Warren Smith & Partners

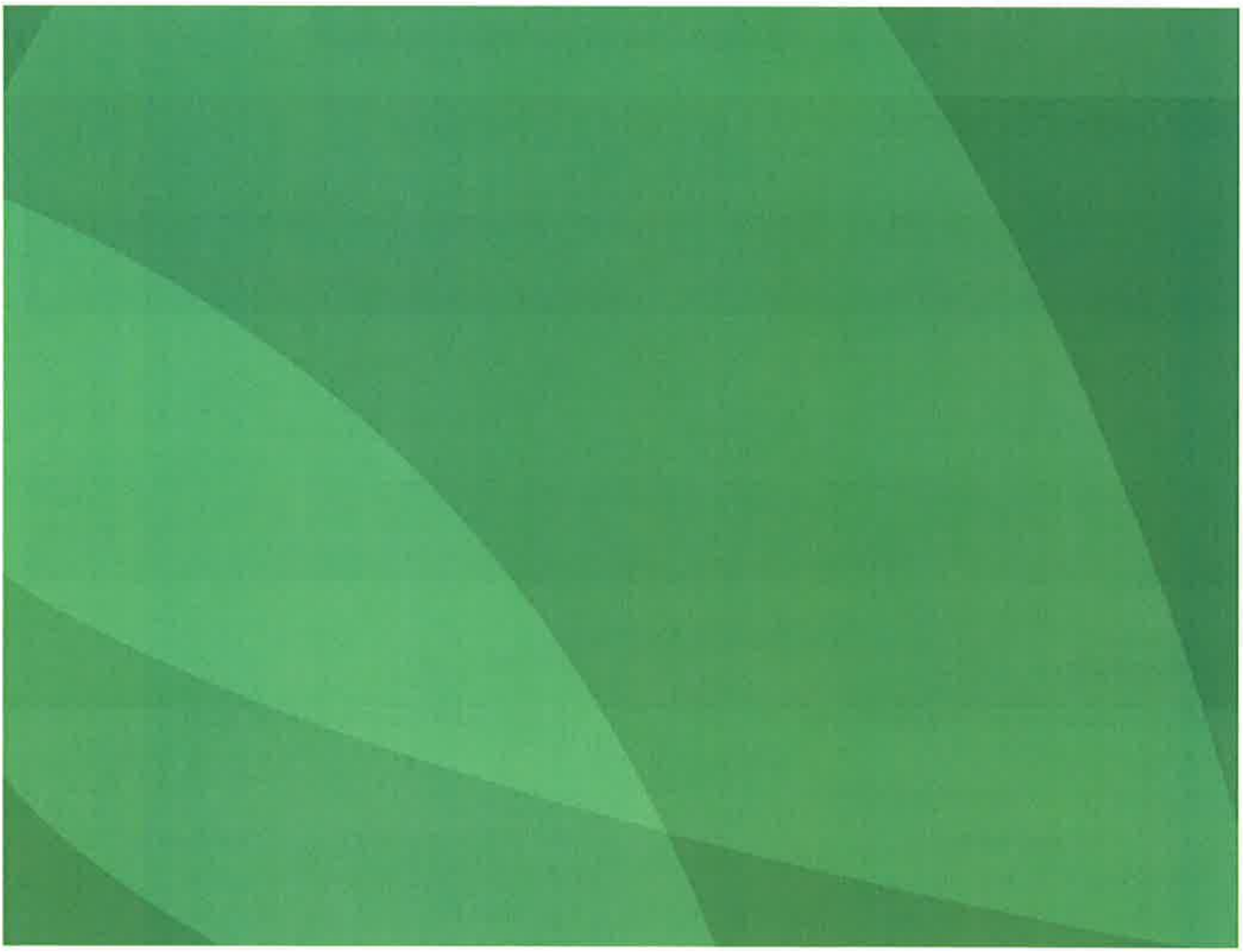
1 November 2017

CIVIL ENGINEERING SERVICES

Old Darby and Joan RSL LifeCare, Narrabeen

Civil & Stormwater

Development Application Report



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DOCUMENT CONTROL

01	1st November 2017	Issue for Development Application	Current
Rev #	**Date**	**Description of Change**	**Status**

APPROVALS

01	L. Singh *Civil Engineer*	L. Shaughnessy *Project Manager – Civil & Water Engineering*	M. Cahalane *Director – Civil & Water Engineering*
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SCHEDULES

1. INTRODUCTION

Warren Smith and Partners (WS+P) has been engaged by TSA Management, on behalf of RSL Lifecare, to prepare a development application (DA) report for the proposed development at the existing Old Darby and Joan site, located within the RSL Lifecare precinct in Narrabeen, NSW. This report will address the following: -

- Proposed site levels;
- On-Site Detention (OSD) system and stormwater drainage system;
- Proposed connections to existing stormwater infrastructure;
- Water Sensitive Urban Design (WSUD) requirements, and;
- Sediment and erosion control.

1.1 BACKGROUND

The development site is located in the RSL LifeCare precinct in Narrabeen, NSW. The development site is located to the south east of the precinct and is bound by Lantana Avenue to the south and existing RSL LifeCare housing to the north, east and west. Internal private roads James Wheeler Street and Second Avenue bound the site to the north west and north east respectively. Please refer to Figure 1 below for an aerial view of the development site.

Figure 1: Aerial View of Development Site (Source: Google Earth)

The site will see the development of new aged care housing consisting of forty-seven (47) units, two (2) new roadways, and the extension of Second Avenue roadway to connect into Lantana Avenue at the south-eastern corner of the development site.

2. EXISTING STORMWATER DRAINAGE

2.1 EXISTING DRAINAGE INFRASTRUCTURE

A desktop review and site inspection was carried out to determine the existing drainage infrastructure within the development site. The inspection revealed the following: -

- There is a total of ten (10) existing residential buildings, one (1) roadway (First Avenue), four (4) metal roof garages and several small sheds and bin storage areas, all of which will require to be demolished to make way for the new development.

- The development site grades north west at a grade of up to 12%, with a total elevation change of up to 13 metres.

- A number of stormwater pit and pipe systems exist throughout the development site which reticulate to existing stormwater pits in James Wheeler Street and Simpson Close.

- The stormwater from the RSL LifeCare precinct eventually discharges to the Narrabeen Lagoon, located approximately 850m downstream of the development site.

- The upstream catchment to the east of the development site also grades north west. However, overland flow from this upstream catchment does not reticulate through the proposed development site as it is directed in a northerly direction, away from the development site, once it hits Second Avenue, based on the survey levels provided.

- An existing stormwater pit in Second Avenue captures some of this overflow emanating from the upstream catchment and reticulates it to James Wheeler Street, through the development site, via a pit and pipe system.

- The upstream catchment south of the development site grades in a westerly direction along Lantana Avenue and does not reticulate through the proposed development.

Please refer to Figure 2 for an illustration of the site grading and stormwater infrastructure, as discussed above.

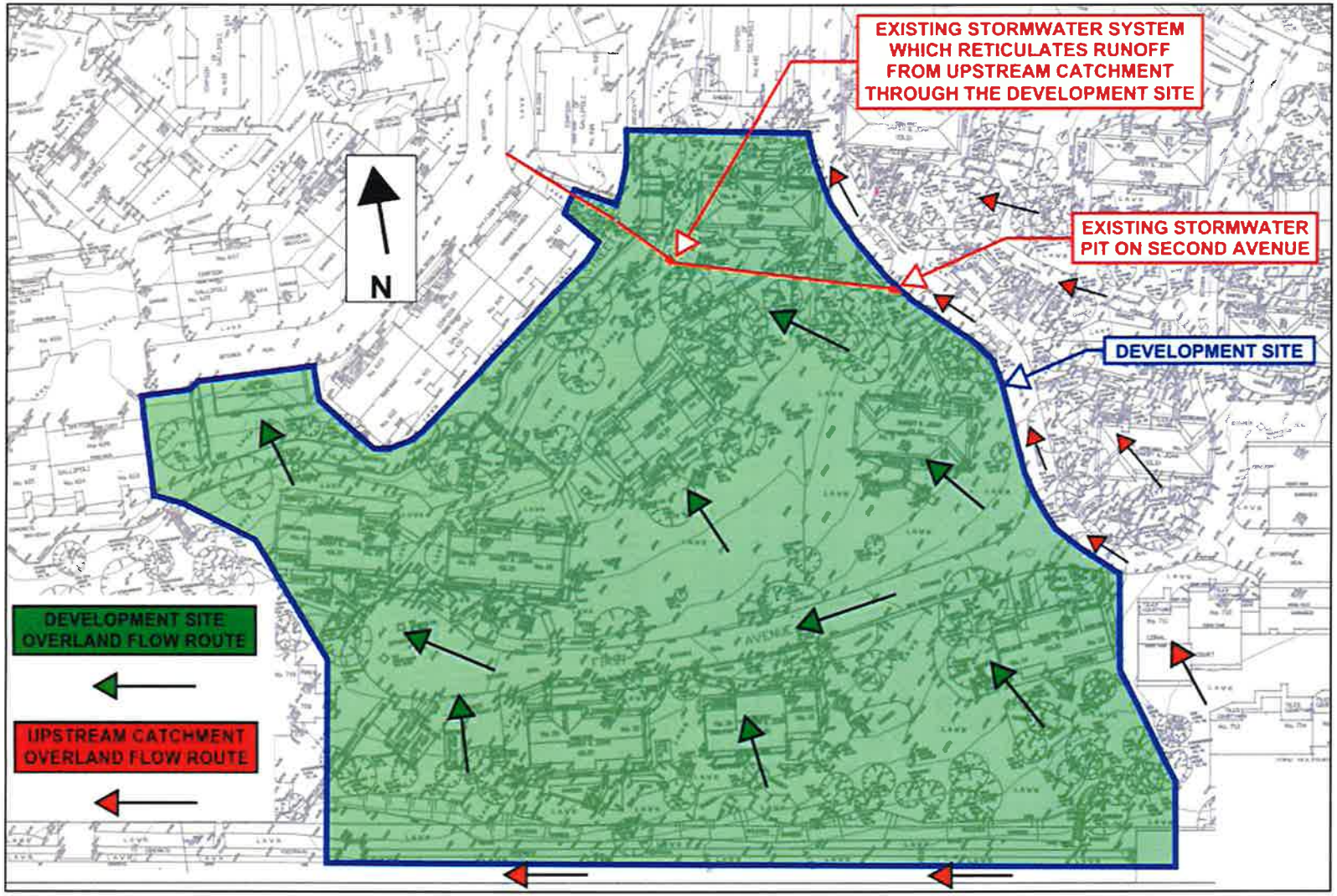

Figure 2: Aerial View of Existing Site Conditions

3. AUTHORITY AND REGULATORY REQUIREMENTS

With reference to the *Warringah Council's Water Management Policy, 2015,* and *Warringah Council's On Site Stormwater Detention Technical Specification, 2012,* the council requirements are as presented in the following sub-sections.

3.1 STORMWATER DRAINAGE REQUIREMENTS

- Runoff from the developed site must not exceed the runoff from the total site prior to the development for the 20%, 5% and 1% AEP storm events. The pre-development conditions must be taken with an impervious fraction of 0% when utilising the full computational method.
- Overland flow paths must be capable of carrying stormwater up to, and including, the 1% AEP storm event to account for 100% blockage to the piped system.
- A minimum freeboard of 300mm must be provided between habitable floor levels and the maximum water level.

3.2 ON SITE DETENTION REQUIREMENTS

- A maximum of 50% of the total site area will be allowed to bypass the OSD system.
- For above ground storage, depths of ponding on driveways and carparks must not exceed 200mm. Paving slopes within storage areas must not be less than 0.7%.
- OSD will not be required where the site of the development is located within a Council established 1% AEP storm event flood plain, and that it can be identified that lesser storm events will also flood the site. Otherwise it will be necessary to provide OSD to control the runoff for the minor storm events.

4. PROPOSED STORMWATER DRAINAGE

The total catchment area of the proposed development is 1.1144 Ha. A breakdown of the proposed development area is presented in Table 1 below.

Table 1: Breakdown of Proposed Development Site Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
Roof	0.5017	-	0.5017
To OSD Tank (excl. Roof)	0.3313	0.2522	0.5835
Bypass	0.0292	-	0.0292
Total	**0.8622**	**0.2522**	**1.1144**

The maximum area of the total development site area bypassing the OSD system shall not be greater than 50%. For this development, a total area of 0.0292 Ha will bypass the OSD which equates to 2.6% of the total development area, therefore satisfying Council's requirements.

Please refer to Figure 3 for an illustration of the stormwater and OSD systems proposed for the development and the WS+P DA drawing package for more details.

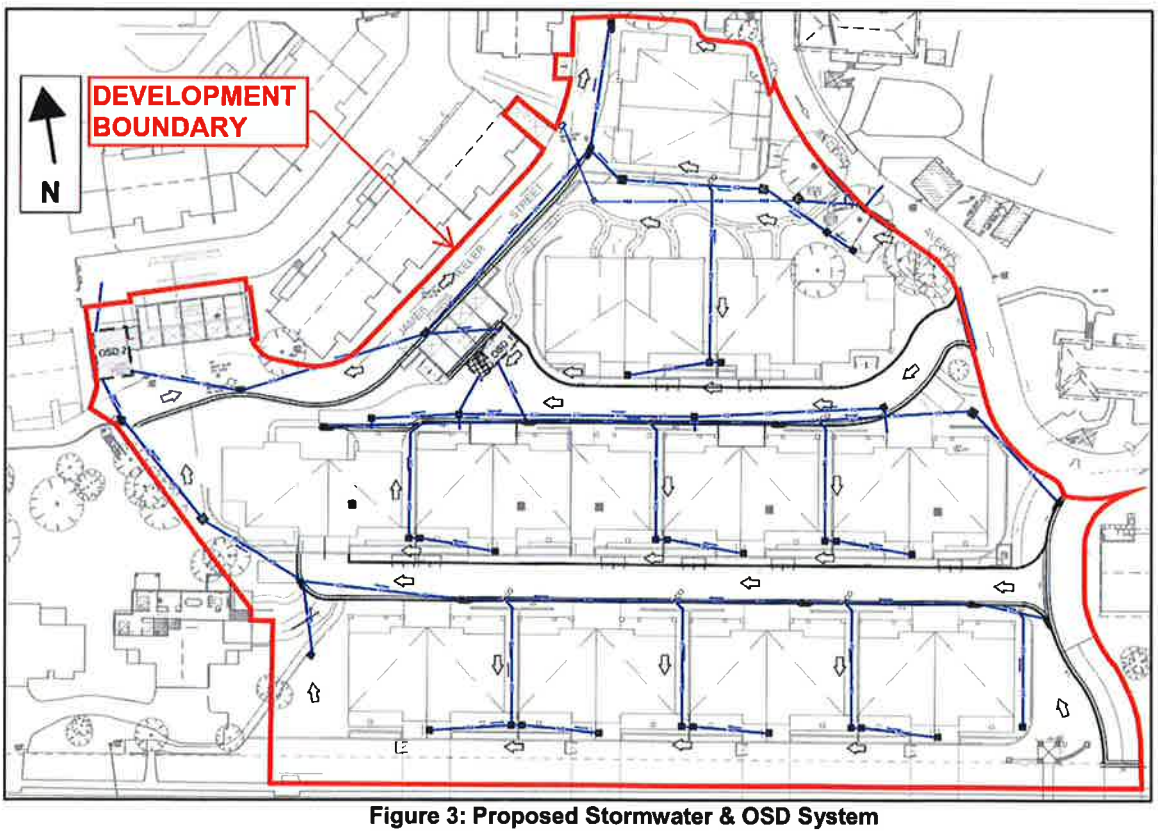

Figure 3: Proposed Stormwater & OSD System

4.1 STORMWATER & OSD SYSTEMS

Warringah Council requires that the runoff from the developed site must not exceed the runoff from the total site prior to the development for the 20%, 5% and 1% AEP storm events.

To satisfy the above condition, it is proposed that two (2) OSD tanks be installed within the development area which will provide sufficient storage to limit the discharge from the development as required. It is proposed that a pit and pipe system be installed throughout the proposed development to capture the majority of surface runoff and roof water, and reticulate it to the two (2) separate OSD tanks. The stormwater and OSD system shall ultimately discharge to an existing stormwater pit in Simpson Close located to the north west of the proposed development; refer Figure 3.

Please refer to Figure 4 for an illustration of the stormwater catchment plan.

Figure 4: Proposed Stormwater Catchment Plan

4.2 DRAINS MODEL SYSTEM PARAMETERS

The OSD storage volumes and site discharges have been calculated using a DRAINS model. DRAINS is a stormwater drainage system design and analysis program which performs hydraulic grade line analysis and generates flows that occur in a drainage system for a particular AEP storm event.

The catchment characteristic factor values used in the DRAINS model are listed below:-

- Soil Type – Normal 3.0
- Paved (Impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Antecedent Moisture Condition 3.0
- Minimum Pit Freeboard 300mm
- Blockage Factor for On-Grade Pits 20%
- Blockage Factor for Sag Pits 50%

The rainfall data has been taken from the Bureau of Meteorology Rainfall IFD Data System using local coordinates.

4.2.1 OSD 1 CATCHMENT

OSD tank 1 shall be a combined rainwater reuse and OSD tank located in proposed Road 2 immediately east of the new garage. It is proposed that a pit and pipe system shall reticulate to the rainwater tank which shall capture roof runoff only. The rainwater reuse tank will have a total volume capacity of 30kL, which will be drawn from for irrigation. Any overflow from the rainwater tank shall be directed into OSD tank 1 through an overflow pipe. A separate pit and pipe system shall capture stormwater runoff from proposed Road 2 and the properties immediately south of Road 2 and reticulate it directly to OSD tank 1. The OSD tank will discharge to a proposed pit in James Wheeler Street before reticulating to OSD 2.

A breakdown of the OSD 1 catchment area is presented in Table 2 below.

Table 2: Breakdown of OSD 1 Catchment Area

Catchment	Total Area (Ha)
Roof to OSD 1	0.0770
Roof to RWT	0.0737
Impervious	0.1317
Pervious	0.0292
Total	**0.3116**

Details of the OSD tank are presented in Table 3 below.

Table 3: OSD Tank 1 Details

Item	Value
Total catchment area discharging to OSD Tank 1	0.3116 Ha
Average Base IL of OSD 1 (RL mAHD)	54.23
Orifice 1 – Low Level Orifice Diameter	175mm
IL of Orifice 1 (RL mAHD)	54.20
Orifice 2 – High Level Orifice Diameter	100mm
IL of Orifice 2 (RL mAHD)	56.00
Required OSD Tank Volume	44.25 kL
Top water level (RL mAHD)	57.18

4.2.2 OSD 2 CATCHMENT

The remainder of the development site shall be captured via a pit and pipe network which shall reticulate directly to OSD tank 2. OSD 2 shall discharge to an existing stormwater pit located in Simpson Close.

A breakdown of the OSD 2 catchment area is presented in Table 4 below.

Table 4: Breakdown of OSD 2 Catchment Area

Catchment	Total Area (Ha)
Roof	0.3510
Impervious	0.1996
Pervious	0.2230
OSD 1	0.3116
Total	**1.0852**

Details of the OSD tank are presented in Table 5 below.

Table 5: OSD Tank 2 Details

Item	Value
Total catchment area discharging to OSD Tank 1	1.0852 Ha
Average Base IL of U/S OSD (RL mAHD)	51.04
Orifice 1 – Low Level Orifice Diameter	290mm
IL of Orifice 1 (RL mAHD)	51.00
Orifice 2 – High Level Orifice Diameter	225mm
IL of Orifice 2 (RL mAHD)	53.00
Required OSD Tank Volume	101.15 kL
Top water level (RL mAHD)	53.93

4.2.3 RESULTS

The development area's OSD tanks have been designed to ensure that the post development stormwater runoff from the site does not exceed the pre-development runoff which emanates from the site during the 20%, 5% and 1% AEP storm events. The pre-development case was modelled assuming an impervious fraction of 0%, in line with Warringah Council's On Site Stormwater Detention Technical Specification.

Please refer to Table 6 below for the development area's discharge results.

Table 6: DRAINS Discharge Results

Scenario	20% AEP Storm Event (L/Sec)	5% AEP Storm Event (L/Sec)	1% AEP Storm Event (L/Sec)
Pre-Development Discharge	244	376	525
Post Development Discharge	237	354	480

4.3 STAGE TWO DEVELOPMENT

The future Stage 2 development will see the construction of an additional thirteen (13) units and two (2) new roadways located to the eastern side of Second Avenue. WS+P has undertaken preliminary stormwater modelling to determine the OSD storage requirement for the Stage 2 development. It has been determined that a total volume capacity of 20.4 kL shall be required. This OSD tank can be suitably located beneath the proposed garage next to existing unit No. 607 in the Stage 1 development site; however, it will be independent of the proposed stormwater system for the current Stage 1 development. Please refer to Figure 5 for an indicative location of the OSD tank for the Stage 2 development.

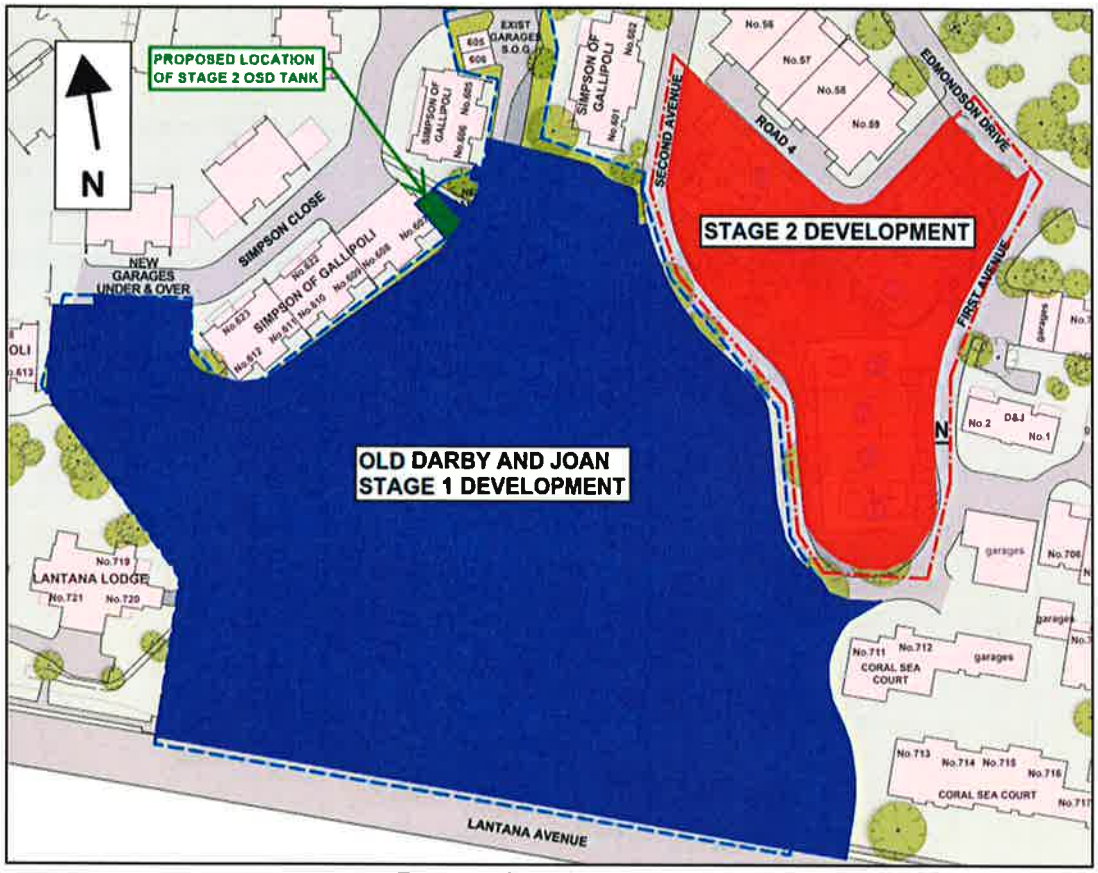

Figure 5: Stage 2 Development

4.4 FREEBOARD

In accordance with the Warringah Council's On-Site Detention Technical Specification, a minimum freeboard of 300mm has been provided between habitable floor levels and the maximum water level adjacent to the properties throughout the development site.

5. OVERLAND FLOW PATH

Warringah Council's On Site Stormwater Detention Technical Specification states that overland flow paths must be capable of carrying stormwater up to, and including, the 1% AEP storm event, accounting for 100% blockage to the piped system. To prevent any ingress of water into the proposed and adjacent properties, an overland flow path has been established along the rear of the properties and is graded in a westerly direction.

Please refer to Figure 6 for an illustration of the proposed overland flow path.

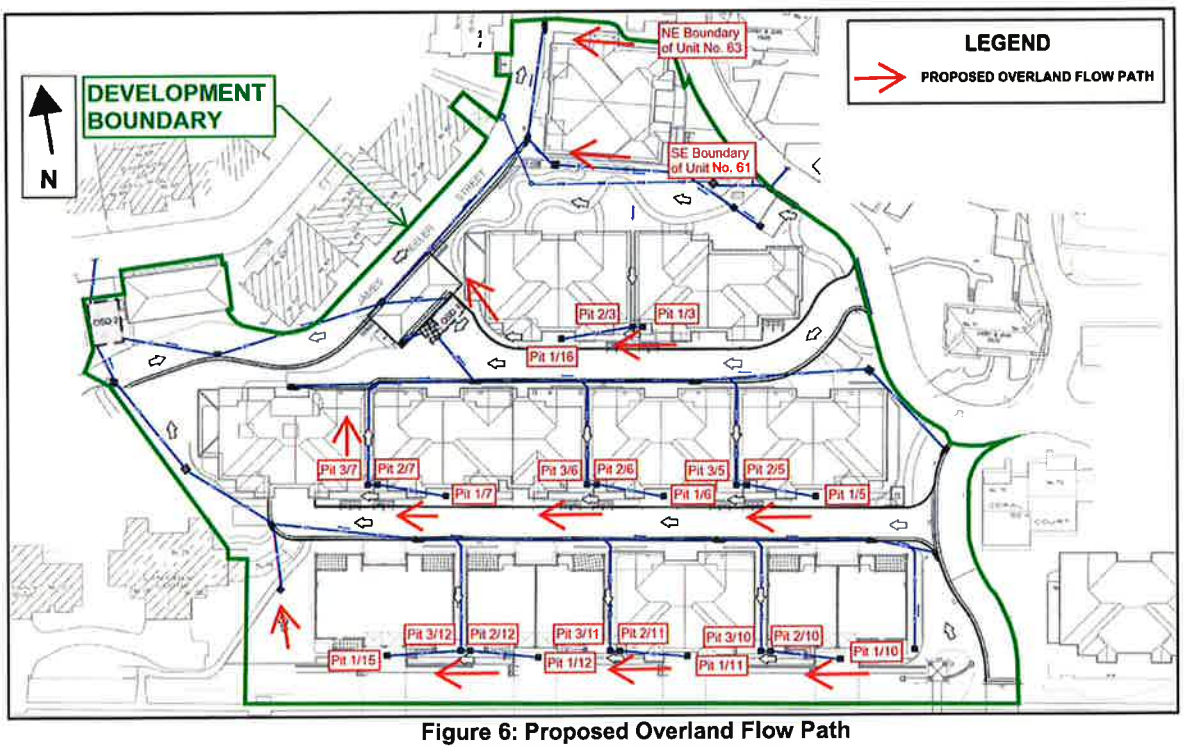

Figure 6: Proposed Overland Flow Path

The DRAINS model has been used to estimate the overland flows across all properties in the development site. Cross-section templates were developed at critical locations in order to model the proposed overland flow paths as accurately as possible. A total of twenty-two (22) cross-sections were developed for the DRAINS model and the depth of flow was evaluated at each location. Please refer to Table 7 for the depth of overland flow that occurs in the 1% AEP storm event with 100% pipe blockage.

Table 7: Depth of Overland Flow

Location	RL at Location (mAHD)	FFL of adjacent property (mAHD)	Depth of Overland Flow (m)	Top Water Level (RL mAHD)	Clearance (m)
NE Boundary of Unit No. 63	55.05	55.15	0.087	55.137	0.013
SE Boundary of Unit No. 61	55.06	55.15	0.071	55.131	0.019
Pit 1/3	58.12	58.20	0.014	58.134	0.066
Pit 2/3	57.13	57.21	0.014	57.144	0.066
Pit 1/5	62.38	62.46	0.019	62.399	0.061
Pit 2/5	62.34	62.46	0.009	62.349	0.111
Pit 3/5	61.11	61.16	0.023	61.133	0.027
Pit 1/6	61.08	61.16	0.024	61.104	0.056
Pit 2/6	61.04	61.16	0.009	61.049	0.111
Pit 3/6	59.78	59.88	0.024	59.804	0.076
Pit 1/7	59.09	59.17	0.024	59.114	0.056
Pit 2/7	59.05	59.17	0.024	59.074	0.096
Pit 3/7	57.85	57.95	0.075	57.925	0.025
Pit 1/10	65.67	65.79	0.078	65.748	0.042
Pit 2/10	65.645	65.79	0.041	65.686	0.104
Pit 3/10	64.41	64.49	0.075	64.485	0.005
Pit 1/11	64.37	64.49	0.042	64.412	0.078
Pit 2/11	64.34	64.49	0.071	64.411	0.079
Pit 3/11	62.72	62.81	0.088	62.808	0.002
Pit 1/12	62.69	62.81	0.072	62.762	0.048
Pit 2/12	62.66	62.81	0.091	62.751	0.059
Pit 3/12	61.67	61.77	0.098	61.768	0.002
Pit 1/15	61.65	61.77	0.079	61.729	0.041
Pit 1/16	57.03	57.06	0.023	57.053	0.007

A cross-section of the overland flow path between Pit 3/12 and 1/15 can be seen in Figure 7. The results show that the overland flow between Pit 3/12 and 1/15 is the largest with a depth of 98mm. A clearance of 2mm is provided; however, it is important to note that this scenario would only occur in the unlikely event of 100% pipe blockage to the entire stormwater system in a 1% AEP storm event.

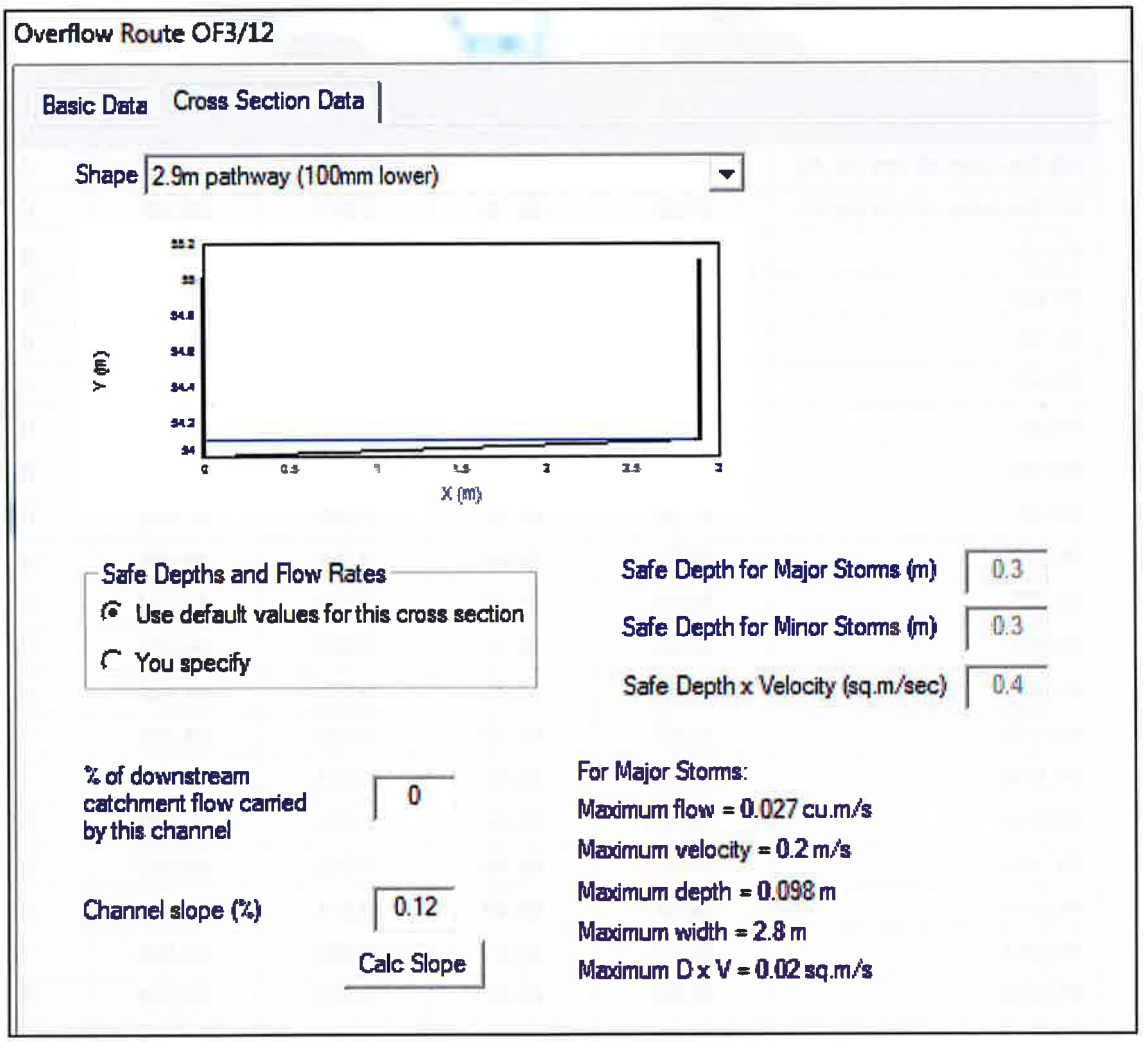

Figure 7: Proposed Cross-Section for OF 3/11

6. WATER QUALITY MANAGEMENT

6.1 POTENTIAL POLLUTANTS GENERATED

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

- Gross pollutants, e.g. Litter;
- Sediment;
- Nutrients (Nitrogen and Phosphorus), and;
- Hydrocarbons.

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

6.2 REGULATORY REQUIREMENTS

With reference to *Warringah Council's Water Management Policy, 2015, Section 8.1.1*, the water quality requirements are presented in Table 8 below and have been incorporated into the design to ensure adequate water quality treatment is provided to the system.

Table 8: Warringah Council Pollutant Reduction Requirements

Pollutant	Reduction Percentage (%)
Gross pollutants	90%
Total suspended solids	85%
Total Phosphorus	65%
Total Nitrogen	45%

6.3 RAINFALL

The rainfall data used in the MUSIC model was based on the Bureau of Meteorology data and is presented in Table 9 below.

Table 9: Rainfall Data for MUSIC Modelling

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

The average potential evapotranspiration (PET) data used in the MUSIC model was based on the average monthly PET data for the Sydney region and is presented in Table 10.

Table 10: Monthly Evapotranspiration Data for MUSIC Modelling

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

6.4 RAINFALL RUNOFF PROPERTIES

In accordance with the Draft NSW MUSIC Modelling Guidelines, dated August 2010, Table 11 and Table 12 present the rainfall runoff properties which have been used.

Table 11: Soil Properties for MUSIC Source Nodes

Parameter	Units	Urban
Impervious Area Parameters		
Rainfall Threshold	mm	1.0 (for roads/paths etc.) 0.3 (for roofs) & 1.5 (for driveways)
Pervious Area Parameters		
Soil Capacity	mm	120
Initial Storage	%	30
Field Capacity	mm	80
Infiltration Capacity Coefficient – a		200
Infiltration Capacity Coefficient – b		1.0
Groundwater Properties		
Initial depth	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	5
Deep Seepage	%	0

Table 12: Stormwater Water Quality Parameters for MUSIC Source Nodes*

Land-Use Category		Log_{10}TSS (mg/L)		Log_{10}TP (mg/L)		Log_{10}TN (mg/L)	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roofs	Mean	1.30	N/A	-0.89	N/A	0.30	N/A
	Std Dev	0.32	N/A	0.25	N/A	0.19	N/A
Sealed Roads with Pervious Fractioms	Mean	2.43	1.20	-0.30	-0.85	0.34	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Landscaped Areas	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12

*These values have been taken from Approach 2 in the Draft NSW MUSIC Modelling Guidelines

6.5 MUSIC MODEL CATCHMENT AREAS & TREATMENT PLAN

The MUSIC model's total catchment area to be treated is 1.0739 Ha. This area has been divided into seven (7) sub-catchments, with a total area of 0.0405 Ha bypassing the system. Please refer to Table 13 for a breakdown of the MUSIC model catchment areas and Figure 8 for an illustration of the MUSIC model catchment plan.

Table 13: Breakdown of MUSIC Model Catchment Areas

Catchment	Area (Ha)	Pervious Area (%)	Impervious Area (%)
OSD 1			
Roof Catchment	0.0737	-	100
Roof to RWT	0.0770	-	100
Road Surfaces	0.0727	-	100
Landscaped Areas	0.0882	33	67
OSD 2			
Roof Catchment	0.3510	-	100
Road Surfaces	0.1337	-	100
Landscaped Areas	0.2776	80	20
Bypass	0.0405	-	100
Total	**1.1144**		

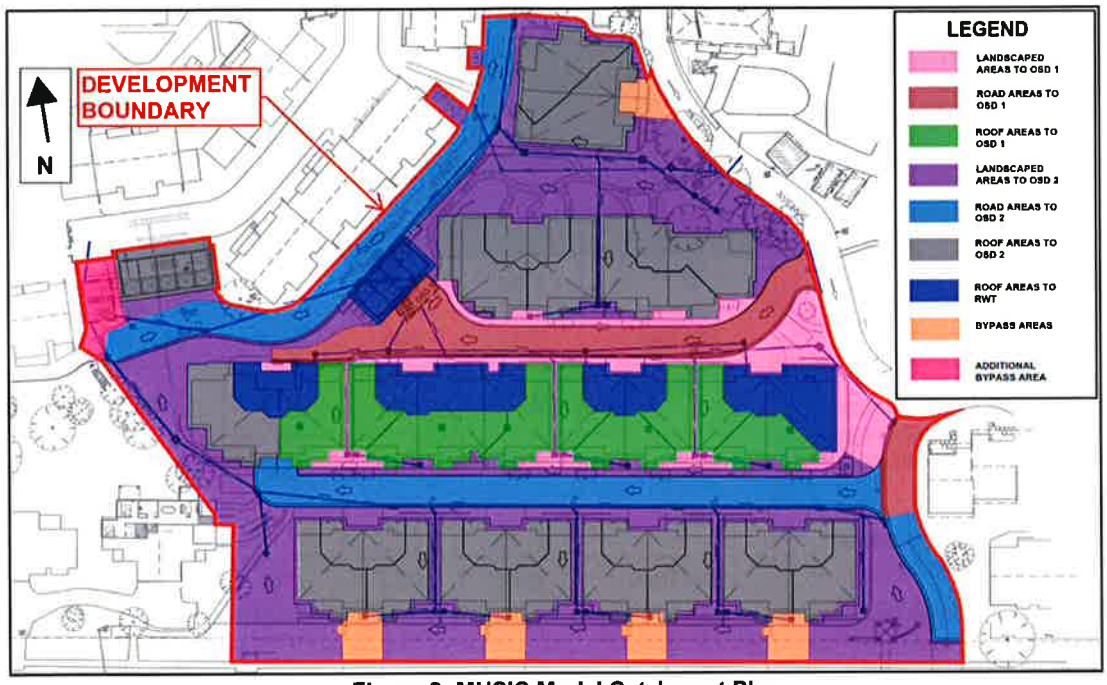

Figure 8: MUSIC Model Catchment Plan

The proposed site treatment will utilise two products by Stormwater 360. The first level of treatment will include Enviropods, which intercept surface runoff at the pit grates and filter the runoff prior to entering the piped stormwater system. It is proposed that thirty-three (33) grated stormwater pits on site will be fitted with enviropod filter baskets. The Enviropod is fitted with a monofilament 200 micron pore size filter bag that removes gross pollutants such as sediment, trash and debris as well as suspended solids; please refer to Figure 9 below for an illustration of a typical Enviropod.

Figure 9: Typical Enviropod Filter

The second treatment device which will be incorporated into the system is a stormfilter system that will be contained within a sectioned area of the OSD storage tank. To achieve the reduction targets, nine (9) and eighteen (18) Stormwater360 690mm phosphorous absorption cartridges will need to be installed into both OSD Tank 1 and OSD Tank 2 respectively. A Psorb Stormfilter cartridge system is provided to remove any remaining suspended sediments and nutrients which have entered the stormwater system, please refer to Figure 10 below for an illustration of a typical Psorb Stormfilter.

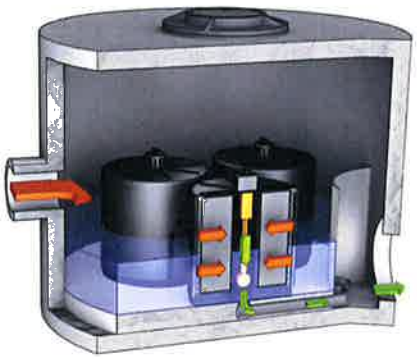

Figure 10: Typical PSorb Stormfilter

6.5.1 RAINWATER REUSE

In order to calculate the proposed total rainwater reuse daily demand, an average water demand of 0.4kL/Year/m^2 has been assumed for irrigation. An average of 2.724kL/Day has been estimated for the rainwater reuse tank; please refer to Table 14 for the irrigation demand calculation.

Table 14: Irrigation Average Daily Water Demand

Use	Average Water Demand	Area to be Irrigated (m^2)	Average Daily Demand (kL/Day)
Irrigation	0.4 kL/Year/m^2	2, 522	2.764

6.6 MUSIC MODELLING RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Please refer to Figure 11 for the stormwater treatment plan and Table 15 for the MUSIC modelling results.

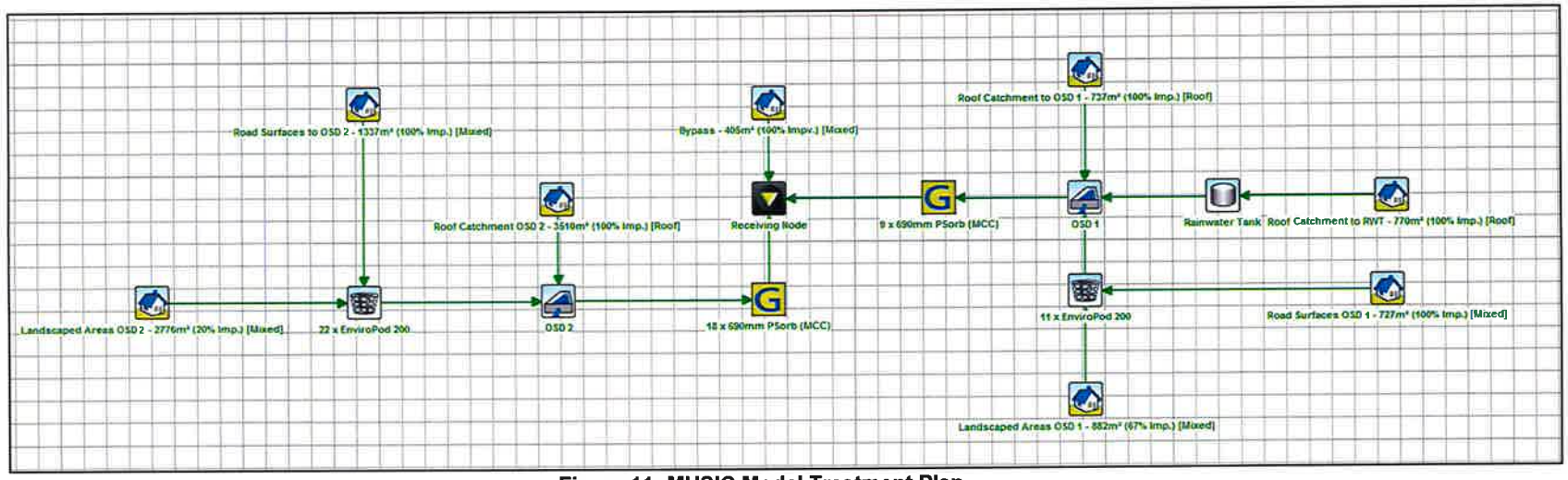

Figure 11: MUSIC Model Treatment Plan

MUSIC results are summarised in Table 15 below and attached in *Schedule 2*.

Table 15: MUSIC Model Results

Pollutant	Sources	Residual Load	% Reduction	Target %
Gross Pollutants (kg/yr)	269	11.2	95.8	90
Total Suspended Solids (kg/yr)	1510	226	85.1	85
Total Phosphorus (kg/yr)	3.26	0.772	76.3	65
Total Nitrogen (kg/yr)	25.4	11.6	54.4	45

7. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the general requirements outlined below.

7.1 SITE PROTECTION MEASURES

It is proposed to provide the following in order to inhibit the movement of sediment off the site during the demolition and construction phases.

7.1.1 SITE ACCESS

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

7.1.2 SEDIMENT CONTROL

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

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

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

- Geotextile fabric buried to a maximum of 100mm below the surface;
- Overlapping any joins in the fabric;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event.

Please refer to Figure 12 for details.

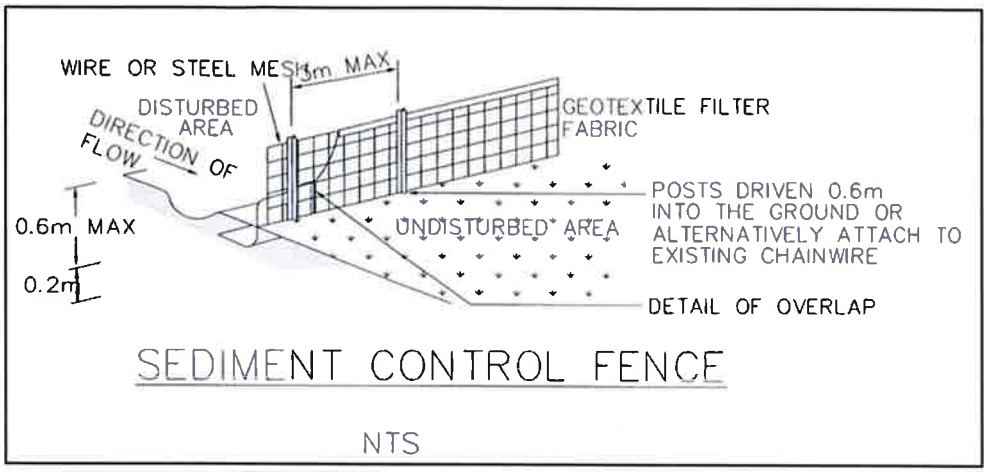

Figure 12: Sediment Control Fence Illustration

Existing stormwater infrastructure is also to be protected from incoming sediment using the following methods:-

- Any Council owned road kerb entry and or gully pits will be protected by Filter Bales and EcoSocks. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

Please refer to Figure 13, Figure 14, and Figure 15 for details.

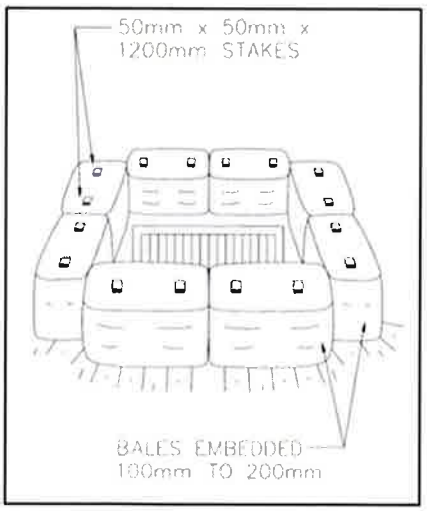

Figure 13: Stormwater Pit Sediment Trap (NTS)

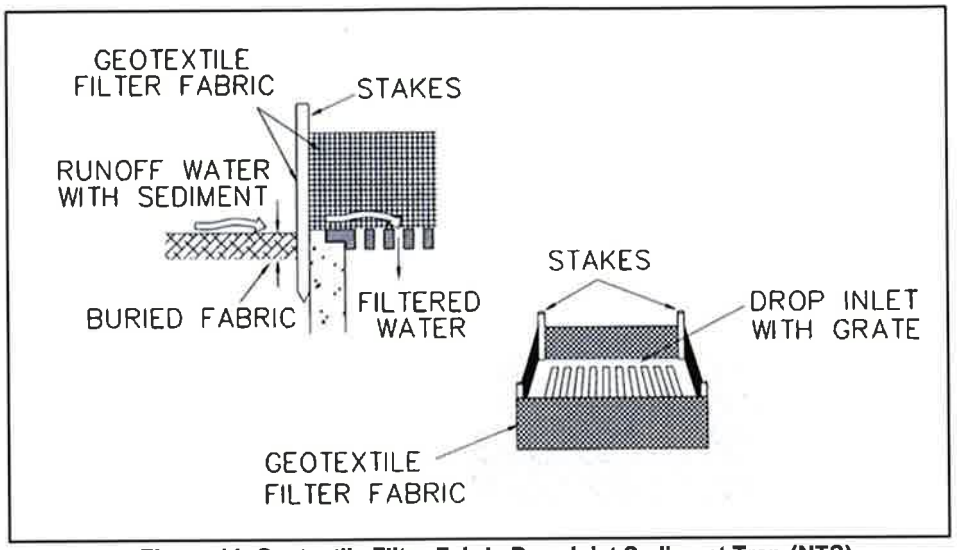

Figure 14: Geotextile Filter Fabric Drop Inlet Sediment Trap (NTS)

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply witht environmental and regulatory requirements.

Durable, Dependable, Reusable.
Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and re-useable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.

Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

1. **FilterBales frames** are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc

2. **Filter medium** (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil.

3. **FilterBales** have a seven (7) stage filtration system:

1. **In through the filter bag**
2. **Through the perforated plastic structure wall**
3. **In through the filter cartridge bag**
4. **Through the bio engineered filter medium**
5. **Out through the filter cartridge bag**
6. **Out through the perforated plastic structure wall**
7. **Out through the filter bag**

4. **The filter bag** is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile.

5. **FilterBales** work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events". During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application.

6. **EcoSocks** are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag.

7. **FilterBales** are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems.

Product Range

Item No.	Description	
HFB001	**High FilterBale,** suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	**Low FilterBale,** suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	**Directional EcoSock,** can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	

Accessories

Item No.	Description	
FCR004	**WaterClean Filter Cartridges** contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

Figure 15: Erosion Control Filter Products

7.2 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.

7.2.1 DUST CONTROL

The following dust control procedures will be adhered to:

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

7.2.2 MAINTENANCE

- It will be the responsibility of the contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary.
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site.
- Gutters and roadways will be kept clean regularly to maintain them free of sediment.
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient as quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site; and,
- Materials processing equipment suitably comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks.

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

SCHEDULE 1 – MUSIC RESULTS

Receiving Node

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Treatment Train Effectiveness

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Sources	11.5	1.51E3	3.26	25.4	269
Residual Load	11.0	226	0.772	11.6	11.2
% Reduction	4.6	85.1	76.3	54.4	95.8