

CIVIL ENGINEERING SERVICES

Forest Lodge, 8 Forest Road Warriewood Water Management Report





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CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Warren Smith Consulting Engineers (WSCE) has been engaged by Kuarto Build Pty Ltd to prepare an updated Water Management report for the proposed development for Forest Lodge Residential Development at 8 Forest Road, Warriewood.

This report provides updates for the purpose of a Section 4.56 submission with reference to a previous Water Management Report prepared by Martens Consulting Engineers dated February 2017.

The Section 4.56 modification of Approval N0440/15 in The Northern Beaches LGA proposes the following design alterations to the original Development Application submission:

- Removal of the internal 5.5m wide road between Buildings A & D and Buildings B & C.
- Provision of a community space between Buildings A & D and Buildings B & C including:
 - 4m wide shared path
 - BBQ areas
 - Seating areas
 - Outdoor gym area
 - Swimming pool
- Provision of a 4m wide ring road around the apartment building developments.

The above modifications impacts the following civil design elements:

- Site grading and retaining
- Bulk earthworks
- Internal stormwater drainage layout
- Upstream diversion trunk drainage pipe alignment and invert levels
- Overland flow paths
- Ring road alignment, longitudinal sections and cross sections.

1.1 BACKGROUND

The existing site is located at 8 Forest Road, Warriewood approximately 35km North-East of the Sydney CBD. The development site is bound by Narrabeen Creek to the north, residential development to the east, and dense bushland to the west and south. Refer to Figure 1.1 which shows the extent of the development site area in which the proposed works are to be undertaken.



Figure 1.1: Aerial View of Property Boundary (Source: SIXMaps)

The proposed development is for townhouses and multi-storey residential buildings with connecting roads.

2. ABBREVIATIONS AND DEFINITIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
DN	Diameter (mm)
EY	Exceedances per Year
IFD	Intensity-Frequency-Duration
L/s	Litres per second
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Detention
PSD	Permissible Site Discharge
RCP	Reinforced Concrete Pipe
RWT	Rainwater Reuse Tank
SID	Safety In Design
SSR	Site Storage Requirement
WSC	Water Services Coordinator
WSUD	Water Sensitive Urban Design

The Use of Must, Shall & Should:

In accordance with the International Organisation for Standardisation (ISO) Directives, the word “shall” is used to state that a requirement is strictly to be followed in order to conform to a Performance Requirement. Consequently, there can be no deviation from that requirement, other than a specific tolerance.

It is noted that in legislation and specifications it is common to use the word “must” to express a requirement. The word “shall” in this document should be considered as equivalent to “must” in the legislation.

The word “should” introduces a suggestion or recommendation that is not a requirement. It is not necessary that such recommendations or suggestions be followed in order to comply with the Performance Requirement.

3. CIVIL SERVICES GENERAL

3.1 PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide an updated report for a Section 4.56 Modification on Approval N0440/15 with reference to the Water Management Report prepared by Martens Consulting Engineers dated February 2017.

3.1.1 DESIGN CRITERIA

Table 3.1: Design Criteria

Item	Design Criteria
Stormwater Drainage Works	AS/NZS 3500.3 – 2015 – Stormwater Drainage AS 2865 – 2009 Safe Working in a Confined Space Warriewood Valley Water Management Specification 2001 Pittwater 21 Development Control Plan Section C6.1
On-Site Detention (OSD)	AS/NZS 3500.3 – 2015 – Stormwater Drainage AS 2865 – 2009 Safe Working in a Confined Space Pittwater 21 DCP Section 5.7 Warriewood Valley Water Management Specification 2001 Warringah Council On-site Stormwater Detention Technical Specifications
Water Quality Requirements and Proposed Treatment System	Draft NSW MUSIC Modelling Guidelines 2010 Pittwater 21 DCP Section B5.9 Stormwater Management – Water Quality - Other than low-Density Residential Warriewood Valley Water Management Specification 2001
Sediment and Erosion Control	Landcom 'Blue Book' – Managing Urban Stormwater Soils and Construction Guideline Edition 4

With reference to the above-mentioned documents, the Council requirements for this report are as presented below:

Water Quantity

With reference to the Warriewood Valley Water Management Specification:

- Minimum site storage requirements (SSR) to be satisfied as per Table A1.
- Permissible site discharges (PSD) to be satisfied as per Table A2.
- The post-development hydrograph is no more than 10% greater than the pre-development hydrograph.

This is further addresses in Section 5 of the report.

Water Quality

With reference to the Warriewood Valley Water Management Specification:

- Water quality assessment and monitoring
- Water quality management based on local conditions and local water acceptance criteria
- Details and management of Stormwater Quality Improvement devices

This is further addresses in Section 6 of the report.

4. OVERLAND FLOW AND FLOODING

A number of flooding assessments have been undertaken for the proposed development. This report references the information detailed within the Flood Study by Martens Consulting Engineers dated February 2017, and the Flood Assessment by GRC Hydro dated 14th April 2022.

4.1 EXISTING CONDITIONS

The site falls within a High Flood Risk zone as identified by Northern Beaches Council. Narrabeen Creek is situated immediately to the north of the site, however mainstream flooding from the creek does not inundate the proposed development up to and including the PMF.

The property is currently affected by overland flooding from an upstream catchment of approximately 81.6ha.

4.2 PROPOSED DEVELOPMENT

The proposed development incorporates flood mitigation and risk minimising measures as part of the design.

The proposed stormwater drainage system associated with the flood mitigation consists of the following:

- Site is subject to upstream overland flow from the southern direction. A retaining wall has been proposed to act as a flood barrier which extends for almost the entire width of the site along the southern boundary. The top of retaining wall level has been nominated to be RL 30.8, which achieves 500mm freeboard to the 1% AEP flood level.
- Proposed swale, pit, and pipe (1500mm Diameter) network to capture upstream overland flow for all events up to 1% AEP and discharge via headwall outlet to Narrabeen creek.

5. WATER QUANTITY MANAGEMENT

The proposed drainage consists of minor and major systems. The minor system consists of below ground drainage consisting of pits and pipes and have been designed for the 5% AEP storm event. The Major system consists of above ground drainage, consisting of overland flow paths which have been designed to cater for the 1% AEP storm event.

The proposed stormwater drainage system consists of the following:

- A central 10kL rainwater tank located in the basement that services a portion of the multi-storey buildings. The reuse from this tank is proposed to be used for irrigation and toilet flushing.
- The western portion of the site is captured via an internal drainage system consisting of a series of swales, pits and pipes and ultimately discharges via a headwall outlet connection (HW/4) to Narrabeen creek. Prior to discharge to the creek, Bioretention Basin 1 has been proposed upstream to the headwall outlet to control post-development flows back to pre-development levels for all storm events up to and including the 1% AEP event.
- Similarly, the eastern portion of the site is captured via drainage network of swales, pits and pipes and discharged via headwall outlet (HW/5) connection to Narrabeen creek. Bioretention Basin 2 has been proposed upstream to headwall outlet to control post-development flows back to pre-development levels for all storm events up to and including the 1% AEP event.

Refer to the stormwater drawings within Schedule 1 for an illustration of the proposed stormwater & OSD system.

5.1 ON-SITE DETENTION SYSTEM

5.1.1 DRAINS INPUT PARAMETERS

The drainage system shall be modelled utilising DRAINS to ensure the system is designed to meet the Council's stormwater requirements. DRAINS is a stormwater drainage design and analysis program which performs hydraulic grade line analysis and generates the flows which would occur for a particular AEP storm event.

The catchment characteristic factor values which have been used in the DRAINS model are summarised below:

- Paved (impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Soil Type - Normal 2.5
- Antecedent Moisture Condition (AMC) 3.0
- Minimum Pit Freeboard 150mm
- Blockage Factor for On-Grade Pits 50%
- Blockage Factor for Sag Pits 50%

Refer to Table 5.1 for the OSD1 and OSD2 details.

Table 5.1: On-Site Detention Basin Details

Item	Detail
On-Site Detention Basin (OSD1) Summary	
Total Catchment Area Draining	0.844 Ha
Average Base IL	22.19m AHD
Outlet Diameter	225 mm
Orifice Diameter	100 mm
Outlet IL	21.49m AHD
Provided Volume	682 m ³
On-Site Detention Basin (OSD2) Summary	
Total Catchment Area Draining	1.168 Ha
Average Base IL	20.20m AHD
Outlet Diameter	300 mm
Orifice Diameter	n/a
Outlet IL	19.87m AHD
Provided Volume	255 m ³

The minimum OSD storage requirement for the total site as specified in the Warriewood WMS 2001 is 368m³/Ha which equates to 741m³ for the proposed development area of 2.012Ha. The 682m³ and 255m³ bioretention basins provide a total of 937m³, which satisfies this requirement.

Refer to the stormwater drawings within Schedule 1 for an illustration of the proposed stormwater catchment.

5.1.2 SITE DISCHARGE RESULTS

The site discharge results for the pre and post development 1% AEP storm events of varying duration are presented in the below Table 5.2.

Table 5.2: Site Discharge Results (Median Value)

Storm Duration	30 min	1 hr	2 hr	3 hr	6 hr
Council PSD Requirement (L/s/ha)	229	331	390	279	235
Required Site PSD (L/s)	472	682	803	575	484
Pre-Development Site Discharge (L/s)	824	625	541	373	322
Post Development Site Discharge (L/s)	460	294	253	231	221

The site discharge results as demonstrated above satisfy the permissible site discharge requirements as specified in the Warriewood Valley WMS 2001 Table A2.

The hydrographs were also analysed to determine that the post-development hydrograph is no more than 10% greater than the pre-development hydrograph. These hydrographs are provided in Schedule 2 and demonstrate that the post-development hydrograph does not exceed the pre-development hydrograph, and thus this condition is satisfied.

5.2 STORMWATER QUANTITY MAINTENANCE

The pit and pipe network shall be inspected at intervals after a major storm event and not exceeding twelve (12) months. Inspections should be undertaken by suitably qualified persons with an understanding and experience in the operation of similar systems.

Inspections should as a minimum:

1. Check that all grates, covers and lintels are in sound condition and are undamaged. Any signs of deterioration should be noted.
2. Check all pits for accumulation of sediment, debris or litter.
3. If pits are found to be affected by sediment, debris or litter, an assessment should be made as to whether the upstream and downstream pipes require cleaning.
4. Inspect outlet and ensure it is in a sound, undamaged condition.

Maintenance of the pit and pipe system should be undertaken as required following the above inspections. Typical maintenance procedures that would need to be undertaken include:

1. Remove sediment, debris and litter from pits including lintels.
2. Remove sediment or other foreign material from pipes.

Rainwater tanks shall be inspected annually for any damages to gutters, first flush system or any other components that may need replacement.

The bioretention basin shall be also inspected at intervals after a major storm event and as indicated in Section 6.5 of this report.

6. WATER QUALITY MANAGEMENT

To adhere to the Northern Beaches Council's requirements for the adequate treatment of the stormwater runoff, a treatment plan has been formulated for the development area to remove the suspended solids and nutrients before being discharged from the site.

6.1 POTENTIAL POLLUTANTS GENERATED

The pollutants that could potentially be generated as a result of the development are as follows:-

- Gross Pollutants, e.g. Litter;
- Sediments;
- Nutrients (Phosphorus and Nitrogen), and;
- Hydrocarbons.

The development has been modelled to demonstrate the performance of the stormwater treatment system utilising a program called MUSIC (Model for Urban Stormwater Improvements Conceptualisation). MUSIC models the proposed stormwater treatment devices and estimates their respective performance against the performance targets of the project. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP), and Total Nitrogen (TN).

6.2 RAINFALL

The rainfall data used in the MUSIC model was based on the Bureau of Meteorology data and is presented in Table 6.1. A five (5) year continuous rainfall period with the maximum available data has been adopted in accordance with the Northern Beaches Council's WSUD & MUSIC Modelling Guidelines.

Table 6.1: Rainfall Data for MUSIC Modelling

Rainfall Station	Rainfall Period	Rainfall Period Dates	Time Step
066062 Sydney Observatory	5 years	1 Jan 1981 – 31 Dec 1985	6 minutes

The average potential evapotranspiration (PET) data used in the MUSIC model was based on the average monthly PET data for the Sydney region and is presented in Table 6.2.

Table 6.2: Monthly Evapotranspiration Data for MUSIC Modelling

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

6.3 RAINFALL RUNOFF PROPERTIES

Table 6.3 and Table 6.4 present the rainfall-runoff properties which have been utilised in the MUSIC model.

Table 6.3: Soil Properties for MUSIC Source Nodes

Parameter	Units	Rainfall Period Dates	
Impervious Area Parameters			
Rainfall Threshold	mm	0.3 (Roofs) 1.5 (Roads/Pathways)	
Pervious Area Parameters			
		Sand	Sandy Clay Loam
Soil Capacity	mm	350	108
Initial Storage	%	30	30
Field Capacity	mm	144	73
Infiltration Capacity Coefficient – a		360	250
Infiltration Capacity Coefficient – b		0.5	1.3
Groundwater Properties			
		Sand	Sandy Clay Loam
Initial Depth	mm	10	10
Daily Recharge Rate	%	100	60
Daily Baseflow Rate	%	50	45
Deep Seepage	%	0	0

Table 6.4: Stormwater Water Quality Parameters for MUSIC Source Nodes*

Land Use Category		Log ₁₀ TSS (mg/L)		Log ₁₀ TP (mg/L)		Log ₁₀ TN (mg/L)	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roofs	Mean	1.30	*	-0.89	*	0.30	*
	Std Dev	0.32	*	0.25	*	0.19	*
Mixed (Paved & Landscape)	Mean	2.20	*	-0.45	*	0.42	*
	Std Dev	0.32	*	0.25	*	0.19	*

*Base flows are only generated from pervious areas; therefore, these parameters are not relevant to impervious areas

6.4 STORMWATER TREATMENT WSUD DEVICES

Stormwater quality treatment is primarily achieved via two bioretention basins. The basins are proposed in the north-east and north-west of the site, with bioretention filter areas of 127m² and 173m² respectively. The bioretention system will degrade pollutants and nutrients through the planting and filter media layers. Treated water then exits through the underdrain to the discharge control pit.

Rainwater tanks also provide a level of stormwater quality treatment by implementing a first flush system which flushes the first polluted water that collects on the roof.

Refer to the stormwater drawings in Schedule 1 for stormwater quality treatment device locations and details.

6.5 MUSIC MODEL TREATMENT RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Refer to **Figure 6.1** for the treatment plan and **Table 6.5** for the treatment results.

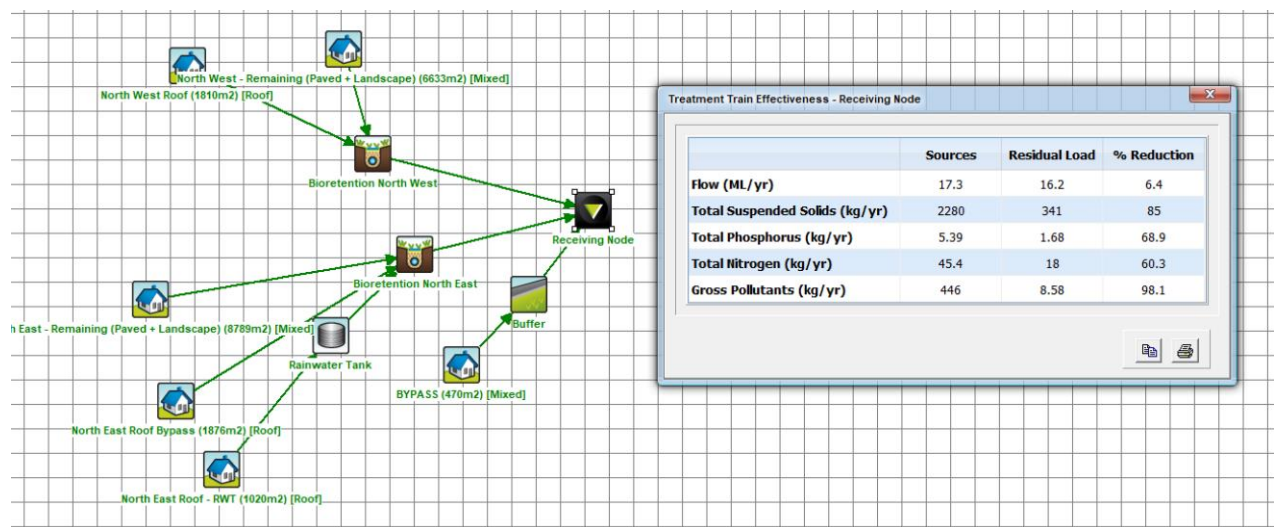


Figure 6.1: MUSIC Model Treatment Plan

Table 6.5: Percentage Based Load Reduction in Pollutant Results

Pollutant Type	Source (kg/yr)	Residual Load (kg/yr)	Reduction % Achieved	Council Target Reduction %
Gross Pollutants (GP)	446	8.58	98.1	90.0
Total Suspended Solids (TSS)	2280	341	85.0	85.0
Total Phosphorus (TP)	5.39	1.68	68.9	65.0
Total Nitrogen (TN)	45.4	18.0	60.3	45.0

As demonstrated within the above results table, the proposed treatment strategy satisfies Northern Beaches Council's targets for pollutant load reduction.

6.6 STORMWATER QUALITY MAINTENANCE

The bioretention basin shall be inspected at intervals after a major storm event and as per the intervals shown in Table 6.5:

Table 6.5: Stormwater Quality Maintenance

Item	Description	Frequency
Filter Media	Check for and remove any build-up or litter from the basin surface.	3 months
	Check for and remove any sediment from inlet pipes, outlet pipes and pits, and filter media.	3 months
	Check for any erosion or scour. Replace or provide additional energy dissipation measures.	3 months
	Replace filter media as required if at capacity or surface is clogged.	10 years or as required
Planting	Assess and treat plant disease or pests and replace if required.	3 months
	Check plant density is consistent with original requirements. Replant as required at appropriate spacings (6-10 plants per m ²).	3 months
	Check for weeds and remove.	3 months
Drainage	Check the underdrain is not blocked. Remove any blockages.	6 months
	Check grates, weirs, inlets and outlets are clear of litter and debris. Repair any damages if identified.	Monthly
General	Check for any operational issues and repair/manage as required.	6 months

6.7 STORMWATER QUALITY MONITORING

Stormwater quality monitoring is proposed to be carried out in the following three locations in the vicinity of the proposed site:

1. Upstream of the site on the south to determine the existing conditions;
2. Downstream of the Basin 1 outlet; and
3. Downstream of the Basin 2 outlet in order to assess the results and impact of the stormwater quality treatment.

Two water and sediment samples are proposed to be taken at each of the above locations – one in dry conditions and one in wet conditions. These samples are to be taken once prior to construction and again at completion of construction for assessment.

The monitoring requirements indicating the variables to be tested are provided in Table C1 from the Warriewood WMS 2001. The acceptance criteria for these variables are shown in Table C2 from the Warriewood WMS 2001. Refer to Schedule 3 for these tables.

6.8 MOSQUITO RISK ASSESSMENT

A mosquito risk assessment has been undertaken to identify possible locations where ponding water can occur and therefore pose a risk of mosquito breeding. The assessment also identified proposed strategies to minimize this risk.

6.8.1 POTENTIAL LOCATION

The below locations have been identified as possible locations where water may lie stagnant and therefore provide a potential breeding environment for mosquitoes:

- General surface areas
- In-ground stormwater pits
- Bioretention/OSD Basins
- Narrabeen Creek

6.8.2 MANAGEMENT STRATEGIES AND RISK ASSESSMENT

The below management strategies or design conditions are listed below for the potential breeding locations:

- General surface areas – Site grading has been designed such that no areas will allow for ponding without in-ground drainage. Overland flow paths have been designed to be directed towards the bioretention basins and ultimately Narrabeen Creek.
- In-ground stormwater pits – The in-ground stormwater system freely drains by gravity and benching has been provided in all pits such that no water will pond within the pits or pipes. Regular maintenance should be carried out in accordance with the stormwater maintenance plan.
- Bioretention/OSD Basins – The basins drain via gravity through the discharge control pit towards Narrabeen Creek. The basins are generally dry in between storm events. Regular maintenance should be carried out in accordance with the stormwater maintenance plan.
- Narrabeen Creek – The creek is well graded with minimal localised flat or low areas at risk of ponding water. The creek runs from a west to east direction.

Per the above management strategies, the mosquito risk for the proposed development is considered to be relatively low.

7. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the guidelines set out in Landcom's Managing Urban Stormwater Soils & Construction Guidelines and the general requirements outlined below.

7.1 SITE PROTECTION MEASURES

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the requirements outlined below to inhibit the movement of sediment off the site during demolition and construction phases.

7.1.1 SITE ACCESS

Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry / Exit consisting of a 1.5m long by 3m wide 'cattle rack'.

7.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt downslope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following: -

- Geotextile fabric buried to a maximum of 150mm below the surface. Refer to Figure 7.1 for details;
- Overlapping any joins in the fabric;
- Turning up on the ends for a length of 1 meter in order to prevent volumes of suspended solids escaping in a storm event;

Refer to Figure 7.1 for details.

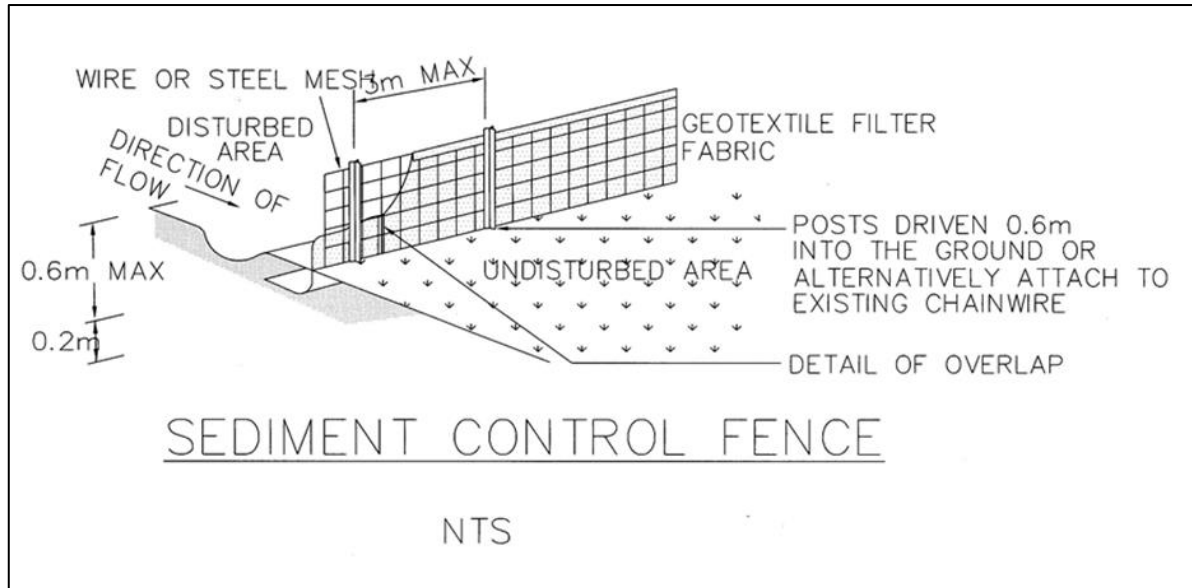


Figure 7.1: Sediment Control Fence Detail

Check Dams have also been proposed to reduce erosive energy levels of concentrated water within drainage channels. They can be built with various materials, including rocks, logs, sandbags, and straw bags under the following requirements:

- Trench the check dam 200mm into the ground across its whole width. Where rock is used, fill the trench to at least 100mm above the ground surface to reduce the risk of undercutting.
- Their maximum height should not exceed 600mm above the gully floor. The centre should act as a spillway, being at least 150mm lower than the outer edges.

Refer to Figure 7.2 below for details.

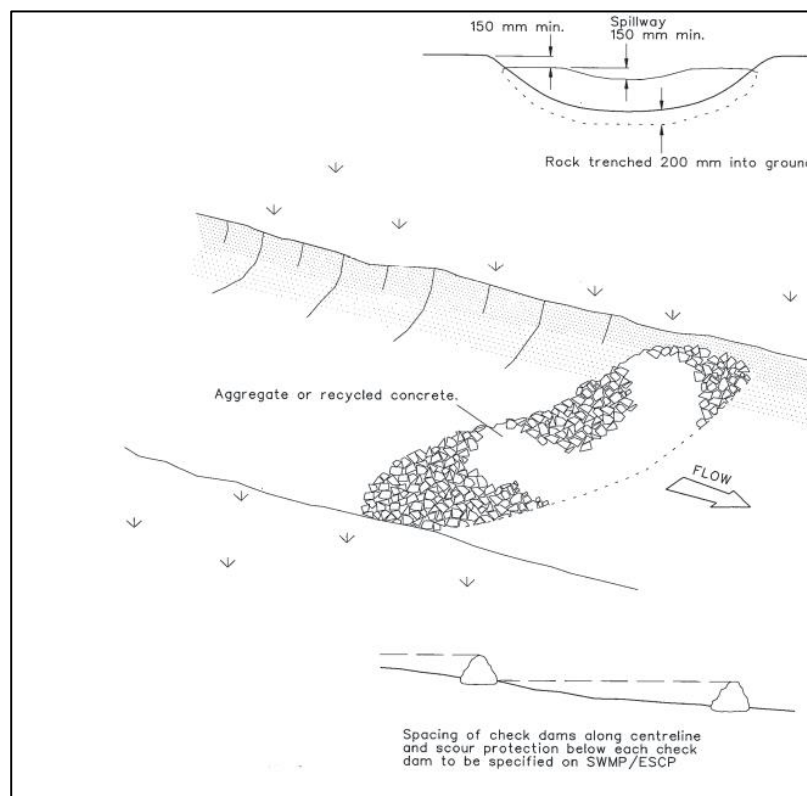


Figure 7.2: Rock Check Dam (NTS)

7.1.3 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained towards a central holding well within the excavation and sediment basins as shown on the Soil and Water Management Plan. The runoff will be allowed to settle out suspended particles and debris, and acceptable water of 50mg per litre of Non-Filterable Residues (NFR) is required to be achieved before discharge.

Upstream catchment runoff is proposed to be diverted through the site as “clean / unaffected water”, directly to Narrabeen Creek via a diversion channel.

7.1.4 DUST CONTROL

The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with TfNSW and local Council Guidelines;
- Soil transport vehicles will use the single main access to the site;
- There will be no burning of any materials on site;
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by the wind. The watercraft will be equipped with a pump and sprays;
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on-site during the construction of the works;
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to traveling on Council Roads, and;
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

7.1.5 SEDIMENT PUMP OUT PITS

Sediment pump out pits shall be installed within the extent of proposed basement. A perforated riser outlet pipe shall be installed to pump any rainwater collected in these pits and shall discharge into a grated inlet pit along the southern boundary of the site. Refer to Figure 7.3 for details of a perforated riser outlet pipe.

The pump out pit within the basement are to discharge to Sediment Basins 1 & 2.

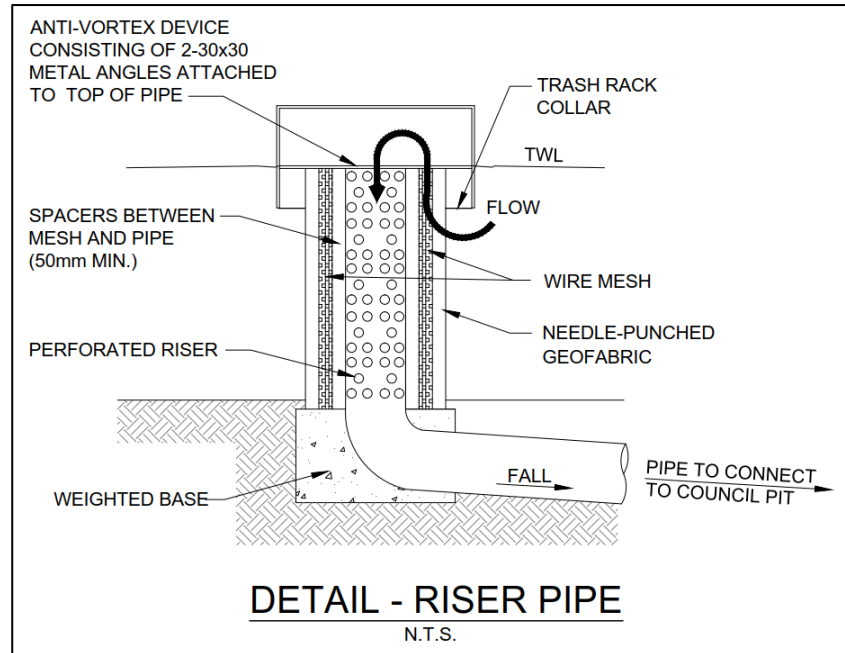


Figure 7.3: Pump Out Pit Outlet Pipe Detail

7.1.6 MAINTENANCE

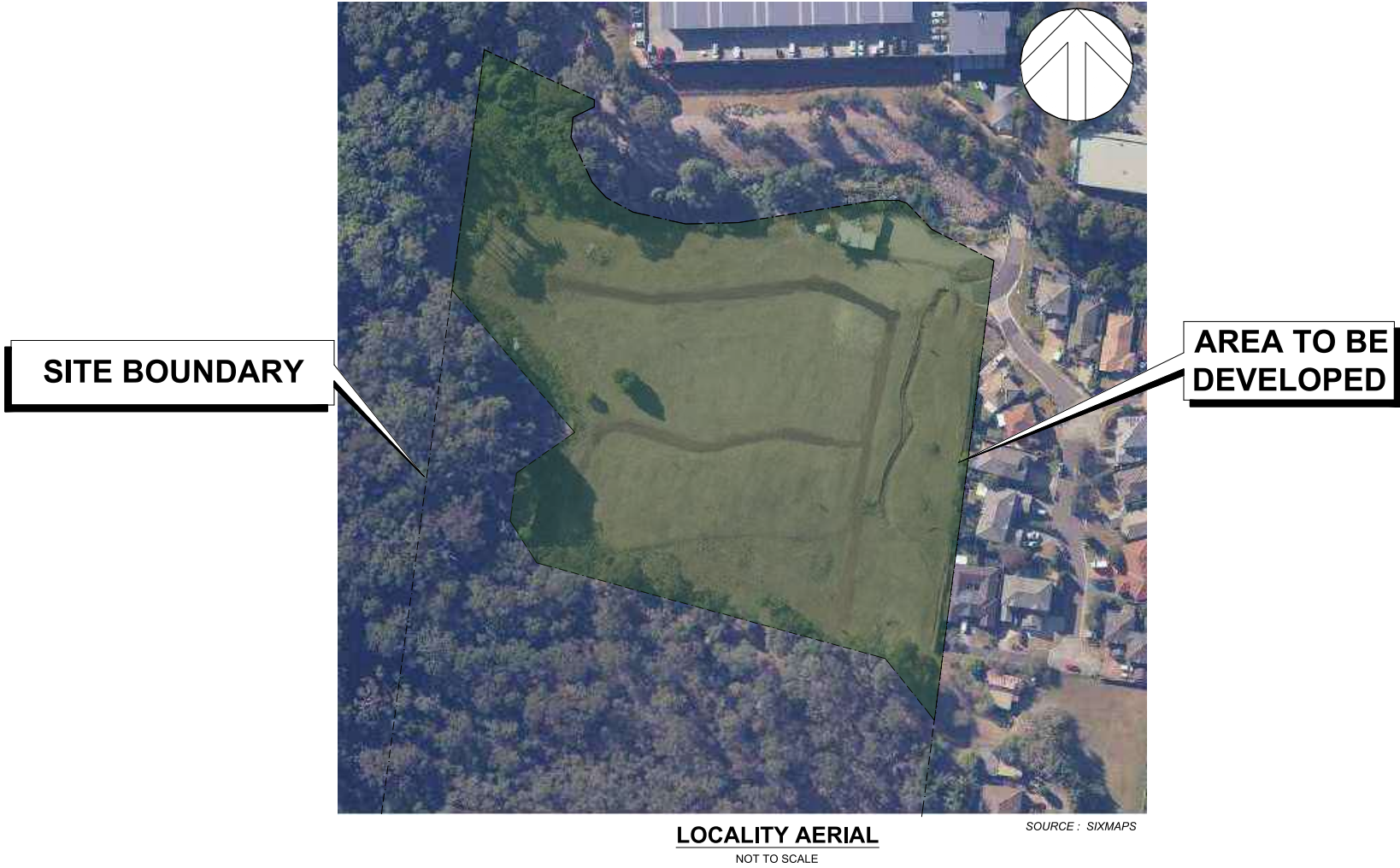
Generally, the following maintenance measures shall be adhered to during construction:

- It will be the responsibility of the site foreman for the building contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily, and the appropriate maintenance to be undertaken as necessary;
- Prior to the closing of the site each day, the road shall be swept, and materials deposited back onto the site;
- Gutters and roadways will be kept clean regularly to maintain them free of sediment;
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles, and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail; a new work method statement must be provided by the contractor to ensure levels are reduced to a manageable level;
- If fugitive emissions have the potential to cause the ambient quality to foul the ambient air quality, measures must be taken in order to safely enclose emissions or implement a local extraction ventilation system;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site;
- Materials processing equipment suitable to comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks, and;
- Suitable and approved bins shall be utilised for the containment of hard waste, including concrete slurries, building waste, and litter. In the case of accidental spills, particularly within the public reserve, the material shall be swept and contained, and not washed into a gutter or waterway.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site and the adjacent public roads, footpaths, and environment.

SCHEDULE 1 CIVIL DRAWINGS

FOREST LODGE WARRIEWOOD CIVIL & STORMWATER ISSUE FOR S4.56



Sheet List Table		
DWG No	DRAWING TITLE	ISSUE
C1.00 Arrangement and Overview Plans		
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C1.03	Exsiting Survey	1
C2.00 Sediment and Erosion Control		
C2.01	Sediment & Erosion Control Plan	4
C2.02	Sediment & Erosion Control Details	1
C3.00 Earthworks		
C3.01	Bulk Earthworks Levels Plan	4
C4.00 Siteworks Plans		
C4.01	General Arrangement Plan-Sheet 1	2
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C5.00 Road Longitudinal and Cross Sections		
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C5.11	Road Long Sections - Access Road	1
C5.12	Road Long Sections - Ring Road	2
C5.21	Road Cross Sections - Access Road	1
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C6.00 Stormwater Drainage		
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C6.07	Stormwater Drainage Details - Sheet 2	2
C6.11	Bioretention Basin Plan - Sheet 1	3
C6.12	Bioretention Basin Plan - Sheet 2	2
C6.13	Bioretention Basin Sections - Sheet 1	1
C6.14	Bioretention Basin Sections - Sheet 2	1
C6.21	Stormwater Catchment Plan - Sheet 1	3
C6.22	Stormwater Catchment Plan - Sheet 2	3
C6.41	Trunk Drainage Longitudinal Section	3

Scale: 1:1000
Plot Date: 18.09.2024
Project: 7368002
Client: KLATRO
Project Manager: KLATRO
Architect: ADS ARCHITECTS
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GLOBAL COMPLIANCE CERTIFICATION
GCC
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CLIENT

PROJECT MANAGER

ARCHITECT

KLATRO

KLATRO

ADS ARCHITECTS



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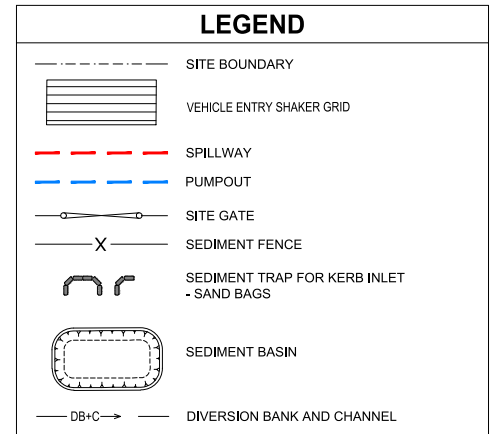
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COVER SHEET

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AS SHOWN	I.K.	I.O.S	J.G.	J.G.
JOB No.	DRAWING No.		ISSUE	
7368002	C1.01		4	
DATE	STATUS			
SEPTEMBER 2023	ISSUE FOR S4.56			

Plot Date



1. GEOTEXTILE INLET FILTER BAGS TO BE FITTED IN ALL EXISTING AND PROPOSED STORMWATER GRATED PITS WITHIN THE DEVELOPMENT AREA WHICH ARE IN USE.
2. STOCKPILE LOCATION SHALL BE DETERMINED ON SITE DURING CONSTRUCTION STAGE. STOCKPILE ARE TO REMAIN CLEAR OF SITE ACCESS, DRAINS AND PAVED AREAS. HEIGHT OF STOCKPILE SHALL NOT EXCEED 2m.
3. INSTALLATION OF ALL EROSION AND SEDIMENT CONTROL MEASURES IS TO BE IN ACCORDANCE WITH THE LATEST EDITION OF THE 'BLUE BOOK - MANAGING URBAN STORMWATER'. ALL CONTROLS ARE TO BE INSTALLED PRIOR TO CONSTRUCTION COMMENCING.
4. THE CONTRACTOR IS RESPONSIBLE FOR THE CORRECT INSTALLATION AND ONGOING MAINTENANCE OF THE CONTROLS. REFER TO DRG C2.02 FOR MAINTENANCE REQUIREMENTS.
5. SUITABLE AND APPROVED BINS SHALL BE UTILISED FOR THE CONTAINMENT OF ALL HARD WASTE, INCLUDING CONCRETE SLURRIES, BUILDING WASTE AND LITTER. IN THE CASE OF ACCIDENTAL SPILLS OF SOIL OR OTHER MATERIAL, PARTICULARLY IN THE PUBLIC RESERVE, THE MATERIAL SHALL BE SWEEP AND CONTAINED AND NOT WASHED INTO A GUTTER.

SEDIMENT BASINS HAVE BEEN SIZED BY USING PROCEDURES DETAILED IN THE 'BLUE BOOK - MANAGING URBAN STORMWATER' FOR TYPE D BASINS. A SUMMARY OF THE CALCULATED AND PROVIDED VOLUMES IS PROVIDED BELOW.

SEDIMENT BASIN 1:	
REQUIRED VOLUME	= 339 m ³
BASE AREA	= 167 m ²
TOP AREA	= 726 m ²
DEPTH	= 2.11 m
MAX SIDE SLOPE	= 1V:2.5H
VOLUME PROVIDED	= 942 m ³

PROVIDE 2m SPILLWAY TO CREEK.

SEDIMENT BASIN 2:
REQUIRED VOLUME = 376 m³
BASE AREA = 157 m²
TOP AREA = 511 m²
DEPTH = 1.2 m
MAX SIDE SLOPE = 1V:2.5H
VOLUME PROVIDED = 400 m³

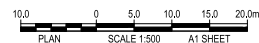
PROVIDE 2m SPILLWAY TO CREEK.

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NORTH

[illegible]

CLIENT	KUATRO
PROJECT	FOREST LODGE WARRIEWOOD

PREPARED BY	
-------------	--

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SEDIMENT & EROSION CONTROL PLAN

SCALE AS SHOWN	DRAWN I.K.	DESIGNED I.O.	CHECKED J.G.	APPROVED J.G.
JOB No. 7368002		DRAWING No. C2.01		ISSUE 4
DATE SEPTEMBER 2023		STATUS ISSUE FOR \$4.56		

Drawings: X:/7368002-1B_A1111_X/7368002SU - Existing Survey, X:/7368002CAR - S106 HIGH RING ROAD
 Plot Date: 17.06.2024@15:59:01 Login Name: Kurbator Cad File: T:/7368002/Drawings/AutoCAD/Civil/Design/Civil 2D/S4.581/Built Earthworks Levels Plan.dwg



NOTE:

1. VOLUMES ARE PRELIMINARY ONLY AND IS SUBJECT TO CHANGE. CONTRACTOR TO CONFIRM BULK EARTHWORKS VOLUMES AND LEVELS BASED ON THEIR OWN ASSUMPTIONS AND CALCULATIONS. THE FOLLOWING DEPTH PROFILES WERE ADOPTED FOR THE BULK EARTHWORKS. NOTE: ASSUMED LEVELS, SUBJECT TO CHANGE DURING DETAILED DESIGN STAGE.

- ASPHALT PAVEMENT (TRAFFICABLE)	= 290 mm
- CONCRETE PAVEMENT (TRAFFICABLE)	= 330mm
- CONCRETE PAVEMENT (NON-TRAFFICABLE)	= 275mm
- CONCRETE FOOTPATH IN ROAD RESERVE	= 175mm
- CONCRETE STRUCTURAL SLABS	= 200 mm
- LANDSCAPING TOP SOIL	= 200 mm

2. VOLUMES FROM PIPE TRENCH HAVE NOT BEEN INCLUDED IN THESE CALCULATIONS.

3. A TOPSOIL REMOVAL OF 300mm HAS BEEN INCLUDED FOR THE OVERALL SITE.

4. BULKING FACTORS HAVE NOT BEEN INCLUDED.

5. ALLOW A +/-15% TOLERANCE FOR THESE VOLUMES.

6. EXTENT OF VERTICAL CUTS IN ROCK TO BE CONFIRMED ON SITE BY CONTRACTOR AND GEOTECHNICAL ENGINEER.

7. EXTENT OF CUTTING/FILLING IN THE VICINITY OF EXISTING TREES SHALL BE CONFIRMED BY THE PROJECT ARBORIST.

8. TREE PROTECTION ZONES TO BE CONFIRMED BY THE PROJECT ARBORIST.

9. ALLOW A +/-15% TOLERANCE FOR THESE VOLUMES.

CUT 6,700 m³
FILL 4,900 m³
NET 1,800 m² EXPORT

4

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PROVIDE MIN 2 x 200W x 100H SLOTS IN WALL FOR EMERGENCY OVERFLOW, TYPICAL FOR COURTYARD AREAS.

PROVIDE MIN 2 x 200W x 100H SLOTS IN WALL FOR EMERGENCY OVERFLOW, TYPICAL FOR COURTYARD AREAS.

BUILDING C
FFL 27.20

BUILDING D
FFL 25.20

LOCAL 1V:1H BATTER TO EXISTING SURFACE. GEOTECHNICAL ENGINEER TO CONFIRM AND SPECIFY BATTER TREATMENT

PROPOSED RETAINING WALL BY STRUCTURAL ENGINEER WITH GEOTECHNICAL ADVICE.

BIORETENTION BASIN 1
REFER C6.02

RETAINED HEIGHT = 1.27m

LOCAL REGRADING AT TOP OF WALL TO DIRECT UPSTREAM OVERLAND FLOW TOWARDS DIVERSION HEADWALL AND PIPE. TOP OF WALL TO BE 500mm ABOVE GROUND LEVEL FOR FLOOD PROTECTION

START OF WALL IN FILL

PROVIDE RENO MATTRESS SCOUR PROTECTION AT TOP OF WALL.

LEGEND

- EXISTING BOUNDARY
- DESIGN SURFACE CONTOUR
- EXISTING SURFACE CONTOUR
- TOP OF BATTER
- BOTTOM OF BATTER
- V.C. VEHICULAR CROSSING (V.C.)
- K&G KERB & GUTTER (K&G)
- K.O. KERB ONLY (K.O.)
- K.I.P. KERB INLET PIT (ON GRADE)
- G.I.P. GRATED INLET PIT
- RL 91.86 FINISHED SURFACE LEVEL
- RL 91.86 FINISHED STORMWATER PIT LID/GRATE LEVEL
- RL 91.86 TOP OF WALL LEVEL
- RL 91.86 BOTTOM OF WALL LEVEL
- 2.5% GRADE ARROW
- RETAINING WALL
- BASEMENT LINE
- UPSTREAM DIVERSION SWALE
- SWALE FLOW ARROW
- RENO MATTRESS

NOTES:

1. GEOTECHNICAL ENGINEER TO CONFIRM EXTENT OF VERTICAL CUT IN ROCK WHERE PERIMETER RETAINING WALLS ARE NOMINATED.
2. REFER STRUCTURAL ENGINEER DRAWINGS FOR RETAINING WALL AND BUILDING SLAB DETAILS.

	EXISTING SURFACE CONTOUR
	EXISTING SURFACE CONTOUR
	TOP OF BATTER
	BOTTOM OF BATTER
	VEHICULAR CROSSING (V.C.)
	KERB & GUTTER (K&G)
	KERB ONLY (K.O.)
	KERB INLET PIT (ON GRADE)
	GRADED INLET PIT
	FINISHED SURFACE LEVEL
	FINISHED STORMWATER PIT LID/GRADE LEVEL
	TOP OF WALL LEVEL
	BOTTOM OF WALL LEVEL
	GRADE ARROW
	RETAINING WALL
	BASEMENT LINE
	UPSTREAM DIVERSION SWALE
	SWALE FLOW ARROW
	RENO MATTRESS

NOTES:

1. GEOTECHNICAL ENGINEER TO CONFIRM EXTENT OF VERTICAL CUT IN ROCK WHERE PERIMETER RETAINING WALLS ARE NOMINATED.
2. REFER STRUCTURAL ENGINEER DRAWINGS FOR RETAINING WALL AND BUILDING SLAB DETAILS.

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5.0 0 2.5 5.0 7.5 10.0m
PLAN SCALE 1:250 A1 SHEET

[illegible]

CLIENT

KUATRO

PROJECT

FOREST LODGE
WARRIEWOOD

PREPARED BY	
-------------	--

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TITLE	GENERAL ARRANGEMENT PLAN-SHEET 2
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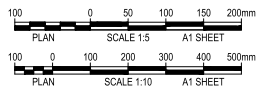
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JOB No.		DRAWING No.		ISSUE

7368002	C4.02	4
DATE SEPTEMBER 2023	STATUS ISSUE FOR \$4.56	

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Plot Date: 14/09/2023 14:07:23
User Name: dward
Job No: 7368002

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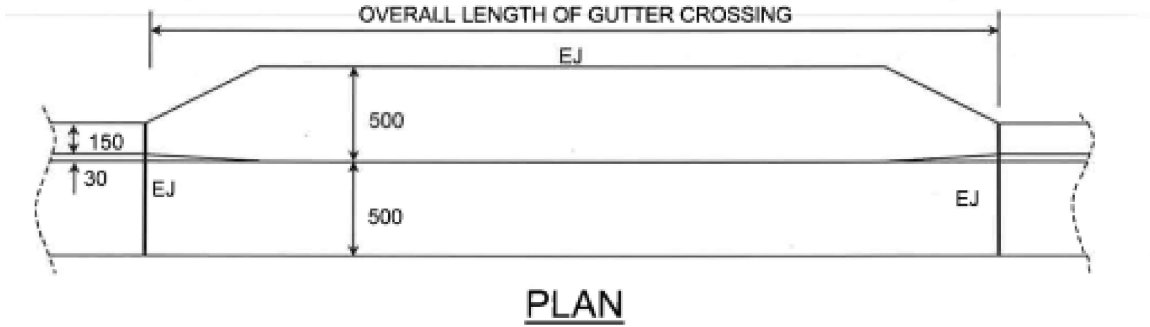


REVISION	AMENDMENT	DATE	REVISION	AMENDMENT	DATE
1	ISSUE FOR \$4.56	03/11/23			
2	ISSUE FOR \$4.56	17/06/24			

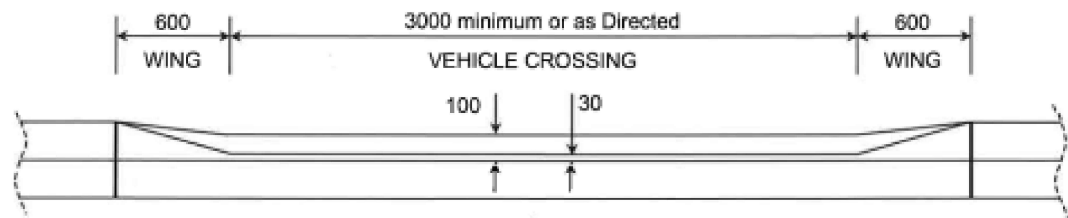
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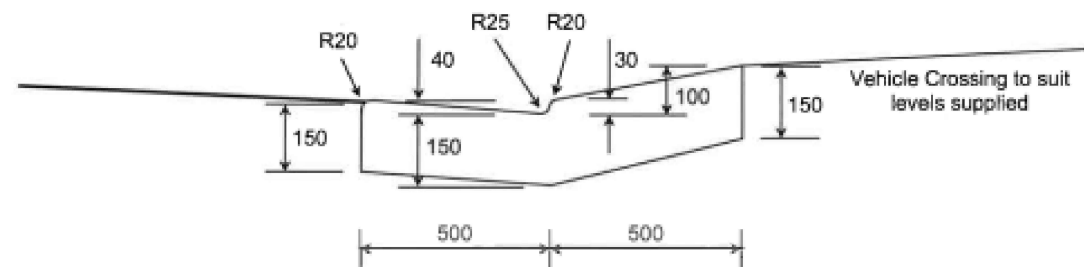
TITLE					
SITEWORKS DETAILS					
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JOB No. 7368002			DRAWING No. C4.51		ISSUE 2
DATE SEPTEMBER 2023		STATUS ISSUE FOR \$4.56			



PLAN



FRONT ELEVATION

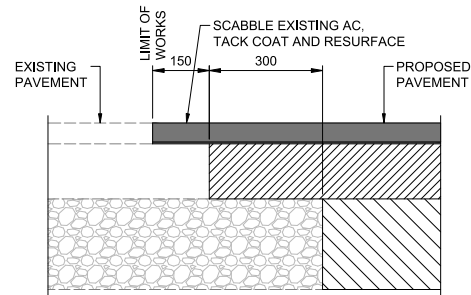


TYPICAL CROSS SECTION

NORTHERN BEACHES COUNCIL VEHICULAR CROSSING (VC)
STANDARD DETAILS (A47284)

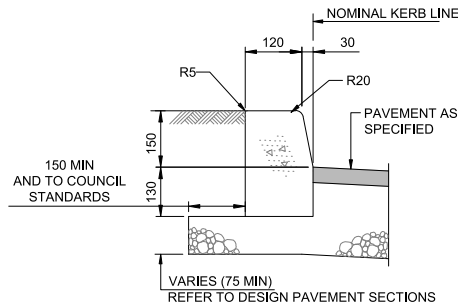
SCALE NTS

2



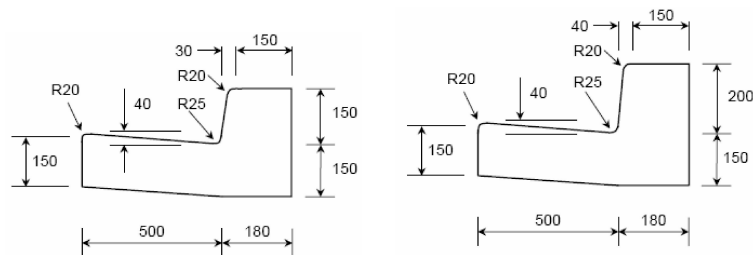
AC CONNECTION TO
EXISTING PAVEMENT

SCALE 1:10



KERB ONLY (KO)

SCALE 1:10



150mm KERB & GUTTER

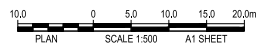
200mm KERB & GUTTER

NORTHERN BEACHES COUNCIL KERB AND GUTTER (K&G)
STANDARD DETAILS (A47284)

SCALE NTS



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CLIENT	KLIATRO
PROJECT	FOREST LODGE WARRIEWOOD



TITLE	ROAD SET-OUT PLAN
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JOB No. 7368002		DRAWING No. C5.01		ISSUE 3
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PROJECT

FOREST LODGE
WARRIEWOOD

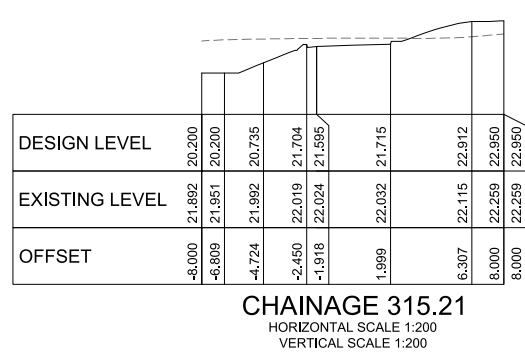
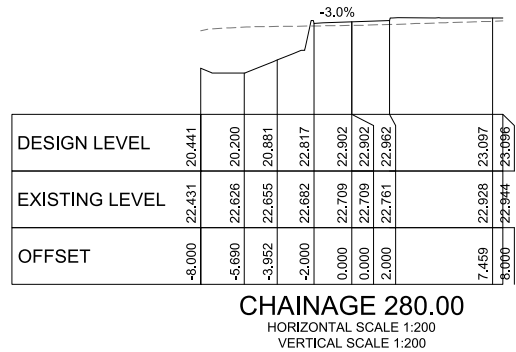
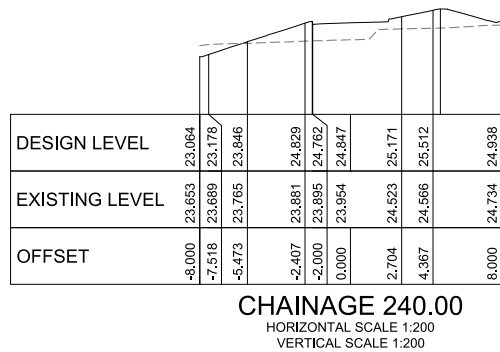
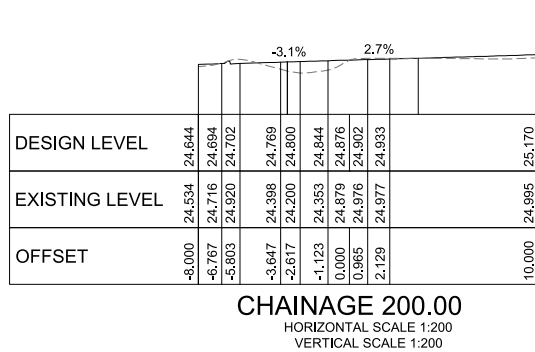
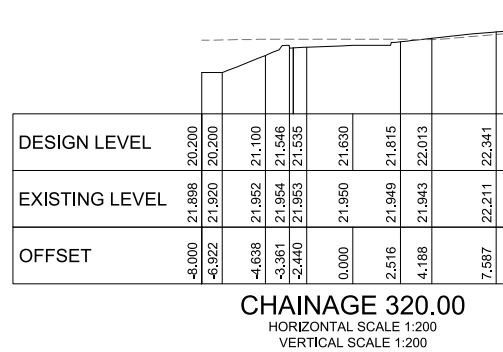
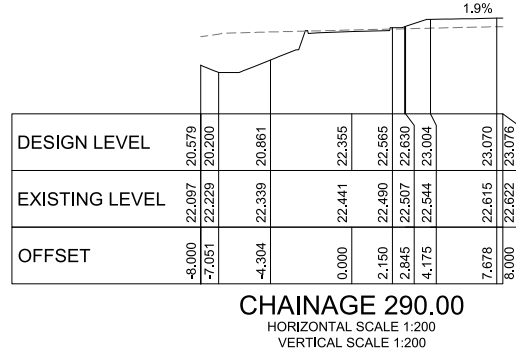
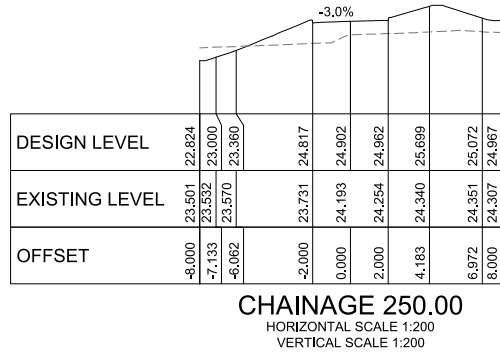
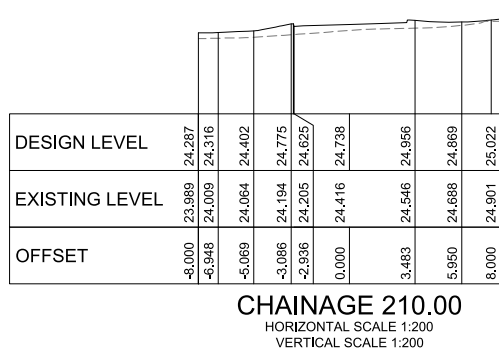
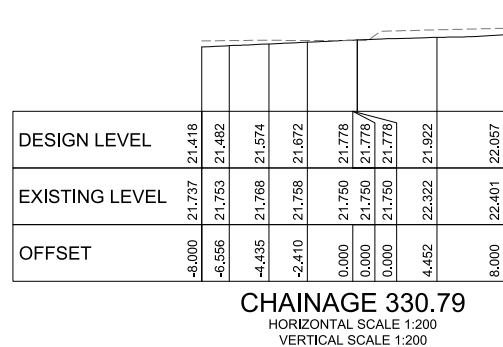
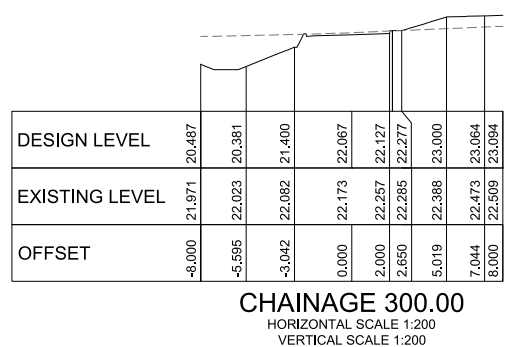
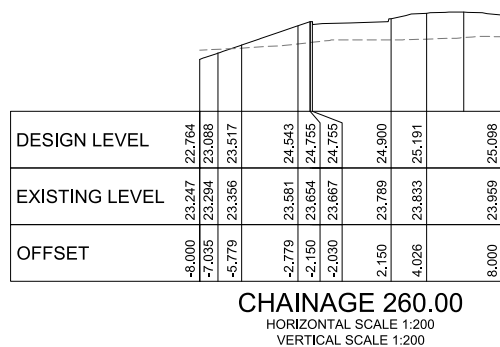
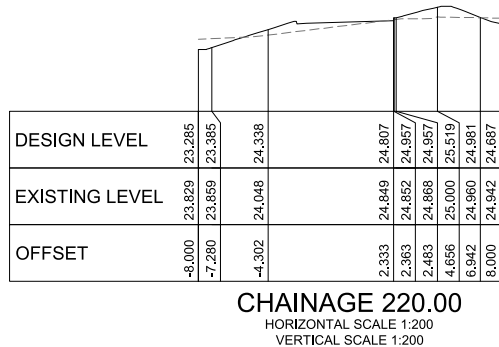
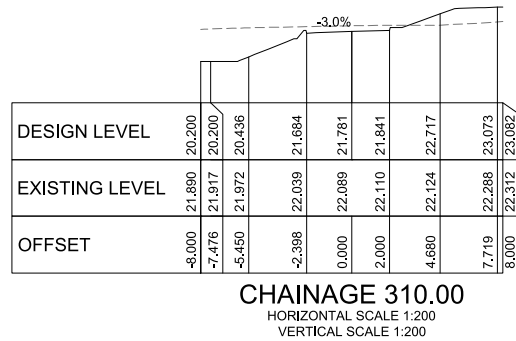
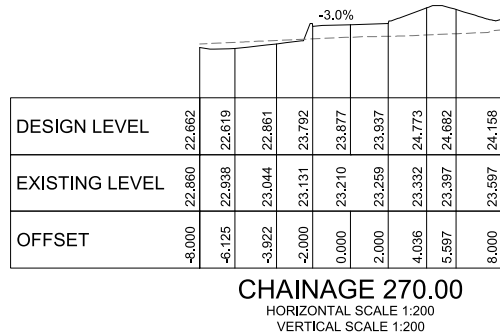
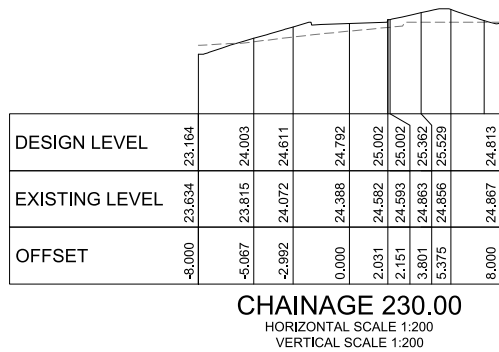
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TITLE				
ROAD LONG SECTIONS - RING ROAD				
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
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JOB No.	DRAWING No.		ISSUE	
7368002		C5.12		2
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SEPTEMBER 2023			ISSUE FOR \$4.56	



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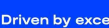
KUATRO

PROJECT

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WARRIEWOOD

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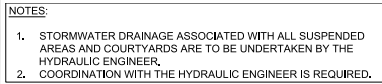


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AUSTRALIA

TITLE				
ROAD CROSS SECTIONS - RING ROAD SHEET 2				
SCALE	DRAWN	DESIGNED	CHECKED	APPROVED
AS SHOWN	I.K.	I.O.S.	J.G.	J.G.
JOB NO.	DRAWING NO.			ISSUE
7368002		C5.23		3
DATE	STATUS		ISSUE FOR \$4.56	
SEPTEMBER 2023				



TITLE										
STORMWATER LAYOUT PLAN-SHEET 1										
SCALE	AS SHOWN	DRAWN	L.K.	DESIGNED	I.O.	CHECKED	J.G.	APPROVED	J.G.	
JOB NO.	7368002		DRAWING NO.		C6.01		ISSUE			2
DATE	SEPTEMBER 2023		STATUS		ISSUE FOR \$4.56					

BIORETENTION BASIN 1
 FILTER AREA = 173m²
 FILTER MEDIA DEPTH = 600mm
 RETENTION BASE RL = 22.19
 RETENTION DEPTH = 300mm
 OSD VOLUME PROVIDED = 682 m³
 REFER TO C6.11 AND C6.13 FOR BASIN PLAN AND SECTIONS.

LEGEND

- EXISTING BOUNDARY
- EXISTING STORMWATER PIPE
- EXISTING STORMWATER PIPE TO BE REMOVED
- INDICATIVE OVERLAND FLOW ROUTE
- PIPE DIAMETER AND DIRECTION OF FLOW
- STORMWATER PIPE (SIZE <Ø1050)
- KERB DRAIN
- KERB INLET PIT (SAG) (900 x 450 GRATE WITH 1.8m WIDE LINTEL)
- GRATED INLET PIT
- PIT STRUCTURE NUMBER
- STORMWATER LINE NUMBER
- SWALE FLOW ARROW
- UPSTREAM DIVERSION SWALE FLOW ARROW
- DRAINAGE BY OTHERS REFER HYDRAULIC ENGINEER DRAWINGS

NOTES:

- STORMWATER DRAINAGE ASSOCIATED WITH ALL SUSPENDED AREAS AND COURTYARDS ARE TO BE UNDERTAKEN BY THE HYDRAULIC ENGINEER.
- COORDINATION WITH THE HYDRAULIC ENGINEER IS REQUIRED.

	EXISTING BOUNDARY
	EXISTING STORMWATER PIPE
	EXISTING STORMWATER PIPE TO BE REMOVED
	INDICATIVE OVERLAND FLOW ROUTE
	PIPE DIAMETER AND DIRECTION OF FLOW
	STORMWATER PIPE (SIZE <Ø1050)
	KERB DRAIN
	KERB INLET PIT (SAG) (900 x 450 GRATE WITH 1.8m WIDE INTEL)
	GRATED INLET PIT
	PIT STRUCTURE NUMBER
	STORMWATER LINE NUMBER
	SWALE FLOW ARROW
	UPSTREAM DIVERSION SWALE FLOW ARROW
	DRAINAGE BY OTHERS REFER HYDRAULIC ENGINEER DRAWINGS

1. STORMWATER DRAINAGE ASSOCIATED WITH ALL SUSPENDED AREAS AND COURTYARDS ARE TO BE UNDERTAKEN BY THE HYDRAULIC ENGINEER.
2. COORDINATION WITH THE HYDRAULIC ENGINEER IS REQUIRED.

BIORETENTION BASIN 1

FILTER AREA	= 173m ²
FILTER MEDIA DEPTH	= 600mm
RETENTION BASE RL	= RL 22.15
RETENTION DEPTH	= 300mm
OSD VOLUME PROVIDED	= 682 m ³

REFER TO C6.11 AND C6.13 FOR BASIN PLAN AND SECTIONS.

SCOUR PROTECTION TO
BE PROVIDED AT
HEADWALL DISCHARGE
LOCATION.

3m WIDE OVERFLOW WEIR —

— PROVIDE FENCE
AROUND TOP OF BASIN.

CONNECTION
DRAINAGE BY
ENGINEER

PROVIDE MIN 2 x 200W x 100H
SLOTS IN WALL FOR
EMERGENCY OVERFLOW.
TYPICAL FOR COURTYARD
AREAS.

SWALE TYPE 2
DEPTH = 0.125m
TOP WIDTH = 1.0m

PROVIDE MIN 2 x 200W x 100H
SLOTS IN WALL FOR
EMERGENCY OVERFLOW.
TYPICAL FOR COURTYARD
AREAS.

COURTYARD DRAINAGE
CONNECTION BY
HYDRAULIC ENGINEER

PROVIDE MIN 2 x 200W x 100H
SLOTS IN WALL FOR
EMERGENCY OVERFLOW.
TYPICAL FOR COURTYARD
AREAS.

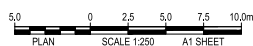
TOP OF WALL TO BE RL30.80
FOR FLOOD PROTECTION.

— KOPPERS LOGS (ø150MM, 500MM SPACING)

PROVIDE RENO MATTRESS
SCOUR PROTECTION

NORTH

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PROJECT	
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FOREST LODGE
WARRIEWOOD

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TITLE

**STORMWATER LAYOUT
PLAN-SHEET 2**

SCALE AS SHOWN	DRAWN I.K.	DESIGNED I.O.	CHECKED J.G.	APPROVED J.G.
JOB No. 7368002		DRAWING No. C6.02		ISSUE 4
DATE SEPTEMBER 2023		STATUS ISSUE FOR \$4.56		

refs: X-7368003-SU - Existing Survey, X-7368002-SU - Existing Survey, X-7368002-TB A/H: X-7368000-AR - Site Plan RING ROAD, X-7368002-WSE-C5-MQ-02 - Design Surface RING ROAD, X-7368002-SW4 layout
Cad File: T:\7368002\Drawings\AutoCAD\Civil\Design\Civil 2D\S4.56\Stormwater Layout Plans-Sheet 2.dwg
Login Name: istewart
Exp Date: 17.06.2024@17:54:33

Ver: 1.7968002_Tp_ArH
 Plot Date: 17/06/2024@18:20:43
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REVISION	AMENDMENT	DATE	REVISION	AMENDMENT	DATE
1	ISSUE FOR \$4.56	03/11/23			
2	RE-ISSUE FOR \$4.56	05/12/23			
3	RE-ISSUE FOR \$4.56	01/02/24			
4	ISSUE FOR \$4.56	17/06/24			

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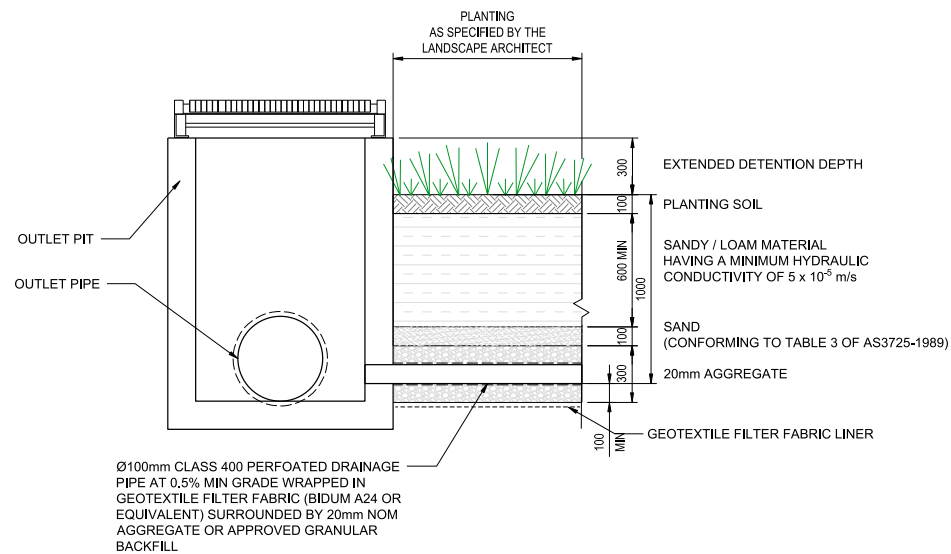
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STORMWATER PIT SCHEDULE

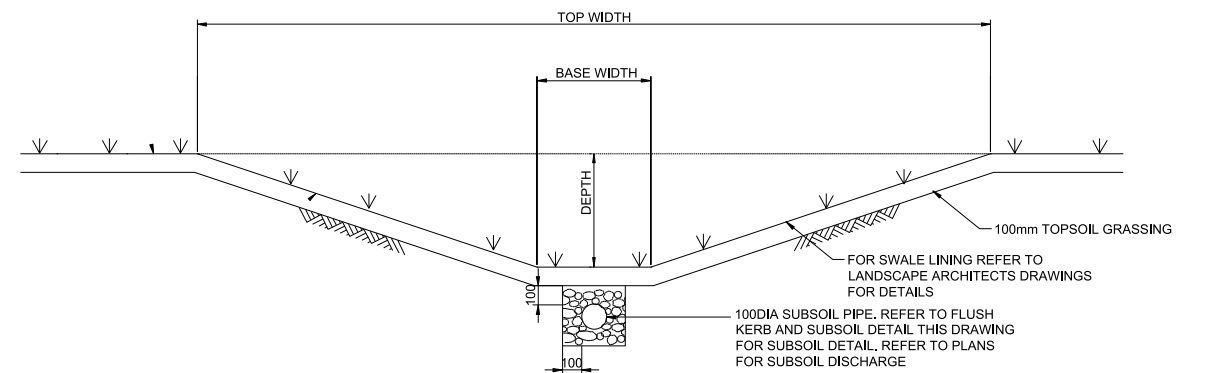
SCALE	AS SHOWN	DRAWN	L.K.	DESIGNED	I.O.	CHECKED	J.G.	APPROVED	J.G.
JOB No.	7368002		DRAWING No.		C6.04		ISSUE		4
DATE	SEPTEMBER 2023		STATUS		ISSUE FOR \$4.56				

NAME	SURFACE ELEV. (m)	PIT DEPTH (m)	PIT SIZE AND TYPE	FROM	TO	LENGTH (m)	U/S IL (m)	D/S IL (m)	SLOPE (%)	PIPE TYPE	DIA (mm)	No. PIPES
Pit 1/1	24.41	0.67	900SQ PIT WITH CLASS B GRATE	Pit 1/1	Pit 2/1	13.20	23.74	23.61	0.98	uPVC	225	1
Pit 2/1	24.50	1.73	900SQ PIT WITH CLASS B GRATE	Pit 2/1	Pit 3/1	17.80	22.77	22.59	1.01	uPVC	225	1
Pit 3/1	23.48	1.49	900SQ PIT WITH CLASS B GRATE	Pit 3/1	Pit 4/1	12.40	21.99	21.87	0.97	uPVC	225	1
Pit 4/1	22.69	0.87	600SQ PIT WITH CLASS B GRATE	Pit 4/1	Pit 5/1	12.00	21.82	21.70	1.00	uPVC	300	1
Pit 5/1	22.64	1.43	900SQ PIT WITH CLASS B GRATE	Pit 5/1	Pit 6/1	18.20	21.21	21.03	0.99	uPVC	300	1
Pit 6/1	21.97	0.99	600SQ PIT WITH CLASS B GRATE	Pit 6/1	Pit 7/1	13.70	20.98	20.84	1.02	uPVC	300	1
Pit 7/1	21.90	1.11	600SQ PIT WITH CLASS B GRATE	Pit 7/1	Pit 8/1	11.90	20.79	20.67	1.01	uPVC	300	1
Pit 8/1	22.09	1.47	900SQ PIT WITH CLASS B COVER	Pit 8/1	Pit 9/1	17.50	20.62	20.45	0.97	uPVC	300	1
Pit 9/1	21.31	1.01	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 9/1	Pit 10/1	7.10	20.30	20.26	0.56	RCP	375	2
Pit 10/1	21.33	1.09	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 10/1	Basin 2	7.20	20.24	20.20	0.56	RCP	375	2
Basin 2	21.40		OSD BASIN 2	Basin 2	HW4	28.20	19.25	18.00	4.43	uPVC	300	1
Pit 13/1	21.49	1.00	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 13/1	Basin 2	2.90	20.49	20.20	10	uPVC	225	1
Pit 1/2	25.80	1.27	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 1/2	Pit 2/2	9.60	24.53	24.01	5.42	uPVC	225	1
Pit 2/2	24.85	0.75	900SQ PIT WITH CLASS B GRATE	Pit 2/2	Pit 3/2	4.20	24.10	24.05	1.19	uPVC	225	1
Pit 3/2	24.86	0.96	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 3/2	Pit 4/2	7.00	23.90	23.83	1.00	uPVC	225	1
Pit 4/2	24.85	1.12	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 4/2	Pit 5/2	44.70	23.73	22.76	2.17	uPVC	225	1
Pit 5/2	23.61	1.01	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 5/2	Pit 6/2	15.40	22.60	22.19	2.66	uPVC	300	1
Pit 6/2	23.24	1.07	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 6/2	Pit 7/2	32.00	22.17	20.94	3.84	uPVC	300	2
Pit 7/2	21.85	0.97	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 7/2	Pit 9/1	7.70	20.88	20.40	6.23	uPVC	300	2
Pit 1/3	23.60	0.90	18m LENGTH ACO TRENCH DRAIN WITH CLASS D GRATE	Pit 1/3	Pit 5/2	7.40	22.70	22.62	1.08	uPVC	150	2
Pit 2/4	23.66	0.90	3.8m LENGTH ACO TRENCH DRAIN WITH CLASS D GRATE	Pit 2/4	Pit 4/4	10.70	22.76	22.34	3.93	uPVC	150	2
Pit 4/4	23.25	0.91	7.2m LENGTH ACO TRENCH DRAIN WITH CLASS D GRATE	Pit 4/4	Pit 6/2	7.40	22.34	22.26	1.08	uPVC	150	2
Pit 1/5	21.85	0.91	900SQ PIT WITH CLASS D GRATE	Pit 1/5	Pit 7/2	7.00	20.94	20.90	0.57	uPVC	300	2
Pit 1/6	26.10	1.10	900SQ PIT WITH CLASS B GRATE	Pit 1/6	Pit 2/6	1.80	25.00	24.85	8.33	uPVC	225	1
Pit 2/6	25.70	1.00	900SQ PIT WITH CLASS B GRATE	Pit 2/6	Pit 3/6	22.50	24.70	24.50	0.89	uPVC	225	1
Pit 3/6	25.46	1.01	900SQ PIT WITH 600 x 900 CLASS B SINGLE GRATE WITH 1.2m LENGTH ACO TRENCH DRAIN	Pit 3/6	Pit 4/6	18.80	24.45	24.27	0.96	uPVC	225	1
Pit 4/6	25.13	1.48	900SQ PIT WITH CLASS B GRATE WITH 2.8m LENGTH ACO TRENCH DRAIN	Pit 4/6	Pit 5/6	23.80	23.65	23.53	0.50	uPVC	300	1
Pit 5/6	25.19	1.69	900SQ PIT WITH 600 x 900 CLASS B SINGLE GRATE WITH 1.2m LENGTH ACO TRENCH DRAIN	Pit 5/6	Pit 6/6	10.20	23.50	23.44	0.59	uPVC	300	1
Pit 6/6	24.87	1.46	900SQ PIT WITH 600 x 900 CLASS B SINGLE GRATE WITH 1.2m LENGTH ACO TRENCH DRAIN	Pit 6/6	Pit 7/6	10.50	23.41	23.35	0.57	uPVC	300	1
Pit 7/6	24.63	1.31	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 7/6	Pit 8/6	17.80	23.32	23.23	0.51	uPVC	300	1
Pit 8/6	24.78	1.58	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 8/6	Pit 8/7	29.90	23.20	23.01	0.64	uPVC	300	1
Pit 1/7	28.80	0.85	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 1/7	Pit 2/7	6.40	27.95	27.70	3.91	uPVC	225	1
Pit 2/7	28.56	0.91	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 2/7	Pit 3/7	16.70	27.65	26.55	6.59	uPVC	225	1
Pit 3/7	27.43	0.93	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 3/7	Pit 4/7	20.40	26.50	25.45	5.15	uPVC	225	1
Pit 4/7	26.31	1.11	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 4/7	Pit 5/7	14.00	25.20	25.00	1.43	uPVC	225	1
Pit 5/7	25.87	0.92	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 5/7	Pit 6/7	19.80	24.95	24.40	2.78	uPVC	225	1
Pit 6/7	25.26	0.91	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 6/7	Pit 7/7	22.40	24.35	23.40	4.24	uPVC	300	1
Pit 7/7	24.66	1.76	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 7/7	Basin 1	7.00	22.90	22.43	6.71	RCP	375	1
Pit 8/7	24.62	1.60	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 8/7	Pit 7/7	13.00	23.02	22.95	0.54	uPVC	300	1
Basin 1	24.30	2.81	OSD BASIN 1	Basin 1	HW5	21.10	21.49	21.00	2.32	uPVC	150	1
Pit 1/8	28.62	1.55	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit1/8	Pit2/8	24.30	27.07	24.64	10.00	uPVC	225	1
Pit 2/8	25.49	0.88	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit2/8	Pit 1/2	4.80	24.61	24.56	1.04	uPVC	225	1
Pit 3/8	26.14	0.89	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 3/8	Pit2/8	7.20	25.25	24.64	8.47	uPVC	225	1
Pit 1/9	22.99	0.96	900SQ PIT WITH CLASS B GRATE	Pit 1/9	Pit 2/9	8.70	22.03	21.70	3.79	uPVC	300	1
Pit 2/9	22.63	2.13	900SQ PIT WITH 600 x 900 CLASS D SINGLE GRATE WITH 1.8m LINTEL OPENING	Pit 2/9	Basin 2	3.00	20.50	20.20	10.00	uPVC	300	1
Pit 1/11	25.46	0.71	900SQ PIT WITH CLASS B GRATE	Pit 1/11	Pit 2/6	2.90	24.75	24.72	1.03	uPVC	225	1
Pit 1/12	23.05	0.95	900SQ PIT WITH CLASS B GRATE	Pit 1/12	Pit 1/9	3.70	22.10	22.06	1.08	uPVC	225	1
Pit 1/14	26.72	0.87	600SQ PIT WITH CLASS B GRATE	Pit 1/14	Pit 2/14	7.70	25.85	25.45	5.19	uPVC	225	1
Pit 2/14	26.29	0.89	900SQ PIT WITH CLASS B GRATE & 3.8m LENGTH ACO TRENCH DRAIN	Pit 2/14	Pit 4/7	17.90	25.40	25.25	0.84	uPVC	225	1
Pit 3/14	25.66	0.96	900SQ PIT WITH CLASS B GRATE & 1.5m LENGTH ACO TRENCH DRAIN	Pit 3/14	Pit 6/7	18.20	24.70	24.40	1.65	uPVC	225	1
Pit 1/15	24.60	0.93	900SQ PIT WITH CLASS B COVER	Pit 1/15	Pit 8/7	7.10	23.67	23.05	8.73	uPVC	150	1



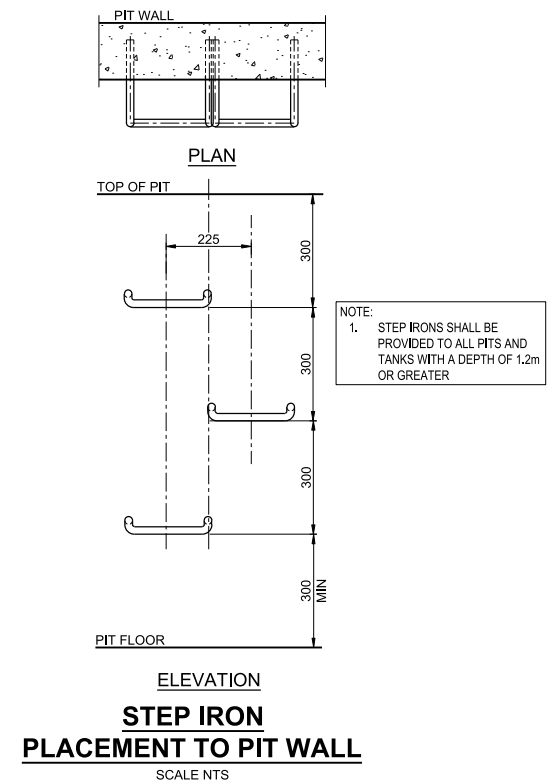
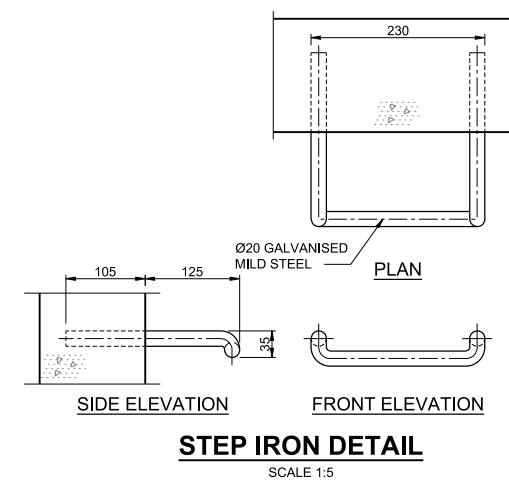
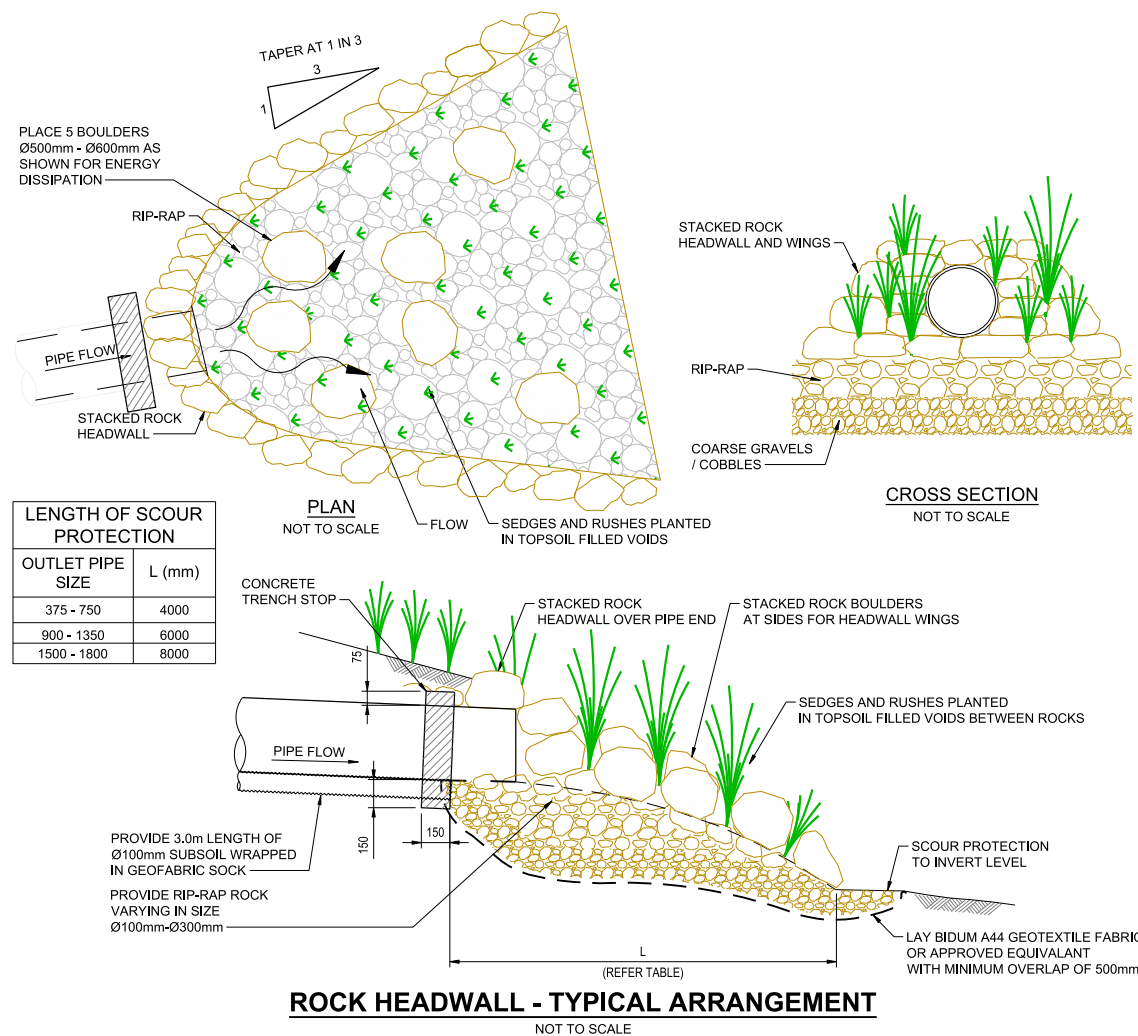
BIORETENTION DETAIL

SCALE 1:20



TYPICAL SECTION THROUGH SWALE

1. REFER TO PLAN FOR SWALE DIMENSIONS
2. SWALE INVERT LEVELS AS SPECIFIED ON PLAN. MIN
LONGITUDINAL GRADE 0.5% (UNO)

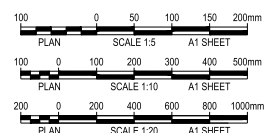


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PROJECT	FOREST LODGE WARRIEWOOD

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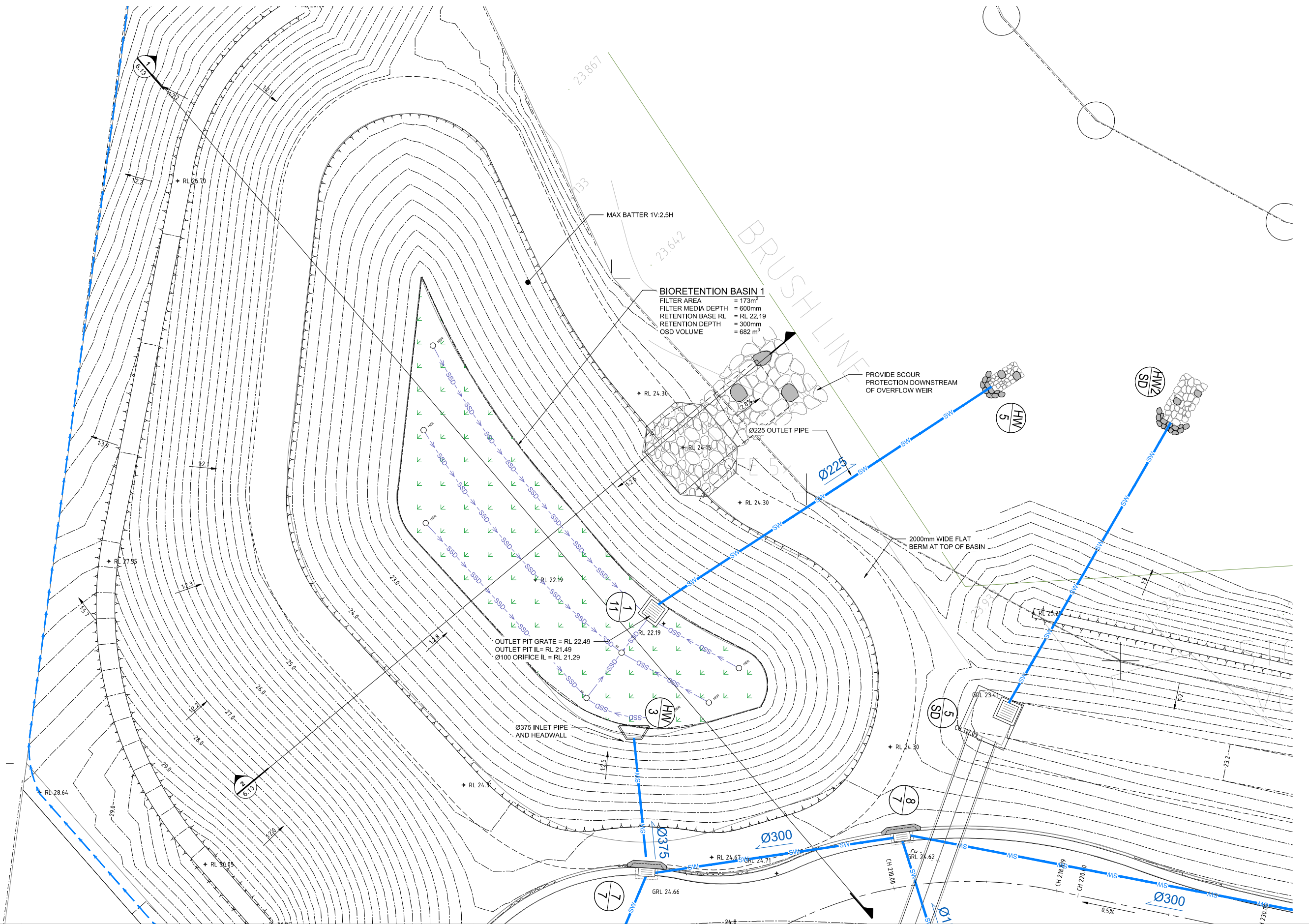
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**STORMWATER DRAINAGE
DETAILS - SHEET 2**

SCALE AS SHOWN	DRAWN I.K.	DESIGNED I.O.	CHECKED J.G.	APPROVED J.G.
JOB No. 7368002		DRAWING No. C6.07		ISSUE 2
DATE SEPTEMBER 2023		STATUS ISSUE FOR \$4.56		

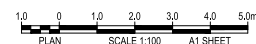


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SHEET SIZE: A1

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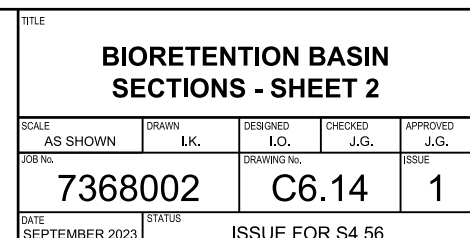
**BIORETENTION BASIN PLAN -
SHEET 1**

SCALE	AS SHOWN	DRAWN	I.K.	DESIGNED	I.O.	CHECKED	J.G.	APPROVED	J.G.
JOB No.				DRAWING No.				ISSUE	
7368002				C6.11				3	
DATE		STATUS		ISSUE FOR S4 56					
SEPTEMBER 2023									

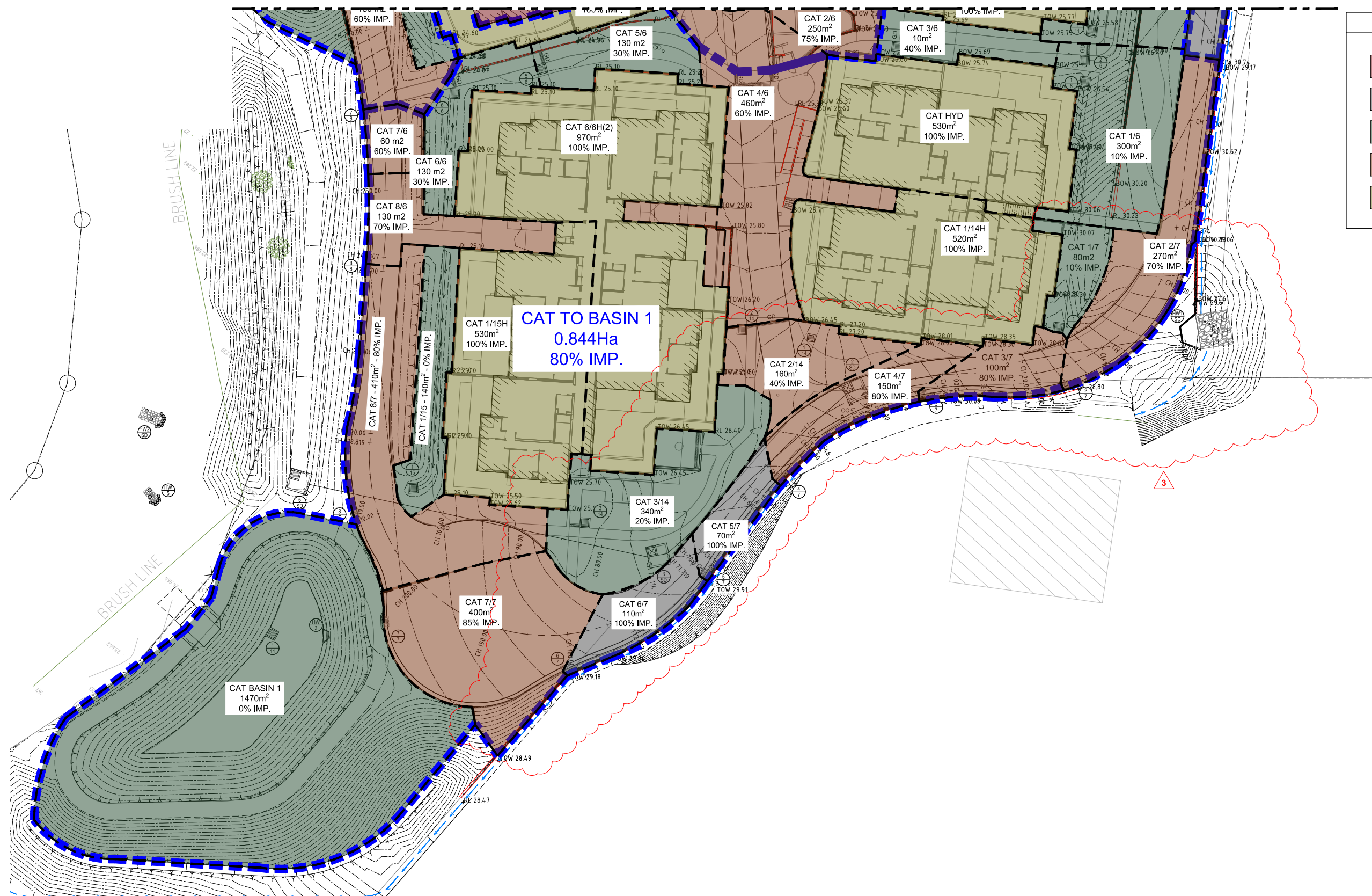


1000 0 500 1000 1500 2000mm
PLAN SCALE 1:50 A1 SHEET

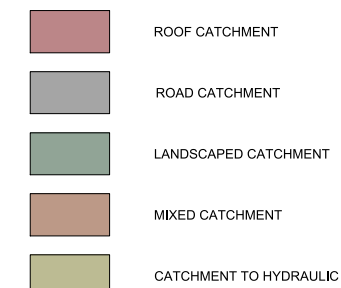
The image shows a section of a grid with a white background. On the left, the word "CLIENT" is written in a small, black, sans-serif font. To its right, the word "KLIATRO" is written in a very large, bold, black, sans-serif font. Below "KLIATRO", the word "PROJECT" is written in a small, black, sans-serif font. To the right of "PROJECT", the words "FOREST LODGE" and "WARRIEWOOD" are stacked vertically in a large, black, sans-serif font.



REFER C6.01 FOR CONTINUATION



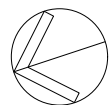
CATCHMENT LEGEND



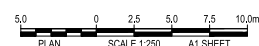
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**STORMWATER CATCHMENT
PLAN - SHEET 2**

SCALE AS SHOWN	DRAWN I.K.	DESIGNED I.O.	CHECKED J.G.	APPROVED J.G.
JOB No.		DRAWING No.		ISSUE

7368002

23	STATUS	ISSUE FOR \$4.56
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3

5.0 0 2.5 5.0 7.5 10.0m
PLAN SCALE 1:250 A1 SHEET

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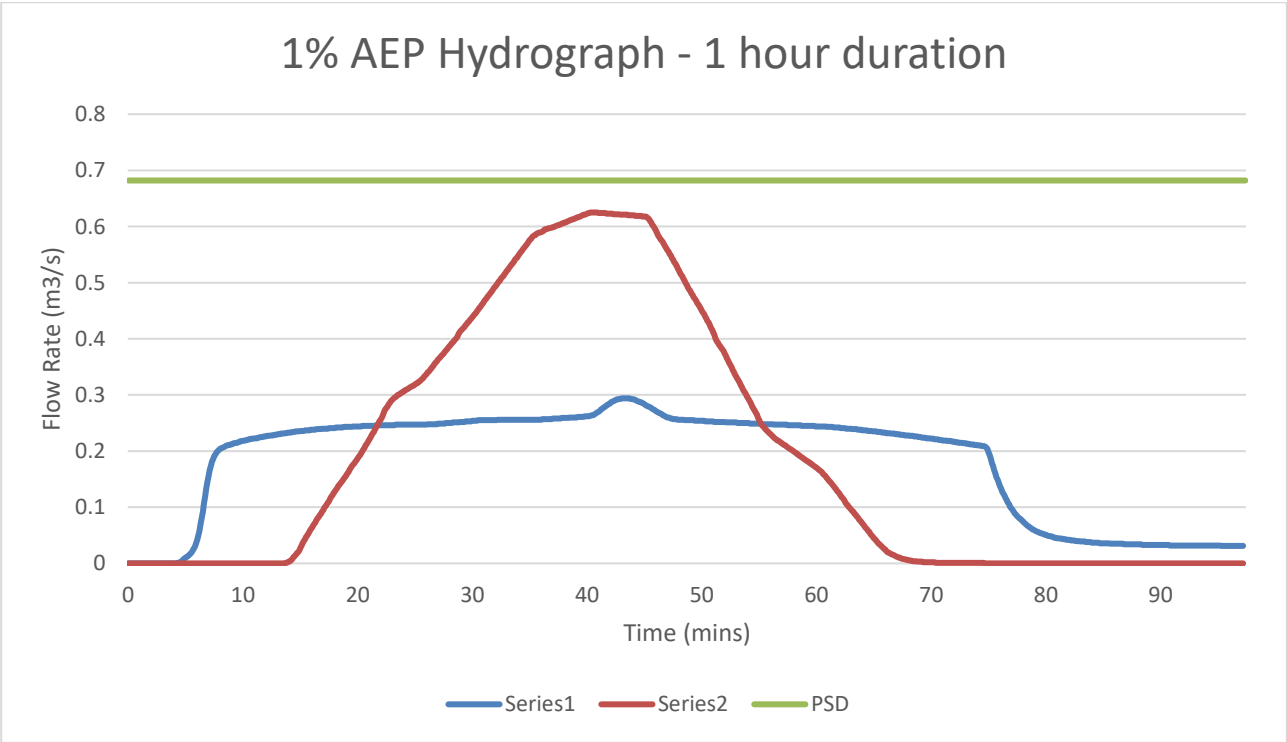
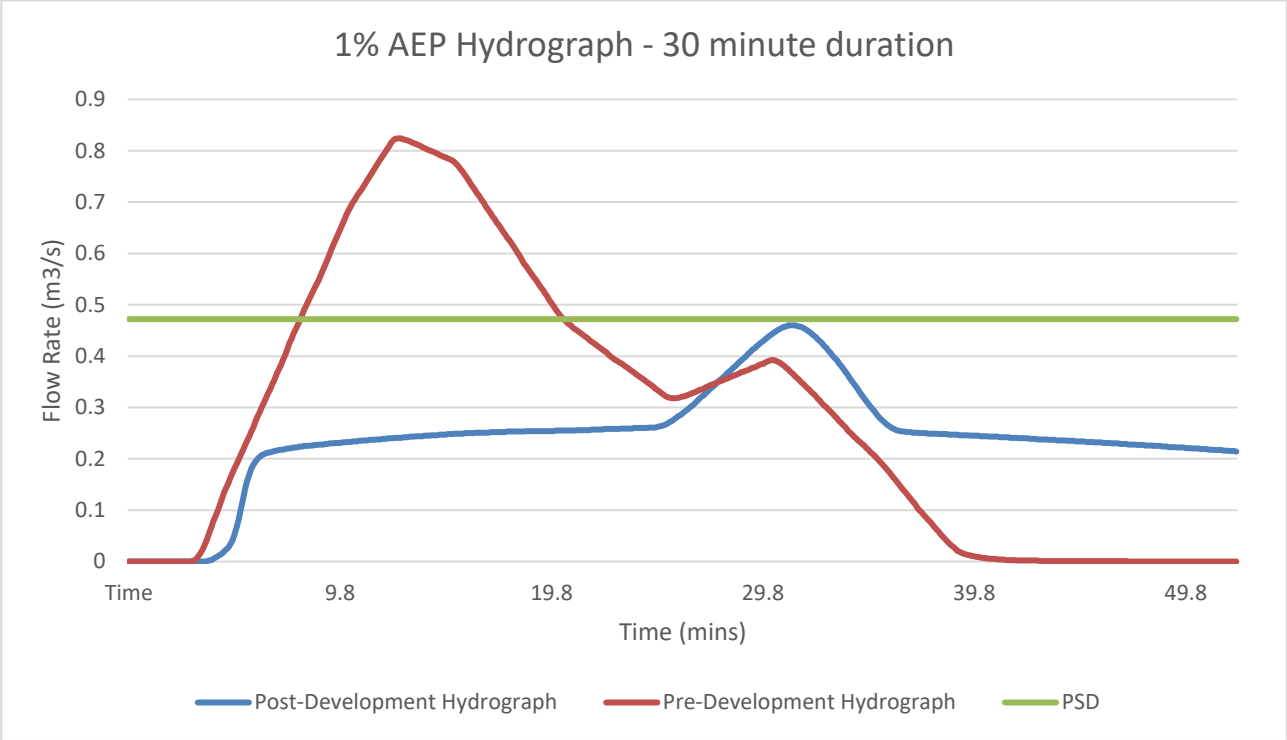
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**TRUNK DRAINAGE
LONGITUDINAL SECTION**

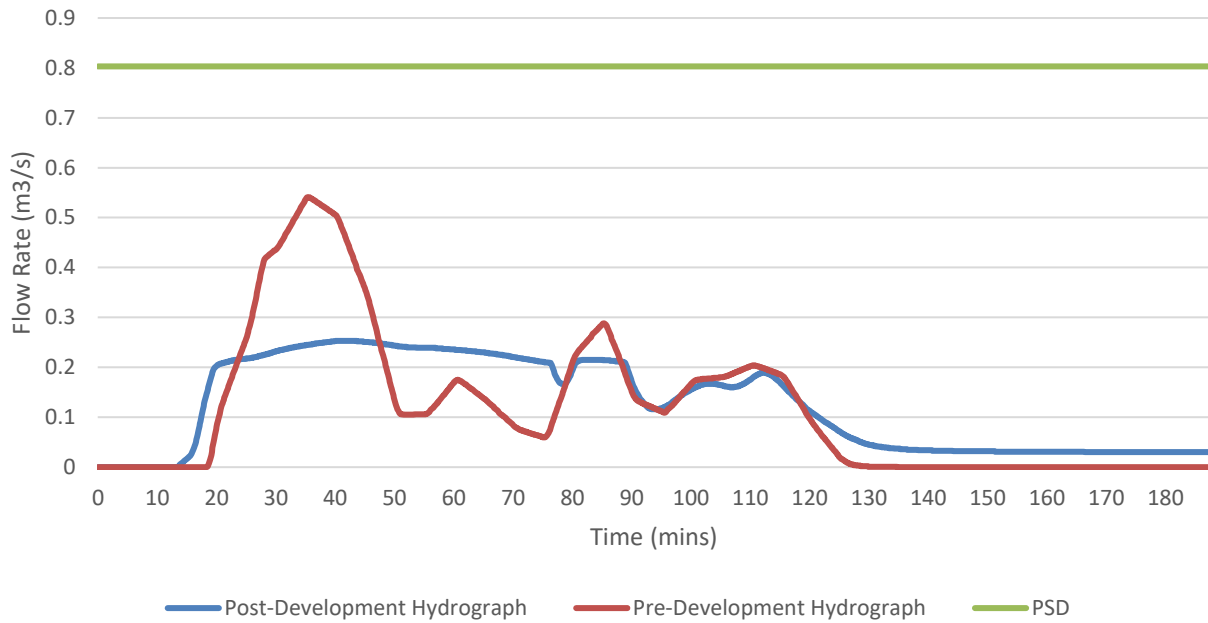
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JOB No. 7368002		DRAWING No. C6.41		ISSUE 3
DATE SEPTEMBER 2023		STATUS ISSUE FOR \$4.56		

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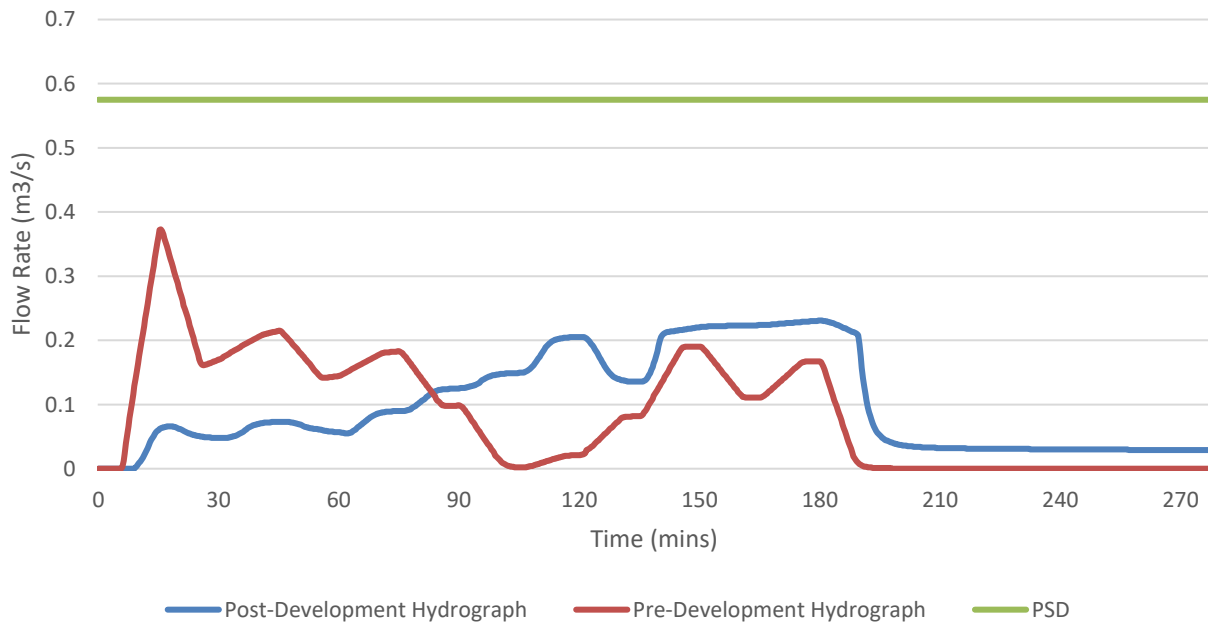
SCHEDULE 2 HYDROGRAPHS



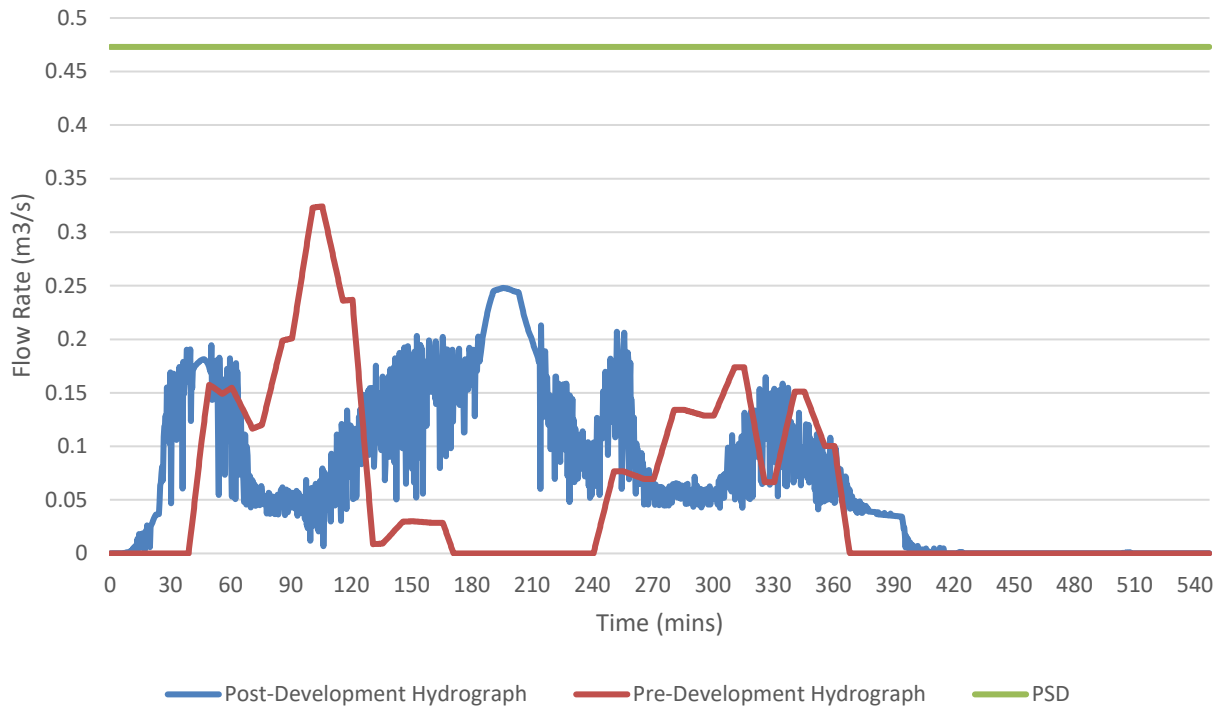
1% AEP Hydrograph - 2 hour duration



1% AEP Hydrograph - 3 hour duration



1% AEP Hydrograph - 6 hour duration



**SCHEDULE 3 MONITORING REQUIREMENTS AND ACCEPTANCE
CRITERIA**

Table C2 Summary of Acceptance Criteria - Site Discharge and Creeks

Media	State	Variable	Units	During Construction Site Discharges/In sector	Post Construction Site Discharges	Instream Short Term (Status Quo)	In-Stream Medium Term	In-Stream Long Term
Water	Physical	Visual	-	No litter	No litter	No litter	No litter	No litter
		Salinity (TDS)	mg/L	NA	NA	1000	1000	1000
		pH (Field)	-	NA	NA	6.6 - 8	6.6 - 8	6.6 - 8
		Temperature (Field)	°C	NA	NA	Status quo	Status quo	Status quo
		Dissolved Oxygen (Field)	%Sat	NA	NA	Status quo	90	90
		Turbidity (Field)	NTU	NA	NA	Status quo	50	20
		Suspended Solids	mg/L	100	50	Status quo	20	6
		Volume Gross Pollutants Removed	Tonne	NA	NA	NA	NA	NA
	Chemical	Total Nitrogen	mg/L	1.6	1.6	Status quo	1.6	1.0
		Ammonia-Nitrogen	mg/L	See Key	See Key	See Key	See Key	See Key
		Total Kjeldahl Nitrogen	mg/L	-	-	-	-	-
		Nitrates and Nitrites	mg/L	-	-	-	-	-
		Total Phosphorous	mg/L	0.1	0.05	Status quo	0.1	0.04
		Ortho-Phosphate	mg/L	-	-	-	-	-
		Non-Filterable Phosphorous	mg/L	-	-	-	-	-
		Hardness (CaCO ₃)	mg/L	NA	NA	-	-	-
		Chromium	µg/L	NA	NA	Status quo	50% status quo	10
		Lead	µg/L	NA	NA	Status quo	50% status quo	1
		Zinc	µg/L	NA	NA	Status quo	50% status quo	50
		Arsenic	µg/L	NA	NA	Status quo	50% status quo	50
		Mercury	µg/L	NA	NA	Status quo	50% status quo	0.1
		Copper	µg/L	NA	NA	Status quo	50% status quo	2
		Phenolic Compounds	µg/L	NA	NA	Status quo	50% status quo	Note
		OC/OP Pesticides	ng/L	NA	NA	Status quo	50% status quo	Note
		Oil & Grease (H.E.M)	mg/L	NA	NA	50	20	5
		PAH	µg/L	NA	NA	Status quo	50% status quo	3
		Chlorophyll-a	mg/m ³	NA	NA	15	15	10
	Biological	Algal Identification and Count	-	NA	NA	Status quo	No algal bloom	No algal bloom
		Faecal Coliform Count	Cfu/100mL	150	150	1000	150	150
		Biotic Index (SIGNAL)	-	NA	NA	Status quo	> 5	> 6
Sediment	Chemical	Chromium	mg/kg	NA	NA	Status quo	50% status quo	80
		Lead	mg/kg	NA	NA	Status quo	50% status quo	50
		Zinc	mg/kg	NA	NA	Status quo	50% status quo	200
		Arsenic	mg/kg	NA	NA	Status quo	50% status quo	20
		Mercury	mg/kg	NA	NA	Status quo	50% status quo	0.15
		Copper	mg/kg	NA	NA	Status quo	50% status quo	65
		Phenolic Compounds	mg/kg	NA	NA	Status quo	50% status quo	Note
		Organochlorine Pesticides	mg/kg	NA	NA	Status quo	50% status quo	Note
		Total PAH	mg/kg	NA	NA	Status quo	50% status quo	4000

Table C1 Summary of Monitoring Requirements

Media	State	Variable	Undeveloped*		Construction Phase**		Post-Construction Phase ***	
			Wet Weather	Dry Weather	Wet Weather	Dry Weather	Wet Weather	Dry Weather
Water	Physical	Visual	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Salinity	U/D	U/D	U/D	U/D	U/D	U/D
		pH (Field)	U/D	U/D	U/D	U/D	U/D	U/D
		Temperature (Field)	U/D	U/D	U/D	U/D	U/D	U/D
		Dissolved Oxygen (Field)	U/D	U/D	U/D	U/D	U/D	U/D
		Turbidity (Field)	U/D	U/D	U/D	U/D	U/D	U/D
		Suspended Solids	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Volume Gross Pollutants Removed	NA	NA	NA	SQID	NA	SQID
	Chemical	Total Nitrogen	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Ammonia-Nitrogen	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Total Kjeldahl Nitrogen	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Nitrates and Nitrites	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Total Phosphorous	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Ortho-Phosphate	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Non-Filterable Phosphorous	U/D/I	U/D/I	U/D/I/ESC	U/D/I	U/D/I/SQID	U/D/I
		Hardness (CaCO ₃)	NA	U/D	NA	U/D	NA	U/D
		Chromium	NA	U/D	NA	U/D	NA	U/D
		Lead	NA	U/D	NA	U/D	NA	U/D
		Zinc	NA	U/D	NA	U/D	NA	U/D
		Arsenic	NA	U/D	NA	U/D	NA	U/D
		Mercury	NA	U/D	NA	U/D	NA	U/D
		Copper	NA	U/D	NA	U/D	NA	U/D
		Phenolic Compounds	NA	U/D	NA	U/D	NA	U/D
		OC/OP Pesticides	NA	U/D	NA	U/D	NA	U/D
		Oil & Grease (H.E.M)	NA	U/D	NA	U/D	NA	U/D
		PAH	NA	U/D	NA	U/D	NA	U/D
		Chlorophyll-a	NA	NA	NA	NA	NA	U/D
	Biological	Algal Identification and Count	NA	U/D	NA	U/D	NA	U/D
		Faecal Coliform Count	U/D/I	U/D/I	U/D/I	U/D/I	U/D/I/SQID	U/D/I
		Biotic Index (SIGNAL)	NA	U/D	NA	U/D	NA	U/D
Sediment	Chemical	Chromium	NA	U/D	NA	U/D	NA	U/D
		Lead	NA	U/D	NA	U/D	NA	U/D
		Zinc	NA	U/D	NA	U/D	NA	U/D
		Arsenic	NA	U/D	NA	U/D	NA	U/D
		Mercury	NA	U/D	NA	U/D	NA	U/D
		Copper	NA	U/D	NA	U/D	NA	U/D
		Phenolic Compounds	NA	U/D	NA	U/D	NA	U/D
		Organochlorine Pesticides	NA	U/D	NA	U/D	NA	U/D
		PAH	NA	U/D	NA	U/D	NA	U/D

*Up to Construction Certificate Issue

**Immediately after site works commence and up to Subdivision Certificate Issue

***Immediately after Subdivision Certificate Issue and up to Handover

SCHEDULE 4 DOCUMENTATION CHECKLIST

DOCUMENTATION CHECKLIST - CONSTRUCTION CERTIFICATE

(Detach and include with submissions)

Section	Item	Requirement	Check (√)
4.1	Water Cycle Assessment - Water Balance Modelling Pre & Post Development		
4.1.1	Stream Gauging, infiltration testing and use of local rainfall data for modelling		
4.2.1	Water Quality Monitoring Plan	♦♦♦♦♦♦♦♦	
4.2.1	Water Quality Monitoring Sites Shown on Plan (at least three)	♦♦♦♦♦♦♦♦	
4.2.1, 2, C	Water Quality Monitoring Data	♦♦♦♦♦♦♦♦	
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data	♦♦♦♦♦♦♦♦	
4.2.1, 2, C	Assessment and interpretation of water quality monitoring data from SQID's		
4.3	Water Quality Management Assessment - Load Modelling Pre and Post Development		
4.3.1, 3	Justification of assumptions for Event Mean Concentrations		
4.3.2	Identification of and details for Stormwater quality facilities	+++++	
4.3.2, 4.4.5	Mosquito Risk Assessment for both Watercourse and Water Quality/Quantity features	+++++	
4.3.6, 4.6.5	Inspection and Cleaning Reports for SQID's and OSD		
4.3.6	Management Plan for Stormwater Quality Improvement Devices	+++++	
4.3.5	Environmental Management Plan (Soil and Water Aspects)	+++++	
4.3.4	Erosion and Sediment Control Plan	+++++	
4.4.3, 4, 5	Existing and Proposed Creek Corridor in plan with cross/long sections with flood levels	+++Note 1+++	
4.4.4	Proposed Creek Corridor Planting Schedule	+++Note 1+++	
4.4.5	Creek Corridor Vegetation Monitoring and Management Plan	♦♦Note 1♦♦	
4.4.5	Vegetation and Creek Maintenance and Monitoring Reports		
4.5	Flood Analysis – existing design conditions	♦♦♦♦♦♦♦♦	
4.5.2	Compliance of structures and creek corridor with flood planning levels	+++++	
4.5.4	Details of Interim Flood Protection Works	+++++	
4.6.3	Design Storm Hydrological Modelling of Site - Pre and Post Development	♦♦♦♦♦♦♦♦	
4.6.3	On-Site Detention Facilities	+++++	
4.6.4	Stormwater Retention Facilities	+++++	
4.7	Stormwater Concept Drainage Plan		

KEY:

	Preliminary Calculations/Assessment Required		Work as Executed Plans
	Concept Design Required	♦♦♦♦♦♦	Required/Reviewed/Updated
+++++	Detailed Assessment/Calculations/Design		Not required

Note 1 Even if the works are not to be constructed by the Applicant on the land to be transferred to Council under the Material Public Benefit Option in the Section 94 Plan, preliminary investigation for Rezoning and concept design at DA stage is required

Completed by Principal Certifier:

Name:

Title:

Organisation:

Signature:

Date: