivision are not currently supported without further detailed assessment of potential impacts on the vegetation and

wetland.

- A landscaping plan will be required and is to use native species of local provenance only. Weed control/management may be required to manage potential spread into the wetland and RFEF (River Flat Eucalypt Forest).
- If clearing of RFEF is proposed, then mitigation or offset measures must be proposed.

ENGINEERING

General

- Council's engineering requirements for subdivisions and developments, including policies and specifications listed herein, can be located on Council's website at the following link: https://www.penrithcity.nsw.gov.au/Building-and-Development/Development-Applications/Engineering-requirements-for-developments/

- All engineering works must be designed and constructed in accordance with Council's *Design Guidelines for Engineering Works for Subdivisions and Developments* and Council's *Engineering Construction Specification for Civil Works.*
- A site survey plan is to be submitted and shall include levels upon adjoining properties, details along the access handle along with details of all drainage infrastructure. The survey plan shall also detail all existing easements and restrictions upon the title.
- The DA submission shall include land owner's consent from Lot 1 DP 747153 (No 126 Andrews Road) and Lot 3 747153 (No 112-124 Andrews Road – Penrith City Council).

Mainstream Flooding

- The site is affected by mainstream flooding from Nepean River.
- Council has undertaken a draft Nepean River Flood Study prepared by Advisian (Worley Parsons Services), dated 16 August 2017. The flood study is proposed to be adopted by Council towards the end of the year. The draft flood study report, appendices and maps are available from Council's website at the following link: https://www.yoursaypenrith.com.au/draft-nepean-river-flood-study-public-exhibition

- Any development shall require the submission of a flood study to assess the impact of the proposed development upon flood flow conveyance through the site for the 1% AEP and 0.5% AEP Nepean River flood events. Assessment of local overland flows is also to be undertaken. The study shall include flood level difference mapping and an assessment of safe velocity / depth ratios through the site and along the access handle.
- Flood safe evacuation access for the 1% AEP flood is to be provided from the development site.
- The development shall not have any adverse flood impacts upon adjoining properties.
- All plans for the site shall have levels and details to AHD.
- The application must demonstrate that the proposal is compatible with the State Government Floodplain Development Manual and Council's Local Environmental

Plan and Development Control Plan for Flood Liable Lands.

- All habitable floor levels shall be a minimum of 0.5m above the 1% AEP flood event.
- A previous development application upon the site by Iplex Pipelines approved under DA13/1174 included a flood study for the site prepared by Worley Parsons (reference 301015-02973-IPLEX FIA, dated 18 September 2014).

Stormwater

- Stormwater drainage for the site must be in accordance with the following:
  - Council's Development Control Plan,
  - *Stormwater Drainage Specification for Building Developments* policy, and
  - *Water Sensitive Urban Design Policy* and *Technical Guidelines.*
- A stormwater concept plan, accompanied by a supporting report and calculations, shall be submitted with the application
- The application shall demonstrate that downstream stormwater systems have adequate capacity to accommodate stormwater flows generated from the development. This may require the provision of on-site detention to reduce stormwater flows or upgrade of stormwater infrastructure to increase capacity.
- On-site Stormwater Detention (OSD) will be required for the western catchment of the site. The Site Storage Rate (SSR) is 280cbm/Ha with a Permissible Site Discharge (PSD) of 120L/s/Ha.
- A water sensitive urban design strategy prepared by a suitably qualified person is to be provided for the site. The strategy shall address water conservation, water quality, water quantity, and operation and maintenance.

Access

- The applicant is to consult with the adjoining land owner of Lot 1 DP 747153 (No 126 Andrews Road) regarding the upgrade of the driveway access off Andrews Road, including the upgrade of drainage culverts and any road works within Andrews Road.

Earthworks

- No retaining walls or filling is permitted for this development which will impede, divert or concentrate stormwater runoff passing through the site.
- Earthworks and retaining walls must comply with Council's Development Control Plan.
- Proposed fill material must comply with Council's Development Control Plan.
- The application is to be supported by a geotechnical report prepared by a suitably qualified person and should include, but not be limited to, the following items; ground water movement, salinity and contamination.

Subdivision Works

- The application is to be accompanied by a subdivision concept plan.
- The subdivision layout shall be in general accordance with Council's Development Control Plan.
- The width and design of the access handles shall be in accordance with Council's Development Control Plan.
- The subdivision shall be deigned to ensure adequate access and turning paths

are provided for Council's waste collection vehicles.

Traffic

- Castlereagh Road and Andrews Road are RMS classified roads and will require referral to the RMS under SEPP Infrastructure.

- A traffic, access and parking assessment is requested. This is requested to include consultation with the RMS Land Use Section with regard to the RMS requirements for this assessment including Castlereagh Road and Andrews Road intersection works that conform to current and proposed future RMS road widths and alignments.

- Council request that the assessment include a traffic impact assessment of the intersections of Castlereagh Road / Proposed Sub-division Access Road and Andrews Road / Proposed Warehouse Access Road. This should include traffic modelling assessments using SIDRA at these two intersections and assessment of level of service, delays, queue lengths at these intersections and required intersection treatments to accommodate traffic growth to at least 10 years in the future.

- The Traffic, Access and Parking assessment is requested to include advice regarding the type and volume of heavy vehicles accessing the development, management of combined access with existing developments to the east and west on Andrews Road, assessment of bicycle parking, bicycle end of journey facilities, staff and visitor parking and heavy vehicle access and turning swept paths in accordance with AS 2890.1, AS 2890.2, AS2890.3, AS2890.6, AS1428, RMS guidelines and Council Development Control Plan (DCP) C10. Please note that Council DCP C10 Section 10.7 requires provision of secure, accessible, all weather bicycle parking and end of journey facilities (showers, change rooms, lockers) in accordance with Planning Guidelines for Walking and Cycling (NSW Government 2004). Please also note that any proposed reduction in parking space numbers from that set out Council's DCP C10 is requested to be supported by assessment of similar existing developments and parking numbers such as those in Erskine Park Industrial Area and provision of additional parking to allow for potential changes of use in the future.

- The proposed road and sub-division off Castlereagh Road would result in small, narrow lots which would not be suitable for heavy vehicle access and manoeuvring and would not be likely to be supported in the form presented. Other access and lot arrangements are requested to be considered including reconsideration of the proposed warehouse location and lot because it restricts options for possible consolidation and lot / access rearrangements to provide larger, more suitable industrial sub-division lots. Any access from Castlereagh Road would be preferable to be a private driveway access and a shorter private access road. Council would then not inherit the road, drainage, street lighting etc. asset liability for infrastructure that only services the development lots.

BUILDING

- Access to and within the building will need to comply with Part D3 of the BCA

and AS1428.1-2009

- Ensure accessible car parking spaces are located close to the main building
- Hydrant protection and possibly sprinkler protection of the building will be required in accordance with Section E of the BCA, it would be advisable to make enquiries now in consultation with a hydraulic engineer
- Ensure construction and essential services provided comply with the provisions of Volume 1 of the Building Code of Australia and relevant standards

WASTE

The current proposal will consist of a warehouse/distribution facility, access road and subdivision. The waste collection infrastructure is required to be amended in accordance with the specifications outlined below:

Commercial Waste Management

The commercial on-site waste infrastructure is to be built in accordance with the provisions outlined in section 2.2.1 of the 'Residential Flat Building Guideline' document:

To allow for the safe and efficient collection of a various waste streams within commercial developments, on-site collection is required in accordance with section 2.2.1 and wider provisions outlined in section 2.2 of the 'Residential Flat Building Guideline' document.

Commercial developments to provide on-site collection infrastructure in accordance with section 3.5.2 Waste Collection Rooms of the 'Residential Flat Building Guideline' document. Room size to be built in accordance with generation rates outlined in the 'Commercial Waste Generation Rates Guideline' document.

All development applications to be submitted with an accompanying 'Plan of Operations', outlining proposed:

- Bin Infrastructure Sizes
- Collection Frequency
- Waste Collection Vehicle Dimensions
- Hours of Collection
- Access to Waste Collection Room

The following is required to be addressed in amended plans submitted to council for review

Note: The application proposed a subdivision on the adjacent lot. The proposed lot sizes are to reflect the ability of each individual lot to permit on-site waste collection in accordance with section 2.2.9 of the 'Residential Flat Building Guideline' document.

Waste Infrastructure Guidelines
For further specific waste operational and infrastructure information please see "Waste Guideline Document: Residential Flat Buildings" located at the following link: https://www.penrithcity.nsw.gov.au/Building-and-Development/Development-Applications/Forms/

Documents to be submitted with development application	▪ Survey Drawing ▪ Site Plan ▪ Floor Plan(s) ▪ Elevation and Section Plans ▪ Statement of Environmental Effects ▪ Stormwater Concept Plan ▪ Waste Management Plan ▪ WSUD Strategy ▪ Landscape Plan ▪ Traffic and Parking Assessment Report ▪ Contamination Assessment (in SEE) ▪ Schedule of External Materials and Finishes ▪ Access Statement ▪ Signage Details (if proposed) ▪ Operational Plan of Management ▪ Acoustic Report / Statement ▪ Flora and Fauna assessment ▪ Odour assessment ▪ Geotechnical Report ▪ Flood Study ▪ 1 x hard copy and 1 x PDF digital copy (additional copies required if integrated development) of your development application Please refer to Council's Development Application checklist, as attached, for further details of submission requirements and ensure that plans submitted illustrate consistent detail. Please ensure you contact Council's duty officer on 4732 7991 to make an appointment for lodgement of this application.
Fees	Please call the Development Services Department Administrative Support on (02) 4732 7991 to enquire about fees and charges.

APPENDIX A

- Sydney Regional Environmental Plan no 20 – Hawkesbury Nepean River (No 2 - 1997)
- State Environmental Planning Policy. No 55 – Remediation of Land
- State Environmental Planning Policy (Infrastructure) 2007
- Penrith Local Environmental Plan 2010
- Penrith Development Control Plan 2014

Important Note

The pre-lodgement panel will endeavour to provide information which will enable you to identify issues that must be addressed in any application. The onus remains on the applicant to ensure that all relevant controls and issues are considered prior to the submission of an application.

Information given by the pre-lodgement panel does not constitute a formal assessment of your proposal and at no time should comments of the officers be taken as a guarantee of approval of your proposal.

It is noted that there is no Development Application before the Council within the meaning of the Environmental Planning and Assessment Act 1979. This response is provided on the basis that it does not fetter the Council's planning discretion and assessment of any Development Application if lodged. It is recommended that you obtain your own independent expert advice.

The response is based upon the information provided at the time of the meeting.

Appendix F

Flood Assessment

F.1 INTRODUCTION

F.1.1 Introduction

The site has been identified by Penrith City Council as being flood affected during the 1% AEP and 0.5% AEP flood events. These events are associated with overbank flooding from the Nepean River which is approximately 1km west of the development site. Reference to the *Nepean River Flood Study, Exhibition Draft Report* (16 August 2017) completed for Penrith City Council by Advisian, has been made and consultation with Councils flooding engineer Mr Myl Senthilvasan (refer Appendix G) regarding the localised assessment relating to this project. We understand the study will be adopted by Council toward the end of 2018 following minor technical updates to the hydraulic output.

Council has requested (as part of the pre-application minutes) the following to be included in the development application documents:

- *Any development shall require the submission of a flood study to assess the impact of the proposed development upon flood flow conveyance through the site for the 1% AEP and 0.5% AEP Nepean River flood events. Assessment of local overland flows is also to be undertaken. The study shall include flood level difference mapping and an assessment of safe velocity / depth ratios through the site and along the access handle.*
- *Flood safe evacuation access for the 1% AEP flood is to be provided from the development site.*
- *The development shall not have any adverse flood impacts upon adjoining properties.*
- *The application must demonstrate that the proposal is compatible with the State Government Floodplain Development Manual and Council's Local Environmental*
- *Plan and Development Control Plan for Flood Liable Lands.*
- *All habitable floor levels shall be a minimum of 0.5m above the 1% AEP flood event.*

Appendix F presents the analysis of the impact of the development on existing flooding has been completed to confirm no affectation on upstream, downstream and adjoining properties in both the 1% AEP and 0.5% AEP events and to confirm the proposed building will meet flood immunity and flood planning requirements as noted above.

Data has been obtained from a number of sources and includes information required for input to the numerical models, together with information required for validation of model results and the adequate representation and presentation of those results.

F.1.2 Survey/ DTM

Survey is required to define the physical attributes of the floodplain topography including the creek cross sections and the associated floodplain levels.

The pre-development scenario survey has been compiled based on information obtained through government sources in the form of ALS survey information. The

on-ground survey information was completed in and around the study area to properly define the existing overland flow path cross section and features.

The proposed development levels were then added to the pre-developed survey surface to create a post developed surface to use in the TUFLOW model and scenario modelling. This DTM was inputted into the TUFLOW model to simulate land filling and proposed compensation areas in and around the flood affected land.

The surveys and design surfaces were used as the basis for the digital terrain model (DTM) used in the hydraulic modelling of the pre and post development scenario respectively.

F.1.3 Previous Studies

A previous study of Reference to the *Nepean River Flood Study, Exhibition Draft Report* (16 August 2017) completed for Penrith City Council by Advisian (formerly Worley Parsons). As noted above, we understand the study will be adopted by Council toward the end of 2018 following minor technical updates to the hydraulic output. Consultation was made with Councils flooding engineer Mr Myl Senthilvasan (refer Appendix G) regarding the localised assessment relating to this project. We understand the minor changes to the council study to not affect the hydraulic output in and around the development site and that the draft flood study should be used to validate the localised assessment required for this development. As such downstream boundary levels, flows and flood levels from the Nepean River study were utilised to calibrate and validate the model completed by Costin Roe Consulting.

It is also noted that a previous development application upon the site by Iplex Pipelines approved under DA13/1174 included a flood study for the site prepared by Worley Parsons (reference 301015-02973-IPLEX FIA, dated 18 September 2014). The 2017 Nepean River study, completed by the same consultants, precedes the 2014 study and although the 2014 study provides good background information has not been utilised in our assessment.

The 2017 *Nepean River Flood Study* was utilised to validate hydrological and flood surface results produced in our assessment for the pre-developed condition. It can be seen when comparing the flood depth results of the Costin Roe Consulting model with the output from the 2017 Flood Study that the results are generally consistent and that the Costin Roe Consulting model is suitable for use in modelling post development scenarios.

F.2 CATCHMENT INVESTIGATION & HYDROLOGY

F.2.1 Contributing Catchment Definition

The Nepean River is located approximately 800 metres west of the proposed site. The river flows south to north through Penrith until it reaches the Penrith Lakes Scheme and International Regatta Centre, at which point it veers sharply west. This change in direction of the river is located directly west of the development site.

Due to the location of the site in close proximity to the Nepean River there is potential during large floods for floodwaters to overtop the banks of the river and inundate the adjoining floodplain and parts of the site. Detailed two-dimensional modelling completed as part of the *Nepean River Flood Study* indicated that extensive flooding will occur across areas east of Castlereagh Road where the site is located.

The contributing catchment associated with the site flooding is associated with the overtopping with the Nepean River banks and has been extrapolated from the Table 7 of the *Nepean River Flood Study* as a percentage of the total flow within the Nepean River floodwaters.

F.2.2 Hydrological Assessment of Existing Catchment

Flood hydrographs for the different flood events were required to be confirmed. Utilising the flood hydrograph defined in *The Nepean River Flood Study* in Table 7, a percentage of the total flow is shown overtopping the river banks at Castlereagh Road. This percentage was applied to the overall Nepean River flood hydrograph to model flows affecting the proposed site. Inflow hydrographs were extrapolated for the 1% AEP and 0.5% AEP events as shown in **Figure F1** and **Figure F2**. Local rainfall was not considered in this assessment and the inflow hydrograph only allows for flooding from the Nepean River.

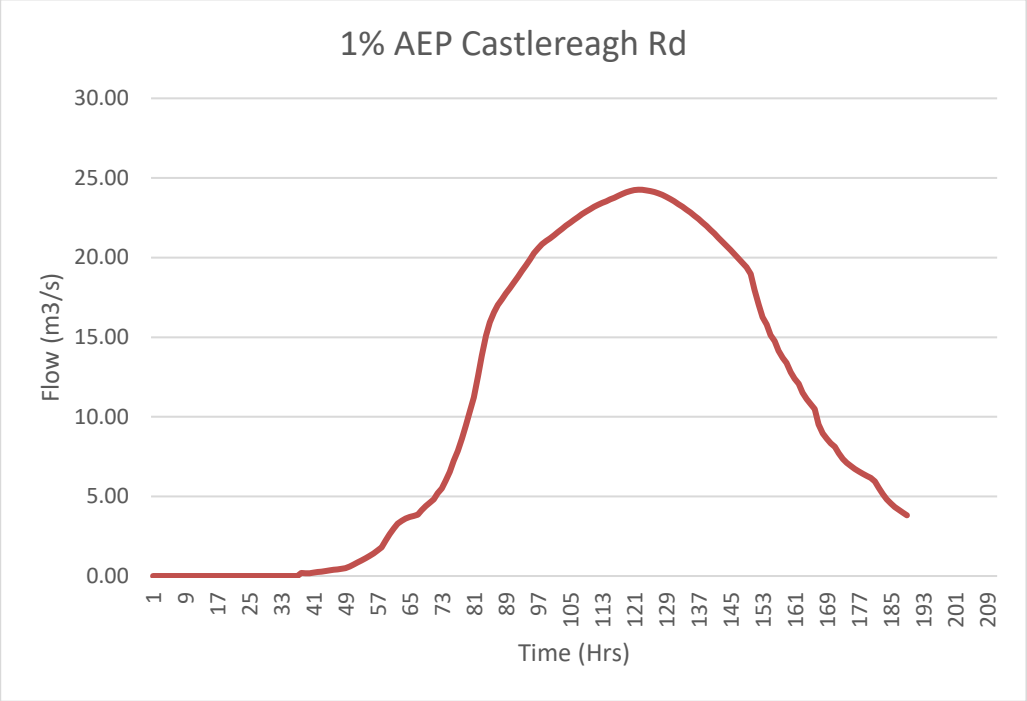


Figure F1 1% AEP Inflow Hydrograph

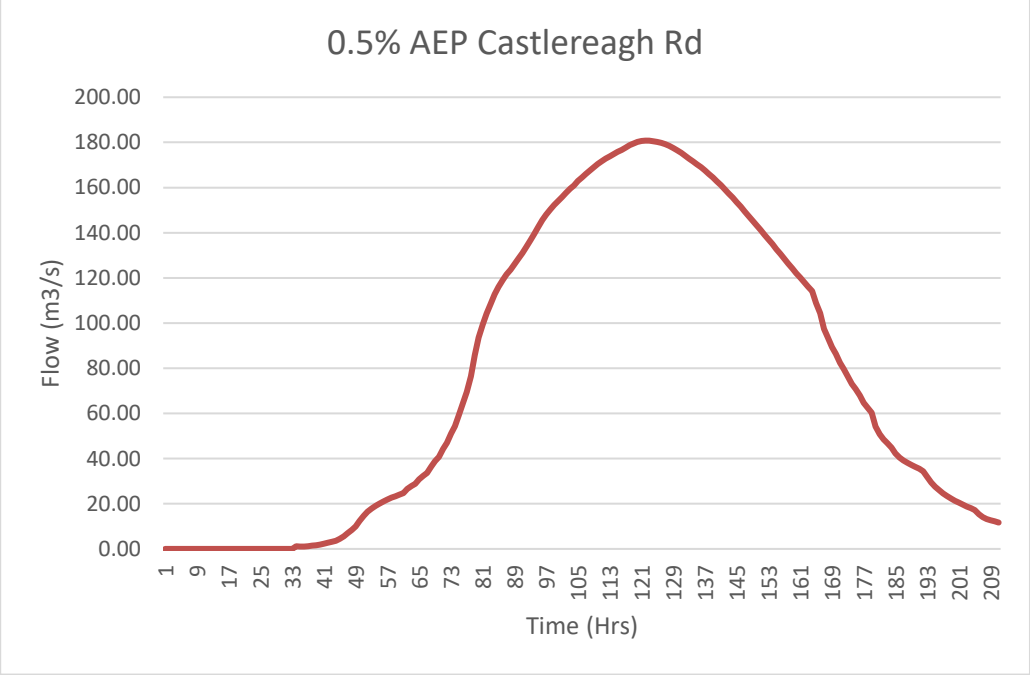


Figure F2 0.5% AEP Inflow Hydrograph

F.3 HYDRODYNAMIC MODEL DEVELOPMENT

F 3.1 Extent and Topography

The model extent is shown in **Figure F.9** of this appendix. The model begins approximately 920m upstream of the development and extending approximately 520m to the north.

F.3.2 Boundary Conditions

Inflow Boundaries

Design inflow hydrographs for the model have been included at a location approximately 920m upstream of the development site with the flows based on hydrology as discussed in **Section F.2** of this Appendix.

The upstream boundary was located sufficiently upstream of the development to ensure the extent of predicted impacts from the development would be covered and any modelling iterations would be resolved clear of the development affectation zone.

Downstream Water Level Boundaries

Downstream boundary location has been included at a distance of approximately 520m downstream of the study area. The downstream water levels have been based on flood levels included in the *Nepean River Flood Study* as follows:

AEP	Boundary Level (m)
1%	24.0
0.5%	25.0

Table F2. Downstream Boundary Water Levels.

Refer **Figure F.3** on following page.

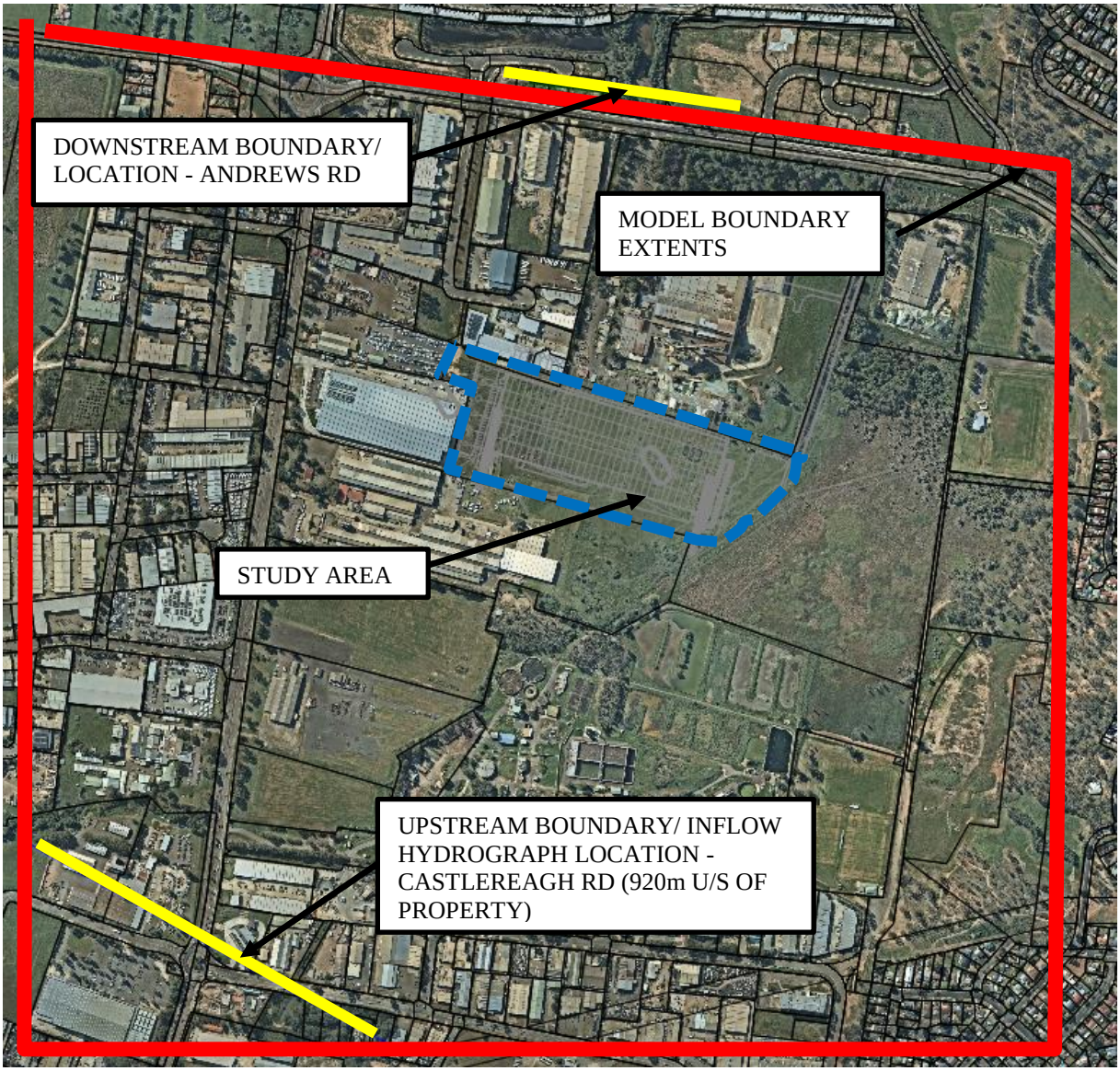


Figure F3. Model Extent and Model Boundary Locations

F.3.3 Channel and Floodplain Roughness

Roughness values adopted in the model are contained in **Table F3** below. These are generally consistent with those included in the *Table 2* of the *Nepean River Flood Study*, except where adjusted to ensure validation of model results and achieving consistency with the results of the *Nepean River Flood Study*.

Table F3. Adopted TUFLOW Element Roughness Values

Model Element	Description	Roughness Parameter Value (Nepean River Flood Study	Roughness Parameter Value (TUFLOW Study)
1	Grassland	0.04	**0.04**
2	Bushland	0.05	**0.05**
3	Roads	0.03	**0.03**
4	Buildings	Block Out	**10.0**
5	Industrial Area	0.07	**0.07**

A figurative representation of where the above roughness values have been applied can be found in **Figure F4.**

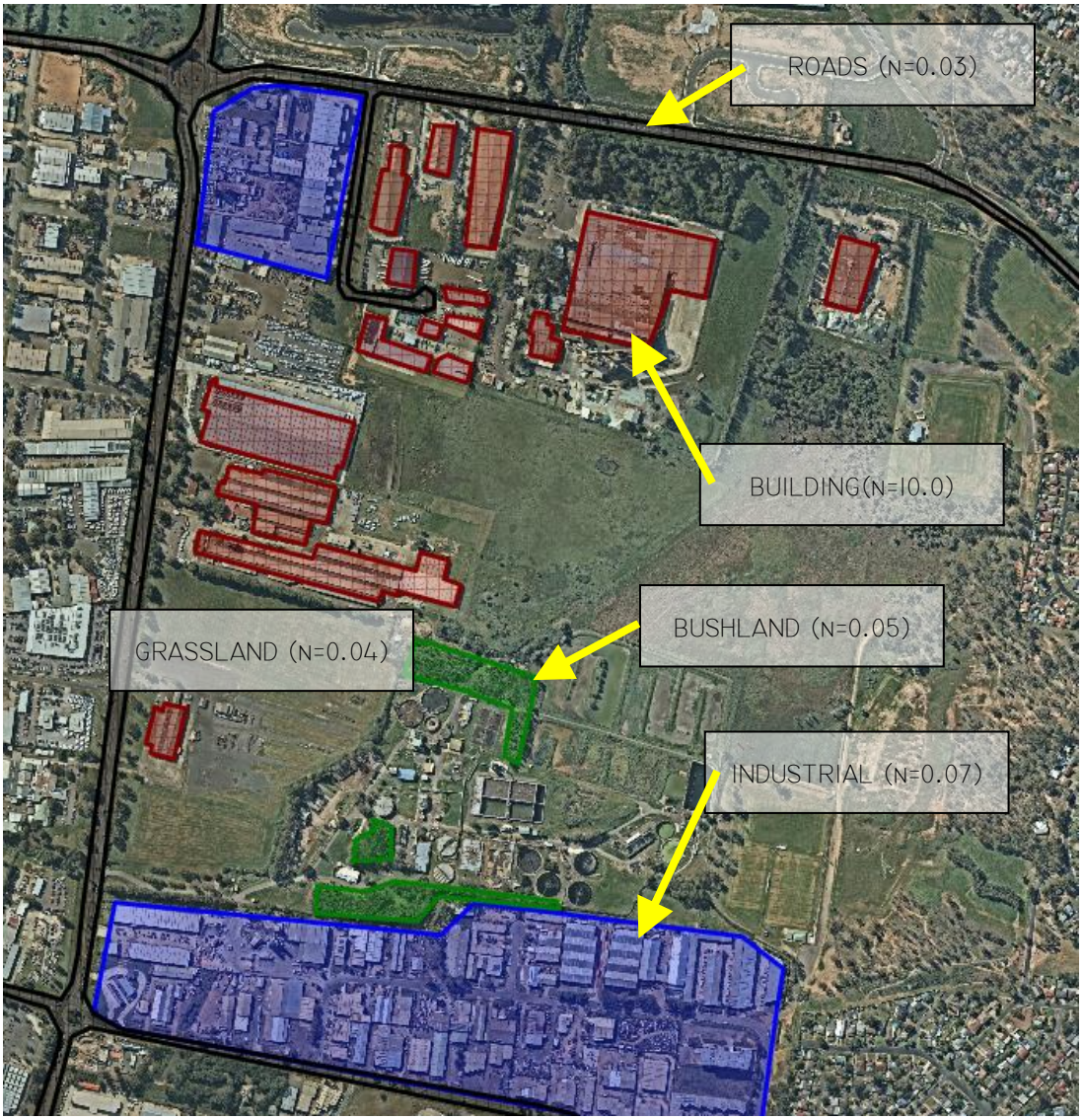


Figure F4 Manning's Roughness Surface Areas

F.3.4 Model Validation

Model validation has been completed by comparing results of the TUFLOW modelling against the results contained in the *Nepean River Flood Study* and adjusting as required to achieve good agreement between the two models. The process for the validation was as follows:

- Establish hydrology, peak flows and hydrograph for modelled events;
- Establish TUFLOW Model using defined parameters;
- Compare results of TUFLOW modelling with South Creek Study including flood depths, flood levels (taking into account the use of consistent DTM's), flood extents and hydraulics. The comparison is made at the peak of the predicted parameters;

- Adjust roughness factors to align TUFLOW flood depths and to within 100mm of *Nepean River Study* Results.

Hydrology and peak flows were established as described in **Section F2** of this report. The hydrological information used in the TUFLOW model is consistent with those of the Nepean River Study.

A number of trial models and iterations of the TUFLOW model were performed. Adjustment of roughness parameters were used to align the flood levels with those compiled in the Nepean River Study.

The comparison of the flood level results shows good alignment of those produced in the TUFLOW model when compared with those of the Nepean River Study. Flood water levels were seen to have a difference less than 100mm and generally in the order of 30-70mm through the floodplain areas. The predicted flood extent is consistent between the two models for the different flood events modelled.

Given the differences in modelling techniques, parameters, predicted model accuracy (+/-200mm) and model components these differences are considered acceptable for the base model and for continuation of post-developed scenario modelling.

F.4 MODEL OUTPUT

Model output for pre and post development conditions for the Nepean River flooding events as discussed in earlier sections have been included in the following Figures.

We note figures represent predicted values at the peak of each event.

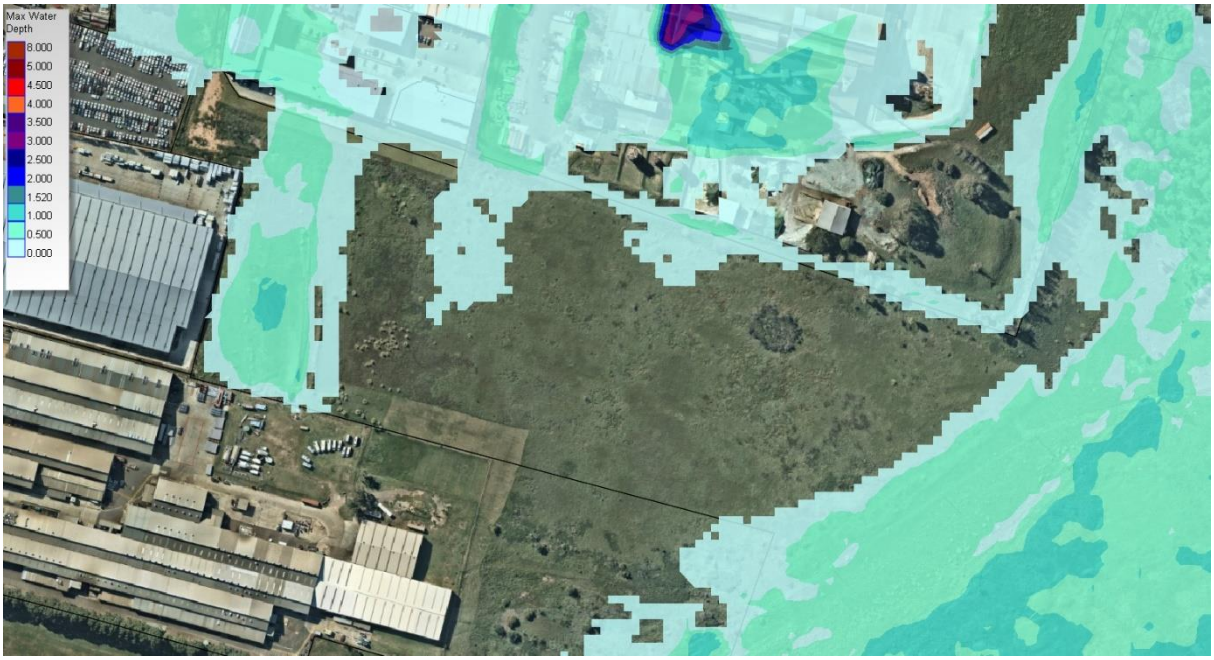


Figure F5 – 1% AEP Flood Depths – Pre-Development

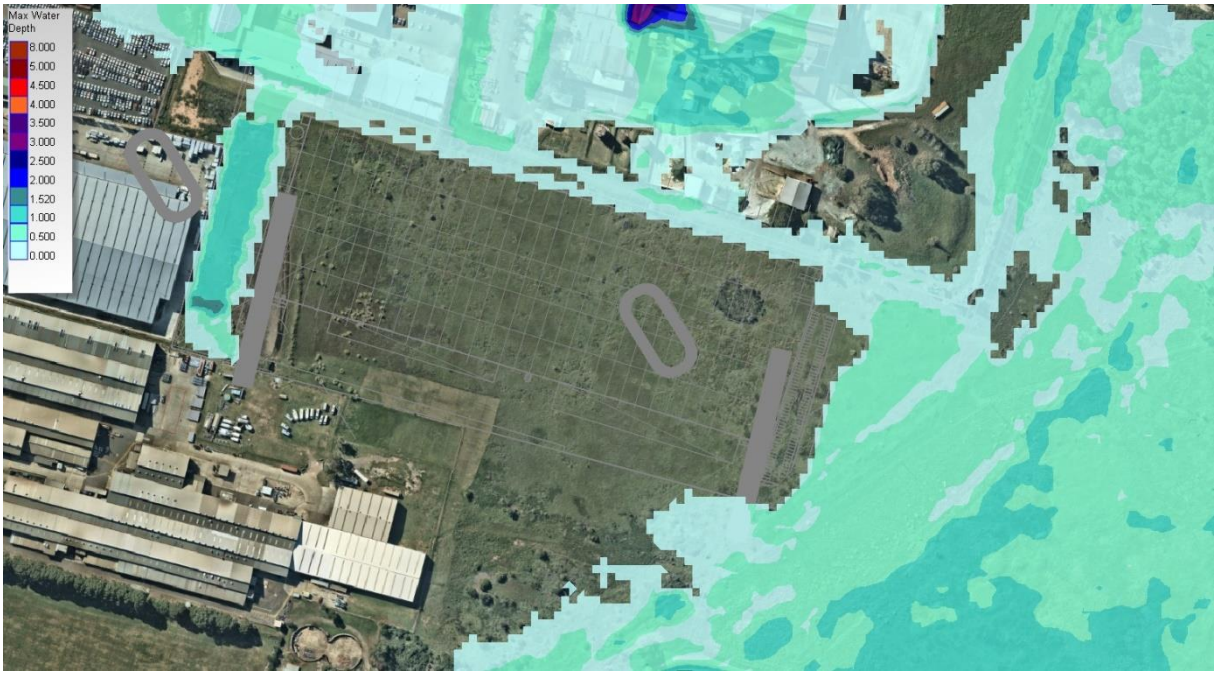


Figure F6 – 1% AEP Flood Depths – Post Development

Figure F7 – 1% AEP Flood Levels – Pre-Development

Figure F8 – 1% AEP Flood Levels – Post Development

Figure F9 – 1% AEP Flood Velocity – Pre-Development

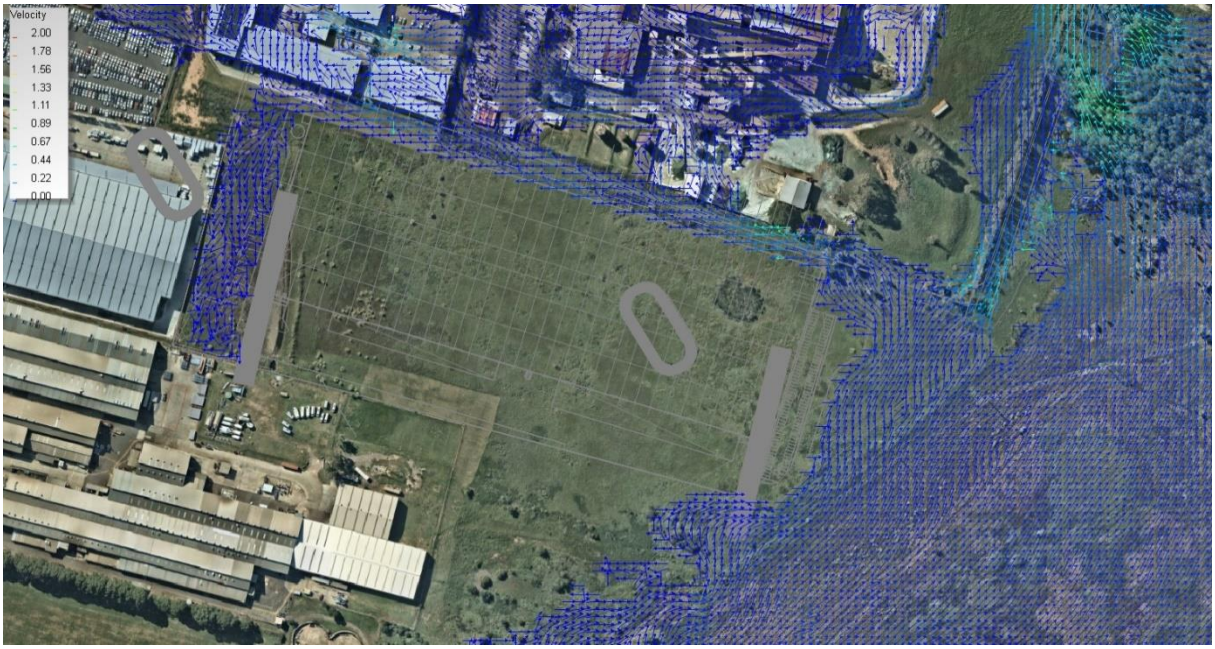


Figure F10 – 1% AEP Flood Velocity – Post Development

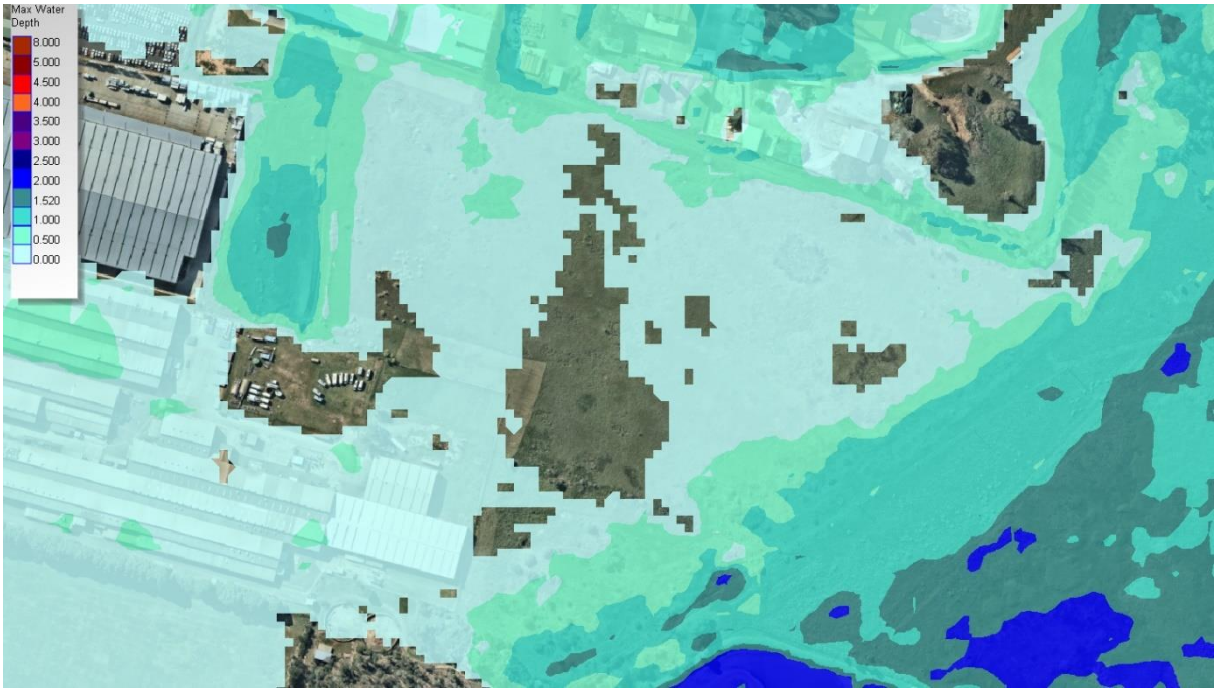


Figure F11 – 0.5% AEP Flood Depth – Pre-Development

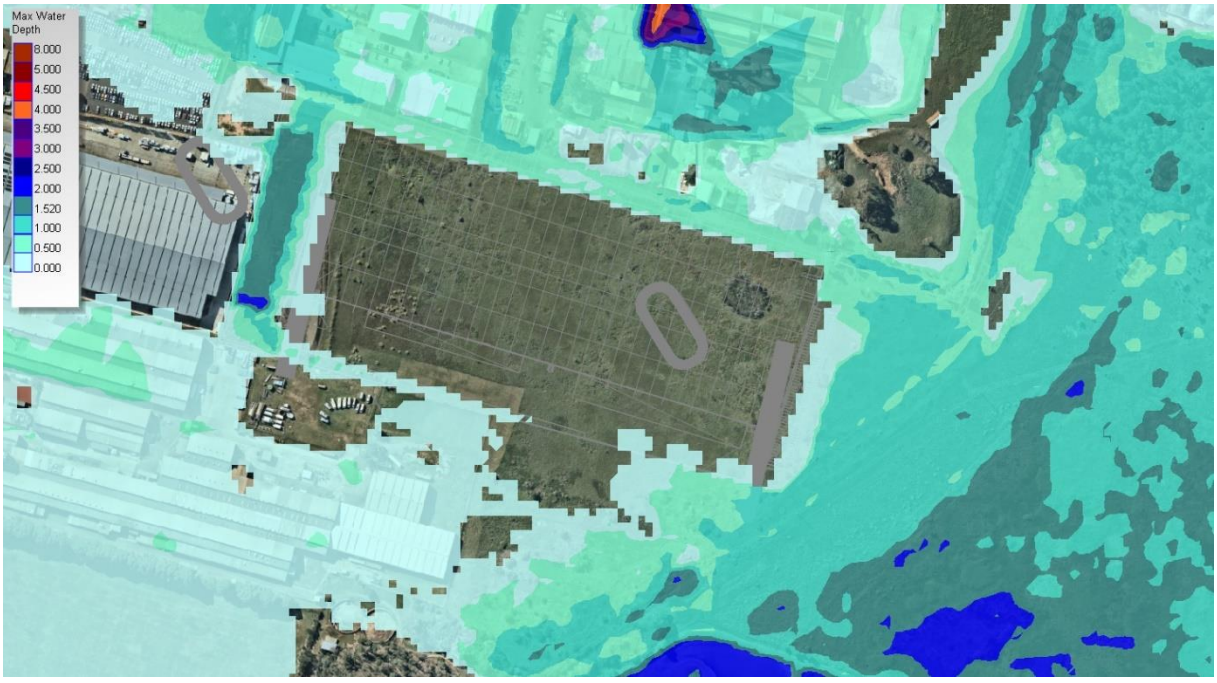


Figure F12 – 0.5% AEP Flood Depth – Post Development

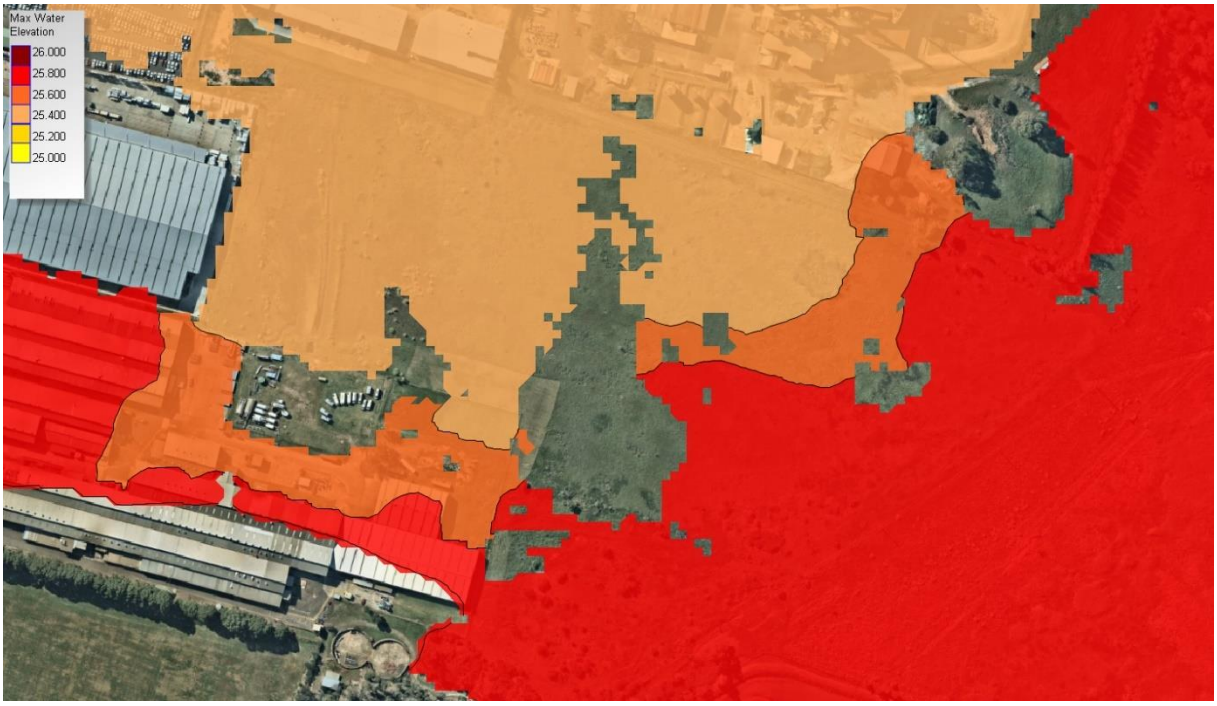


Figure F13– 0.5% AEP Flood Level – Pre-Development

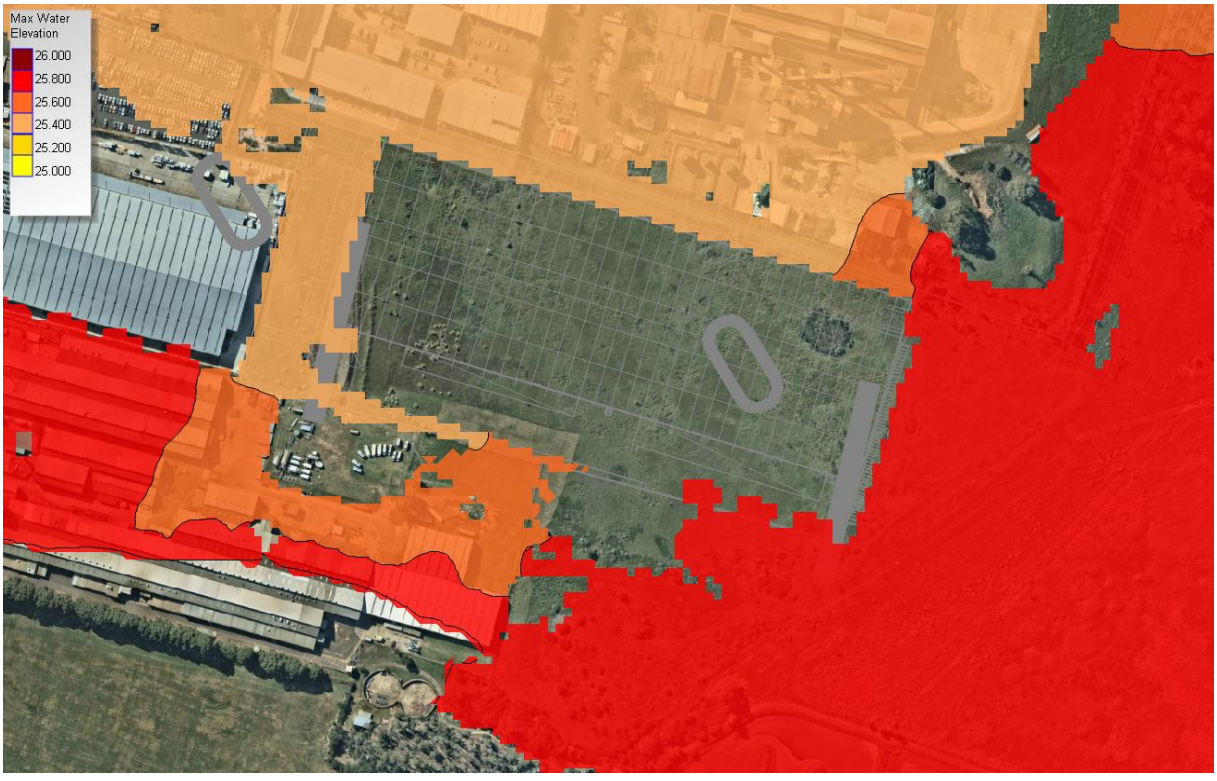


Figure F14 – 0.5% AEP Flood Level – Post Development

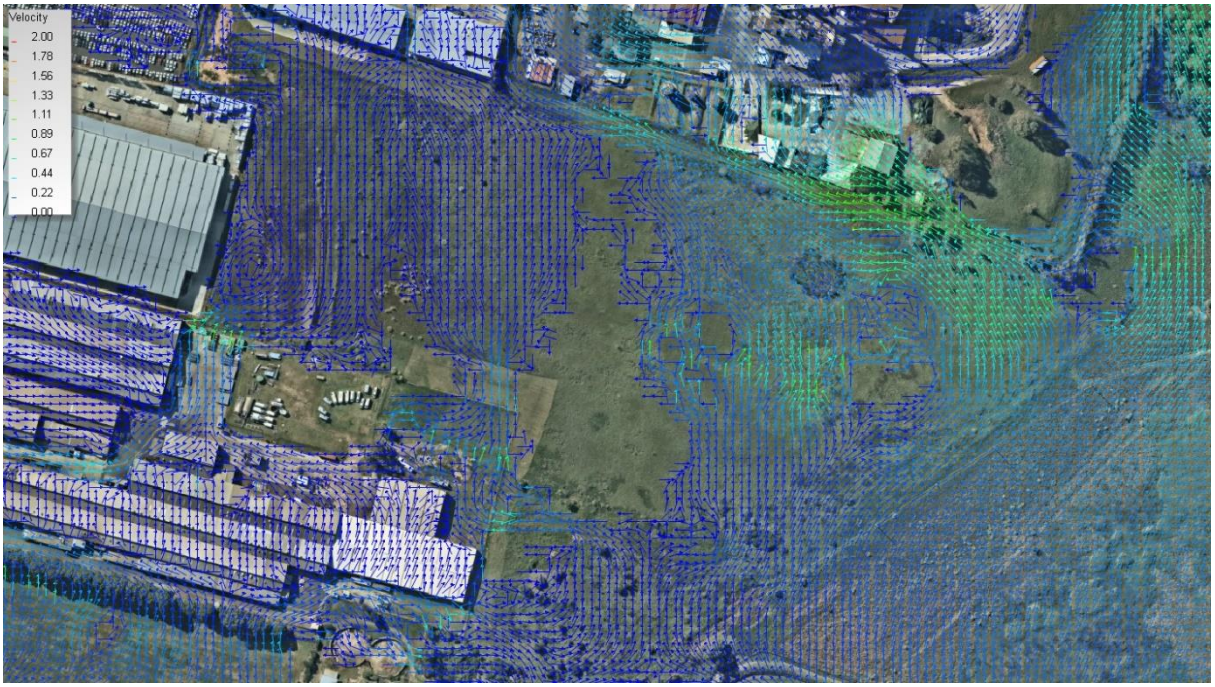


Figure F15 – 0.5% AEP Flood Velocity – Pre-Development

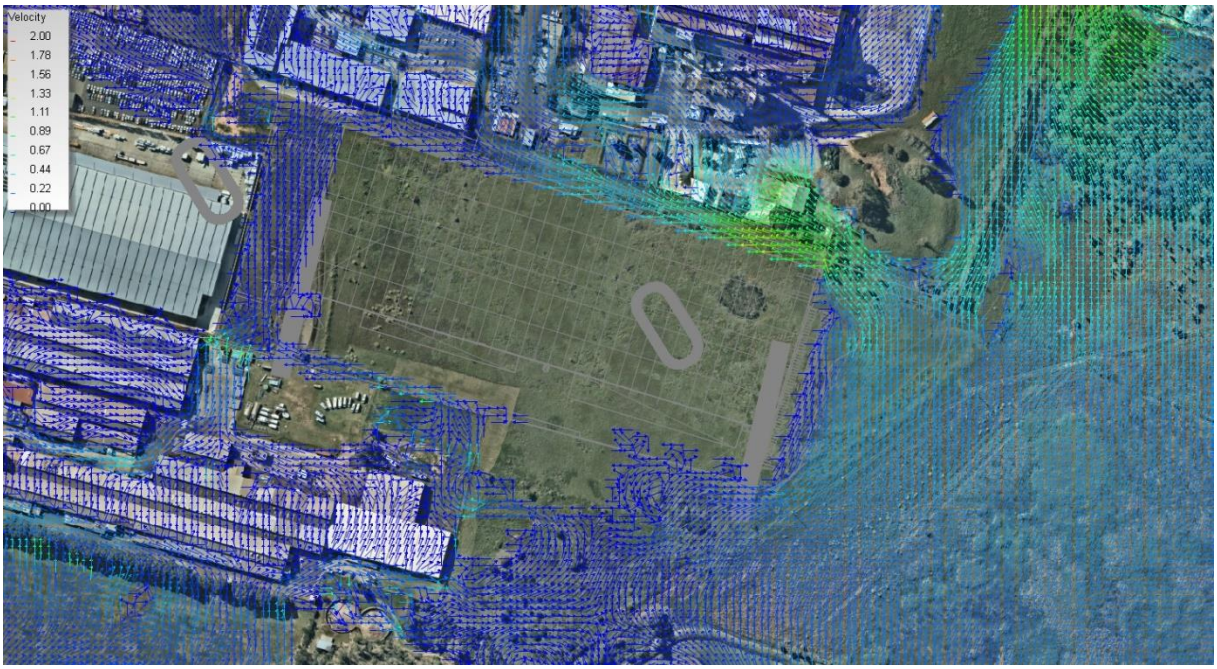


Figure F16 – 0.5% AEP Flood Velocity – Post Development

F.5 FLOOD SAFETY AND EVACUATION

F5.1 Introduction

This section of the report presents the relevant information in relation to egress and evacuation during the approach of a significant flood event.

This framework has been completed with consideration to the State Emergency and Rescue Management Act 1989 (NSW), the State Emergency Service Act 1989 (NSW), and the Penrith City Council Local Flood Plan 2012. The analysis is based on modelling results, prepared as part of the Nepean River Flood Study, and review of evacuation procedures outlines in the Hawkesbury River Flood Emergency Sub Plan 2014. The Sub Plan indicates that flood warnings and evacuation planning across the site would be based on monitoring of the Victoria Bridge Flood Gauge.

F5.2 Preparedness

Development of Warning Systems

The proposed facility should have a facility specific plan which sets out flood warden, evacuation zones and responsible persons. As noted the advice in this report can be used as a framework for these site-specific plans, in conjunction with Penrith Council and SES sub plans as required.

The NSW SES Penrith Local Controller is responsible for monitoring the flood risk over the area and for issuing flood warnings to the community. Any person or group occupying the precinct at the time of flood danger should adhere to any warnings issued. The warning message will normally be issued via SMS (phone text) by the SES. During periods of heavy or forecast heavy rainfall it is important that one or some of the occupants of a facility should be able to receive such messages. The occupants must then immediately follow the flood evacuation plan in this report or the instructions of the SES controller in the area.

As described in **Section F5.3** below, the SES Warning System is based on gauges on the Nepean River. This river directly increases flood levels around the proposed site. The SES system will provide good initial guidance, however in addition to the SES flood warning system, it is recommended that an in-house or precinct wide warning system also be employed to cover more localised flood events.

If an SES warning message has not already been issued, the recommended flood evacuation actions within this flood evacuation framework should be followed when the water level meets or exceeds the 5% AEP depth marker and be placed on alert at the 10% AEP depth.

Preparation Steps

It is the responsibility of the occupants of the each facility to understand the risks and dangers of flooding across the precinct, and the need to evacuate in such an event.

It is recommended that the users of the each facility are registered to able to receive flood warning messages via SMS from the NSW SES.

Lastly, the evacuation framework, including the evacuation route, contained in this report must be understood and adapted to each specific facility. It is recommended that a copy or copies of this route and plan are kept at several locations on site such as the maintenance manager, and office administrator.

5.3 Flood Response

Start of Response Operations

The response operations by the SES will begin once a trigger is prompted.

- On receipt of the first of a Bureau of Meteorology Flood Watch, Preliminary Flood Warning or Flood Warning for the Nepean River;
- When other evidence leads to an expectation of flooding within the Penrith local government area.

First triggers by SES will be when the flood gauge on Victoria Bridge Reaches RL 22.0m AHD.

Response Strategies

Following the reception of a warning message, the response operations should commence. This normally begins with necessary property protection for the site. This could include sandbagging, moving any furniture, machinery or stock that may be affected by flood levels greater than flood planning levels allow for. As noted all developed land has been sited at the 0.5% AEP flood level plus 500mm freeboard or higher, so this step may not be necessary and individual plans should be made for the facility to ensure damage to property is minimised.

As shown in Figure F17 it is recommended that evacuation of the site be directed through the proposed access driveway to the north to Andrews Road. Once on Andrews Road, evacuees should be directed to the east and onwards to the Northern Road. The recommended evacuation route would be 'cut' initially when floodwaters overtop the access driveway and Andrews Road to the north. ALS survey indicates that evacuation would be cut when floodwaters build up to a level of approximately 24.20m AHD.

Table F4 provides information relating to differing AEP storm events, SES warnings and the status of the vehicular evacuation route. It is noted that there is no direct correlation data published between AEP events and the SES flood warning levels within the Penrith City Council.

Design Flood (AEP)	Flood Warning (SES)	Victoria Bridge Gauge Level (m)	Predicted Flood Level at Site^ (m)	Status of Evacuation Route
-	Minor	18.0	-	Not Impacted
20%		20.1	-	Not Impacted
10%		21.6	-	Not Impacted
-	Moderate/ Level 1	22	-	Potentially Impacted ^^
5%	-	23.4	-	Potentially Impacted ^^
-	Major/ Level 2-	24.5	-	Potentially Impacted ^^
2%	-	24.9	-	Potentially Impacted ^^
1%	-	26.1	25.3	Cut
0.5%	-	27.1	25.8	Cut

Table F4. Flood Route Evacuation Status

^^: Note evacuation route likely to impacted by increased traffic due to evacuation of lower lying areas.

Other potential evacuation routes, such as through the existing facility to the south-west and out to Castlereagh Road, would also be expected to be inundated and potentially hazardous during the 0.5% AEP event. These routes are not recommended to be utilised during major storm events, however are available for use during smaller events.

The final route to an Emergency Refuge Centre would need to be assessed in more detail as part of a site-specific plan. This analysis has sought only to confirm that sufficient flood evacuation routes would be available for the site

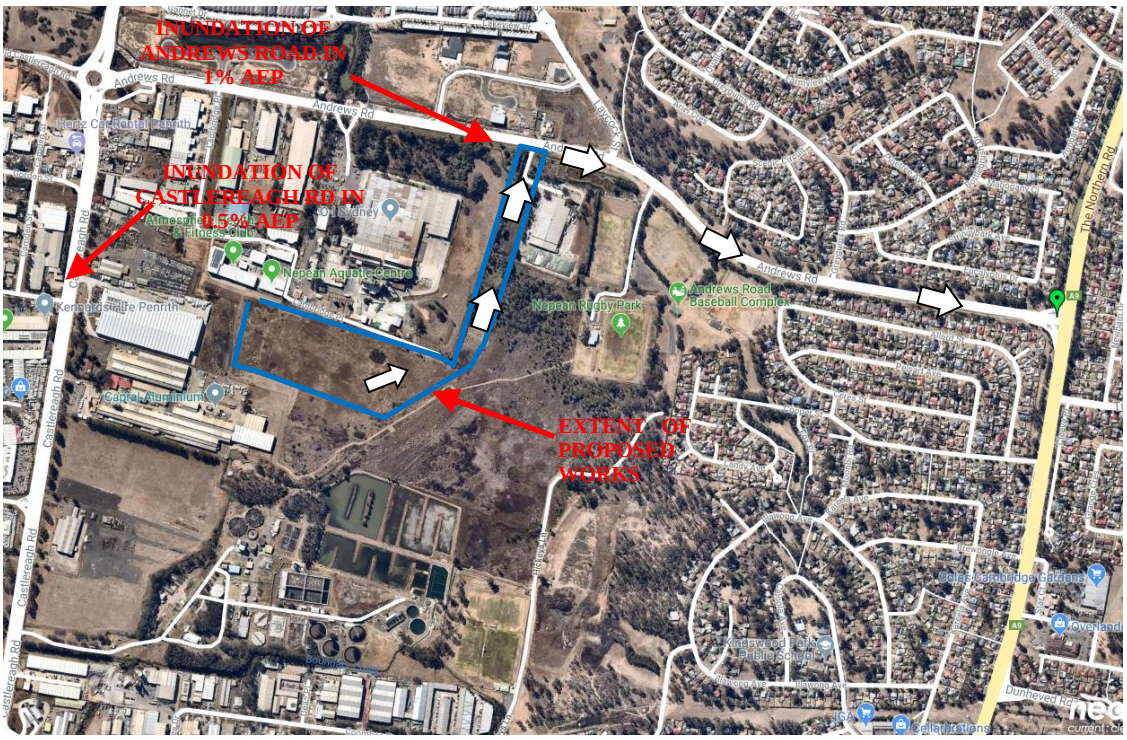


Figure F5. Potential Flood Evacuation Route

The transport by which the affected occupants travel along the evacuation route is private vehicle. If one does not own a private vehicle, then alternate transport for evacuation should be sought. However, in the event that flood waters have encroached the flood evacuation route, it is important that under no circumstances should flood waters be driven through, noting vehicles can be swept away by flood water at depths of only 200mm. On-site refuge is available for flooding events up to the 0.5& AEP. For events exceeding this, no refuge is available and emergency evacuation will be required.

End of Response Operations

Once the flood levels recede below the trigger level and the danger posed by flooding has passed, the NSW SES Liverpool Local Controller will issue an "all clear" message which will be conveyed in the same format as the warning message, via SMS. Building occupiers can then return to the precinct.

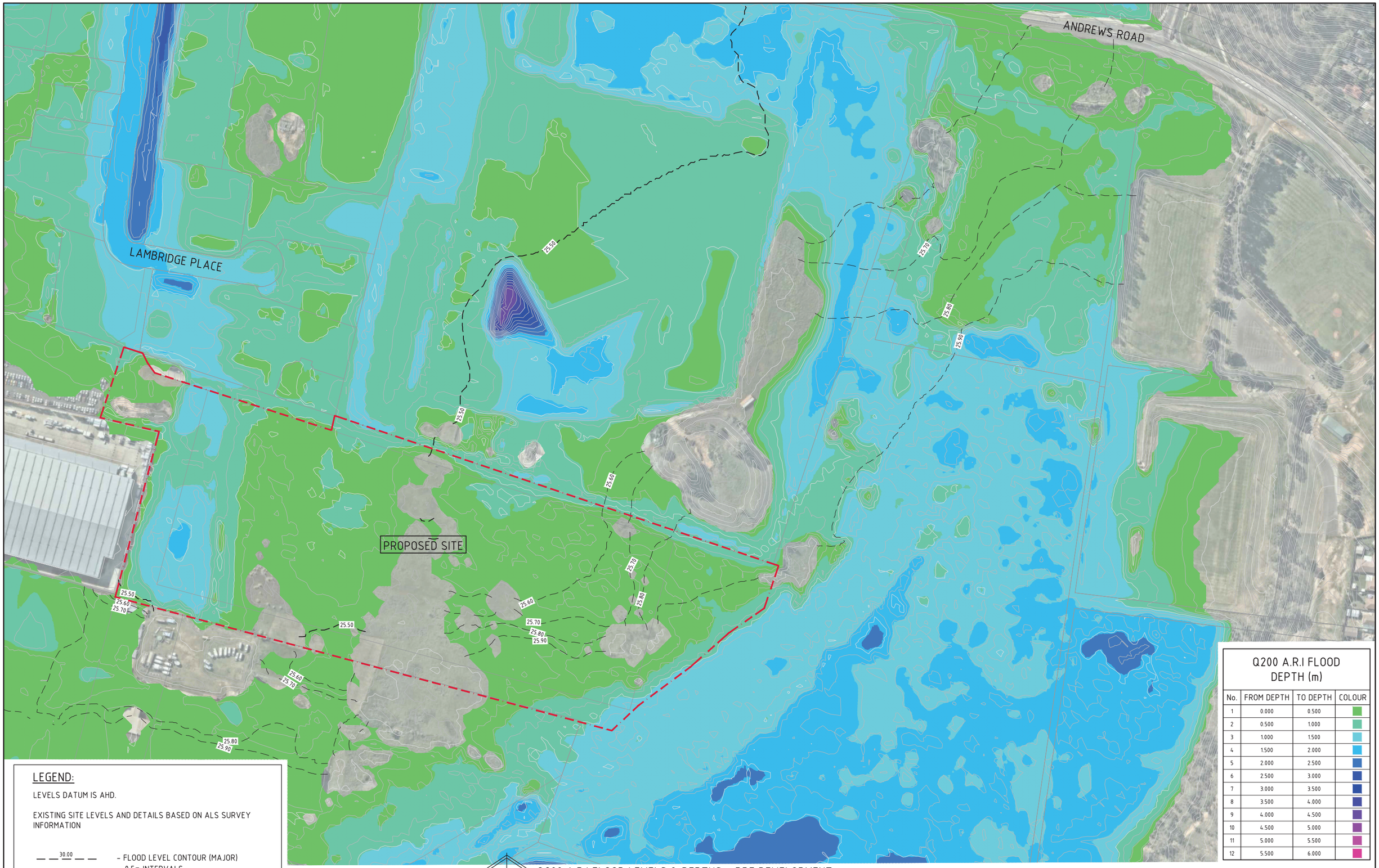
F.6 FLOOD ASSESSMENT CONCLUSION

This Appendix to the Civil Engineering Report for Lot 128 Andrews road Penrith, has been prepared to assess the effect of flooding on the proposed development, and also to confirm no affectation on upstream downstream or adjoining properties. Further the assessment was also completed to ensure that sufficient flood-ways are available, post development, during the 0.5% AEP flood event.

A TUFLOW hydrodynamic flood model has been completed and the pre and post development flood events assessed for flooding as a result of the Nepean River banks overtopping during a regional flood event. Peak flows were assessed for the critical duration associated with flooding from the Nepean River.

The flood assessment confirms the 1% AEP level of RL25.30m AHD and 0.5% AEP level of 25.80m, and that the proposed development (being sited at RL 26.30m AHD) meets flood planning requirement of the 1% AEP plus 0.5m. Further noting the proposed building development is above the 0.5% AEP event.

The assessment of the 0.5% AEP event confirms that floodway paths are available to the west, north and north-west of the building. There is negligible effect on flood water local to the development and no off-site affectation.



LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON ALS SURVEY INFORMATION

30.00 - FLOOD LEVEL CONTOUR (MAJOR) 0.5m INTERVALS

30.20 - FLOOD LEVEL CONTOUR (MINOR) 0.1m INTERVALS

Q200 A.R.I FLOOD DEPTH (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.000	0.500	
2	0.500	1.000	
3	1.000	1.500	
4	1.500	2.000	
5	2.000	2.500	
6	2.500	3.000	
7	3.000	3.500	
8	3.500	4.000	
9	4.000	4.500	
10	4.500	5.000	
11	5.000	5.500	
12	5.500	6.000	

Q200 A.R.I FLOOD LEVELS & DEPTHS - PRE DEVELOPMENT

1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m

1:1500 SCALE AT A1 SHEET SIZE

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ISSUED FOR INFORMATION	30.10.18	A

AMENDMENTS DATE ISSUE

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HAWTHORN EAST VIC 3123
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PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

CONSULT AUSTRALIA

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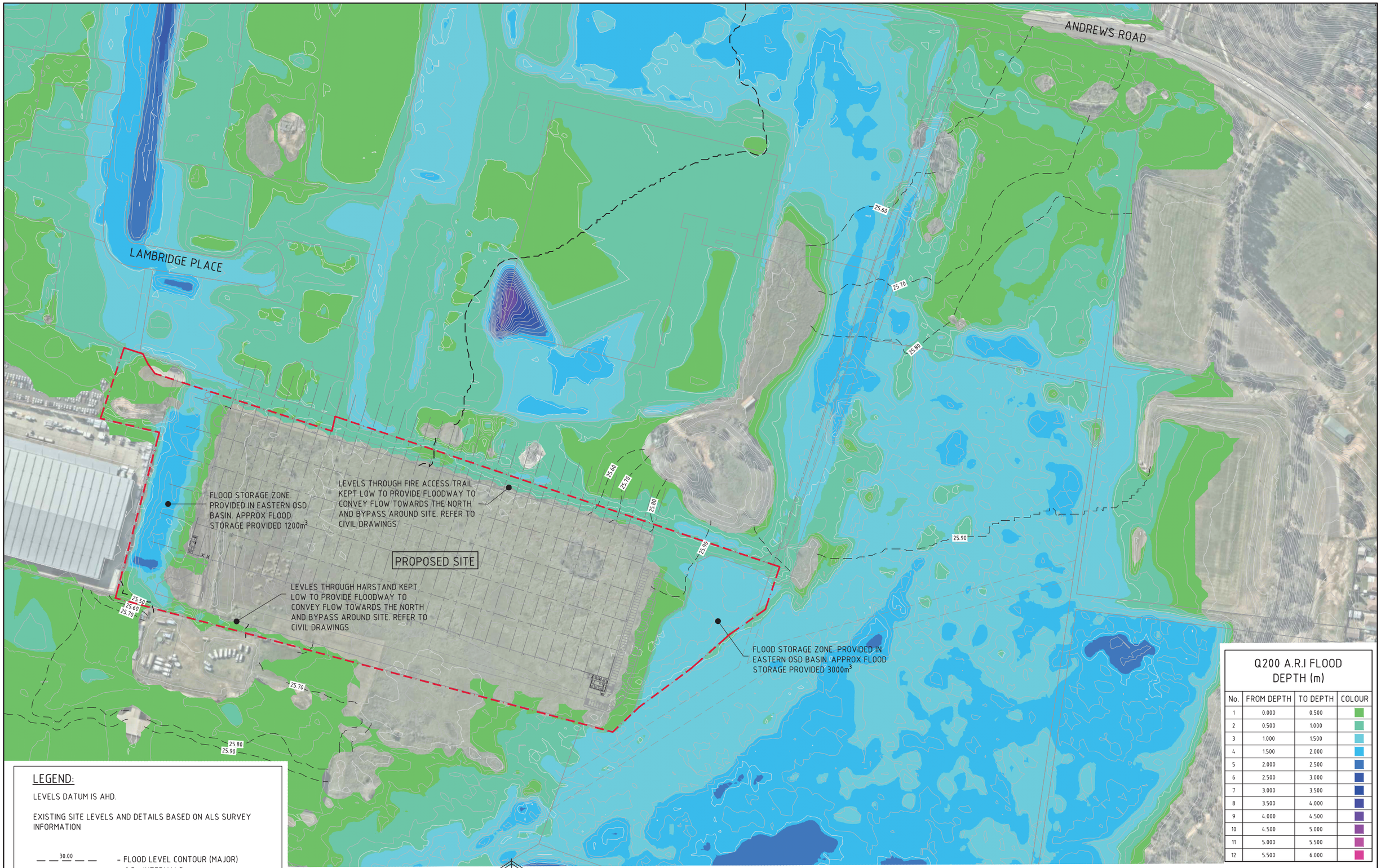

LEGEND:

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30.20 - FLOOD LEVEL CONTOUR (MINOR) 0.1m INTERVALS

Q200 A.R.I FLOOD DEPTH (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.000	0.500	
2	0.500	1.000	
3	1.000	1.500	
4	1.500	2.000	
5	2.000	2.500	
6	2.500	3.000	
7	3.000	3.500	
8	3.500	4.000	
9	4.000	4.500	
10	4.500	5.000	
11	5.000	5.500	
12	5.500	6.000	

Q200 A.R.I FLOOD LEVELS & DEPTHS - POST DEVELOPMENT

1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m

1:1500 SCALE AT A1 SHEET SIZE

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ANDREWS ROAD

LAMBRIDGE PLACE

FLOOD STORAGE ZONE. PROVIDED IN WESTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 1200m³

LEVELS THROUGH FIRE ACCESS TRAIL KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

PROPOSED SITE

MAXIMUM FLOOD AFFLUX 100mm LOCALLY ADJACENT TO PROPOSED BUILDING

LEVLES THROUGH HARSTAND KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

MAXIMUM FLOOD AFFLUX 31mm LOCALLY TO ADJACENT SITE

FLOOD STORAGE ZONE. PROVIDED IN EASTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 3000m³

Q200 A.R.I FLOOD LEVEL DIFFERNCE (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.010	0.025	
2	0.025	0.050	
3	0.050	0.075	
4	0.075	0.100	
5	0.100	0.200	

NOTE:
FLOOD LEVEL DIFFERENCE PROVIDED FOR THE PRE DEVELOPED SCENARIO VS THE POST DEVELOPMENT SCENARIO
ORIGINAL SURFACE - PRE-DEVELOPMENT Q200 FLOOD LEVEL
COMPARISON SURFACE - POST-DEVELOPMENT SCENARIO Q200 FLOOD LEVEL

Q200 A.R.I FLOOD AFFLUX - POST DEVELOPMENT
1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m
1:1500 SCALE AT A1 SHEET SIZE

FOR INFORMATION ONLY

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PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

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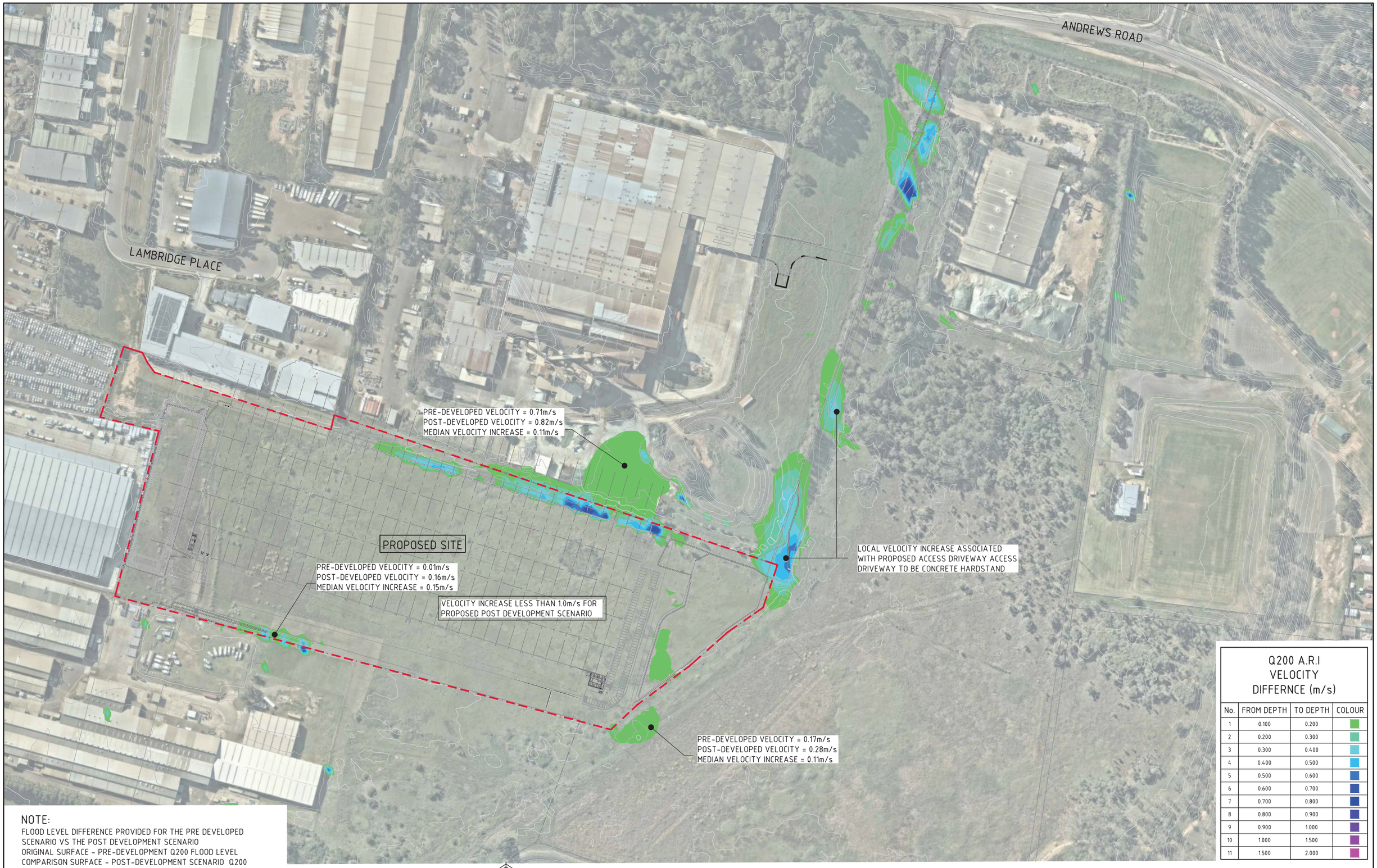

Q200 A.R.I
VELOCITY
DIFFERNCE (m/s)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.100	0.200	
2	0.200	0.300	
3	0.300	0.400	
4	0.400	0.500	
5	0.500	0.600	
6	0.600	0.700	
7	0.700	0.800	
8	0.800	0.900	
9	0.900	1.000	
10	1.000	1.500	
11	1.500	2.000	

NOTE:
FLOOD LEVEL DIFFERENCE PROVIDED FOR THE PRE DEVELOPED SCENARIO VS THE POST DEVELOPMENT SCENARIO
ORIGINAL SURFACE - PRE-DEVELOPMENT Q200 FLOOD LEVEL
COMPARISON SURFACE - POST-DEVELOPMENT SCENARIO Q200 FLOOD LEVEL

Q200 A.R.I VELOCITY AFFLUX - POST DEVELOPMENT
1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m
1:1500 SCALE AT A1 SHEET SIZE

FOR INFORMATION ONLY

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ISSUED FOR INFORMATION	30.10.18	A
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PROJECT
PROPOSED DEVELOPMENT
128 ANDREWS ROAD
PENRITH, NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
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Q200 A.R.I VELOCITY AFFLUX
POST DEVELOPMENT

DRAWING No C013620.00-F04
ISSUE B

ANDREWS ROAD

LAMBRIDGE PLACE

PROPOSED SITE

25.20

25.20

25.03

25.08

25.12

25.30

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON ALS SURVEY INFORMATION

30.00 - FLOOD LEVEL CONTOUR (MAJOR) 0.5m INTERVALS

30.20 - FLOOD LEVEL CONTOUR (MINOR) 0.1m INTERVALS

Q100 A.R.I FLOOD DEPTH (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.000	0.500	
2	0.500	1.000	
3	1.000	1.500	
4	1.500	2.000	
5	2.000	2.500	
6	2.500	3.000	
7	3.000	3.500	
8	3.500	4.000	
9	4.000	4.500	
10	4.500	5.000	
11	5.000	5.500	
12	5.500	6.000	

Q100 A.R.I FLOOD LEVELS & DEPTHS - PRE DEVELOPMENT

1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m

1:1500 SCALE AT A1 SHEET SIZE

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128 ANDREWS ROAD
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ANDREWS ROAD

LAMBRIDGE PLACE

FLOOD STORAGE ZONE. PROVIDED IN EASTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 1200m³

LEVELS THROUGH FIRE ACCESS TRAIL KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

PROPOSED SITE

LEVLES THROUGH HARSTAND KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

FLOOD STORAGE ZONE. PROVIDED IN EASTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 3000m³

25.04 25.08 25.09 25.10 25.20 25.26 25.20 25.20 25.20 25.27 25.27 25.21 25.04 25.20

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON ALS SURVEY INFORMATION

30.00 - FLOOD LEVEL CONTOUR (MAJOR) 0.5m INTERVALS

30.20 - FLOOD LEVEL CONTOUR (MINOR) 0.1m INTERVALS

Q100 A.R.I FLOOD DEPTH (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.000	0.500	
2	0.500	1.000	
3	1.000	1.500	
4	1.500	2.000	
5	2.000	2.500	
6	2.500	3.000	
7	3.000	3.500	
8	3.500	4.000	
9	4.000	4.500	
10	4.500	5.000	
11	5.000	5.500	
12	5.500	6.000	

Q100 A.R.I FLOOD LEVELS & DEPTHS - POST DEVELOPMENT

1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m

1:1500 SCALE AT A1 SHEET SIZE

FOR INFORMATION ONLY

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128 ANDREWS ROAD
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ANDREWS ROAD

LAMBRIDGE PLACE

FLOOD STORAGE ZONE. PROVIDED IN WESTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 1200m³

LEVELS THROUGH FIRE ACCESS TRAIL KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

PROPOSED SITE

MAXIMUM FLOOD AFFLUX 98mm IN SINGLE LOCATION LOCALLY ADJACENT TO PROPOSED BUILDING

LEVLES THROUGH HARSTAND KEPT LOW TO PROVIDE FLOODWAY TO CONVEY FLOW TOWARDS THE NORTH AND BYPASS AROUND SITE. REFER TO CIVIL DRAWINGS

FLOOD STORAGE ZONE. PROVIDED IN EASTERN OSD BASIN. APPROX FLOOD STORAGE PROVIDED 3000m³

Q100 A.R.I FLOOD LEVEL DIFFERNCE (m)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.010	0.025	
2	0.025	0.050	
3	0.050	0.075	
4	0.075	0.100	
5	0.100	0.200	

NOTE:
FLOOD LEVEL DIFFERENCE PROVIDED FOR THE PRE DEVELOPED SCENARIO VS THE POST DEVELOPMENT SCENARIO
ORIGINAL SURFACE - PRE-DEVELOPMENT Q100 FLOOD LEVEL
COMPARISON SURFACE - POST-DEVELOPMENT SCENARIO Q100 FLOOD LEVEL

Q100 A.R.I FLOOD AFFLUX - POST DEVELOPMENT

1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m

1:1500 SCALE AT A1 SHEET SIZE

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AMENDMENTS DATE ISSUE

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PROJECT
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128 ANDREWS ROAD
PENRITH, NSW

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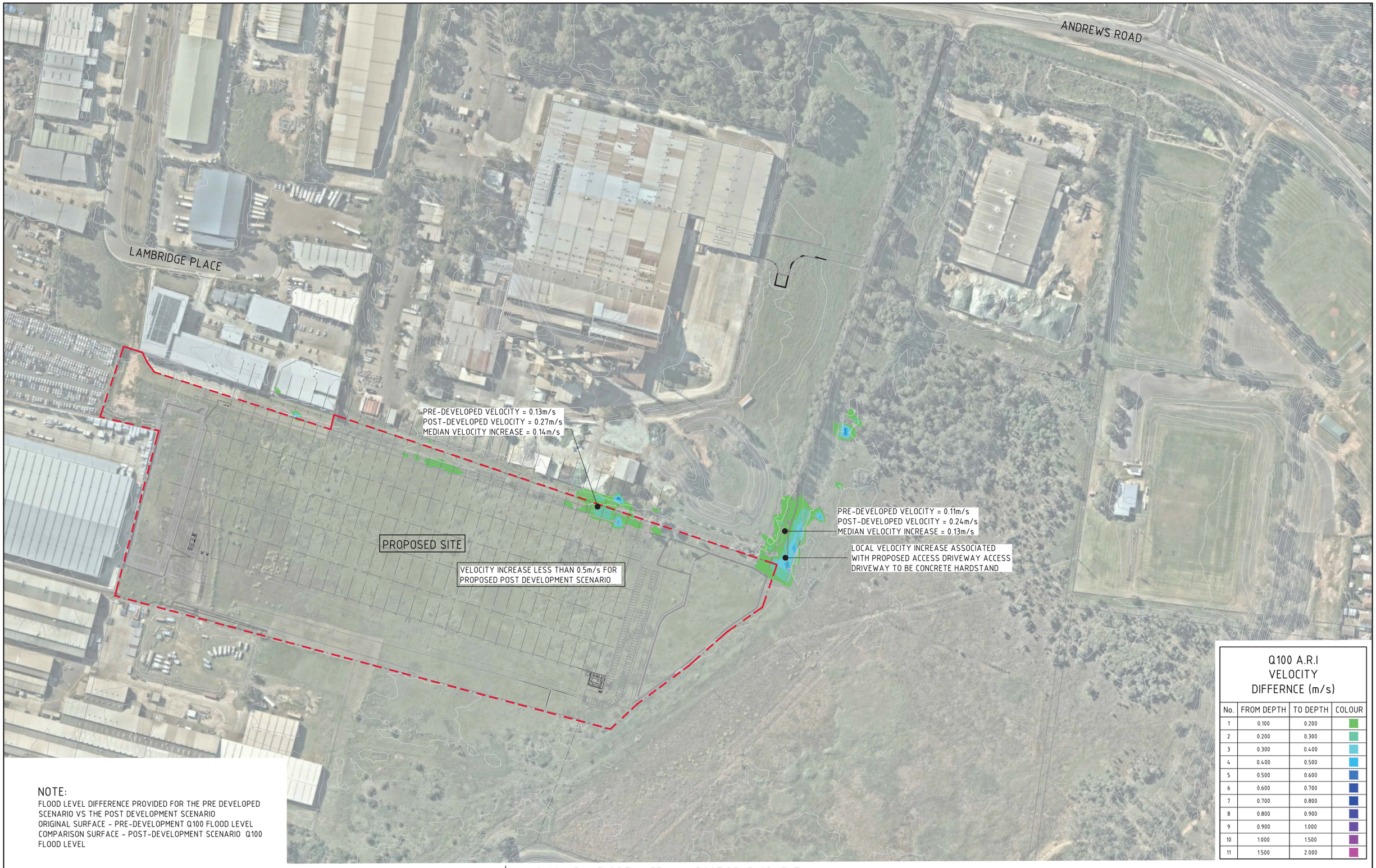

NOTE:
FLOOD LEVEL DIFFERENCE PROVIDED FOR THE PRE DEVELOPED SCENARIO VS THE POST DEVELOPMENT SCENARIO
ORIGINAL SURFACE - PRE-DEVELOPMENT Q100 FLOOD LEVEL
COMPARISON SURFACE - POST-DEVELOPMENT SCENARIO Q100 FLOOD LEVEL

Q100 A.R.I
VELOCITY
DIFFERNCE (m/s)

No.	FROM DEPTH	TO DEPTH	COLOUR
1	0.100	0.200	
2	0.200	0.300	
3	0.300	0.400	
4	0.400	0.500	
5	0.500	0.600	
6	0.600	0.700	
7	0.700	0.800	
8	0.800	0.900	
9	0.900	1.000	
10	1.000	1.500	
11	1.500	2.000	

Q100 A.R.I VELOCITY AFFLUX - POST DEVELOPMENT
1:1500 SCALE

15m 0 15 30 45 60 75 90 105 120 135 150m
1:1500 SCALE AT A1 SHEET SIZE

FOR INFORMATION ONLY

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128 ANDREWS ROAD
PENRITH, NSW

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Costin Roe Consulting
PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE
Q100 A.R.I VELOCITY AFFLUX
POST DEVELOPMENT

DRAWING No C013620.00-F08
ISSUE B

Appendix G

Council Correspondence

1 August 2018

Mark

I can confirm our discussions detailed in your email. In addition to flood levels/ velocities impact assessment, flood evacuation is also needed to be addressed. This is depending on the type/ extent of the proposed development and the location of the site. You may need to contact the SES (Contact: Peter Cinque, Email: peter.cinque@swd.ses.nsw.gov.au) regarding flood evacuation.

Regards

Myl Senthilvasan
Engineering Coordinator - Policy and Projects

E myl.senthilvasan@penrith.city
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From: Mark Wilson [mailto:Mark@costinroe.com.au]
Sent: Wednesday, 1 August 2018 11:48 AM
To: Mylvaganam Senthilvasan <myl.senthilvasan@penrith.city>
Cc: Mitchell Cross <Mitchell.Cross@costinroe.com.au>; Mitchell Kent <MKent@cadenceproperty.com.au>; Chris Wilson (cwilson@willowtp.com.au) <cwilson@willowtp.com.au>
Subject: RE: 13620.00 Flood Model - Andrews Road Penrith

Myl,
Thanks for your time this morning.

Confirming our discussion as follows:

- Councils flood modellers (Advisian) are currently re-running the numerical models to address some hydraulic requirements in and around Penrith Lakes area.
- This final model would be ready in approximately two months. This would then need to be reviewed and confirmed by council prior to a final report being produced and then being able to be used by external parties.
- The flood level and conveyance in and around the Andrews road development site are unlikely to be impacted by the adjustments currently being made to the model by Advisian.
- We understand councils preference for a site specific flood study to include boundary conditions taken from the revised model discussed above.

- Further to above, Council however understands that timing of the updated study is unlikely to fit with proposed development application timeframe and that an alternate set of boundary conditions would need to be agreed with council to use in the site specific model suitable for a development application. These would need to include such items as:
    - Extent of study area including confirmation of distance upstream and downstream of the study area.
    - Upstream/ in-flow conditions.
    - Downstream boundary level for 5% AEP, 1% AEP, 0.5% AEP and PMF.

Post our discussion I have confirmed with our client that current timeframes for the application will be for a circa September submission, hence the site specific flood assessment will need to be undertaken prior to the updated Advisian modelling. This being the case we will need to get the ball rolling on confirmation of the above parameters and will correspond with you further on this.

Again thanks for your time and if you have anything further to include to the above please advise, thanks Mark.

Best Regards,

Mark Wilson
Director

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PRECISION | COMMUNICATION | ACCOUNTABILITY

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From: Mylvaganam Senthilvasan <myl.senthilvasan@penrith.city>
Sent: Wednesday, 18 July 2018 1:45 PM
To: Mark Wilson <Mark@costinroe.com.au>
Cc: Mitchell Cross <Mitchell.Cross@costinroe.com.au>
Subject: RE: 13620.00 Flood Model - Andrews Road Penrith

Hi Mark
I am afraid to say that the Nepean flood model is not yet available, we are currently fixing an error in the modelling, would take a minimum of two months to complete and produce the final study documents.
Then we need to report to Council, so probably the model will be made available to public later this year.

Regards

Myl Senthilvasan
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From: Mark Wilson [mailto:Mark@costinroe.com.au]
Sent: Monday, 16 July 2018 3:45 PM
To: Mylvaganam Senthilvasan <myl.senthilvasan@penrith.city>
Cc: Mitchell Cross <Mitchell.Cross@costinroe.com.au>
Subject: 13620.00 Flood Model - Andrews Road Penrith
Importance: High

Myl,
We spoke briefly a month or so back about flood modelling around Andrews Road, Penrith and the Nepean River Flood study.
I was wondering if an electronic model is available for the Nepean River study (similar to what was provided to us for South Creek) to assist in our local model for the Andrews Road project, and if so how we would go about obtaining it.
Thanking you in advance for your help, Mark.

Best Regards,

Mark Wilson
Director

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