41 KING STREET TARAGO PLANNING PROPOSAL

STORMWATER MASTER PLAN
APRIL 2025

PREPARED FOR GROUP ONE PTY LTD

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Cover photo: Courtesy of N Evans, showing the view from the existing house overlooking the valley to North West of the site

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1. INTRODUCTION

Spiire Australia Pty Ltd (Spiire) has been engaged by Group One Pty Ltd (Group One) to prepare a stormwater master plan (SMP) including a flood risk management study to support the rezoning of 41 King Street Tarago (The Site) from RU2 (Rural Landscape) to RU5 (Village), to allow residential development.

This report considers a catchment scale proof of concept design to support a planning proposal. Further refinement and details will be determined at the subsequent development application and detailed design phases of the project.

The Site landholding is approximately 10ha and is located on the western edge of the existing Tarago township, 1.6km from the centre of town. The site borders the town to the west and is surrounded by rural residential/agricultural land on all other boundaries. Tarago is part of the Goulburn Mulwaree Council (GMC) LGA, who's standards will form the basis of the proposed future development design.

The Site and the existing township drain to the Mulwaree River which runs along the eastern edge of the Tarago township. The site is therefore located within the Sydney drinking water catchment and subject required to show a neutral or beneficial effect (NorBE) on water quality to the concurrence of WaterNSW.

Figure 1 Site Locality

The current overall development concept was developed by Place Logic and is presented in Figure 2 with the key characteristic of the development as follows:

- 26 residential lots (subject to future design refinement)
  - 24 lots 2500- 3000m2
  - 2 lots >4000m2
  - 1 lot for Open Space/WSUD and potential future lot
- No mains water connection
- All lots are unsewered.

Figure 2 Concept development layout (Place Logic)

As the proposed development involves the subdivision of more than 4 unsewered lots it has been classified as a development class, N_{ul} development and therefore need to be assessed in accordance with Module 4 of the NorBE assessment Guideline.

2. FLOOD IMPACT ASSESSMENT / HYDROLOGY

2.1 REQUIREMENTS & OBJECTIVES

The hydrological analysis of 41 King Street Tarago has the following objectives:

- Analyse the existing catchment both internal and external and calculate peak flows entering and exiting the site for both the minor 20% AEP and major 1% AEP flow events.
- Assess whether the site is in flood prone land and thus unsuitable for development.
- Analyse the impact of the proposed residential development for both the minor 20% AEP and major 1% AEP flow events.
- Develop a concept option capable of mitigating any downstream flood impacts caused by the development.

The future engineering design of the development will need to achieve the objectives set out in GMC Development Design Specification D5. It is noted that this specification refers AR&R87 methodologies, however, to align with current best practices AR&R19 methodologies and modelling practices have been adopted in this study.

2.2 EXISTING CONDITIONS

2.2.1 CATCHMENT DESCRIPTION

The site is located on top of ridge just below the peak of the hill and as such it has three separate outfall locations. The site has a slope of typically between 5 and 10%. However, along the edges of the site there are areas in excess of 25%.

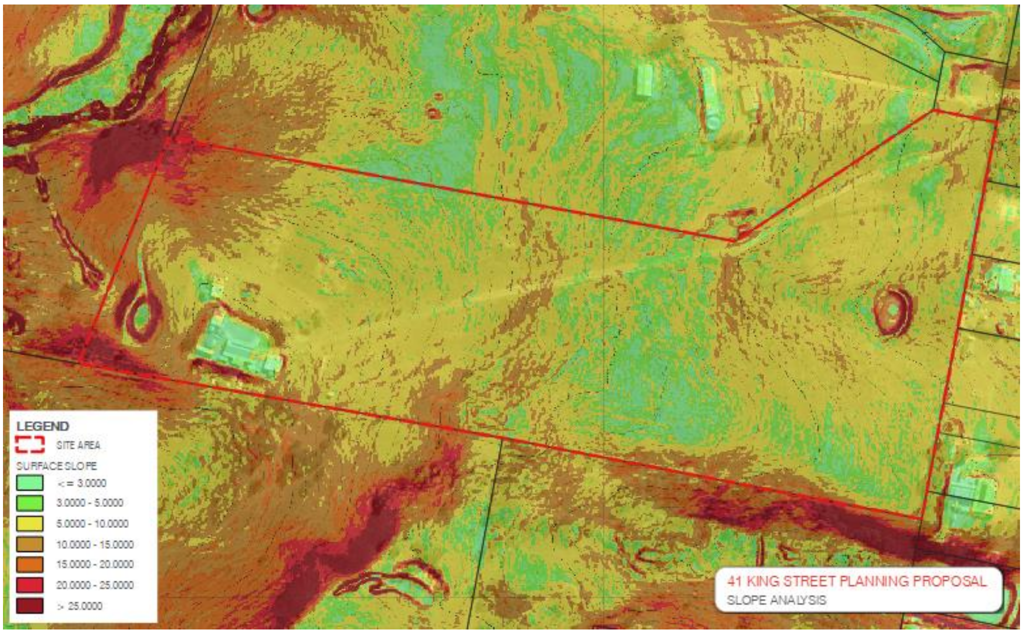


Figure 3 Slope Analysis

The site has been fully cleared of any native trees typical of its previous agricultural land use with the ground cover predominantly grassed with some areas covered in blackberries and other weeds during the site visit.

2.2.2 EXISTING SITE FLOOD RISK POTENTIAL

Flows in the two surrounding water courses (both offsite) were assessed to determine the risk of potential riverine flood impact on The Site. No previous detailed flood studies of the area could be found.

The unnamed creek to the west of the Site has an upstream catchment of 180ha. The RFFE model was utilised to obtain a concept flow for assessment. The upper 95% confidence flow was selected to provide a conservative assessment of the predicted flows. The 1%AEP event was determined to be 47.2m^3/s (median flow 17.3 m^3/s).

The flood level in the creek was then determine from a PC convey section taken from the creek perpendicular to the low point of The Site (North West corner). Figure 4 shows the predicted flood level within the creek with the red dot on the right of the section representing the Site boundary.

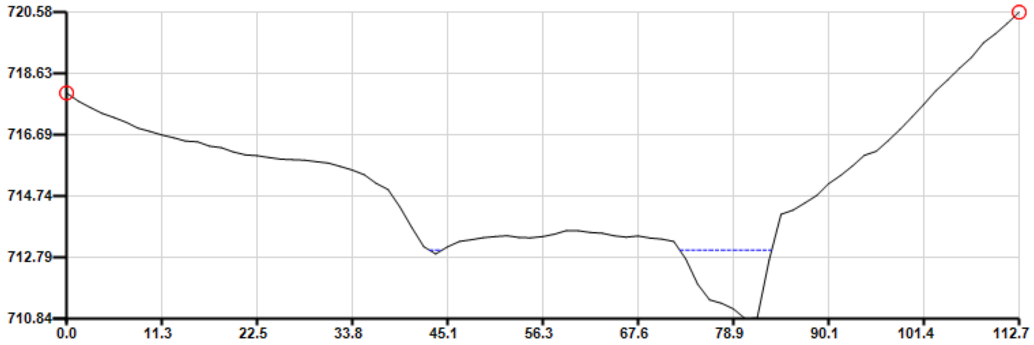


Figure 4 Unnamed Creek Flood level

The Site boundary is 8m higher than the calculated creek flood level, and therefore no risk of riverine flooding from this unnamed creek on the Site was determined without the need for further detailed analysis.

The same methodology was applied to the drainage depression to the South of the site. This drainage depression has a catchment of 20ha. The upper 95% confidence flow was determined as 10.5m^3/s (median flow 3.95 m^3/s). Figure 5, shows the predicted flood levels. The Site Boundary is to the right of the figure

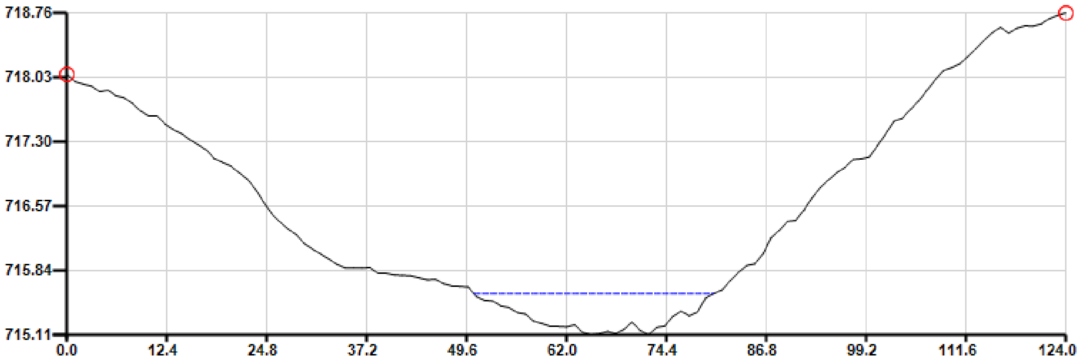


Figure 5 Southern Drainage Depression Flood Level

The Site boundary is 3m higher than the calculated flood level, and therefore no risk of flooding was attributed to this drainage line without the need for further detailed analysis.

It was therefore deemed that there is no existing flood risk from riverine flooding to the proposed development site. As the site is located significantly higher than the surrounding watercourse detailed hydraulic modelling is not seen as necessary to confirm this assertion.

2.2.3 EXISTING CONDITIONS HYDROLOGY MODELLING

The Site naturally drains in three directions, forming three sub catchments as displayed in Figure 6 A more detailed catchment plan is presented in Appendix A. Due to the different sizes of the sub catchments, they were required to be treated differently in accordance Australian Rainfall and Runoff (ARR) 2019 methodologies.

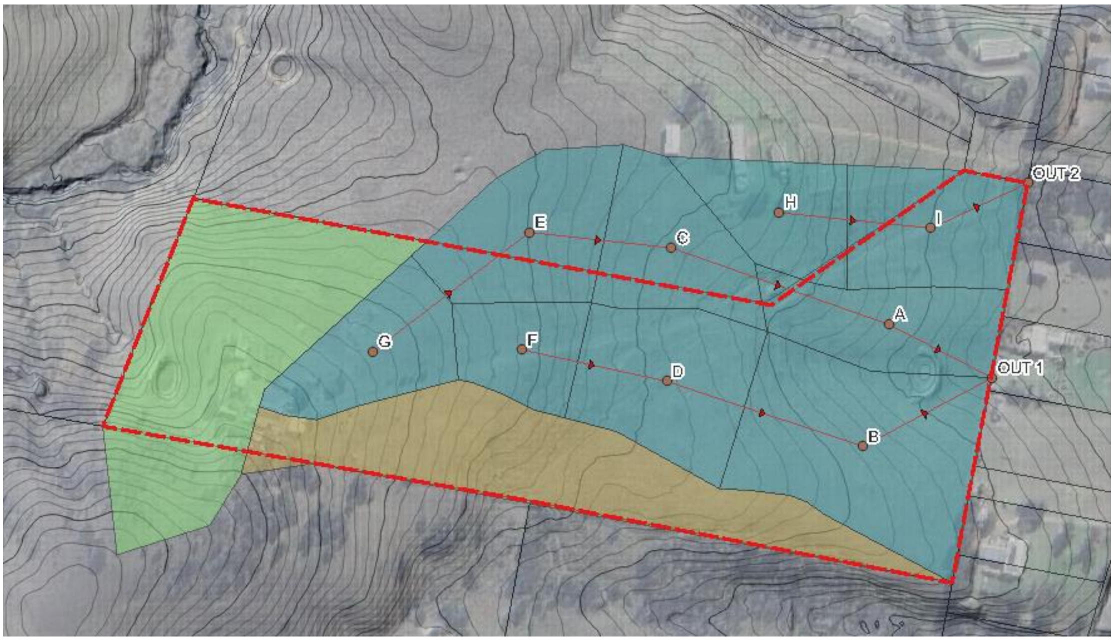


Figure 6 Existing Catchment Delineation

2.2.3.1 Eastern Catchment (Blue)

The Eastern catchment was modelled using the hydraulic design program RORB in accordance with Australian Rainfall and Runoff (ARR) 2019 methodology. The catchment plan for the RORB model is presented in Appendix A. RORB reach type 2 was used to model all reaches due to the slope of the site.

RORB Parameters

In accordance with ARR2019 guidelines an ensemble simulation was used to calculate the median flow in the critical event. The rainfall temporal patterns were obtained through the ARR Data Hub website on the 03/07/23. The rainfall IFD's data was obtained through the BOM Website on the 03/07/23.

Initial and continue loss value were also obtain through ARR Data Hub website and the OEH recommended reduction factors applied.

The default RORB equation was adopted to calculate the Kc routing coefficient with no local formula found. Alternate equation listed in ARR where not seen as applicable to the Site due to the relatively small catchment been analysed.

Parameters used in the model are presented below in Table 1.

Table 1: Pre-developed RORB model parameters.

Parameter		Value
Loss Parameters	1% AEP Initial Loss (mm)	5.6
	20%AEP Initial Loss (mm)	9.0
	Continuing Loss (mm/hr)	1.12

Parameter		Value
RORB runoff routing parameters	m	0.8
	kc	0.64
Catchment Fraction Impervious		0.05

The results of the analysis were compared to the conventional rational method calculation using a Bransby Williams TC and the RFFE model. Results of the different methods are also presented in Table 2.

Table 2 RORB Model Comparison (flow exiting site)

Design Event	RFFE	Rational (Bransby Williams)	RORB
1%AEP Flow (m^3/s)	1.6	1.7	1.8

All three methodologies produced results of a very similar magnitude and therefore the model was deemed suitable for use without change.

2.2.3.2 Western Catchment (green)

The western catchment has a total area of 2.4ha of which 0.5ha is an external contributing catchment. Due to the size of the catchment, it was deemed suitable to use a rational calculation to determine the areas predevelopment peak flows.

The flow calculated leaving the site in the 1% AEP event was calculated at 0.55m^3/s

2.2.3.3 Southern Catchment (brown)

In order to consolidate the number of asset and reduce the future maintenance burden of their maintenance, it was elected to divert the southern (brown) catchment into the main (blue) catchment draining to the east (towards the Tarago town centre). Therefore, developed flows will be less than the pre-developed flows and the objectives will be met without any calculation required.

2.3 PROPOSED CONDITIONS

The overall treatment strategy is to divert as much of the estate catchment to a single treatment asset. It is proposed to divert and convey the stormwater runoff via the road network and the associated vegetated roadside channels.

Nuisance flows both entering and exiting the site will be captured in drainage swales at the boundaries and conveyed via the road network to the point of discharge.

Figure 7 Flow Paths

The remaining catchment to the west of the site will continue to flow toward the unnamed creek. Despite the increase of impervious surface expected from future development as the total area has been reduced, so has the developed flows leaving site. Further details are provided in section 2.3.2.

There is also an area to the north of the site that cannot be graded back to the proposed basin. This includes some flows entering the block from the neighbouring allotment to the north. It is proposed to over attenuate the flows that drain to the basin to offset flows that cannot be captured, ensuring peak predeveloped flows will not be exceeded in the design events by the development.

The development catchment plan is presented below in Figure 8 with the two areas that do not drain to the basin presented in green and purple respectively.

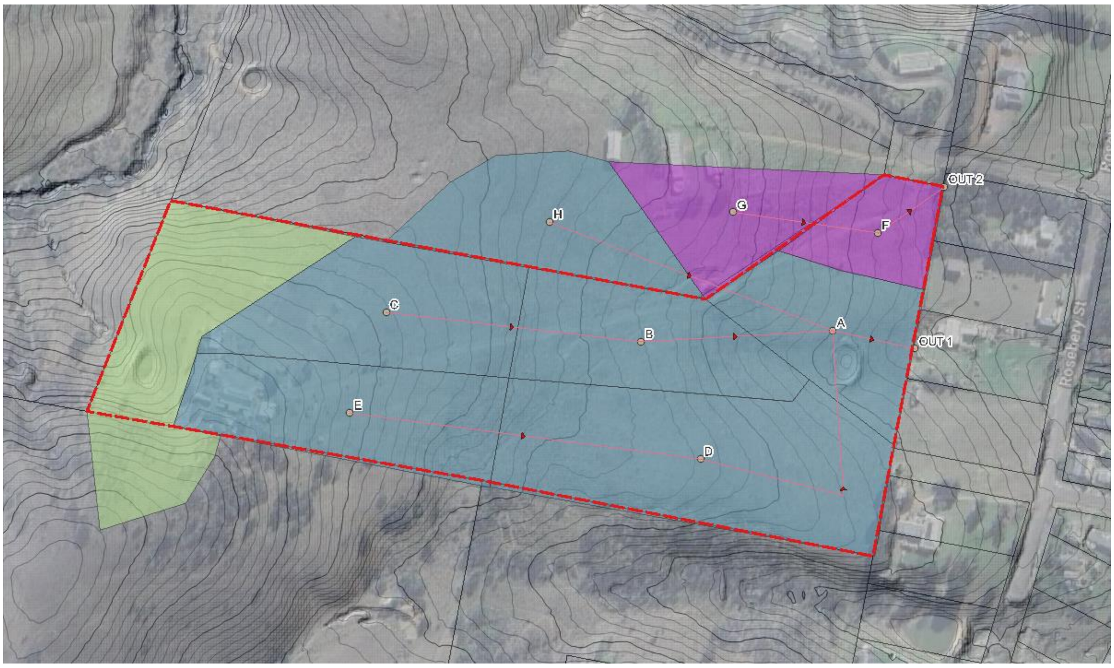


Figure 8 Developed RORB Catchment Plan

2.3.1 EASTERN CATCHMENT

The RORB model was updated to reflect the proposed new catchment areas, flow lengths and fraction impervious. A fraction impervious of 0.3 was assumed for the proposed allotment areas and 0.5 for the road network based on the typical section in the Place Logic Concept Master Plan.

The same loss parameters used in the pre-developed model. The Kc value was scaled proportionally with the change in the average flow length. Parameters used are presented below in Table 3.

Table 3 Developed RORB parameters.

Parameter		Value
Loss Parameters	1% AEP Initial Loss (mm)	5.6
	20%AEP Initial Loss (mm)	9.0
	Continuing Loss (mm/hr)	1.12
RORB runoff routing parameters	m	0.8
	kc	0.75
Catchment Fraction Impervious	Undeveloped	0.05
	Lots	0.3
	Road	0.5

The model was iteratively run with a detention basin until the predeveloped flow for the site were achieved for both the 1% and 20% AEP events. The results of this analysis as well as the proposed basin size are presented in Table 4.

The outlet configuration for the detention basin was assumed to be a 525mm pipe culvert. This was sized to choke the flows back to the predeveloped values for both the major and minor event.

Table 4 Developed Model Results

	20%AEP	1%AEP
Predeveloped Flow	0.65 m^3/s	1.79 m^3/s
Developed Unattenuated Flow	1.11 m^3/s	2.31 m^3/s
Developed Attenuated Flow	0.59 m^3/s	1.33 m^3/s
Flood Storage Volume	900 m^3	1,600 m^3

2.3.2 WESTERN CATCHMENT

The flows exiting the site through the western catchment were determined using rational calculation in the same manner as the predeveloped flows. The western catchment reduced in area to 1.9ha total (previously 2.4ha) of which the same 0.5ha of external catchment was included. The developed model runoff coefficient was updated to reflect the change in impervious area. The 20% reduction in area was able to offset the increase in impervious area as presented below in Table 5.

Table 5 Western Catchment Developed Flows

	20%AEP	1%AEP
Predeveloped Flow	0.17 m^3/s	0.55 m^3/s
Developed Flow	0.15 m^3/s	0.48 m^3/s

2.3.3 GMC METHODOLGY

The RORB calculated basin storage volume was compared to the site storage requirement listed in the GMC drainage design handbook. With approximately 75% of the site draining to the basin and an impervious area of just under 40%, a detention storage volume of 1,040 m^3 minimum is required.

Site Storage Requirement (cum/ha)

	Percentage of Development Area Draining to OSD System						
Percent Impervious	100	95	90	85	80	75	70
10	20	26	32	36	39	41	43
20	37	43	50	54	58	62	66
30	53	61	68	73	77	83	89
40	70	78	86	91	96	104	111
50	86	95	104	110	115	125	134
60	103	112	121	127	133	142	152
70	119	129	138	144	150	160	169
80	136	145	155	161	168	177	187
90	152	162	172	179	185	195	204

Figure 9 GMC Drainage Design Handbook Required Site Storage

2.4 SUMMMARY

- The Site has no perceived flood risk due to it elevation compared to surrounding drainage paths.
- Internal site flows can be conveyed by vegetated roadside swales, to be sized during future design phases.
- Nuisance flows exiting the site will be diverted to and conveyed by the road network removing residual risk to external blocks.
- Increases in peak stormwater flows caused by development can be mitigated by a singular retarding basin on The Site preliminarily sized at 1,600 m^3.

3. STORMWATER QUALITY

3.1 REQUIREMENTS & OBJECTIVES

The GMC design specification defaults to the WaterNSW requirement as the development is within the Sydney drinking water Catchment. As proposed development will result in the construction of more than 2,500m2 of impervious area a MUSIC model is required. The current recommended practice guideline "*Using MUSIC in the Sydney Drinking Water Catchment*" (WaterNSW, 2023) states the requirements for stormwater quality treatment to achieve concurrence with WaterNSW as

- The mean annual pollutant loads for the post-development case (including mitigation measures) should aim for 10% less than the pre-development case for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). For gross pollutants, the post-development load only needs to be equal to or less than pre-development load.

- Pollutant concentrations for TP and TN for the post-development case (including mitigation measures) must be equal to or better compared to the pre-development case for between the 50th and 98th percentiles over the five-year modelling period when runoff occurs. Periods of zero flow are not accounted for in the statistical analysis as there is no downstream water quality impact.

3.2 SITE CHARACTERISTICS

3.2.1 EXISTING LANDUSE/SURFACE TYPE

The predeveloped catchment can be described as a cleared rural residential lot with a number of existing structures and an unsealed driveway/hardstand area. The Site was broken down into four different sub catchments, roof connected to rainwater tanks, roofs not connected to rainwater tanks, Unsealed Roads and the residual Agricultural/cleared rural land. The catchment delineation is presented below in and the respective areas presented in Table 6

Figure 10: Pre-Developed Landuse

Table 6: Pre-Developed MUSIC Catchments

Land Use/Surface Type	Area (ha)
Roof Tank	0.052
Roof	0.025
Unsealed driveway and hardstand areas	0.100
Cleared rural land	9.520
Total	10.000

For the purpose of the pre-development MUSIC model, it was conservatively assumed that all roof area connected to a tank would reach the tank without any reduction applied.

3.2.2 SOIL PARAMETERS

Based on boreholes at surrounding sites assessed through and other soil maps observed through eSPADE. At the root zone depth of 0.5m The Site soil was classified as sandy clay loam for the purpose of this assessment. Parameters presented in the WaterNSW guideline were adopted for all sub catchments.

3.2.3 CLIMATE DATA

Tarago and the Site are located within rainfall Zone 1. The climate data was downloaded from the WaterNSW website on the 14/06/2023 and were used for all climate and rainfall parameter in the MUSIC model.

3.3 POST-DEVELOPED CATCHMENT

3.3.1 DEVELOPED LANDUSE/SURFACE TYPE

The proposed residential development was broken down into three main landuse/surface types, roof, residential and road. There is also the additional landuse type for the open space at the basin, revegetated land was deemed the most applicable for this surface type for the proposed surface type.

Without a more detailed plans of the future houses to be built on the site, the roof area for the dwellings was estimated based on the recent nearby subdivision to the north of Tarago at 300m2. Based on the recommendation in the guideline it was assumed that only 80% of the roof area would be captured by gutters and conveyed to the rainwater tank. The remainder of the surface area was included in the residential source nodes area.

The Site was also broken down into various different sub catchment based on the overall geometry of the catchment and concept treatment train routes. The MUSIC catchment plan and surface types are presented below in

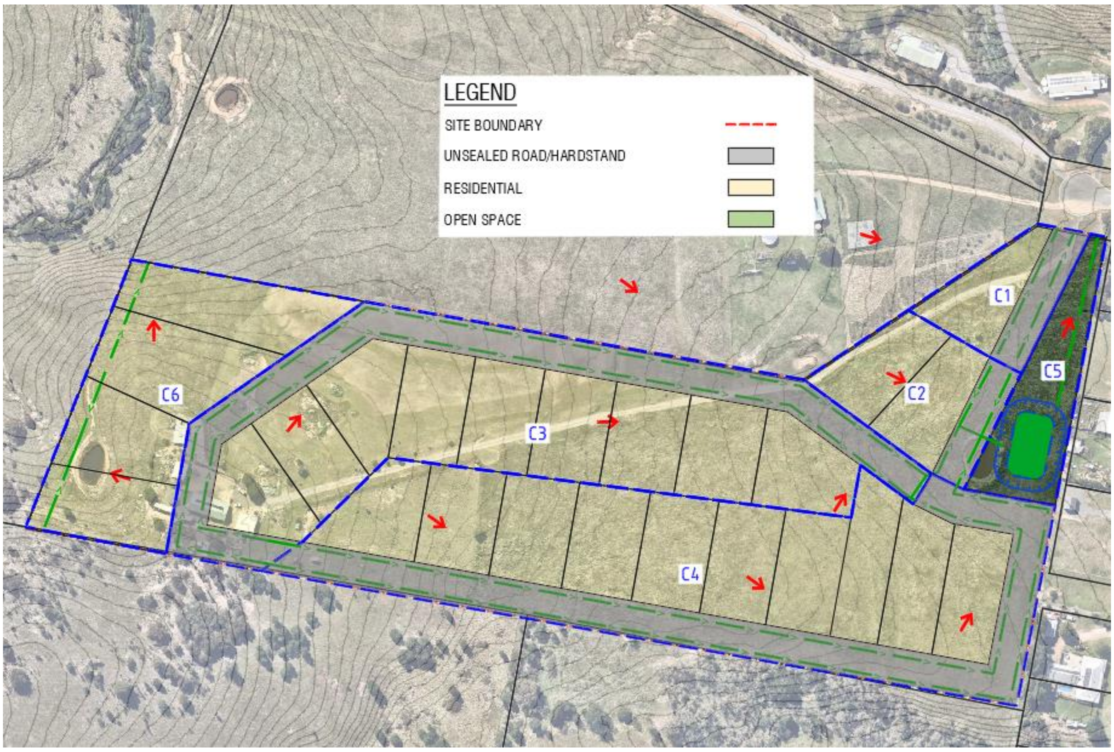


Figure 11.

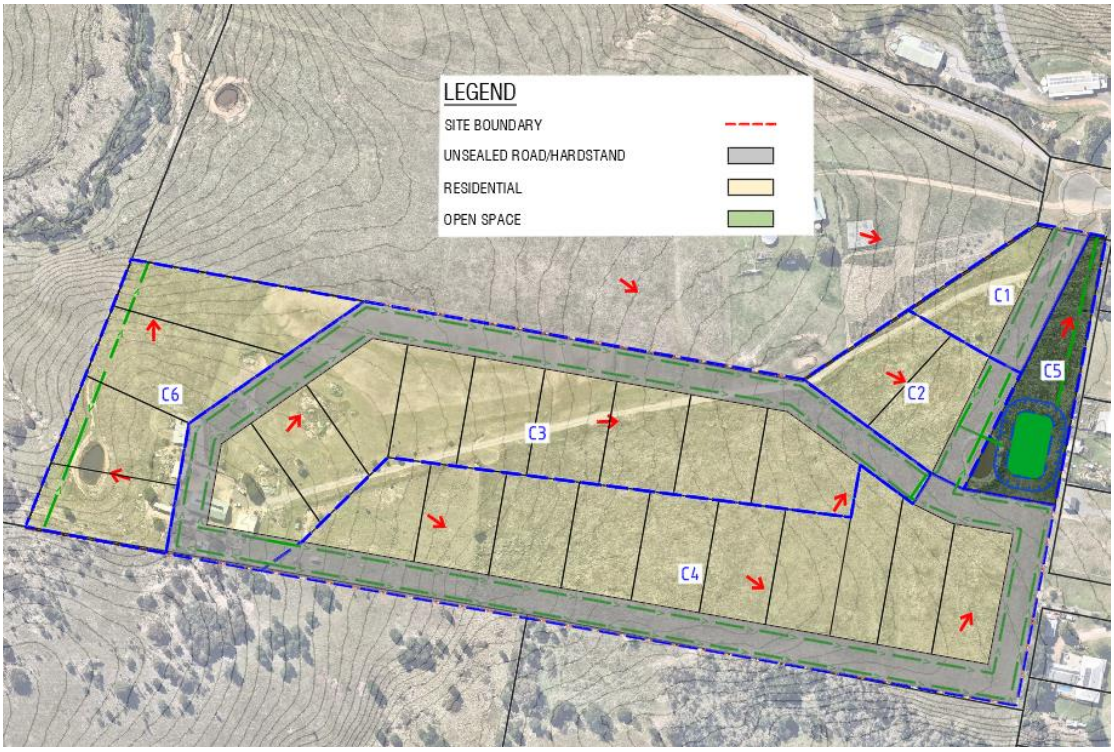


Figure 11: Developed MUSIC catchment and pollutant generation surface types

Table 7: Developed MUSIC Catchment Areas

Land Use/ Surface Type	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5	Catchment 6
Lots (no.)	1	2	9	10	0	4
Roof (ha)	0.024	0.048	0.216	0.24		0.096
Residential (ha)	0.226	0.452	2.049	2.263		1.311
Road (ha)	0.172	0.148	1.121	1.154		
Open Space (ha)					0.482	
Total Area (ha)	0.422	0.648	3.386	3.657	0.482	1.407

3.3.2 MITIGATION

In order to achieve NorBE approval, a range of different mitigation/treatment assets are proposed. These assets all together form the treatment train for the site. These assets have been sized in accordance with the guidelines and to achieve the objectives for the site.

3.3.2.1 Tanks

All lots will require a rainwater tank as a source of potable water as there is no reticulated water available to the site. Tanks have been conceptually sized based on the lot sizes at 10kL/lot. Based on the similar development in the area it is highly likely that the future lot owners will construct larger rainwater tanks however this will only improve treatment performance in the MUSIC model and therefore the default value was adopted.

As no details exist for the future dwellings, it was assumed they would all have 4 bedrooms in line with the WaterNSW guideline so that a daily internal daily reuse rate could be calculated.

External reuse was also assumed for all dwellings at the recommended 55 kL/yr/dwelling. This irrigation demand was distributed on a monthly basis based on the ACT government single residential waterway calculator in order to represent the distribution of this irrigation more accurately.

Tanks are to be managed by future lot owners.

3.3.2.2 Buffer Strip

A Buffer strip was assumed for both the road area and the lot area not captured by the tank. Buffer strip for residual lot areas was based on a 5m setback, 35m frontage and 5m wide driveway, which was the worst case based on the concept layout. Buffer strip for roads was assumed to be at a 1m wide. With the entirety of the road network been buffered.

Road verge buffer strips to be managed by GMC. Block buffer strips to be managed by future lot owners.

3.3.2.3 Vegetated Swale

As detailed in section 2.3 of this report it is proposed to convey all stormwater via vegetated roadside swales. In the music model the swale length was estimated as half the length from the top of the catchment to the discharge point/downstream catchment. The swale gradient was calculated based on the existing site topography of the site. Swale depth was based on the typical section presented in Figure 12. The sizing of the swales will need to be refined in future stages of the design to ensure they can adequately convey flows which will likely result in a larger footprint. Swale vegetation height was assumed to be 0.25m.

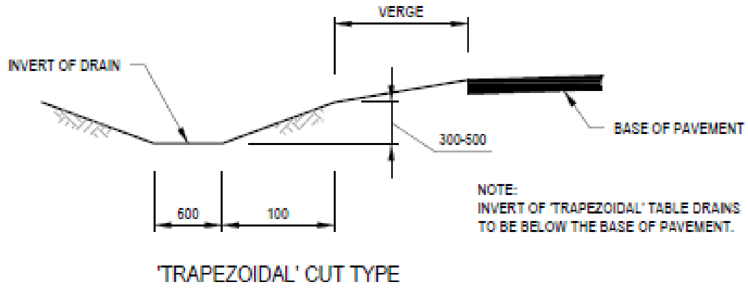


Figure 12: Swale typical section

Vegetated roadside swales are to be managed by GMC.

3.3.2.4 Bioretention Systems

Nutrients generated by the site are proposed to be treated via a lined bioretention system. The bioretention system was iteratively sized until the treatment objectives were achieved.

The parameters used in the bio retention basin are presented in Table 8. The final bioretention basin area required to achieve the treatment objectives was 600m^2.

Table 8: Bioretention Basin Parameters

Parameter	Adopted value
Extended Detention Depth	0.3 m
Saturated Hydraulic Conductivity	200 (mm/hr) (100 mm/hr modelled)
Filter Depth	0.5 m

Parameter	Adopted value
TN Content of Filter Media	400 (mg/kg)
Orthophosphate Content of Filter Media	40 (mg/kg)
Submerged Zone with Carbon Present	No*
Filter Media Area	600m^2

*A submerged zone with carbon could not be used due to the due to the phosphorous leaching calculated by MUSIC.

The Bioretention Basin is to be managed by GMC.

3.4 RESULTS

The MUSIC modelling treatment performance results are presented below in Table 9. The results show that the pollutant reduction targets for the catchment have been met. The cumulative frequency charts for Phosphorous and Nitrogen concentration are presented in figures Figure 13 and Figure 14 respectfully.

Table 9: MUSIC results

	Annual Pollutant Loading (kg/yr)			
Scenario	TSS	TP	TN	GP
Pre-developed	2020	3.35	20.4	48.5
Post-developed	144	1.63	18.1	0
Difference	1876	1.72	2.3	48.5
Improvement	93%	51%	11%	100%
Compliant	Y	Y	Y	Y

Nitrogen is the controlling pollutant from an annual loading perspective.

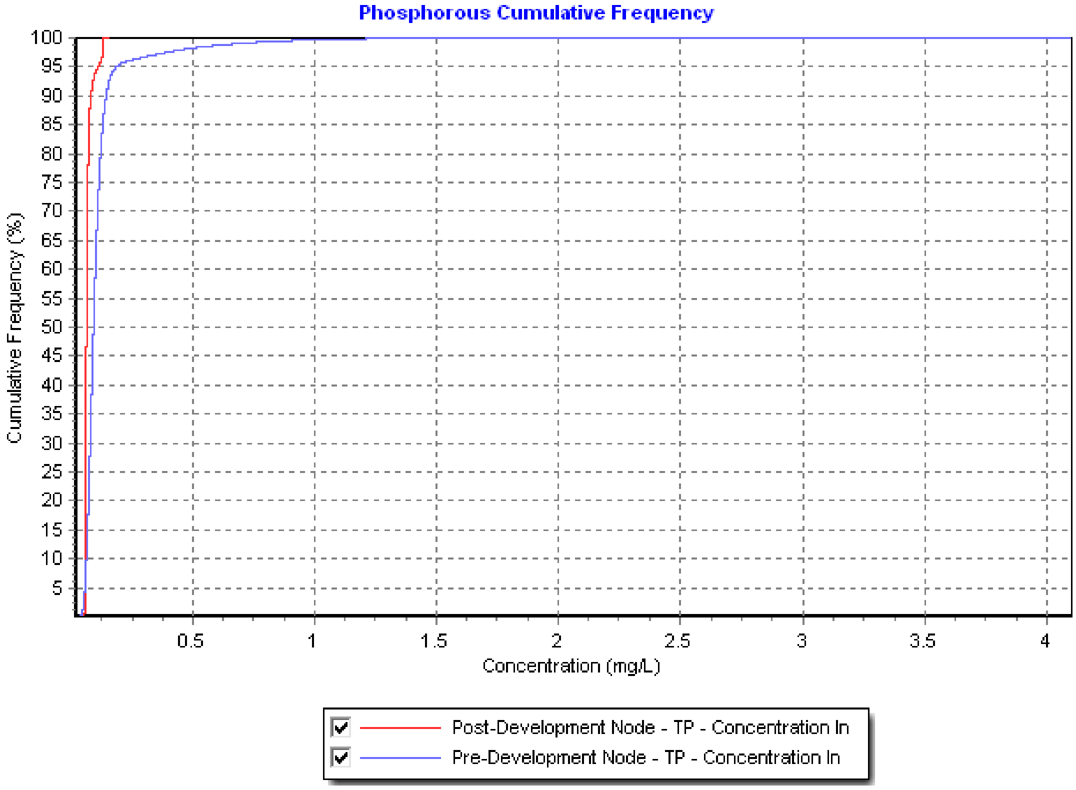


Figure 13: Phosphorous Cumulative Frequency

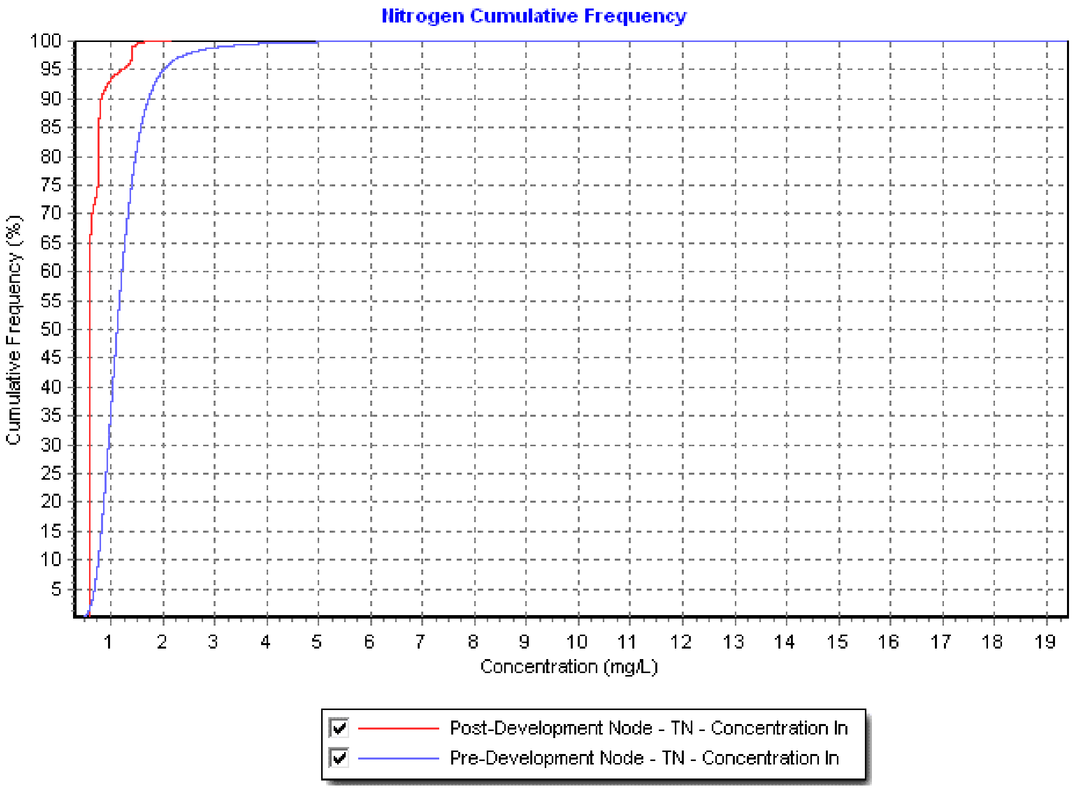


Figure 14: Nitrogen Cumulative Frequency

3.5 CONCLUSION

The MUSIC model results show that NorBE criteria can be achieved for the site even when complete disturbance is assumed.

The modelled post-development total suspended solids, total phosphorus, total nitrogen and gross pollutant loads are all 10% less than pre-development conditions.

The 50th to 98th percentiles of total phosphorus and total nitrogen concentrations for the post-development scenario are lower than the pre-development conditions. However, to achieve this the submerged zone had to be removed from the bioretention system.

Nitrogen was the controlling pollutant for the design of this development to achieve NorBE.

Treatment device implanted to achieve neutral or beneficial effect on water quality for the development:

- 10-kL rainwater tank to all dwellings
- Vegetated roadside swales convey all stormwater
- 5m landscaped buffer strip between residential dwellings and vegetated swales
- 600m^2 Bioretention Basin

4. CONCEPT SOIL AND WATER MANAGEMENT PLAN

4.1 REQUIREMENTS & OBJECTIVES

The future development will require the disturbance of soil and as such a Soil and Water Management Plan (SWMP) will need to form part of the future Construction Environmental Management Plan (CEMP) to be developed and implemented by the future contractor.

A full SWMP to the GMC D7 specification cannot be complete, as detailed civil design grading works have not been conducted. However, consideration of SWMP principles in the planning phase will allow additional mitigation measures to be implemented.

One of the key parts of the SWMP is the Erosion and Sediment Control Plan (ESCP). For the purpose of the planning proposal an ESCP has been developed based on the conservative assumption that the entire site will be cleared, and no staging of works will occur. This is not the intention of the project, at this stage, but has been considered the most appropriate assumption to develop a proof-of-concept ESCP.

The purpose of the ESCP is to:

- Limit/minimise disturbed area.
- Isolate clean (external) water
- Control runoff and sediment movement throughout the site where possible

This concept SWMP has been developed using Managing Urban Stormwater: Soils and Construction (NSW Gov, 2004), also known as the “Blue Book”.

4.2 SOIL AND WATER MANAGEMENT RISKS

Table 10: Soil and Water Management Site Risks

Risk	Impact
Discharge of contaminated water from within site boundary	Contamination of adjacent watercourse and riparian environment. Poor quality water entering waterways and riparian environment impacting on water quality and ecosystem function.
Erosion	Sediment degrading surrounding environment and increased turbidity for downstream users
Flood flows	Contamination of floodwaters by sewage, fuels and/or chemicals onsite
Hazardous substances spills/leaks	Contamination of soil, watercourses, riparian environment and groundwater ecosystems
Dust	Poor air quality, sediments leaving site
Sediment tracking onto public roads	Potential impact on traffic safety

4.3 MANAGEMENT OF SOIL AND WATER

Table 11: ESC Mitigation Measures

Mitigation Measures	
Erosion potential to be minimised. ▶ Minimise earthworks in areas where slope are greater than 10% ▶ Design to allow for staging of works. ▶ Maximise undisturbed area during detailed grading.	Design
Erosion potential to be minimised. ▶ External Catchments to be divert around the site. ▶ Stabilise catchment as soon as woks completed. ▶ Utilise existing cleared, disturbed and or sealed areas for vehicle and machinery access, materials laydowns and stockpiles. ▶ Excavation to be backfilled as soon as possible. ▶ Of road driving to be minimised as much as possible	Construction
A Sediment and Erosion Control Plan (ESCP) to be developed and implemented and monitored regularly throughout construction.	Construction
Moisture control, all exposed surfaces shall be watered down via the use of a water truck to control dust exiting the site.	Construction

4.4 CONSTRCUTION WORKS PHASING

The site has multiple outlet points and therefore multiple catchments that will each require their own construction erosion and sediment controls. However, the disturbance to the catchment will need to follow the same typical process phasing to allow control of sediment and erosion. The basic stage of works for erosion and sediment control are as follows.

- Preparing for construction works:
  - Installation of site fencing, including demarcation of no-go zones identified by other studies.
  - Installation of silt fences, often in conjunction with site fencing.
  - Stabilise vehicle access points to the site.
  - Construct clean water diversion drains from the top of each catchment and around the perimeter to the receiving water.
  - Construct sediment control basins, with the aim to utilise existing and future drainage asset location where possible.
  - Construct dirty water drains (otherwise known as construction swales) and any required slope breaks through the catchment to convey construction runoff to the construction sedimentation basin.
- During construction works:
  - Aim to restrict or phase disturbed areas, in order to reduce mobilised sediment.

- Protect stockpiles, with appropriate cover, silt fences, and maintained to correct height.
- Maintain sediment control basin after every rainfall event, as per Blue Book requirements.
- Conduct inspections of all erosion and sediment control measures weekly and before every rainfall event. Maintain any control that needs attention within 24hrs.
- Take regular dissolved solids testing of site discharged water to ensure sediment compliance.

- Post construction works completion:
  - Achieve Blue Book required ground cover for all finished earthen surfaces, whether by polymer binders or grassing.
  - Leave all lots with appropriate silt fencing and any required slope breaks, to prepare for building phase to begin.
  - Leave construction sediment control basin in place during the building phase, until sufficient lot works are complete. This may require an operations agreement between GMC and the developer.

4.5 EROSION AND SEDIMENT CONTROLS

The concept ESCP is presented in Figure 15, the details of the various control measures are discussed in detail below.

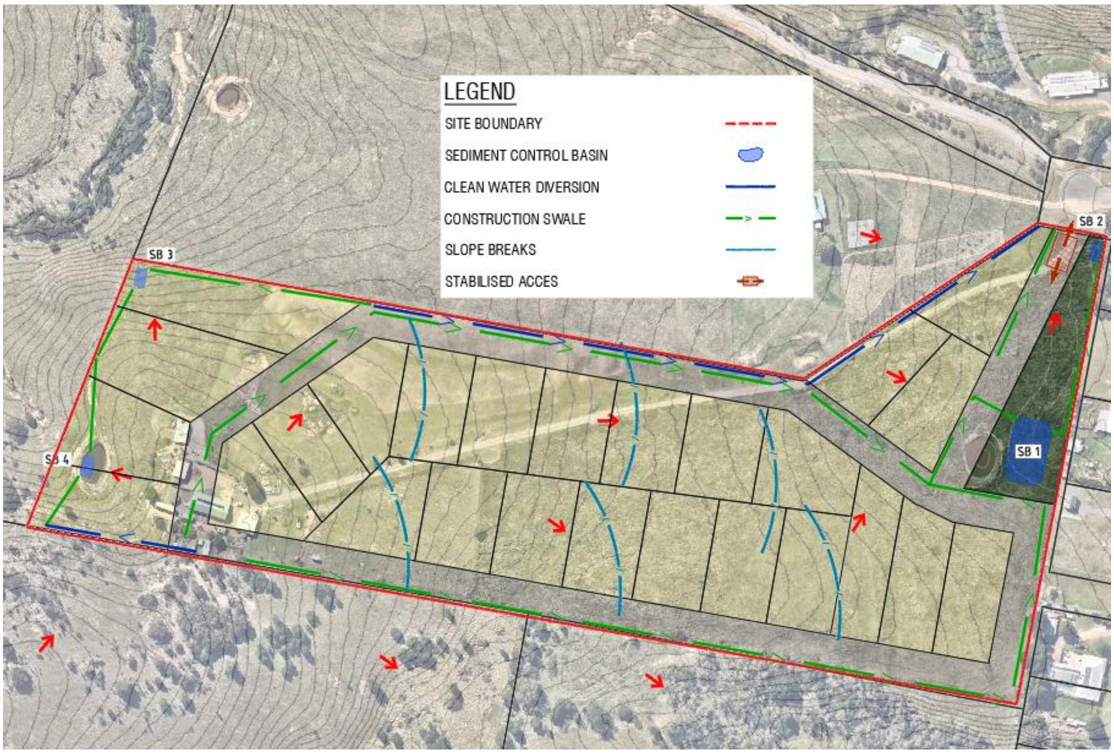


Figure 15: Concept Erosion and Sediment Control Plan

4.5.1 CLEAN WATER DIVERSION DRAINS

Clean water diversion drains will be constructed at all external catchment entry points to the site. These will be sized with the intention of conveying all flows up to the 20% AEP flow event. In location where steep site grades are present the swale will be stabilised either by vegetation, rock or geofabrics.

The intent of the clean water diversion swale is to reduce the quantity of water flowing over the site and therefore the potential for erosion to occur.

4.5.2 SEDIMENT BASINS

A significant part of the construction sediment control measures is the implementation of sediment control basins. The basins are located at the downstream end of each construction catchment. The sediment basin will form the last line of defence before sediment exits the site.

The concept sediment basins have been sized based on the calculated sediment mobilisation (soil loss) using the RUSLE equation. As presented in Figure 15, four proposed construction sediment basins are proposed.

4.5.2.1 Sediment Control Basin Parameters & Assumptions

Table 12 presents common parameters used in sediment control basin sizing across all basins.

Table 12: Typical sediment control basin sizing parameters.

Parameter	Value
Rainfall Event to be Captured	5-day, 85th %ile = 22.2 From Blue Book, Page 6-24
IFD: 2yr 6hr storm	6.94mm/hr BOM
Rainfall Erosivity (R-Factor)	1240 Calculated based on 2yr 6hr storm
Soil Erodibility (K-Factor)	0.026 In lieu of more detail, largest factor used from Blook Book page C-124
Length/Gradient (LS-Factor)	Using 80m limited slope length, gradient from site contours
Erosion Control Practice (P-Factor)	1.3 Typical construction value
Ground Cover (C-Factor)	1 Typical construction value
Calculated Maintenance (De-Silting) Period	6 months

Assumptions regarding catchments:

- Sediment control basins are sized for each catchment to be 100% disturbed, i.e. basins are sized for the maximum required volume. Phasing of works within catchments can be used to reduce the basin volume.
- External catchments are assumed to be diverted around works areas and bypass end-of-line sediment control basins.

4.5.2.2 Sediment Control Basin Sizes

Table 13 summarises stored sediment per maintenance period (3 months), the calculated required sediment control basin volume for each catchment, and the available volume as shown in concept form on the SWMP drawings.

Table 13: Sediment control basin sizes. *Refer to existing basin assumptions in Section 8.3.2.

Catchment Asset	Catchment Area (ha)	Storage Zone Volume (m^3 / 3 months)	Required Basin Volume (m^3)	Available Basin Volume (m^3)
SB 1	7.7	218	325	543
SB 2	0.8	23	34	57
SB 3	0.8	24	35	59
SB 4	0.7	19	35	54

4.5.2.3 Sediment Pond Discharge

Water captured by the sediment ponds will be treated to the WQO presented in Table 14 unless approval from council is obtained if further inclement weather is predicted.

Table 14: Sediment basin Water Quality Objectives

Parameter	Target
pH	6.5 – 8.5 pH
Total Suspended Solids (mg/L)	< 50 NTU
Hydrocarbons	No hydrocarbon sheens observed

4.5.3 CONSTRUCTION SWALES

Construction swales will be constructed to control flows through the Site. The constructed swales will direct flows to the sediment basin for treatment/flocculation before discharge from the site.

Construction swales will be sized with the intention of conveying all flows up to the 20% AEP flow event. In location where steep site grades are present the swale will be stabilised either by vegetation, rock or geofabrics.

4.5.4 STABILISED SITE ACCESS AND SHAKEDOWN

The stabilised access to the site shall be constructed with a shakedown grid. The shakedown grid shall be located at the entry t exist to the site and all vehicles shall be made to pass over it upon leaving the site.

4.5.5 SLOPE BREAKS

Slope breaks shall act as a temporary measure where a large portion of the site needs to be opened for earthworks. Slope breaks can consist of constructed swales, silt fencing, mulch bunds etc. The purpose of slope breaks is to reduce the erosion length across the sight and has been conceptually limited to 80m between controls.

4.5.6 SILT FENCING

Silt fencing shall be installed around all stockpiles.

4.5.7 LEVEL SPREADERS

Level spreaders shall be constructed at the end of all constructed swales and clean water diversion drains.

4.6 ROLES AND RESPONSIBILITIES

It is the responsibility of the developer to ensure adequate measure are implemented to control erosion and sediment on The Site.

The developer shall request that the contractor supply documentary evidence of all checks and maintenance to undertaken throughout the construction process.

The Developer shall be responsible for notifying the EPA and GMC of any spills or non-conformance with the future approved SWMP.

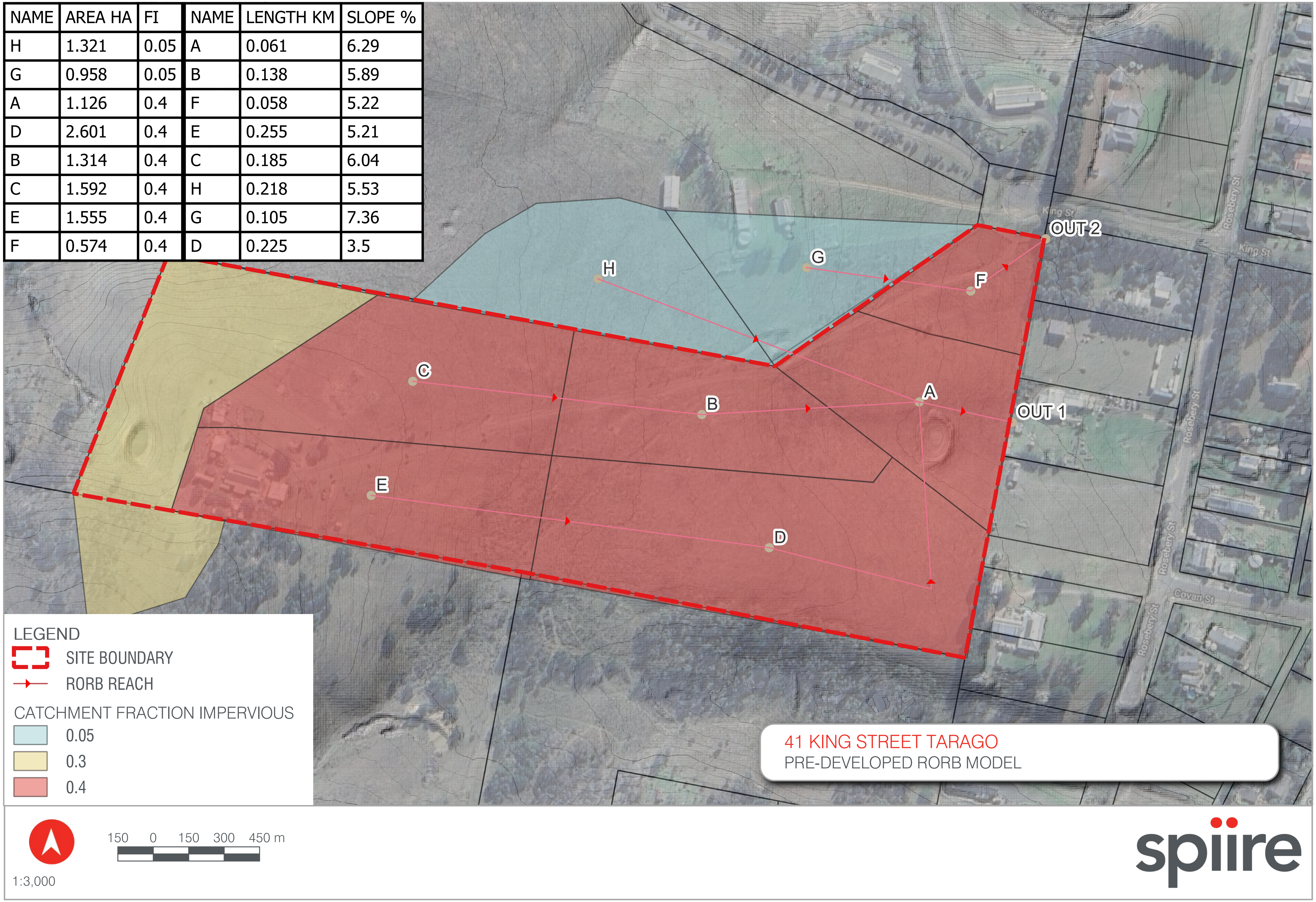
5. CONCLUSION

This document provides supporting information regarding stormwater elements of the 41 King Street Tarago's planning proposal. Primary findings from this report include:

- The Site has no perceived flood risk due to it elevation compared to surrounding drainage paths.
- Internal site flows can be managed and conveyed by vegetated roadside swales, to be sized during future design phases.
- Nuisance flows exiting the site will be diverted to and conveyed by the road network removing residual risk to external blocks. Peak flows have been managed at all site outfall location to be less than the pre-developed flows. A singular retarding basin is required to achieve this.
- The MUSIC model results show that NorBE criteria can be achieved for the site even when complete disturbance is assumed with the construction of a treatment train of buffer strip, vegetated swales and a 600m^2 bioretention basin.
- Proposed Soil and Water Master Plan measures are calculated to appropriately manage environmental effects of the development.

APPENDIX A – RORB CATCHMENT PLANS

NAME	AREA HA	FI	NAME	LENGTH KM	SLOPE %
H	1.321	0.05	A	0.061	6.29
G	0.958	0.05	B	0.138	5.89
A	1.126	0.4	F	0.058	5.22
D	2.601	0.4	E	0.255	5.21
B	1.314	0.4	C	0.185	6.04
C	1.592	0.4	H	0.218	5.53
E	1.555	0.4	G	0.105	7.36
F	0.574	0.4	D	0.225	3.5



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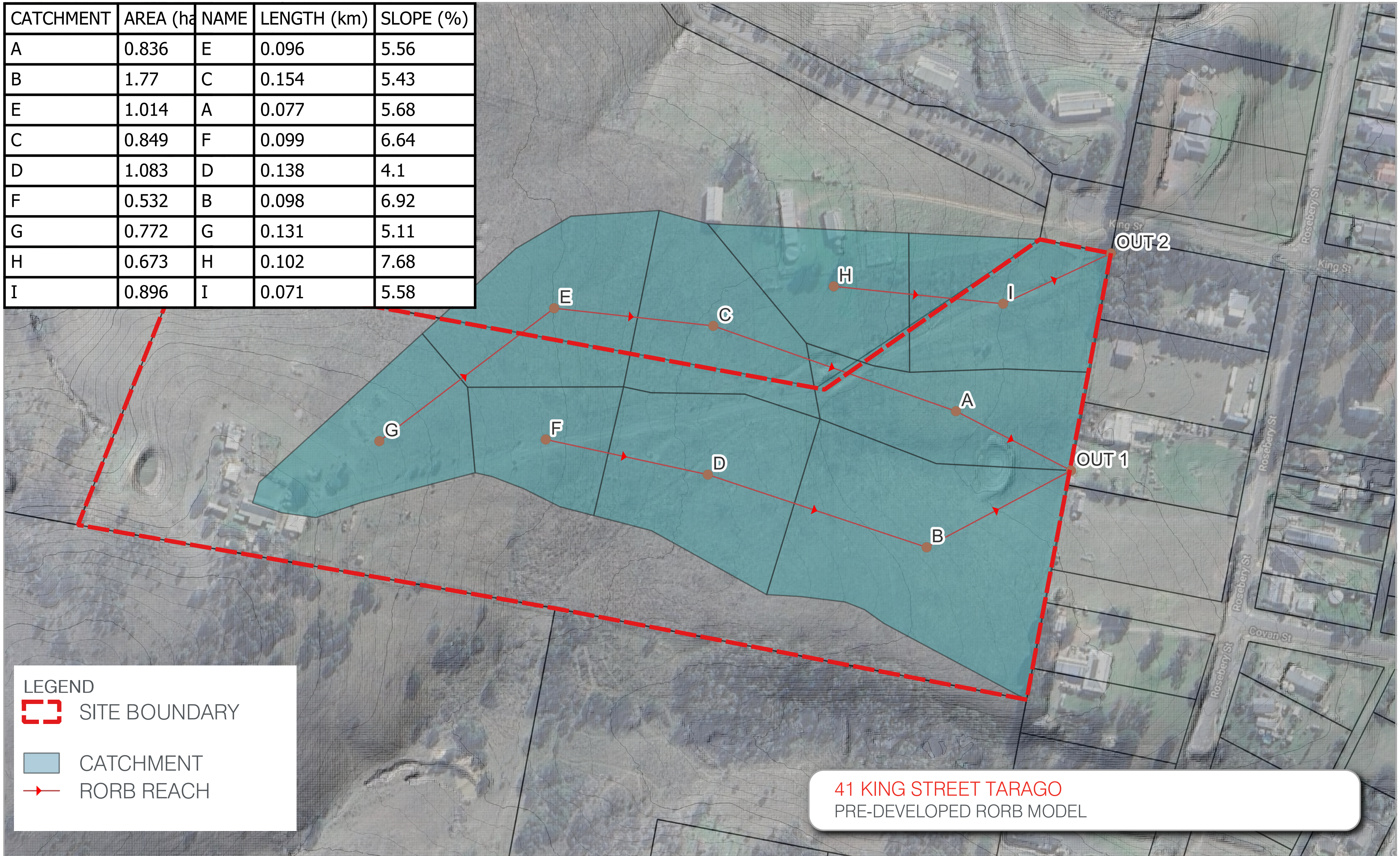
CATCHMENT	AREA (ha	NAME	LENGTH (km)	SLOPE (%)
A	0.836	E	0.096	5.56
B	1.77	C	0.154	5.43
E	1.014	A	0.077	5.68
C	0.849	F	0.099	6.64
D	1.083	D	0.138	4.1
F	0.532	B	0.098	6.92
G	0.772	G	0.131	5.11
H	0.673	H	0.102	7.68
I	0.896	I	0.071	5.58



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APPENDIX B – NORBE PRE-ASSESSMENT CHECKLIST

1. Is the site of the proposed development in the Sydney drinking water catchment?
Yes

2. Is the proposed development consistent with any WaterNSW instruments, restrictions or covenants on the title?
Yes

3. Is the proposed development located on Crown perpetual leasehold land?
No

4. Does the proposal have an identifiable potential impact on water quality? - see Table A2
Yes

Criteria for identifiable water quality impact	Yes	No	Comments
Flow of water is concentrated on part of the site during construction or operation	Y		Greenfields subdivision works
Flow of water is impeded on part of the site during construction or operation	Y		Greenfields subdivision works
Proposed development during construction or operation will discharge effluent (including to sewer), dust, stormwater or other pollutants	Y		Greenfields subdivision works
Any other matter considered to result in an identifiable impact on water quality			

5. To which Development Class does the proposal belong?
Subdivision, unsewered ≥4 lots, Nul, module 4

6. Is the documentation complete?
Stormwater items covered by this report to a planning proposal level (not all items can be provided until development application design).

For Sewer items refer report by Soil and Water.

7. Does the water cycle management study meet WaterNSW requirements?
Stormwater items covered by this report to a planning proposal level (not all items can be provided until development application design).

For Sewer items refer report by Soil and Water.

APPENDIX C – NORBE MODULE 4 CHECKLIST

GENERIC SUBDIVISION QUESTIONS:

4.01 Is the development layout and lot numbering consistent throughout all reports?

NA, planning proposal only, lot number are not final.

4.02 Is the development staged?

NA, planning proposal only to be determined at Development Application.

For the purpose of the assessment staged work has not been assumed.

STANDARD STORMWATER AND DEVELOPMENT SITE RISKS

4.03 Does any of the area to be developed (*excluding* the effluent management area (EMA), but *including* any proposed roads, dwelling access, rights-of-way or building envelopes) occur in areas where the slope is greater than 20% (11.4_0)?

No, natural slopes greater than 20% only occur in two locations at the edge of The Site in which building envelops can be positioned to avoid disturbance at Development application stage.

4.07 Is any area to be disturbed in relation to the development proposal (*including* any proposed building envelopes, but *excluding* EMAs) located within a 1% annual exceedance probability (AEP) flood level or flood prone areas associated with watercourses and drainage depressions?

No, see section 2.2.2 of the Stormwater Masterplan Report.

4.09 Is rainfall erosivity greater or equal to 4,000 mm/ha/hr/year?

No, See section 4.5.2.1 Stormwater Masterplan Report, rainfall erosivity is 1240mm/ha/hr/year

4.10 Do any of the proposed construction works associated with the development occur where more than 10% of the soils on the site are dispersive?

Yes, See section 4 Stormwater Masterplan Report.

4.11 Do the soils in the area to be developed have a wide-spread salinity or sodicity risk?

No

4.13 Are proposed building envelopes or associated works (other than crossings and approaches) located within 40 metres of a watercourse or waterbody?

No, See place logic masterplan report.

4.15 Will more than 250 m[2] of vegetation be removed on each proposed lot (including clearing for roads, dwelling access and Asset Protection Zones (APZ))?

Yes.

4.16 Can the works (including for the APZ) be relocated to minimise vegetation clearing and soil exposure?

No, MUSIC model provided.

4.17 Are there any potentially contaminated sites on any of the proposed lots?

TBC not covered by scope of this report.

4.18 For each lot and the proposed subdivision as a whole, are there any other site constraints that may impact on the proposed development?

No/TBC by other reports.

STANDARD WASTEWATER QUESTIONS:

Not covered by this report, refer report by Soil and Water.

ROADS/RIGHTS-OF-WAY/DWELLING ACCESS:

Not covered by this report.

SEDIMENT AND EROSION CONTROL:

4.49 Does the site contain active moderate or severe gully or sheet erosion?

No.

4.50 Are there any erosion control works on the site?

Yes, water quality basin proposed for construction. Temporary sediment pond will be constructed.

STORMWATER QUALITY MANAGEMENT QUESTIONS RELATING TO DEVELOPMENT RISKS

4.51 Are there any areas on the site that can provide opportunities for remediation or protection to offset water quality impacts to ensure NorBE is satisfied?

No.

4.52 If the increased impervious surface is between 250 m^2 and 2,500 m^2, have suitable stormwater quality improvement devices (SQIDs) been incorporated to meet NorBE?

Yes, see section 3 of Stormwater Masterplan Report

4.53 Are the type and location of proposed SQIDs consistent across all documentation and modelling?

Planning Proposal stage, locations are not final.

4.54 Are proposed stormwater management measures located off-line?

Yes.

4.56 Are the proposed stormwater management measures located above the 2% AEP flood level?

Yes

4.58 Is the model and associated report consistent with WaterNSW's performance standard 'Using MUSIC in the Sydney Drinking Water Catchment'?

Yes

4.59 Does the model indicate at least a 10% 'improvement' in pollutant loads for total suspended solids, total phosphorus and total nitrogen?

Yes

4.60 Are the post-development cumulative probability pollutant concentration curves for total phosphorus and total nitrogen between the 50th and 98th percentiles equal to or less than the pre-development curves?

Yes

4.61 Do the proposed stormwater management measures have appropriate discharge points that are not likely to lead to other water quality problems such as erosion?

Yes