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CIVIL ENGINEERING REPORT FOR DEVELOPMENT APPLICATION

PROPOSED DEVELOPMENT AT 100 SOUTH CREEK ROAD CROMER

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1 INTRODUCTION

1.1 Introduction

EG Funds Management Pty Ltd proposes to develop 100 South Creek Road, Cromer, NSW as a warehouse & distribution facility. The site consists of a total area of 7.47Ha approximately and is currently developed. The proposed development consists of an approximate area of 4.45Ha.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by EG Funds Management Pty Ltd to prepare this Engineering Report in support of the proposed Development Application for 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; and
- Erosion 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 and to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is 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 and water quality requirements for the development. These drawings are conceptual only and subject to change during detail design.

1.3 Authority Jurisdiction

The site is located within the Northern Beaches Council area and the requirements of the former *Warringah DCP 2011* and *PL 850 WATER – Water Management Policy* apply.

2 DEVELOPMENT SITE

2.1 Location

The proposed development is located in the suburb of Cromer, at the intersection of Inman Road and South Creek Road as shown in **Figure 2.1**.

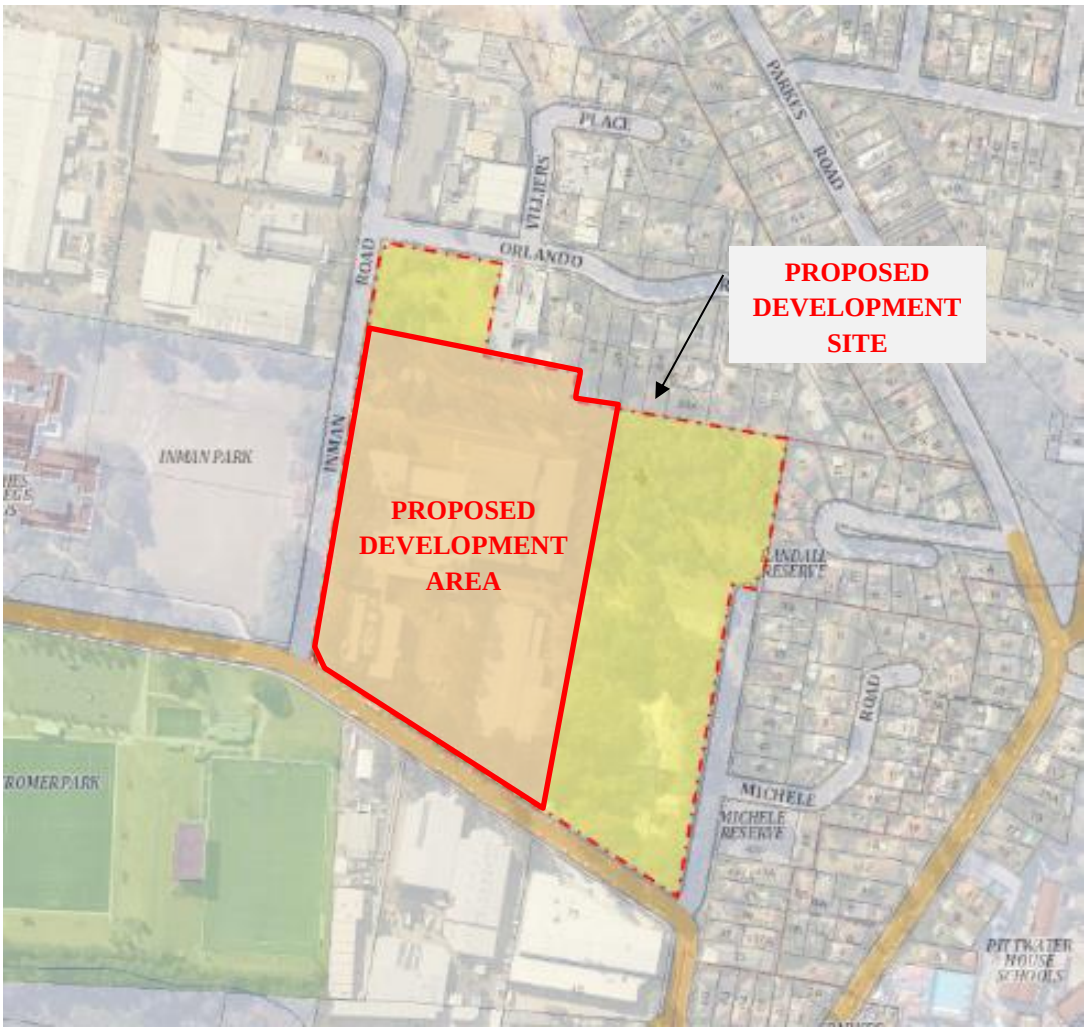

Figure 2.1. Locality Map (Source: SIX Maps 2019)

2.2 Existing Site

The site, being Lot 1 DP1220196, encompasses a total area of 7.47 Ha. The proposed development is estimated to consist of an area of 4.45Ha.

The site is bounded by Orlando Road on the north, South Creek on the south, Inman Road on the west and Campbell Avenue and existing residential and commercial lots to the east.

The site is currently developed with multiple industrial building and car parking facilities. It is noted that there is existing heritage listed buildings located to the west of the site and a heritage listed tower. There is an existing open channel and culvert system running from the north to the south along the eastern extent of the development area draining an upstream urban catchment through the property.

Falls over the site are generally from north to south. The highest level on the site is at RL29.5m AHD at the north- eastern corner, directly adjacent to Orlando Road. The lowest level is located at the south- western corner of the site, at the intersection of Inman Road and South Creek Road, at RL11.8m AHD.

2.3 Proposed Development

The total development area does not encompass the whole site. It is bounded by the existing eastern channel, a portion of the western boundary and the northern and southern boundaries. However, the development area does not comprise of the north-western portion of the site.

The proposed development is for a multi-level warehouse, office and storage facility. The development layout is based on the architectural layout by SBA Architects as shown in **Figures 2.2** & **2.3**.

The proposed warehouse buildings consist of 11 warehouse units with a total area of 15,489m^2 and encompasses a suspended portion. Suspended offices are also proposed at each warehouse unit and consists of a total area of 1,850m^2. Basement level car parking areas and self- storage units are proposed in the southern portion of the development area. Truck loading/ circulation areas are provided from Inman Road and South Creek Road and through the central hardstand. The existing heritage listed buildings are proposed to be utilised as offices and a café.

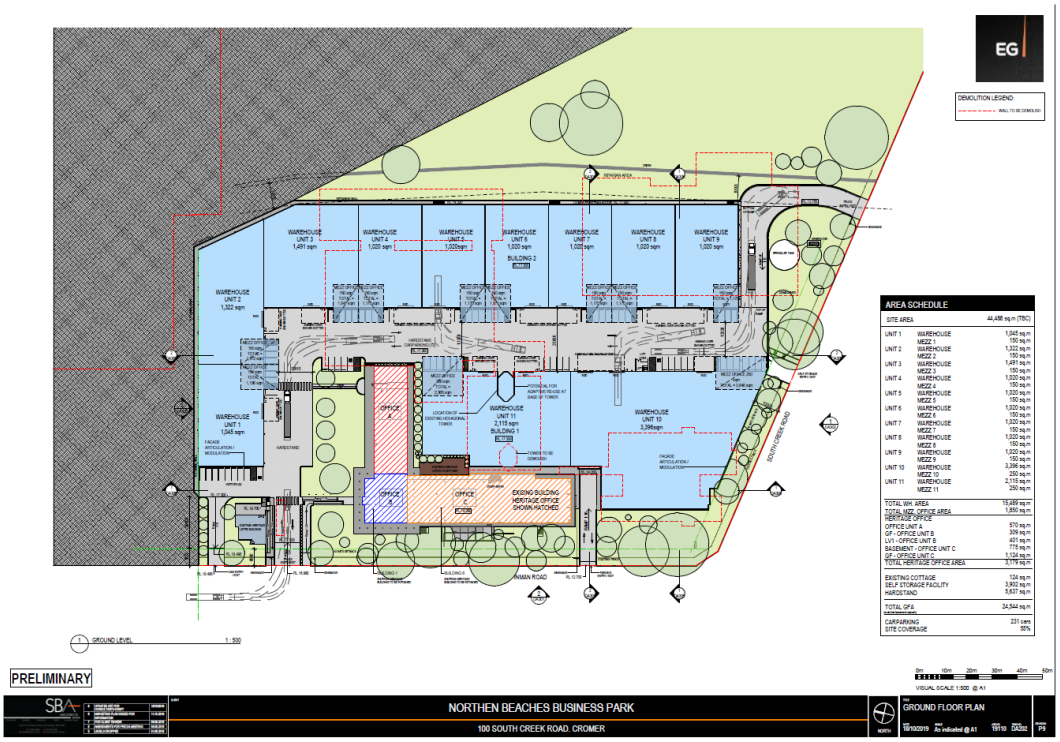

Figure 2.2. Development Layout – Ground Floor

Figure 2.3. Development Layout – Basement Floor

3 SITE WORKS

3.1 Bulk Earthworks & Retaining Walls

Earthworks will be required through the site to facilitate the construction of the new warehouse and self-storage units and the basement car parking area. The final levels over the site will be subject to detailed earthworks modelling and volume. The existing and proposed levels are shown on the Costin Roe drawings in **Appendix A**.

Soil Erosion and Sediment Control measures including sedimentation basins area to be provided during the construction phase in accordance with the approved drawings and the Soil and Water Management Plan in **Section 5** of this report.

3.2 Embankment Stability

To assist in maintaining embankment stability permanent batters' slopes will be no steeper than 3- horizontal to 1- vertical while temporary batters will be no steeper than 2- horizontal to 1- vertical.

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 5** of this report.

3.3 Supervision of Earthworks

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

3.4 Retaining Walls

The civil engineering objective is to minimise retaining walls within the constraints of the architectural layout and allowable grading (as per AS2890.1 and AS2890.2) through paved areas and batters in landscaped areas.

Given the existing falls and nature of the industrial development, retaining walls will be required. Where possible, landscaped batters are proposed to limit and reduce retaining wall construction.

Location and indicative heights of retaining walls are shown on drawing **Co13674.01-DA50** in **Appendix A**.

4 STORMWATER MANAGEMENT

4.1 Hydrologic Modelling and Analysis

4.1.1 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, Northern Beaches Council and accepted engineering practice.

Runoff from buildings 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" (1987 Edition), Volumes 1 and 2 (AR&R).

Storm events for the 5, 20- & 100-Year ARI event have been assessed.

4.1.2 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.

4.1.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for DRAINS modelling for the 5 to 100 Year ARI events, was taken from Northern Beaches Council *On-site Stormwater Detention Technical Specification*.

4.1.4 Runoff Models

In accordance with the recommendations and standards of Northern Beaches Council, the calculation of the runoff from storms of the design ARI has been calculated with the catchment modelling software DRAINS.

The design parameters for the DRAINS model are to be based on the recommendations as defined by Northern Beaches Council and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type	2.5	
	Paved (Impervious) Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition	3.0	

Table 4.1: DRAINS Parameters

4.2 Hydraulics

4.2.1 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 perform to or exceed the required standard.

4.2.2 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/grate level, for the peak runoff from the Minor System runoff.

The calculated water surface for the peak runoff from the Major System runoff will not exceed a freeboard level of 300mm below the finished floor level of the building.

4.2.3 Public Safety

For all areas subject to pedestrian traffic, the 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.

4.2.4 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).

4.2.5 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 estate road system and to the regional water quality/ detention basin.

4.3 Site Drainage

4.3.1 Existing Site Drainage

The property is currently developed with in-ground drainage throughout the site. The site has an existing culvert and an open channel trunk drainage system which runs along the east from the north to the south. Upstream flows discharge into the channel at the northern end via two ø600 RCP. The flows are then conveyed along the open channel and culvert towards the downstream discharge point which consists of two ø900 RCP which cross under South Creek Road.

4.3.2 Proposed Site Drainage

The proposed stormwater system consists of a major/ minor system which conveys surface water from the warehouse roof areas, hardstand, parking areas and truck circulation areas to a stormwater management basin prior to discharge from the site via the existing trunk drainage.

The existing culvert consisting of two ø825 RCP running under the existing driveway to the east and the associated headwall is to be demolished. The channel is to be reinstated to allow flows to effectively be conveyed from the north to the south as discussed further in **Section 4.4**.

Reference to drawings **Co136741.01-DA41** & **DA42** shows the proposed drainage layout including the stormwater management measures. Further discussion on the stormwater management measures are made in **Sections 5** and **6** of this report.

4.4 External Catchments and Flooding

The site is subject to overland flow from an upstream catchment to the north of the property. The existing catchment is approximately 18.5 Ha and comprises residential and urbanised surfaces of approximately 75-80% impervious. Reference to Figure 4.1 shows the approximate catchment extent and location.

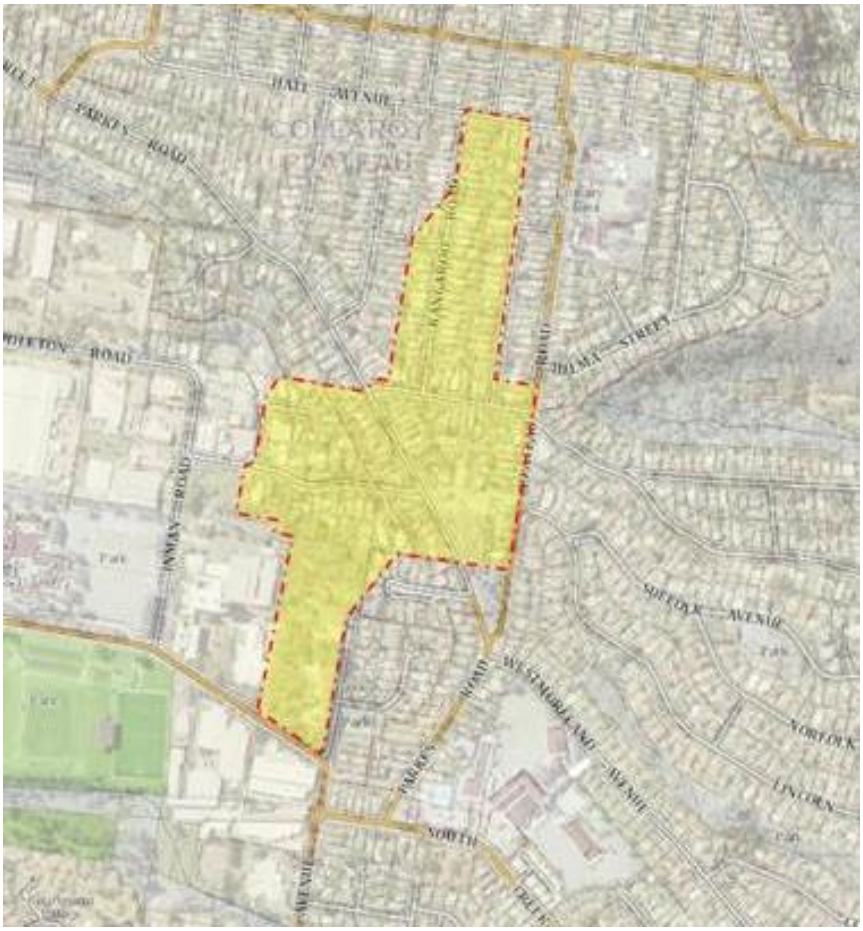

Figure 4.1. Upstream Catchment (Source: SIX Maps 2019)

Given the urban environment and relatively small upstream catchment, storms which would produce overland flow would be intense and short in duration. The catchment is sensitive to intense storms of short duration which result in rapidly increasing and decreasing flows and peak flows (and hence maximum flood depths) occurring over short durations.

Based on a conservative rational method calculation, the 1% AEP flow is estimated to be 8-9 m^3/s.

The existing flow path comprises open channel of:

- Sandstone bedrock
- Vegetated and rock lined base with stabilised sandstone banks and vegetated overbanks,
- box culvert and pavements.

Figure 4.2 shows a typical existing cross section with vegetated and rock lined base with stabilised sandstone banks and vegetated overbank areas adjacent to South Creek Road.

Figure 4.2. Typical Channel

As part of the development it is proposed to complete rehabilitation works on the flow path. The proposed works include removal of the existing culvert system and pavements and reinstatement of the channel. The proposed channel reinstatement will maintain the conveyance of the external catchment through the site and have adequate capacity as per the existing stormwater open channel and culverts.

The proposed development will be site at a level greater than 0.5m above the 1% AEP overland flow level. Basement areas will be bunded to meet the flood planning requirements.

In sizing the stormwater management system and erosion control for the development, only flows from within the development site have been considered as per the requirements of Northern Beaches Council, with upstream catchment and flow path bypassing any development management systems.

5 WATER QUANTITY MANAGEMENT

5.1 Onsite Stormwater Detention

Northern Beaches Council requires on-site detention to be provided to limit the runoff discharged from private property into the underground piped drainage system to pre-developed flow and to assist in mitigating the increased stormwater runoff generated by the development.

Northern Beaches 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 development site.

Section 4 of Northern Beaches Council's *On-Site Stormwater Detention Technical Specification* states "The general requirement of Council's OSD Specification is to ensure that the site's stormwater runoff after any development does not exceed the runoff prior to the development."

5.2 Methodology

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

As the site area is greater than 1200m^2, the simplified method consisting of PSD/SSR rates as described in Section 4.2.2. of the Warringah Council's *On-site Stormwater Detention Technical Specification* cannot be 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 and storage relationship.

In order to assess the existing and operational phase perk discharges from the development site, a DRAINS hydrological model was used to estimate peak flows from the catchments on site from various storm durations for Q5 year ARI to Q100 year ARI events.

5.3 Existing & Post Development Peak Flows

Table 5.1. shows the existing and developed flows at the downstream discharge point.

ARI	Design Storm Duration	Peak Flow (m^3/s)		
		Undeveloped	Developed	
			Site (no attenuation)	Site (+ attenuation)
5	5	0.585	1.630	0.538
	10	0.835	1.520	0.639
	20	1.150	1.750	0.766
	30	1.260	1.660	0.785
	60	1.270	1.610	0.805
	120	1.370	1.660	0.821
20	5	1.090	2.140	1.130
	10	1.310	1.980	0.789
	20	1.780	2.290	0.958
	30	1.800	2.200	0.976
	60	1.820	2.140	1.009
	120	1.940	2.210	1.034
100	5	1.750	2.800	0.834
	10	1.870	2.460	0.968
	20	2.370	2.820	1.469
	30	2.240	2.640	1.455
	60	2.350	2.670	1.788
	120	2.470	2.730	1.841

Table 5.1. Q5, Q20 & Q100 ARI Peak Flows from Development

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 an OSD system to be located at the south-east landscaped zone. The discharge location will be via a pipe into the eastern channel, prior to discharge from the site.

The proposed OSD will be provided within an above ground, combined water quantity and water quality management basin.

A number of combinations of storage and outlet arrangements have been modelled. The adopted arrangement models the basin configuration as shown in **Table 5.2.** and the proposed layout can also be observed on drawing **Co13674.01-DA40** with details on drawing **DA43**.

ARI	Duration (mins)	Peak Flow (m^3/s)					Depth (mm)	Storage (m^3)
		No. Atten.	With Attenuation					
			Low	High	Bypass	Total		
5	120	1.370	0.656	-	0.165	0.821	1160	615
20	120	1.940	0.804	-	0.230	1.034	1730	917
100	120	2.470	0.884	0.666	0.291	1.841	2010	1100

Table 5.2. 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 Northern Beaches Council have been met.

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 and minimise the adverse impact these pollutants could have on receiving waters, and to also meet the requirements specified by Northern Beaches Council.

Northern Beaches Council has nominated, in *Section 8.1.1* of their *PL 850 WATER – Water Management Policy*, 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	65%
Total Nitrogen	45%
pH	6.5-8.5

6.2 Proposed Stormwater Treatment System

Developed impervious areas including roof, hardstand, car parking, roads and other extensive paved areas are required to be treated by the Stormwater Treatment Measures (STM's). The STM's shall be sized according to the catchment area of the developed site. The STM's for the development shall be based on a treatment train approach to ensure that all of the objectives are met.

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

- Primary treatment to parking and hardstand areas is to be performed via the provision of Ocean Protect OceanGuard Pit Inserts. Pre-treatment of stormwater will assist in mitigating the potential for early onset sedimentation of the bio-retention system;
- Tertiary treatment to the warehouse roof areas, the hardstand and car parking areas is to be performed via 663m^2 of bio-retention located towards the south- eastern corner of the site, adjacent to the access ramp off South Creek Road.
- A portion of the roof will also be treated via rainwater reuse and settlement within the rainwater tank.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

The MUSIC model was chosen to model water quality. This model has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and 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 these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in *Section 8.1.1* of their *PL 850 WATER – Water Management Policy* 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 "*13674.01Cromer DA_Rev1.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if Northern Beaches Council's requirements have been achieved. The model was set up using the Northern Beaches Council parameters from the *WSUD and MUSIC Modelling Guidelines (2016)* and the layout of the MUSIC model is presented in **Appendix B**.

6.3.2 Rainfall Data

Six-minute pluviographic data was provided by Northern Beaches Council which has been 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	066062 Sydney Observatory
Rainfall Period	1981 – 1985 (5 years)
Mean Annual Rainfall (mm)	857
Evapotranspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

6.3.3 Rainfall Runoff Parameters

Parameter	**Value**
Rainfall Threshold (Roads/Paths)	1.50
Rainfall Threshold (Roofs)	0.30
Sand	
Soil Storage Capacity (mm)	350
Initial Storage (% capacity)	30
Field Capacity (mm)	144
Infiltration Capacity Coefficient a	360
Infiltration Capacity Coefficient b	0.5
Initial Depth (mm)	10
Daily Recharge Rate (%)	100
Daily Baseflow Rate (%)	50
Daily Seepage Rate (%)	0
Sandy Clay Loam	
Soil Storage Capacity (mm)	108
Initial Storage (% capacity)	30
Field Capacity (mm)	73
Infiltration Capacity Coefficient a	250
Infiltration Capacity Coefficient b	1.3
Initial Depth (mm)	10
Daily Recharge Rate (%)	60
Daily Baseflow Rate (%)	45
Daily Seepage Rate (%)	0

6.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on Northern Beaches Council land use parameters as per the **Table 6.1.**:

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	-	-	-	-	-	-
	Roads	-	-	-	-	-	-
	Landscaping	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.30	0.19
	Landscaping	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 and the catchments shown in **Table 6.2**.

The relevant stormwater catchment sizes are listed below in **Table 6.2.** and shown in **Appendix B**.

Catchment	Area (Ha)	Source Node	% Impervious	Stormwater Treatment
R1	0.442	Roof	100	Bio-retention & Rainwater Tank
R2	0.556	Roof	100	Bio-retention
R3	0.551	Roof	100	Bio-retention
R4	0.209	Roof	100	Bio-retention
R5	0.018	Roof	100	Bio-retention
H1	0.967	Sealed Road	100	Bio-retention
L1	0.157	Mixed	0	Bio-retention
L2	0.081	Mixed	0	Bio-retention
LB1	0.204	Mixed	0	Bypass
LB2	0.166	Mixed	0	Bypass
LB3	0.160	Mixed	0	Bypass
Total	3.511			

Table 6.2. Music Model Source Nodes

6.3.5 Treatment Nodes

Rainwater tank and bio-retention nodes have been used in the modelling of the development.

6.3.6 Results

Table 6.3. 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	Target Met
Flow (ML/yr)	41.8	38.5	8	N/A
Total Suspended Solids (kg/yr)	5580	826	85.2	85
Total Phosphorus (kg/yr)	12.1	3.78	68.7	65
Total Nitrogen (kg/yr)	91.4	37.1	59.4	45
Gross Pollutants (kg/yr)	940	0	100	90

Table 6.3. MUSIC analysis results

The model results indicate that, through the use of the STM's in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of Northern Beaches Council – Water Management Policy 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 *Section 8.1.1* of Northern Beaches Council *PL 850 WATER – Water Management Policy* have been met.

The MUSIC modelling has shown that the proposed treatment train of SQID's will provide stormwater treatment which will meet the Northern Beaches Council requirements in an effective and economical manner.

Hydrocarbon removal cannot be modelled with MUSIC software. The proposed distribution/ storage facility would be expected to produce low source loadings of hydrocarbons. Potential sources of hydrocarbons would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (carparking only). The potential for hydrocarbon pollution 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 bio-retention swales which are predicted to achieve a 90% reduction of this pollutant.

Given the expected low source loadings of hydrocarbons and removal efficiencies of the treatment devices we consider that the requirements of the Northern Beaches Council have been met.

6.4 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the development's 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, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting is proposed for this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development and to satisfy the requirements of Northern Beaches Council.

In general terms the rainwater harvesting system will be an 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 MUSIC software to balance the supply and demand and to provide a reduction in non-potable water.

6.4.1 Internal Base Water Demand

Indoor water demand has been estimated for an industrial/ commercial development of an allowance of 0.1kL/day/ toilet or urinal. No allowance is required for disable toilets.

The above rates result in the following internal non-potable demand:

Estimate	12 Toilets	1.2 kL/day

6.4.2 External Base Water Demand

The external base water demand has been estimated for an industrial/ commercial development of 0.3kL/year/m^2 as PET-Rain for subsurface irrigation.

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

Irrigated Area (0.3kL/year/m^2)	7000m^2	2000 kL/year
TOTAL		**2000 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.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the calculated base water demands and proposed roof catchment areas. Allowances in the MUSIC model have been made for high flow bypass which will be managed by a high flow and low flow roofwater collection configuration along a portion of the southern elevation of the warehouse.

Roof Catchment (m^2)	High-Flow Bypass (l/s)	Tank Size in MUSIC (kL)	Predicted Demand Reduction (%)	Provided Tank (kL)
4420	100	50	67	60

Table 6.4. Rainwater Reuse Requirements

The MUSIC model, results summarised in **Table 6.4**, predicts that there will be a 67% reduction in non-potable water demand for the development with the provision of a minimum 60 kL rainwater tank.

We note that the final configuration and sizing of the rainwater tanks is subject to detail design considerations and optimum site utilisation.

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) to assist in the effective operation and maintenance of the various water quality components.

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the below nominated frequency it is recommended that inspections are made following large storm events.

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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
BIO-RETENTION BASIN			
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	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.
INLET & JUNCTION PITS			
Inside of pits	Six- Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of pits	Four- Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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.
OCEANGUARD 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 EROSION & SEDIMENT CONTROLS

An erosion and sediment control plan (ESCP) is included on drawings **Co13674.01-DA20** & **DA25**. These plans show the works can proceed without polluting the receiving waters. A detailed plan will be prepared after development consent is granted and before works commence.

7.1 General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued 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 specification and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and Northern Beaches Council specifications.
3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

7.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 7.1**.

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.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands	Entry prohibited except for essential management works	

Table 7.1. Limitations to access

7.3 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan 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 remain on the surface at the completion of works.

3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.

4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.

5. 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.

6. Where practical, foot and vehicular traffic will be kept away from all recently established areas

7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law 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

8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.

9. 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.

7.4 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. Silt/ sediment fences and appropriate stabilisation of stockpiles are to be provided as detailed on the drawings.

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 meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, 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 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 stabilised.

7.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service will be provided at least weekly.

7.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:

   - At least weekly.
   - Immediately before site closure.
   - 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
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

2. In addition, a suitably qualified person 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. The responsible person will ensure that:

    - The plan is being implemented correctly
    - Repairs are undertaken as required
    - Essential modifications are made to the plan if and when necessary

The report shall carry 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 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 of installing additional diversion upslope.
    - Blockages are cleared (these might 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 meters from hazard areas will be removed. Such hazard areas include and 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 or less 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 stabilised

12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

8 CONCLUSION

This Civil Engineering Report has been prepared to support the Development Application for the proposed warehouse and storage facilities at 100 South Creek Road, Cromer, NSW.

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 quality management strategy has been developed to reduce pollutant loads in the stormwater leaving this site. The stormwater management for the development has been designed in accordance with *Section 8.1.1* of the Northern Beach Council's *PL 850 WATER – Water Management Policy*.

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 bio-retention basin 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.

9 REFERENCES

- Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book, Landcom
- Northern Beaches Council WSUD & MUSIC Modelling Guidelines (2016)
- PL 850 WATER – Water Management Policy (2017), Warringah
- Warringah Council On-site Stormwater Detention Technical Specification
- Warringah Development Control Plan (2011)

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

PROPOSED INDUSTRIAL DEVELOPMENT
100 SOUTH CREEK ROAD, CROMER, NSW
CIVIL ENGINEERING DRAWINGS FOR DEVELOPMENT APPLICATION

DRAWING LIST

DRAWING NO.	DRAWING TITLE
C013674.01-DA10	DRAWING LIST & GENERAL NOTES
C013674.01-DA20	EROSION & SEDIMENT CONTROL PLAN
C013674.01-DA25	EROSION & SEDIMENT CONTROL DETAILS - SHEET 1
C013674.01-DA26	EROSION & SEDIMENT CONTROL DETAILS - SHEET 2
C013674.01-DA41	STORMWATER DRAINAGE PLAN - GROUND LEVEL
C013674.01-DA42	STORMWATER DRAINAGE PLAN - BASEMENT
C013674.01-DA45	STORMWATER DETAILS - SHEET 1
C013674.01-DA46	STORMWATER DETAILS - SHEET 2
C013674.01-DA47	STORMWATER DETAILS - SHEET 3
C013674.01-DA48	STORMWATER DETAILS - SHEET 4
C013674.01-DA51	FINISHED LEVELS PLAN - GROUND LEVEL
C013674.01-DA52	FINISHED LEVELS PLAN - BASEMENT
C013674.01-DA55	TYPICAL SECTIONS
C013674.01-DA65	RETAINING WALL DETAILS

LOCALITY PLAN
NOT TO SCALE

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.

SITE PREPARATION NOTES:

1. ALL EARTHWORKS SHALL BE COMPLETED GENERALLY IN ACCORDANCE WITH THE GUIDELINES SPECIFIED IN THE GEOTECHNICAL REPORT.
2. EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY LTS LOCKLEY TITLED 50384001DT DATED 21/06/16.
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 (EG. COSTIN ROE SITE PREPARATION NOTES IN DWG C013003.01-EWC10)
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.

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.

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 SITE MANAGER 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 SITE MANAGER. 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 SITE MANAGER 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.

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 DA51 & DA52.
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 25 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.

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	B
ISSUED FOR INFORMATION ONLY	01.11.19	A
AMENDMENTS	DATE	ISSUE

ARCHITECT

CLIENT
EG FUNDS MANAGEMENT
GOVERNOR PHILLIP TOWER
21/1 FARRER PLACE
SYDNEY, NSW 2000

PROJECT
PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
TW	TW	OCT 2019	MW	A1	AS SHOWN	C013674.01-DA10

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DRAWING TITLE
DRAWING LIST & GENERAL NOTES

DRAWING No C013674.01-DA10 ISSUE B

LEGEND:

- DENOTES SILT FENCE WITH CATCH DRAIN
- DENOTES SILT FENCE
- DENOTES DIVERSION DRAIN
- DENOTES DIRECTION OF OVERLAND FLOW

SEDIMENTATION BASIN NOTE:

FOR SEDIMENT & EROSION CONTROL DETAILS REFER TO DRAWING C013674.01-C25 & C26.

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 (44.0mm).

APPROXIMATE AREA OF DISTURBED SITE = 4.45Ha

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.

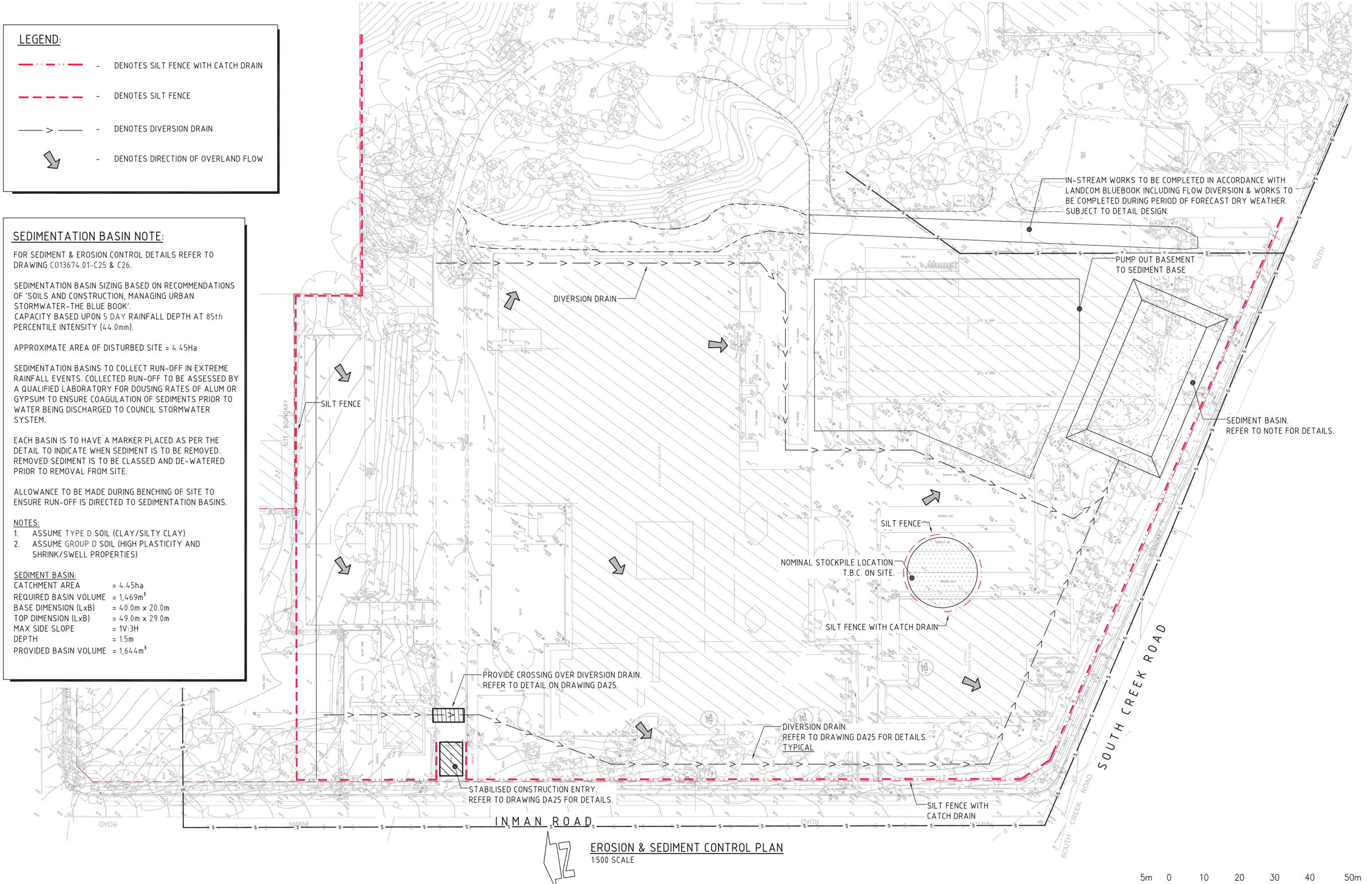
EACH BASIN IS TO HAVE A MARKER PLACED AS PER THE DETAIL TO INDICATE WHEN SEDIMENT IS TO BE REMOVED. REMOVED SEDIMENT IS TO BE CLASSED AND DE-WATERED PRIOR TO REMOVAL FROM SITE.

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)

SEDIMENT BASIN:

CATCHMENT AREA	= 4.45ha
REQUIRED BASIN VOLUME	= 1,469m³
BASE DIMENSION (LxB)	= 40.0m x 20.0m
TOP DIMENSION (LxB)	= 49.0m x 29.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 1,644m³



EROSION & SEDIMENT CONTROL PLAN
1:500 SCALE

5m 0 10 20 30 40 50m
1:500 SCALE AT A1 SHEET SIZE

FOR DEVELOPMENT APPLICATION

ISSUE	DATE	AMENDMENTS
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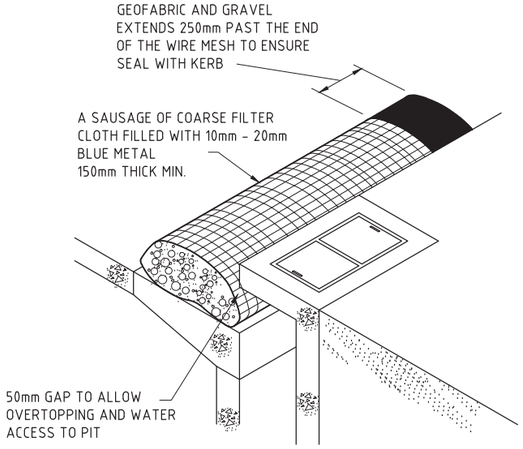
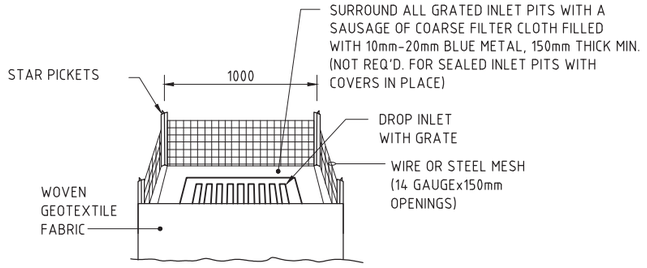
DRAWING TITLE
EROSION & SEDIMENT CONTROL PLAN

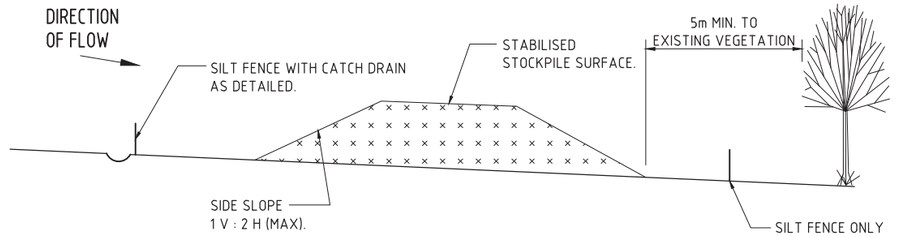
DRAWING No C013674.01-DA 20 | ISSUE A



KERB INLET PIT CONTROL
N.T.S



GRATED INLET PIT FILTER DETAIL
N.T.S



TYPICAL STOCKPILE DETAIL
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.

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.

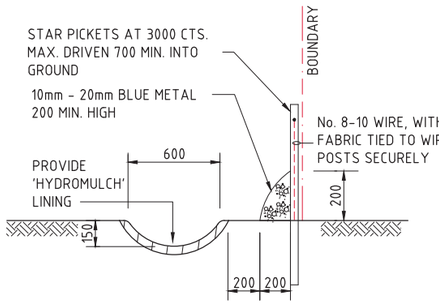
NOTES:
ALL EROSION & SEDIMENT CONTROL MEASURES TO BE INSPECTED & MAINTAINED DAILY BY SITE MANAGER.

MINIMISE DISTURBED AREAS.

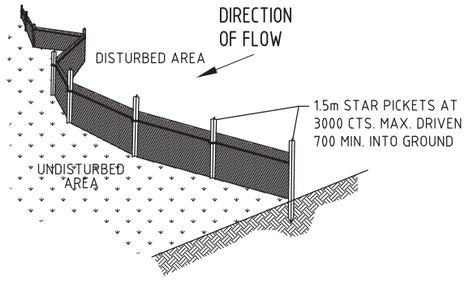
ROADS & FOOTPATHS TO BE SWEPT DAILY.

1.2m TURF TO BE PLACED BEHIND KERBS.

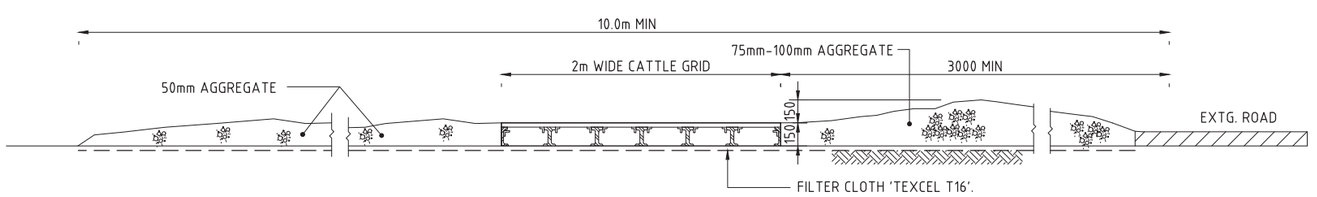
DUST MINIMISATION CONTROL BY WATERING TO BE IMPLEMENTED BY SITE MANAGER AS REQUIRED OR AS DIRECTED BY THE EPA.



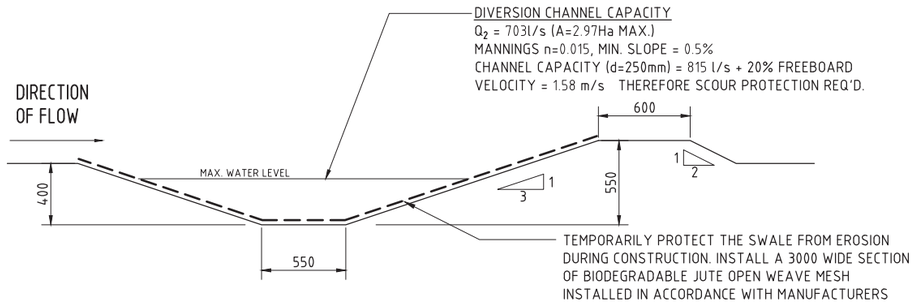
TYPICAL OPEN DRAIN & SILT FENCE
SCALE 1:20



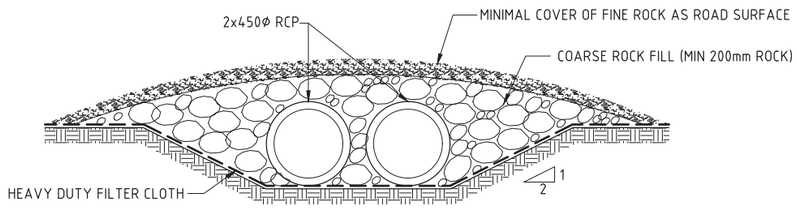
TYPICAL SILT FENCE DETAIL
N.T.S.
PROVIDE 1m RETURNS AT 30m INTERVALS.
TYPICAL



SECTION 1:20 (1 / DA20) : STABILISED CONSTRUCTION ENTRANCE 'TRUCK SHAKER'



DIVERSION DRAIN SECTION
SCALE 1:20



TYPICAL CROSSING OVER DIVERSION CHANNEL
SCALE 1:20

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SHEET SIZE

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	A
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CROMER, 2099, NEW SOUTH WALES

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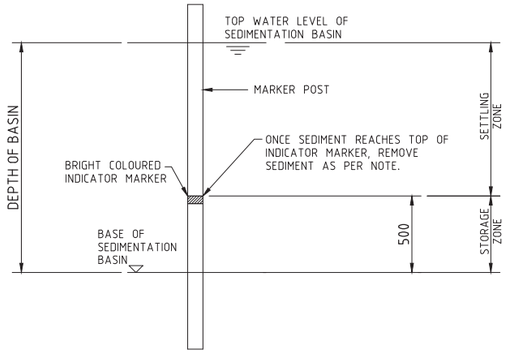
DRAWING TITLE
EROSION & SEDIMENT CONTROL
DETAILS - SHEET 1

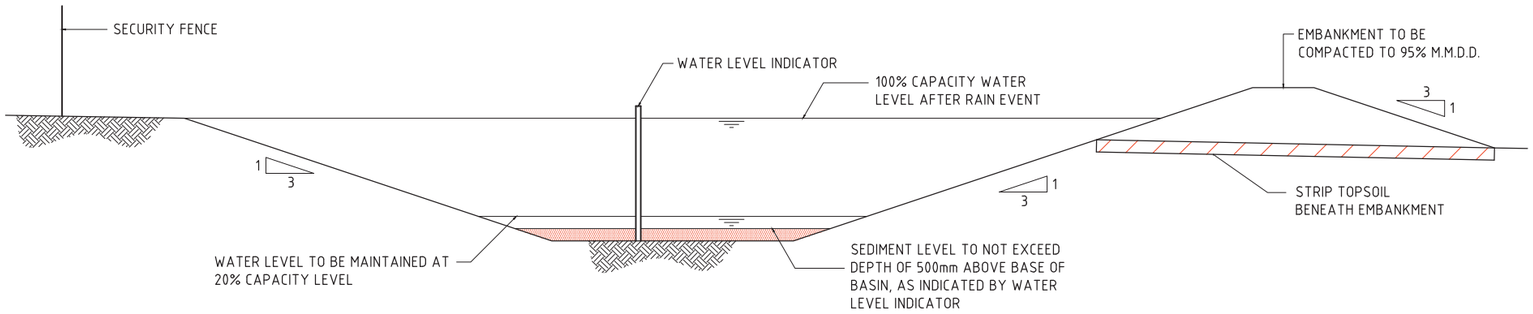
DRAWING No C013674.01-DA 25

ISSUE A



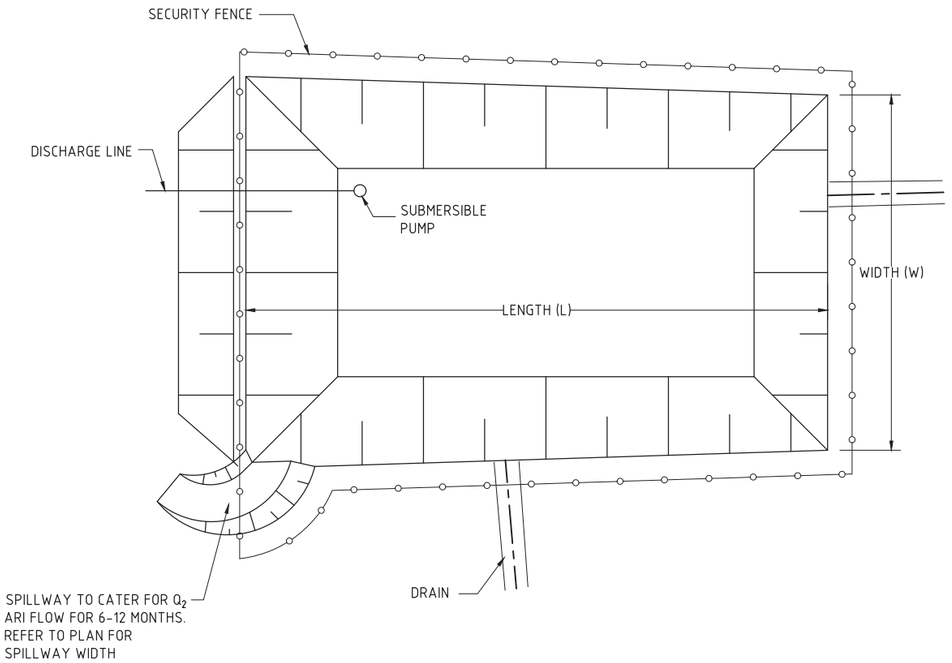
SEDIMENT STORAGE MARKER

SCALE 1:20



TYPICAL SEDIMENT CONTROL BASIN SECTION

SCALE 1:50



TYPICAL SEDIMENT CONTROL POND PLAN

SCALE 1:250

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SHEET SIZE

500mm 0 1 2 3 4 5m

SCALE 1:50 AT A1 SHEET SIZE

2m 0 5 10 15 20 25m

SCALE 1:250 AT A1 SHEET SIZE

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DRAWING TITLE
EROSION & SEDIMENT CONTROL DETAILS - SHEET 2

DRAWING No C013674.01-DA26

ISSUE A

LEGEND:

LEVELS DATUM IS AHD.

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- GRATED DRAIN (300W x 200D U.N.O.)
- DRAINAGE LINE
- ROOFWATER LINE
- EXISTING SEWER MAIN
- FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

APPROXIMATE EXTENT OF EXISTING WATERWAY TO BE MAINTAINED

APPROXIMATE EXTENT OF EXISTING WATERWAY

LOCATION OF EXISTING CULVERT DISCHARGE INTO CHANNEL VIA 2×Ø600 PIPES TO BE MAINTAINED

STORMWATER LINE EXPECTED TO PASS ABOVE EXISTING Ø225 SEWER. SEWER TO BE POT-HOLE SURVEYED TO CONFIRM CLEARANCE TO PROPOSED STORMWATER.

APPROXIMATE EXTENT OF WATERWAY TO BE REINSTATED. REMOVE EXISTING CULVERTS & PAVEMENT AND CONSTRUCT WATERWAY.

APPROXIMATE EXTENT OF EXISTING WATERWAY TO BE MAINTAINED

EXISTING HEADWALL & CULVERT UNDER EXISTING DRIVEWAY TO BE DEMOLISHED

EXISTING 2×Ø825 PIPES TO BE DEMOLISHED

RETAINING WALL 2

DISCHARGE TO REINSTATED CHANNEL AT I.L.10.85 APPROX.

EXISTING HEADWALL & 2×Ø900 PIPES TO BE PRESERVED

RETAINING WALL 3

PROPOSED BUILDING FFL 17.30

PROVIDE DROPPER

PROVIDE DROPPER. STORMWATER PIPES TO DISCHARGE INTO BASEMENT IN-GROUND DRAINAGE SYSTEM.

PROVIDE HAVESTOCK FLOOR DRAINS ALONG SUSPENDED SLAB. PIPES TO BE SLUNG UNDER SLAB AND TO DISCHARGE INTO BASEMENT IN-GROUND DRAINAGE SYSTEM. REFER TO DRAWINGS DA42 & DA45 FOR DETAILS.

RETAINING WALL 1. REFER TO DRAWING DA51 FOR DETAILS. TYPICAL

EXISTING BUILDING FFL 18.29

PIT C01 · PIT C02 · PIT C03 · PIT C04 · PIT C05 · PIT D01 · PIT A01 · PIT A02 · PIT A03 · PIT A04 · PIT A05 · PIT A06 · PIT A07 · PIT A08 · FD 01 · FD 02

ORLANDO ROAD · SOUTH CREEK ROAD · INMAN ROAD · SITE BOUNDARY

STORMWATER MANAGEMENT BASIN

F.S.L. = 12.00m
OSD STORAGE = 1,325m³
FILTER MEDIA AREA = 663m²
MEDIA DEPTH = 500mm
EXTENDED DETENTION DEPTH = 300mm
BIO-RETENTION FILTRATION AREA EXCLUSIVE OF SCOUR PROTECTION, INLET STRUCTURES & OUTLET STRUCTURES.

STORMWATER DRAINAGE NOTES:

REFER TO DRAWING DA10 FOR STORMWATER DRAINAGE NOTES

STORMWATER PIT SCHEDULE:

REFER TO DRAWING DA42 FOR STORMWATER PIT SCHEDULE

STORMWATER DRAINAGE PLAN - GROUND FLOOR

1:500 SCALE

5m 0 10 20 30 40 50m
1:500 SCALE AT A1 SHEET SIZE

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DRAWING TITLE
STORMWATER DRAINAGE PLAN
GROUND FLOOR

DRAWING No C013674.01-DA41 ISSUE B

LEGEND:

LEVELS DATUM IS AHD.

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- GRATED DRAIN (300W × 200D U.N.O.)
- DRAINAGE LINE
- ROOFWATER LINE
- EXISTING SEWER MAIN

PIT SCHEDULE

NETWORK A

PIT No.	GRATE RL	TYPE	SIZE	COMMENT
PIT A 01	17.05	SGGP	900×900	⊕
PIT A 02	17.05	SGGP	900×900	⊕
PIT A 03	17.05	SGGP	900×900	⊕
PIT A 04	17.05	SGGP	900×900	⊕
PIT A 05	17.12	SJP	900×900	
PIT A 06	17.00	SGGP	900×900	⊕
PIT A 07	17.00	SGGP	900×900	⊕
PIT A 08	17.00	SGGP	900×900	⊕

NETWORK B

PIT No.	GRATE RL	TYPE	SIZE	COMMENT
PIT B 01	14.05	SGGP	900×900	⊕
PIT B 02	14.05	SGGP	900×900	⊕
PIT B 03	14.05	SGGP	900×900	⊕
PIT B 04	14.05	SGGP	900×900	⊕
PIT B 05	14.05	SGGP	900×900	⊕
PIT B 06	14.05	SGGP	900×900	⊕
PIT B 07	14.05	SGGP	900×900	⊕
PIT B 08	14.05	SGGP	900×900	⊕
PIT B 09	14.05	SGGP	900×900	⊕
PIT B 10	14.05	SGGP	900×900	⊕
PIT B 11	14.05	SGGP	900×900	⊕
PIT B 12	14.05	SGGP	900×900	⊕
PIT B 13	14.05	SGGP	900×900	⊕
PIT B 14	14.05	SGGP	900×900	⊕
PIT B 15	14.05	SGGP	900×900	⊕
PIT B 16	14.05	SGGP	900×900	⊕
PIT B 17	14.05	SGGP	900×900	⊕
PIT B 18	14.05	SGGP	900×900	⊕
PIT B 19	13.70	SJP	900×900	

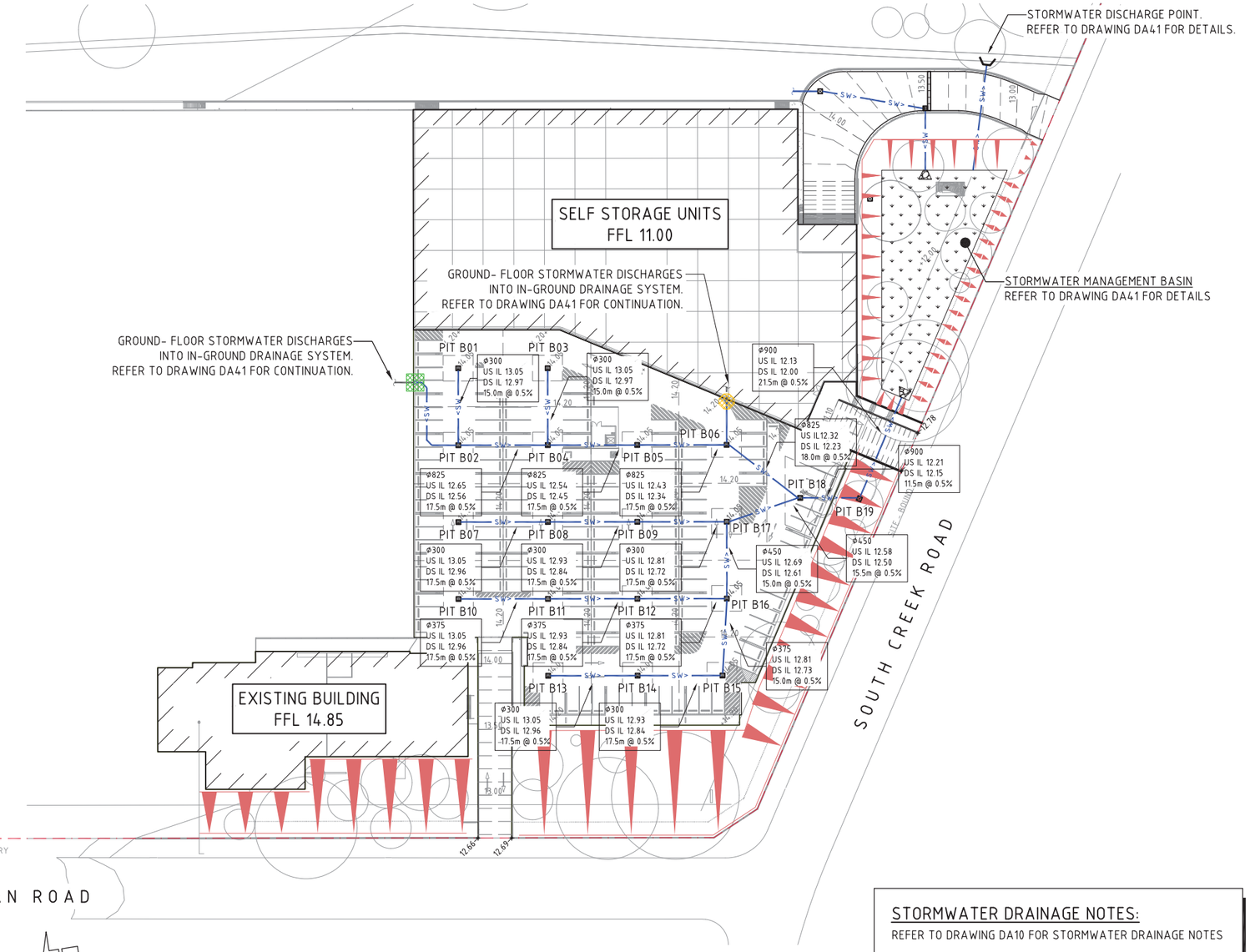
NETWORK C

PIT No.	GRATE RL	TYPE	SIZE	COMMENT
PIT C 01	17.25	SJP	900×900	
PIT C 02	17.00	SJP	900×900	
PIT C 03	15.00	SJP	900×900	
PIT C 04	13.92	SJP	900×900	
PIT C 05	13.50	SGGP	900×900	⊕

NETWORK D

PIT No.	GRATE RL	TYPE	SIZE	COMMENT
PIT D 01	12.45	BIP	1200×1200	

⊕ DENOTES PIT TO BE FITTED WITH OCEANGUARD OCEANPROTECT PIT INSERT



STORMWATER DRAINAGE PLAN - BASEMENT
1:500 SCALE

STORMWATER DRAINAGE NOTES:

REFER TO DRAWING DA10 FOR STORMWATER DRAINAGE NOTES

5m 0 10 20 30 40 50m
1:500 SCALE AT A1 SHEET SIZE

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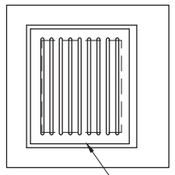
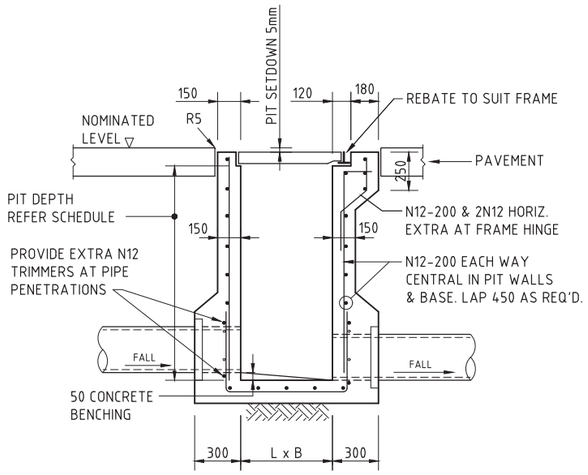
DRAWING TITLE
STORMWATER DRAINAGE PLAN
BASEMENT

DRAWING No C013674.01-DA42

ISSUE B



PLAN
SCALE 1:20



SEE SCHEDULE
L DIMENSION IN DIRECTION OF DOWNSTREAM PIPE

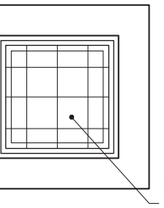
SECTION
SCALE 1:20

SINGLE GRATED GULLY PIT - SGGP

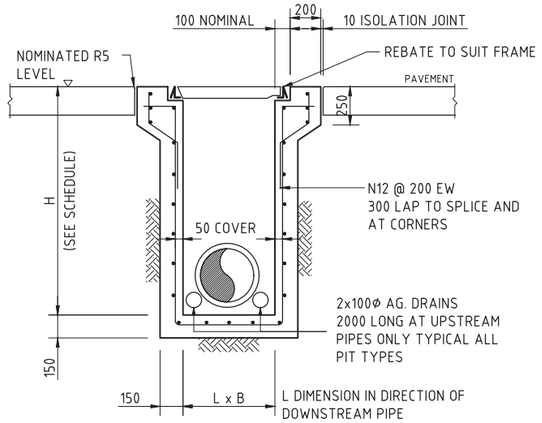
NOTES:

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. CLEAR CONCRETE COVER.
4. FOR PITS DEEPER THAN 1200mm CLIMB RAILS SHALL BE PROVIDED.

CONCRETE QUALITY					
ELEMENT	SLUMP	AGGREGATE (MAX. SIZE)	CEMENT TYPE	ADMIXTURE	F'c (MPa)
PIT	80	20	GP	NIL	25

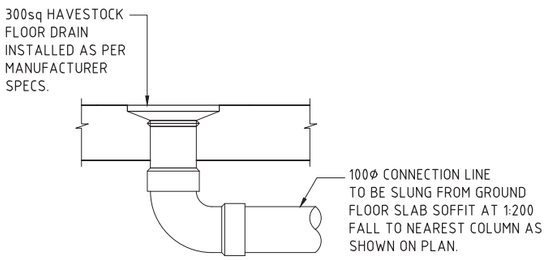


PLAN
1:20

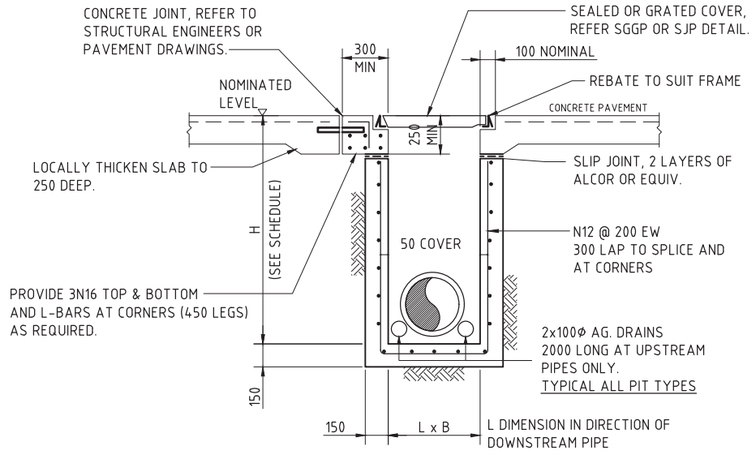


SECTION
SCALE 1:20

SEALED JUNCTION PIT - SJP



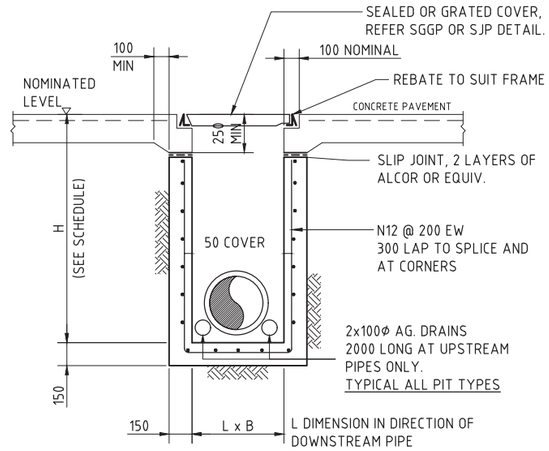
FLOOR DRAIN - FD
SCALE 1:10
(FOR USE IN SUSPENDED SLABS)



SECTION
SCALE 1:20

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)



SECTION
SCALE 1:20

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)

200mm 0 500 1000 1500 2000mm
SCALE 1:20 AT A1 SIZE SHEET

100mm 0 200 400 600 800 1000mm
SCALE 1:10 AT A1 SIZE SHEET

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	B
ISSUED FOR INFORMATION ONLY	01.11.19	A

ARCHITECT

CLIENT
EG FUNDS MANAGEMENT
GOVERNOR PHILLIP TOWER
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SYDNEY, NSW 2000

PROJECT
PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
TW	TW	OCT 2019	MW	A1	AS SHOWN	C013674.01-DA45

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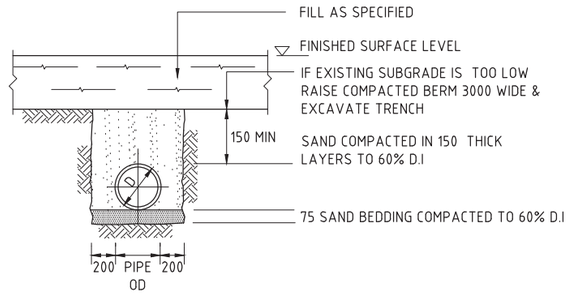
DRAWING TITLE
STORMWATER DRAINAGE DETAILS
SHEET 1

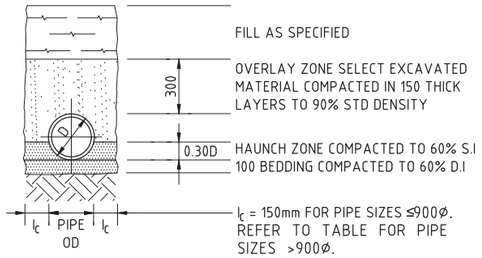
DRAWING No C013674.01-DA45

ISSUE B

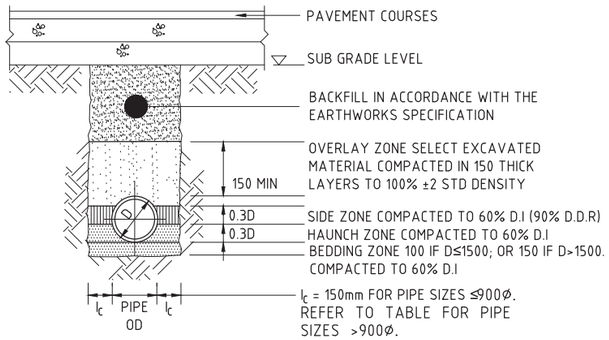
SUPPORT TO AG. DRAIN



SUPPORT TO uPVC PIPES



TYPE H1 SUPPORT TO CONCRETE PIPES AT LANDSCAPED AREAS



TYPE HS2 SUPPORT TO CONCRETE PIPES UNDER PAVEMENT

D≤ 1350, MAX FILL = 4.0m
D> 1350, MAX FILL = 3.0m

BEDDING & HAUNCH MATERIAL GRADING	
SIEVE SIZE	WEIGHT PASSING(%)
19	100
2.36	100 TO 50
0.60	90 TO 20
0.30	60 TO 10
0.15	25 TO 0
0.075	10 TO 0

SIDE ZONE MATERIAL GRADING	
SIEVE SIZE	WEIGHT PASSING(%)
75	100
9.5	100 TO 50
2.36	100 TO 30
0.60	50 TO 15
0.075	25 TO 0

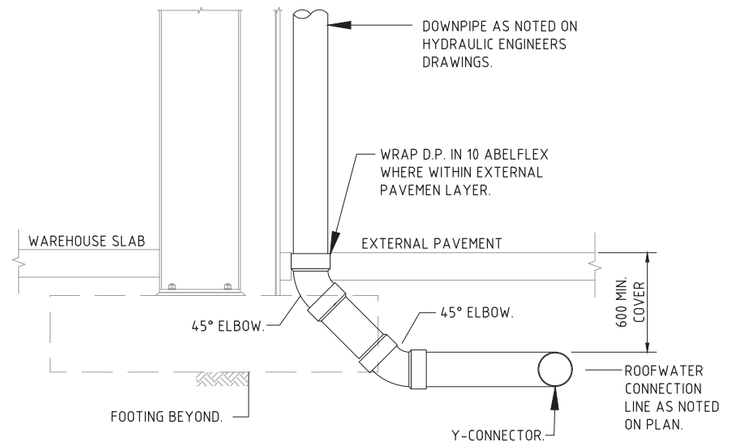
SELECT FILL MATERIAL IN ACCORDANCE WITH TABLE 1 AS 3725

SIDE ZONE WIDTH	
PIPE SIZE	l_c (mm)
≤900ø	150
1050ø	175
1200ø	200
1350ø	225
1500ø	250
1650ø	275
1800ø	300

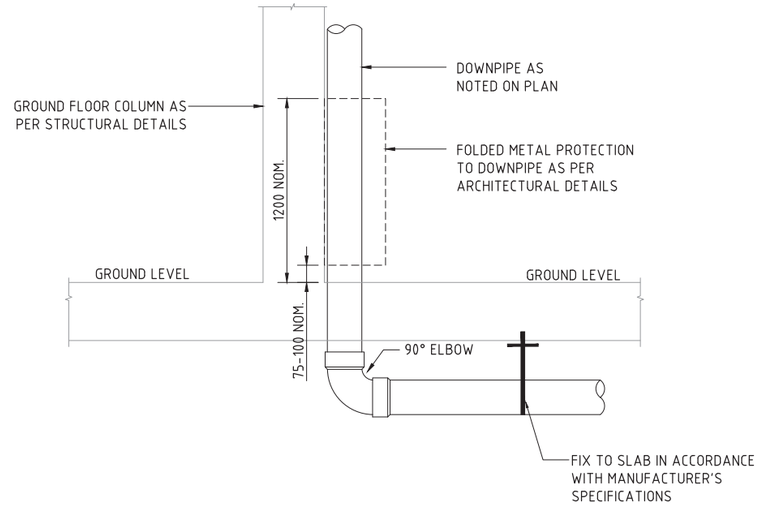
REFER TO ENGINEER FOR TRENCH WIDTHS FOR PIPE SIZES GREATER THAN 1800ø

PIPE LAYING DETAILS

SCALE 1:20



DOWNPIPE TURN-UP DETAIL
(CLEAR OF FOOTING)
SCALE 1:20



DOWNPIPE TURN-UP DETAIL
(AT COLUMN LOCATION)
SCALE 1:20

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SIZE SHEET

FOR DEVELOPMENT APPLICATION

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PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

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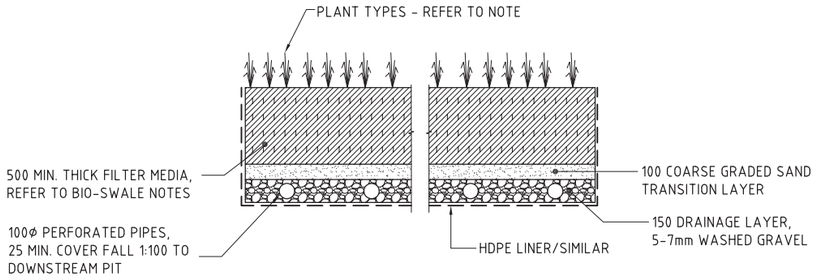
DRAWING TITLE
STORMWATER DRAINAGE DETAILS SHEET 2

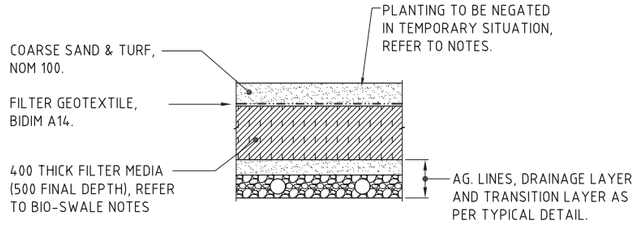
DRAWING No C013674.01-DA46

ISSUE B



TYPICAL BIO-RETENTION DETAIL

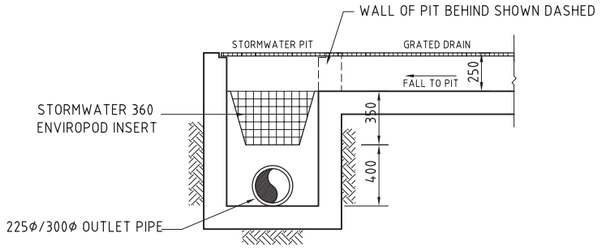
SCALE 1:20



TEMPORARY BIO-RETENTION PROTECTION DETAIL

SCALE 1:20

TEMPORARY CONSTRUCTION REQUIREMENT DETAIL - REFER TO NOTES FOR IMPLEMENTATION PERIODS.



GRATED DRAIN/STORMWATER PIT WITH ENVIROPOD CONFIGURATION

SCALE 1:20

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

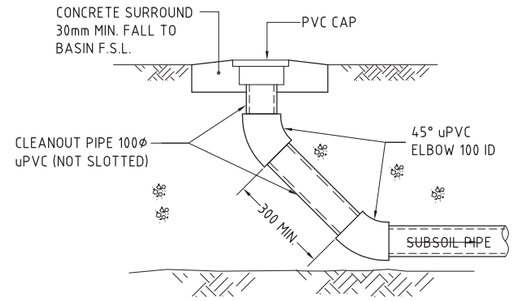
FILTER MEDIA TO BE ASSESSED BY QUALIFIED HORTICULTURALIST TO ENSURE CAPABILITY OF SUPPORTING PLANT LIFE.

DRAINAGE LAYER TO BE CLEAN GRAVEL 5-7mm.

PLANTS TO BE IN ACCORDANCE WITH NORTHERN BEACHES CITY COUNCIL REQUIREMENTS.

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.

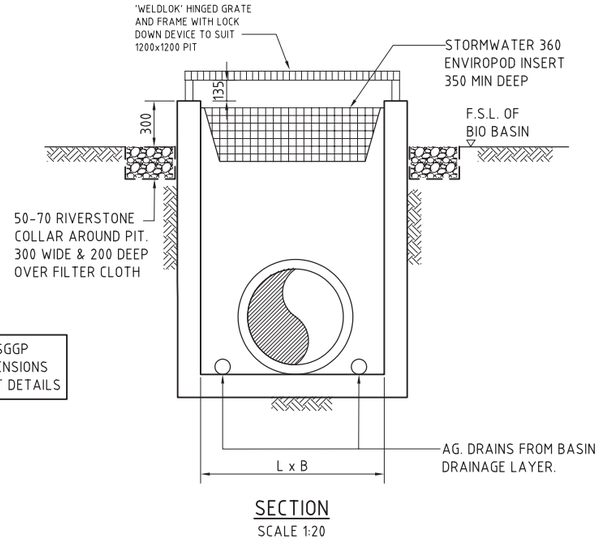
BIO-RETENTION TO BE PARTIALLY INSTALLED, FOLLOWING COMPLETION OF THE ROAD, WITH THE TOP 75-100mm OF FILTER MEDIA REPLACED WITH A FINE TO COARSE SAND UNDERLAIN WITH A GEOTEXTILE LAYER (REFER TO DETAIL). FOLLOWING COMPLETION OF THE UPSTREAM DEVELOPMENT AND SITE STABILISATION, THE SAND IS TO BE REMOVED,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



BIORETENTION CLEANOUT EYE ELEVATION

SCALE 1:20

DENOTED C.E. ON PLAN



REFER TO TYPICAL SGGP DETAIL FOR PIT DIMENSIONS AND REINFORCEMENT DETAILS

SECTION

SCALE 1:20

BASIN INLET PIT - BIP

BIO-RETENTION BASIN DETAILS

SCALE 1:20

FOR DEVELOPMENT APPLICATION

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SIZE SHEET

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PROJECT
PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
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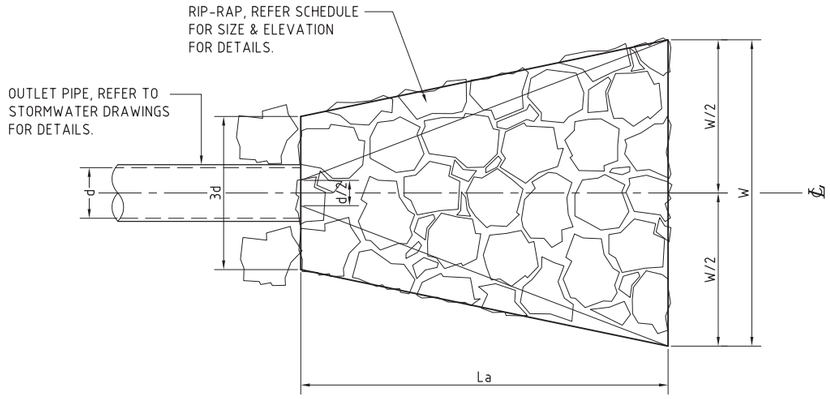
DRAWING TITLE
STORMWATER DRAINAGE DETAILS SHEET 3

DRAWING No C013674.01-DA47

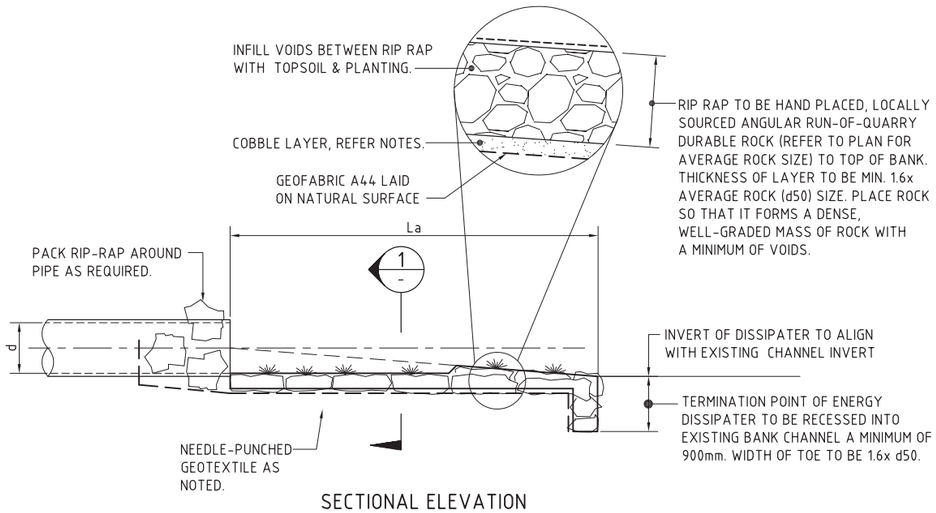
ISSUE B

DISSIPATER NOTES :

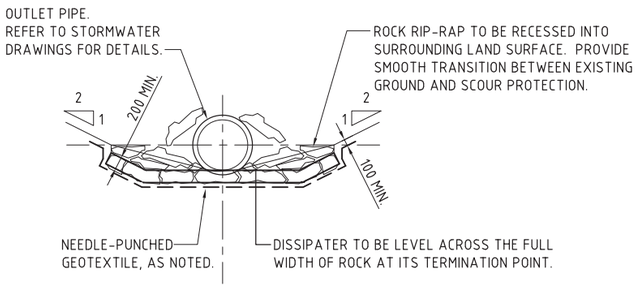
1. ALIGN STRUCTURE EVENLY WITH BANK.
2. LOCATE STRUCTURE AT INVERT LEVEL OF STREAM AND POINT IN A DOWNSTREAM DIRECTION.
3. PIPE TO REST ON, AND BE PACKED IN, BY RIP-RAP (SIZE AS NOTED).
4. DISCHARGE INTO STREAM WHERE BEDROCK IS PRESENT, OTHERWISE SCOUR PROTECT AS REQUIRED.
5. SCOUR PROTECT THE OPPOSITE 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= 150mm MINIMUM) AS NOTED ON THE PLAN. 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.



PLAN



SECTIONAL ELEVATION



SECTION 1:50 (1/-)

STORMWATER OUTLET DISSIPATER

SCALE 1:50

500mm 0 1 2 3 4 5m

SCALE 1:50 AT A1 SIZE SHEET

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	A
AMENDMENTS	DATE	ISSUE

ARCHITECT

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SYDNEY, NSW 2000

PROJECT
PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
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DRAWING TITLE
STORMWATER DRAINAGE DETAILS SHEET 4

DRAWING No C013674.01-DA48

ISSUE A

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED BY LTS LOCKLEY SURVEYORS TITLED 05384 001DT DATED 21/06/2018.

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- GRATED DRAIN (300W × 200D U.N.O.)
- S — EXISTING SEWER MAIN
- 50.00 — FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- 50.10 — FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

APPROXIMATE EXTENT OF EXISTING WATERWAY TO BE MAINTAINED

APPROXIMATE EXTENT OF WATERWAY TO BE REINSTATED. REMOVE EXISTING CULVERTS & PAVEMENT AND CONSTRUCT WATERWAY.

APPROXIMATE EXTENT OF EXISTING WATERWAY TO BE MAINTAINED

APPROXIMATE EXTENT OF EXISTING WATERWAY

PROVIDE BATTERS TO TOP EXISTING WATERWAY

PROVIDE BATTERS TO TOP OF REINSTATED WATERWAY. MAX. 1V:3H.

RETAINING WALL 2
HEIGHT = 4.2m MAX.
LENGTH = 76m APPROX.

END OF WALL 1

START OF WALL 2

2 DA55

1 DA55

END OF WALL 2

START OF WALL 3

PROPOSED BUILDING
FFL 17.30

RETAINING WALL 3
HEIGHT = 1.5 MAX.
LENGTH = 74m APPROX.

PROVIDE MAX. 1V:3H BATTER TO TOP OF WALL WITH BERMS AT TOP & BOTTOM

END OF WALL 3

STORMWATER MANAGEMENT BASIN
REFER TO DRAWING DA41 FOR DETAILS

RETAINING WALL 1
HEIGHT = 6.0m MAX.
LENGTH = 170m APPROX.
REINFORCED EARTH WALL.

RETAINING WALL 4
REFER TO DRAWING DAS2 FOR DETAILS

PROPOSED BUILDING
FFL 17.30

EXISTING BUILDING
FFL 18.29

START OF WALL 1

PROVIDE MAX. 1V:3H BATTERS WITH BERMS AT TOP & BOTTOM. TYPICAL

ORLANDO ROAD

INMAN ROAD

SOUTH CREEK ROAD

SITE BOUNDARY

12 FINISHED LEVELS PLAN – GROUND FLOOR
1:500 SCALE

5m 0 10 20 30 40 50m
1:500 SCALE AT A1 SCALE

FOR DEVELOPMENT APPLICATION

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PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

CONSULT AUSTRALIA

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
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DRAWING TITLE
FINISHED LEVELS PLAN
GROUND FLOOR

DRAWING No C013674.01-DA51

ISSUE B

LEGEND:

LEVELS DATUM IS AHD.

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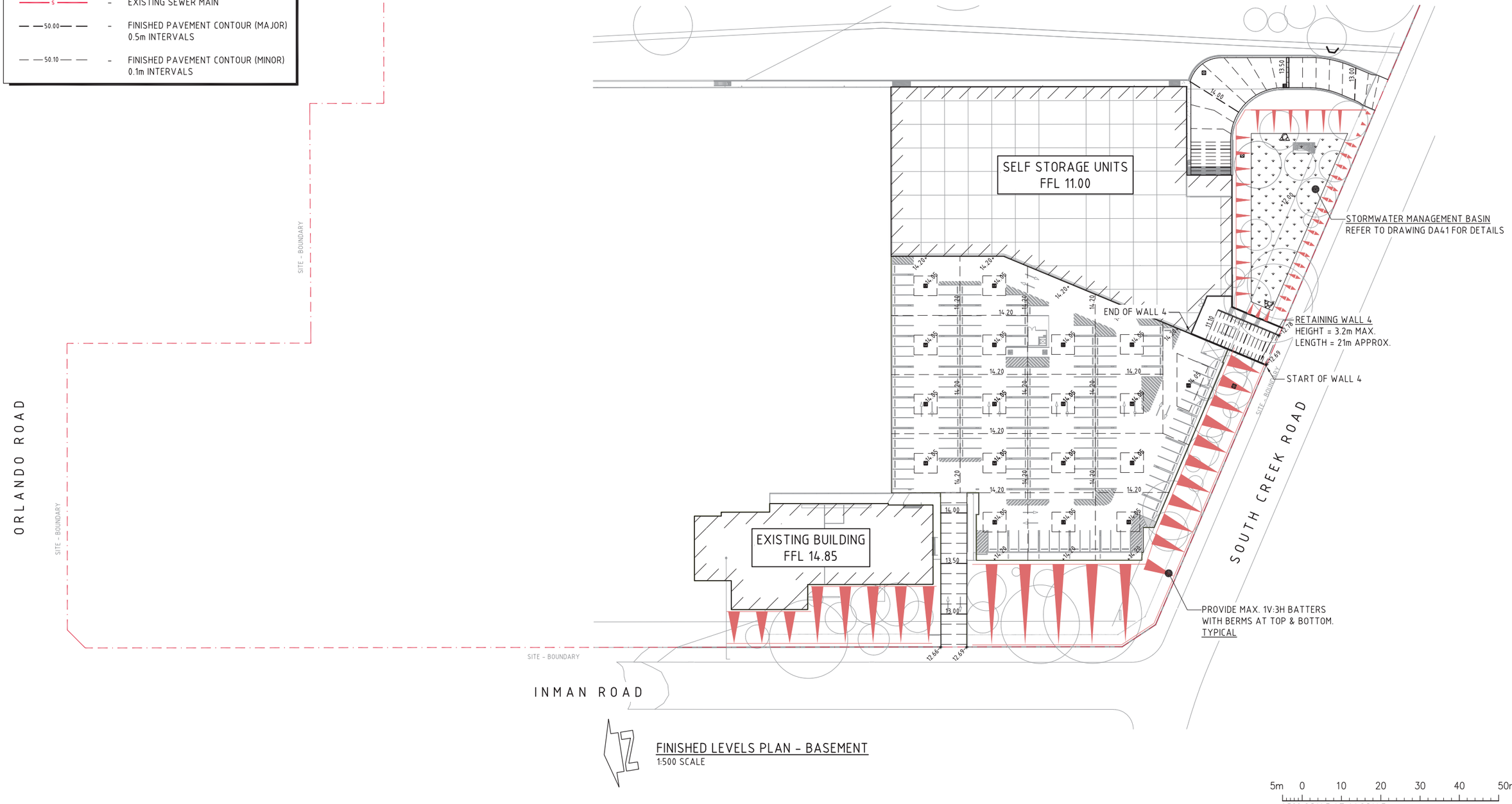
- SJP, SEALED JUNCTION PIT
- GRATED DRAIN (300W × 200D U.N.O.)
- EXISTING SEWER MAIN
- 50.00 – FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- 50.10 – FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS



FINISHED LEVELS PLAN - BASEMENT

1:500 SCALE

5m 0 10 20 30 40 50m

1:500 SCALE AT A1 SCALE

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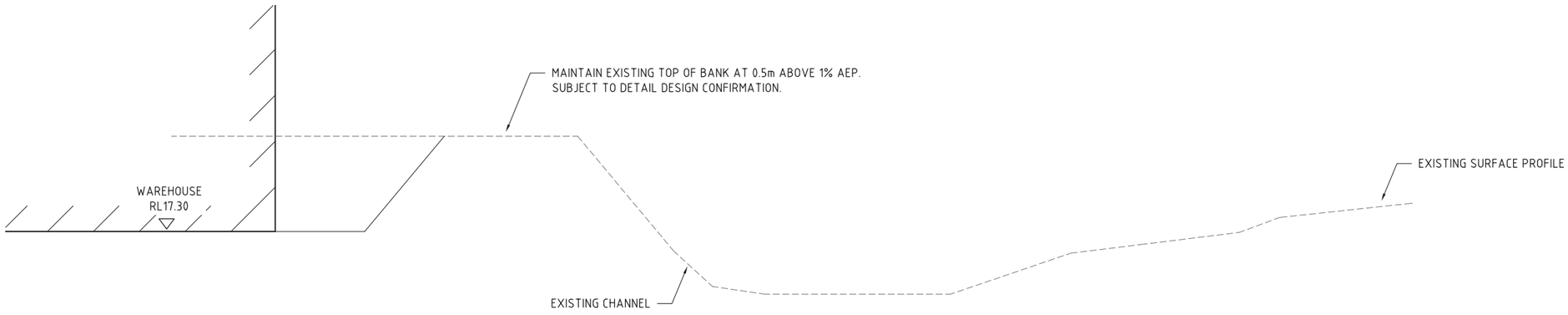
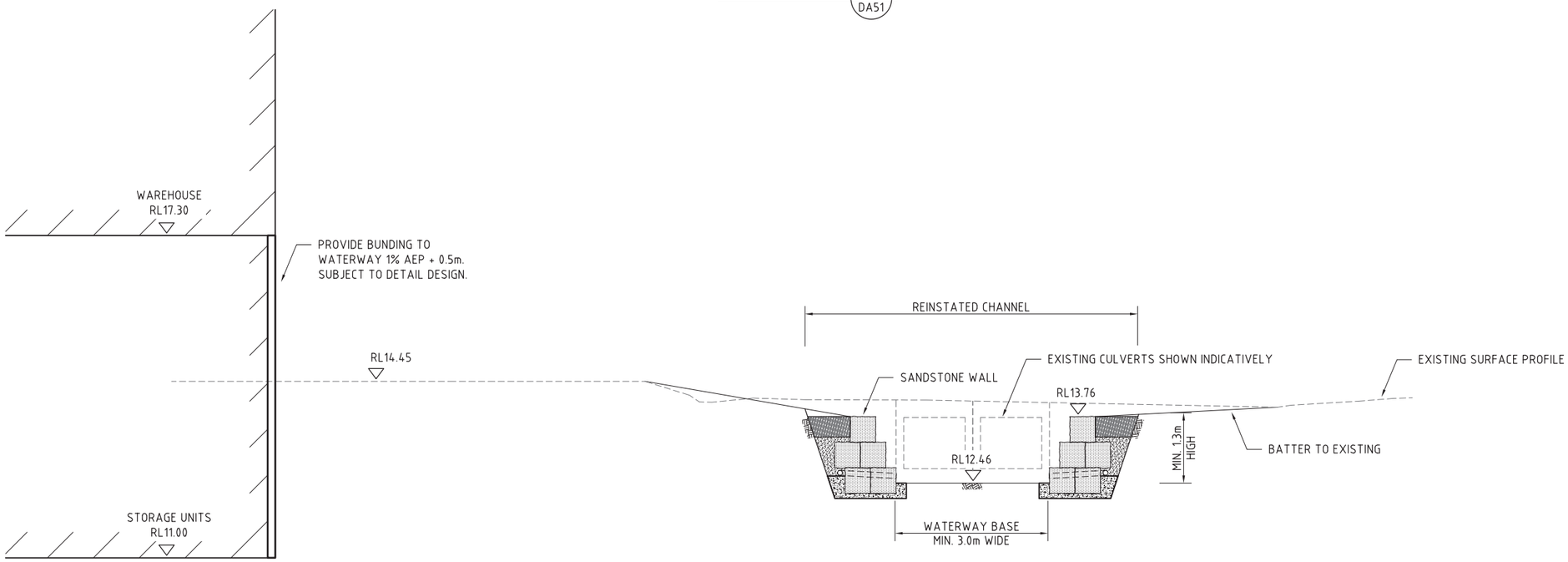
DRAWING TITLE
FINISHED LEVELS PLAN
BASEMENT

DRAWING No C013674.01-DA52

ISSUE B



SECTION 1:50 (2 / DA51)



SECTION 1:50 (1 / DA51)

500mm 0 1 2 3 4 5m
1:50 SCALE AT A1 SCALE

FOR DEVELOPMENT APPLICATION

ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	A
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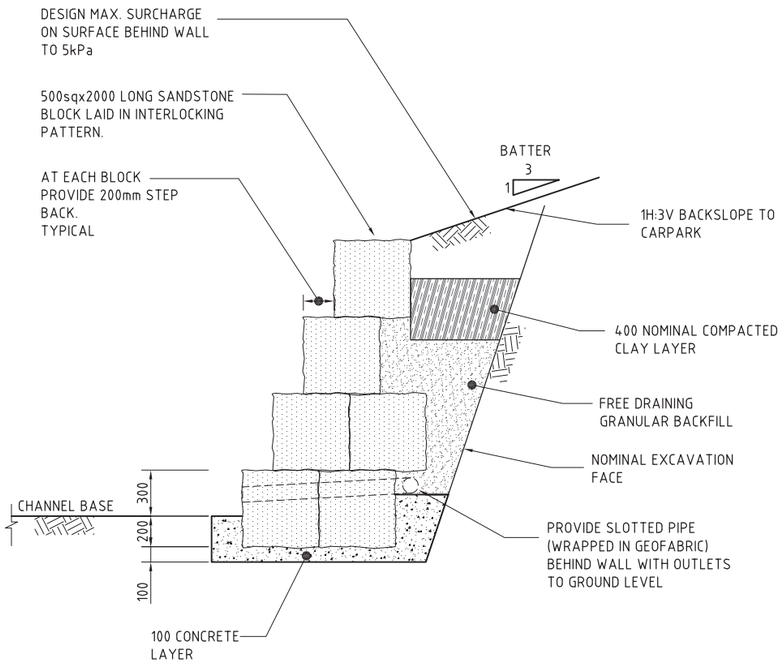
DRAWING TITLE
TYPICAL SECTIONS

DRAWING No C013674.01-DA55 ISSUE A



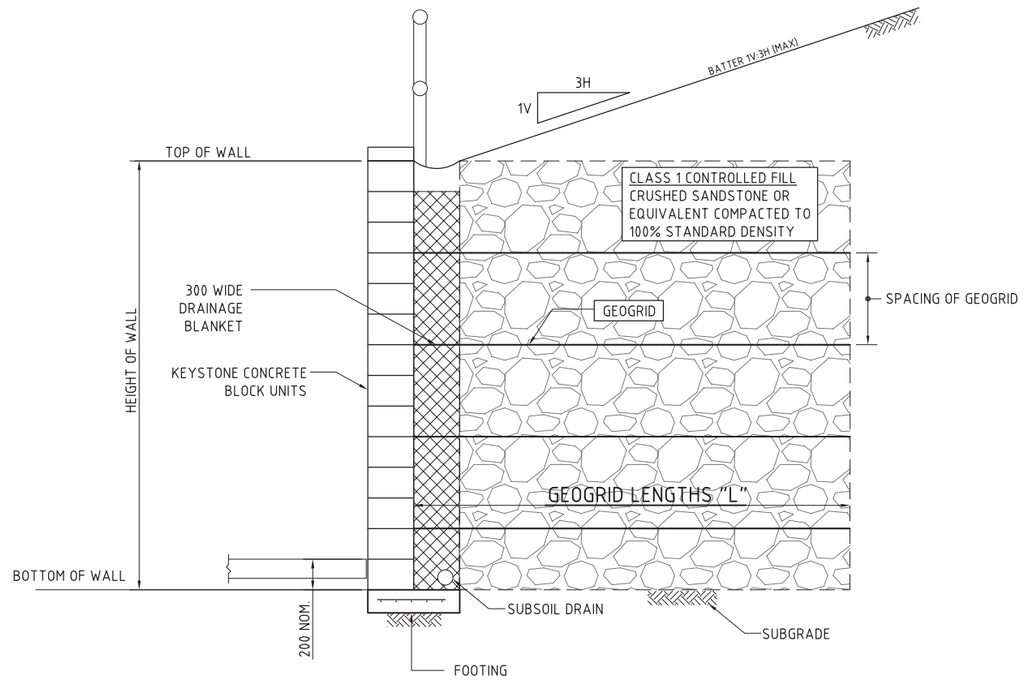
SANDSTONE WALL DETAIL

SCALE 1:20

NOTE:

BASED ON 500x500x2000 LONG STANDARD CUT SANDSTONE BLOCKS LAID IN INTERLOCKING BRICK PATTERN:

- FIRST TWO COURSES TO BE 2xSANDSTONE BLOCKS IN 100 MASS CONCRETE BEDDING.
- THIRD & FOURTH COURSE TO BE 1 SANDSTONE BLOCK.
- STEP EACH SUCCESSIVE COURSES 200mm BACK



REINFORCED EARTH RETAINING WALL

SCALE 1:20

WALL HEIGHT "H"	GEOGRID LENGTH "L"	GEOGRID TYPE
2300	2600	GX50/30
3300	3500	GX50/30
4300	4700	GX50/30
5300	5800	GX50/30
6400	6900	GX50/30
7400	7600	GX50/30

NOTE :
INDICATIVE DETAIL ONLY. DESIGN TO BE CONFIRMED / PROVIDED BY D+C CONTRACTOR.

REINFORCED EARTH RETAINING WALL NOTES:

1. ALL COMPONENTS AND INSTALLATION SHALL COMPLY WITH AS4678 AND THE STANDARDS REFERRED TO THEREIN.
2. MINIMUM HEIGHT (H) TO GEOGRID REINFORCEMENT LENGTH (L) TO BE 1.0.
3. MINIMUM BEARING CAPACITY OF FOUNDATION (BASED ON MINIMUM H/L RATIO OF 1.0) TO BE AS FOLLOWS:
   a. H MAX. 2.0m = 100 kPa
   b. H MAX. 3.5m = 150 kPa
   c. H MAX. 5.0m = 200 kPa

   BEFORE COMMENCEMENT OF CONSTRUCTION THE FOUNDATION SHALL BE INSPECTED AND VERIFIED BY A QUALIFIED GEOTECHNICAL ENGINEER.
4. WHERE MINIMUM BEARING IS NOT ACHIEVABLE OR NOT MEETING DESIGN REQUIREMENT, THE FOUNDATION MATERIAL IS TO BE EXCAVATED AND REPLACED WITH APPROVED MATERIAL PLACED IN ACCORDANCE WITH THE FILLING SPECIFICATION TO A MINIMUM COMPACTION OF 100% SMDD AND PLACED WITHIN 2% OF OMC.
5. MINIMUM SURCHARGE LOADS TO BE APPLIED AS FOLLOWS U.N.O. ON PLAN:
   a. LIVE LOAD = 20 kPa
   b. DEAD LOAD = 5 kPa
   c. CONSTRUCTION TRAFFIC LIVE LOAD = 10 kPa
6. THE GEOGRIDS SHALL BE OF THE TYPE AND INDEX STRENGTH NOMINATED ON THE DRAWINGS. THE MINIMUM GEOGRIDS SHALL BE A SINGLE LENGTH IN THE DIRECTION OF DESIGN TENSION, NOT LAPPED, MAKING PROVISION FOR CONNECTION TO THE FACING ACROSS THE WHOLE WIDTH OF THE FACING AND PROVIDING FOR THE SPECIFIED ANCHORAGE WITHIN THE DESIGNATED ANCHORAGE ZONE. GEOGRIDS SHALL COVER THE WHOLE OF THE PLAN AREA BEHIND THE WALL FOR THE SPECIFIED ANCHORAGE LENGTH AND SHALL BE LAPPED WITH ADJACENT SECTIONS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
7. MINIMUM WALL EMBEDMENT AT THE TOE OF THE WALL TO BE 300mm.
8. DESIGN LIFE OF STRUCTURE IS TO BE 100 YEARS.
9. SELECT BACKFILL MATERIAL WITHIN THE REINFORCED SOIL BLOCK SHALL BE SOUND GRANULAR MATERIAL OF NATURAL OR INDUSTRIAL ORIGIN, NON-EXPANSIVE, FREE FROM ORGANIC OR OTHER DELETERIOUS MATERIAL CONFORMING TO THE PHYSICAL, CHEMICAL AND ELECTROCHEMICAL LIMITS AS SPECIFIED AND SHALL NOT BE SUBJECT TO BREAKDOWN UNDER COMPACTION. THE SELECT BACKFILL MATERIAL IS TO HAVE THE FOLLOWING PARAMETERS:
   a. MINIMUM INTERNAL FRICTION, Ø = 34°
   b. EFFECTIVE COHESION, C'= 0 kPa
   c. UNIT WEIGHT = 21 kN/m^3
   d. PH BETWEEN 4 AND 9.
10. SELECT BACKFILL IS TO BE PLACED AND COMPACTED IN LAYERS NOT MORE THAN 300mm (LOOSE). COMPACTION TO NOT LESS THAN 100% SMDD WILL BE ACHIEVED AND MATERIAL PLACED WITHIN 2% OF OMC. DENSITY TESTING SHALL BE PERFORMED IN EACH COMPACTED LIFT IN ACCORDANCE WITH AS3798.
11. PROVIDE A DRAINAGE LAYER DIRECTLY BEHIND THE FACING UNITS IN A MINIMUM 300mm WIDE 12-20mm AGGREGATE LAYER. FACING UNIT VOIDS TO BE FILLED WITH AGGREGATE. PROVIDE 100mm MINIMUM AG. DRAIN IN GEOTEXTILE SOCK AT TOE OF WALL FACING AND CONNECT TO DRAINAGE SYSTEM AT 30m MAX. SPACING.
12. THE NEED FOR A CHIMNEY DRAIN OR DRAINAGE AT THE REAR OF THE MASS SOIL BLOCK IS TO BE CONFIRMED ON SITE BY THE GEOTECHNICAL ENGINEER AND DESIGNER FOLLOWING PREPARATION OF THE FOUNDATION AND PRIOR TO CONSTRUCTION OF THE MASS SOIL BLOCK.
13. CONSTRUCTION EQUIPMENT WEIGHING MORE THAN 500kG STATIC WEIGHT IS TO BE KEPT BACK 1.5m FROM THE REAR FACE OF THE WALL FACING UNITS. COMPACTION OF THE SELECT FILL MATERIAL WITHIN THE 1.5m STRIP ADJACENT TO THE WALL SHALL BE ACHIEVED BY LIGHT MECHANICAL TAMPERS (VIBRATING PLATE, TRENCH COMPACTOR OR SIMILAR) TO GIVE THE SAME DENSITY AS IN THE REMAINDER OF THE SELECT FILL.
14. ALL DESIGN AND CONSTRUCT WALL SYSTEM TO BE COMPLETED IN ACCORDANCE WITH THESE NOTES.

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SIZE SHEET

FOR DEVELOPMENT APPLICATION

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPLICATION	26.11.19	A

ARCHITECT

CLIENT
EG FUNDS MANAGEMENT
GOVERNOR PHILLIP TOWER
21/1 FARRER PLACE
SYDNEY, NSW 2000

PROJECT
PROPOSED DEVELOPMENT
100 SOUTH CREEK ROAD
CROMER, 2099, NEW SOUTH WALES

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
TW	TW	OCT 2019	MW	A1	AS SHOWN	C013674.01-DA65

Costin Roe Consulting Pty Ltd.
Consulting Engineers ACN 003 696 448
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Costin Roe Consulting

PRECISION | COMMUNICATION | ACCOUNTABILITY

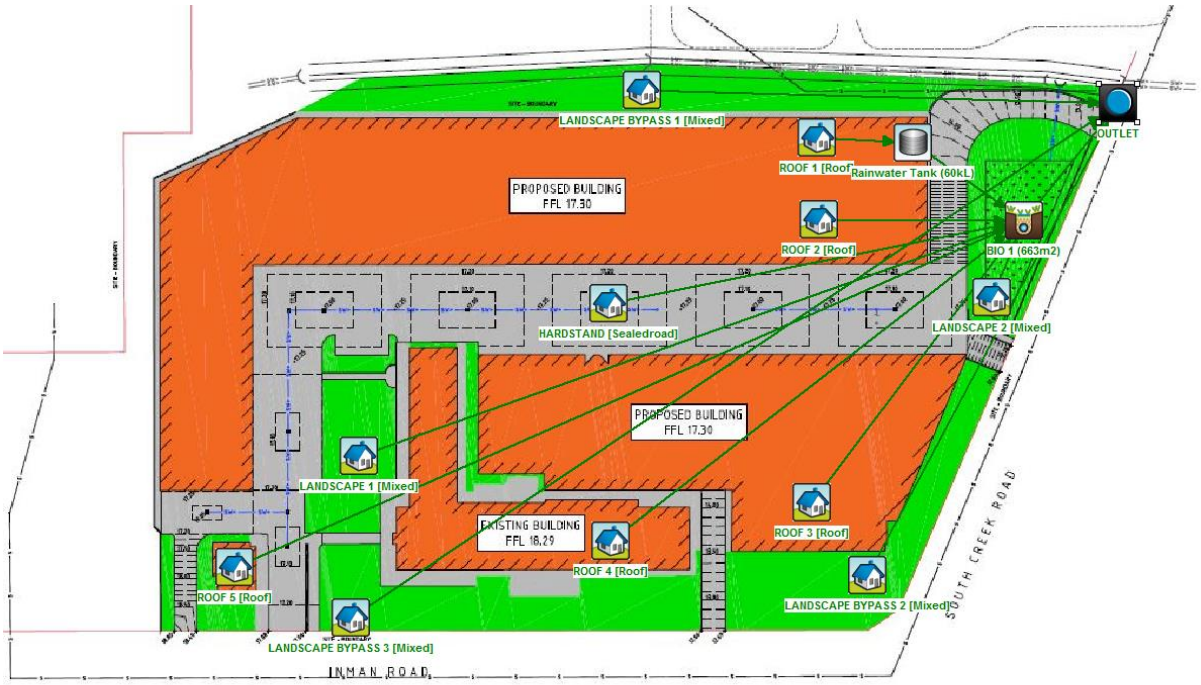
DRAWING TITLE
RETAINING WALL DETAILS

DRAWING No C013674.01-DA65

ISSUE A

Appendix B

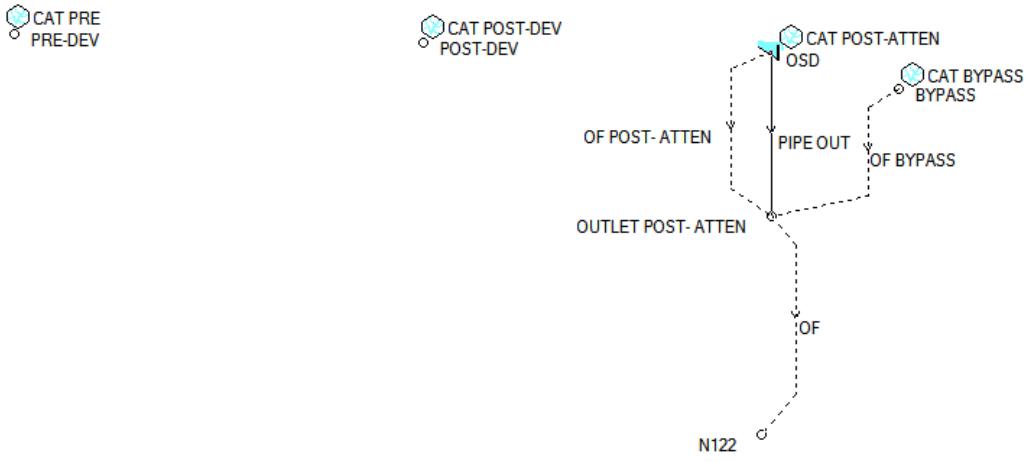
MUSIC MODEL CONFIGURATION



	Sources	Residual Load	% Reduction
Flow (ML/yr)	41.8	38.5	8
Total Suspended Solids (kg/yr)	5580	826	85.2
Total Phosphorus (kg/yr)	12.1	3.78	68.7
Total Nitrogen (kg/yr)	91.4	37.1	59.4
Gross Pollutants (kg/yr)	940	0	100

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.	. . . . .