SEEC

Strategic Environmental & Engineering Consulting

Surface Water and Water Cycle Management Study

Planning Proposal for Proposed Industrial Subdivision at:
Lots 100, 101 and 102 DP1161331
Wilson Drive, Marulan

Prepared for:

Citywest Corp P/L ATF The Copulos (Sunshine) u/t

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SEEC

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Document Certification

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Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

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Document Issue Table

Version	Date	Author	Reviewed	Notes
DRAFT A	20/12/2022	JA	BJ	Draft Issue For Discussion
FINAL 01	9/2/2023	JA	BJ	For DA Submission
DRAFT B	17/5/2023	JA	CLIENT	Update per Council Comments – For Review
FINAL 02	19/7/2024	JA	BJ	Updated DA Submission
FINAL 03	03/9/2025	JA	BJ	Updated For VPA Approval

SUMMARY

The following report is a Surface Water and Water Cycle Management Study (WCMS) focusing on stormwater management and storm water quality. It is designed to comply with the requirements of various consent authorities that require new developments to demonstrate a level of environmental responsibility by maintaining or improving water quality.

This report contains:

- A description of the proposed development. Refer to Section 2;
- A detailed site description. Refer to Section 3;
- An investigation into how the proposed development is expected to affect the site. Refer to Section 4;
- Stormwater and Water Quality Modelling results to justify the proposed measures outlined in Section 7. Refer to Sections 5 and 6.
- A series of measures to offset the potential impacts of the development and any major existing issues. Refer to Section 7

The most important component of this report for the developer is Section 7. It contains a series of measures to be implemented that will minimise potential problems caused by the development. This is referred to as a Water Cycle Management Plan (WCMP). It takes into account the existing conditions (Section 3) and the likely impacts of the development (Section 4). In most cases, the planned measures in Section 7 of this report will become “conditions of consent” of any future DA approval.

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1 INTRODUCTION

1.1 Project Overview

SEEC have been commissioned by Citywest Corp P/L ATF The Copulos (Sunshine) u/t, to prepare this updated Surface Water and Water Cycle Management Study (WCMS). It is required to accompany a Development Application to Goulburn-Mulwaree Council (GMC) for the subdivision of Lots 100, 101 and 102 DP1161331 Wilson Drive, Marulan into 35 industrial lots with 2 drainage/public reserves and supporting road network (37 total lots).

This report has been prepared in accordance with the following guidelines and recommendations:

- ***Australian Rainfall & Runoff (AR&R) – A Guide to Flood Estimation 2019.***
- ***Goulburn Mulwaree Local Environmental Plan (LEP) 2009.***
- ***Goulburn Mulwaree Development Control Plan (DCP) 2009.***
- ***Goulburn Mulwaree Council – Standards for Engineering Works 2013.***
- ***AS/NZS 3500.3:2021 Plumbing and Drainage, Part 3: Stormwater Drainage.***

This study includes:

- An investigation into the existing storm water cycle;
- An assessment of how the proposed development is expected to affect the management of the water cycle;
- An estimation of Pre and Post development peak flows including required on-site detention; and
- A plan for managing the surface water and water treatment cycle to strive for a Neutral or Beneficial Effect (NorBE) on the quality and quantity of water leaving the site.

Sewer and potable water demands are not included in this WCMS.

The site location is provided in Figure 1.

The site is within the Sydney Drinking Water Catchment which is administered by WaterNSW who require all new developments to demonstrate a Neutral or Beneficial Effect on water quality.

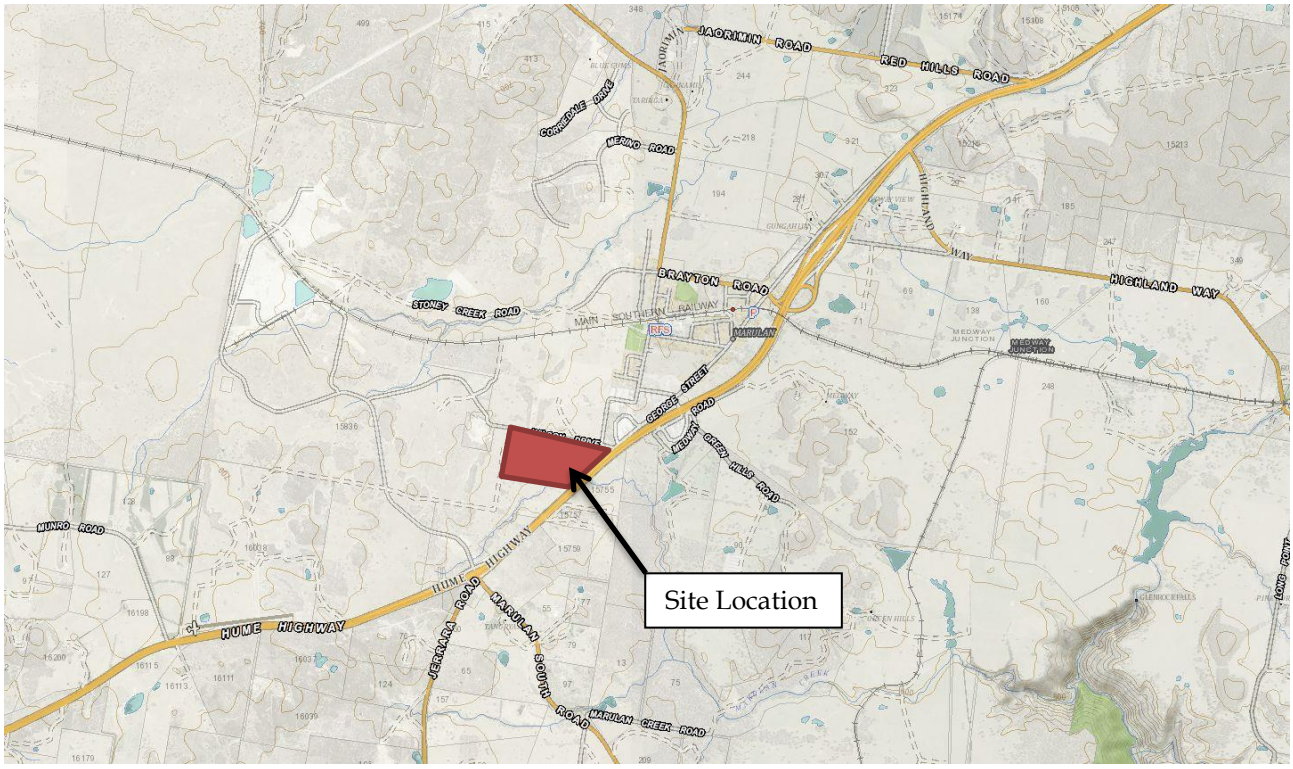


Figure 1 - Site Location.

1.2 Key Requirements

Council provided a written response regarding the development approval on 5 July 2023 requiring additional information including a revised and detailed Surface Water and Water Cycle Management study prepared by a suitably qualified engineer. The details of the assessment must be for all stormwater events ranging from the 39% Annual Exceedance Probability (AEP) up to and including the 1% AEP. The report must be compliant with the requirements of GMC DCP 2009, AR&R 2019 and relevant NSW guidelines.

1.3 Scope and Limitations

This report has been prepared by Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd for Citywest Corp P/L ATF The Copulos (Sunshine) u/t and may only be used and relied on by Citywest Corp P/L ATF The Copulos (Sunshine) u/t for the purpose agreed between SEEC and Citywest Corp P/L ATF The Copulos (Sunshine) u/t as set out in Section 1.1 of this report.

SEEC otherwise disclaim responsibility to any person other than Citywest Corp P/L ATF The Copulos (Sunshine) u/t arising in connection with this report. SEEC also exclude implied warranties and conditions, to the extent legally permissible.

The services undertaken by SEEC in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. SEEC have

no responsibility or obligation to update this report to account for events or changes occurring after the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by SEEC described in this report. SEEC disclaim liability arising from any of the assumptions being incorrect.

2 PROPOSED DEVELOPMENT

This proposed development seeks Torren title subdivision of Lots 100, 101 & 102 of DP 1161331 Wilson Drive, Marulan (The Site) to create 35 industrial lots with 2 drainage/public reserves and supporting road network (37 total lots).

The proposal will involve road construction, related infrastructure including stormwater drainage and water quality treatment structures such as Bioretention and on-site detention basins. Proposed earthworks/site regrading will fill a number of man-made dams and divert minor watercourses across the site.

The proposed development is shown in Figure 2.

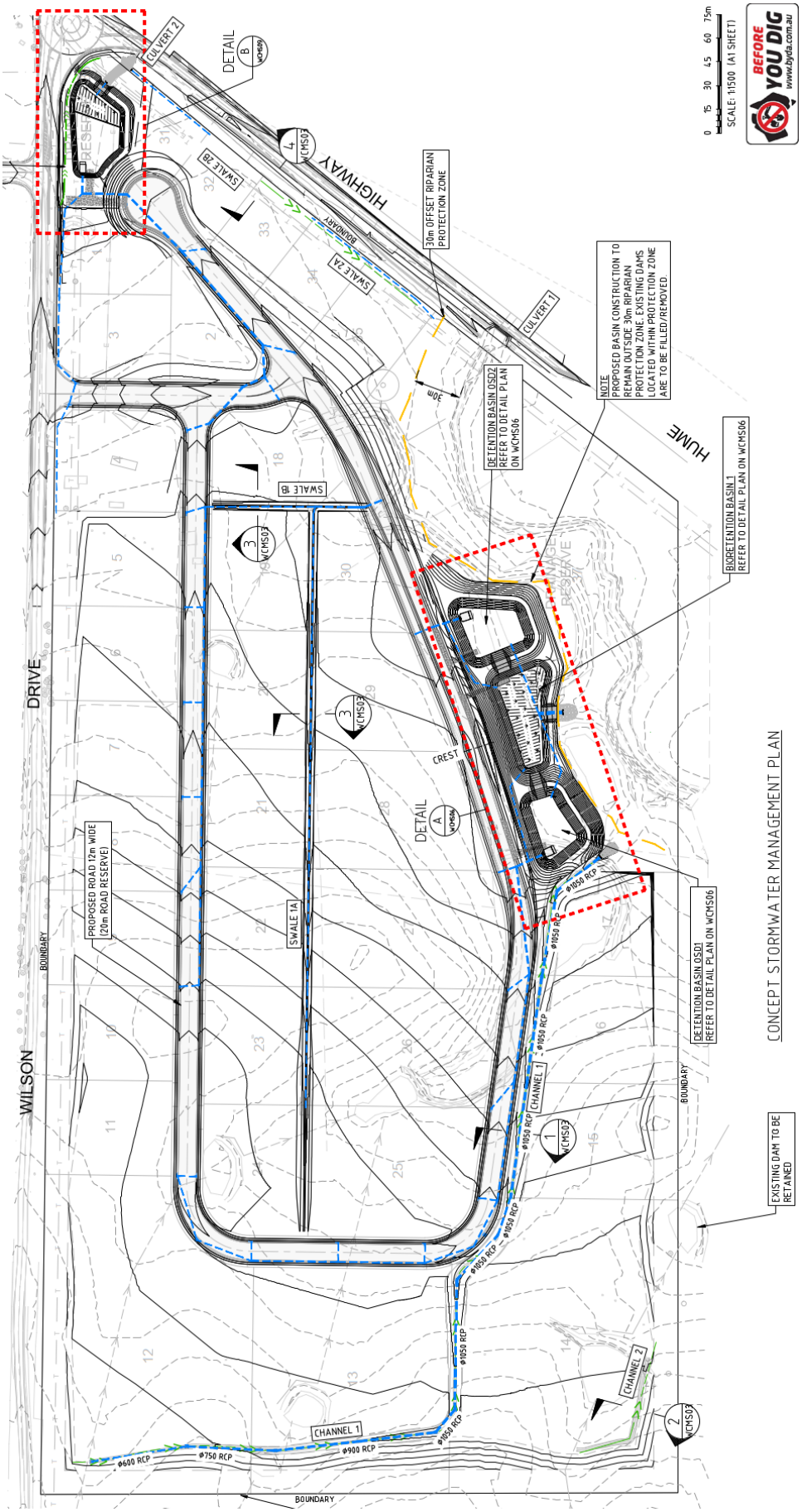


Figure 2 - The Proposed Development.

3 SITE DESCRIPTION

3.1 Location and General Conditions

The site occupies a total area of approximately 31 ha. The majority of it is covered in pasture grass and is used for cattle grazing. A number of steel sheds and a homestead are located in the north east corner of the site (Figure 3). The site is bound in the north by Wilson Drive, in the east by the Hume Highway, in the south and west by similar land. In the northwest it is bound by land that contains a waste depot.

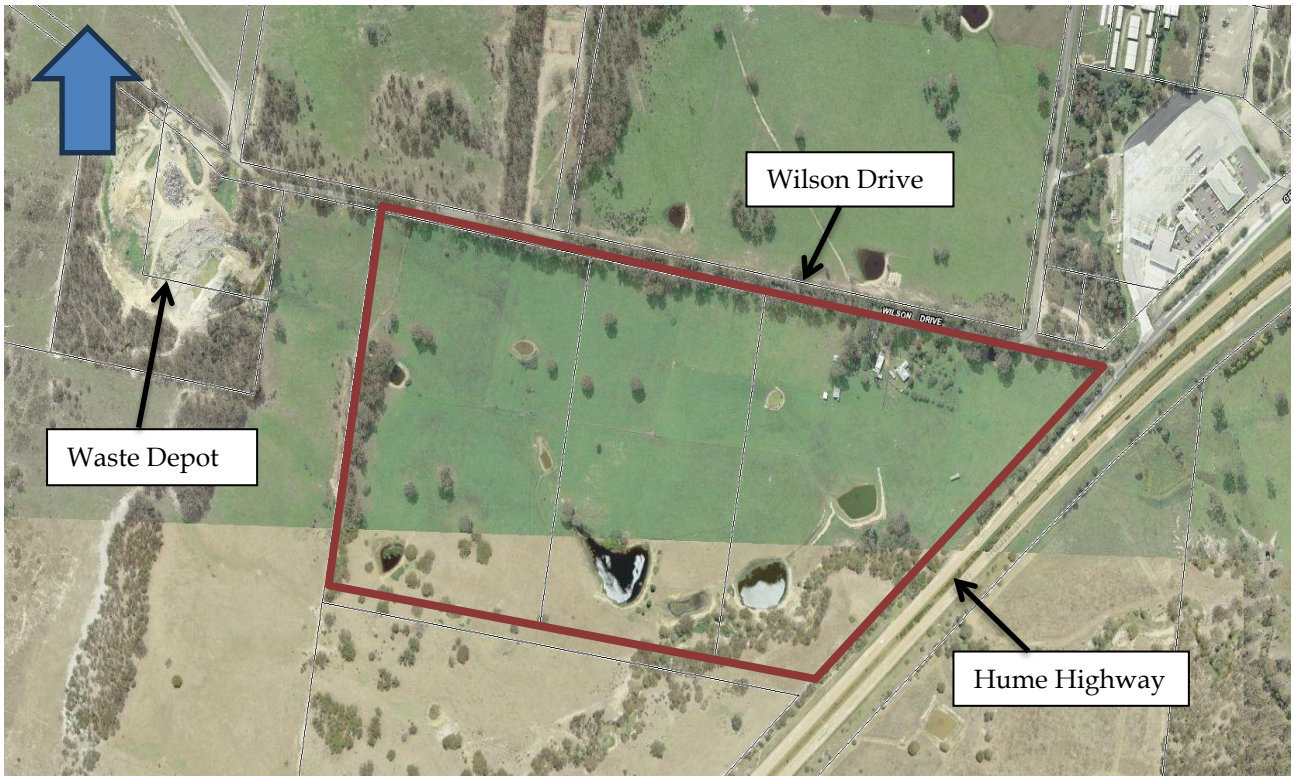


Figure 3 - Existing Site.

3.2 Topography and Surface Drainage

The site occupies a generally south-east facing side slope of about 5% gradient. It mainly drains to a chain of six dams, sometimes via contour drains. Four additional smaller farm dams are located on the site. A drainage line passes through the west of the site and is marked as a second-order stream. The chain of dams lies on this drainage line (Figure 4). There are two other drainage lines marked as first order streams in the far south west and in the east of the site.

However, none of the drainage lines described above have formed bed and banks and so none of them are considered rivers under the act. Ultimately, all surface water drains to a third order stream in the south east of the site. This stream drains east under the Hume Highway; a small part of the site lies to the north-east of it (Figure 4). The third order stream is marked as a permanent stream; ultimately it joins Marulan Creek.

Run-on only occurs in the west of the site; the second-order stream originates in a waste depot to the west of the site (Figure 3 and Figure 4).

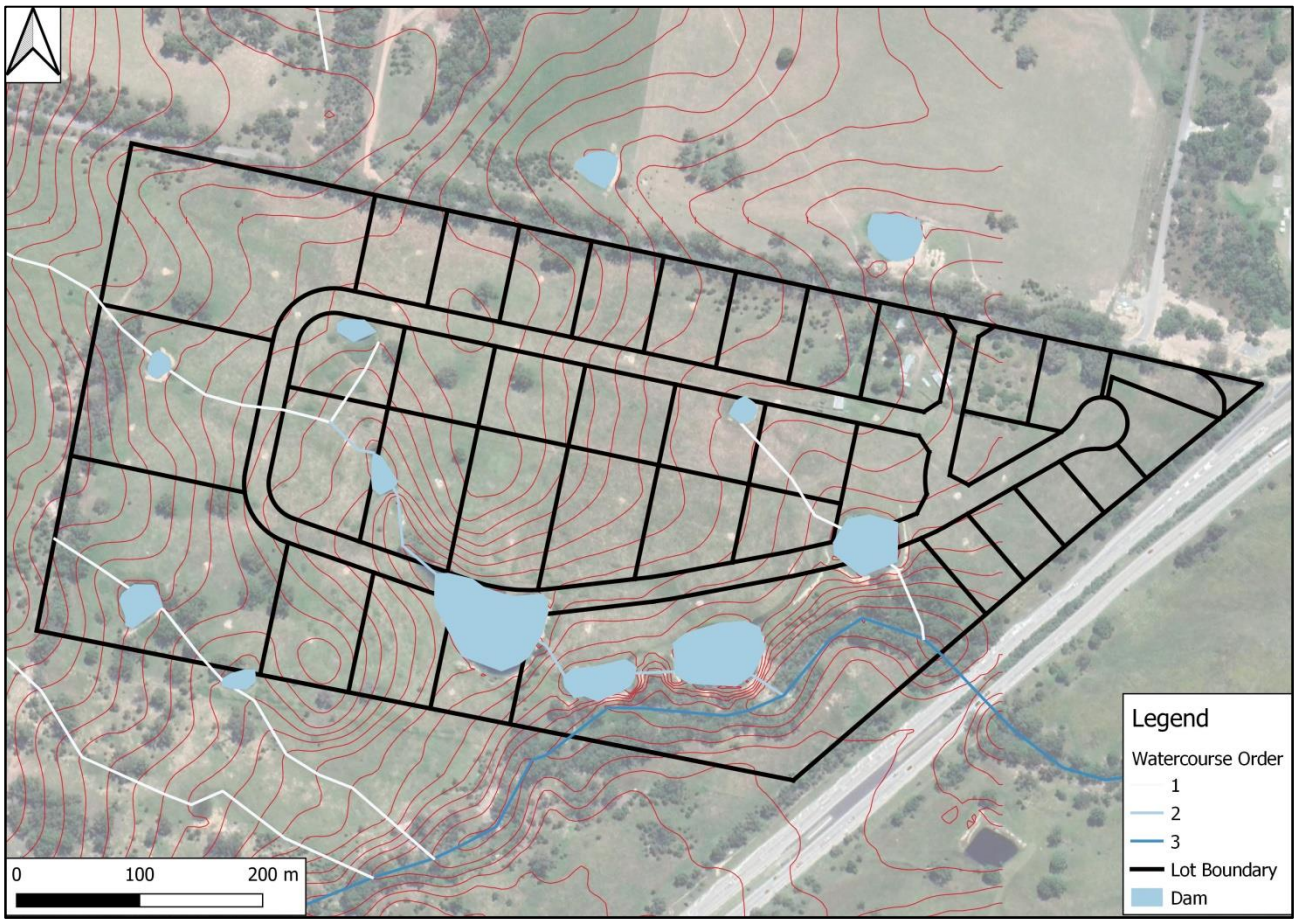


Figure 4 – Existing Drainage lines and dams (Source: NearMap).

3.1 Groundwater Bores

According to mapping available from WaterNSW, there are no licensed groundwater bores on the site.

3.2 Soils and Geology

Soil landscape mapping by the SCA/DLWC (2002) shows the site is on the Marulan (ml) and Jaqua (jq) Soil Landscapes (Figure 5). Both these soil landscapes are derived on granite bedrock and generally consist of sandy clay loam topsoil over clay subsoil. The developed land will mostly be confined in the east, on the Jaqua Soil Landscape while the irrigated pasture will be in the west, on the Marulan Soil Landscape.



Figure 5 - Soil Landscape Mapping (SCA/DLWC (2002)).

Laboratory testing of soils in this landscape by SCA/DLWC (2002) found the K-factor (soil erodibility index) to vary between 0.024 (low) and 0.065 (very high) and the soils to be potentially dispersive (Type D). The soils are particularly prone to sheet and wind erosion when cleared. Landcom (2004) classifies the soils as Hydrological Group C (impaired drainage).

3.3 Climate and Erosion Potential

Marulan experiences a temperate climate, with warm summers and cool winters. According to the Australian Bureau of Meteorology, nearby Marulan – George Street (Site No.70063) the median annual rainfall is 702 mm. There is no evaporation data for the town of Marulan however according to WaterNSW (2019) (*Designing and Installing On-Site Wastewater Systems; A WaterNSW Current Recommended Practice)* Marulan lies within Evaporation Zone 3 which experiences an average of 1,261 mm of evaporation per year. Rainfall is evenly distributed across the year while evaporation is significantly greater in summer (Figure 6).

The estimated rainfall erosivity factor (R-factor) is 1,270 which is relatively low. The erosion hazard at this site is low due to the low slope gradient and the low R-Factor (Figure 4.6, Landcom (2004)).

Table 1 - Median monthly rainfall (Marulan – George Street) and evaporation (WaterNSW, 2019 Evaporation Zone 3).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rain (mm)	55.6	55.2	52.0	34.8	31.2	45.6	31.2	33.3	38.5	47.0	52.6	53.0	702.0
Evap (mm)	187	145	124	79	51	34	39	61	88	123	146	185	1261

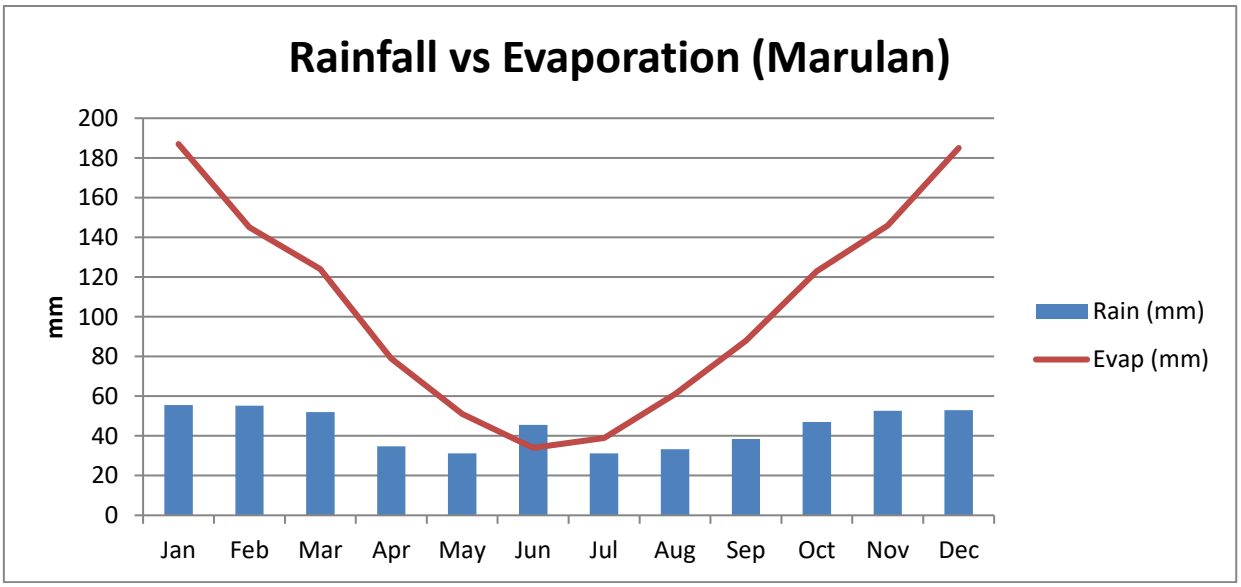


Figure 6 - Graph showing Rainfall and Evaporation.

3.4 Salinity

The soil landscape mapping (SCA/DLWC, 2002) identifies the Marulan and Jaqua Soil Landscapes as having a risk of localised saline discharge. However, there were no signs of saline soils (e.g. die-back, seepage scalds) on the site. Based on this, salinity is not expected to be problematic to the development.

3.5 Governing Bodies Constraints and Opportunities

The site is within the Goulburn-Mulwaree Shire Council and Sydney Drinking Water Catchment area and must therefore accord with their Current Recommended Practices (CRPs), Local Environmental Plan (LEP) and Development Control Plans (DCPs).

4 IDENTIFYING FUTURE WATER QUALITY ISSUES

4.1 Soil and Water Management during Construction

During construction there will be some short to long-term soil disturbance. A Soil and Water Management Plan as discussed in Section 7.1 will be required to manage soil disturbance during construction.

4.2 Production, Management and Disposal of Wastes

4.2.1 Industrial Waste

We anticipate that new industrial lots would have access to Council's waste transfer stations (as part of annual rates) and each lot would have it's own trade waste agreement with a license provider depending on each individual proposed development.

4.2.2 Effluent Disposal

The proposal is based on the understanding that Council is currently undertaking an expansion and upgrade of the existing Marulan Wastewater Treatment Plant, and it is predicted, at this time, that the new plant will become operational during 2024. It is proposed that all new industrial lots would connect to this reticulated sewerage system.

4.2.3 Other Pollutants

Due to an increase in impervious surfaces, the development may generate quantities of pollutants entrained in stormwater runoff. The measures outlined in Section 6 have been developed to ensure that the water quality of the site runoff is kept at a neutral or beneficial level when compared with the pre-development scenario.

4.3 Land Surface Changes

4.3.1 Land Use Change

There will be significant land surface changes as a result of this development. These changes will impact the overall level of impervious surfaces across the site and are expected to lead to increased runoff. The proposed changes are:

4.3.1.1 Construction of new industrial buildings on each new lot together with associated driveways, hardstand areas etc.

4.3.1.2 Construction of sealed road pavements which would have kerb and gutter and footpaths. The estimated effective imperviousness of the road easement would be 75 percent.

4.3.2 Overland Flow/ Localised Flooding

A detailed Flood Impact Assessment has been undertaken of the existing and proposed overland flow paths and third order watercourse flowing through the south-eastern corner of the site (Figure 4) for the 63%, 18%, 10%, 5%, 2%, 1%, 0.5%, 0.2% Annual Exceedance Probability (AEP) and Probable maximum Flood (PMF) flood events.

The results show that there would likely be no adverse flood impacts or actionable nuisance to immediately upstream, adjacent, and downstream properties as result of any proposed works. Refer to SEEC report 21000286-FS-02 Rev C for details of this assessment.

4.4 Pre vs Post Assessment of Stormwater Quality

The proposed future land use at this site, if left unmitigated, is expected to lead to an increase in stormwater discharge and pollutant production due to increased runoff from impervious surfaces (roofs, paved areas, parking areas, etc.).

Section 7 of this report contains a Water Cycle Management Plan that demonstrates how the proposed surface water management system can achieve a neutral or beneficial effect on water quality. The MUSIC software was used to validate the performance of the system with the adopted methodology and model assumptions provided in Section 6.

5 HYDROLOGY

5.1 Calculation Method

A DRAINS model was adopted to estimate flow hydrographs for input into the hydraulic model. As the existing site and external catchments are rural, the RAFTS storage routing model was adopted for the design storm events. The same DRAINS model was adopted for the flood assessment as described in Flood Impact Assessment also prepared by SEEC (21000286-FS-02 Rev C).

The model can be calibrated to historical flow records using recorded rainfall data (pluviometer) and by adjusting infiltration losses, catchment roughness (within realistic tolerances) and the storage delay time co-efficient (B). However, as there are no calibration data for this catchment, the model has been developed with reasonable regional data and compared against the Regional Flood Frequency Estimation tool available from the Australian Rainfall and Runoff data hub and Rational Method flow estimates. This is outlined in the accompanying Flood Impact Assessment report 21000286-FS-02 Rev C.

5.2 Rainfall Data

The DRAINS model incorporates the latest ARR2019 procedures. Rainfall depths and temporal patterns were sourced from the Australian Rainfall and Runoff (AR&R) Data Hub. The temporal pattern for the site is the SSmainland (Southern Slopes (Vic/NSW). A copy of the IFD Chart and table for the site is attached in Appendix A.

5.3 Existing Catchment Delineation

The catchment areas adopted in the DRAINS model are shown in Figure 7. The existing catchment is predominantly paddock areas with a small portion of sealed roads. Manning's roughness used was 0.045 to account for the existing landform (paddocks). Existing sealed roads within the site have been modelled with a mannings roughness of 0.025

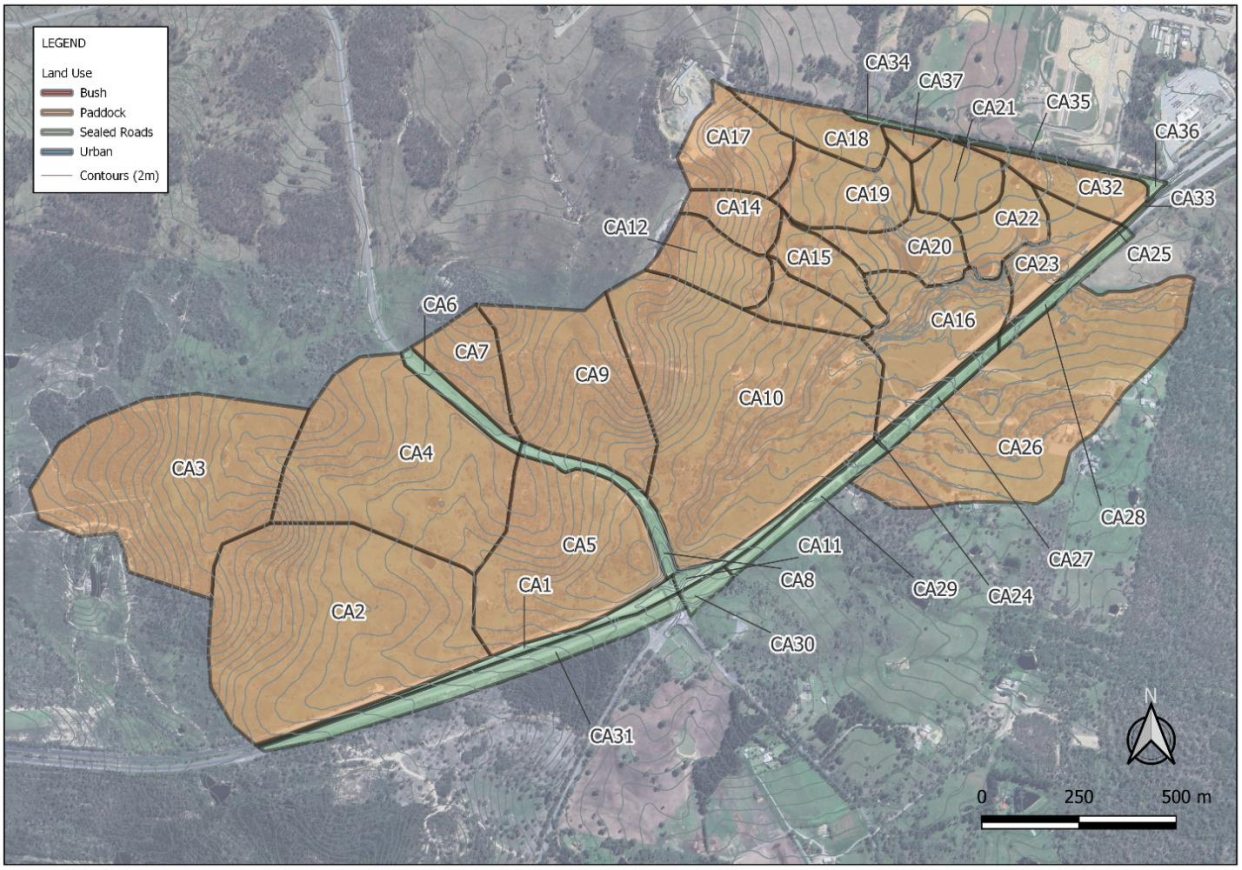


Figure 7: Existing Sub-catchments.

The sub-catchment areas and slopes are provided in Table 2 below. Paddocks have been modelled with 100% perviousness (0% imperviousness). Most sealed roads have been modelled with 70% imperviousness (30% perviousness), however, road catchments along Wilson Drive have been modelled with 60% imperviousness (40% perviousness), as the catchment includes dense vegetation within the road reserve.

Table 2: Existing Catchment Characteristics.

Name	Area (ha)	Impervious (%)	Slope (%)	Roughness
CA01	2.112	70	1.7	0.025
CA02	29.905	0	4.02	0.045
CA03	23.363	0	6.3	0.045
CA04	22.202	0	3.68	0.045
CA05	16.215	0	2.9	0.045
CA06	1.408	70	0.92	0.025
CA07	4.094	0	5.63	0.045
CA08	1.773	70	2.24	0.025
CA09	13.714	0	4.49	0.045
CA10	32.892	0	4.31	0.045
CA11	1.238	70	1.44	0.025
CA12	4.455	0	6.21	0.045
CA13	2.805	0	4.86	0.045

Name	Area (ha)	Impervious (%)	Slope (%)	Roughness
CA14	2.787	0	7.43	0.045
CA15	3.360	0	4.07	0.045
CA16	9.119	0	2.44	0.045
CA17	5.697	0	4.81	0.045
CA18	3.532	0	4.51	0.045
CA19	6.045	0	4.1	0.045
CA20	4.541	0	3.82	0.045
CA21	3.725	0	2.62	0.045
CA22	3.734	0	2.36	0.045
CA23	4.078	0	3.25	0.045
CA24	0.350	70	2.28	0.025
CA25	0.377	70	1.02	0.025
CA26	24.578	0	2.26	0.045
CA27	1.324	70	2.33	0.025
CA28	1.274	70	1.27	0.025
CA29	1.652	70	1.41	0.025
CA30	0.724	70	1.95	0.025
CA31	4.890	70	1.86	0.025
CA32	3.655	0	1.9	0.045
CA33	0.158	70	1.9	0.025
CA34	0.357	60	2.58	0.025
CA35	0.246	60	2.54	0.025
CA36	0.361	60	2.5	0.025
CA37	0.734	0	3	0.025
TOTAL	**243.47**			

5.4 Rainfall Loss Parameters

The AR&R Data Hub indicated an initial rainfall loss of 11.0mm and a continuing Loss of 2.9mm/hr for this region. Typically losses are higher for the more frequent events and lower for the less frequent storm events based on antecedent rainfall conditions.

The AR&R data losses were adopted and adjusted slightly to obtain greater alignment to the Rational Method peak flow estimates and be within the RFFE predicted flow ranges described in Section 4.4 of the Flood Impact Assessment report (21000286-FS-02 Rev C). The following parameters were adopted in the DRAINS/RAFTS model.

- Constant rainfall loss model.
- Impervious Area Initial Loss – 1mm.
- Impervious Area Continuing Loss – 0mm/hr.
- Pervious Area Initial Loss.
    - 11mm (63%, 18%, 10% AEP).
    - 5mm (5%, 2%, 1%, 0.5% and 0.2% AEP).
- Pervious Area Continuing Loss.
    - 2.5mm/hr (63%, 18%, 10% AEP).
    - 1.5mm/hr (5%, 2%, 1%, 0.5% and 0.2% AEP).
- BX = 1.

5.5 DRAINS Model – Existing Catchment

5.5.1 Model Initial Conditions

The DRAINS pre-development model layout is shown in Figure 8 below. The following parameters were adopted in the DRAINS/RAFTS model.

- Existing dams not modelled to simulate at capacity i.e. full.
- Culverts under Hume Highway
  - 2 x 2400mm wide x 1800mm high Reinforced Concrete Box Culvert (RCBC) (southern culvert).
  - 1 x 800mm wide x 900mm high Reinforced Concrete Box Culvert (RCBC) (northern culvert).
- Culverts under Marulan South Road
  - 2 x 1800mm wide x 1200mm high RCBC.
- No culvert blockage.
- Outlet nodes are freely discharging to the atmosphere.
- No climate change allowance (adjusted in TUFLOW for the accompanying Flood Risk Assessment).

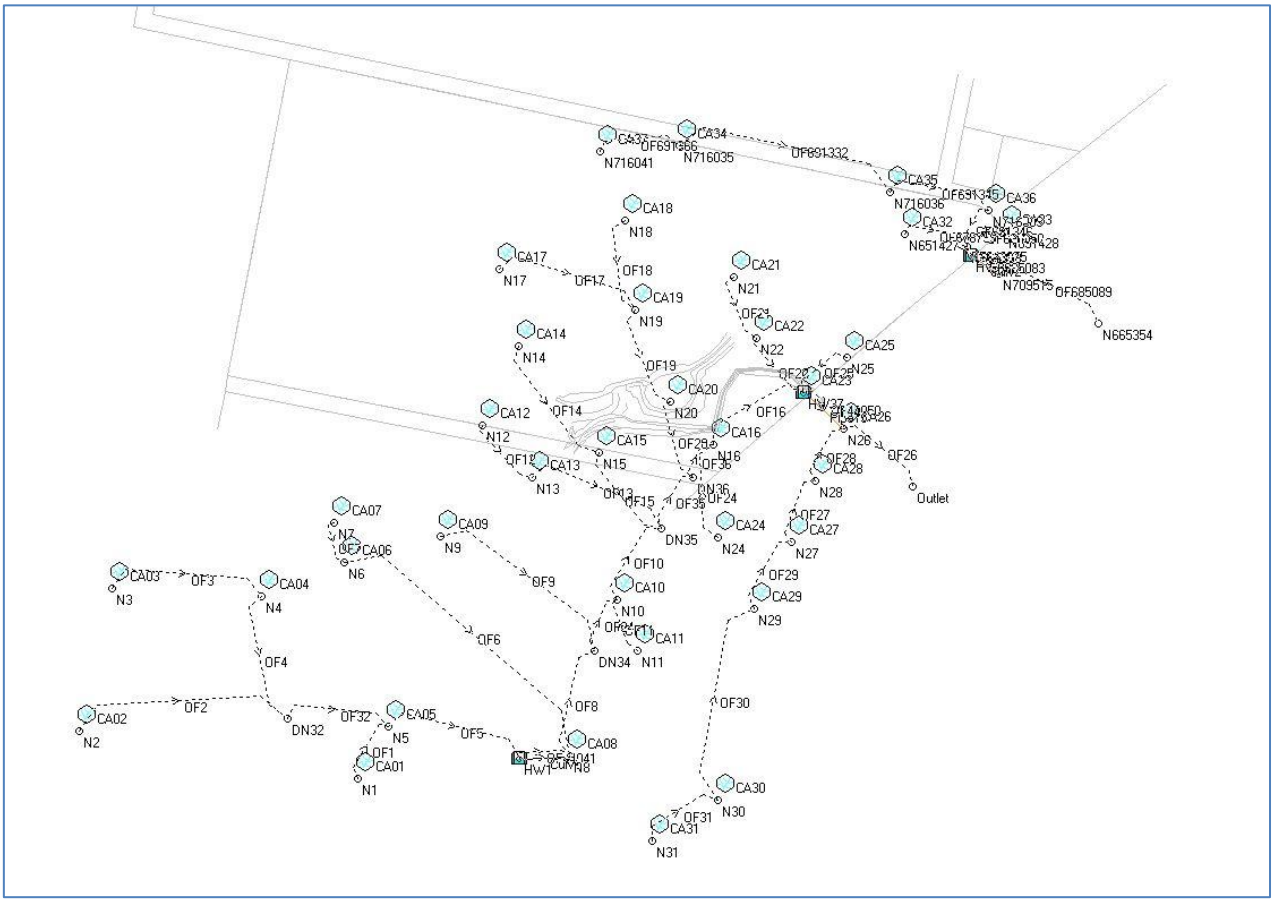


Figure 8 - DRAINS Pre-Development Model Layout

5.6 Developed Catchment Delineation

The developed catchment areas included in the DRAINS model are shown in Figure 9 and Figure 10. Following the proposed development, the upstream catchment (south of the site)

will remain largely paddock with some sealed road sections. The DRAINS model nodes for this upstream catchment have therefore not been modified for the developed scenario.

According to the civil earthworks plans and geotechnical investigations, the new allotments will be subject to cut and fill to establish relatively flat industrial lots. Some lots will be cut into soil or rock, while others will be filled with suitable compacted material. All allotments will be finished with 200-300mm of topsoil and grassed prior to further development. For modelling purposes, these allotments have been represented as vacant grassed lots. The DRAINS model has been amended to represent the vacant developed lots with an imperviousness of 0% and the Manning's roughness reduced to 0.04 to account for landform changes. Sealed roads within the site have been modelled with 75% imperviousness (25% perviousness) with a mannings roughness of 0.025.

For future development, each individual lot owner will be responsible for assessing the change in imperviousness on their allotment and providing sufficient on-site detention (OSD) to limit post-development flows to pre-development conditions. Hydrologic modelling for each lot should assume a base case of 0% imperviousness with Manning's roughness of 0.04, consistent with the post-developed DRAINS model. Their individual lot model should then be updated to reflect the proposed development scenario (e.g. 80% imperviousness), with on-site detention sized to attenuate flows back to the 0% imperviousness base case. This requirement can be conditioned as part of future development applications, using the catchment parameters provided in Table 3.

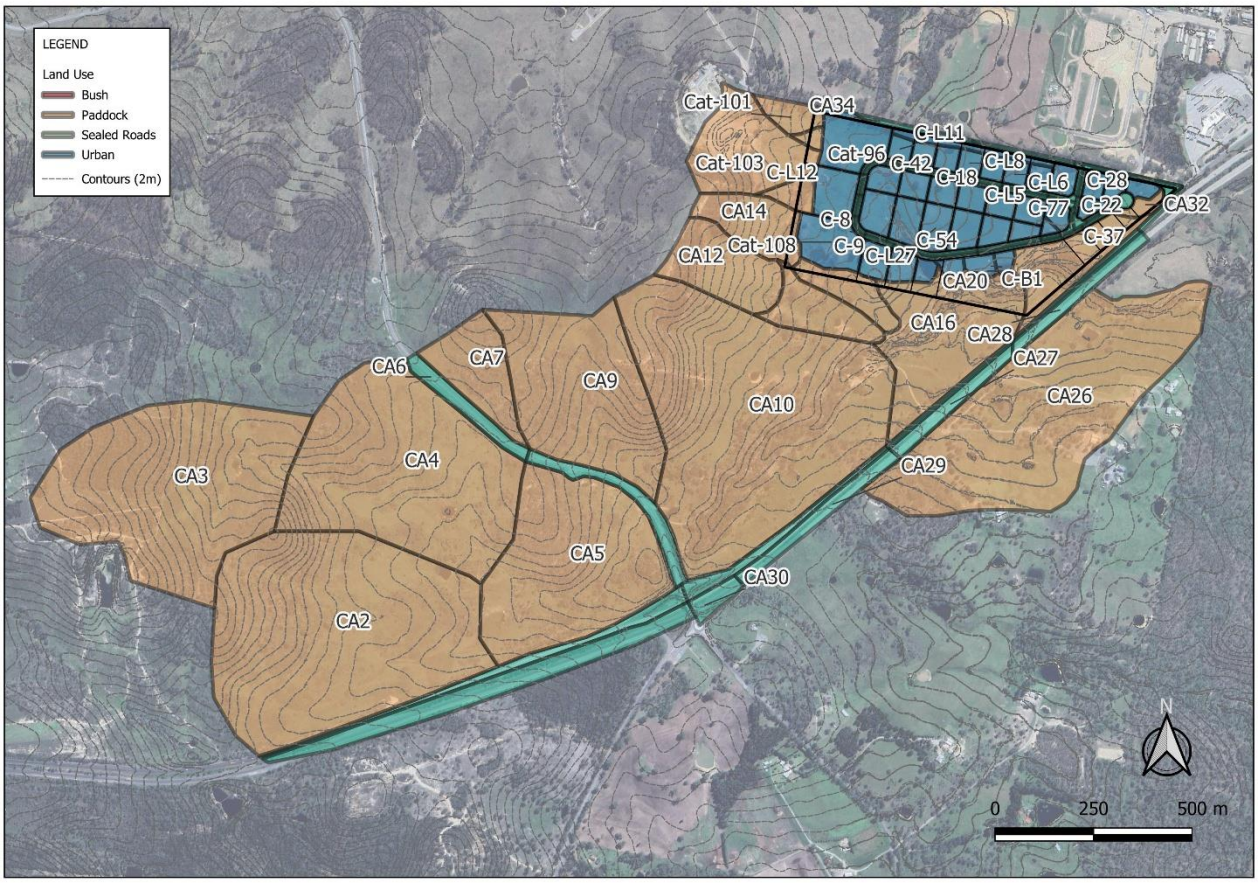


Figure 9: Developed Scenario Sub-catchments.

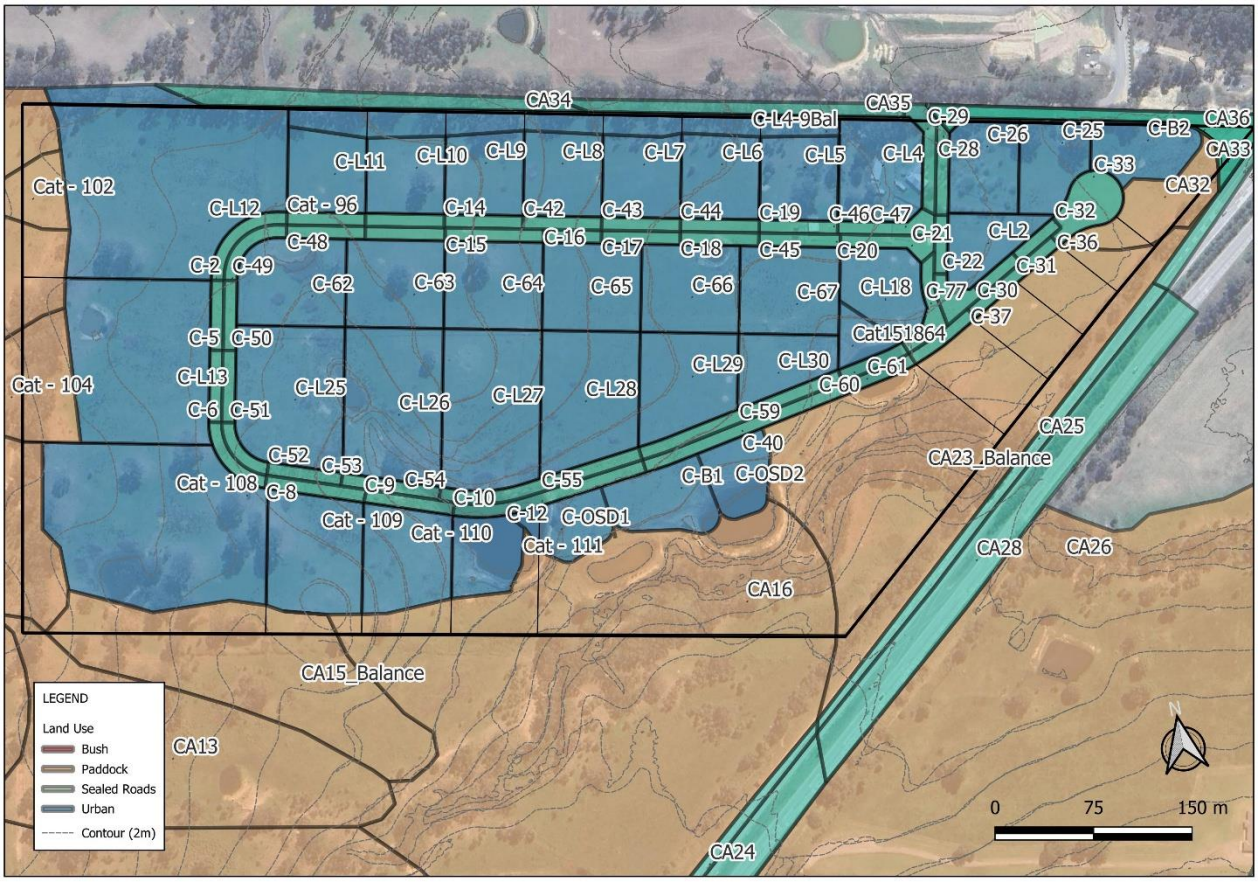


Figure 10: Developed Scenario Sub-catchments within the site.

The sub-catchment areas, slopes and manning's roughness coefficients are provided in Table 3.

Table 3: Developed Catchment Characteristics.

Name	Area (ha)	Impervious (%)	Slope (%)	Manning's n
C-10	0.068	75	2.47	0.025
C-12	0.150	75	2.09	0.025
C-14	0.060	75	2.85	0.025
C-15	0.061	75	2.64	0.025
C-16	0.075	75	3.78	0.025
C-17	0.044	75	3.63	0.025
C-18	0.060	75	1.64	0.025
C-19	0.060	75	1.14	0.025
C-2	0.081	75	0.47	0.025
C-20	0.062	75	0.10	0.025
C-21	0.084	75	1.15	0.025
C-22	0.045	75	1.74	0.025
C-25	0.340	0	0.10	0.04
C-26	0.381	0	4.21	0.04

Name	Area (ha)	Impervious (%)	Slope (%)	Manning's n
C-28	0.069	60	4.72	0.025
C-29	0.098	60	4.39	0.025
C-30	0.072	75	1.24	0.025
C-31	0.039	75	2.65	0.025
C-32	0.041	75	2.64	0.025
C-33	0.184	80	2.26	0.025
C-36	0.085	75	2.36	0.025
C-37	0.057	75	1.13	0.025
C-40	0.165	75	0.49	0.025
C-42	0.060	75	3.88	0.025
C-43	0.060	75	3.99	0.025
C-44	0.060	75	1.68	0.025
C-45	0.060	75	1.10	0.025
C-46	0.060	60	1.65	0.025
C-47	0.089	75	1.54	0.025
C-48	0.060	75	0.78	0.025
C-49	0.065	75	0.74	0.025
C-5	0.053	75	0.82	0.025
C-50	0.053	75	0.57	0.025
C-51	0.055	60	0.70	0.025
C-52	0.051	75	2.09	0.025
C-53	0.057	75	2.62	0.025
C-54	0.076	75	2.55	0.025
C-55	0.158	75	2.26	0.025
C-59	0.163	75	2.20	0.025
C-6	0.055	75	0.79	0.025
C-60	0.054	60	0.68	0.025
C-61	0.056	75	0.63	0.025
C-62	0.535	0	0.89	0.04
C-63	0.502	0	2.79	0.04
C-64	0.503	0	3.58	0.04
C-65	0.503	0	3.19	0.04
C-66	0.503	0	1.61	0.04
C-67	0.512	0	1.34	0.04
C-77	0.090	75	1.68	0.025
C-8	0.065	75	1.76	0.025
C-9	0.076	60	2.60	0.025
CA01	2.112	70	1.70	0.025
CA02	29.905	0	4.02	0.045
CA03	23.363	0	6.30	0.045

Name	Area (ha)	Impervious (%)	Slope (%)	Manning's n
CA04	22.202	0	3.68	0.045
CA05	16.215	0	2.90	0.045
CA06	1.408	70	0.92	0.025
CA07	4.094	0	5.63	0.045
CA08	1.773	70	2.24	0.025
CA09	13.714	0	4.49	0.045
CA10	32.892	0	4.31	0.045
CA11	1.238	70	1.44	0.025
CA12	4.455	0	6.21	0.045
CA13	2.805	0	4.86	0.045
CA15_Balance	1.935	0	4.07	0.045
CA16	9.544	0	2.44	0.045
CA20_balance	0.560	0	3.82	0.045
CA23_Balance	3.873	0	3.25	0.045
CA24	0.350	70	2.28	0.025
CA25	0.377	70	1.02	0.025
CA26	24.578	0	2.26	0.045
CA27	1.324	70	2.33	0.025
CA28	1.274	70	1.27	0.025
CA29	1.652	70	1.41	0.025
CA30	0.724	70	1.95	0.025
CA31	4.890	70	1.86	0.025
CA32	0.420	0	1.90	0.045
CA33	0.158	70	1.90	0.025
CA34	0.357	60	2.58	0.025
CA35	0.246	60	2.54	0.025
CA36	0.354	70	2.50	0.025
Cat - 101	1.068	0	4.51	0.04
Cat - 102	0.281	0	4.51	0.04
Cat - 103	5.699	0	4.81	0.04
Cat - 104	0.805	0	4.81	0.04
Cat - 108	1.786	0	2.60	0.04
Cat - 109	0.652	0	2.57	0.04
Cat - 110	0.514	0	2.55	0.04
Cat - 111	0.310	0	1.84	0.04
Cat - 96	0.060	75	0.74	0.025
Cat151864	0.130	0	0.80	0.04
C-B1	0.376	5	1.00	0.045
C-B2	0.336	5	1.00	0.045
C-channel2	3.201	0	8.00	0.045

Name	Area (ha)	Impervious (%)	Slope (%)	Manning's n
C-L10	0.351	0	3.70	0.04
C-L11	0.367	0	2.00	0.04
C-L12	2.157	0	1.00	0.04
C-L13	1.324	0	1.00	0.04
C-L18	0.364	0	0.60	0.04
C-L2	0.283	0	2.00	0.04
C-L25	0.862	0	2.20	0.04
C-L26	0.869	0	2.90	0.04
C-L27	0.904	0	3.40	0.04
C-L28	0.753	0	2.10	0.04
C-L29	0.551	0	3.00	0.04
C-L30	0.322	0	1.60	0.04
C-L4	0.499	0	2.40	0.04
C-L4-9Bal	0.741	0	2.86	0.04
C-L5	0.384	0	1.60	0.04
C-L6	0.385	0	1.50	0.04
C-L7	0.376	0	2.50	0.04
C-L8	0.384	0	4.10	0.04
C-L9	0.374	0	4.10	0.04
C-OSD1	0.268	100	1.00	0.045
C-OSD2	0.265	100	1.00	0.045
TOTAL	**243.807**			

5.7 DRAINS Model – Developed Catchment

5.7.1 Model Initial Conditions

The DRAINS post-development model layout is shown in Figure 11 below. The DRAINS model was adopted from the pre-developed scenario and then amended with the following additions:

- Allotment slopes changed to match the finished cut and fill plan.
- Fraction Impervious Area for Lots (assumes individual lot on-site detention) = 0%.
- Mannings roughness of new allotments lowered to represent a vacant grassed block.
- Mannings and percent impervious adjusted for proposed new roads where applicable.
- Proposed stormwater system including channels, gully pits, pipes and basins.
- Pit blockage factor (On-grade pits) = 0.2 (20% blocked).
- Pit blockage factor (Sag pits) = 0.5 (50% blocked).
- Minimum pit freeboard (Minor 10% AEP) = 150mm.
- Revised Pit Loss Coefficients Using Queensland Urban Design Manual (QUDM) QUDM Charts.
- Initial basin water levels set to the outlet pit level.

- The model adopted adjusted catchments as described in Table 3.

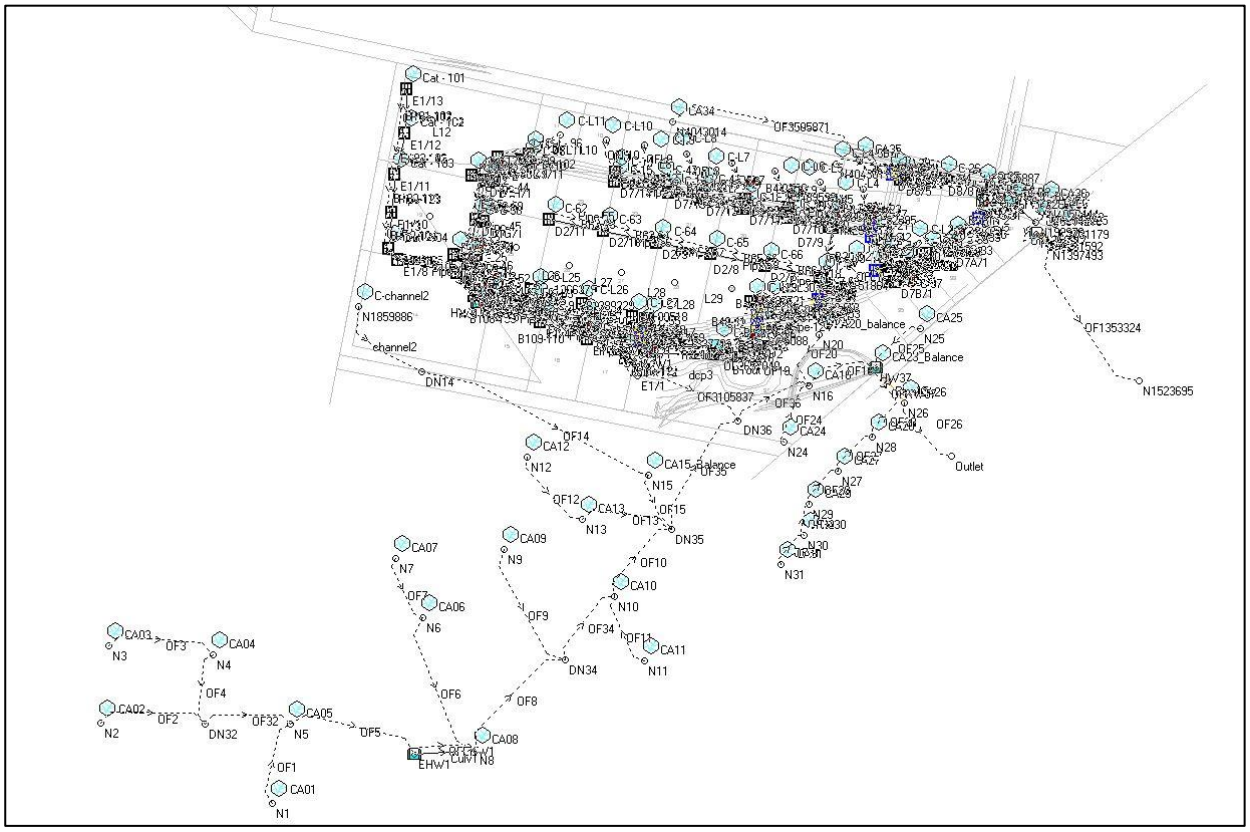


Figure 11 - DRAINS Post Development Model Layout

5.8 DRAINS Model Results

5.8.1 Pre and Post Development Comparison

Table 4 and Table 5 below summarise the pre and post development flows for all storms ranging from the 63% AEP (1 EY) up to and including the 1% AEP at the two critical locations being the existing northern and southern culverts under the Hume Highway. The results show that the proposed basins mitigate post development flows as required.

A full summary of the resulting post development site flows including pit, pit, road and overland flow paths for both the design minor storm event (10% AEP) and major storm event (1% AEP) is provided in Appendix B.

Table 4 - Northern Culvert Pre & Post Development Peak Flows

SCENARIO	PEAK STORM FLOWS - AVERAGE EXCEEDANCE PROBABLITY (AEP)					
	63% AEP (1 EY) (m^3/s)	18.3% AEP (0.2 EY) (m^3/s)	10% AEP (m^3/s)	5% AEP (m^3/s)	2% AEP (m^3/s)	1% AEP (m^3/s)
PRE DEVELEOPMENT	0.156	0.326	0.415	0.630	0.759	0.917
POST DEVELOPMENT (NO OSD)	0.266	0.521	0.549	0.716	0.901	1.077
POST DEVELOPMENT (WITH OSD)	0.155	0.309	0.307	0.470	0.656	0.817

Table 5 - Southern Culvert Pre & Post Development Peak Flows

SCENARIO	PEAK STORM FLOWS - AVERAGE EXCEEDANCE PROBABLITY (AEP)					
	63% AEP (1 EY) (m^3/s)	18.3% AEP (0.2 EY) (m^3/s)	10% AEP (m^3/s)	5% AEP (m^3/s)	2% AEP (m^3/s)	1% AEP (m^3/s)
PRE DEVELEOPMENT	4.642	10.701	13.578	20.409	25.763	29.783
POST DEVELOPMENT (NO OSD)	4.713	11.085	13.840	20.294	25.920	29.948
POST DEVELOPMENT (WITH OSD)	4.503	10.575	12.916	18.722	24.006	28.085

The potential increase in peak flow rates is to be offset with the provision of on-site detention to reduce the post development flows below the pre development flows as shown in Table 4 and Table 5 above. Refer to the flood mapping in Appendix C of the accompanying Flood Impact Assessment 21000286-FS-02 Rev C for details.

5.8.2 On-Site Detention

The two on-site detention basins (OSD) adopted in the DRAINS model incorporate bioretention basins upstream of the northern and southern culverts. These are outlined in Section 7.2.5 and shown in the accompanying Concept Stormwater Management Plans attached in Appendix C.

6 WATER QUALITY MODELLING (MUSIC)

Pre and post development sediment and stormwater pollutant loads were modelled using MUSIC (Model for Urban Stormwater Improvement Conceptualisation), developed by eWater. MUSIC contains algorithms based on the known performance characteristics of common stormwater quality improvement structures used in Australia. These data are derived from research undertaken by eWater and others. The models are appropriately calibrated and all amendments to MUSIC defaults are noted in Section 6.2.

The modelling quantifies the loads of the principal pollutants before and after the development. Statistics are produced in MUSIC for the following parameters:

- Flow (ML/yr).
- Peak Flow (m3/s) (although this is not used in a NorBE assessment).
- TSS - Total Suspended Solids (kg/yr).
- TP - Total Phosphorus (kg/yr).
- TN - Total Nitrogen (kg/yr).
- Gross Pollutants (kg/yr).

6.1 MUSIC Modelling Inputs

6.1.1 Climate Data

Creation of a MUSIC catchment file requires an associated meteorological data file. The data used here is “Zone 1" data supplied by WaterNSW. Basic rainfall and evapotranspiration statistics are in Table 6 and the time-series graph is in Figure 12.

Table 6 - Rainfall and PET Statistics for MUSIC Climate Zone 1.

Measure	Statistics						
	mean	median	maximum	minimum	10%ile	90%ile	mean annual (mm)
Rainfall (mm/6 minute steps)	0.008	0	12.5	0	0	0	721
Potential evapotranspiration (mm/day)	2.966	2.60	4.81	1.23	1.29	4.52	1083

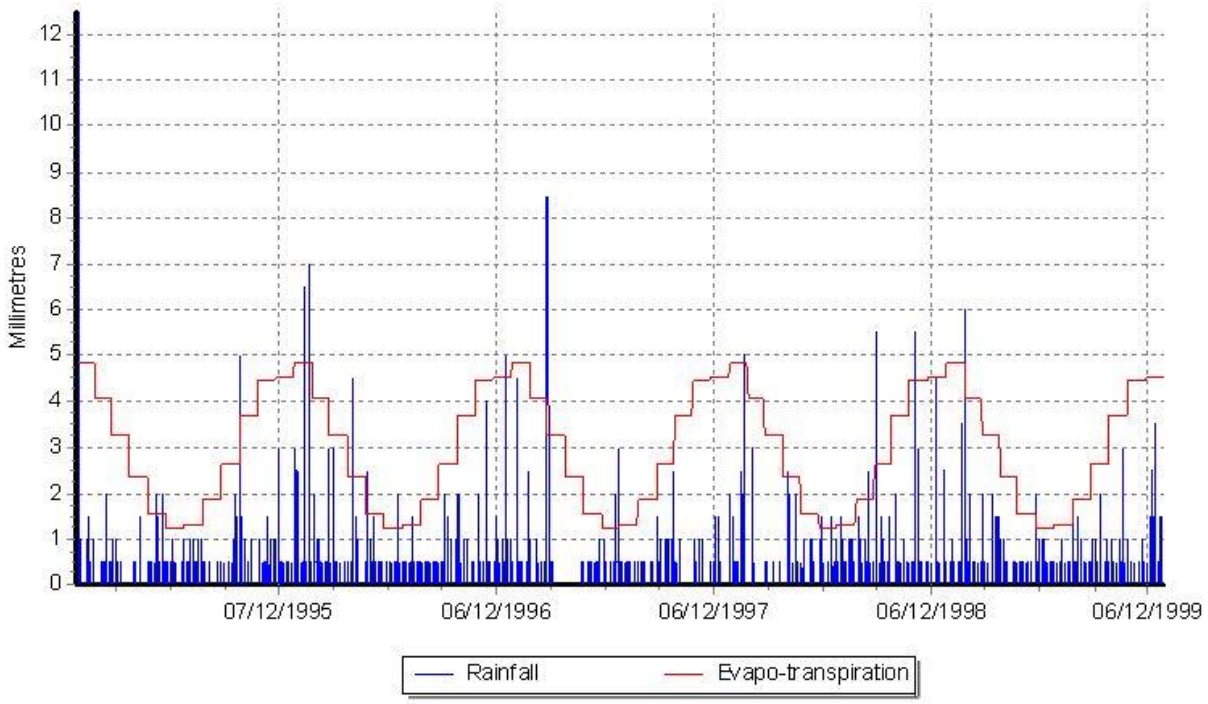


Figure 12 - Time Series Graph for WaterNSW Zone 1 data set

6.1.2 Calibration

Table 7 presents the event mean concentrations (EMCs) of various surfaces and land uses. These are the defaults in MUSIC for the various land uses represented as source nodes. The existing land use is rural grazing which is modelled as an agricultural land use in MUSIC.

Table 7 - Event Mean Concentrations (Storm Flow)

Source Node	TSS mean (log mean)	TSS std dev (log std dev)	TP mean (log mean)	TP std dev (log std dev)	TN mean (log mean)	TN std dev (log std dev)
Road (sealed)	269 (2.43)	2.1 (0.32)	0.5 (-0.30)	1.8 (0.25)	2.19 (0.34)	1.55 (0.19)
Agricultural land	141 (2.15)	2 (0.31)	0.6 (-0.22)	2 (0.3)	3.02 (0.48)	1.82 (0.26)
Industrial land	141 (2.15)	2.09 (0.32)	0.251 (-0.6)	1.78 (0.25)	2 (0.3)	1.55 (0.19)

The pervious area characteristics for each source node have been calibrated based on a silty clay soil with a 0.5 m rooting depth (WaterNSW, 2019). Calibration is shown in Table 8. The MUSIC schematic for development is shown in Figure 13.

Table 8 - Pervious area calibrations used in MUSIC

	Silty Clay Soil
Soil storage capacity (mm)	54
Initial storage (mm)	25
Field capacity (mm)	51
Infiltration capacity coefficient (a) (mm/d)	180
Infiltration capacity exponent (b)	3
Groundwater initial depth (mm)	10
Daily recharge rate (%)	25
Daily baseflow rate (%)	25
Daily deep seepage rate (%)	0

6.1.3 Pre-development Modelling Assumptions

The pre-development models use a single, 26.95ha, agricultural source node set to 98% pervious. Existing dams to be removed have been modelled using a standard 'Pond' MUSIC treatment node with an approximate surface area of 13,860m^2.

6.1.4 Post-development Modelling Assumptions

Post-development modelling is based on the following assumptions:

- The stormwater system described in Section 7 and the accompanying Stormwater Management Plan (Appendix C) is implemented.
- The model is divided into five main sub-catchments as described in Table 9 - Catchments Post Development – Full Development (All Stages) and as shown in Figure 14.

All future lots areas have been modelled as Industrial land use with a 0% impervious area as the water quality treatment modelling is for the proposed subdivision works only (roads and footpaths etc.). The owner of each future lot would need to undertake their own Neutral or Beneficial Assessment (NorBE) on water quality relating to the amount of impervious area proposed with the lot (i.e roof area, driveways and sheds etc.). All roads reserve areas have been modelling as 75% effective impervious, this includes the road pavements and footpaths either side of the roadway.

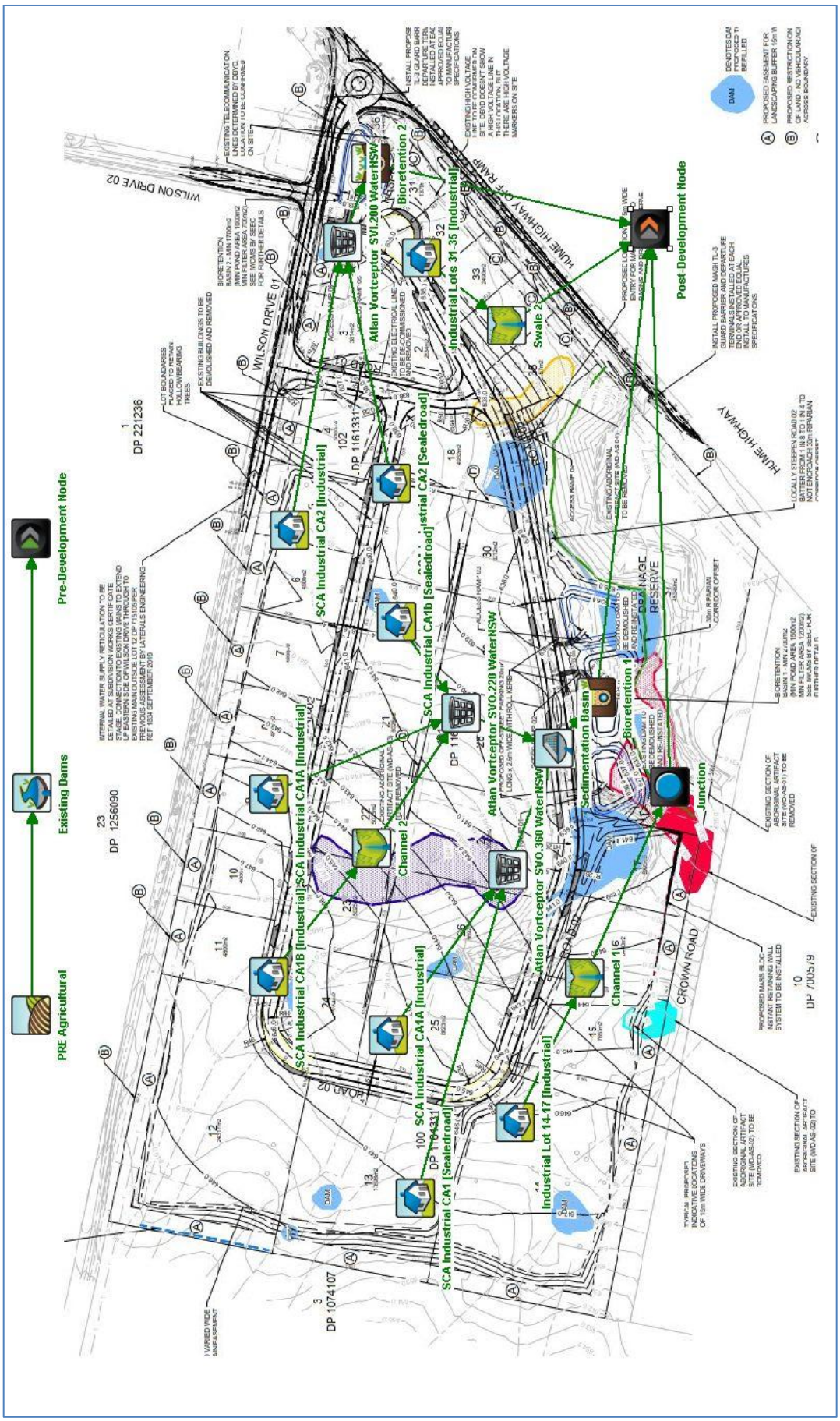


Figure 13: MUSIC model schematic – Existing at left.

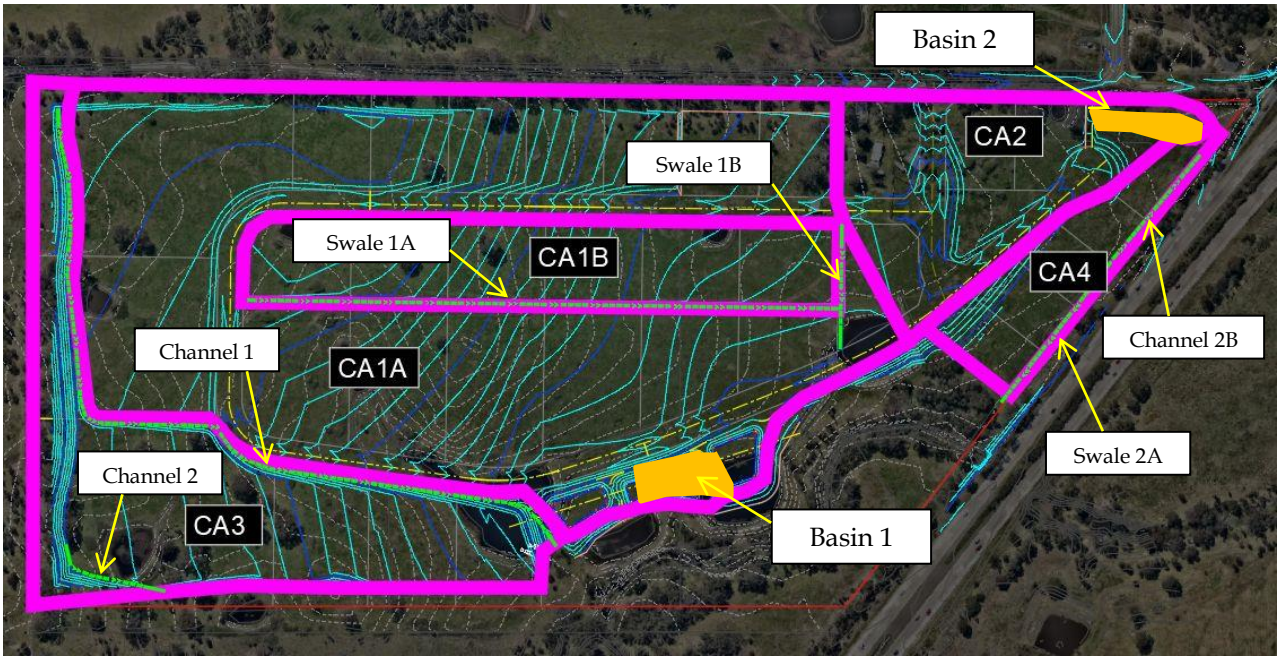


Figure 14 - Catchment Plan and Bioretention Basins

Table 9 - Catchments Post Development – Full Development (All Stages)

Catchment	Industrial (ha)	Road (ha)	Total (ha)	Drains to and Treated By
CA1A	12.14	2.34	14.48	Basin 1
CA1B	3.05	0	3.05	Swales 1A & 1B and then to Basin 1
CA2	2.09	0.95	3.04	Basin 2
CA3	5.01	0	5.01	Channel 1
CA4	1.37	0	1.37	Swales 2A & 2B

6.2 Modelling Results

6.2.1 Mean Annual Loads

Table 10 presents the results of the modelling for the development. It shows the proposed treatment system would improve the existing mean annual loads of sediment and nutrients in stormwater leaving the site.

Table 10 – Stage 1 MUSIC results – Mean Annual Loads

	Inflow	
	Pre	Post
Flow (ML/yr)	19.1	37.8
Total Suspended Solids (kg/yr)	1.66E3	383
Total Phosphorus (kg/yr)	8.44	3.47
Total Nitrogen (kg/yr)	49.9	41.5
Gross Pollutants (kg/yr)	5.12	0.00

The mean annual post development loads are all reduced by more than 10% and is in line with NorBE requirements.

6.2.2 Pollutant Concentrations

To demonstrate neutral or beneficial effect, the post-development pollutant concentrations need to be less than or equal to the pre-development concentrations between (at least) 50 and 98 percent of the time. Figure 15 and Figure 15 show the Total Phosphorous (TP) and Total Nitrogen) TN graphs for pollutant concentrations in both pre and post (treated) development scenarios. NorBE is met in all cases.



Figure 15 - Total Phosphorous Concentration Graph

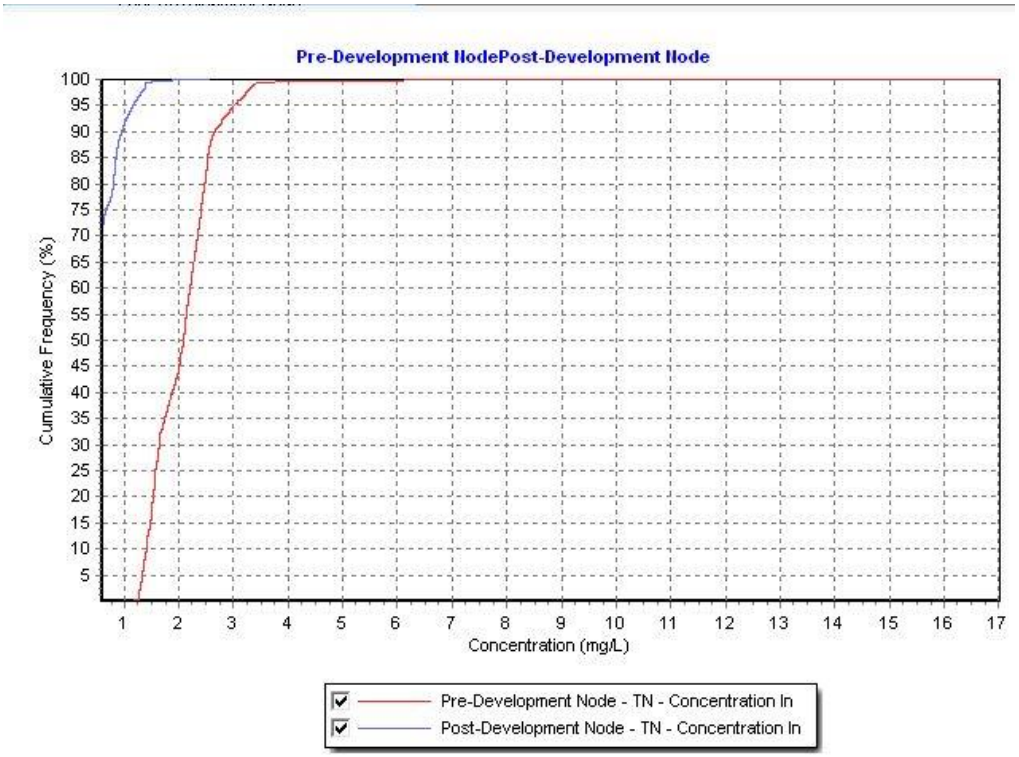


Figure 16 - Total Nitrogen Concentration Graph

7 WATER CYCLE MANAGEMENT PLAN

7.1 Construction Soil and water Management Plan (SWMP)

7.1.1 Subdivision Construction

A construction-phase Soil and Water Management Plan (SWMP) would be prepared for the proposed construction works as parts of the site have been identified at moderate to high risk of erosion. This is due to the moderate slopes on site and more than 2,500 m^2 of land would be disturbed when the new roads and basins are built. A Concept Soil and Water Management Plan 21000286_P01_SWMP01 to SWMP06 have been prepared for the development and are provided with the Concept Stormwater Management Plans attached in Appendix C.

The implementation of the SWMP must adhere to the guidelines and recommendations in Landcom, 2004 (The "Blue Book") and should include the following *generic* principles:

- Sediment fencing is to be used downslope of any construction area until works are complete (Standard Drawing SD 6-8, Landcom, 2004).
- Construction of suitably sized sediment basins to capture sediment run-off during the construction of the roads and disturbed lands during earthworks.
- Topsoil will be stripped from any construction areas and stockpiled following Standard Drawing SD 4-1 (Landcom, 2004) for later re-use.
- The upslope catchment length of exposed soil areas will be kept below 80m. Any slope length exceeding 80m will have a berm installed to direct overland flows onto well protected, vegetated lands.
- Construction traffic access is to be limited to the minimum required for efficient construction. Areas not essential for construction purposes are to be protected from traffic entry through the use of barrier and/or sediment fencing. Table 11 contains details of access limitations during construction in accordance with Landcom (2004).
- While C-factors[1] are likely to rise to 1.0 during the work's program, they will not exceed those given in Table 12.
- Diversion berms will be used to divert "clean" runoff from upslope of any construction areas away. Discharges are to be onto a stabilised, well-vegetated area, preferably using a level spreader or sill.
- Rapidly rehabilitate disturbed lands to bring C-factors down to acceptable levels (see Table 12) and minimise the risk of erosion.
- Areas of concentrated flow (e.g. drainage pathways, swales etc.) are to be protected using appropriate erosion control measures. We suggest a biodegradable Rolled Erosion Control Product (RECP) such as coconut fibre matting or jute matting to provide stable ground cover until vegetation regenerates.

[1] C-factor is a measure of ground cover. It is a value between 0.005 and 1, with lower values indicating better ground cover and higher values for exposed soil with no vegetation or erosion control measure in place. At a construction site, a C-factor of 0.1 can be achieved with 60% grass cover.

Table 11 – Limitations to access during construction works

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 should 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 on site. 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, including re-veg areas	Entry prohibited except for essential management works.	Thinning of growth might be necessary, for example, for fire reduction or weed removal.

Table 12 – Maximum acceptable C-factors at nominated times during works

Lands	Maximum C-factor	Remarks
Waterways and other areas subjected to concentrated flows (e.g. table drains), post construction	0.05	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows will be limited to those shown in Table 5.2 of Landcom (2004). Foot and vehicular traffic will be prohibited in these areas
Stockpiles, post construction	0.10	Applies after ten working days from completion of formation. Maximum C-factor of 0.10 equals 60% ground cover
All lands, including waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later. Maximum C-factor of 0.15 equals 50% ground cover
All lands post construction	0.1/0.05	0.1 applies after 10 days of works finish and can be achieved by 60 percent ground cover. 0.05 applies after 60 days and can be achieved with 70 percent ground cover.

7.1.2 Individual Lots

In the future, each development application on each new lot must be accompanied by an Erosion and Sediment Control Plan (ESCP) as described by Landcom, 2004. Chapter 9 of Landcom (2004) gives some generic examples.

7.2 Stormwater Management

7.2.1 Stormwater Management Plan

Site stormwater is to be managed in accordance with the Surface Water Management Plans prepared by SEEC, drawings 21000286_P01_WCMS01 TO WCMS14 (Appendix C) and as outlined in the following section. Stormwater drainage modelling has been undertaken using DRAINS urban stormwater drainage modelling software as described in Section 5 of this report.

A full summary of the resulting post development site flows including pit, pit, road and overland flow paths for both the design minor storm event (10% AEP) and major storm event (1% AEP) is provided in Appendix B

7.2.2 Earthworks

It is proposed to undertake extensive site earthworks and re-grading of the proposed lots and for the installation of the new roads and stormwater drainage and water quality infrastructure. All lots would drain to a road or inter-allotment drainage easement system. Refer to the preliminary civil design plans by Allen Price Scarratts Pty Ltd for information on cut and fill volumes for the development.

7.2.3 Internal Road Drainage

7.2.3.1 Pit and Piped Drainage System and Gross Pollutant Traps

All new industrial roads would incorporate kerb and guttering with a pit and piped drainage system in accordance with Councils standards. The site is zoned industrial therefore the minor pipe stormwater drainage system has been designed to cater for the 10% AEP storm event. Pit locations have been designed to ensure that flow widths are no greater than 2.5m in accordance with Councils – *Standards for Engineering Works 2013*.

End of line Gross Pollution Traps (GPT's) are to be provided and are specified as Atlan Vortceptor Type GPT's or other similar device approved by Council.

Each basin will also incorporate a sediment forebay at the inlet.

7.2.3.2 Roads as Major Overland Flow Paths

All storm flows greater than the minor 10% AEP storm event are to be conveyed by the road and kerb and gutter system. The system has been designed that the maximum depth of water within the road carriageway is no greater than 0.2m and the velocity x depth product is below 0.4m^2/s where the safety of children is considered and 0.6m^2/s where it is expected that the safety of only vehicles are affected.

A full summary of the resulting post development site flows including pit, pit, road and overland flow paths for both the design minor storm event (10% AEP) and major storm event (1% AEP) is provided in Appendix B.

7.2.4 Grassed Channels/Swales

There are several grassed lined channels/swales to be constructed and located within inter-allotment drainage easements to direct 1% AEP flows from upstream catchments through

the site to a lawful discharge point at the existing creek, or surcharge flows greater than the minor piped drainage system to the bioretention basins. These are shown in Figure 14 and are described as follows.

7.2.4.1 Channel 1

A pipe system is located along the southern side of the subdivision and is required to capture and convey flows (up to the 1% AEP) from the existing upstream northwestern catchment that flows through the site. The channel is provided to capture any surcharged flows from the piped system due to blockage. The channel dimensions (Figure 17) have been sized to cater for the 1% AEP flows including freeboard based on 50% blockage of the piped drainage system below. Driveway cross-overs will be required over the channel to access the lot and are to be designed to ensure that continuous flow within the channel under each driveway is maintained.

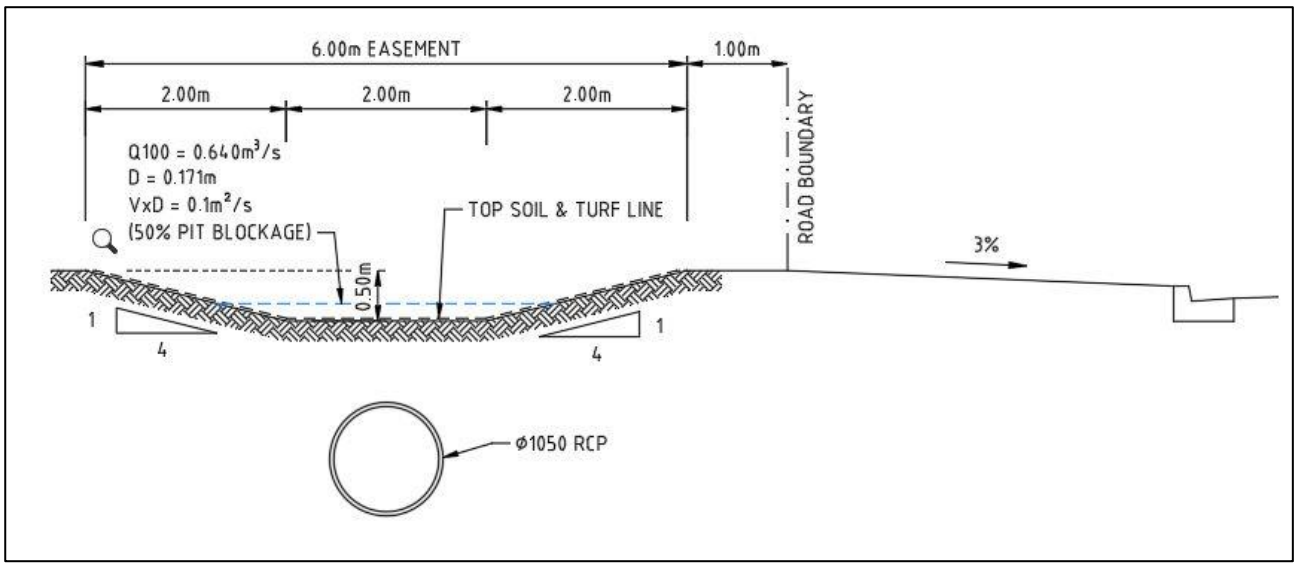


Figure 17 – Typical Section Through Channel 1

7.2.4.2 Channel 2

Channel 2 is located in the southern wester corner of the site and has been designed to divert the upstream 1% AEP peak flows through the back of proposed Lot 14 into the existing overland flow path. Figure 18 shows the channel dimensions and predicted 1% AEP flow level.

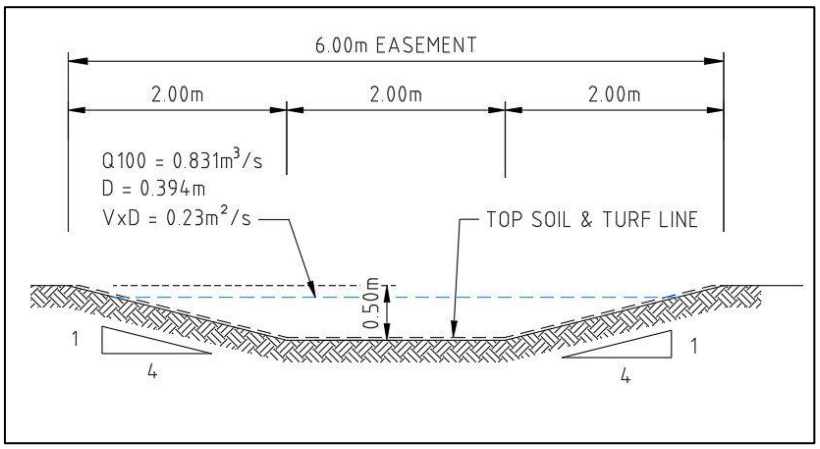


Figure 18 - Typical Section Through Channel 2

7.2.4.3 Swales 1A and 1B

These are part of the interallotment drainage system for Lots 18 to 24 and serve as stormwater pre-treatment prior to the basins and as overland surcharge paths for the underground interallotment drainage system (1 % AEP storm event plus blockage). Figure 19 shows the swale dimensions and 1% AEP flow level.

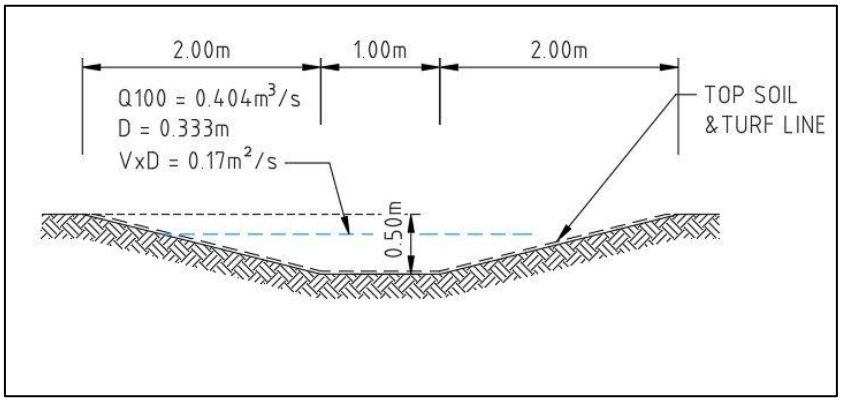


Figure 19 - Typical Section Through Swales 1A and 1B

7.2.4.4 Swales 2A and 2B

These are part of the interallotment drainage system for Lots 31 to 35 and serve as pre stormwater treatment prior to the basins and as overland surcharge paths for the underground interallotment drainage system (1 % AEP storm event plus blockage). Figure 20 shows the swale dimensions and 1% AEP flow level.

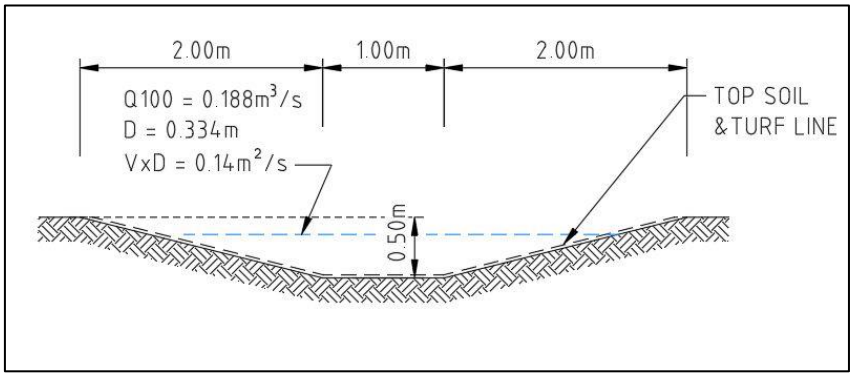


Figure 20 - Typical section Through Swales 2A and 2B

7.2.5 Ground Water Management

Any areas of the site that required subsoil drainage to intercept any potential ground water are to be designed in conjunction with advice from a geotechnical consultant and are to be connected into the proposed site stormwater drainage system. The would include subsoil drainage under kerbs if required.

7.2.6 On-Site Detention

As discussed in Section 5.8.1, post development flows are expected to increase due to increased impervious area without the inclusion of on-site detention. Post development flows from the development can be reduced by the provision of an above-ground on-site detention (OSD) basin. The basins can be incorporated as part of each Bioretention Basin (Basins 1

and 2) located at the end of each catchment and located in their own dedicated drainage reserve. These would limit post-development flows to no more than pre-development flows.

Each basin has been designed so that that the bioretention basin design flow is 'offline' to the larger storm flows. Low flows from the smaller more frequent storm events are diverted to the bioretention basin section for treatment. These low flows are also pretreated by the end of line Atlan Vortceptor Type GPT's (or equivalent). Larger flows for Basin 1 surcharge into OSD1 and OSD2 which provide separate detention storage and provide further treatment of storm flows by trapping coarse sediment within proposed sediment forebays that is not collected by the GPT's. This same method is also applied to Basin 2 except that the OSD portion of the basin is separate from the Bioretention area by a partition wall.

The required OSD storage volume and post development outflow for each basin for the minor 10% AEP (10 year ARI) and 1% AEP (100 Year ARI) storm events have been summarised in Table 13 to Table 18 below.

Table 13 - On-Site Detention Basin Size Summary (63% AEP – 1 EY)

Basin	Q63%, Post Developed Peak Flow (No OSD)	Q63%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	0.606	0.396	34.7	614
2	0.227	0.116	48.9	496

Table 14 - On-Site Detention Basin Size Summary (18.13% AEP – 0.2 EY)

Basin	Q18.13%, Post Developed Peak Flow (No OSD)	Q18.13%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	1.265	0.755	40.3	945
2	0.356	0.144	59.6	640

Table 15 - On-Site Detention Basin Size Summary (10% AEP)

Basin	Q10%, Post Developed Peak Flow (No OSD)	Q10%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	1.722	0.798	53.7	1160
2	0.425	0.183	56.9	756

Table 16 - On-Site Detention Basin Size Summary (5% AEP)

Basin	Q5%, Post Developed Peak Flow (No OSD)	Q5%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	2.468	0.896	63.7	2,109
2	0.552	0.306	44.6	893

Table 17 - On-Site Detention Basin Size Summary (2% AEP)

Basin	Q2%, Post Developed Peak Flow (No OSD)	Q2%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	3.009	1.095	63.6	2,725
2	0.667	0.422	36.7	927

Table 18 - On-Site Detention Basin Size Summary (1% AEP)

Basin	Q1%, Post Developed Peak Flow (No OSD)	Q1%, Post Developed Peak Flow (With OSD)	Reduction	Total OSD Volume
	m^3/s	m^3/s	%	m^3
1	3.465	1.602	53.8	3,082
2	0.766	0.506	33.9	949

7.3 Bioretention Basins

It is proposed to construct two bioretention basins. Bioretention Basin 1 has a filter media surface area of 1,200m^2 and bioretention basin 2 has a filter media area of 700m^2. Both would be designed and built to the latest version of the *Adoption Guidelines for Stormwater Biofiltration Systems*. With care they would be made attractive landscape features in the drainage reserves. Each basin would:

- have a 50mm thick gravel mulch surface;
- be planted with spiky, native, moisture-tolerant, plants such as Carex sp. and Juncus sp.;
- have a 500 mm thick filtration zone;
- have a 200 mm thick, carbon/gravel anaerobic zone at the base;
- have a 100 mm thick transition layer between the drainage layer and the filtration zone;
- have a grated high-flow outlet set 300 mm above the surface;
- drain via subsoil drainage pipes; and
- have signs erected informing the public of its purpose and the risk of rising water levels.

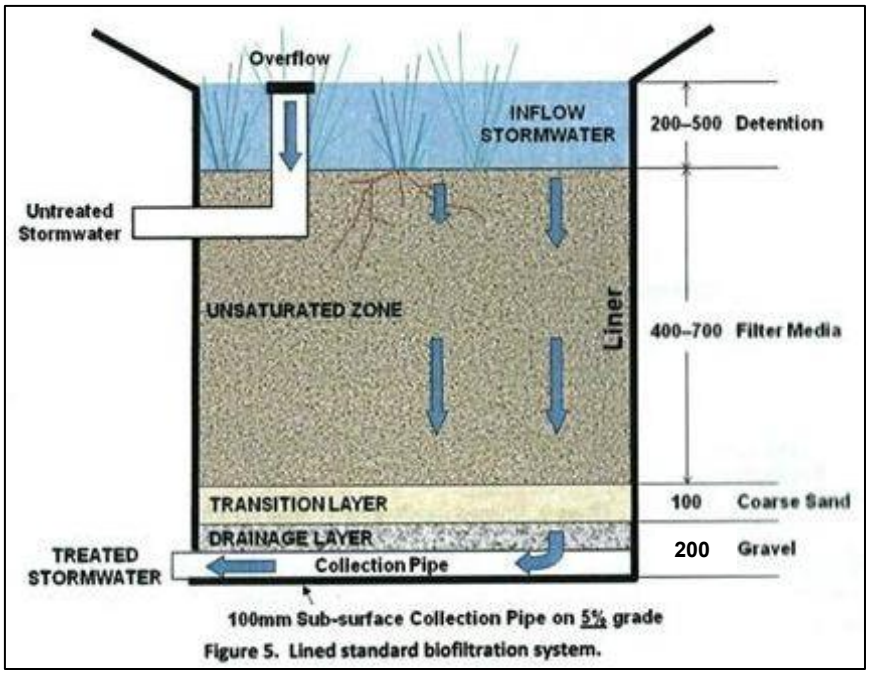


Figure 21 – Typical Section Bioretention Basin (Diagrammatic Only)

7.3.1 Bioretention Basin Media Specification

The filtration media will be well-graded loamy sand with:

- Hydraulic conductivity (ASTM F1815-06) between 250 and 300 mm/hour.
- pH between 5.5 and 7.5.
- Organic content less than 5%.
- Electrical conductivity less than 1.2 dS/m.
- Orthophosphate content less than 40 mg/kg.
- Total nitrogen content <400 mg/kg.

Subject to adequate hydraulic conductivity the following particle size distribution is a guide:

Clay and silt	< 3%	(<0.05 mm)
Very fine sand	5-30%	(0.05 - 0.15 mm)
Fine sand	10-30%	(0.15 - 0.25 mm)
Med-Coarse sand	40-60%	(0.25 - 1.0 mm)
Coarse sand	7-10%	(1.0 - 2.0 mm)
Fine gravel	<3%	(>2.0 mm)

The filtration media will be minimally compacted with no more than one pass of a vibratory plate compacter or drum roller.

The transition layer shall be clean, well-graded sand containing little or no clay and silt (<2%). D15 of the transition layer must be <5 x D85 of the filter media.

The drainage layer shall be 2 - 7 mm washed screenings with <2% silt and clay.

7.4 Future Development of Lots

Any future development of individual lots will be subject to separate development applications. With regards to stormwater management, each lot will be required to ensure that post development flows are not greater than the pre-development (undeveloped) site area. Also, in accordance with WaterNSW advise, any subsequent applications for the development on the proposed lots will be subject to the provisions of Part 6.5 of the State Environmental Planning Policies (SEPP) and will need to be assessed according to NorBE test in relation to the potential effect of each lot scale development on water quality. Specific parameters related to future modelling of the pre and post development run-off are outlined in Section 5.6.

7.5 Monitoring and Maintenance

7.5.1 Construction Phase

- The sediment basins and other construction-related soil and water management structures/products would be the responsibility of the developer.
- The sediment basins would:
  - Remain online until its catchment is at least 90 percent stabilised (by hard surfaces and/or a minimum 70 percent ground cover).
  - Be maintained as per the directions of the SWMP. Note this would require regular flocculation after rainfall and periodic removal of accumulated sediment to ensure the design capacity is maintained.
  - Be converted to bioretention/OSD basins when its catchment is stable with sufficient ground cover.

7.5.1.2 Other erosion and sediment control measures would be maintained as per the directions given in the SWMP.

7.5.2 Grassed Swales/Bioretention Basins

- The swales and the bioretention basins will be regularly checked for erosion and will involve reviewing the condition of grass cover and vegetation.
- Any choked/blocked areas will be cleaned up to ensure they maintain an effective runoff/ infiltration balance.
- Any bare areas or vegetative die-off will be rapidly rehabilitated.
- If water ponds on the surface of the bioretention basins for more than 24 hours after rainfall:
  - the subsoil drainage pipe will be inspected/cleared; and (if clear);
  - the permeability of the system will be checked by a geotechnical engineer or soil scientist. If the filter media is clogged it will require replacement.

7.5.2.2 Atlan Vortceptor Gross Pollution Traps (GPT's)

The developer would be responsible for the maintenance of the GPT's until transferred to Council.

7.5.2.3 The Pit and Pipe Network

The developer would be responsible for the maintenance of the pit and pipes during the subdivision works. After that they would be transferred to Council. The pits and pipes would require flushing to remove sediment prior to handing them over to Council.

7.5.3 Lot-Specific Erosion and Sediment Control

Each lot specific development should instigate its own Erosion and Sediment Control Plan during construction to prevent the trunk drainage pipes being over-loaded with sediment. Policing this would be the responsibility of Council.

7.5.4 Operational Environmental Management Plan

An Operational Environmental Management Plan (OEMP) will be provided to WaterNSW for approval prior to issuing of the subdivision certificate stage detailing the proposed stormwater management maintenance schedule and actions.

8 CONCLUSIONS

The results of the MUSIC modelling demonstrate that a beneficial effect can be achieved, providing the proposed Water Cycle Management Plan (Section 7) is implemented. Without these specific measures, the development could potentially have a negative impact on water quality. The plan includes a set of long-term maintenance strategies to ensure that the effectiveness of the proposed measures provides ongoing benefits for water quality.

Note that this requires the owner of each future lot to achieve their own Neutral or Beneficial Assessment (NorBE) on water quality and pre and post development site flows relating to the amount of impervious area proposed with the lot.

Section 7 of this report details the measures required to achieve a neutral or beneficial effect. We recommend that this plan be implemented in full, as it provides an integrated management strategy for water quality control.

9 REFERRENCES

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WaterNSW (2019) - *Using MUSIC in Sydney's Drinking Water Catchments – A WaterNSW Standard.*

10 APPENDIX A - Intensity Frequency Duration (IFD) Table and Chart

10.1 2016 AR&R IFD Table & Chart

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All Design Rainfall Depth (mm)

Issued: 17-Nov-21

Location Label:

Requested Latitude -34.72 Longit 149.983994

Nearest gri Latitude 34.712 Longit 149.9875 (E)

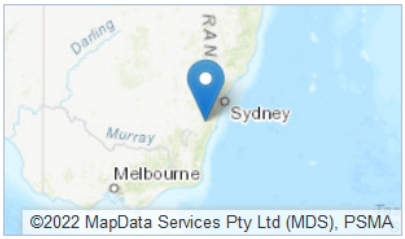
		Exceed Annual Exceedance Probability (AEP)																	
Duration	Duration in min	12EY	6EY	4EY	3EY	2EY	63.2%	50%	0.5EY	20%	0.2EY	10%	5%	2%	1%	1 in 200	1 in 500	1 in 1000	1 in 2000
1 min	1	0.607	0.719	0.918	1.06	1.28	1.67	1.88	2.09	2.56	2.61	3.03	3.5	4.14	4.64	5.09	5.74	6.25	6.75
2 min	2	1.05	1.26	1.61	1.86	2.21	2.81	3.11	3.45	4.05	4.13	4.69	5.33	6.19	6.86	7.6	8.64	9.45	10.3
3 min	3	1.39	1.67	2.16	2.51	3.01	3.87	4.3	4.77	5.65	5.77	6.59	7.52	8.77	9.74	10.8	12.2	13.3	14.5
4 min	4	1.68	2.02	2.63	3.07	3.7	4.81	5.37	5.96	7.15	7.29	8.39	9.61	11.3	12.6	13.8	15.7	17.1	18.5
5 min	5	1.93	2.33	3.04	3.56	4.31	5.64	6.32	7.02	8.51	8.68	10	11.5	13.6	15.2	16.7	18.8	20.5	22.2
10 min	10	2.91	3.51	4.58	5.38	6.56	8.71	9.86	10.9	13.5	13.8	16.1	18.6	22.1	24.8	27.2	30.7	33.3	36
15 min	15	3.66	4.38	5.68	6.65	8.09	10.8	12.2	13.5	16.7	17.1	19.9	23.1	27.4	30.8	33.8	38.1	41.4	44.7
20 min	20	4.29	5.1	6.56	7.65	9.27	12.3	13.9	15.4	19	19.4	22.6	26.2	31	34.9	38.2	43.1	46.9	50.7
25 min	25	4.83	5.71	7.29	8.48	10.2	13.5	15.2	16.9	20.8	21.2	24.6	28.5	33.7	37.8	41.5	46.8	50.9	55.1
30 min	30	5.31	6.24	7.93	9.19	11.1	14.6	16.4	18.2	22.2	22.6	26.2	30.3	35.8	40.1	44	49.7	54.1	58.5
45 min	45	6.51	7.57	9.49	10.9	13	17	19	21	25.3	25.9	29.8	34.2	40.2	44.9	49.4	55.9	60.8	65.8
1 hour	60	7.47	8.62	10.7	12.3	14.6	18.8	20.9	23.2	27.7	28.3	32.4	37.1	43.4	48.4	53.2	60.2	65.6	71
1.5 hour	90	8.95	10.3	12.6	14.4	17	21.6	24	26.6	31.4	32	36.5	41.6	48.4	53.8	59.2	67	72.9	78.9
2 hour	120	10.1	11.5	14.1	16.1	18.8	23.9	26.4	29.3	34.4	35.1	39.9	45.3	52.7	58.4	64.2	72.6	79.1	85.5
3 hour	180	11.8	13.5	16.5	18.7	21.9	27.6	30.4	33.8	39.5	40.3	45.7	51.9	60.3	66.8	73.3	82.7	89.9	97.2
4.5 hour	270	13.6	15.6	19.1	21.6	25.3	31.9	35.3	39.2	46	46.9	53.3	60.6	70.4	78.1	85.4	96.3	105	113
6 hour	360	14.9	17.1	21.1	23.9	28.1	35.5	39.4	43.7	51.6	52.6	60.1	68.4	79.7	88.4	96.6	109	118	127
9 hour	540	16.7	19.4	24.1	27.5	32.4	41.3	46	51.1	61.2	62.4	71.7	82.2	96.2	107	117	131	142	153
12 hour	720	18	21	26.3	30.2	35.8	45.9	51.4	57.1	69.2	70.6	81.6	94	111	123	135	151	164	177
18 hour	1080	19.9	23.4	29.6	34.1	40.8	53	59.9	66.5	82.1	83.8	97.8	114	135	151	165	186	202	217
24 hour	1440	21.2	25	31.9	37	44.6	58.4	66.3	73.6	92.1	94	110	129	154	173	190	214	233	252
30 hour	1800	22.2	26.3	33.7	39.3	47.5	62.7	71.4	79.3	100	102	121	141	169	190	213	242	265	289
36 hour	2160	23	27.3	35.2	41.1	49.8	66.1	75.6	83.9	107	109	129	152	182	205	231	264	290	317
48 hour	2880	24.2	28.9	37.5	43.9	53.5	71.5	82	91	116	119	141	167	201	227	256	294	325	356
72 hour	4320	25.9	31.1	40.6	47.8	58.5	78.8	90.3	100	129	131	157	186	224	254	285	329	363	399
96 hour	5760	26.9	32.5	42.8	50.5	61.9	83.5	95.7	106	136	139	166	196	237	269	302	347	384	421
120 hour	7200	27.6	33.6	44.4	52.5	64.6	87.1	99.7	111	141	144	171	202	244	277	312	359	397	436
144 hour	8640	28	34.3	45.8	54.3	66.9	90.1	103	114	145	148	175	207	250	283	319	368	406	447
168 hour	10080	28.3	35	47	55.9	68.9	92.8	106	117	148	151	179	210	254	288	324	374	414	456

Location

Label: Not provided

Latitude: -34.722 [Nearest grid cell: 34.7125 (S)]

Longitude: 149.984 [Nearest grid cell: 149.9875 (E)]



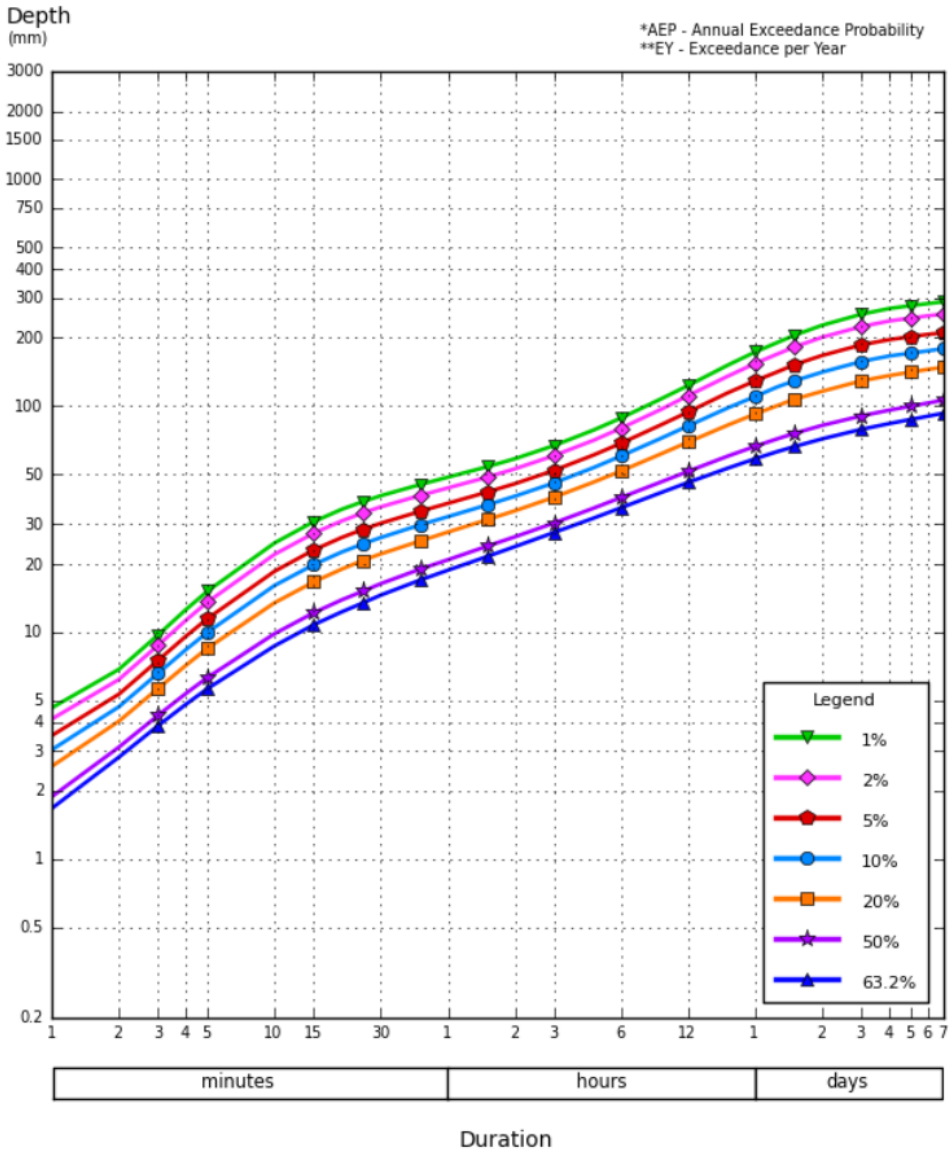
IFD Design Rainfall Depth (mm)

Issued: 20 December 2022

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

Table | Chart

Unit: mm



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11 APPENDIX B – DRAINS Model Calculation Summary Sheets for 10% AEP Minor and 1% AEP Storm Events

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ILSAX CALCULATION SUMMARY SHEET

DRAINS results prepared from Version 2023.11.8726.15750

Soil Type 3

AMC 3

Entire Catchment Area

Paved	15.16 ha	(6.2%}
Supplementary	0 ha	(0%}
Grassed	228.5 ha	(93.7%}
Total Area	243.661 ha	

LOCATION AND LAND-USE | **TIME AND RUNOFF** | **INLET DESIGN** | **PIPE SYSTEM DESIGN** | **PIT RESULTS**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	29a	29b	30	31	32	33	34
						Kinematic Wave or Friends Formula Parameters					Overflows Approaching Pit																									
AEP	Pit, Node or Basin Name	Sub-Catchment Area (ha)	Land-Use Type (ILSAX)	Percent-age (%)	Constant Flow Time (minutes)	Length (m)	Slope (%)	Roughness n	Total Entry Time, t_c (minutes)	Peak Sub-Catchment Flowrate (m^3/s) *worst storm	Origin of Approach Flows	Peak Flowrate(s) (m^3/s)	Flow Width (m)	Depth x Velocity (m^2/s)	Inlet Family	Inlet Size	Peak Approach Flow (m^3/s)	Bypass Flow(s) (m^3/s)	Peak Flow in Pipe (m^3/s)	Reach Length (m)	Pipe Slope (%)	Pipe Diameter (mm)	U/S Pipe Invert Level (m)	D/S Pipe Invert Level (m)	U/S HGL in Pipe (m)	D/S HGL in Pipe (m)	Pipe Flow Velocity (m/s)	Pressure Change Coeff. Ku	QUDM Chart No. 2008 [2016]	QUDM Chart Ratios	Water Surface Elevation (m)	Ground Surface Level (m)	Pit Free-board (m)	Pit Name	Remarks
10%	**D2/11**	0.535	Paved	0	0	0.1	0.1	0.013	0.2	0.024					GMC Surface In	600x900	0.024	0.007	0.017	75	2.8	300	644.374	642.271	644.517	642.434	0.51	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.52	645.303	0.79	**D2/11**	
			Supp.	0	0	0.1	0.1	0.01																												
			Grassed	100	6	88.499	0.89	0.17	34.48																											
1%	**D2/11**	0.535	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	0.17	0.067					< - - - as above - - - >		0.067	0.025	0.051	< - - - - - - - - - -		as above	- - - - - - - - - - >		644.548	642.449	1.19	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.55	645.303	0.75	**D2/11**	
			Grassed						29.98																											
10%	**D2/10**	0.502	Paved	0	6	0.1	0.1	0.01	6.16	0.028	D2/11	0.034	1.53	0.03	GMC Surface In	600x900	0.035	0.011	0.042	75	2.6	300	642.246	640.296	642.404	640.409	1.74	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	642.43	643.703	1.27	**D2/10**	
			Supp.	0	6	0.1	0.1	0.01																											
			Grassed	100	6	95.272	2.79	0.17	25.99																											
1%	**D2/10**	0.502	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.15	0.079	D2/11	0.103	1.96	0.07	< - - - as above - - - >		0.104	0.044	0.1	< - - - - - - - - - -		as above	- - - - - - - - - - >		642.449	640.459	2.52	4.12	A1-4 [A2-3	).0, Vo2 / (2gL	642.45	643.703	1.25	**D2/10**	
			Grassed						24.69																											
10%	**D2/9**	0.503	Paved	0	6	0.1	0.1	0.01	6.17	0.03	D2/10	0.04	1.51	0.03	GMC Surface In	600x900	0.041	0.013	0.067	75	2.52	375	640.221	638.328	640.409	638.529	1.18	1.33	A1-5 [A2-4	, Qg / Qo = 0.4	640.41	641.379	0.97	**D2/9**	
			Supp.	0	6	0.1	0.1	0.01																											
			Grassed	100	6	96.955	3.58	0.17	25.81																											
1%	**D2/9**	0.503	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.083	D2/10	0.126	1.96	0.08	< - - - as above - - - >		0.127	0.057	0.168	< - - - - - - - - - -		as above	- - - - - - - - - - >		640.418	639.484	2.81	0.97	A1-5 [A2-4	, Qg / Qo = 0.4	640.42	641.379	0.96	**D2/9**	
			Grassed						22.68																											
10%	**D2/8**	0.503	Paved	0	6	0.1	0.1	0.01	6.17	0.029	D2/9	0.041	1.57	0.03	GMC Surface In	600x900	0.042	0.013	0.101	75	1.24	375	638.303	637.373	638.529	637.599	1.41	1.6	A1-5 [A2-4	, Qg / Qo = 0.3	638.53	639.746	1.22	**D2/8**	
			Supp.	0	6	0.1	0.1	0.01																											
			Grassed	100	6	96.514	3.19	0.17	26.45																											
1%	**D2/8**	0.503	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.15	0.081	D2/9	0.136	2.11	0.09	< - - - as above - - - >		0.138	0.062	0.242	< - - - - - - - - - -		as above	- - - - - - - - - - >		639.443	638.455	2.07	0.98	A1-5 [A2-4	, Qg / Qo = 0.3	639.48	639.746	0.26	**D2/8**	
			Grassed						24.1																											
10%	**D2/7**	0.503	Paved	0	6	0.1	0.1	0.01	6.17	0.025	D2/8	0.037	1.58	0.03	GMC Surface In	600x900	0.038	0.012	0.118	76.373	1	450	637.348	636.584	637.589	636.896	1.36	0.91	A1-5 [A2-4	, Qg / Qo = 0.2	637.6	638.463	0.86	**D2/7**	
			Supp.	0	6	0.1	0.1	0.01																											
			Grassed	100	6	96.846	1.61	0.17	31.16																											
1%	**D2/7**	0.503	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.069	D2/8	0.13	2.14	0.08	< - - - as above - - - >		0.131	0.081	0.313	< - - - - - - - - - -		as above	- - - - - - - - - - >		638.455	637.793	1.97	0.57	A1-5 [A2-4	, Qg / Qo = 0.2	638.45	638.463	0.01	**D2/7**	
			Grassed						27.19																											
10%	**D2/6**	0.512	Paved	0	6	0.1	0.1	0.01	6.17	0.024	D2/7	0.034	1.76	0.02	GMC Surface In	600x900	0.036	0.011	0.147	3	1	450	636.559	636.529	636.865	636.852	1.27	1.07	A1-5 [A2-4	, Qg / Qo = 0.2	636.9	638.041	1.14	**D2/6**	
			Supp.	0	6	0.1	0.1	0.01																											
			Grassed	100	6	97.32	1.34	0.17	32.67																											
1%	**D2/6**	0.512	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.15	0.067	D2/7	0.144	2.62	0.08	< - - - as above - - - >		0.148	0.067	0.382	< - - - - - - - - - -		as above	- - - - - - - - - - >		637.751	637.714	2.4	0.85	A1-5 [A2-4	, Qg / Qo = 0.2	637.79	638.041	0.25	**D2/6**	
			Grassed						29.59																											
10%	**D2/5**		Paved								D2/6	0.011	1.46	0.01	GMC Surface In	600x900	0.011	0.002	0.591	30.752	0.6	675	636.454	636.269	636.831	636.68	1.44	0.53	1-25 [A2-3	6, Qg/Qo=0.02	636.85	638.031	1.18	**D2/5**	
			Supp.								Pit2582595	0	0	0																					
			Grassed																																	
1%	**D2/5**		Paved								D2/6	0.067	2.25	0.04	< - - - as above - - - >		0.158	0.021	1.045	< - - - - - - - - - -		as above	- - - - - - - - - - >		637.594	637.485	1.46	0.86	1-20 [A2-3	6, Qg/Qo=0.0	637.71	638.031	0.32	**D2/5**	
			Grassed								Pit2582595	0.091	3.66	0.06																					
10%	**D2/4**	0.144	Paved	0	5				5	0.026	D2/5	0.027	1.61	0.02	GMC Surface In	600x900	0.028	0	0.604	5.568	0.59	675	636.244	636.211	636.589	636.538	1.76	1.73	7 [A2-8 & A	, Qg / Qo = 0.0	636.68	637.793	1.11	**D2/4**	
			Supp.	0	2																															
			Grassed	100	5				5																											
1%	**D2/4**	0.144	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.053	D2/5	0.058	1.93	0.04	< - - - as above - - - >		0.074	0	1.088	< - - - - - - - - - -		as above	- - - - - - - - - - >		637.289	637.268	1.52	1.63	7 [A2-8 & A	, Qg / Qo = 0.0	637.48	637.793	0.31	**D2/4**	
			Grassed						5																											
10%	**D2/3**	0.054	Paved	60	5				5	0.013	D2/4	0.013	0.64	0.04	GMC Kerb Inlet	1.8m Lintel	0.013	0.001	0.609	12	0.6	675	636.136	636.064	636.531	636.476	1.4	0.32	A1-5 [A2-4	, Qg / Qo = 0.0	636.54	637.514	0.98	**D2/3**	
			Supp.	0	6																															
			Grassed	40	5				5																											
1%	**D2/3**	0.054	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.022	D2/4	0.022	0.78	0.06	< - - - as above - - - >		0.022	0.003	1.1	< - - - - - - - - - -		as above	- - - - - - - - - - >		637.245	637.195	1.54	0.29	A1-5 [A2-4	, Qg / Qo = 0.0	637.27	637.514	0.25	**D2/3**	
			Grassed						5																											
10%	**D2/2**	0.056	Paved	75	5				5	0.014					GMC Kerb Inlet	1.8m Lintel	0.014	0.001	0.611	85.98	0.6	675	636.032	635.516	636.432	636.16	1.38	1.45	[A2-28 & A	, Qg / Qo = 0.0	636.48	637.513	1.04	**D2/2**	
			Supp.	0	6																															
			Grassed	25	5				5																											
1%	**D2/2**	0.056	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.025					< - - - as above - - - >		0.025	0.003	1.113	< - - - - - - - - - -		as above	- - - - - - - - - - >		636.946	636.565	1.56	1.56	[A2-28 & A	, Qg / Qo = 0.0	637.2	637.513	0.32	**D2/2**	
			Grassed						5																											
10%	**D2/1**	0.168	Paved	75	6	84.345	0.49	0.013	12.28	0.031	D2/2	0.016	1.46	0.03	GMC Kerb Inlet	2.4m Lintel Sa	12.04	0	0.725	8	0.75	750	635.491	635.431	636.086	636.075	0.96	1.98	H-O'L	o = 0.04, S / D	636.16	637.095	0.94	**D2/1**	
			Supp.	0	6	0.1	0.1	0.01			D3A/1	12.008	32.75	0.58																					
			Grassed	25	6	84.345	0.49	0.17	35.37																											
1%	**D2/1**	0.168	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	10.89	0.049	D2/2	0.028	1.87	0.04	< - - - as above - - - >		25.073	0	1.43	< - - - - - - - - - -		as above	- - - - - - - - - - >		636.299	636.266	1.62	1.99	H-O'L	o = 0.09, S / D	636.57	637.095	0.53	**D2/1**	
			Grassed						28.86		D3A/1	25.021	38.5	1																					
10%	**LF2**		Paved												UNLIMITED	UNLIMITED	0		0.662	8	4.45	750	635.706	635.35	636.075	635.593	2.7	ot calculated			636.07	637	0.93	**LF2**	
			Supp.																																	
			Grassed																																	
1%	**LF2**		Paved												< - - - as above - - - >		0		1.363	< - - - - - - - - - -		as above	- - - - - - - - - - >		636.214	636.19	2.1	ot calculated			636.27	637	0.73	**LF2**	
			Grassed																																	
10%	**L11**	0.367	Paved	0	5				5	0.066							0.066	0.066																	**L11**	
			Supp.	0	2																															
			Grassed	100	5				5																											
1%	**L11**	0.367	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.135							0.135	0.135																	**L11**	
			Grassed						5																											
10%	**L10**	0.3512	Paved	0	5				5	0.063							0.063	0.063																	**L10**	
			Supp.	0	2																															
			Grassed	100	5				5																											
1%	**L10**	0.3512	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.129							0.129	0.129																	**L10**	
			Grassed						5																											
10%	**L9**	0.3742	Paved	0	5				5	0.067							0.067	0.067																	**L9**	
			Supp.	0	2																															

			Grassed	100	5				5																								
1%	**L9**	0.3742	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.138								0.138	0.138														**L9**
			Grassed						5																								
10%	**L8**	0.3839	Paved	0	5				5	0.069								0.069	0.069														**L8**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L8**	0.3839	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.141								0.141	0.141														**L8**
			Grassed						5																								
10%	**L7**	0.3762	Paved	0	5				5	0.068								0.068	0.068														**L7**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L7**	0.3762	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.139								0.139	0.139														**L7**
			Grassed						5																								
10%	**L6**	0.3847	Paved	0	5				5	0.069								0.069	0.069														**L6**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L6**	0.3847	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.142								0.142	0.142														**L6**
			Grassed						5																								
10%	**L5**	0.3637	Paved	0	5				5	0.065								0.065	0.065														**L5**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L5**	0.3637	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.134								0.134	0.134														**L5**
			Grassed						5																								
10%	**L4**	0.312	Paved	0	5				5	0.056								0.056	0.056														**L4**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L4**	0.312	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.115								0.115	0.115														**L4**
			Grassed						5																								
10%	**L2**	0.2833	Paved	0	5				5	0.051								0.051	0.051														**L2**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L2**	0.2833	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.104								0.104	0.104														**L2**
			Grassed						5																								
10%	**L18**	0.3636	Paved	0	5				5	0.065								0.065	0.065														**L18**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**L18**	0.3636	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.134								0.134	0.134														**L18**
			Grassed						5																								
10%	**D7/15**	0.06	Paved	75	6	58.986	2.85	0.013	8.77	0.013	L10	0.051	10.28	0.01	GMC Kerb Inlet 1.8m Lintel	0.064	0.023	0.05	12.031	1.01	375	643.811	643.69	643.973	643.866	1.09	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.04	644.821	0.78	**D7/15**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	58.986	2.85	0.17	18.93																								
1%	**D7/15**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.33	0.021	L10	0.104	10.42	0.01	< - - - as above - - - >	0.125	0.064	0.086	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			644.024	643.94	1.32	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.15	644.821	0.67	**D7/15**
			Grassed						16.88																								
10%	**D7/14**	0.061	Paved	75	6	60.142	2.64	0.013	8.86	0.013					GMC Kerb Inlet 1.8m Lintel	0.013	0.001	0.06	75	3.63	375	643.665	640.943	643.844	641.198	1.16	1.71	] [A2-28 & A	, Qg / Qo = 0.2	643.87	644.794	0.93	**D7/14**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	60.142	2.64	0.17	19.39																								
1%	**D7/14**	0.061	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.41	0.021					< - - - as above - - - >	0.021	0.002	0.104	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			643.9	641.293	1.42	1.8	] [A2-28 & A	, Qg / Qo = 0.1	643.94	644.794	0.85	**D7/14**
			Grassed						17.26																								
10%	**D7/13**	0.075	Paved	75	6	73.334	3.78	0.013	8.9	0.016	D7/14	0.036	1.33	0.07	GMC Kerb Inlet 1.8m Lintel	0.052	0.001	0.135	44.139	4.08	450	640.918	639.116	641.174	639.433	1.45	1.57	.1-20 [A2-3	3, Qg/Qo=0.12	641.2	642.072	0.87	**D7/13**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	73.334	3.78	0.17	19.54																								
1%	**D7/13**	0.075	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.44	0.026	D7/14	0.109	2.16	0.13	< - - - as above - - - >	0.135	0.005	0.238	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			641.26	640.364	1.84	1.54	.1-20 [A2-3	3, Qg/Qo=0.1(	641.29	642.072	0.78	**D7/13**
			Grassed						17.39																								
10%	**D7/12**	0.044	Paved	75	6	42.987	3.63	0.013	8.13	0.01	D7/13	0.043	1.79	0.06	GMC Kerb Inlet 1.8m Lintel	0.053	0.001	0.223	60	1.08	450	639.091	638.445	639.422	638.777	1.78	1.12	] [A2-37 & A	= 1.50, (Qu /	639.43	640.446	1.01	**D7/12**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	42.987	3.63	0.17	15.95																								
1%	**D7/12**	0.044	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	7.79	0.016	D7/13	0.199	3.33	0.15	< - - - as above - - - >	0.215	0.002	0.353	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			640.157	639.398	2.22	1.23	.1-20 [A2-3	0, Qg/Qo=0.0	640.36	640.446	0.08	**D7/12**
			Grassed						14.37																								
10%	**D7/11**	0.06	Paved	75	6	58.37	1.64	0.013	9.24	0.013	D7/12	0.044	1.92	0.06	GMC Kerb Inlet 1.8m Lintel	0.057	0.001	0.296	60	1.09	525	638.377	637.725	638.743	638.061	2.03	0.59	] [A2-37 & A	= 1.50, (Qu /	638.78	639.576	0.8	**D7/11**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	58.37	1.64	0.17	21.17																								
1%	**D7/11**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.73	0.021	D7/12	0.233	3.75	0.15	< - - - as above - - - >	0.254	0.003	0.503	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			639.314	638.689	2.32	0.71	] [A2-37 & A	= 1.50, (Qu /	639.4	639.576	0.18	**D7/11**
			Grassed						18.76																								
10%	**D7/10**	0.06	Paved	75	6	58.668	1.1	0.013	9.67	0.012	D7/11	0.046	1.87	0.07	GMC Kerb Inlet 1.8m Lintel	0.058	0.001	0.365	62.234	1.09	600	637.645	636.966	638.037	637.389	1.86	0.5	] [A2-37 & A	= 1.50, (Qu /	638.06	638.926	0.87	**D7/10**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	58.668	1.1	0.17	23.15																								
1%	**D7/10**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.09	0.021	D7/11	0.244	3.64	0.16	< - - - as above - - - >	0.265	0.003	0.634	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			638.646	638.1	2.24	0.59	] [A2-37 & A	= 1.50, (Qu /	638.69	638.926	0.24	**D7/10**
			Grassed						20.43																								
10%	**D7/9**	0.062	Paved	75	6	60.104	1.56	0.013	9.35	0.015	D7/10	0.037	1.74	0.06	GMC Kerb Inlet 2.4m Lintel	0.052	0.001	0.374	5.2	1.1	600	636.94	636.883	637.358	637.319	1.78	0.37	A1-5 [A2-4	, Qg / Qo = 0.0	637.39	638.1	0.71	**D7/9**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	0.1	0.1	0.17	6.77																								
1%	**D7/9**	0.062	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.82	0.025	D7/10	0.212	3.51	0.15	< - - - as above - - - >	0.237	0.054	0.656	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			638.065	638.026	2.32	0.34	A1-5 [A2-4	, Qg / Qo = 0.0	638.1	638.1	0	**D7/9**
			Grassed						6.65																								
10%	**Pit2582595**		Paved								D7/9	0.005	0.45	0.02	GMC Kerb Inlet 2.4m Lintel	0.005	0	0.472	69.7	0.54	825	636.86	636.484	637.276	636.871	1.92	1.88	] [A2-37 & A	= 1.50, (Qu /	637.32	638.09	0.77	**Pit2582595**
			Supp.																														
			Grassed																														
1%	**Pit2582595**		Paved								D7/9	0.205	3.48	0.14	< - - - as above - - - >	0.205	0.011	0.856	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			637.866	637.714	1.6	1.72	.1-20 [A2-3	3, Qg/Qo=0.0(	638.03	638.09	0.06	**Pit2582595**
			Grassed																														
10%	**D7J/1**	0.06	Paved	75	6	58.809	3.88	0.013	8.52	0.013	L9	0.065	10.32	0.01	GMC Kerb Inlet 1.8m Lintel	0.078	0.036	0.067	19.889	3.62	375	641.663	640.943	641.851	641.198	1.21	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	641.92	642.673	0.75	**D7J/1**
			Supp.	0	6	0.1	0.1	0.01			D7/15	0	0	0																			
			Grassed	25	6	58.809	3.88	0.17	17.77																								
1%	**D7J/1**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.12	0.021	L9	0.134	10.49	0.01	< - - - as above - - - >	0.166	0.109	0.119	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			641.915	641.293	1.5	5.29	A1-4 [A2-3	).0, Vo2 / (2gL	642.01	642.673	0.66	**D7J/1**
			Grassed						15.9		D7/15	0.011	1.3	0.01																			
10%	**D7H/1**	0.06	Paved	75	6	58.919	3.99	0.013	8.5	0.013	L8	0.023	1.05	0.06	GMC Kerb Inlet 1.8m Lintel	0.036	0.043	0.069	12	2.65	375	639.434	639.116	639.625	639.433	1.22	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	639.68	640.444	0.76	**D7H/1**
			Supp.	0	6	0.1	0.1	0.01			D7J/1	0	0	0																			
			Grassed	25	6	58.919	3.99	0.17	17.68																								
1%	**D7H/1**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.1	0.021	L8	0.064	1.74	0.1	< - - - as above - - - >	0.085	0.199	0.121	< - - - - - - - - - - - - as above - - - - - - - - - - - - >			640.381	640.364	1.1	3.15	A1-4 [A2-3	..5, Vo2 / (2gL	640.44	640.444	0.01	**D7H/1**
			Grassed						15.83		D7J/1	0	0	0																			

10%	**D7G/1**	0.06	Paved	75	6	59.18	1.68	0.013	9.25	0.013	L7	0.001	0.19	0.01	GMC Kerb Inlet 1.8m Lintel	0.014	0.044	0.071	12	1	375	638.565	638.445	638.807	638.777	0.94	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	638.87	639.575	0.7	**D7G/1**
			Supp.	0	6	0.1	0.1	0.01			D7H/1	0	0	0																				
			Grassed	25	6	59.18	1.68	0.17	21.18																									
1%	**D7G/1**	0.06	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.73	0.021	L7	0.002	0.28	0.02	< - - - as above - - - >	0.024	0.233	0.133	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			639.435	639.398	1.2	3.23	A1-4 [A2-3(..3, Vo2 / (2gD	639.56	639.575	0.01	**D7G/1**
			Grassed						18.77		D7H/1	0.001	0.22	0.01																				
10%	**D7F/1**	0.06	Paved	75	6	59.694	1.14	0.013	9.67	0.012	L6	0.001	0.2	0.01	GMC Kerb Inlet 1.8m Lintel	0.014	0.046	0.071	12	1	375	637.915	637.795	638.11	638.061	1.23	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	638.19	638.927	0.74	**D7F/1**
			Supp.	0	6	0.1	0.1	0.01			D7G/1	0.001	0.21	0.01																				
			Grassed	25	6	59.694	1.14	0.17	23.14																									
1%	**D7F/1**	0.06	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		9.08	0.021	L6	0.005	0.36	0.03	< - - - as above - - - >	0.034	0.244	0.139	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			638.738	638.689	1.26	3.28	A1-4 [A2-3(..2, Vo2 / (2gD	638.91	638.927	0.01	**D7F/1**
			Grassed						20.42		D7G/1	0.008	0.59	0.03																				
10%	**D7E/1**	0.06	Paved	60	6	58.919	1.65	0.013	9.26	0.011	L5	0.001	0.2	0.01	GMC Kerb Inlet 2.4m Lintel	0.012	0.037	0.077	4.9	1.31	600	637.174	637.11	637.458	637.439	0.58	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	637.5	638.099	0.6	**D7E/1**
			Supp.	0	6	0.1	0.1	0.01			D7F/1	0	0	0																				
			Grassed	40	6	58.919	1.65	0.17	21.22																									
1%	**D7E/1**	0.06	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.74	0.018	L5	0.002	0.32	0.01	< - - - as above - - - >	0.022	0.212	0.15	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			638.04	638.038	0.53	5.03	A1-4 [A2-3( ).4, Vo2 / (2gD	638.09	638.099	0.01	**D7E/1**
			Grassed						18.81		D7F/1	0.002	0.31	0.02																				
10%	**Pit2582531**		Paved								D7E/1	0.015	0.96	0.04	GMC Kerb Inlet 2.4m Lintel	0.015	0.005	0.108	12.207	1	600	637.088	636.966	637.358	637.319	0.87	2.15	[A2-28 & A, Qg / Qo = 0.4	637.44	638.038	0.6	**Pit2582531**
			Supp.																															
			Grassed																															
1%	**Pit2582531**		Paved								D7E/1	0.048	1.72	0.07	< - - - as above - - - >	0.048	0.205	0.236	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			638.029	638.026	0.84	6.21	A1-4 [A2-3( ).6, Vo2 / (2gD	638.04	638.038	0	**Pit2582531**
			Grassed																															
10%	**D7D/1**	0.089	Paved	75	6	51.446	1.54	0.013	9.06	0.019	L4	0.001	0.24	0.01	GMC Kerb Inlet 2.4m Lintel Sa	0.02	0	0.072	15.102	1	600	636.422	636.271	636.637	636.402	1.59	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.64	637.457	0.82	**D7D/1**
			Supp.	0	6	0.1	0.1	0.01			Pit2582531	0	0	0																				
			Grassed	25	6	51.446	1.54	0.17	20.33																									
1%	**D7D/1**	0.089	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.58	0.031	L4	0.003	0.37	0.01	< - - - as above - - - >	0.034	0.091	0.197	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			636.708	636.506	1.91	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.82	637.457	0.63	**D7D/1**
			Grassed						18.05		Pit2582531	0	0	0																				
10%	**D7/8**	0.084	Paved	75	6	53.889	1.15	0.013	9.44	0.018	D7D/1	0	0	0	GMC Kerb Inlet 2.4m Lintel Sa	0.018	0	0.093	31.356	1.33	825	636.044	635.626	636.24	635.822	0.96	1.45	7 [A2-8 & A, Qg / Qo = 0.1	636.24	637.428	1.19	**D7/8**
			Supp.	0	6	0.1	0.1	0.01																										
			Grassed	25	6	53.889	1.15	0.17	22.08																									
1%	**D7/8**	0.084	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.89	0.029	D7D/1	0	0	0	< - - - as above - - - >	0.029	0	0.298	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			636.401	636.066	1.35	1.79	7 [A2-8 & A, Qg / Qo = 0.5	636.4	637.428	1.03	**D7/8**
			Grassed						19.53																									
10%	**D7/7**	0.045	Paved	75	6	44.479	1.74	0.013	8.71	0.01					GMC Kerb Inlet 1.8m Lintel	0.01	0	0.097	14.939	1	825	635.608	635.459	635.822	635.683	0.88	1.61	7 [A2-8 & A, Qg / Qo = 0.0	635.82	637.395	1.57	**D7/7**
			Supp.	0	6	0.1	0.1	0.01																										
			Grassed	25	6	44.479	1.74	0.17	18.66																									
1%	**D7/7**	0.045	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.28	0.016					< - - - as above - - - >	0.016	0.001	0.308	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			636.041	635.985	1.08	1.75	7 [A2-8 & A, Qg / Qo = 0.0	636.07	637.395	1.33	**D7/7**
			Grassed						16.65																									
10%	**D7/6**		Paved												grated gully pits 600x600	0		0.175	20.336	1	825	635.441	635.238	635.683	635.473	1.4	0.88	H-O'L o = 0.00, S / D	635.68	637.392	1.71	**D7/6**
			Supp.																															
			Grassed																															
1%	**D7/6**		Paved												< - - - as above - - - >	0		0.385	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			635.81	635.638	1.66	1.35	H-O'L o = 0.00, S / D	635.98	637.392	1.41	**D7/6**
			Grassed																															
10%	**D7/5**	0.072	Paved	75	6	42.816	1.24	0.013	8.93	0.015	D7/7	0.457	11.03	0.04	GMC Kerb Inlet 1.8m Lintel	0.473	0.001	0.207	39.148	1.81	825	635.206	634.499	635.473	634.728	1.71	1.08	H-O'L o = 0.08, S / D	635.47	637.008	1.54	**D7/5**
			Supp.	0	6	0.1	0.1	0.01			D7C/1	0.001	0.24	0.01																				
			Grassed	25	6	42.816	1.24	0.17	19.7																									
1%	**D7/5**	0.072	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.46	0.025	D7/7	0.853	11.48	0.08	< - - - as above - - - >	0.883	0.008	0.418	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			635.592	634.782	2.57	1.46	H-O'L o = 0.20, S / D	635.64	637.008	1.37	**D7/5**
			Grassed						17.52		D7C/1	0.005	0.42	0.02																				
10%	**D7/4**	0.039	Paved	75	6	37.274	2.65	0.013	8.15	0.009	D7/5	0.001	0.21	0.01	GMC Kerb Inlet 1.8m Lintel	0.01	0	0.208	39.147	1.88	825	634.467	633.731	634.728	634.019	1.43	0.39	A1-5 [A2-4(, Qg / Qo = 0.0	634.73	636.112	1.38	**D7/4**
			Supp.	0	6	0.1	0.1	0.01																										
			Grassed	25	6	37.274	2.65	0.17	16.03																									
1%	**D7/4**	0.039	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		7.81	0.014	D7/5	0.001	0.26	0.01	< - - - as above - - - >	0.015	0.002	0.431	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			634.782	634.152	2.29	0.77	A1-5 [A2-4(, Qg / Qo = 0.1	634.78	636.112	1.33	**D7/4**
			Grassed						14.44																									
10%	**D7/3**	0.041	Paved	75	6	38.327	2.64	0.013	8.18	0.009	L2	0.001	0.23	0.01	GMC Kerb Inlet 1.8m Lintel	0.164	0.015	0.265	46.054	1.77	825	633.713	632.9	634.019	633.216	1.47	1.47	1-20 [A2-3:0, Qg/Qo=0.28	634.02	635.203	1.18	**D7/3**
			Supp.	0	6	0.1	0.1	0.01			D7/4	0.154	10.27	0.02																				
			Grassed	25	6	38.327	2.64	0.17	16.22																									
1%	**D7/3**	0.041	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		7.84	0.015	L2	0.003	0.36	0.02	< - - - as above - - - >	0.48	0.048	0.515	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			634.142	633.375	1.83	1.1	1-20 [A2-3:0, Qg/Qo=0.17	634.15	635.203	1.05	**D7/3**
			Grassed						14.59		D7/4	0.462	12.56	0.05																				
10%	**D7/2**	0.184	Paved	80	6	55.914	2.26	0.013	8.87	0.041	D7/3	0.001	3	0	GMC Kerb Inlet 2.4m Lintel Sa	0.044	0	0.305	24.214	1.02	825	632.875	632.628	633.216	632.967	1.47	1.25	9 [A2-6 & A, Qg / Qo = 0.1	633.22	634.231	1.02	**D7/2**
			Supp.	0	6	0.1	0.1	0.01			D7A/1	0.002	2.08	0																				
			Grassed	20	6	55.914	2.26	0.17	19.43																									
1%	**D7/2**	0.184	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.42	0.067	D7/3	0.005	5.04	0	< - - - as above - - - >	0.088	0	0.625	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			633.349	633.194	1.97	1.31	9 [A2-6 & A, Qg / Qo = 0.2	633.38	634.231	0.86	**D7/2**
			Grassed						17.29		D7A/1	0.016	2.29	0.01																				
10%	**D7/1**		Paved								D7/2	0.001	0.29	0.01	GMC Kerb Inlet 1.8m Lintel	0.001	0	0.303	10.255	1	825	632.603	632.5	632.967	632.903	1.33	1.92	[A2-28 & A, Qg / Qo = 0.0	632.97	633.62	0.65	**D7/1**
			Supp.																															
			Grassed																															
1%	**D7/1**		Paved								D7/2	0.005	0.53	0.02	< - - - as above - - - >	0.005	0	0.625	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			633.104	633.071	1.84	1.5	[A2-28 & A, Qg / Qo = 0.0	633.19	633.62	0.43	**D7/1**
			Grassed																															
10%	**N196976**	0.729	Paved	0	5				5	0.131	BASIN 2					0.131	0.457													631.62	631.46		**N196976**
			Supp.	0	2						N4052444																							
			Grassed	100	5				5																									
1%	**N196976**	0.729	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		5	0.269	BASIN 2					0.269	0.853													631.63	631.46		**N196976**
			Grassed						5		N4052444																							
10%	**D7C/1**	0.09	Paved	75	6	37.946	1.68	0.013	8.49	0.019	L18	0.001	0.22	0.01	GMC Kerb Inlet 2.4m Lintel Sa	0.02	0	0.08	17.076	1	450	635.987	635.816	636.183	635.98	1.53	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.24	637.13	0.89	**D7C/1**
			Supp.	0	6	0.1	0.1	0.01			D7/8	0	0	0																				
			Grassed	25	6	37.946	1.68	0.17	17.63																									
1%	**D7C/1**	0.09	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.09	0.032	L18	0.054	2	0.07	< - - - as above - - - >	0.342	0.016	0.149	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			636.257	636.046	1.82	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.39	637.13	0.74	**D7C/1**
			Grassed						15.78		D7/8	0.256	11.39	0.03																				
10%	**D7B/1**	0.057	Paved	75	6	54.191	1.13	0.013	9.47	0.012					GMC Kerb Inlet 1.8m Lintel	0.012	0.001	0.012	20.598	2.95	375	636.297	635.69	636.385	635.737	1.42	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.38	637.308	0.92	**D7B/1**
			Supp.	0	6	0.1	0.1	0.01																										
			Grassed	25	6	54.191	1.13	0.17	22.22																									
1%	**D7B/1**	0.057	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		8.92	0.02					< - - - as above - - - >	0.02	0.001	0.019	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			636.412	635.749	1.73	5.93	A1-4 [A2-3( ).0, Vo2 / (2gD	636.41	637.308	0.9	**D7B/1**
			Grassed						19.65																									
10%	**D8/6**	0.098	Paved	60	5				5	0.024	N4043015				GMC Kerb Inlet 2.4m Lintel Sa	0.024	0.154	0.15	13.484	1	375	634.19	634.055	634.76	634.663	1.36	3.84	A1-4 [A2-3( ).5, Vo2 / (2gD	635.1	635.202	0.1	**D8/6**
			Supp.	0	6						N4043017																							
			Grassed	40	5				5																									
1%	**D8/6**	0.098	Paved	< - - - - - - - - - -		as above	- - - - - - - - - - >		5	0.041	N4043015				< - - - as above - - - >	0.041	0.462	0.15	< - - - - - - - - - - - -	as above	- - - - - - - - - - - - >			634.811	634.739	1.36	3.68	A1-4 [A2-3( ).7, Vo2 / (2gD	635.22	635.202	0	**D8/6**
			Grassed						5		N4043017																							
10%	**D8/5**	0.069	Paved	60	5				5	0.017					GMC Kerb Inlet 1.8m Lintel	0.017	0.001	0.165	17.821	1	375	634.03	633.851	634.474	634.316	1.49	1.77	[A2-20 & A, Qg / Qo = 0.1	634.66	635.371	0.71	**D8/5**
			Supp.	0	6																													

			Grassed	40	5				5																						
1%	D8/5	0.069	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.029						< - - - as above - - - >		0.029	0.005	0.173	< - - - - - - - - - -		as above		- - - - - - - - - - >	634.62	634.501	1.56	1.66	I [A2-20 & A, Qg / Qo = 0.1	634.74	635.371	0.63	D8/5
			Grassed						5																						
10%	D8/4		Paved								D8/5	0.14	3.23	0.05	UNLIMITED	UNLIMITED	0.14	0.001	0.168	43.853	1.23	375	633.826	633.287	634.243	633.87	1.52	0.66	9 [A2-6 & A, Qg / Qo = 0.0	634.32	635.177	0.86	D8/4
			Supp.																												
			Grassed																												
1%	D8/4		Paved								D8/5	0.391	4.14	0.13	< - - - as above - - - >		0.391	0.005	0.181	< - - - - - - - - - -		as above		- - - - - - - - - - >	634.445	634.17	1.64	0.66	9 [A2-6 & A, Qg / Qo = 0.0	634.5	635.177	0.68	D8/4
			Grassed																												
10%	D8/3	0.381	Paved	0	6	0.1	0.1	0.01	6.17	0.025	D8/4	0.14	12.23	0.02	GMC Surface In	600x900	0.165	0.007	0.18	54.37	1.14	375	633.287	632.667	633.77	633.227	1.63	0.69	A1-5 [A2-4 , Qg / Qo = 0.1	633.87	634.446	0.58	D8/3
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	84.484	4.21	0.17	23.38																						
1%	D8/3	0.381	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.069	D8/4	0.391	14.1	0.04	< - - - as above - - - >		0.46	0.027	0.191	< - - - - - - - - - -		as above		- - - - - - - - - - >	634.142	633.568	1.73	0.78	A1-5 [A2-4 , Qg / Qo = 0.2	634.17	634.446	0.28	D8/3
			Grassed						20.63																						
10%	D8/2	0.34	Paved	0	6	0.1	0.1	0.01	6.16	0.009	D8/3	0.051	2.57	0.02	GMC Surface In	600x900	0.009	0.004	0.19	14.217	1	375	632.642	632.5	633.047	632.903	1.72	1.65	7 [A2-8 & A, Qg / Qo = 0.0	633.23	634.059	0.83	D8/2
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	87.158	0.1	0.17	57.44																						
1%	D8/2	0.34	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.025	D8/3	0.104	2.86	0.04	< - - - as above - - - >		0.026	0.018	0.217	< - - - - - - - - - -		as above		- - - - - - - - - - >	633.274	633.071	1.96	1.38	7 [A2-8 & A, Qg / Qo = 0.1	633.57	634.059	0.49	D8/2
			Grassed						51.79																						
10%	D7A/1	0.085	Paved	75	6	84.382	2.36	0.013	9.63	0.018	D7B/1	0.527	13.92	0.06	GMC Kerb Inlet	1.8m Lintel	0.545	0.001	0.018	14.637	1.53	375	634.387	634.163	634.489	634.23	1.33	5.93	A1-4 [A2-3).0, Vo2 / (2gL	634.49	635.397	0.91	D7A/1
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	25	6	84.382	2.36	0.17	22.96																						
1%	D7A/1	0.085	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.05	0.029	D7B/1	0.901	15.32	0.09	< - - - as above - - - >		0.93	0.005	0.025	< - - - - - - - - - -		as above		- - - - - - - - - - >	634.51	634.244	1.43	5.93	A1-4 [A2-3).0, Vo2 / (2gL	634.51	635.397	0.89	D7A/1
			Grassed						20.27																						
10%	N1	2.112	Paved	70	5				5	0.527							0.527	0.527													N1
			Supp.	0	2																										
			Grassed	30	5				5																						
1%	N1	2.112	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.901							0.901	0.901													N1
			Grassed						5																						
10%	N2	29.905	Paved	0	5				5	5.382							5.382	5.382													N2
			Supp.	0	2																										
			Grassed	100	5				5																						
1%	N2	29.905	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	11.018							11.018	11.018													N2
			Grassed						5																						
10%	N1859886	3.132	Paved	0	6	50	8	0.013	8.24	0.14							0.14	0.14													N1859886
			Supp.	0	0	50	8	0.013																							
			Grassed	100	6	150	8	0.3	34.44																						
1%	N1859886	3.132	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	7.88	0.391							0.391	0.391													N1859886
			Grassed						29.95																						
10%	E1/13	1.068	Paved	0	6	0.1	0.1	0.01	6.16	0.057					grated gully pits	1.2x1.2	0.057	0	0.06	60.976	1	600	647.288	646.679	647.445	646.797	1.52	5.93	A1-4 [A2-3).0, Vo2 / (2gL	647.45	648.789	1.34	E1/13
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	161.024	6	0.17	27.77																						
1%	E1/13	1.068	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.157					< - - - as above - - - >		0.157	0.001	0.155	< - - - - - - - - - -		as above		- - - - - - - - - - >	647.567	646.885	1.81	5.93	A1-4 [A2-3).0, Vo2 / (2gL	647.57	648.789	1.22	E1/13
			Grassed						25.37																						
10%	E1/12	0.281	Paved	0	6				6	0.051	E1/13	0.036	2.36	0.02	grated gully pits	1.2x1.2	0.052	0	0.098	56.361	1	750	646.535	645.971	646.728	646.164	1.09	5.93	A1-4 [A2-3).0, Vo2 / (2gL	646.73	648.178	1.45	E1/12
			Supp.																												
			Grassed	100	5				5																						
1%	E1/12	0.281	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6	0.104	E1/13	0.107	2.68	0.05	< - - - as above - - - >		0.114	0	0.211	< - - - - - - - - - -		as above		- - - - - - - - - - >	646.758	646.231	1.92	2.02	A1-6 [A2-5 , Qg / Qo = 0.5	646.76	648.178	1.42	E1/12
			Grassed						5																						
10%	E1/11	5.699	Paved	0	6	0.1	0.1	0.01	6.16	0.219	E1/12	0.029	2.32	0.01	grated gully pits	1.2x1.2	0.219	0.002	0.288	52.828	1	900	645.811	645.282	646.164	645.539	1.92	5.93	A1-4 [A2-3).0, Vo2 / (2gL	646.16	647.614	1.45	E1/11
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	312.381	6	0.17	38.4																						
1%	E1/11	5.699	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.611	E1/12	0.082	2.59	0.04	< - - - as above - - - >		0.613	0.016	0.795	< - - - - - - - - - -		as above		- - - - - - - - - - >	646.231	645.734	2.73	5.93	A1-4 [A2-3).0, Vo2 / (2gL	646.23	647.614	1.38	E1/11
			Grassed						34.83																						
10%	E1/10		Paved								E1/11	0.019	2.22	0.01	grated gully pits	1.2x1.2	0	0	0.287	49.297	1	900	645.257	644.764	645.539	644.997	2.2	0.24	A1-5 [A2-4 , Qg / Qo = 0.0	645.54	647.085	1.55	E1/10
			Supp.																												
			Grassed																												
1%	E1/10		Paved								E1/11	0.052	2.4	0.02	< - - - as above - - - >		0.001	0	0.805	< - - - - - - - - - -		as above		- - - - - - - - - - >	645.734	645.184	2.76	0.28	A1-5 [A2-4 , Qg / Qo = 0.0	645.73	647.085	1.35	E1/10
			Grassed																												
10%	E1/9	0.805	Paved	0	6	0.1	0.1	0.01	6.17	0.047	E1/10	0	0	0	grated gully pits	1.2x1.2	0.047	0	0.342	18.739	1.08	1050	644.624	644.422	644.93	644.712	1.74	0.95	9 [A2-6 & A, Qg / Qo = 0.1	644.93	646.592	1.66	E1/9
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	129.061	6	0.17	26.15																						
1%	E1/9	0.805	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.131	E1/10	0	0	0	< - - - as above - - - >		0.131	0.001	0.934	< - - - - - - - - - -		as above		- - - - - - - - - - >	645.101	644.933	2.41	0.8	9 [A2-6 & A, Qg / Qo = 0.1	645.1	646.592	1.49	E1/9
			Grassed						22.97																						
10%	E1/8		Paved								E1/9	0.481	10.57	0.05	grated gully pits	900x900	0.481	0	0.342	82.26	1.71	1050	644.417	643.007	644.712	643.302	1.69	0.66	9 [A2-6 & A, Qg / Qo = 0.0	644.71	646.39	1.68	E1/8
			Supp.																												
			Grassed																												
1%	E1/8		Paved								E1/9	1.349	11.05	0.13	< - - - as above - - - >		1.349	0	0.944	< - - - - - - - - - -		as above		- - - - - - - - - - >	644.933	643.523	2.2	0.66	9 [A2-6 & A, Qg / Qo = 0.0	644.93	646.39	1.46	E1/8
			Grassed																												
10%	E1/7		Paved								E1/8	0.013	1.24	0.03	grated gully pits	900x900	0.001	0	0.331	38.753	1.75	1050	643.002	642.325	643.302	642.656	1.6	0.66	9 [A2-6 & A, Qg / Qo = 0.0	643.3	644.761	1.46	E1/7
			Supp.																												
			Grassed																												
1%	E1/7		Paved								E1/8	0.028	1.76	0.04	< - - - as above - - - >		0.007	0	0.923	< - - - - - - - - - -		as above		- - - - - - - - - - >	643.523	642.891	2.13	0.66	9 [A2-6 & A, Qg / Qo = 0.0	643.52	644.761	1.24	E1/7
			Grassed																												
10%	E1/6		Paved								E1/7	0.024	2.44	0.03	grated gully pits	1.2x1.2	0.024	0	0.352	24.546	1.82	1050	642.32	641.874	642.656	642.21	1.46	1.75	7 [A2-8 & A, Qg / Qo = 0.0	642.66	644.184	1.53	E1/6
			Supp.																												
			Grassed																												
1%	E1/6		Paved								E1/7	0.09	4.1	0.05	< - - - as above - - - >		0.09	0	0.951	< - - - - - - - - - -		as above		- - - - - - - - - - >	642.866	642.333	2.58	1.72	7 [A2-8 & A, Qg / Qo = 0.0	642.89	644.184	1.29	E1/6
			Grassed																												
10%	E1/5		Paved								E1/6	0.017	1.27	0.04	grated gully pits	900x900	2.471	0.001	0.402	72.75	2.26	1050	641.869	640.226	642.21	640.529	1.92	1.07	A1-5 [A2-4 , Qg / Qo = 0.2	642.21	643.728	1.52	E1/5
			Supp.								N3144385	2.468	20.82	0.18																		
			Grassed																												
1%	E1/5		Paved								E1/6	0.052	2.11	0.06	< - - - as above - - - >		5.082	0.01	1.122	< - - - - - - - - - -		as above		- - - - - - - - - - >	642.333	640.685	3.05	0.93	A1-5 [A2-4 , Qg / Qo = 0.1	642.33	643.728	1.4	E1/5
			Grassed								N3144385	5.052	25.77	0.3																		
10%	E1/4	0.652	Paved	0	6	100.939	2.57	0.013	10.79	0.035	E1/5	0.016	1.44	0.03	grated gully pits	900x900	0.043	0	0.436	68.522	2.33	1050	640.201	638.605	640.529	638.898	2.18	0.63	A1-5 [A2-4 , Qg / Qo = 0.1	640.53	641.985	1.46	E1/4
			Supp.	0	6	0.1	0.1	0.01																							
			Grassed	100	6	100.939	2.57	0.17	28.42																						
1%	E1/4	0.652	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	10.04	0.098	E1/5	0.138	3.53	0.09	< - - - as above - - - >		0.223	0.002	1.223	< - - - - - - - - - -		as above		- - - - - - - - - - >	640.685	639.061	3.35	0.56	A1-5 [A2-4 , Qg / Qo = 0.0	640.68	641.985	1.3	E1/4
			Grassed						24.88																						

10%	**E1/3**	0.514	Paved	0	6	0.1	0.1	0.01	6.17	0.029	E1/4	0.012	1.24	0.03	grated gully pits	900x900	0.03	0	0.464	55.228	3.18	1050	638.58	636.826	638.898	637.138	2.13	0.53	A1-5 [A2-4	, Qg / Qo = 0.(	638.9	640.409	1.51	**E1/3**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	100	6	91.375	2.55	0.17	27.17																								
1%	**E1/3**	0.514	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.15	0.081	E1/4	0.069	2.66	0.07	< - - - as above - - - >		0.138	0.001	1.302	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	639.061	637.37	3.33	0.46	A1-5 [A2-4	, Qg / Qo = 0.(	639.06	640.409	1.35	**E1/3**
			Grassed						24.73																								
10%	**E1/2**	0.31	Paved	0	6	0.1	0.1	0.01	6.17	0.019	E1/3	0.003	0.4	0.01	grated gully pits	900x900	0.022	0	0.481	34.861	8.06	1050	636.801	633.992	637.138	634.169	4.95	0.84	9 [A2-6 & A	, Qg / Qo = 0.(	637.14	638.58	1.44	**E1/2**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	100	6	69.298	1.84	0.17	25.78																								
1%	**E1/2**	0.31	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	6.14	0.051	E1/3	0.045	2.14	0.05	< - - - as above - - - >		0.096	0	1.349	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	637.37	634.286	6.7	0.8	9 [A2-6 & A	, Qg / Qo = 0.(	637.37	638.58	1.21	**E1/2**
			Grassed						22.65																								
10%	**D1/11**	0.06	Paved	75	6	58.356	0.78	0.013	10.05	0.012					GMC Kerb Inlet	1.8m Lintel	0.012	0.001	0.011	12	1	375	645.013	644.893	645.113	645.079	0.47	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	645.11	646.023	0.91	**D1/11**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	58.356	0.78	0.17	24.95																								
1%	**D1/11**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.41	0.02					< - - - as above - - - >		0.02	0.007	0.023	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	646.011	646.01	0.21	3.22	A1-4 [A2-3	..7, Vo2 / (2gL	646.01	646.023	0.01	**D1/11**
			Grassed						21.94																								
10%	**D1/10**	0.06	Paved	75	6	66.951	0.74	0.013	10.83	0.012	L11	0.056	10.3	0.01	GMC Kerb Inlet	1.8m Lintel	0.068	0.024	0.064	42.184	1	375	644.868	644.446	645.052	644.657	1.19	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	645.08	646.024	0.94	**D1/10**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	66.951	0.74	0.17	28.59																								
1%	**D1/10**	0.06	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.76	0.02	L11	0.115	10.45	0.01	< - - - as above - - - >		0.135	0.09	0.099	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.962	645.908	0.9	2.96	A1-4 [A2-3	..9, Vo2 / (2gL	646.01	646.024	0.01	**D1/10**
			Grassed						23.59																								
10%	**D1/9**		Paved								D1/10	0.032	1.33	0.07	GMC Kerb Inlet	1.8m Lintel	0.001	0.003	0.079	36.907	1	375	644.421	644.052	644.626	644.304	1.28	1.83	9 [A2-6 & A	, Qg / Qo = 0.3	644.66	646.001	1.34	**D1/9**
			Supp.																														
			Grassed																														
1%	**D1/9**		Paved								D1/10	0.056	1.7	0.09	< - - - as above - - - >		0.005	0.03	0.131	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.858	645.654	1.18	1.35	9 [A2-6 & A	, Qg / Qo = 0.4	645.91	646.001	0.09	**D1/9**
			Grassed																														
10%	**D1/8**	0.081	Paved	75	6	79.727	0.47	0.013	12.15	0.015	D1/9	0	0	0	GMC Kerb Inlet	1.8m Lintel	0.752	0.008	0.157	54.95	1	450	643.977	643.428	644.253	643.753	1.53	1.97	H-O'L	o = 0.22, S / D	644.3	645.654	1.35	**D1/8**
			Supp.	0	6	0.1	0.1	0.01			PL12	0.737	17.91	0.06																				
			Grassed	25	6	79.727	0.47	0.17	34.75																								
1%	**D1/8**	0.081	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	10.79	0.024	D1/9	0.263	11.44	0.03	< - - - as above - - - >		1.795	0.125	0.274	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.488	645.194	1.73	2.08	H-O'L	o = 0.27, S / D	645.65	645.654	0	**D1/8**
			Grassed						28.38		PL12	1.508	21.59	0.1																				
10%	**D1/7**	0.053	Paved	75	6	51.925	0.82	0.013	9.72	0.011	D1/8	0.011	1.22	0.02	GMC Kerb Inlet	1.8m Lintel	0.012	0.001	0.178	54.879	1	450	643.403	642.854	643.698	643.204	1.61	0.75	.1-20 [A2-3	0, Qg/Qo=0.1(	643.75	645.369	1.62	**D1/7**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	51.925	0.82	0.17	23.41																								
1%	**D1/7**	0.053	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.13	0.018	D1/8	0.03	1.9	0.04	< - - - as above - - - >		0.033	0.057	0.326	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.096	644.44	2.05	1.33	.1-20 [A2-3	0, Qg/Qo=0.27	645.19	645.369	0.18	**D1/7**
			Grassed						20.64																								
10%	**D1/6**	0.055	Paved	75	6	53.202	0.79	0.013	9.82	0.011	D1/7	0.013	1.31	0.03	GMC Kerb Inlet	1.8m Lintel	12.975	0.003	0.219	32.79	1	450	642.829	642.501	643.156	642.796	1.97	1.34	H-O'L	o = 0.09, S / D	643.2	645.075	1.87	**D1/6**
			Supp.	0	6	0.1	0.1	0.01			PL13	12.963	26.04	0.77																				
			Grassed	25	6	53.202	0.79	0.17	23.86																								
1%	**D1/6**	0.055	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.21	0.019	D1/7	0.024	1.7	0.04	< - - - as above - - - >		27.179	0.045	0.456	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	643.899	643.067	2.87	1.63	H-O'L	o = 0.19, S / D	644.44	645.075	0.64	**D1/6**
			Grassed						21.03		PL13	27.155	32.61	1.32																				
10%	**D1/5**		Paved								D1/6	0.012	0.79	0.04	grated gully pits	600x600	0.001	0.002	0.219	32.791	1.09	525	642.401	642.045	642.699	642.346	1.72	0.26	9 [A2-6 & A	, Qg / Qo = 0.(	642.7	644.856	2.16	**D1/5**
			Supp.																														
			Grassed																														
1%	**D1/5**		Paved								D1/6	0.021	1.13	0.05	< - - - as above - - - >		0.003	0.045	0.456	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	642.999	642.63	2.11	0.26	9 [A2-6 & A	, Qg / Qo = 0.(	643.07	644.856	1.79	**D1/5**
			Grassed																														
10%	**D1/4**	0.065	Paved	75	6	63.105	1.76	0.013	9.33	0.014	D1/5	0.013	0.85	0.04	GMC Kerb Inlet	1.8m Lintel	0.015	0.001	0.25	76.082	1.45	525	642.02	640.914	642.346	641.238	1.78	0.87	H-O'L	o = 0.06, S / D	642.35	644.032	1.69	**D1/4**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	63.105	1.76	0.17	21.56																								
1%	**D1/4**	0.065	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.8	0.022	D1/5	0.022	1.16	0.05	< - - - as above - - - >		0.024	0.008	0.508	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	642.48	641.368	2.55	1.07	H-O'L	o = 0.12, S / D	642.63	644.032	1.4	**D1/4**
			Grassed						19.09																								
10%	**D1/3**	0.076	Paved	60	6	74.109	2.6	0.01	8.78	0.016	D1/4	0.062	10.32	0.01	GMC Kerb Inlet	1.8m Lintel	0.078	0.001	0.351	68.52	2.35	600	640.832	639.221	641.217	639.475	3.08	1.05	l [A2-37 & /	= 1.50, (Qu /	641.24	642.21	0.97	**D1/3**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	40	6	74.109	2.6	0.01	8.78																								
1%	**D1/3**	0.076	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.34	0.028	D1/4	0.165	10.56	0.02	< - - - as above - - - >		0.193	0.006	0.712	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	641.358	639.611	3.66	1.01	l [A2-37 & /	= 1.50, (Qu /	641.37	642.21	0.84	**D1/3**
			Grassed						8.34																								
10%	**D1/2**	0.068	Paved	75	6	65.894	2.47	0.013	9.08	0.014	D1/3	0.036	1.48	0.07	GMC Kerb Inlet	1.8m Lintel	0.035	0.001	0.486	70.028	2.97	750	639.069	636.989	639.438	637.777	2.24	0.95	.1-20 [A2-3	0, Qg/Qo=0.31	639.44	640.634	1.2	**D1/2**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	65.894	2.47	0.17	20.43																								
1%	**D1/2**	0.068	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.6	0.024	D1/3	0.111	2.4	0.12	< - - - as above - - - >		0.111	0.005	0.98	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	639.555	638.381	3.24	0.44	.1-25 [A2-3	0, Qg/Qo=0.03	639.56	640.634	1.08	**D1/2**
			Grassed						18.14																								
10%	**D1/1**	0.149	Paved	75	6	62.785	2.09	0.013	9.15	0.032	D1/2	0.063	10.32	0.01	GMC Kerb Inlet	2.4m Lintel Sa	10.8	0	0.821	8	1	825	636.921	636.841	637.618	637.592	1.7	1.43	H-O'L	o = 0.14, S / D	637.78	638.51	0.73	**D1/1**
			Supp.	0	6	0.1	0.1	0.01			D1A/1	10.705	34.11	0.49																				
			Grassed	25	6	62.785	2.09	0.17	20.73																								
1%	**D1/1**	0.149	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.65	0.052	D1/2	0.167	10.56	0.02	< - - - as above - - - >		22.442	0.263	1.488	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	637.95	637.865	2.78	1.32	H-O'L	o = 0.10, S / D	638.38	638.51	0.13	**D1/1**
			Grassed						18.4		D1A/1	22.223	40.56	0.85																				
10%	**LF-OSD1**		Paved												UNLIMITED	UNLIMITED	0		0.708	16.391	3.27	825	637.036	636.5	637.541	636.796	4.1	ot calculated			637.59	638.4	0.81	**LF-OSD1**
			Supp.																														
			Grassed																														
1%	**LF-OSD1**		Paved												< - - - as above - - - >		0		1.401	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	637.735	637.383	2.9	ot calculated			637.86	638.4	0.54	**LF-OSD1**
			Grassed																														
10%	**D1H/1**	0.065	Paved	75	6	60.91	0.74	0.013	10.22	0.013	D1/11	0.015	0.96	0.04	GMC Kerb Inlet	1.8m Lintel	0.014	0.001	0.012	12	4.93	375	644.644	644.052	644.74	644.304	0.56	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.74	645.656	0.92	**D1H/1**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	60.91	0.74	0.17	25.76																								
1%	**D1H/1**	0.065	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.55	0.022	D1/11	0.029	1.35	0.06	< - - - as above - - - >		0.028	0.015	0.033	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.654	645.654	0.3	3.19	A1-4 [A2-3	..7, Vo2 / (2gL	645.65	645.656	0	**D1H/1**
			Grassed						22.62																								
10%	**D1G/1**	0.053	Paved	75	6	51.926	0.57	0.013	10.15	0.01	D1H/1	0.006	6.33	0	GMC Kerb Inlet	1.8m Lintel	0.016	0.001	0.01	12	7.34	375	644.359	643.478	644.449	643.753	0.52	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	644.45	645.369	0.92	**D1G/1**
			Supp.	0	6	0.1	0.1	0.01																									
			Grassed	25	6	51.926	0.57	0.17	25.41																								
1%	**D1G/1**	0.053	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	9.49	0.018	D1H/1	0.362	16.19	0.03	< - - - as above - - - >		0.38	0.005	0.026	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	645.199	645.194	0.24	3.72	A1-4 [A2-3	..2, Vo2 / (2gL	645.21	645.369	0.15	**D1G/1**
			Grassed						22.33																								
10%	**D1F/1**	0.055	Paved	60	5				5	0.013	D1G/1	0.072	2.38	0.08	GMC Kerb Inlet	1.8m Lintel	0.07	0.001	0.015	11.999	7.38	375	643.789	642.904	643.891	643.204	0.61	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	643.89	645.074	1.18	**D1F/1**
			Supp.	0	6																												
			Grassed	40	5				5																								
1%	**D1F/1**	0.055	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.023	D1G/1	0.179	3.44	0.13	< - - - as above - - - >		0.175	0.003	0.025	< - - - - - - - - - - - - -		as above		- - - - - - - - - - - - >	644.441	644.44	0.23	4.44	A1-4 [A2-3	).7, Vo2 / (2gL	644.45	645.074	0.63	**D1F/1**
			Grassed						5																								
10%	**D1E/1**	0.051	Paved	75	6	50.617	2.09	0.013	8.77	0.011	D1F/1	0.015	1.18	0.03	GMC Kerb Inlet	1.8m Lintel	0.026	0.001	0.012	12	6.73	375	642.971	642.163	643.072	642.346	0.51	5.93	A1-4 [A2-3	).0, Vo2 / (2gL	643.07	644.031	0.96	**D1E/1**
			Supp.	0	6	0.1	0.1	0.01																									

			Grassed	25	6	50.617	2.09	0.17	18.95																					
1%	D1E/1	0.051	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.33	0.018	D1F/1	0.056	2.16	0.07	< - - - as above - - - >	0.074	0.002	0.019	< - - - - - - - - - -		as above		- - - - - - - - - - >	643.105	642.63	0.52	5.93	A1-4 [A2-3().0, Vo2 / (2gL	643.1	644.031	0.93	D1E/1
			Grassed						16.89																					
10%	PL25	0.862	Paved	0	5				5	0.136					GMC Surface In	600x900	0.136	0.062	0.073	7	1	375	641.755	641.685	641.977	641.96	1.08	5.93	A1-4 [A2-3().0, Vo2 / (2gL	642.09	642.965	0.88	PL25
			Supp.	0	2																									
			Grassed	100	7				7																					
1%	PL25	0.862	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.3					< - - - as above - - - >	0.3	0.165	0.134	< - - - - - - - - - -		as above		- - - - - - - - - - >	642.171	642.13	1.22	4.69	A1-4 [A2-3().1, Vo2 / (2gL	642.48	642.965	0.48	PL25
			Grassed						7																					
10%	D1D/1	0.057	Paved	75	6	55.406	2.62	0.013	8.73	0.012	D1E/1	0	0	0	GMC Kerb Inlet	1.8m Lintel	0.038	0.021	0.122	22.519	2.66	375	641.655	641.055	641.91	641.238	2.27	1.77	7 [A2-8 & A, Qg / Qo = 0.4	641.96	642.666	0.71	D1D/1
			Supp.	0	6	0.1	0.1	0.01			PL25	0.026	10.18	0																		
			Grassed	25	6	55.406	2.62	0.17	18.77																					
1%	D1D/1	0.057	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.3	0.02	D1E/1	0.028	9.26	0	< - - - as above - - - >	0.111	0.087	0.233	< - - - - - - - - - -		as above		- - - - - - - - - - >	641.989	641.368	2.37	1.65	7 [A2-8 & A, Qg / Qo = 0.4	642.13	642.666	0.54	D1D/1
			Grassed						16.75		PL25	0.063	10.32	0.01																	
10%	PL26	0.869	Paved	0	5				5	0.137					GMC Surface In	600x900	0.137	0.063	0.074	7	1	375	639.979	639.909	640.254	640.241	0.85	5.93	A1-4 [A2-3().0, Vo2 / (2gL	640.34	641.189	0.85	PL26
			Supp.	0	2																									
			Grassed	100	7				7																					
1%	PL26	0.869	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.303					< - - - as above - - - >	0.303	0.167	0.136	< - - - - - - - - - -		as above		- - - - - - - - - - >	640.642	640.6	1.23	3.79	A1-4 [A2-3().8, Vo2 / (2gL	640.93	641.189	0.26	PL26
			Grassed						7																					
10%	D1C/1	0.076	Paved	75	6	73.903	2.55	0.013	9.27	0.016	D1D/1	0.012	10.12	0	GMC Kerb Inlet	1.8m Lintel	0.054	0.036	0.141	16.952	2.6	375	639.879	639.438	640.154	639.625	2.56	5.7	A1-4 [A2-3().0, Vo2 / (2gL	640.24	640.891	0.65	D1C/1
			Supp.	0	6	0.1	0.1	0.01			PL26	0.026	10.18	0																		
			Grassed	25	6	73.903	2.55	0.17	21.31																					
1%	D1C/1	0.076	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.75	0.026	D1D/1	0.048	10.27	0	< - - - as above - - - >	0.17	0.14	0.262	< - - - - - - - - - -		as above		- - - - - - - - - - >	640.225	639.726	2.88	3.15	A1-4 [A2-3().0, Vo2 / (2gL	640.6	640.891	0.29	D1C/1
			Grassed						18.88		PL26	0.096	10.41	0.01																	
10%	PL27	0.922	Paved	0	5				5	0.139					GMC Surface In	600x900	0.139	0.064	0.074	7	1	375	637.741	637.671	638.07	638.058	0.72	5.93	A1-4 [A2-3().0, Vo2 / (2gL	638.15	638.955	0.81	PL27
			Supp.	0	2																									
			Grassed	100	8				8																					
1%	PL27	0.922	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.286					< - - - as above - - - >	0.286	0.156	0.13	< - - - - - - - - - -		as above		- - - - - - - - - - >	638.583	638.546	1.18	3.32	A1-4 [A2-3(..2, Vo2 / (2gL	638.77	638.955	0.19	PL27
			Grassed						8																					
10%	D1A/1	0.157	Paved	75	6	75.646	2.26	0.013	9.44	0.033	D1C/1	0	0	0	grated gully pit≤	900x900	4.314	0.006	0.314	12	1	525	637.341	637.221	637.84	637.777	1.48	4.84	A1-4 [A2-3().0, Vo2 / (2gL	638.06	638.51	0.45	D1A/1
			Supp.	0	6	0.1	0.1	0.01			PL27	0.076	2.6	0.03																		
			Grassed	25	6	75.646	2.26	0.17	22.09		PL28	4.205	26.35	0.25																		
1%	D1A/1	0.157	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	8.9	0.054	D1C/1	0	0	0	< - - - as above - - - >	8.873	0.362	0.411	< - - - - - - - - - -		as above		- - - - - - - - - - >	638.463	638.381	1.9	2.07	H-O'L o = 0.40, S / D	638.55	638.51	0	D1A/1
			Grassed						19.54		PL27	0.212	3.07	0.08																	
											PL28	8.607	32.33	0.42																	
10%	PL28	0.805	Paved	0	5				5	0.127					GMC Surface In	600x900	0.127	0.057	0.068	7	1	375	637.741	637.671	638.068	638.058	0.67	5.93	A1-4 [A2-3().0, Vo2 / (2gL	638.13	638.955	0.82	PL28
			Supp.	0	2																									
			Grassed	100	7				7																					
1%	PL28	0.805	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.28					< - - - as above - - - >	0.28	0.152	0.128	< - - - - - - - - - -		as above		- - - - - - - - - - >	638.582	638.546	1.16	3.34	A1-4 [A2-3(..2, Vo2 / (2gL	638.77	638.955	0.19	PL28
			Grassed						7																					
10%	PL29	0.603	Paved	0	0	100	3	0.013	4.31	0.044					GMC Surface In	600x900	0.044	0.015	0.029	7	1	375	635.934	635.864	636.281	636.279	0.28	5.93	A1-4 [A2-3().0, Vo2 / (2gL	636.29	637.394	1.1	PL29
			Supp.	0	0	0	-1	-1																						
			Grassed	100	0	100	3	0.17	20.14																					
1%	PL29	0.603	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	3.62	0.125					< - - - as above - - - >	0.125	0.056	0.069	< - - - - - - - - - -		as above		- - - - - - - - - - >	636.798	636.791	0.62	3.62	A1-4 [A2-3(..3, Vo2 / (2gL	636.83	637.394	0.56	PL29
			Grassed						16.92																					
10%	D3A/1	0.166	Paved	75	5				5	0.042	D2/3	0.043	2.24	0.05	GMC Kerb Inlet	2.4m Lintel Sa	6.077	0	0.14	11.999	2.29	450	635.834	635.559	636.182	636.16	1.06	5.93	A1-4 [A2-3().0, Vo2 / (2gL	636.28	637.095	0.82	D3A/1
			Supp.	0	6						PL29	6.034	30.21	0.32																	
			Grassed	25	5				5		PL30	0	0	0																	
1%	D3A/1	0.166	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.073	D2/3	0.073	2.79	0.07	< - - - as above - - - >	24.032	0.028	0.28	< - - - - - - - - - -		as above		- - - - - - - - - - >	636.673	636.565	1.76	3.17	A1-4 [A2-3().9, Vo2 / (2gL	636.79	637.095	0.3	D3A/1
			Grassed						5		PL29	12.536	35.26	0.55																	
											PL30	11.42	30	0.58																	
10%	PL30	0.373	Paved	0	5				5	0.067					GMC Surface In	600x900	0.067	0.026	0.041	7	1	375	635.934	635.864	636.281	636.279	0.38	5.93	A1-4 [A2-3().0, Vo2 / (2gL	636.3	637.394	1.1	PL30
			Supp.	0	2																									
			Grassed	100	5				5																					
1%	PL30	0.373	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	0.137					< - - - as above - - - >	0.137	0.063	0.074	< - - - - - - - - - -		as above		- - - - - - - - - - >	636.802	636.791	0.67	3.61	A1-4 [A2-3(..3, Vo2 / (2gL	636.86	637.394	0.54	PL30
			Grassed						5																					
10%	PL13	1.324	Paved	0	0	-1	-1	-1	0	0.039					GMC Surface In	600x900	0.039	0.012	0.026	7	1	375	642.999	642.929	643.213	643.204	0.41	5.93	A1-4 [A2-3().0, Vo2 / (2gL	643.22	645.374	2.15	PL13
			Supp.	0	0	-1	-1	-1																						
			Grassed	100	0	150	1	0.3	50.21																					
1%	PL13	1.324	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	0	0.111					< - - - as above - - - >	0.111	0.048	0.063	< - - - - - - - - - -		as above		- - - - - - - - - - >	644.449	644.44	0.57	2.38	A1-4 [A2-3(!.9, Vo2 / (2gL	644.48	645.374	0.89	PL13
			Grassed						44.69																					
10%	PL12	2.157	Paved	0	0	-1	-1	-1	0	0.067					GMC Surface In	600x900	0.067	0.026	0.042	7	1	375	644.127	644.057	644.329	644.304	0.69	5.93	A1-4 [A2-3().0, Vo2 / (2gL	644.35	645.954	1.61	PL12
			Supp.	0	0	-1	-1	-1																						
			Grassed	100	0	135	1	0.3	47.13																					
1%	PL12	2.157	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	0	0.192					< - - - as above - - - >	0.192	0.096	0.096	< - - - - - - - - - -		as above		- - - - - - - - - - >	645.675	645.654	0.87	2.23	A1-4 [A2-3().1, Vo2 / (2gL	645.75	645.954	0.2	PL12
			Grassed						41.95																					
10%	HW2	1.786	Paved	0	6	166.673	2.6	0.013	12.11	0.076							0.076	0	0.076	8	1	L.2W x 0.3I	643.808	643.728	643.927	643.784	1.13	0.5		643.93	644.508	0.58	HW2
			Supp.	0	6	0.1	0.1	0.01																						
			Grassed	100	6	166.673	2.6	0.17	34.56																					
1%	HW2	1.786	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	11.44	0.212							0.212	0	0.212	< - - - - - - - - - -		as above		- - - - - - - - - - >	643.955	643.834	1.67	0.5		644.04	644.508	0.46	HW2
			Grassed						31.42																					
10%	N3	23.363	Paved	0	5				5	4.205							4.205	4.205													N3
			Supp.	0	2																									
			Grassed	100	5				5																					
1%	N3	23.363	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	8.607							8.607	8.607													N3
			Grassed						5																					
10%	N4	22.202	Paved	0	5				5	3.996	N3	0.309	13.54	0.03			4.305	6.034													N4
			Supp.	0	2																									
			Grassed	100	5				5																					
1%	N4	22.202	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	8.18	N3	0.528	14.85	0.05			8.708	12.536													N4
			Grassed						5																					
10%	N5	16.215	Paved	0	5				5	2.918	N1	0.047	2.54	0.02			16.505	12.008													N5
			Supp.	0	2						DN32	13.587	12.43	2.5																	
			Grassed	100	5				5																					
1%	N5	16.215	Paved	< - - - - - - - - - -		as above		- - - - - - - - - - >	5	5.974	N1	0.131	2.97	0.05			35.578	25.021													N5
			Grassed						5		DN32	29.604	21.57	3.61																	
10%	EHW1		Paved								N5	0.802	15.87	0.07			0.802	0	11.957	61.7	0.75	900	648.8	648.337	653.708	649.237	6.27	0.5		655.51	656.8	1.29	EHW1
			Supp.																											
			Grassed																											

1%	**EHW1**		Paved									N5	1.641	18.71	0.13		1.641	11.42	13.601	<- - - - - - - - - - - - as above - - - - - - - - - - - ->						654.898	649.237	7.13	0.5		657.1	656.8	-0.3	**EHW1**
			Grassed																														
10%	**N8**	1.773	Paved	70	5				5	0.442	EHW1	1.212	16.76	0.11		1.755	12.963													648.33	648.33		**N8**
			Supp.	0	2						N6	0.101	1.28	0.16																		
			Grassed	30	5				5																								
1%	**N8**	1.773	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.756	EHW1	2.536	20.1	0.19		3.498	27.155													648.33	648.33		**N8**
			Grassed						5		N6	0.206	1.68	0.25																		
10%	**N7**	4.094	Paved	0	5				5	0.737						0.737	0.737																**N7**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N7**	4.094	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	1.508						1.508	1.508																**N7**
			Grassed						5																								
10%	**N6**	1.408	Paved	70	5				5	0.351	N7	15.398	28.77	1.69		15.749	0.941																**N6**
			Supp.	0	2																												
			Grassed	30	5				5																								
1%	**N6**	1.408	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.601	N7	32.703	60.69	2.23		33.304	1.975																**N6**
			Grassed						5																								
10%	**N9**	13.714	Paved	0	5				5	2.468						2.468	2.468																**N9**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N9**	13.714	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	5.052						5.052	5.052																**N9**
			Grassed						5																								
10%	**N10**	32.892	Paved	0	5				5	5.92	DN34	0	0	0		7.335	13.587																**N10**
			Supp.	0	2						N11	1.415	6.52	0.27																		
			Grassed	100	5				5																								
1%	**N10**	32.892	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	12.118	DN34	3.968	22.04	0.27		18.744	29.604																**N10**
			Grassed						5		N11	2.658	7.56	0.46																		
10%	**N11**	1.238	Paved	70	5				5	0.309						0.309	0.309																**N11**
			Supp.	0	2																												
			Grassed	30	5				5																								
1%	**N11**	1.238	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.528						0.528	0.528																**N11**
			Grassed						5																								
10%	**N12**	4.455	Paved	0	5				5	0.802						0.802	0.802																**N12**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N12**	4.455	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	1.641						1.641	1.641																**N12**
			Grassed						5																								
10%	**N13**	2.805	Paved	0	5				5	0.505	N12	1.328	6.29	0.26		1.833	1.212																**N13**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N13**	2.805	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	1.033	N12	2.365	7.15	0.42		3.398	2.536																**N13**
			Grassed						5																								
10%	**N15**	2.464	Paved	0	5				5	0.443	DN14	0	0	0		0.443	0.481																**N15**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N15**	2.464	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.908	DN14	0	0	0		0.908	1.003																**N15**
			Grassed						5																								
10%	**N16**	9.544	Paved	0	5				5	1.718	N20	0.094	2.07	0.09		1.812	15.398																**N16**
			Supp.	0	2						N24	0	0	0																		
			Grassed	100	5				5		DN36																						
											B1out																					
1%	**N16**	9.544	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	3.516	N20	0.161	2.52	0.13		3.677	32.703																**N16**
			Grassed						5		N24	0	0	0																		
											DN36																					
											B1out																					
10%	**N20**	0.56	Paved	0	5				5	0.101						0.101	0.101																**N20**
			Supp.	0	2																												
			Grassed	100	5				5																								
1%	**N20**	0.56	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.206						0.206	0.206																**N20**
			Grassed						5																								
10%	**HW37**	3.36	Paved	0	5				5	0.605	N16	0.039	1.59	0.07		1.366	0	0	5	2	100	0		0.5						631.18	632	0.82	**HW37**
			Supp.	0	2						N25	0.722	16.63	0.06																		
			Grassed	100	5				5																								
1%	**HW37**	3.36	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	1.238	N16	0.067	2.01	0.09		2.168	3.968	<- - - - - - - - - - - - as above - - - - - - - - - - - ->					0.5					632.15	632	-0.15	**HW37**
			Grassed						5		N25	0.863	17.31	0.07																		
10%	**N26**	24.578	Paved	0	5				5	4.423	HW37	0	0	0		4.509	16.279													629.96	629.2		**N26**
			Supp.	0	2						N28	0.086	1.47	0.12																		
			Grassed	100	5				5																								
1%	**N26**	24.578	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	9.055	HW37	0	0	0		9.203	34.466													630.41	629.2		**N26**
			Grassed						5		N28	0.148	1.8	0.16																		
10%	**N28**	1.274	Paved	70	5				5	0.318	N27	0.125	1.69	0.15		0.443	1.415																**N28**
			Supp.	0	2																												
			Grassed	30	5				5																								
1%	**N28**	1.274	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.544	N27	0.219	2.09	0.21		0.763	2.658																**N28**
			Grassed						5																								
10%	**N27**	1.324	Paved	70	5				5	0.33	N29	0.154	3.24	0.12		0.484	1.415																**N27**
			Supp.	0	2																												
			Grassed	30	5				5																								
1%	**N27**	1.324	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.565	N29	0.462	5.91	0.21		1.027	2.658																**N27**
			Grassed						5																								
10%	**N29**	1.652	Paved	70	5				5	0.412	N30	0.17	1.86	0.18		0.582	1.396																**N29**
			Supp.	0	2																												
			Grassed	30	5				5																								
1%	**N29**	1.652	Paved	<- - - - - - - - - - - -		as above		- - - - - - - - - - - ->	5	0.705	N30	0.348	2.43	0.29		1.053	2.658																**N29**
			Grassed						5																								
10%	**N30**	0.724	Paved	70	5				5	0.181	N31	0.226	2.52	0.18		0.407	1.328																**N30**
			Supp.	0	2																												
			Grassed	30	5				5																								

| | | |

Column 5: Percentages of paved, supplementary and grassed areas for ILSAX, or impervious and pervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model.
Column 6: Constant flow times for the paved, supplementary and grassed areas (minutes) for ILSAX, or impervious and impervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model.
Column 7: Lengths of paved, supplementary and grassed area flow path segments (m) for ILSAX, or impervious and impervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model.
Column 8: Slopes of paved, supplementary and grassed area flow path segments (%) for ILSAX, or impervious and impervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model.
Column 9: Roughnesses of paved, supplementary and grassed area flow path segments (Manning's values) for ILSAX, or impervious and impervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model."
Column 10: Total flow times for the paved, supplementary and grassed areas (minutes) for ILSAX, or impervious and pervious areas for the rational method and ERM, or effective impervious areas (EIAs),remaining impervious areas (RIAs) and pervious areas (PAs) for the IL-CL model.
For the rational methoid, it is the total catchment time of concentration.
Column 11: Peak Sub-Catchment Flowrate (m^3/s). For the rational method, the output indicates whether this is a full catchment or partial area estimate.
Column 12: Origin of Overflows, the names of any pits or nodes from which overflows come to the pit.
Column 13: Peak Overflows from upstream pits or nodes(m3/s), which may include flows from the sub-catchment through which they flow.
- not outputted for the rational method.)
Column 14: Approach Flow Width (m) - not outputted for the rational method.
Column 15: Approach Flow Depth x Velocity (m^2/s) - not outputted for the rational method.
Column 16: Inlet Family, in the DRAINS classification.
Column 17: Inlet Size, in the DRAINS classification.
Column 18: Total Approach Flow (m^3/s), sum of peaks of local sub-catchment runoff hydrograph plus overflow hydrographs directed to the pit.
(This will probably overestimate the true peak coming from additi0on of hydrographs.)
Column 19: Bypass Flow (m^3/s), the overflow occurring because of lack of inlet capacity or overflowing of the pipe system
Column 19a: Baseflow or Direct Inflow Peak (m^3/s), if present in the model; otherwise this column does not appear.
Column 20: Flow in Pipe (m^3/s).
Column 21: Pipe Length (mm).
Column 22: Pipe Slope (%).
Column 23: Pipe Diameter (mm) or Box Dimensions (m).
Column 24: Upstream Pipe Invert Level (m AHD).
Column 25: Downstream Pipe Invert Level (m AHD).
Column 26: Upstream Pipe Hydraulic Grade Line Level (inside the pipe) (m AHD).
Column 27: Downstream Pipe Hydraulic Grade Line Level (m AHD).
Column 28: Pipe Flow Velocity (m/s), for full or part-full flow.
Column 29: Pit Pressure Change Coefficient, the Ku value applying to the main line through the pit.
Column 29a: Chart Structure Number. If the QUDM method for determining Ku is applied, the number of the Chart in QUDM (2008) that is used to determine pit pressure change K factors is displayed.
If this is given as 'H-O'L' the equations in a paper by Hare and O'Loughlin are used.
Column 29b: Ratios used to define a K value from the appropriate QUDM chart, if teh QUDM method is applied.
Column 30: Water Surface Elevation (m AHD).
Column 31: Surface or Kerb and Channel (Kerb and Gutter) Obvert Level (m AHD).
Column 32: Freeboard (m), the difference between the levels in the two previous columns.
Column 33: Pit Name (repeated).

12 APPENDIX C – Concept Stormwater Management Plans

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PROPOSED INDUSTRIAL SUBDIVISION AT

LOTS 100–102 DP 1161331

WILSON DRIVE, MARULAN

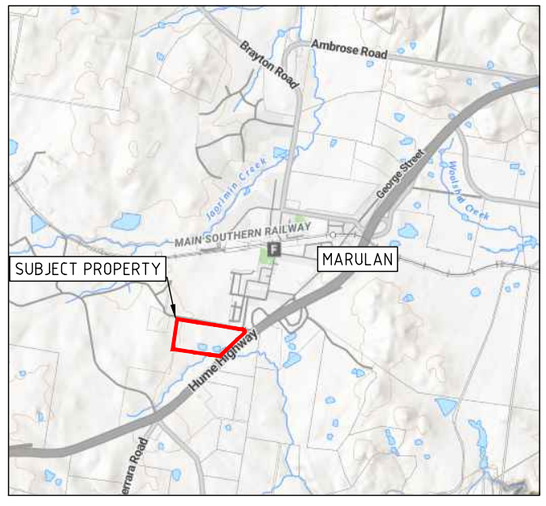
CONCEPT STORMWATER MANAGEMENT PLAN

DEVELOPMENT APPLICATION ISSUE

NOT FOR CONSTRUCTION

DRAWING SCHEDULE

SHEET NO.	DRAWING TITLE
WCMS00	TITLE SHEET, DRAWING SCHEDULE AND LOCALITY PLAN
WCMS01	CONCEPT STORMWATER MANAGEMENT SITE PLAN & WATER QUALITY MEASURES
WCMS02	CONCEPT STORMWATER CATCHMENT PLAN, OSD SUMMARY & DRAINS MODEL LAYOUT
WCMS03	CONCEPT STORMWATER TYPICAL SECTIONS & DETAILS
WCMS04	MUSIC MODEL LAYOUT & NORBE ASSESSMENT RESULTS
WCMS05	STORMWATER MANAGEMENT & WATER QUALITY DEVICES MAINTENANCE CHECKLISTS
WCMS06	BIORETENTION BASIN 1 & OSD1/2 DETAIL PLAN & TYPICAL SECTION
WCMS07	DETENTION BASIN OSD1 TYPICAL SECTIONS & DETAILS
WCMS08	DETENTION BASIN OSD2 TYPICAL SECTIONS & DETAILS
WCMS09	BIORETENTION BASIN 1 TYPICAL SECTIONS & DETAILS
WCMS10	BIORETENTION BASIN 2 DETAIL PLAN & TYPICAL SECTION
WCMS11	BIORETENTION BASIN 2 TYPICAL SECTIONS & DETAILS
WCMS12	ATLAN VORTCEPTOR GPT DETAIL PLANS
WCMS13	CONCEPT BIORETENTION BASIN 1 LANDSCAPE PLAN
WCMS14	CONCEPT BIORETENTION BASIN 2 LANDSCAPE PLAN
SWMP01	CONCEPT SOIL & WATER MANAGEMENT NOTES, CALCULATIONS & GENERAL INSTRUCTIONS
SWMP02	CONCEPT SOIL & WATER MANAGEMENT PLAN
SWMP03	CONCEPT SOIL & WATER MANAGEMENT TYPICAL DETAILS
SWMP04	CONCEPT SOIL & WATER MANAGEMENT STANDARD DRAWINGS SHEET 1 OF 3
SWMP05	CONCEPT SOIL & WATER MANAGEMENT STANDARD DRAWINGS SHEET 2 OF 3
SWMP06	CONCEPT SOIL & WATER MANAGEMENT STANDARD DRAWINGS SHEET 3 OF 3



LOCALITY PLAN

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.

SCALE: (on A1 Original)

DA

North

CLIENT

CITYWEST CORP R/L
ATF THE COPULOS
(SUNSHINE) U/T

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PROJECT TITLE

PROPOSED SUBDIVISION
LOTS 100–102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE

TITLE SHEET, DRAWING SCHEDULE & LOCALITY PLAN

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS00	11

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Plot Date: Wednesday, 3 September 2025 5:55:05 PM CAD File Name: O:\21000286 Lots 100–102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg

NOTE

THIS REPORT HAS BEEN DEVELOPED BASED ON AGREED REQUIREMENTS AS UNDERSTOOD BY SEEC AT THE TIME OF INVESTIGATION. IT APPLIES ONLY TO A SPECIFIC TASK ON THE NOMINATED LANDS. OTHER INTERPRETATIONS SHOULD NOT BE MADE, INCLUDING CHANGES IN SCALE OR APPLICATION TO OTHER PROJECTS. ANY RECOMMENDATIONS CONTAINED IN THIS ASSESSMENT ARE BASED ON AN HONEST APPRAISAL OF THE OPPORTUNITIES AND CONSTRAINTS THAT EXISTED AT THE SITE AT THE TIME OF INVESTIGATION, SUBJECT TO THE LIMITED SCOPE AND RESOURCES AVAILABLE. WITHIN THE CONFINES OF THE ABOVE STATEMENTS AND TO THE BEST OF MY KNOWLEDGE, THIS ASSESSMENT DOES NOT CONTAIN ANY INCOMPLETE OR MISLEADING INFORMATION.

STORMWATER DESIGN SUMMARY

GENERAL

1. IT IS THE CONTRACTORS RESPONSIBILITY TO LOCATE & LEVEL ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS.
2. ALL PIPES TO HAVE MIN 300mm COVER IF LOCATED WITHIN PROPERTY.
3. ALL WORK TO BE DONE IN ACCORDANCE WITH AS/NZ 3500.3 AND GOULBURN MULWAREE COUNCIL SPECIFICATIONS.
4. SURVEY INFORMATION WITHIN THE PROPERTY PROVIDED BY ALLAN PRICE & SCARRATTS PTY LTD. CONTOURS FOR UPSLOPE CATCHMENTS & NEIGHBOURING PROPERTIES OBTAINED FROM ELVIS LIDAR DATA. LEVELS SHOWN ARE TO AN ASSUMED DATUM AND TO BE CONFIRMED PRIOR TO CONSTRUCTION.
5. REFER TO THE ACCOMPANYING 'DRAINS' MODEL FOR STORMWATER DRAINAGE CALCULATIONS.
6. FUTURE DEVELOPMENTS WITHIN THE PROPOSED LOTS ARE TO PROVIDE ON SITE DETENTION AND TREATMENT TO BE APPROVED WITH EACH RESPECTIVE DEVELOPMENT APPLICATION
7. IF ANY CHANGES ARE REQUIRED TO THE PLANS DURING CONSTRUCTION DUE TO UNFORESEEN SITE CONSTRAINTS, THE DESIGN ENGINEER IS TO BE CONTACTED IMMEDIATELY.

LOCATION OF STRUCTURES

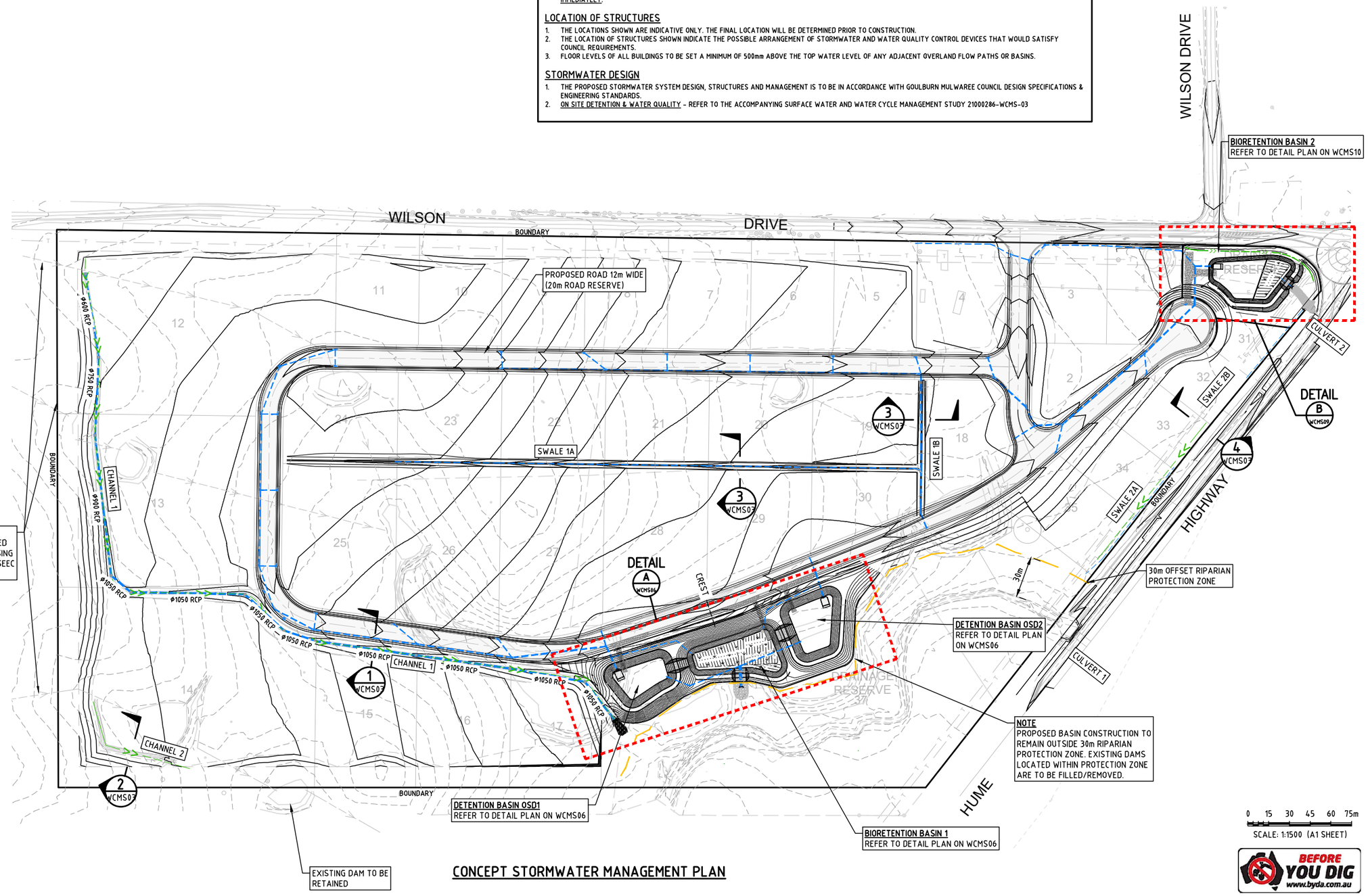
1. THE LOCATIONS SHOWN ARE INDICATIVE ONLY. THE FINAL LOCATION WILL BE DETERMINED PRIOR TO CONSTRUCTION.
2. THE LOCATION OF STRUCTURES SHOWN INDICATE THE POSSIBLE ARRANGEMENT OF STORMWATER AND WATER QUALITY CONTROL DEVICES THAT WOULD SATISFY COUNCIL REQUIREMENTS.
3. FLOOR LEVELS OF ALL BUILDINGS TO BE SET A MINIMUM OF 500mm ABOVE THE TOP WATER LEVEL OF ANY ADJACENT OVERLAND FLOW PATHS OR BASINS.

STORMWATER DESIGN

1. THE PROPOSED STORMWATER SYSTEM DESIGN, STRUCTURES AND MANAGEMENT IS TO BE IN ACCORDANCE WITH GOULBURN MULWAREE COUNCIL DESIGN SPECIFICATIONS & ENGINEERING STANDARDS.
2. ON SITE DETENTION & WATER QUALITY – REFER TO THE ACCOMPANYING SURFACE WATER AND WATER CYCLE MANAGEMENT STUDY 21000286-WCMS-03

LEGEND:

- BOUNDARY LINE
- PROPOSED ROAD
- × RL 622.26 — PROPOSED LEVEL
- STORMWATER DRAINAGE PIPE
- INTERALLOTMENT PIT
- CONCRETE COVER JUNCTION PIT
- KERB INLET PIT
- ROCK ENERGY DISSIPATOR
- DIRECTION OF SURFACE WATER FLOW
- OSD/BIORETENTION BASIN
- BIORETENTION FILTER AREA
- PROPOSED DRAINAGE CHANNEL
- EXISTING SURFACE WATER FLOW PATH



CONCEPT STORMWATER MANAGEMENT PLAN

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
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04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:1500
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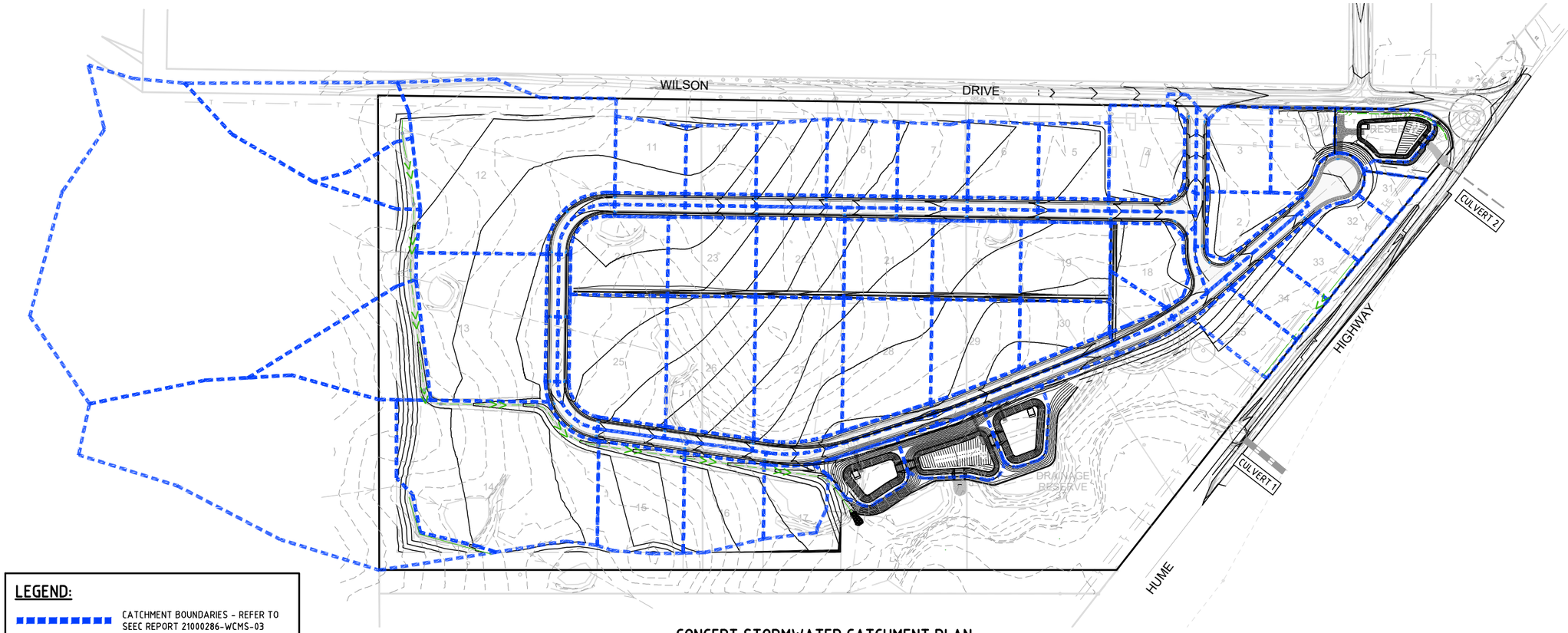
PROJECT TITLE: PROPOSED SUBDIVISION LOTS 100–102 DP 1161331 WILSON DR, MARULAN

DRAWING TITLE: CONCEPT STORMWATER MANAGEMENT SITE PLAN & WATER QUALITY MEASURES

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS01	11

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LEGEND:

CATCHMENT BOUNDARIES - REFER TO SEEC REPORT 21000286-WCMS-03

CONCEPT STORMWATER CATCHMENT PLAN

0 20 40 60 80 100m

SCALE: 1:2000 (A1 SHEET)

OSD CALCULATIONS SUMMARY

SITE DETAILS

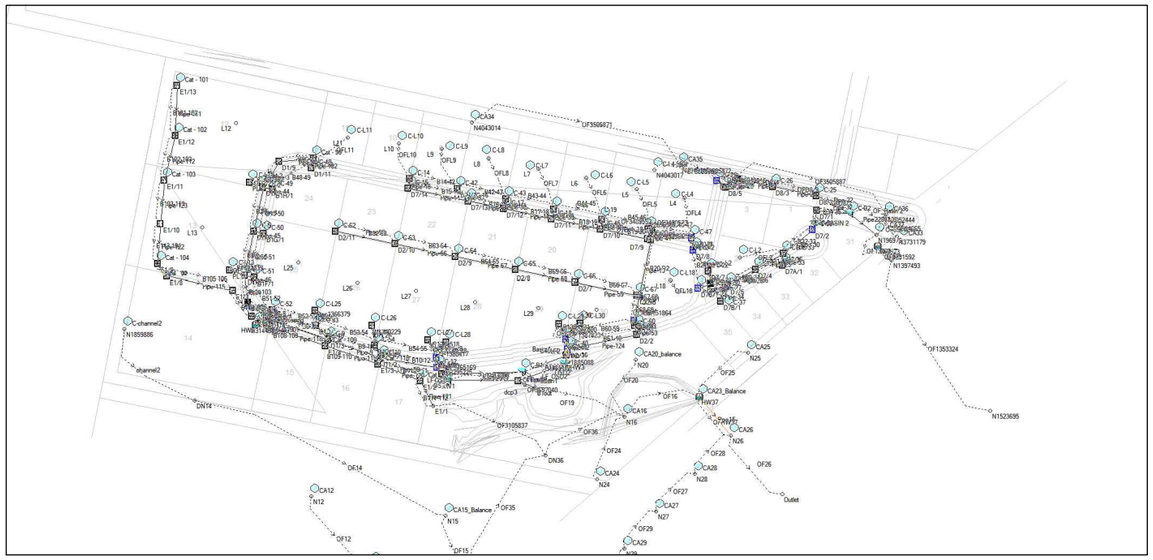
TOTAL SITE AREA	= 31.0 Ha
PRE-DEVELOPMENT IMPERVIOUS AREA	= 0%
POST DEVELOPMENT IMPERVIOUS AREA	= 8.0%

PRE- & POST-DEVELOPMENT DISCHARGE & STORAGE VOLUMES

PRE- AND POST-DEVELOPED FLOWS AT CULVERTS 1 & 2 ARE COMPARED FOR THE 10-YEAR (MINOR) AND 100-YEAR (MAJOR) STORM EVENTS.

	CULVERT 1	CULVERT 2
PRE-DEVELOPMENT Q_{10YR}	= 11.72 m^3/s	= 0.415 m^3/s
POST-DEVELOPMENT Q_{10YR}	= 11.17 m^3/s	= 0.307 m^3/s
PRE-DEVELOPMENT Q_{100YR}	= 26.33 m^3/s	= 0.917 m^3/s
POST-DEVELOPMENT Q_{100YR}	= 24.58 m^3/s	= 0.817 m^3/s

REFER TO THE ACCOMPANYING SURFACE WATER & WATER CYCLE MANAGEMENT REPORT & 'DRAINS' MODEL FOR DETAILED CALCULATIONS.



'DRAINS' MODEL LAYOUT

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DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:2000
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PROJECT TITLE

PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

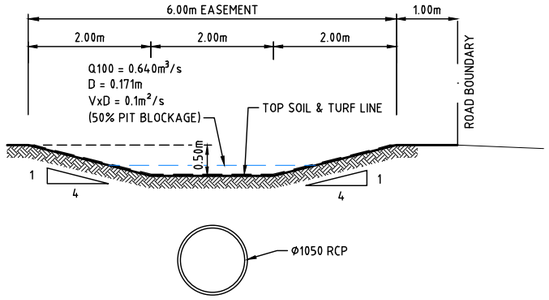
DRAWING TITLE

CONCEPT STORMWATER CATCHMENT PLAN, OSD SUMMARY & DRAINS MODEL LAYOUT

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS02	11

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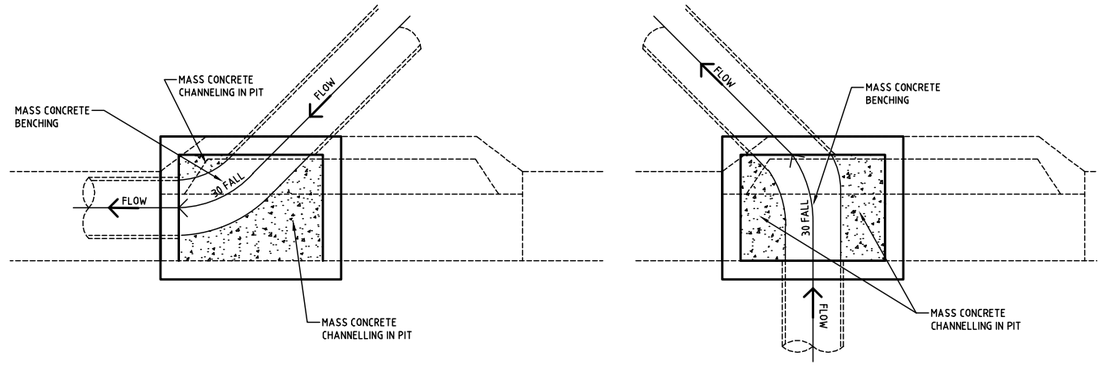
TYPICAL SECTION THROUGH CHANNEL 1

SECTION 1 WCMS07

SCALE: 1:50

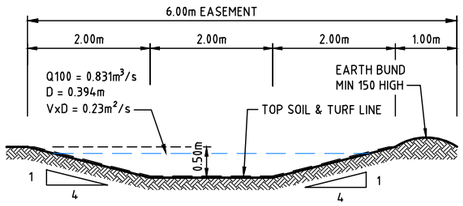
STORMWATER PIT NOTES

1. PIT GRATE AND FRAME TO BE 'WELDLOK' GG78-42A FOR INDUSTRIAL ROADS, FITTED WITH A LOCKABLE 'J' BOLT
2. ALL LINTELS TO BE APPROVED PRECAST TYPE. DIMENSIONS SHOWN ON PLAN TO DENOTE CLEAR OPENINGS.
3. COMPRESSIVE STRENGTH (FC) FOR CAST INSITU CONCRETE SHALL BE A MINIMUM 25MPa AT 28 DAYS.
4. ø100mm SUBSOIL DRAINAGE PIPE 3m LONG WRAPPED IN FABRIC SOCK TO BE PROVIDED ADJACENT TO INLET PIPES.
5. DETAILS REFER TO PITS CONSTRUCTED ADJACENT TO FLEXIBLE PAVEMENTS. TOTAL ISOLATION OF PITS IS REQUIRED ADJACENT TO RIGID PAVEMENTS.
6. ALL PITS TO BE ADEQUATELY STREAMLINED AND BENCHED.
7. GRATES TO BE PROVIDED WITH ADEQUATE LOCKING CLIPS TO 'J' BOLTS.
8. REINFORCING FABRIC: SL82 MESH IS TO BE PLACED CENTRALLY IN ALL PITS GREATER THAN 1500mm DEEP. REINFORCEMENT IS TO BE CONTINUOUS THROUGH ALL WALLS AND BASE. MESH CAN BE BENT AT CORNERS OR JOINED BY N12 'L' BARS (300 LEGS) AT 400 CENTRES. COVER ON STEEL IS 40 UNLESS SHOWN OTHERWISE
9. ALL PITS TO CONFORM TO GMC STANDARD DRAWING SD-D11.
10. PITS DEEPER THAN 600mm SHALL HAVE CLIMB IRONS IN ACCORDANCE WITH GMC STANDARD DRAWING SD-D11.
11. PITS DEEPER THAN 2.0m ARE TO BE DESIGNED BY A PROFESSIONAL STRUCTURAL ENGINEER.
12. WHERE EXTENDED CHAMBER WIDTH EXCEEDS 1200mm, ROOF REINFORCEMENT TO BE DESIGNED BY A PROFESSIONAL STRUCTURAL ENGINEER.
13. ALL HEADWALLS TO BE PRECAST TYPE TO SUIT THE RELEVANT PIPE SIZE REQUIRED U.N.O. ALL CULVERT INLETS AND OUTLETS TO HAVE MIN. 150ø ROCK RIP-RAP SCOUR PROTECTION WITH NON-WOVEN GEOTEXTILE UNDERLAY U.N.O.



TYPICAL PIT BENCHING AND CHANNELLING FOR ENTRY PIPES NOT ENTERING PIT AT 90°

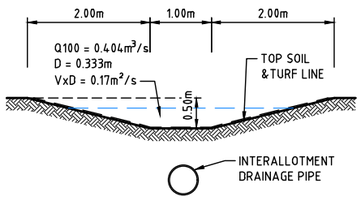
SCALE 1:20



TYPICAL SECTION THROUGH CHANNEL 2

SECTION 2 WCMS07

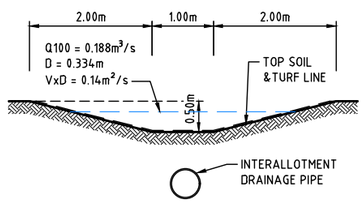
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TYPICAL SECTION THROUGH SWALE 1A & 1B

SECTION 3 WCMS07

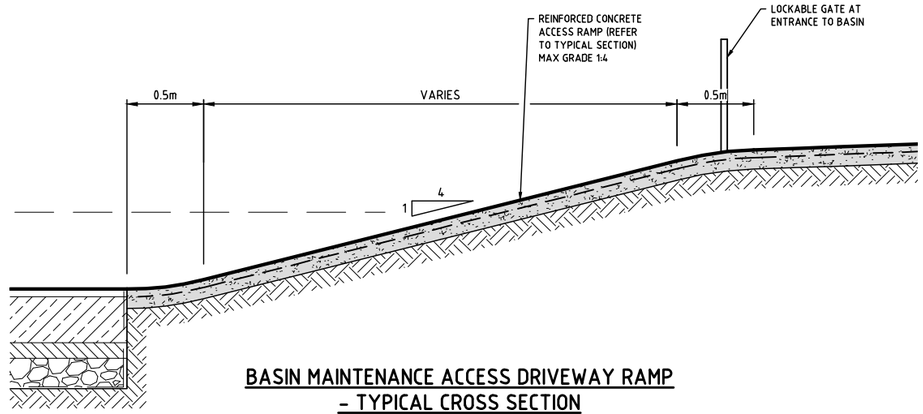
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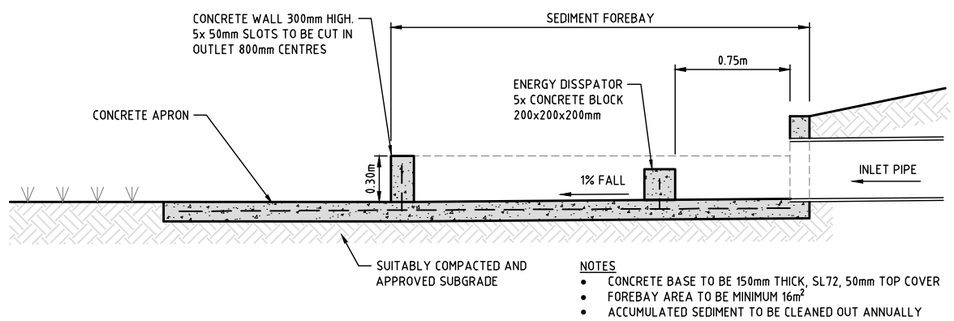
TYPICAL SECTION THROUGH SWALE 2A & 2B

SECTION 4 WCMS07

SCALE: 1:50

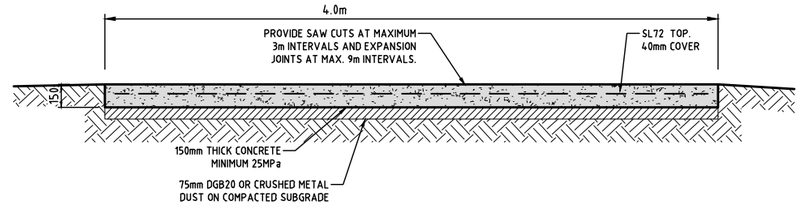


BASIN MAINTENANCE ACCESS DRIVEWAY RAMP - TYPICAL CROSS SECTION

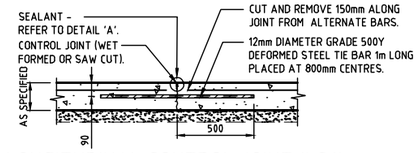


NOTES
- CONCRETE BASE TO BE 150mm THICK, SL72, 50mm TOP COVER
- FOREBAY AREA TO BE MINIMUM 16m²
- ACCUMULATED SEDIMENT TO BE CLEANED OUT ANNUALLY

SEDIMENT FOREBAY TYPICAL DETAIL



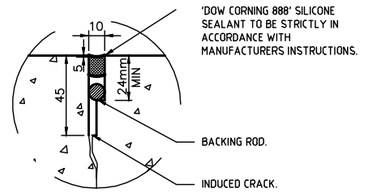
BASIN MAINTENANCE ACCESS DRIVEWAY - TYPICAL CROSS SECTION



LONGITUDINAL CONTROL JOINT 'LCJ'

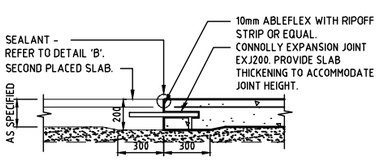
SCALE 1:20 (A1 SHEET)

1. JOINT TO BE SAWN AS SOON AS CONCRETE HAS HARDENED SUFFICIENTLY THAT IT WILL NOT BE DAMAGED BY SAWING (MAX. 24HRS).



DETAIL 'A' - PAVEMENT SEALANT

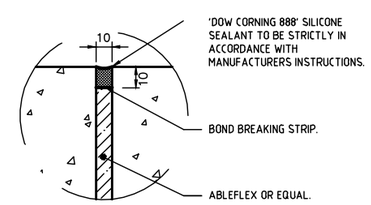
N.T.S



EXPANSION/CONSTRUCTION JOINT 'EJ'

SCALE 1:20 (A1 SHEET)

1. EXPANSION JOINT TO BE USED AS A 'STOP POUR' JOINT.
2. PROVIDE AN EXPANSION JOINT (EJ) AT MAXIMUM 15m INTERVALS.



DETAIL 'B' - PAVEMENT SEALANT

N.T.S

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DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	
DA	

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PROJECT TITLE: PROPOSED SUBDIVISION LOTS 100-102 DP 1161331 WILSON DR, MARULAN

DRAWING TITLE: CONCEPT STORMWATER TYPICAL SECTIONS & DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS03	11

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TABLE 2 - MUSIC RESULTS - MEAN ANNUAL LOADS

	Inflow	
	Pre	Post
Flow (ML/yr)	19.1	37.8
Total Suspended Solids (kg/yr)	1.66E3	383
Total Phosphorus (kg/yr)	8.44	3.47
Total Nitrogen (kg/yr)	49.9	41.5
Gross Pollutants (kg/yr)	5.12	0.00

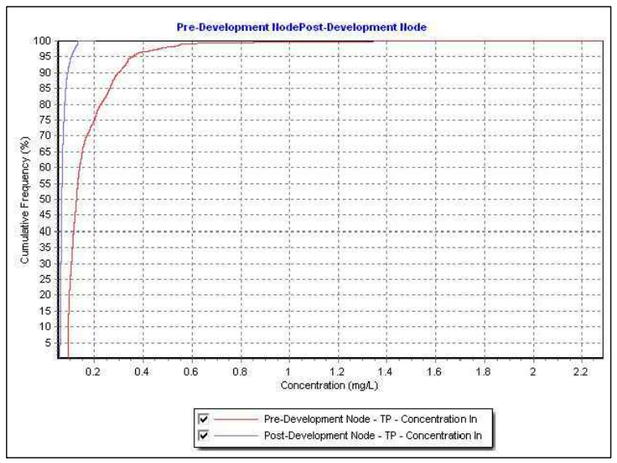


FIGURE 2 - MUSIC RESULTS - TP CONCENTRATIONS

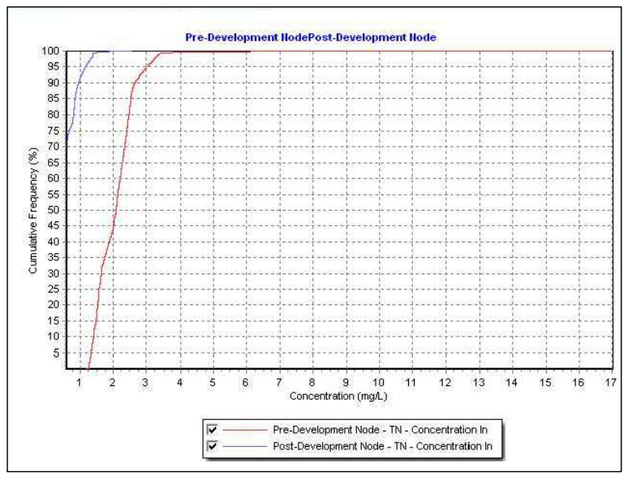


FIGURE 3 - MUSIC RESULTS - TN CONCENTRATIONS

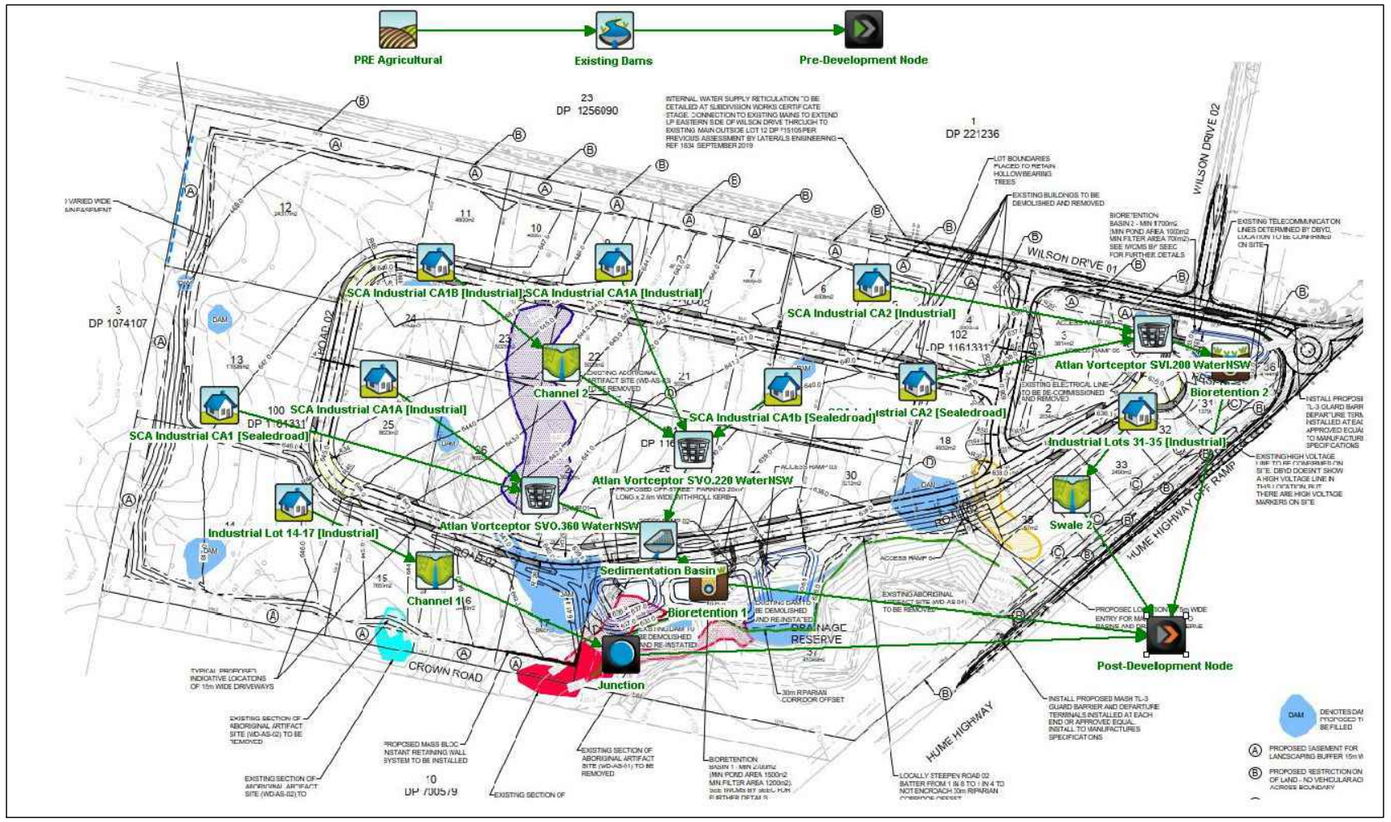


FIGURE 4 - MUSIC MODEL SCHEMATIC
MUSIC MODEL RUN - "21286_MUSIC_10.sqz"

NOTE:
FOR ASSUMPTIONS MADE IN THE MUSIC MODEL REFER TO THE ACCOMPANYING REPORT 21000286_WCMS_REV03.

NorBE Assessment

The results of the MUSIC modelling show:

- A clear benefit to water quality in terms of Mean Annual Loads
- A clear benefit to water quality in terms of Total Phosphorous concentrations
- A clear benefit to water quality in terms of Total Nitrogen concentrations.

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DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	N.T.S.

DA

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PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
MUSIC MODEL LAYOUT &
NORBE ASSESSMENT RESULTS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS04	11

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TABLE 3 - PIT AND PIPE MAINTENANCE

Stormwater Pit & Pipe Maintenance Checklist					
Frequency:	Annual				
Location					
Site Inspection by:	Name and signature:		Date:		
Pit Inspected					
Instructions:	Fill out the inspection checklist below. Every row must have a tick. If there is a tick placed in a shaded box action is required.				
Inspection items	**Y**	**N**	**Action required**		
Is there debris surrounding the pit?			Remove debris and place material in garbage or on site compost before opening the pit cover.	Actioned By: Date	
Is there litter and debris in the pit?			Remove it and dispose it in garbage collection bin.	Actioned By: Date	
Is the access cover to the pit closed?			Secure any access covers to prevent risk of entry.	Actioned By: Date	
Is water ponding in the base of the pit?			Water ponding in pit may be a sign of a pipe blockage. Plumber will be required to investigate.	Actioned By: Date	
For kerb inlet pits, is the lintel blocked with litter or debris?			Remove it and dispose it in garbage collection bin.	Actioned By: Date	
Are outlet pipes blocked?			Remove blockage from outlet pipes by flushing pits and removing debris. Debris to be disposed of in the garbage collection bin.	Actioned By: Date	
For pits fitted with in-pit filtration devices					
Is there damage to baskets, holes in filter mesh?			Replace/mend damaged baskets.	Actioned By: Date	
Is there damage to frame or seals?			Replace/mend damage.	Actioned By: Date	
Is there litter and debris in the filter basket?			Remove it and dispose it in garbage collection bin.	Actioned By: Date	
Is the overflow by-pass blocked?			Remove blockage.	Actioned By: Date	
Additional comments:					

TABLE 4 - BIORETENTION BASIN MAINTENANCE CHECKLIST

Raingarden/Bioretention Basin Maintenance Checklist					
Frequency:	Quarterly and after 20 mm of rainfall.		Date:		
Site Inspection by:					
Instructions:	Fill out the inspection checklist below. Every row must have a tick. If there is a tick placed in a shaded box action is required.				
Inspection items	**Y**	**N**	**Possible Actions**		
Litter on surface?			Remove litter to Council garbage collection	Actioned By: Date	
Sediment accumulation at inflow points?			Remove sediment and ensure inflow point is stabilised with gravel as necessary	Actioned By: Date	
Any weeds?			Remove the weeds	Actioned By: Date	
Any dead or dying plants?			Any plants that might be sick or have died should be replaced with native plants that are efficient in nutrient removal. Species such as Carex and Juncus (a local nursery can help).	Actioned By: Date	
Any erosion at inlet?			Consider placing a new manifold at end of pipe or drain onto rocks.	Actioned By: Date	
Is the gravel mulch intact?			Replace gravel layer with 10-20mm aggregate gravel to achieve a depth of 50 mm.	Actioned By: Date	
Is the vegetation too dense (at least 15 percent of the surface should be clear)?			Remove excess vegetation.	Actioned By: Date	
Is the high-flow outlet/weir clear of debris?			Remove debris and place in Council garbage collection or on compost heap.	Actioned By: Date	
Is there a cake of sediment on the surface more than 5 mm thick?			Remove it and dispose it appropriately	Actioned By: Date	
Are the subsoil drains clear (flush them via the inspection ports)			Flush pipes and re-test. Seek professional advice if necessary	Actioned By: Date	
NOTE: Water should not pond on the bioretention basin surface for more than 24 hours after rainfall ceases.					
Is there sediment in the outlet pit?			Remove it.	Actioned By: Date	
Is there oil on the surface?			Remove it and investigate why. Is it a one-off event or is there a concentrated source?	Actioned By: Date	
Are the information protective structures and the informative signs intact and readable?			Repair/replace as necessary	Actioned By: Date	
Additional comments:					

TABLE 5 - RAINWATER COLLECTION SYSTEM MAINTENANCE CHECKLIST

Rainwater Tank/Collection System Maintenance Checklist - Table 5					
Site Inspection by:	Name and signature:		Date:		
Instructions:	Fill out the inspection checklist below. Every row must have a tick. If there is a tick placed in a shaded box action is required.				
Inspection items	**Frequency**	**Y**	**N**	**Possible Actions**	
Are the gutters full of debris or ponding?	**Every 3 months**			Clean leaves from gutters - remove more regularly if required. If water is ponding, repair gutter to ensure water flows to downpipe. Ideally install gutter-guards.	Actioned By: Date
Are there any tree branches overhanging the roof or are likely to grow to overhang the roof?	**Annual**			If safe and where permitted, consider pruning back and overhanging branches.	Actioned By: Date
Are access covers to the storage tank sealed/closed?	**Annual**			Secure any open access covers to prevent risk of entry.	Actioned By: Date
Are the screens on inlet, outlets, overflows and other openings do not have holes, are clear of debris and are securely fastened?	**Annual**			Remove litter and clear screens. Place debris in waste receptacle. Repair and defective screens to keep out mosquitoes.	Actioned By: Date
Inspect tank water. Is there the presence of rats, birds, frogs, lizards or other vermin or insects?	**Annual**			Remove any infestations, identify point of entry and close. Vermin and insect-proof mesh.	Actioned By: Date
Is there a mosquito problem?	**Annual**			Seek professional advice on eradication of mosquitoes in the rainwater tank. Identify point of entry and close with insect-proof mesh with holes no greater than 1.6mm in diameter.	Actioned By: Date
Is the roof and coatings in poor condition?	**Annual**			Repair any leaks as necessary.	Actioned By: Date
Are the suction strainers, in-line strainers and pump location full of debris?	**Annual**			Replace or repair the missing or damaged signage to fittings. Clean suction strainers, in-line strainers and debris from pump location.	Actioned By: Date
Is signage at external roof water taps and any removable handle taps being properly used?	**Annual**			Replace or repair the missing or damaged signage to fittings.	Actioned By: Date
Are all plumbing and pump connections watertight/without leakage?	**Annual**			Secure any open access covers to prevent risk of entry.	Actioned By: Date
Is the backflow prevention valve operational?	**Annual**			Service the back-flow prevention valves annually in compliance with AS/NZS 2845.1:2010.	Actioned By: Date
Is the mains supply valve operational?	**Annual**			Service the mains supply valves annually (the tanks are supplied with mains water if the storage level falls below 5 precent)	Actioned By: Date
Is the rainwater tank overflow to the bioretention basin stable, any erosion present?	**Annual**			Consider placing additional rock at outlet to dissipate outcoming flows.	Actioned By: Date
Drain, clean out and check condition of the tank walls and roof to ensure no holes have arisen due to tank deterioration.	**Triennial**			Due to access and safety, it is recommended that professionals are called to repair the rainwater tanks as required.	Actioned By: Date
Every three-years check tanks for sludge accumulation. Is excessive sludge (>5 mm) present?	**Triennial**			Due to access and safety, it is recommended that professionals are called to de-sludge the rainwater tanks every three years (place the sludge over a well-vegetated area away from any concentrated flow).	Actioned By: Date
Additional comments:					

Water Quality Maintenance

Pits and Pipes: The various pits and pipes in the road require periodic maintenance. Undertake the works described in Table 3. Initially the developer will maintain the pits and pipes but ultimately they would pass the work onto council.

The Bioretention Basins (Raingarden): The bioretention basins are designed to filter rainwater derived from the development. For maintenance, undertake the works described in Table 4. The developer would be required to look after the bioretention basins for a period of time before handing over to Council.

Rainwater Collection System: The individual lot owner would look after their own rainwater collection systems (gutters and tanks). Undertake the maintenance work described in Table 5.

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	N.T.S.

DA

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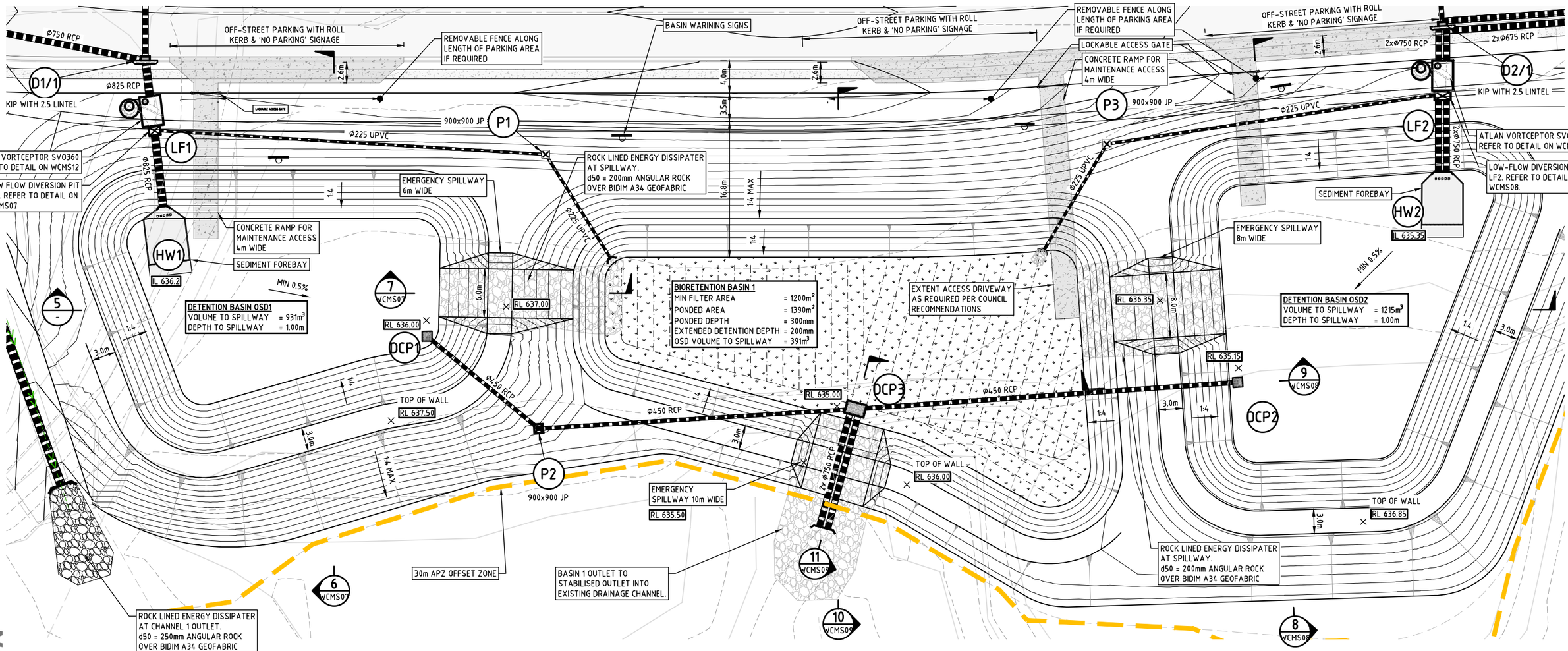
PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
STORMWATER MANAGEMENT
& WATER QUALITY DEVICES
MAINTENANCE CHECKLISTS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS05	11

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Plot Date: Wednesday, 3 September 2025 5:55:21 PM CAD File Name: O:\21000286 Lots 100-102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg



BIORETENTION BASIN 1 & ONSITE DETENTION BASIN OSD1 & OSD2 DETAIL PLAN

0 2.5 5 7.5 10 12.5m

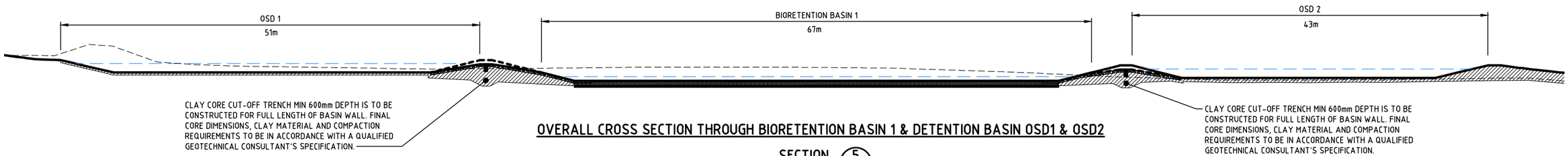
SCALE: 1:250 (A1 SHEET)

LEGEND:

- BOUNDARY LINE
- PROPOSED ROAD
- × RL 622.26 PROPOSED LEVEL
- STORMWATER DRAINAGE PIPE
- GRATED INLET PIT
- BASIN WARNING SIGN
- CONCRETE COVER JUNCTION PIT
- KERB INLET PIT
- ROCK ENERGY DISSIPATOR
- OSD/BIORETENTION BASIN
- BIORETENTION FILTER AREA

BASIN CONSTRUCTION NOTE

1. BASIN LAYOUT & CROSS SECTIONS ARE INDICATIVE ONLY. A GEOTECHNICAL CONSULTANT IS TO BE ENGAGED TO ADVISE ON THE FINAL BASIN WALL CONSTRUCTION AND SUITABILITY OF THE EXISTING SUB-SOILS FOR STRUCTURAL ADEQUACY AND WATER HOLDING ABILITY.
2. REFER TO CIVIL PLANS BY ALLAN PRICE DEVELOPMENT CONSULTANTS FOR ACCESS DRIVEWAY PROFILES



OVERALL CROSS SECTION THROUGH BIORETENTION BASIN 1 & DETENTION BASIN OSD1 & OSD2

SECTION 5 / - SCALE: 1:20

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:250

DA

North

CLIENT: CITYWEST CORP R/L ATF THE COPULOS (SUNSHINE) U/T

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(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE: PROPOSED SUBDIVISION LOTS 100–102 DP 1161331 WILSON DR, MARULAN

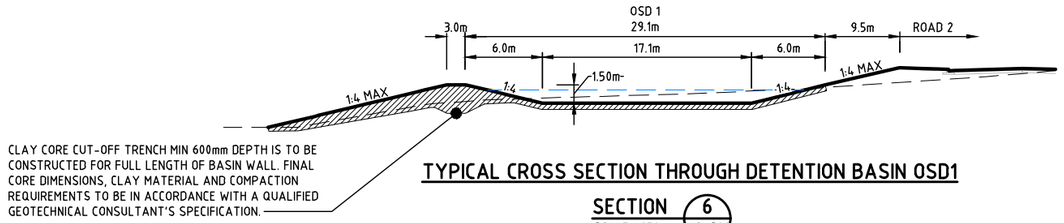
DRAWING TITLE: BIORETENTION BASIN 1 & DETENTION BASIN OSD1 & OSD2 DETAIL PLAN

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS06	11

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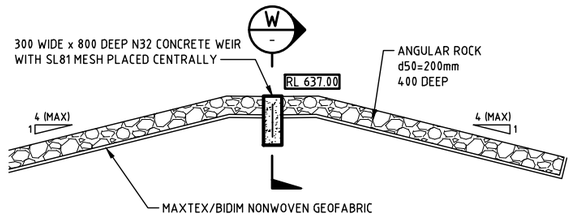
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BASIN CONSTRUCTION NOTE
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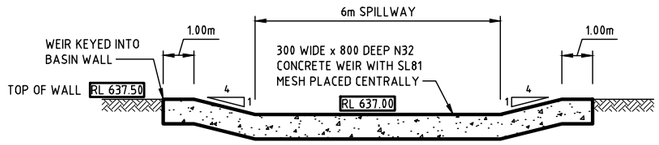


TYPICAL CROSS SECTION THROUGH DETENTION BASIN OSD1

SECTION 6 WCMS06
SCALE: 1:250



OSD1 CONCRETE SPILLWAY WEIR - TYPICAL SECTION



OSD1 CONCRETE SPILLWAY WEIR - TYPICAL SECTION

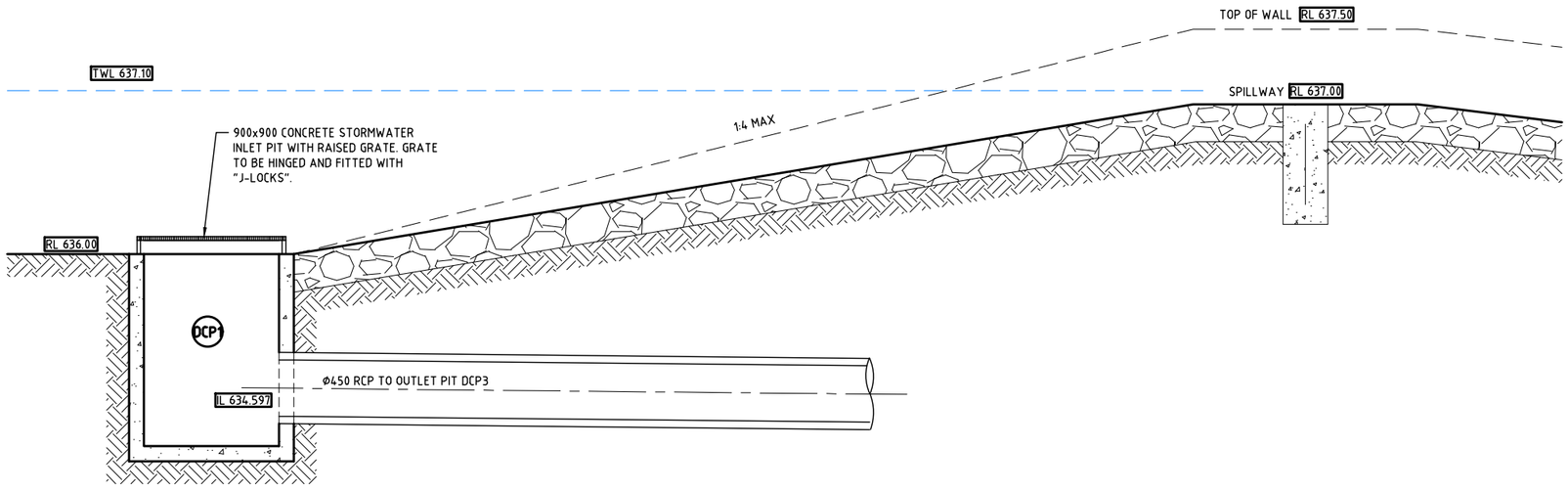
SECTION W -
SCALE: 1:100



NOTE:
SIGN SHALL BE PLACED IN A CLEAR AND VISIBLE LOCATION IN THE VICINITY OF THE BIORETENTION BASIN.

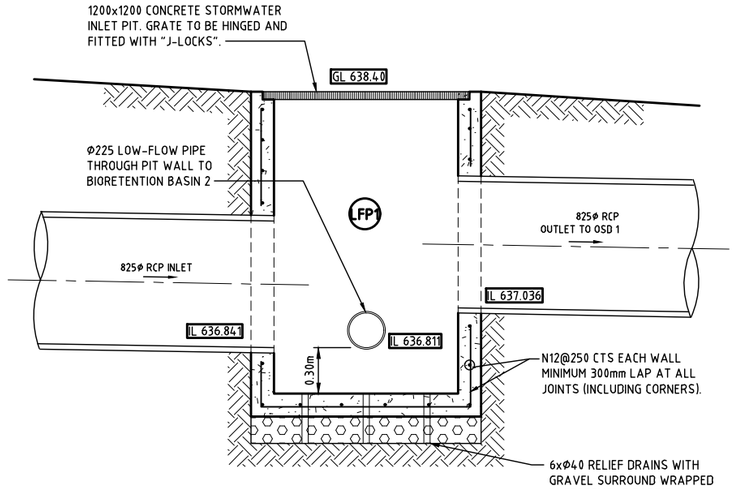
COLOURS:
TRIANGLE AND 'WARNING' - RED
WATER - BLUE
FIGURE AND OTHER LETTERING - BLACK

BIORETENTION WARNING SIGN DETAILS



DETENTION BASIN OSD1 OUTLET DETAIL

SECTION 7 WCMS06
SCALE: 1:20



OSD1 LOW-FLOW DIVERSION PIT

0 0.2 0.4 0.6 0.8 1.0m
SCALE: 1:20 (A1 SHEET)

0 0.5 1 1.5 2 2.5m
SCALE: 1:50 (A1 SHEET)

0 1 2 3 4 5m
SCALE: 1:100 (A1 SHEET)

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
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05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.

SCALE: (on A1 Original)
DA

North

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(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

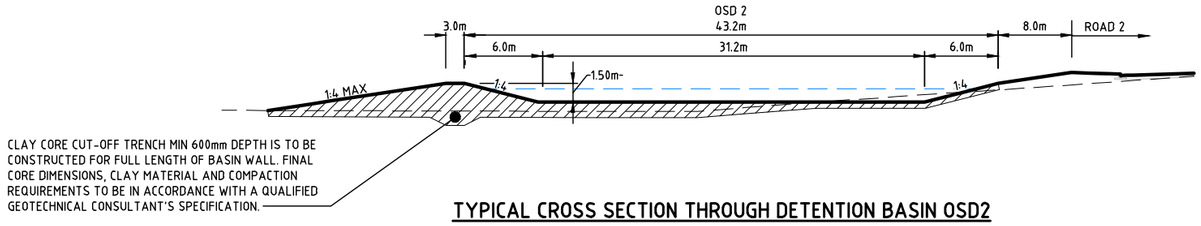
DRAWING TITLE
DETENTION BASIN OSD1
TYPICAL SECTIONS & DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS07	11

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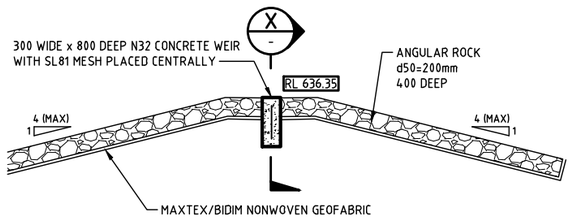
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BASIN CONSTRUCTION NOTE
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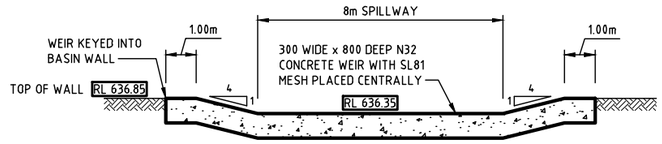


TYPICAL CROSS SECTION THROUGH DETENTION BASIN OSD2

SECTION 8 / WCMS06
SCALE: 1:250



OSD2 CONCRETE SPILLWAY WEIR - TYPICAL SECTION



OSD2 CONCRETE SPILLWAY WEIR - TYPICAL SECTION

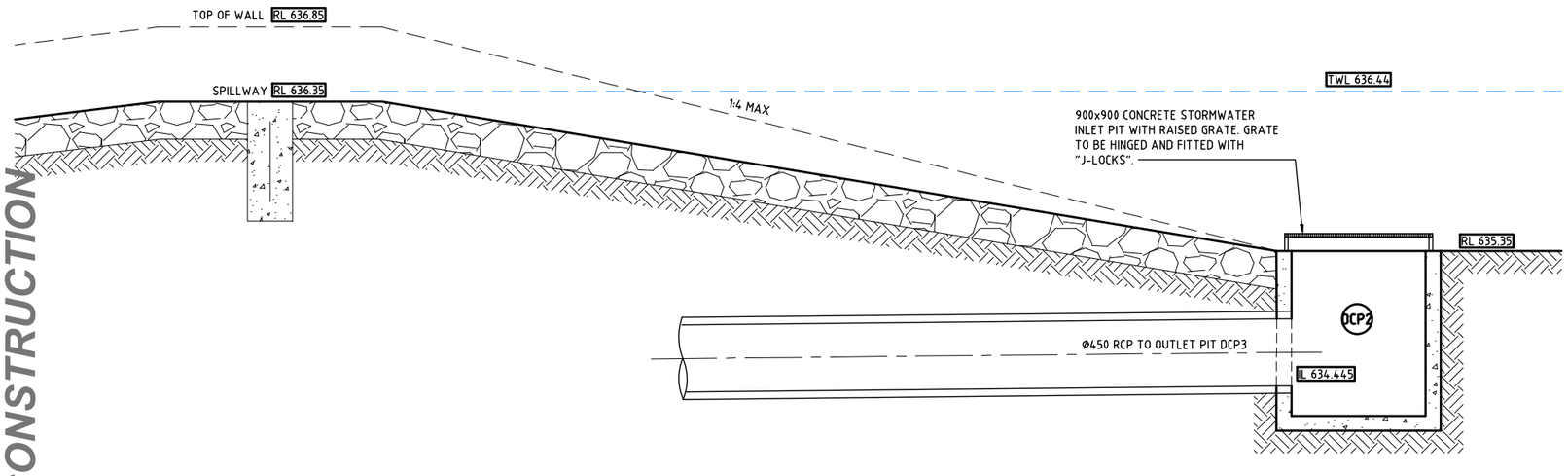
SECTION X / -
SCALE: 1:100



NOTE:
SIGN SHALL BE PLACED IN A CLEAR AND VISIBLE LOCATION IN THE VICINITY OF THE BIORETENTION BASIN.

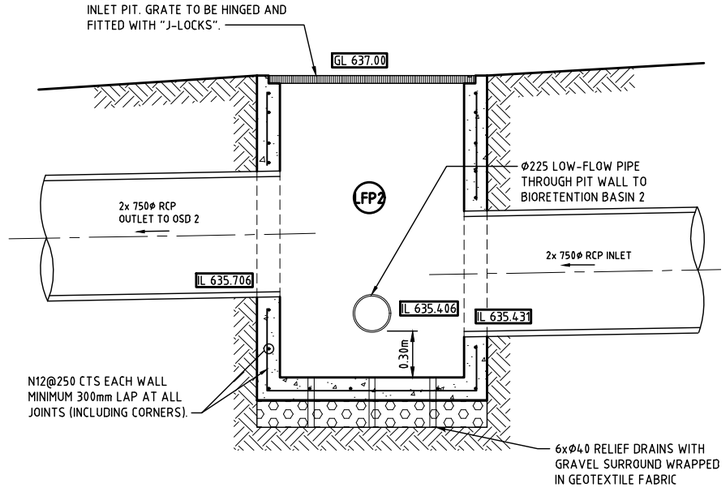
COLOURS:
TRIANGLE AND 'WARNING' - RED
WATER - BLUE
FIGURE AND OTHER LETTERING - BLACK

BIORETENTION WARNING SIGN DETAILS



DETENTION BASIN OSD2 OUTLET DETAIL

SECTION 9 / WCMS06
SCALE: 1:20



OSD2 LOW-FLOW DIVERSION PIT

0 0.2 0.4 0.6 0.8 1.0m
SCALE: 1:20 (A1 SHEET)

0 0.5 1 1.5 2 2.5m
SCALE: 1:50 (A1 SHEET)

0 1 2 3 4 5m
SCALE: 1:100 (A1 SHEET)

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	
DA	

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(f) 02 4862 3088
email: reception@seec.com.au
WWW.SEEC.COM.AU

PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

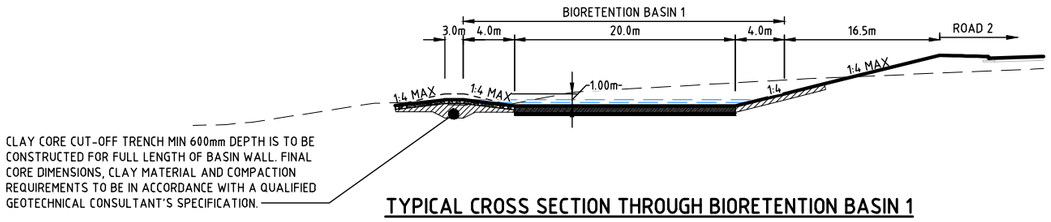
DRAWING TITLE
DETENTION BASIN OSD2
TYPICAL SECTIONS & DETAILS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS08	11

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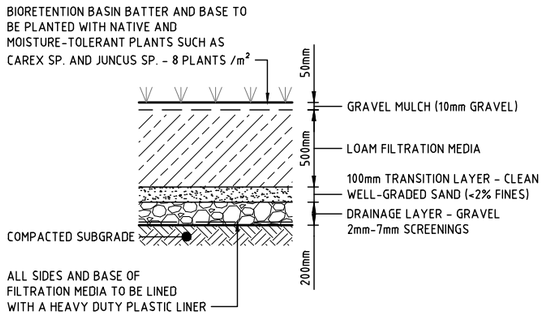
Plot Date: Wednesday, 3 September 2025 5:55:33 PM CAD File Name: O:\21000286 Lots 100-102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg

BASIN CONSTRUCTION NOTE
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TYPICAL CROSS SECTION THROUGH BIORETENTION BASIN 1

SECTION 10 WCMS01
SCALE: 1:250



BIORETENTION MEDIA DETAIL

SCALE 1:20

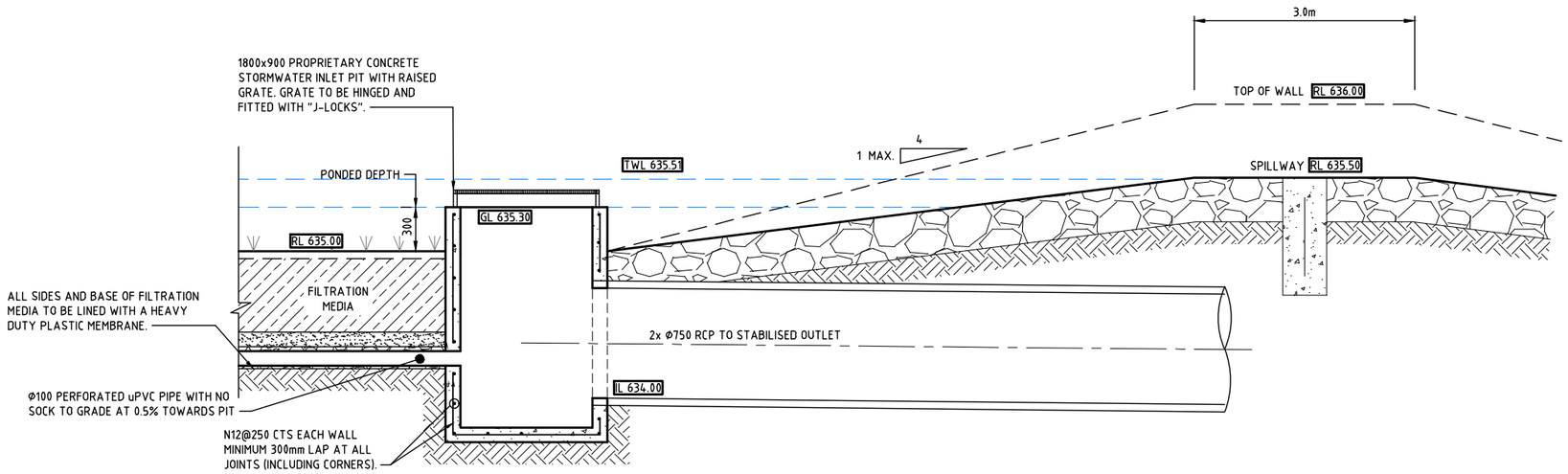


NOTE:
SIGN SHALL BE PLACED IN A CLEAR AND VISIBLE LOCATION IN THE VICINITY OF THE BIORETENTION BASIN.

COLOURS:

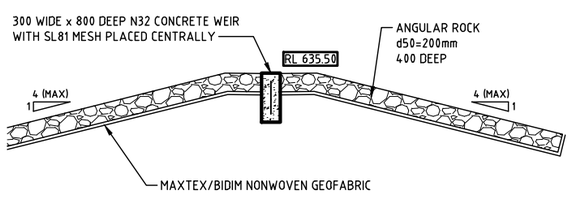
TRIANGLE AND 'WARNING'	- RED
WATER	- BLUE
FIGURE AND OTHER LETTERING	- BLACK

BIORETENTION WARNING SIGN DETAILS

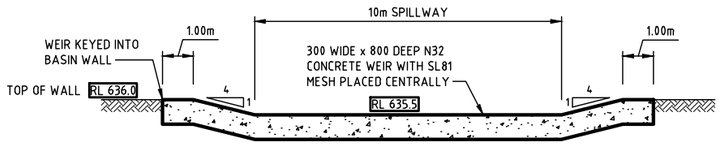


BIORETENTION BASIN 1
TYPICAL SECTION THROUGH OUTLET

SECTION 11 WCMS08
SCALE: 1:20



BASIN 1 CONCRETE SPILLWAY WEIR - TYPICAL SECTION



BASIN 1 CONCRETE SPILLWAY WEIR - TYPICAL SECTION

SECTION Y -
SCALE: 1:100

BIORETENTION BASIN FILTER BED MEDIA SPECIFICATION

THE FILTRATION MEDIA SHALL BE A WELL GRADED LOAMY SAND WITH:
- HYDRAULIC CONDUCTIVITY (ASTM F1815-06) BETWEEN 200 AND 300mm/HOUR
- PH BETWEEN 5.5 AND 7.5
- ORGANIC CONTENT LESS THAN 5 PERCENT
- ELECTRICAL CONDUCTIVITY LESS THAN 1.2 DS/M
- ORTHOPHOSPHATE CONTENT LESS THAN 40 mg/kg
- NITROGEN CONTENT <400mg/kg

SUBJECT TO ADEQUATE HYDRAULIC CONDUCTIVITY THE FOLLOWING PARTICLE SIZE DISTRIBUTION IS A GUIDE:

CLAY AND SILT	< 3%	(<0.05mm)
VERY FINE SAND	5-30%	(0.05 - 0.15mm)
FINE SAND	10-30%	(0.15 - 0.25mm)
MED-COARSE SAND	40-60%	(0.25 - 1.0mm)
COARSE SAND	7-10%	(1.0 - 2.0mm)
FINE GRAVEL	<3%	(>2.0mm)

THE FILTRATION MEDIA WILL BE COMPACTED WITH ONE PASS OF A VIBRATORY PLATE COMPACTER OR DRUM ROLLER.

THE TRANSITION LAYER SHALL BE CLEAN, WELL-GRADED SAND CONTAINING LITTLE OR NO CLAY AND SILT (<2% FINES). D15 OF THE TRANSITION LAYER MUST BE ≤ 5 X D85 OF THE FILTER MEDIA.

THE DRAINAGE LAYER SHALL BE 2-7mm WASHED SCREENINGS.

BIORETENTION BASIN CONSTRUCTION NOTES

1. PROVIDE APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES - PROTECT FILTRATION MEDIA DURING CONSTRUCTION WORKS FROM UNCONTROLLED SITE RUNOFF LIKELY TO CAUSE SEDIMENTATION (DURING EXCAVATION WORKS LIMIT AREAS OF DISTURBANCE AROUND THE BASIN, STABILISE PERMANENT WORKS AS SOON AS POSSIBLE AND PRIOR TO ANY RAINFALL EVENT PROVIDE TEMPORARY GROUND COVER OVER EXPOSED AREAS USING GEOFABRIC OR TURF).
2. ENSURE NO HEAVY MACHINERY OR OBJECTS ARE LEFT ON THE FILTRATION MEDIA AS THIS CAN COMPACT AND POTENTIAL BLOCK THE FILTRATION LAYER.
3. ALL BATTERS AND SUBGRADE/ EARTHWORKS TO ACHIEVE MINIMUM OF 95% STANDARD COMPACTION IN ACCORDANCE WITH AS 1289.
4. PERFORATED PIPES CAN BE SLOTTED WITH 1.5mm WIDE x 7.5mm LONG PERFORATIONS. DO NOT USE A SOCK.
5. INSPECTION OPENINGS FOR THE BASIN SUB-SOIL DRAINAGE SYSTEM ARE TO BE PROVIDED AS SHOWN ON THIS PLAN.
6. A SECURED SITE FENCE IS TO BE PROVIDED AROUND THE BIORETENTION BASIN SYSTEM TO ENSURE THAT ACCESS FROM PUBLIC IS RESTRICTED.

0 0.2 0.4 0.6 0.8 1.0m
SCALE: 1:20 (A1 SHEET)

0 2.5 5 7.5 10 12.5m
SCALE: 1:250 (A1 SHEET)

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.

SCALE: (on A1 Original)

DA

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PO Box 1098, Bowral NSW 2576.
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(f) 02 4862 3088
email: reception@seec.com.au
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PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
BIORETENTION BASIN 1
TYPICAL SECTIONS & DETAILS

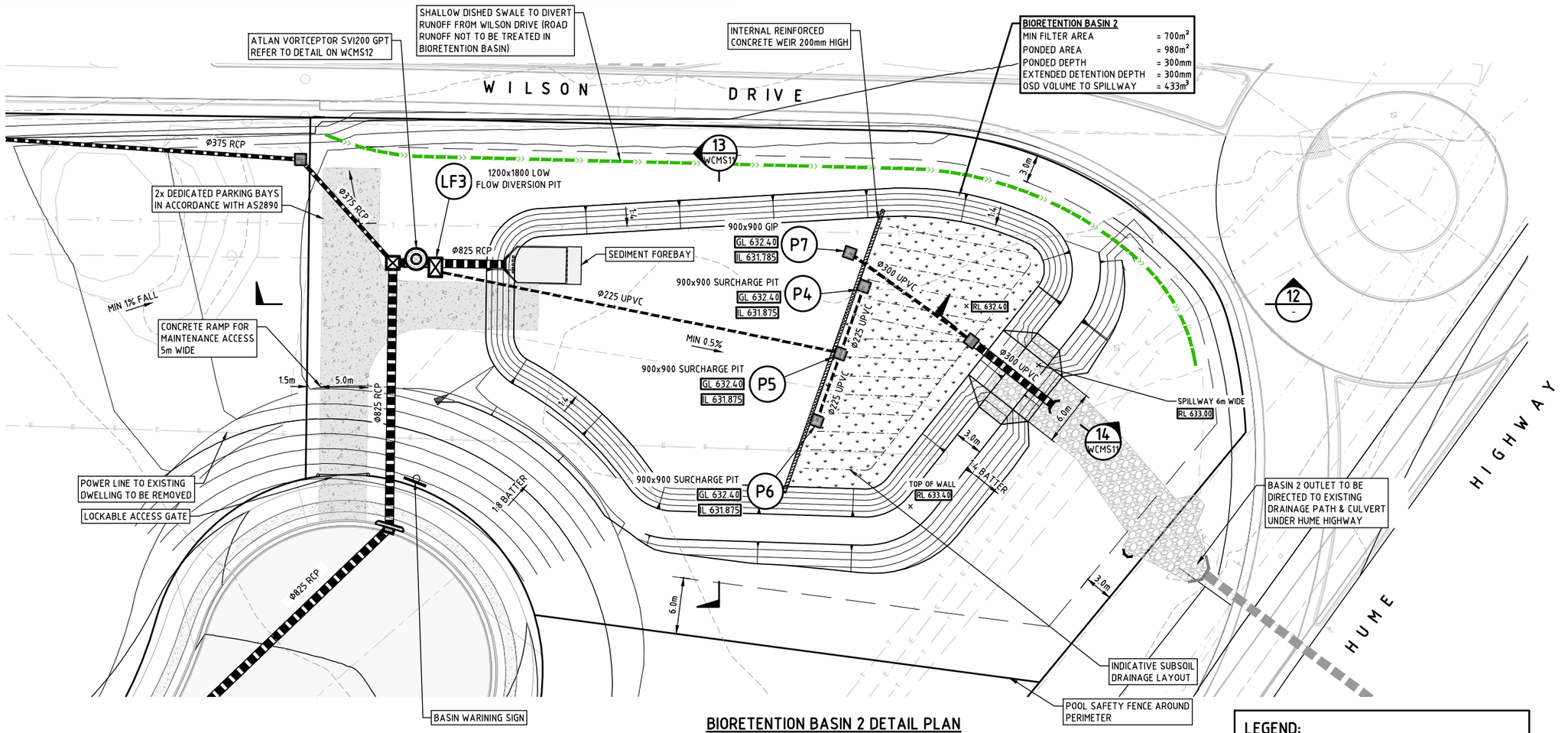
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS09	11

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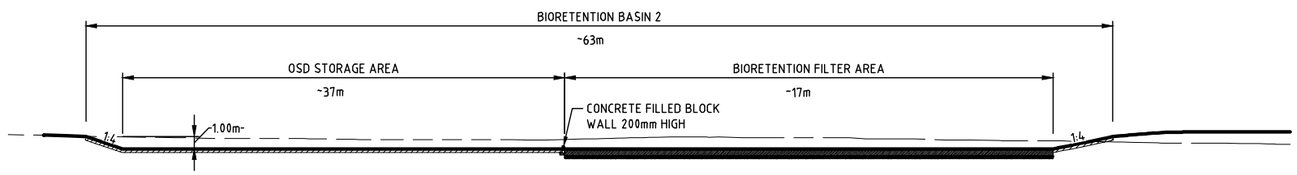
Plot Date: Wednesday, 3 September 2025 5:55:35 PM CAD File Name: O:\21000286 Lots 100-102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg

BASIN CONSTRUCTION NOTE

1. BASIN LAYOUT & CROSS SECTIONS ARE INDICATIVE ONLY. A GEOTECHNICAL CONSULTANT IS TO BE ENGAGED TO ADVISE ON THE FINAL BASIN WALL CONSTRUCTION AND SUITABILITY OF THE EXISTING SUB-SOILS FOR STRUCTURAL ADEQUACY AND WATER HOLDING ABILITY.
2. REFER TO CIVIL PLANS BY ALLAN PRICE DEVELOPMENT CONSULTANTS FOR ACCESS DRIVEWAY PROFILES



BIORETENTION BASIN 2 DETAIL PLAN



TYPICAL SECTION THROUGH BIORETENTION BASIN 2

SECTION 12 -
SCALE: N/A

LEGEND:

- BOUNDARY LINE
- PROPOSED ROAD
- × RL 622.26 — PROPOSED LEVEL
- STORMWATER DRAINAGE PIPE
- GRATED INLET PIT
- CONCRETE COVER JUNCTION PIT
- KERB INLET PIT
- ROCK ENERGY DISSIPATOR
- OSD/BIORETENTION BASIN
- BIORETENTION FILTER AREA
- GRASSED SWALE
- BASIN WARNING SIGN

0 2.5 5 7.5 10 12.5m
SCALE: 1:250 (A1 SHEET)

NOT FOR CONSTRUCTION

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DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:250

DA

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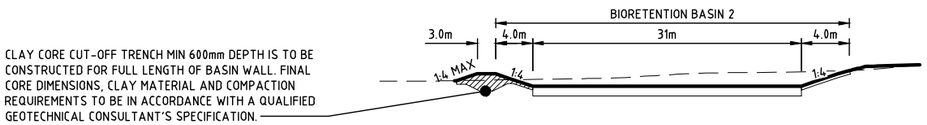
PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100–102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
BIORETENTION BASIN 2
DETAIL PLAN & TYPICAL SECTION

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS10	11

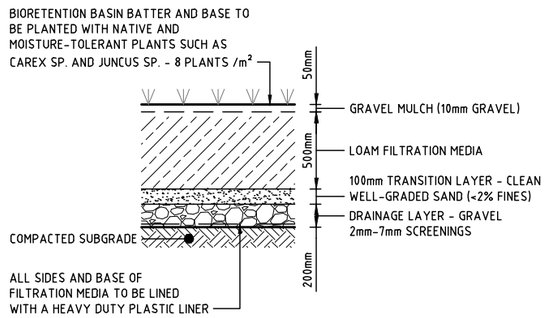
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TYPICAL CROSS SECTION THROUGH BIORETENTION BASIN 2

SECTION 13 WCMS10
SCALE:1:250



BIORETENTION MEDIA DETAIL

SCALE 1:20

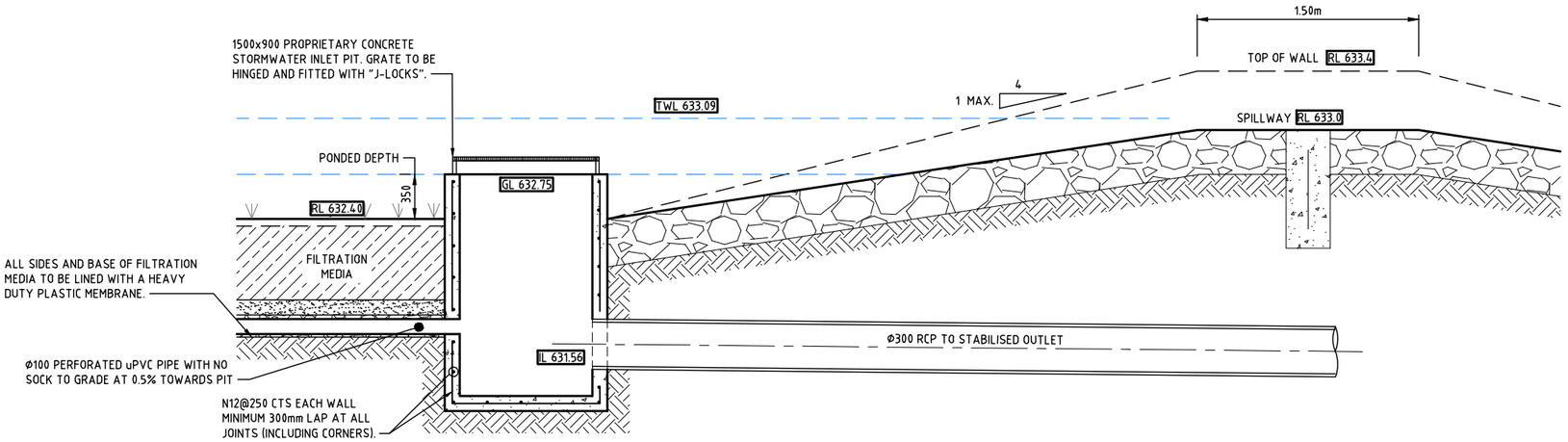


NOTE:
SIGN SHALL BE PLACED IN A CLEAR AND VISIBLE LOCATION IN THE VICINITY OF THE BIORETENTION BASIN.

COLOURS:

TRIANGLE AND 'WARNING'	- RED
WATER	- BLUE
FIGURE AND OTHER LETTERING	- BLACK

BIORETENTION WARNING SIGN DETAILS



BIORETENTION BASIN 2
TYPICAL SECTION THROUGH OUTLET

SECTION 14 WCMS10
SCALE:1:20

BIORETENTION BASIN FILTER BED MEDIA SPECIFICATION

THE FILTRATION MEDIA SHALL BE A WELL GRADED LOAMY SAND WITH:

- HYDRAULIC CONDUCTIVITY (ASTM F1815-06) BETWEEN 200 AND 300mm/HOUR
- PH BETWEEN 5.5 AND 7.5
- ORGANIC CONTENT LESS THAN 5 PERCENT
- ELECTRICAL CONDUCTIVITY LESS THAN 1.2 DS/M
- ORTHOPHOSPHATE CONTENT LESS THAN 40 mg/kg
- NITROGEN CONTENT <400mg/kg

SUBJECT TO ADEQUATE HYDRAULIC CONDUCTIVITY THE FOLLOWING PARTICLE SIZE DISTRIBUTION IS A GUIDE:

CLAY AND SILT	< 3%	(<0.05mm)
VERY FINE SAND	5-30%	(0.05 - 0.15mm)
FINE SAND	10-30%	(0.15 - 0.25mm)
MED-COARSE SAND	40-60%	(0.25 - 1.0mm)
COARSE SAND	7-10%	(1.0 - 2.0mm)
FINE GRAVEL	<3%	(>2.0mm)

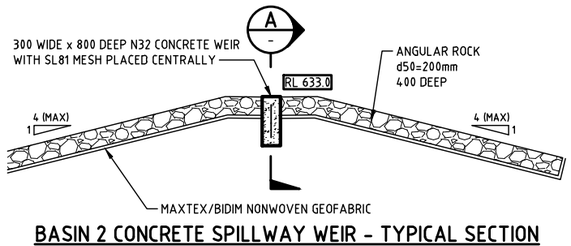
THE FILTRATION MEDIA WILL BE COMPACTED WITH ONE PASS OF A VIBRATORY PLATE COMPACTER OR DRUM ROLLER.

THE TRANSITION LAYER SHALL BE CLEAN, WELL-GRADED SAND CONTAINING LITTLE OR NO CLAY AND SILT (<2% FINES). D15 OF THE TRANSITION LAYER MUST BE ≤ 5 X D85 OF THE FILTER MEDIA.

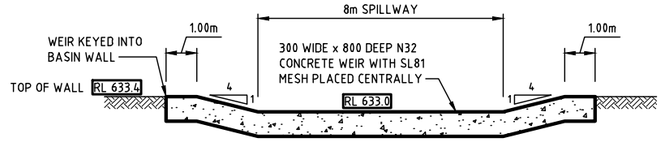
THE DRAINAGE LAYER SHALL BE 2-7mm WASHED SCREENINGS.

BIORETENTION BASIN CONSTRUCTION NOTES

1. PROVIDE APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES - PROTECT FILTRATION MEDIA DURING CONSTRUCTION WORKS FROM UNCONTROLLED SITE RUNOFF LIKELY TO CAUSE SEDIMENTATION (DURING EXCAVATION WORKS LIMIT AREAS OF DISTURBANCE AROUND THE BASIN, STABILISE PERMANENT WORKS AS SOON AS POSSIBLE AND PRIOR TO ANY RAINFALL EVENT PROVIDE TEMPORARY GROUND COVER OVER EXPOSED AREAS USING GEOFABRIC OR TURF).
2. ENSURE NO HEAVY MACHINERY OR OBJECTS ARE LEFT ON THE FILTRATION MEDIA AS THIS CAN COMPACT AND POTENTIAL BLOCK THE FILTRATION LAYER.
3. ALL BATTERS AND SUBGRADE/ EARTHWORKS TO ACHIEVE MINIMUM OF 95% STANDARD COMPACTION IN ACCORDANCE WITH AS 1289.
4. PERFORATED PIPES CAN BE SLOTTED WITH 1.5mm WIDE x 7.5mm LONG PERFORATIONS. DO NOT USE A SOCK.
5. INSPECTION OPENINGS FOR THE BASIN SUB-SOIL DRAINAGE SYSTEM ARE TO BE PROVIDED AS SHOWN ON THIS PLAN.
6. A SECURED SITE FENCE IS TO BE PROVIDED AROUND THE BIORETENTION BASIN SYSTEM TO ENSURE THAT ACCESS FROM PUBLIC IS RESTRICTED.



BASIN 2 CONCRETE SPILLWAY WEIR - TYPICAL SECTION



OSD1 CONCRETE SPILLWAY WEIR - TYPICAL SECTION

SECTION A -
SCALE:1:100

0 0.2 0.4 0.6 0.8 1.0m
SCALE: 1:20 (A1 SHEET)

0 2.5 5 7.5 10 12.5m
SCALE: 1:250 (A1 SHEET)

NOT FOR CONSTRUCTION

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DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:250
	DA

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PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
BIORETENTION BASIN 2
TYPICAL SECTIONS & DETAILS

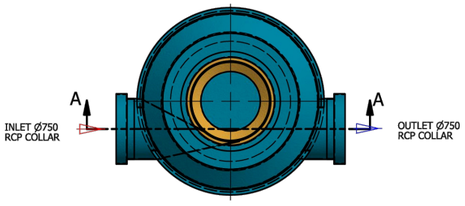
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS11	11

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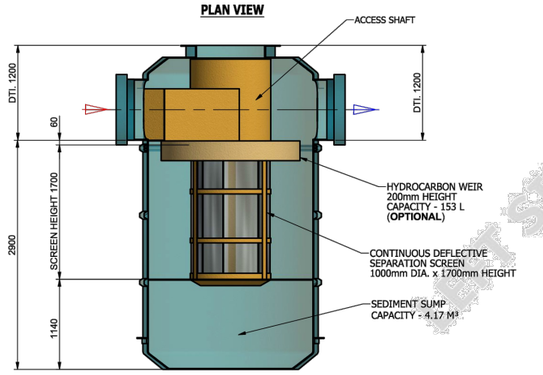
Plot Date: Wednesday, 3 September 2025 5:55:44 PM CAD File Name: O:\21000286 Lots 100-102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg

Spel Vortceptor Site Level Confirmation			
Vortceptor Flow	Off-Line ☐	In-Line ☐	
Flow Configuration	Left ☐	Right ☐	
finished surface level (FSL)	RL:		
Access Cover Thickness		mm	
Inlet Pipe Size :	Ø		
Inlet Invert Level	RL:		
Outlet Pipe size	Ø		
Outlet Invert Level	RL:		
Company			
Name :			
Date :			

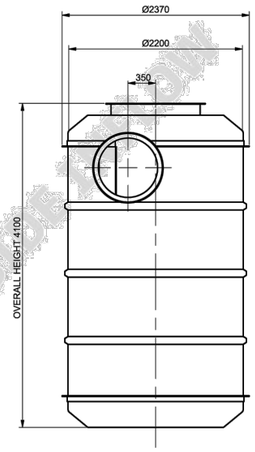
Technical Sheet



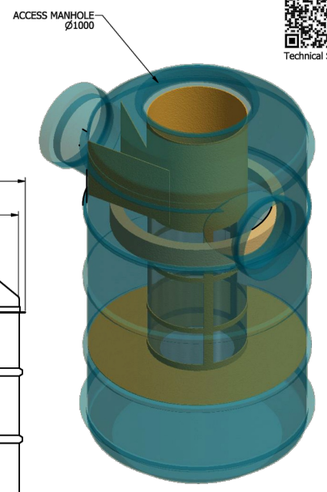
PLAN VIEW



SECTION A-A



SIDE VIEW



ISOMETRIC VIEW

INSTALLATION ACCORDING TO SPEL STORMWATER PRODUCT INSTALLATION GUIDE.

ISSUED FOR CONSTRUCTION

TOLERANCE: All Dimensions to Closest 10 mm & +/- 30 mm

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

REV	DATE	BY	DESCRIPTION	CHK
1	8/07/2022	J.MAKIN	INITIAL RELEASE	

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	Drawn	Date
	J.MAKIN	8/07/2022
	Check	Date
	Verified	Date
	Approved	Date
	Request No.	

spelstormwater joy in water
spel.com.au

PROJECT :

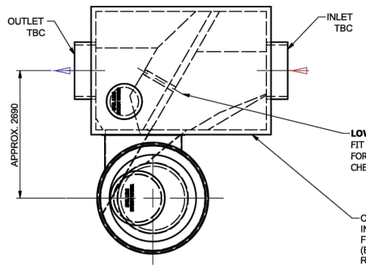
TITLE SPELVORTCEPTOR - INLINE
SVI.200/22.L.750.RCP
GENERAL ARRANGEMENT
TFR: 200 LPS , MAX FLOW : 992 LPS

SCALE	SIZE	SHEET	REV
N.T.S	A3	1	1

CUSTOMER CODE : DWG No. SP22-VC35230-S

LEFT SIDE INFLOW

REVISION HISTORY				
REV	DESCRIPTION	DESIGNER	DATE	CHECKED BY
1	INITIAL RELEASE	M.MAKIN	17/06/2019	

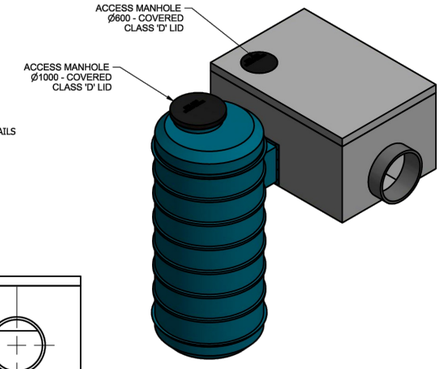


Site Level Confirmation		
Finished Surface Level (FSL)	RL:	
Access Cover Thickness		mm
Inlet Invert Level	RL:	
Outlet Invert Level	RL:	
Company:		
Name:		
Date:		

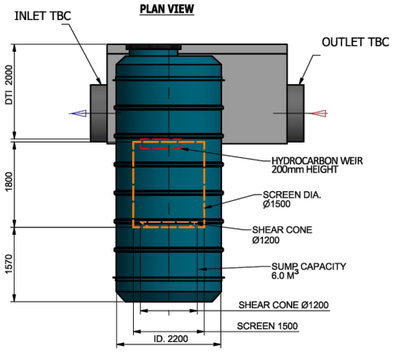
LOW FLOW BYPASS
FIT CAPPED PVC LOW FLOW BYPASS PIPE TO WEIR,
FOR DIVERSION OF LOW FLOWS DURING MAINTENANCE.
CHECK WITH CONSULTING ENGINEERS FOR SIZING & DESIGN DETAILS

CONCRETE DIVERSION CHAMBER
INTERNAL SIZE : **3600 L x 2500 W x 1800 H**
FOR REPRESENTATION PURPOSE ONLY
(BY OTHERS)
REFER DWG : **P19-VC16450-C**

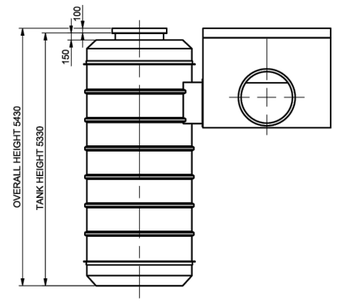
PLAN VIEW



ISOMETRIC VIEW



ELEVATION VIEW



SIDE VIEW

NOTE:

- BALLAST & BUOYANCY CALCULATIONS TO BE DONE AT TIME OF QUOTING
- BALLAST SUPPLIED BY OTHERS
- EDUCTION / VACUUM TYPE MAINTENANCE ONLY

TOLERANCE: ALL DIMENSIONS 10mm UNLESS OTHERWISE STATED.

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	Drawn	Date
	M.MAKIN	17/06/2019
	Check	Date
	Verified	Date
	Approved	Date
	Request No.	
	RN41158	

spelstormwater joy in water
spel.com.au

PROJECT :

TITLE SPEL VORTCEPTOR OFF-LINE
SVO.360.L.1050
GENERAL ARRAGNGEMENT

SCALE	SIZE	SHEET	REV
N.T.S	A3	1	1

CUSTOMER CODE : DWG No. SP19-VC11840-P

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DRAWING STATUS	
DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	
DA	

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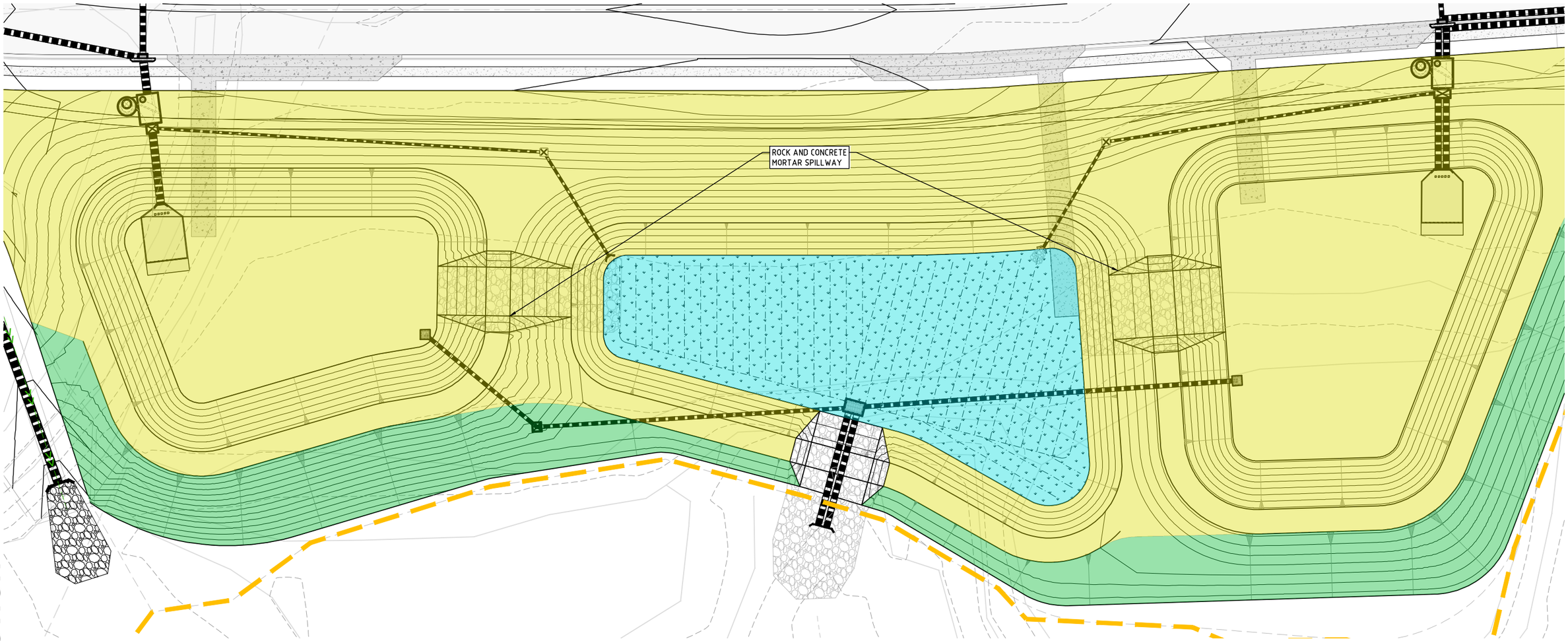
PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100–102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
ATLAN VORTCEPTOR GPT
DETAIL PLANS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS12	11

Plot Date: Wednesday, 3 September 2025 5:55:46 PM CAD File Name: O:\21000286 Lots 100–102 DP 1161331 Wilson Dr, Marulan\Drawings\21000286_P01_WCMS_REV 11.dwg

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NOT FOR CONSTRUCTION

CONCEPT BIORETENTION BASIN 1 LANDSCAPE PLAN

NOTE
FINAL LANDSCAPE ARRANGEMENT TO BE CONFIRMED BY A QUALIFIED HORTICULTURALIST/LANDSCAPE ARCHITECT PRIOR TO IMPLEMENTATION AND IN COORDINATION WITH COUNCIL'S DEVELOPMENT TEAM

LEGEND:

1,900 m^2	MULCHED & VEGETATED AREA (TREES, SHRUBS & GROUND COVER) - MELALEUCA STYPHELIOIDES, LEPTOSPERMUM, CALLISTUM
8,100 m^2	GRASSED/TURFED AREAS
1,200 m^2	BIORETENTION FILTER AREA MIX OF JUNCUS USITATUS, LOMANDA LONGIFOLIA, CAREY APPRESSA AT 8 PLANTS/m^2

0 2.5 5 7.5 10 12.5m
SCALE: 1:250 (A1 SHEET)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

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DRAWN BY	S.B.
FINAL APPROVAL	J.A.
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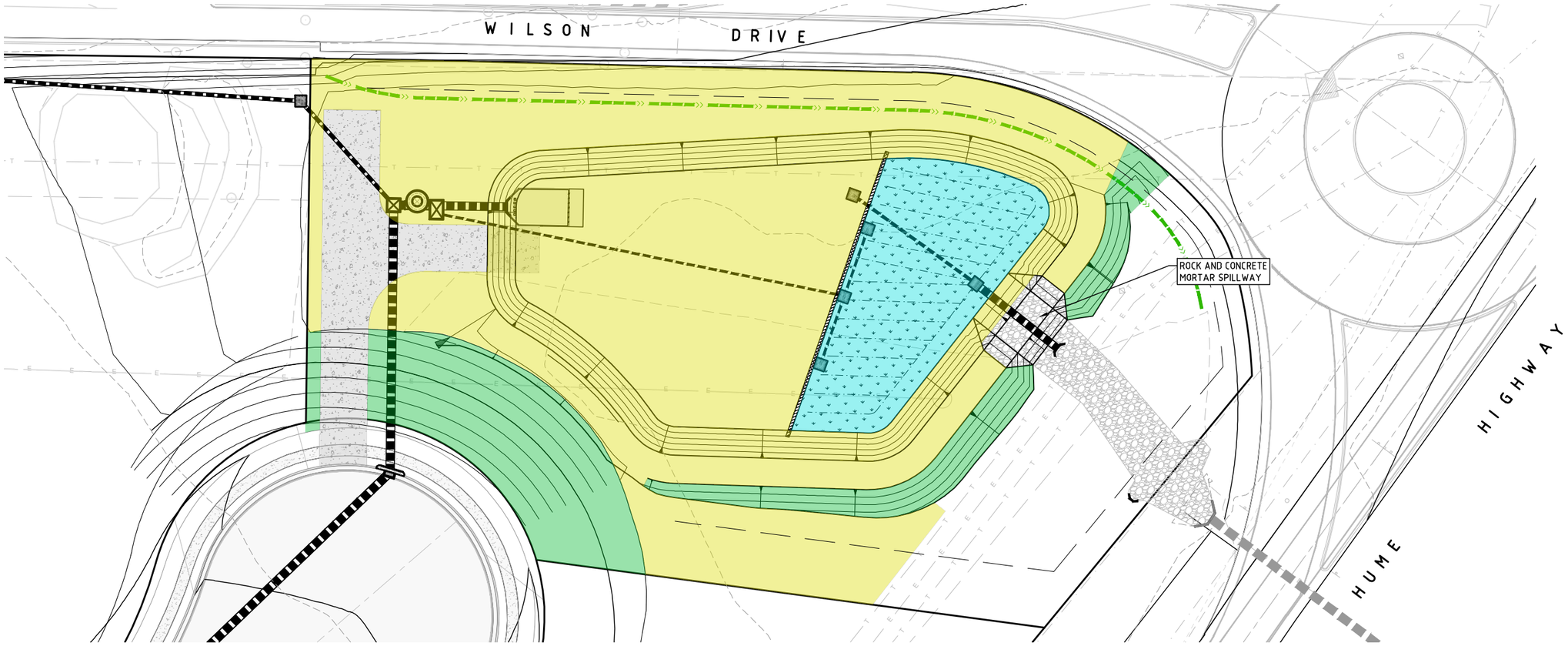
PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
CONCEPT BIORETENTION BASIN 1
LANDSCAPE PLAN

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS13	11

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CONCEPT BIORETENTION BASIN 2 LANDSCAPE PLAN

NOTE
FINAL LANDSCAPE ARRANGEMENT TO BE CONFIRMED BY A QUALIFIED HORTICULTURALIST/LANDSCAPE ARCHITECT PRIOR TO IMPLEMENTATION AND IN COORDINATION WITH COUNCIL'S DEVELOPMENT TEAM

LEGEND:

600 m²	MULCHED & VEGETATED AREA (TREES, SHRUBS & GROUND COVER) - MELALEUCA STYPHELIOIDES, LEPTOSPERMUM, CALLISTUM
2,600 m²	GRASSED/TURFED AREAS
400 m²	BIORETENTION FILTER AREA MIX OF JUNCUS USITATUS, LOMANDA LONGIFOLIA, CAREY APPRESSA AT 8 PLANTS/m²

0 2.5 5 7.5 10 12.5m
SCALE: 1:250 (A1 SHEET)

NOT FOR CONSTRUCTION

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.
SCALE: (on A1 Original)	1:250

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PROJECT TITLE
PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
CONCEPT BIORETENTION BASIN 2
LANDSCAPE PLAN

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	WCMS14	11

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GENERAL SOIL AND WATER MANAGEMENT REQUIREMENTS

SOIL AND WATER MANAGEMENT STAGING REQUIREMENTS

This Soil and Water Management Plan (SWMP) has been prepared in accordance with Blue Book Volume 1 (Landcom, 2004). This SWMP is a concept SWMP only. It outlines the over-arching erosion and sediment control requirements and locations of major controls only. A construction stage SWMP is to be prepared prior to starting works to detail all controls, design/sizing specifications and management requirements for all works/stages and to ensure that the installed controls are applicable to the inherent risk and the nature of the works underway.

An erosion hazard assessment has been completed for all areas within the proposed work zone. The predicted soil loss across all site areas has been determined in accordance with the following:

A = R x K x LS x C x P

Where

A = Annual soil loss due to erosion (t/ha/yr)
R = Rainfall erosivity factor
K = Soil erodibility factor
LS = Topographic factor derived from slope length (SL) and slope gradient (S)
C = Cover and management factor
P = Erosion control practice factor

The following values have been used:

R : 1,330 (from 2-year 6-hour storm)
K : 0.05 (conservative, NSW eSPADE)
LS : 1.35 (max 5%, 100m)
C : 1.0 (Construction stage - i.e. no soil surface protection or ground cover applied)
P : 1.3 (for general construction areas)

Based on the above data, the potential soil loss is estimated at 117 t/ha/yr. Soil Loss Class 1 (very low).

Maximum Disturbed Catchments:
CA1 = 16.6 ha;
CA2 = 3.1 ha;
CA3 = 3.9 ha;
CA4 = 1.4 ha

Under Blue Book standards, sediment basins are required if the soil loss is > 200 t/yr. Therefore, sediment basins are required for CA1, CA2 and CA3. Refer to Catchment Breakup Plan on this sheet.

DESIGN ASSUMPTIONS AND BACKGROUND INFORMATION

- IFD: 2year, 6hour storm intensity = 7.28 mm/hr
- Volumetric runoff coefficient (CV) = 0.5 (assuming hydrologic group D runoff coefficient - low infiltration, high runoff)
- 5-day, 85th %ile rainfall depth = 22.2 mm
- Runoff coffeficient (C_{10}) for grassed upslope/clean water areas = 0.5

SOIL AND WATER MANAGEMENT INSTRUCTIONS

Before commencement of earthworks, the site is to be secured and the following erosion and sediment control measures installed in order except for items 11 to 19, which are to be undertaken regularly throughout all stages of works (Refer to the 'Site Inspection, Monitoring and Maintenance' notes):

1. Establish a stabilised site access (Refer to Standard Drawing SD 6-14 on SWMP06) in the location shown and anywhere where construction vehicles access a work area from a sealed public road.
2. Install/maintain flagging fencing or similar as necessary to delineate the project and disturbance limits and to minimise unnecessary disturbance. Refer to Table 2 on SWMP03.
3. Minimise disturbance to only what is required for safe and efficient construction and stage disturbance as much as possible.
4. Construct upslope clean channels where shown on SWMP02 to direct upslope clean water around the work area. Channels and batters are to be stabilised (e.g. biodegradable soil polymer spray, mesh and seeded; geofabric; or to final design - to future design with construction plans).
5. Establish sediment fencing in the locations shown and following Standard Drawing SD 6-8 on SWMP06.
6. Establish a site office, toilet and parking area within project boundary (exact locations TBC onsite).
7. SB1, SB2 and SB3 are to be constructed including their outlet spillways and energy dissipators (Refer to Drawing SWMP02 for locations and to Standard Drawing SD 6-4 on SWMP05 and 'Sediment Basin' notes below for all sizing and lining specifications).
8. Dirty water diversion drains are to be constructed and stabilised (Refer to Standard Drawing SD 5-6, sizing and lining specifications to future detail).
9. Establish the stockpile areas within the main earthworks area as shown and following Standard Drawing SD 4-1 on SWMP04 and the 'Topsoil Stripping, Soil Management and Stockpiling' notes below.
10. Earthworks can now commence.
11. Undertake road works and stormwater drainage works in accordance with engineering details. Drainage to be maintained offline at this stage (unless directing flows into the sediment basins).
12. Undertake progressive stabilisation of lands as final earthworks and road works are completed in each area (rather than waiting until the completion of works).
13. Install sandbag checks along the front and back of all new kerb and gutters at maximum 80m intervals to minimise the risk of erosion and divert flows into kerbs. Refer to Photo 1 on SWMP03.
14. Undertake dust suppression as required.
15. Prior to forecast rainfall (>50% chance of 5mm or more in 24 hours) stabilise all exposed batters with a biodegradable soil polymer, hydromulch, jute mat or similar alternative.
16. Install slope breaks across entire width of boxed out road works at maximum 80m intervals as shown on Drawing SWMP03 and Standard Drawing SD 5-5 on SWMP05 whenever rain is forecast (>50% chance of 5mm or more in 24 hours). No longer required once select material (smz) or similar is placed.
17. Monitoring, maintenance and inspections are to be carried out regularly as required and in accordance with the 'Site Inspection, Monitoring and Maintenance' notes.
18. As areas are completed (i.e. at least 70% final cover over the catchment), temporary sediment and drainage controls can be decommissioned and removed.
19. Final stabilisation is to be completed in accordance with the 'Stabilisation' notes and Table 1.

TOPSOIL STRIPPING, SOIL MANAGEMENT AND STOCKPILING

Soils are to be stripped and managed in accordance with the following:

- As much as possible topsoil is to be stripped when slightly moist (not wet or dry).
- Topsoil is to be stripped (to a depth of approximately 100mm) separately from the underlying subsoil. Topsoil depths may vary across the project site and care should be taken to avoid stripping underlying soil horizons (subsoil) with the topsoil layer.

All stockpiles must be constructed and maintained in accordance with Standard Drawing SD 4-1 on SWMP04 and the following:

- Stockpiles are not to be positioned within 20m of a creek or drainage depressions.
- Mulched vegetation, topsoil and subsoil (if applicable) are to be stockpiled separately wherever possible.
- Inactive stockpiles are to be stabilised to achieve a C-factor of 0.1 (i.e - equivalent to 60% grass cover) within 10 days of formation using a temporary soil stabiliser (e.g. Vital Stonewall), geotextile, jute matting or equivalent.
- Topsoil stockpiles should be constructed to no more than 2 meters in height wherever possible.
- Stockpiles should be battered down at a maximum slope of 2:1 wherever possible.

SEDIMENT BASINS

- The sediment basins are to be constructed to Standard Drawing SD 6-4 on SWMP05.
- The sediment basins are to be built to incorporate a spillway per Detail 2 on SWMP03 (sizing to future detail).
- Water quality is to be tested prior to discharge to verify compliance with the requirements under 'Dirty Water Treatment and Discharge Requirements' notes and Table 3 on SWMP03.
- Any release of water from the sediment basins might require flocculation to achieve adequate settling of dispersible fine material (Refer to the 'Dirty Water Treatment and Discharge Requirements' below).
- If the water is going to be used within the construction site for dust-suppression purposes and will drain back into the sediment capture system it does not require flocculation.
- Note that, if construction water is pumped into a tanker truck for later use, it cannot be discharged from the tanker into a creek/dam without first being treated and tested.

SEDIMENT TRAP OPERATION AND MAINTENANCE

- The sediment traps are to be maintenance-cycled following rainfall. Within 5-days after rainfall of 5mm or more (i.e. sufficient to cause runoff):
  - De-water the sediment traps to restore the design capacities in accordance with the 'Dirty Water Treatment and Discharge Requirements' notes below;
  - Check the level of accumulated sediment in the traps. If the sediment level exceeds 30% of the trap capacity clean out and remove the sediment. Material removed from the traps must be taken to an active stockpile or blended with general fill.
  - Note that if rainfall (sufficient to cause runoff) occurs within 5 days of the previous rainfall event, the 5-day maintenance requirement is reset.
- After each rainfall event, inspect the sediment traps to ensure spillway and inlet points are stable and free from scour. Repair as required.

DIRTY WATER TREATMENT AND DISCHARGE REQUIREMENTS

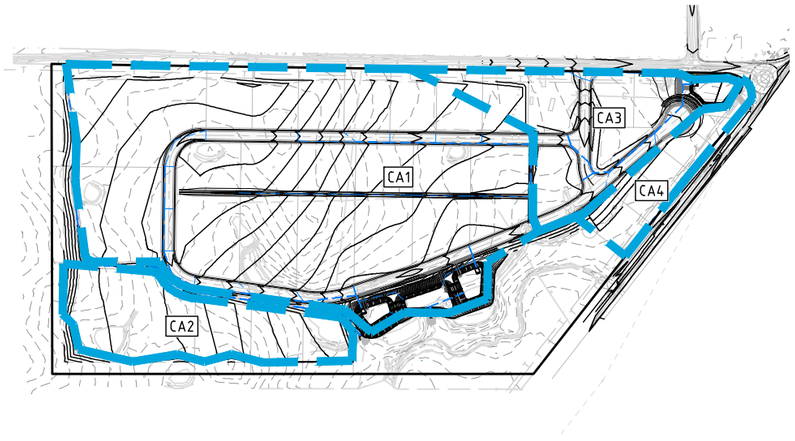
- Any active discharge of water from the project (i.e. where water is moved offsite via direct action such as pumping rather than flowing off the project as a result of heavy rainfall) is to achieve:
  - 50mg/L or less TSS (Total Suspended Sediment); and
  - neutral pH (6.5 to 8.5); and
  - no visible trace of oil or grease.
- Flocculation can be achieved by using gypsum (or similar) at a rate of approximately 30 kg/100 m^3 of stormwater. Refer to manufacturers guidelines for dosage details.
- Ensure the flocculant/coagulant is thoroughly mixed/diluted with water (e.g. within an IBC) prior to spreading evenly over the entire water surface for proper treatment. Dirty water from the basins can be used for mixing the flocculant/coagulant.
- These de-watering requirements apply to dirty water accumulating in any sort of excavation, sump, or other ponded water body on the project.

STABILISATION

- Undertake progressive stabilisation of disturbed ground surfaces as they are completed rather than at the end of the works program (Refer to Table 1).
- Final rehabilitation is to achieve the C-factors (ground cover) detailed in Table 1 on SWMP03.
- Areas to be revegetated are to be topsoiled first. Refer to Standard Drawing SD 4-2 on SWMP04.
- Appropriate seedbed preparation is to be carried out when revegetating lands (Refer to Standard Drawing SD 7-1 on SWMP04).
- Wherever possible, re-use cleared/mulched vegetation for either temporary or permanent stabilisation of disturbed areas. If mulch is not available or appropriate then the use of jute mesh, soil stabilisers (e.g. Vital Stonewall) hydomulching or an appropriate alternative is to be considered for provision of ground cover until vegetation has established.
- As surfaces are stabilised (at least 90% of any finished area has at least 70% ground cover) and permanent drainage measures are installed, temporary erosion and sediment control structures and water management structures can be removed (e.g. sediment fence and diversion drains).
- Ensure any new vegetation is watered regularly to promote growth if natural rainfall is insufficient.

SITE INSPECTION, MONITORING AND MAINTENANCE

- Regular site inspections are to be conducted by the site environment manager (or their representative) and records of all such inspections are to be made available upon inspection. Inspections are to be undertaken:
  - At least weekly during normal construction hours; and
  - Prior to forecast rainfall (>50% chance of 5mm or more in 24 hours); and
  - Daily during rain events (if safe to do so); and
  - Within 24 hours of the cessation of a rain event that causes runoff (if safe to do so).
- Additional erosion and sediment controls will be installed as necessary to ensure environmental protection.
- Sediment or rocks tracked from the site will be removed from public roads as soon as possible (e.g. with street sweepers).
- After rainfall, sediment accumulated in trapping devices (e.g. sediment fence) will be removed to a secure location where it can't wash or blow offsite (preferably to an active stockpile).
- Weather conditions will be monitored onsite and daily rainfall will be recorded.
- Safe storage areas for wastes, fuels, excess concrete and other potential contaminants are to be delineated by the site manager.



SWMP CATCHMENT BREAKUP PLAN

N.T.S.

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
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09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, SWMP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
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04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS

DESIGN BY	S.B.
DRAWN BY	S.B.
FINAL APPROVAL	J.A.

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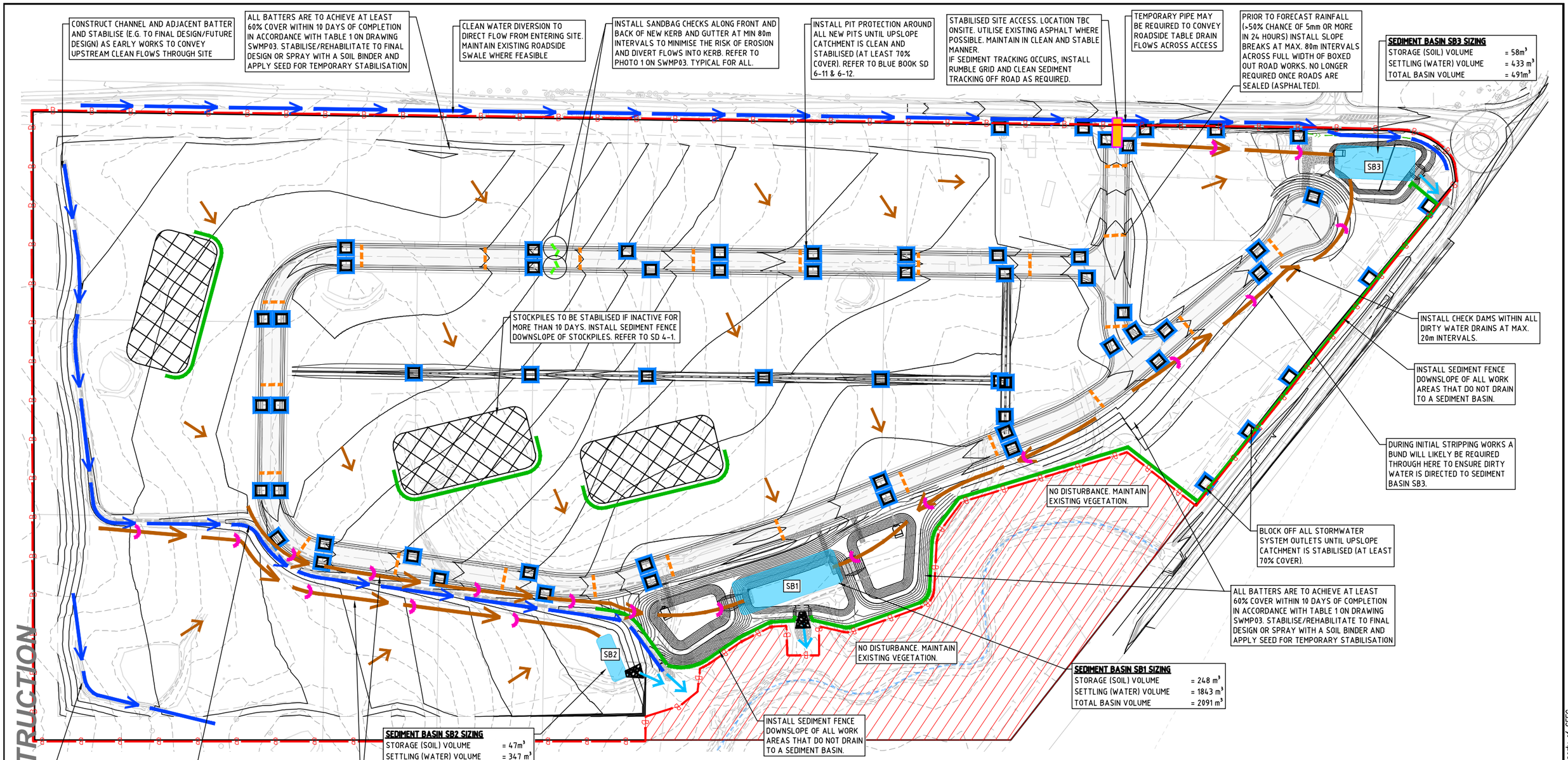
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PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

DRAWING TITLE
SOIL & WATER MANAGEMENT NOTES, CALCULATIONS & GENERAL INSTRUCTIONS

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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CONCEPT SOIL & WATER MANAGMENT PLAN

0 12.5 25 37.5 50 62.5m

SCALE: 1:1250 (A1 SHEET)

LEGEND:

- SEDIMENT FENCE (SD6-8 ON SWMP06)
- CLEAN WATER DRAIN
- DIRTY WATER DRAIN (SD5-6 ON SWMP05)
- CONTOUR BERM/SLOPE BREAK
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- CHECK DAM (SD5-4 ON SWMP04)
- STOCKPILE AREA (SD4-1 ON SWMP04)
- DISSIPATER OULET/INLET (GEOTEXTILE + ROCK ø200min. OR CONCRETE)
- STABILISED SITE ACCESS (SD6-14 ON SWMP06)
- STORMWATER PIT
- PIT PROTECTION (SD6-11 OR 6-12 ON SWMP06)
- NO DISTURBANCE
- SANDBAG CHECKS (REFER TO PHOTO 1 ON SWMP03)
- EXISTING WATERCOURSE
- SITE BOUNDARY
- SEDIMENT BASIN (SD6-4 ON SWMP05)

LOCATIONS OF EROSION AND SEDIMENT CONTROLS AND OTHER FEATURES ARE APPROXIMATE AND INDICATIVE ONLY. ALL LOCATIONS ARE TO BE CONFIRMED ONSITE PRIOR TO INSTALLATION.

THIS EROSION AND SEDIMENT CONTROL PLAN ONLY RELATES TO CONTROL MEASURES ASSOCIATED WITH THIS STAGE OF WORKS. FOR ALL OTHER STAGES REFER TO THEIR RELEVANT EROSION AND SEDIMENT CONTROL PLANS.

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PROJECT TITLE: PROPOSED SUBDIVISION LOTS 100–102 DP 1161331 WILSON DR, MARULAN

DRAWING TITLE: CONCEPT SOIL & WATER MANAGEMENT PLAN

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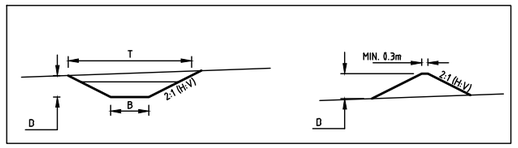
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TABLE 1 MAXIMUM ACCEPTABLE C-FACTORS AT NOMINATED TIMES		
LANDS	**MAXIMUM C-FACTOR**	**REMARKS**
Waterways and other areas subjected to concentrated flows (e.g. table drains), post construction and during operation	0.05 (70% cover)	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows will be limited to those shown in Table 5.2 of Landcom (2004). Foot and vehicular traffic will be prohibited in these areas
Stockpiles and batters, post construction	0.10 (60% cover)	Applies after ten working days from completion of formation. Maximum C-factor of 0.10 equals 60% ground cover
All lands, including waterways and stockpiles during construction and operation	0.15 (50% cover)	Applies after 20 working days of inactivity, even though works might continue later.
All lands post construction	0.10 - 0.05 (60%-70% cover)	0.10 applies after 20 working days of completion of works and 0.05 within 2 months of completion of works.

TABLE 2 LIMITATIONS TO ACCESS DURING CONSTRUCTION		
LAND USE	**LIMITATION**	**REMARKS**
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 should 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 on site. 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, including revegetation areas	Entry prohibited except for essential management works	Thinning of growth might be necessary, for example, for fire reduction or weed removal

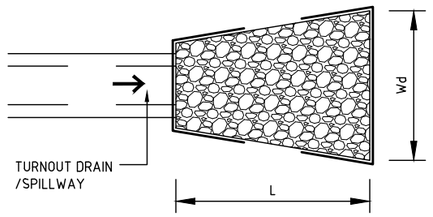
TABLE 3	
STORMWATER DISCHARGE/RELEASE LIMITS	
CHARACTERISTIC	**LIMIT**
pH	6.5-8.5
Total suspended solids (mg/L)	50 (Maximum)
Turbidity (NTU)	An approved correlated NTU value which corresponds to <50mg/L TSS
Hydrocarbons	Nil

DETAIL 1 - DIVERSION DRAIN/CHUTE



GEOTEXTILE UNDERLAY (BIDIM A34 MIN. OR EQUIVALENT).

ROCK: d_{50} = AS SPECIFIED



- REFER TO TABLE 5 FOR MINIMUM SIZING REQUIREMENTS AND DETAILS FOR VARIOUS STRUCTURES.
- ROCK DISSIPATERS TO BE INSTALLED IN ACCORDANCE WITH BLUE BOOK STANDARD DRAWING (SD 5-8).

DETAIL 2 - ROCK DISSIPATER



PHOTO 1 - SANDBAGS INSTALLED ALONG NEW KERB AND GUTTER TO MINIMISE RISK OF EROSION AND DIVERT FLOWS INTO KERBS.

NOTE: SANDBAGS ARE TO BE INSTALLED ALONG FRONT AND BACK OF NEW KERB AND GUTTER AT MAX 80m INTERVALS WHEN RAIN IS IMMINENT.

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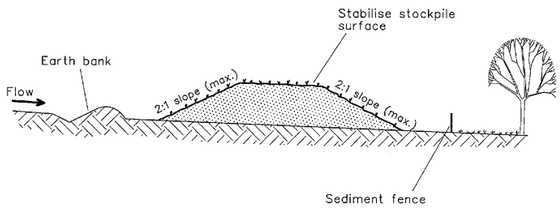
DRAWING TITLE
CONCEPT SOIL & WATER MANAGEMENT TYPICAL DETAILS

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21000286	P01	SWMP03	11

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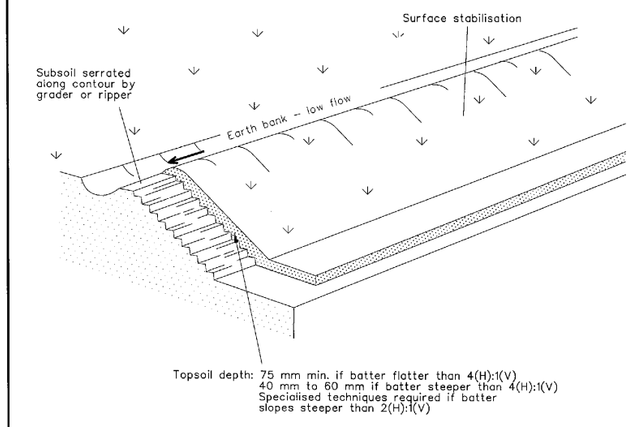
NOT FOR CONSTRUCTION



Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

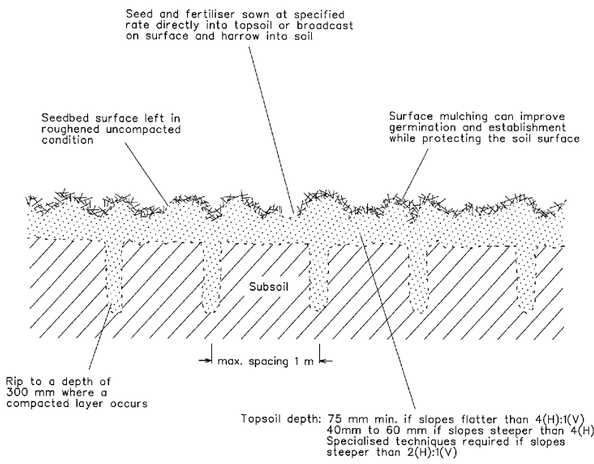
STOCKPILES **SD 4-1**



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

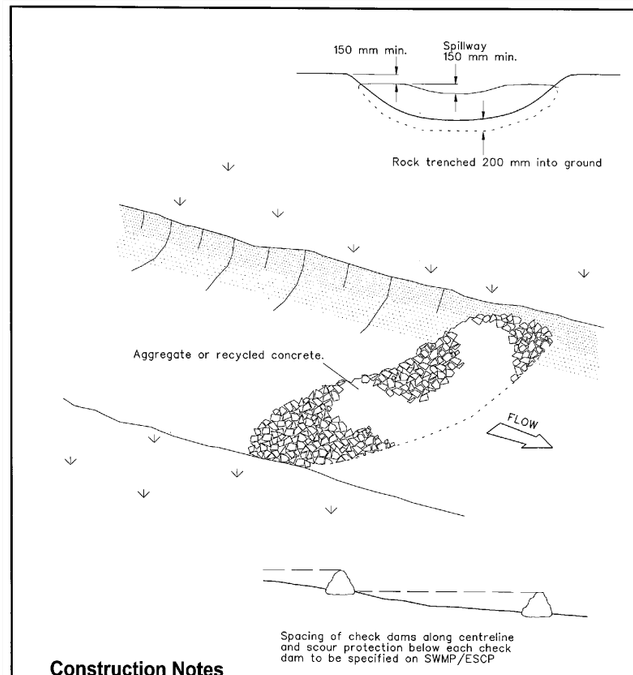
REPLACING TOPSOIL **SD 4-2**



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION **SD 7-1**



Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM **SD 5-4**

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
11	03/09/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
10	22/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS
09	20/08/25	S.B.	S.B.	J.A.	MINOR AMENDMENTS, ESCP ADDED
08	15/08/25	S.B.	S.B.	J.A.	BASIN REDESIGN TO ADDRESS COUNCIL COMMENTS
07	29/05/25	S.B.	C.A.	J.A.	DIMENSIONS ADDED TO BASINS
06	19/07/24	S.B.	S.B.	J.A.	MINOR AMENDMENTS
05	17/05/24	S.B.	S.B.	J.A.	AMENDMENTS TO BASINS, DETAILS
04	22/12/23	S.B.	S.B.	J.A.	AMENDMENTS TO BIORETENTION BASIN 1

DRAWING STATUS: DA

DESIGN BY: S.B.
DRAWN BY: S.B.
FINAL APPROVAL: J.A.
SCALE: (on A1 Original)

North

CLIENT: CITYWEST CORP R/L ATF THE COPULOS (SUNSHINE) U/T

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PROJECT TITLE: PROPOSED SUBDIVISION LOTS 100-102 DP 1161331 WILSON DR, MARULAN

ALL STANDARD DRAWINGS ARE FROM LANDCOM, 2004.

DRAWING TITLE: CONCEPT SOIL & WATER MANAGEMENT STANDARD DRAWINGS SHEET 1 OF 3

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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FINAL APPROVAL: J.A.
SCALE: (on A1 Original)

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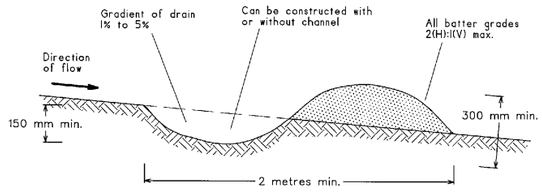
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PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	SWMP05	11

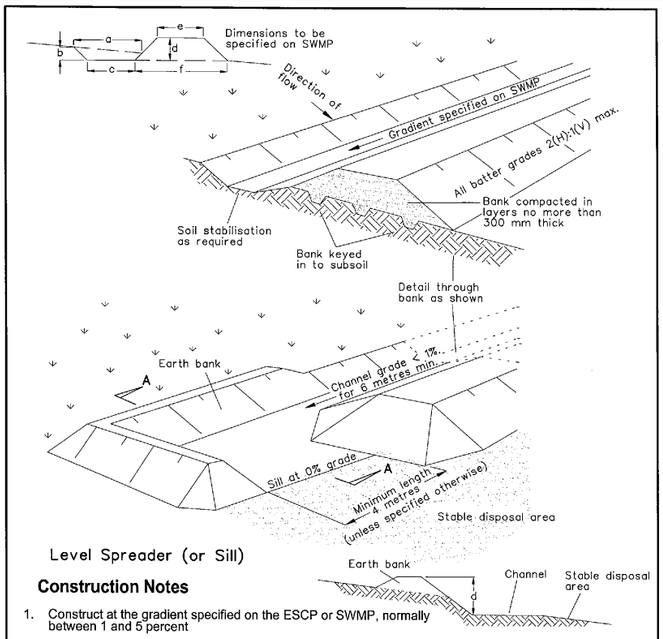


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) **SD 5-5**



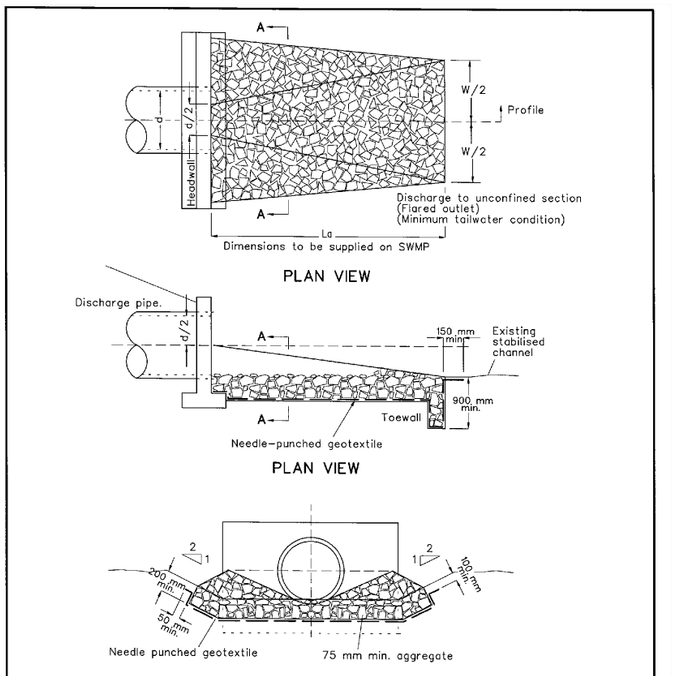
Level Spreader (or Sill)

Section AA

Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) **SD 5-6**

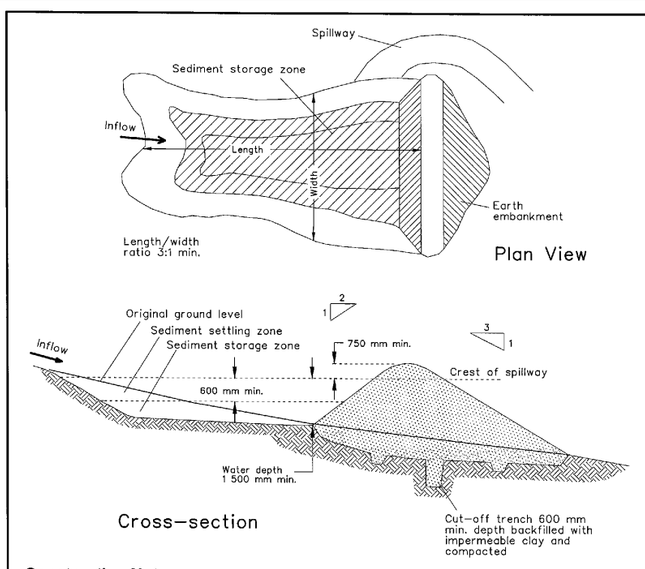


CROSS SECTION AA

Construction Notes

1. Compact the subgrade fill to the density of the surrounding undisturbed material.
2. Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
3. Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
4. Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
5. Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

ENERGY DISSIPATER **SD 5-8**



Cross-section

Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

EARTH BASIN - WET **SD 6-4**
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

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DESIGN BY: S.B.
DRAWN BY: S.B.
FINAL APPROVAL: J.A.
SCALE: (on A1 Original)

DRAWING STATUS

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PROJECT TITLE

PROPOSED SUBDIVISION
LOTS 100-102 DP 1161331
WILSON DR, MARULAN

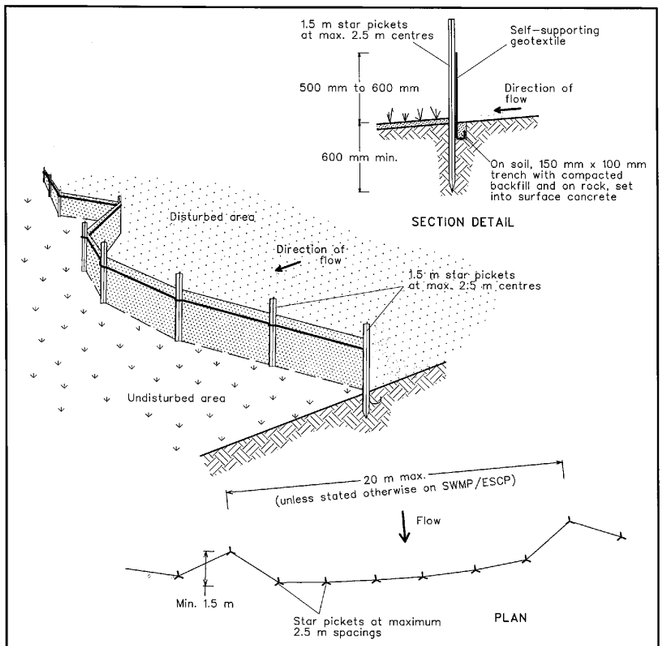
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CONCEPT SOIL & WATER
MANAGEMENT STANDARD DRAWINGS
SHEET 3 OF 3

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
21000286	P01	SWMP06	11

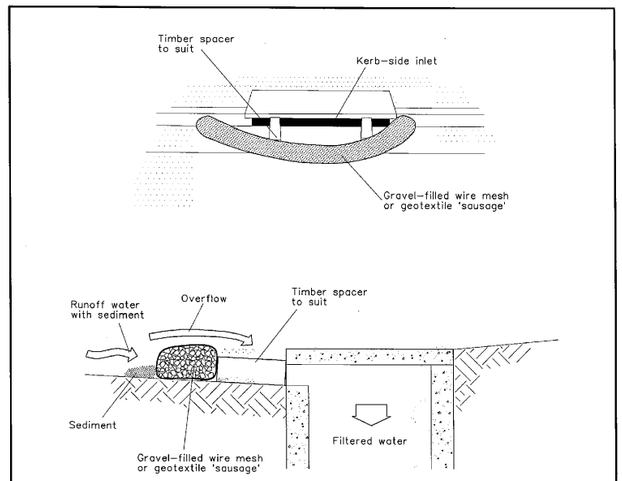
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Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE **SD 6-8**

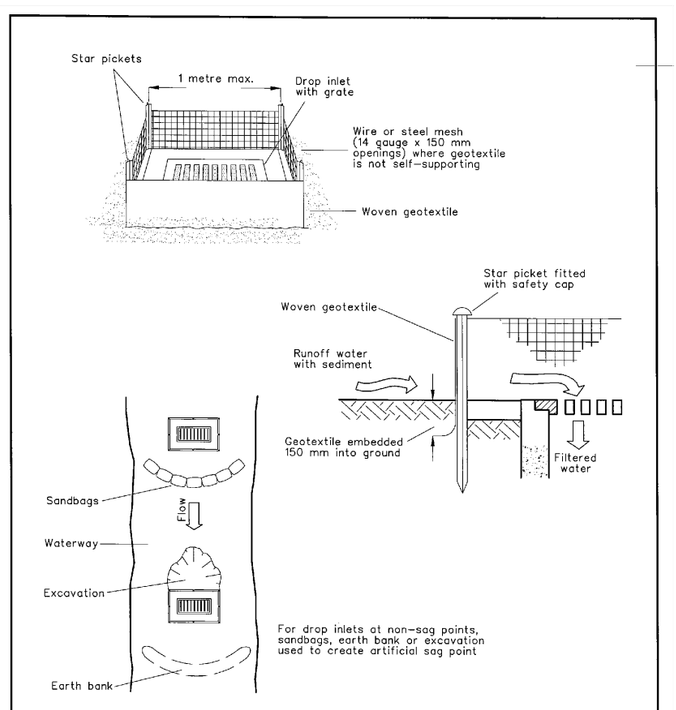


NOTE: This practice only to be used where specified in an approved SWMP/ESCP.

Construction Notes

1. Install filters to kerb inlets only at sag points.
2. Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
3. Form an elliptical cross-section about 150 mm high x 400 mm wide.
4. Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
5. Form a seal with the kerb to prevent sediment bypassing the filter.
6. Sandbags filled with gravel can substitute for the mesh or geotextile providing they are placed so that they firmly abut each other and sediment-laden waters cannot pass between.

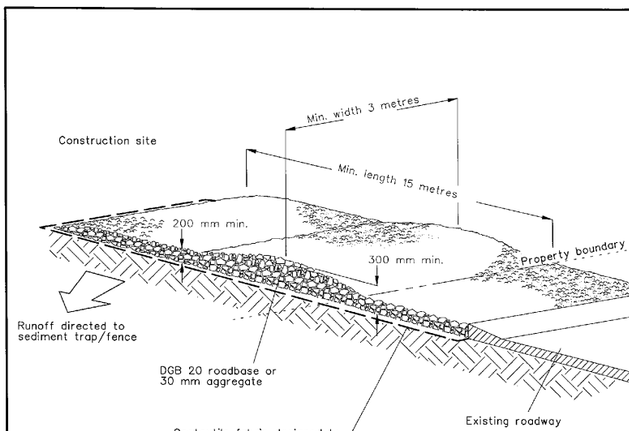
MESH AND GRAVEL INLET FILTER **SD 6-11**



Construction Notes

1. Fabricate a sediment barrier made from geotextile or straw bales.
2. Follow Standard Drawing 6-7 and Standard Drawing 6-8 for installation procedures for the straw bales or geofabric. Reduce the picket spacing to 1 metre centres.
3. In waterways, artificial sag points can be created with sandbags or earth banks as shown in the drawing.
4. Do not cover the inlet with geotextile unless the design is adequate to allow for all waters to bypass it.

GEOTEXTILE INLET FILTER **SD 6-12**



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS **SD 6-14**

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