TATTERSALL LANDER PTY LTD

CONCEPT STORMWATER MANAGEMENT REPORT

for

PROPOSED HOLIDAY PARK DEVELOPMENT

288 MUNGO BRUSH ROAD HAWKS NEST

LOT 2 IN DP 1015609

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TATTERSALL LANDER PTY LTD

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1.0 INTRODUCTION

This report has been prepared to support a Concept Application for a holiday park development proposed for 288 Mungo Brush Rd, Hawks Nest (Lot 2 in DP 1015609).

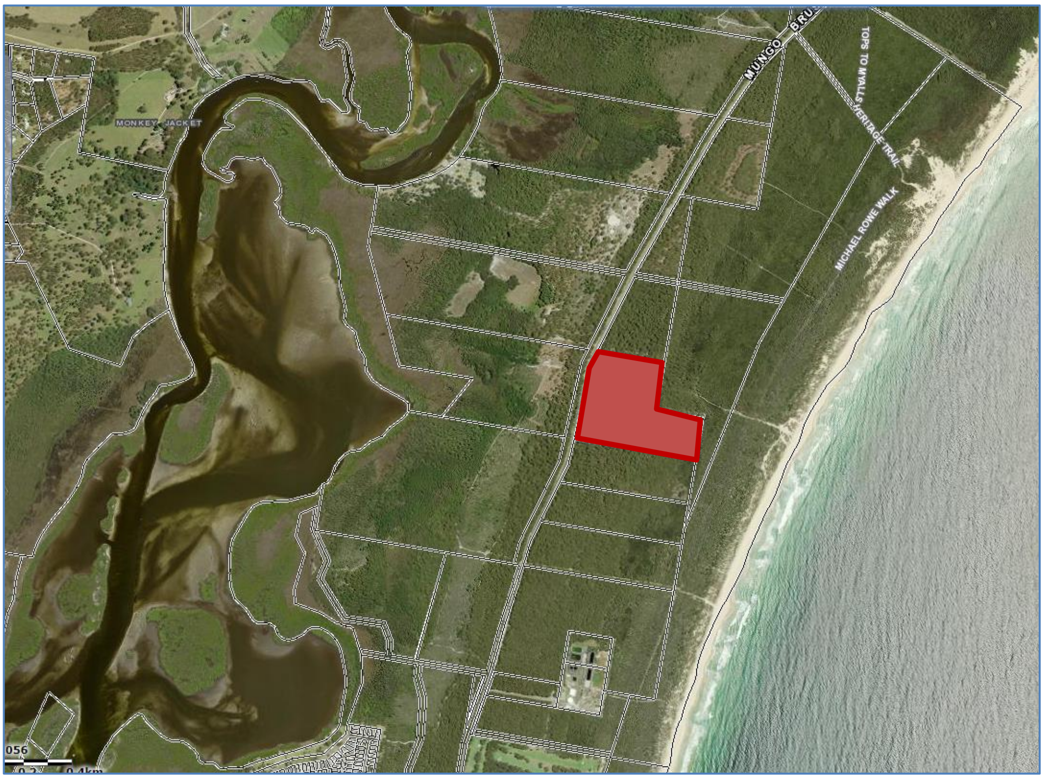


Figure 1: Locality Diagram

2.0 BACKGROUND INFORMATION

The site has a history of use as a rural property. The majority of the site is vegetated in some form, with various areas of clearing for access tracks, sheds and other vegetation disturbances associated with the use of the property.

3.0 SITE CONTEXT

The site is zoned RU2 Rural Landscape, and has frontage to Mungo Brush Road for its full western boundary.

The topography within the development footprint is best described as gently sloping and undulating. Consistent with much of the Hawks Nest / Mungo Brush area, there are no well-defined drainage flow paths and it is expected that all rainfall generally leaves the site via infiltration to groundwater.

Levels generally range from 6.0m-8.0m AHD. The development area is mostly vegetated, with mature forest trees and native understorey. Some areas of clearing exist for access tracks, plus there are two reasonable sized sheds and a small cabin on the property.

Figure 2: Site Aerial Image

Photo 1: Existing Site

4.0 PROPOSED DEVELOPMENT

It is proposed to construct a holiday park primarily on the north-western portion of the site. The proposal will include: -

1. Minor bulk earthworks,
2. 223 sites, comprising;
   - 93 camping sites
   - 130 short term sites
3. Community facilities,
4. Roads and drainage,
5. Other associated infrastructure,

A proposed layout plan can be seen below.

Figure 3: Proposed Development

While this application does not specifically propose cabin/dwelling construction, it is acknowledged that cabins may be installed on any of the short-term sites at some future date. In order to give a holistic view of the possible ultimate development scenario, these possible future cabins have been included in the modelling of this report.

5.0 WATER QUALITY TARGETS

As a site >2,500sq.m with less than 10% existing impervious surface, the Water Sensitive Design section of the Great Lakes Council Development Control Plan states that a water quality treatment train for this development should meet the pollution reduction targets in Table 1 below:

Table 1: Stormwater Quality Targets

Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	Neutral or Beneficial Effect (NorBE)
Total Phosphorus (TP)	Neutral or Beneficial Effect (NorBE)
Total Nitrogen (TN)	Neutral or Beneficial Effect (NorBE)

6.0 CONSTRAINTS AND OPPORTUNITIES / BEST PLANNING PRACTICES

Drainage and water quality considerations have been key considerations in the planning process, with large biofiltration areas (Council's preferred device) included through the concept design process.

The existing sandy soils onsite present a significant challenge to achieving compliance with the NorBE water quality DCP targets, as high infiltration sand sites result in very low existing pollutant levels. Similarly, the existing mostly undisturbed vegetated nature of the site will further reduce the target pre-development pollutant levels. It is considered unlikely that any development proposal could meet the DCP water quality targets on a site like this.

Council has previously advised the 1% AEP 2100 Flood Level at the site is 2.3m AHD, and the resulting Flood Planning Level is 2.8m AHD. With existing levels well above this, there are no regional flooding constraints associated with the site. Similarly, with the high permeability sand soils and close proximity to the ocean to the east and river to the west, it is expected that the existing site levels should be well clear of the water table. This is supported by the site geotechnical assessment, which found groundwater to be at a depth of about 6.5m below ground level at Borehole 3.2.

The lack of any existing drainage paths, high permeability sandy soils and generally elevated terrain present opportunities for large scale regrading to effect proper and efficient WSUD and drainage design, and disposal via infiltration. However, this opportunity is limited by the desire to retain significant portions of existing vegetation. As such, the design concept proposes a 'light touch' layout what will require a more small-scale distributed approach to treatment / detention / infiltration disposal where possible, taking advantage of the existing natural low points for stormwater treatment and disposal.

7.0 SOIL AND WATER MANAGEMENT

A critical time for increase pollutant loads is during construction, and with this in mind, current practice recommends guidelines from Landcom's "Blue Book". Erosion and sediment control measures should be designed and specified in accordance with the "Blue Book" guidelines, and to Council's satisfaction, and be inspected and maintained during the construction phase. This will assist in ensuring adherence to pollutant prevention measures, particularly the removal of suspended solids (sediment).

As the construction footprint will be in excess of 2,500sq.m, typically it would be expected that a detailed Soil and Water Management Plan would need to be prepared for construction prior to release of the Subdivision Works Certificate. This would normally include calculations of likely soil loss during construction, instructions on preferred construction sequence and limiting land disturbance, and calculations for the provision and sizing of any temporary sedimentation basin to cover the period of civil works.

As a general comment on this site, the combination of flat grades and high permeability sandy soils are likely to limit any significant risk of erosion and sedimentation issues. The following RUSLE calculation illustrates this (references are to "The Blue Book" – Managing Urban Stormwater, Landcom, 2004);

2-year 6hour Intensity = 11.5mm/hr	(former GLC Engineering Dept)
R = 2860	(Eq 2 App A)
K = 0.005	(Tab 14 App C)
LS = 0.19 (1% Slope for 80m)	(Tab A1 App A)
P = 1.3	(Tab A2 App A)
C = 1.0 (bare earth during construction)	

The resulting computed soil loss is therefore calculated as 2.72m^3/ha/yr, or 20.9m^3/yr for the proposed development footprint. As this is far less than 150 m^3/yr trigger in The Blue Book, no sedimentation basin would be required (S6.3.2 (d)), and the erosion risk should be able to be adequately addressed with standard construction erosion control measures such as silt fencing and sandbagging.

8.0 INTEGRATED WATER CYCLE MANAGEMENT

It is expected that all community facilities and short-term sites will be serviced with reticulated water and sewer connected to the MidCoast Water Services network.

BASIX is not technically applicable in a tourist park. However, to decrease the development's demand on potable water and also in line with WSUD principles, roof water runoff from the proposed community buildings and any future cabins installed on short term sites is to be directed into rainwater tanks for reuse onsite (toilet, laundry and external landscaping uses).

There is currently no recycled water service to the site. However, there is a recycled water service running from the nearby sewer treatment plant and back into Hawks Nest to a reservoir between the Myall Park sporting fields and the North Coast Holiday Camp. This reservoir is over 3km from the site, and given this distance it is not expected that MidCoast Council would require connection to this service. However, the supply main leaving the treatment plant is only 1.1km from the development site and could potentially be branched off and extended to the site (to a new reservoir and pump reticulation) if requested by the development, for use on external landscape areas associated with the proposed development.

9.0 STORMWATER MANAGEMENT - HYDROLOGY

9.1 FLOODING

Council have advised the 1% AEP 2100 Flood Level at the site is 2.3m AHD, and the resulting Flood Planning Level is 2.8m AHD. The entire site is well clear of this level.

9.2 DRAINAGE

The nature of urban development is that it increases the amount of impervious surface in a catchment, which in turn can decrease runoff times and create higher peak flow rates. It is important with new developments that measures are put in place to prevent increases in runoff from the site that may impact on surrounding properties.

In this instance, there is no obvious defined drainage paths from the site and flowing onto Mungo Brush Rd or adjacent properties. With significantly high infiltration rates available in the in-situ sand soils and desire to limit site disturbances, the proposal will aim to collect stormwater runoff from impervious surfaces for it to be treated and then infiltrated. The infiltration areas will need to be sized so that no overflow is expected from the site in any rainfall event up to and including the 1% AEP event.

The original (June 2023) drainage proposal for this site was to utilise the existing natural low points on the site for storage and infiltration of runoff from impervious surfaces. This was proposed as the approach that resulted in the smallest overall modification to the existing landform that resulted in a manageable number of stormwater assets to manage and maintain.

In response to Council's December 2023 RFI, an alternate scheme has been investigated where stormwater remains dispersed across the site. Through preliminary modelling and ongoing correspondence and discussions with Council staff, it has been concluded that something more closely resembling the original solution is considered the most appropriate solution for the site;

1. Roof areas shall be piped to rainwater tanks for reuse, and
2. Tank overflows and runoff from other impervious areas directed distributed raingardens distributed around the site as dictated by the existing terrain,
3. Raingarden overflow in larger events will enter shallow surface storages / infiltration areas created by nature low points across the site, localised minor earthworks and/or small berm structures within the adjacent landscaping areas (care will need to be taken with regard to the critical root zones of any retained vegetation).

This drainage strategy aims to keep the runoff as localised as possible and minimise the need for extensive piped drainage and constructed overland flow paths. A concept stormwater plan can be seen in Appendix B.

A hydrological model of the development site and surrounding areas has been prepared utilising the DRAINS computer modelling software to conceptualise the sizing of the proposed infiltration areas. IFD, temporal data and loss data was downloaded from the BOM and ARR Data Hub for the site (Latitude,-32.649 Longitude,152.188) and used to create a 1D hydrologic and hydraulic model.

The complete model will be made available to Council with the submission of this report, so model inputs and setup can be reviewed in detail. A general summary of various model inputs, including various assumptions and interpretations from ARR19 is provided below.

9.2.1 LOSSES

Sandy soil conditions exist on the site, consistent with the Hawks Nest area. A Horton ILSAX hydrological model has been set up using;

- Type 1 (high infiltration) soil,
- Paved (impervious) area depression storage = 1mm
- Grassed (pervious) are depression storage = 5mm
- Supplementary areas – not used, per Council’s stormwater guidelines

It is noted that the ILSAX model assumes an initial rate of around 250mm/hr and continuing rate around 30mm/hr for Type 1 soils. The geotechnical report found extremely high infiltration rates on the site (average hydraulic conductivity in the order of 4,000-20,000mm/hr) - while this does not account for factors such as tree roots, or the impacts of organics or compaction in the topsoil layer, it is expected that the ILSAX model is still significantly conservative with relation to runoff generated from pervious areas of this site. The BOM rainfall data indicates the maximum 1% 5min rainfall intensity is 336mm/hr (an order of magnitude lower than the bottom end of the quoted hydraulic conductivity), so it is not expected that there will be any notable runoff from any permeable surfaces in any rainfall events.

9.2.2 IMPERVIOUS AREA

While previous ARR87 hydrologic methods utilised Total Impervious Area inputs, the new ARR19 guidelines make a clear and deliberate distinction in terminology, and recommend the use of Effective Impervious Area rather than TIA, to more accurately represent real observed catchment runoff conditions.

Following this lead, DRAINS also recommends breaking catchment areas up into Effective Impervious Area, Remaining Impervious area and Pervious Area (or Paved, Supplementary and Grassed). DRAINS routes the RIA / Supplementary area through the Pervious Area to reflect the intention of the ARR19 guidelines.

However, it is understood that Council requires the use of Total Impervious Area only and no use of Supplementary areas, a conservative position more in line with the old ARR87 guidelines. For this assessment, a TIA of 2.12Ha was has been modelled (being 1.40ha of pavement measured directly off the architectural plans, and 0.72Ha of roof area from community facilities measured off the plans and from an conservative assumption of 50sq.m cabin installed on every short-term site). This equates to 29% of the 7.260ha proposed development area, or 13.6% of the total site area.

Note that the APZ / perimeter road area around the site has not been included in the DRAINS catchment area as this area is intended to be a gravel track with no formal drainage. The area won't have vehicular traffic, there will be minimal changes to existing ground levels, and it won't have any formal drainage – runoff will not be concentrated but will shed directly onto an adjacent grassed APZ area and infiltrated.

9.2.3 PRE-BURST

Transformational Pre-burst rainfall data was sourced from the ARR data hub, which is determined from the Initial Loss value minus the Probability Neutral Burst Initial Losses. As this model adopts a Horton ILSAX hydrological method, the pre-burst data is not applied.

9.2.4 AREAL REDUCTION FACTOR

The total catchment area is less than 1km^2 so the ARF was set to 1.

9.2.5 TAILWATER CONDITIONS

With the proposed development located above the reach of any regional flood impacts, the modelling has been done with a free outfall condition. Given the aim of the design is to ensure zero surface discharge from the site, this assumption is not particularly relevant to the results.

9.2.6 PRE-CONDITION MODEL

The assessment of the existing site has concluded there are no existing natural waterways or discharge points, and it appears the sandy soils provide sufficient infiltration capacity to infiltrate all rainfall. In smaller events, rainfall on the site will infiltrate where it lands, and in larger events it may collect at the various depressions and low points across the site until it soaks away.

There is some possibility that water would build up to a point where it flows across the boundaries onto the adjacent properties or the road reserve, and a 2D Rainfall-on-Grid model could be used to assess this. However, with no legal easements to permit such discharge post-development, a target of zero off-site discharge has been adopted for the purposes of this assessment. The reported hydraulic conductivity values in the geotechnical report mean any surface runoff from the existing site is highly unlikely.

A detail survey plan can be seen in Appendix A.

9.2.7 DESIGN STATE MODEL

A simple 1D node and link model was created to reflect the proposed development site, and its various sub-catchments. Lumped nodes have been used for each catchment, including lumped detention nodes for the total biofiltration raingardens and infiltration areas.

A proposed pipe network has not been included in the model at this Concept design point, but given the relatively small size of the localised sub-catchments within the site, there would be limited routing impacts expected from the pipe network that would have any impacts on the modelled infiltration basin behaviour.

9.2.7.1 INFILTRATION DISPERSION AREAS

The stormwater concept design looks to take advantage of the existing central depression through the centre of the site to deal with most of the stormwater treatment and disposal. For smaller separate catchments that fall east and west, smaller more localised treatment / disposal areas will be required, some of which would be linked to the larger central infiltration areas via a piped stormwater system. This needs to be limited to areas that will not impact on the Tree Protection Zones of trees being retained.

Detailed design of the raingarden and infiltration area will be completed at a later stage in the project. Given the undulating nature of the site and lack of natural drainage paths, some natural low points / areas will likely be identified during next, more detailed phase of the design where smaller, more localised measures may be able to be implemented to minimise the scale of trunk stormwater infrastructure required. A concept design can be seen in the DA design plans in Appendix B.

The infiltration areas main features include;

- Pre-treatment in sediment forebays at locations of concentrated pipe inflows,
- Potential use of slotted or pervious pipes where a piped system is required for stormwater conveyance (after raingarden treatment), to assist in promoting infiltration across the site,
- Infiltration for regular rainfall events (nominally up to the 20% AEP event) through localised infiltration areas,
- Overflow to large areas of retained vegetation onsite, for irregular major event storage and infiltration (nominally events between 20% and 1%)
- Side slopes generally <10% per the existing landform, with localised areas up to 4(H):1(V) batter slopes adjacent to any fill areas. All areas with a storage depth greater than 300mm will be required to be fenced for public safety, in accordance with Council's Stormwater Design Guideline.

Modelling the discharge behaviour of this sort of drainage arrangement is obviously highly dependent on the in-situ infiltration rates. Sandy soils can exhibit a large range in rates for saturated hydraulic conductivity. The initial version of this report adopted a value of 180mm/hr as no geotechnical data was available at that time. Since then, the Geotechnical Assessment by Regional Geotechnical Solutions has found on-site saturated hydraulic conductivity to be in the range of (4,000-20,000mm/hr).

For the purposes of this assessment, a value of 1,000mm/hr has been adopted, being the lower of the end of the observed range and including a Sandy Soil moderation factor = 0.5 (per ARQ S11.3.2, Engineers Australian 2003) to account possible site variability, and an additional factor of safety of 2 to account for possible long term reductions due to sedimentation / compaction. It is considered that long term siltation of the infiltration areas is not a significant concern in this proposal, as restorative maintenance is possible being an open infiltration system (as opposed to below infiltration ground tanks).

It is noted that maintenance of the infiltration areas will be required from both amenity and bushfire perspectives, but mowing / slashing with heavy machinery should not be permitted, as this will compact the surface and result in a reduction in available infiltration capacity.

While the potential option for the use of slotted pipes for any trunk drainage is noted, the scope of any pipe network has not been investigated at this Concept design stage, and the effect of infiltration discharge from any slotted pipes has not been included into this assessment.

9.2.8 RESULTS

The following tables and figures illustrate that the modelled ensemble median peak water levels stay within the nominated infiltration areas for all storms up to the 1% AEP storm event. The simplest way to interpret the results in Figure 4 is the zero discharge (in red) to the south west (to Mungo Brush Rd), and south east (to adjacent property), demonstrating all runoff is captured and infiltrated onsite.

The reported water elevations in the figures below are indicative only, as the nodes are lumped nodes representing multiple biofiltration / infiltration storage structures – more detail can be added to this in future phases of the project design.

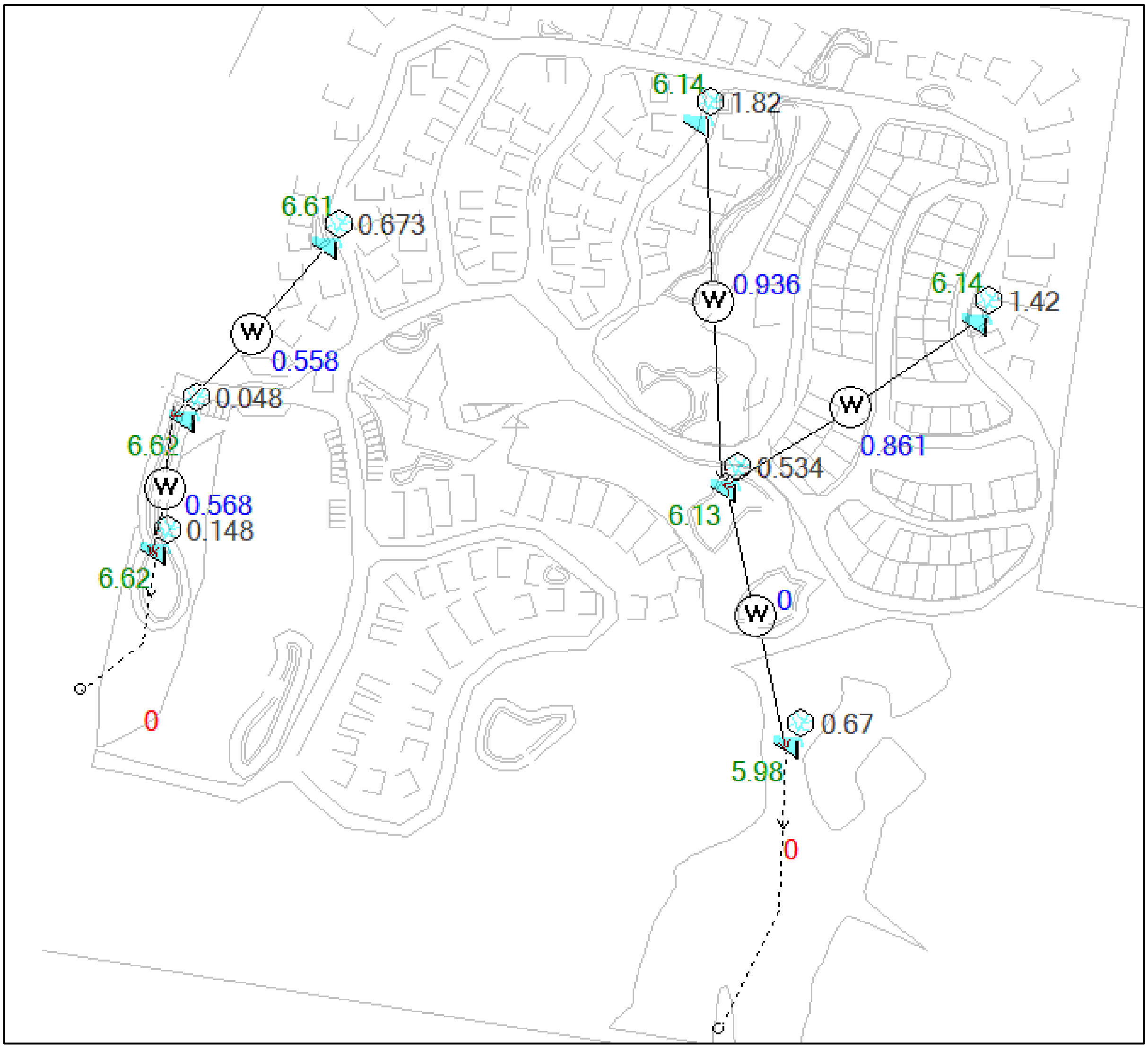


Figure 4: 1% AEP Ensemble Median Peak Water Levels and Flow Rates

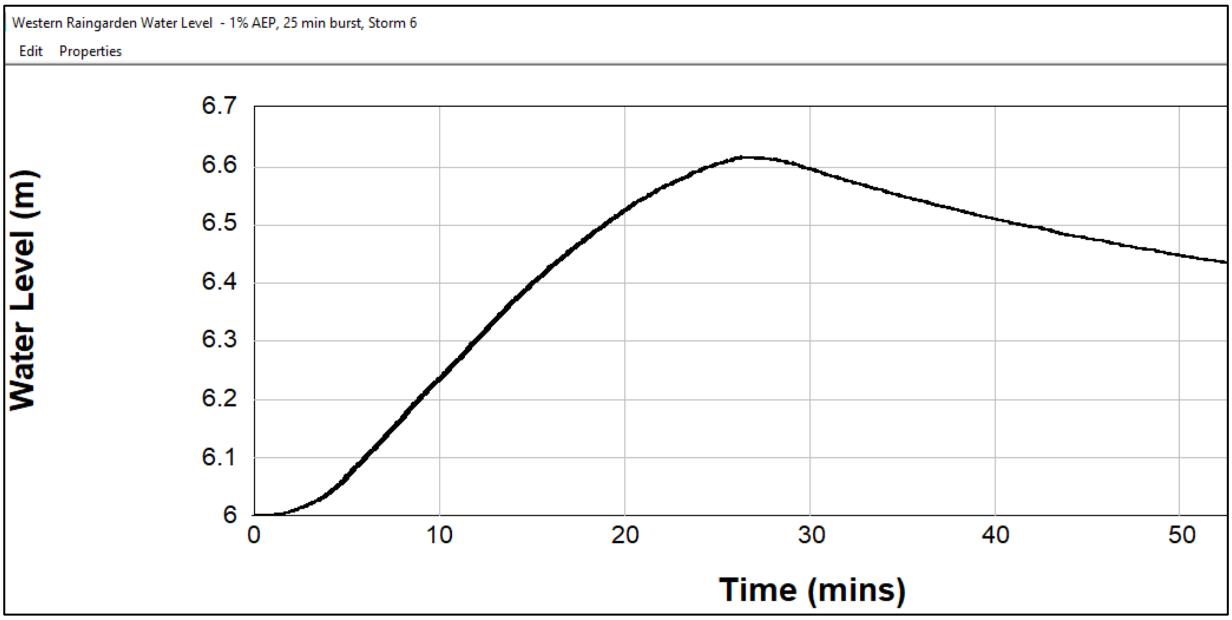


Figure 5: 1% AEP Ensemble Median Storage Level (Western Catchment)

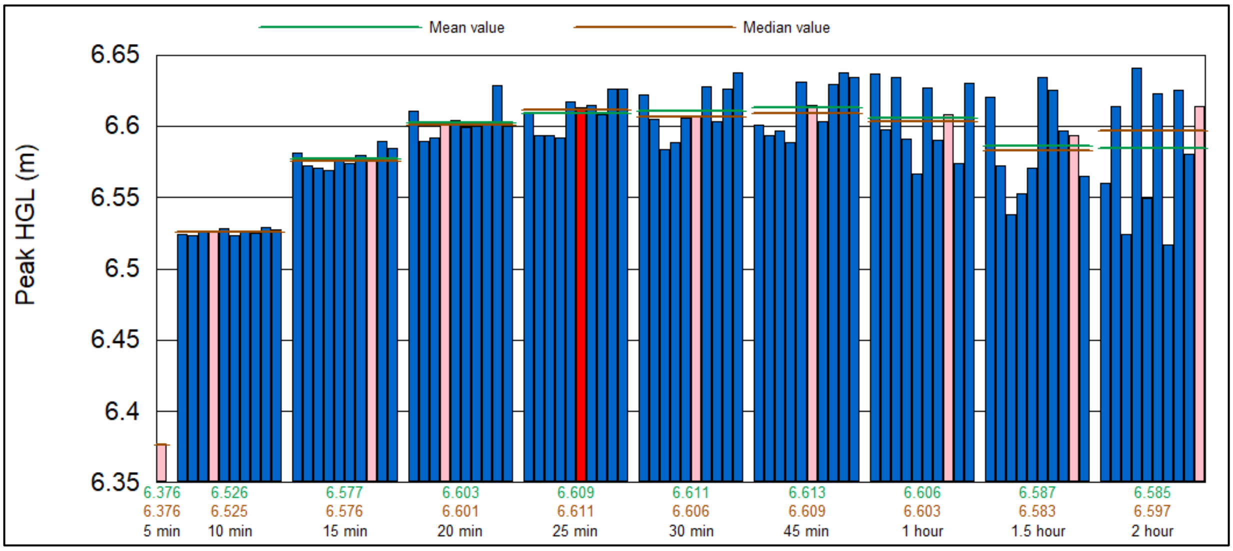


Figure 6: 1% AEP Ensemble Median Storage Level (Western Catchment)

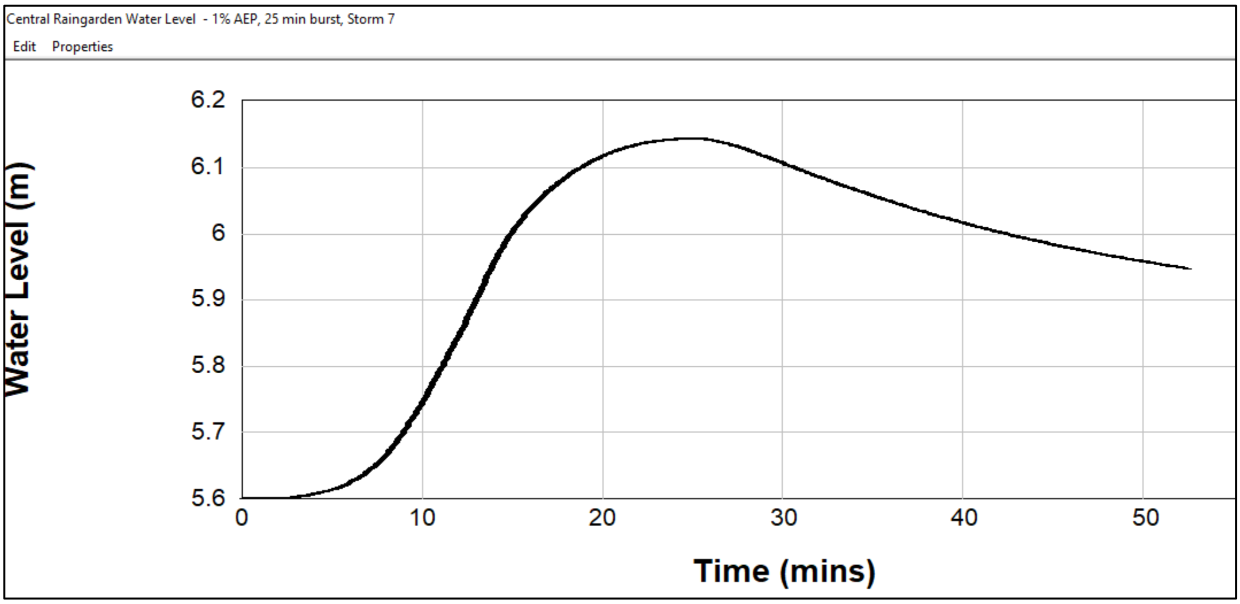


Figure 7: 1% AEP Ensemble Median Storage Level (Central/Eastern Catchment)

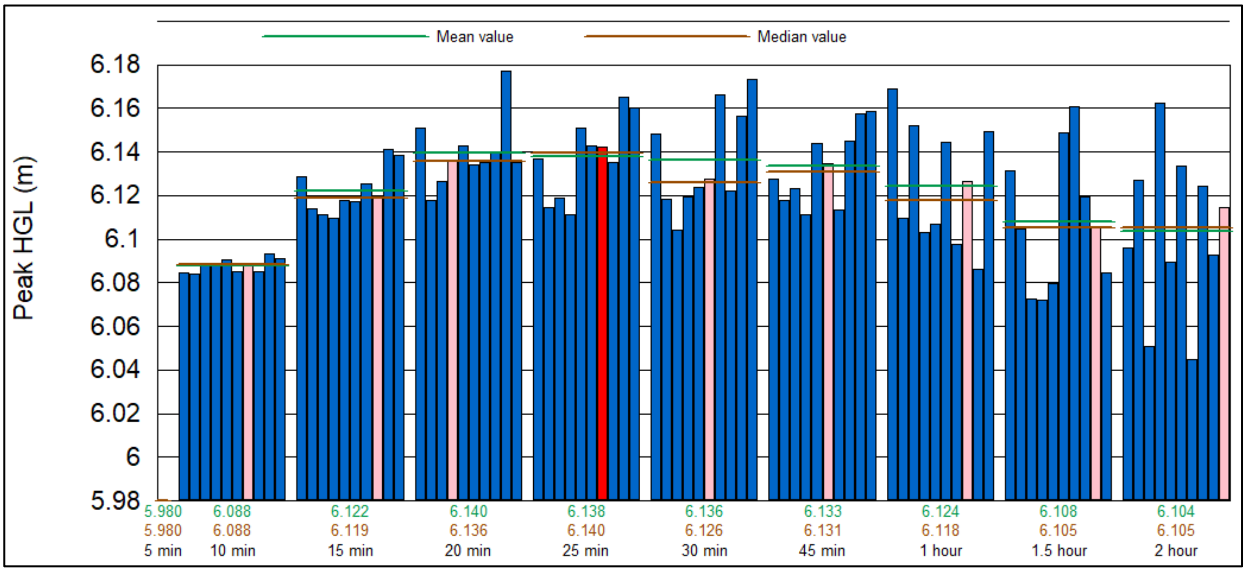


Figure 8: 1% AEP Ensemble Median Storage Level (Central/Eastern Catchment)

10.0 STORMWATER MANAGEMENT – WATER QUALITY MODEL

10.1 BACKGROUND

The quality of runoff generated by the site is important to ensure the preservation of the downstream environments as an increased proportion of impervious area can lead to a subsequent increase in the quantities of suspended solids, phosphorus and nitrogen exiting the site in stormwater runoff. While this site will discharge exclusively via infiltration, the water quality of the water being infiltrated from the site may still be important for the receiving groundwater. The aim of this section of the study is to determine what measures can reasonably be undertaken as part of this development towards meeting the water quality objectives set out in Table 1 in Section 5 of this report.

10.2 MUSIC MODELLING

MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the Cooperative Research Centre for Catchment Hydrology. MUSIC provides the ability to model both quality and quantity of runoff generated by catchments. Therefore MUSIC can simulate annual stormwater volumes, and expected annual pollutant loadings.

MUSIC is designed to model stormwater runoff systems in urban catchments. It is used to simulate a range of temporal and spatial scales. Catchment modelling can be performed for areas up to 100 km^2, with times steps from 6 minutes to 24 hours to match the range of spatial scale. This enables long term modelling of continuous historical rainfall data from pluviograph sources, and reflects the ability to account for temporal variation in data for an annual rainfall series directly.

MUSIC also has the ability to model a number of treatment devices, and measure their effectiveness in terms of the quantity and quality of runoff downstream. This allows determination of the degree of reduction in annual pollutant loadings.

It is important to note that the MUSIC simulation relies heavily on input variables and MUSIC models can be calibrated to local conditions. However, for the scale of most urban development projects, it is generally considered unreasonable to perform a calibration and input parameters can be sourced from various guidelines, such as Council's WSD Guideline or the current NSW MUSIC Modelling Guidelines.

10.2.1 CLIMATE / RAINFALL

To accurately model a site of this size, continuous rainfall record spanning at least five years with a six minute timestep is required. MidCoast Council have prepared a template for use across the LGA and this template has been utilised to create the model for this report.

The rainfall record in the template is ten years of data between the dates of 1/1/1969 and 31/12/1978. This data produced a mean annual rainfall of 1234mm. It is noted that the long term average rainfall (obtained from the Bureau of Meteorology) for Nelson Bay (approximately 13km from the site) is 1348mm.

10.2.2 EVAPORATION

To accurately model the outcome of water quality treatment measures, potential evapotranspiration (PET) data is required. Again, this data has been taken from the MidCoast Council template which has a mean annual value of 1367mm.

It is noted that the previous approach of determining monthly average areal potential evapotranspiration values from maps in the 'Climate Atlas of Australia, Evapotranspiration' (BoM, 2001) resulted in an annual average of 1335mm.

10.2.3 NODE PARAMETERS

The MUSIC model was used to simulate the pollutant export generated during a ten year period of average rainfall. Rainfall-runoff parameters for Sand soils were adopted from Section 4.6.5 of the Midcoast Council Guidelines for Water Sensitive Design Strategies (2019). Typical pollutant concentrations were derived from the NSW MUSIC Modelling Guidelines (2015). The adopted parameters can be seen below.

Note that a Rainfall Threshold of 1.5mm/day was adopted for the "Sealed Road" and "Unsealed Road" nodes, and 0.3mm/day was adopted for the "Roof" node per Table 5-4 in the NSW MUSIC Modelling Guidelines (2015). A Rainfall Threshold of 1.0mm/day adopted for all other nodes.

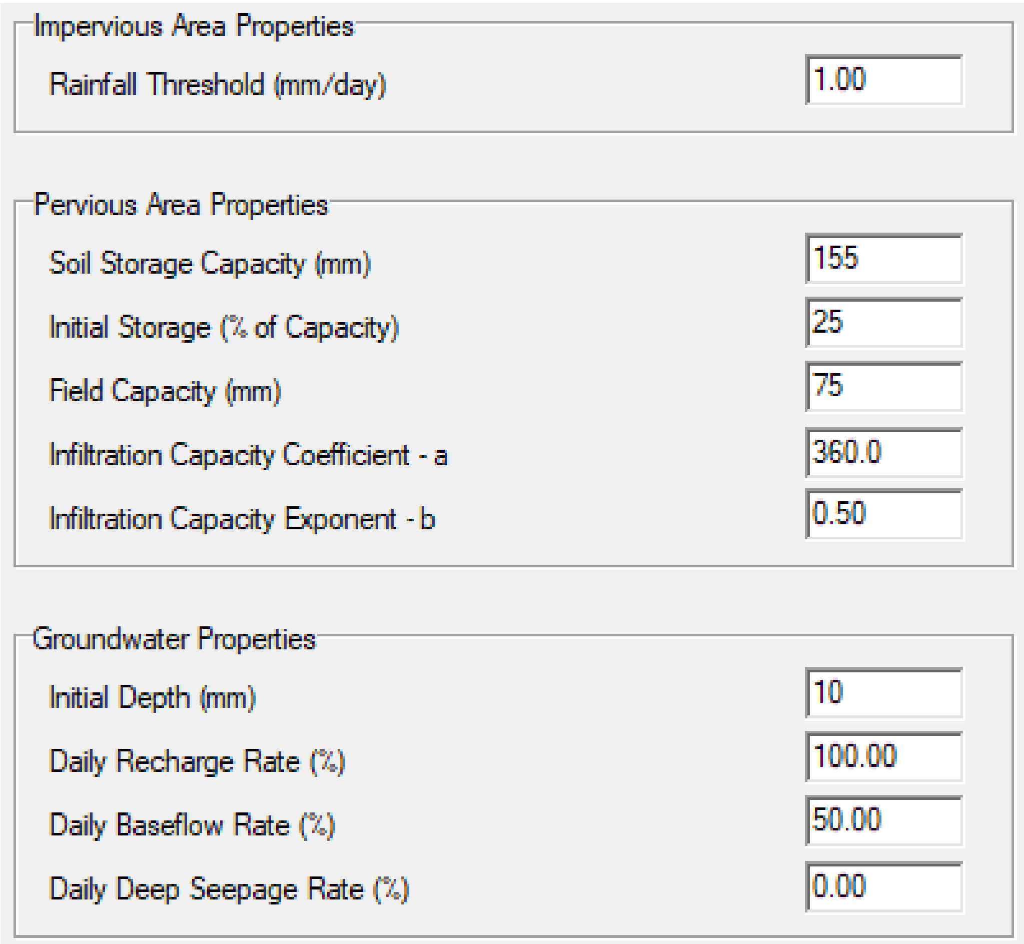


Figure 9: Adopted Rainfall-Runoff MUSIC Parameters

Table 2: Adopted MUSIC Pollutant Generation Parameters

	Rural Residential	Re-vegetated	Forest	Roof	Residential	Unsealed Road
Baseflow TSS Mean (mg/L)	14	14	6	-	15.8	16
Stormflow TSS Mean (mg/L)	90	90	40	20	140	1000
Baseflow TP Mean (mg/L)	0.06	0.06	0.06	-	0.14	0.14
Stormflow TP Mean (mg/L)	0.22	0.22	0.08	0.13	0.25	0.5
Baseflow TN Mean (mg/L)	0.9	0.9	0.3	-	1.3	1.3
Stormflow TN Mean (mg/L)	2	2	0.9	2	2	2.2

10.2.4 EXISTING FLOW & POLLUTANT ANALYSIS

The existing site was modelled to simulate the current pollutant loads from the site. The vegetated portions of the site have been modelled as a Forest node with zero percentage impervious, which best represents the existing landuse. The portions of the site that have been cleared / disturbed have been modelled as a rural landuse with zero percent impervious.

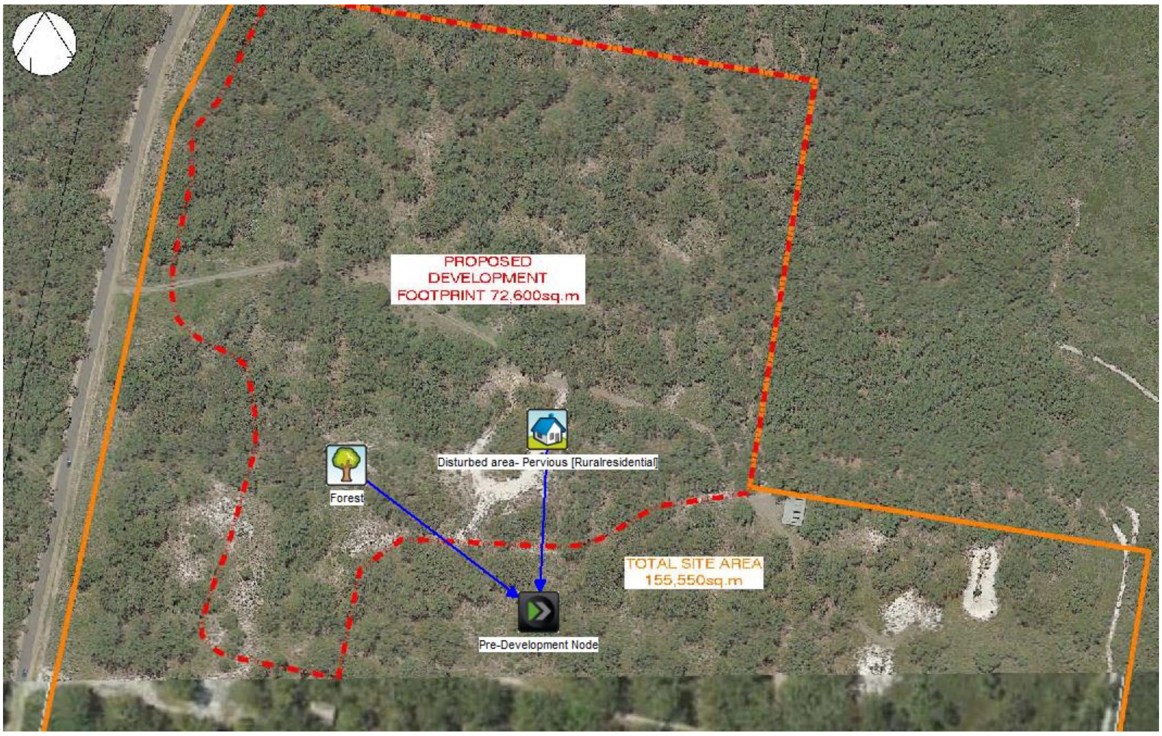


Figure 10: Existing State MUSIC Model

10.2.5 PROPOSED DEVELOPMENT FLOW & POLLUTANT ANALYSIS

The proposed development was modelled to determine expected pollutant loads and the effectiveness of the proposed water treatment measures. The catchment was broken up into different areas depending on the surface type, including;

- Roof areas from community building structures (measured directly off the architectural plans), modelled as “Roof” nodes with 100% impervious area;
- Roof areas from prospective future cabins on short term sites (assumed at 50sq.m per site), modelled as “Roof” nodes with 100% impervious area;
- All access road areas (measured directly off the architectural plans) were modelled as a “Residential” landuse with 100% impervious area;
- Bushfire perimeter road (measured directly off the architectural plans) modelled as a “Unsealed Road” landuse with 50% impervious area;
- Biofiltration areas (including the landscaped batters into the biofilters) have been included as a separate source node with a “re-vegetated” landuse as it is not accurate to include them as an urban landuse. These areas are 100% pervious, have complete native vegetation coverage, and would experience

none of the pollutant generating activities typical of urban lands (lawn clippings, fertilisation, dog droppings, deciduous leaf-fall etc).

- Conservation area modelled as a Forest node,
- Perimeter bushfire APZ maintenance buffer area modelled as a ‘rural’ landuse,
- Remaining urban pervious areas were modelled as a residential node with 0% imperviousness. This area represents the short-term site areas not covered by a cabin roof, the camping sites, the open spaces around the various community facilities and grassed and landscaped areas.

Modelled treatment nodes include;

- Rainwater tanks – A total of 20kl of combined storage for the (or 5kl each on each of the four community buildings), and 2kl tanks on each short term site for cabin roof area. It has been assumed that 100% of the roof areas from these structures will be connected to the tanks. It is expected that captured water from these tanks will be used onsite in toilet, laundry and external uses only.

It is noted that tanks are only required on short term sites if a permanent cabin structure is installed - sites utilised for caravans / camping do not require tanks.

The adopted tank sizes have been determined from results of a preliminary sensitivity analysis and confirmed with Council officers as appropriate. These are considered a realistic minimum tank size, and would not preclude the use of larger tanks if desired by the park operators. A summary of this assessment can be seen in Appendix D.

For the tanks on the short-term sites, Council have reviewed water usage data from similar facilities in their LGA and have advised that a usage rate of 0.1kl/day/cabin should be adopted.

For the tanks attached to the community facilities, based on Midcoast Water Services Equivalent Tenements Policy rate at 0.5ET/toilet, in total the community facilities would equate to 5ET, or equivalent to 5 standard dwellings – i.e. equivalent internal reuse rates for 5x55L/day was adopted from the Council WSD Guidelines. External reuse may be extensive if utilised for maintaining landscaping adjacent to these structures, but there is no real reliable guidance on what the average reuse rate may be, so a rate of 36kL/yr/ET (distributed by PET minus Rain) was adopted as the lower value from the Council and NSW MUSIC modelling guidelines.

It is noted that the preliminary sensitivity testing detailed in Appendix D demonstrated that the tank sizes and reuse rates are largely insignificant to the overall modelling results. This is primarily due to the small catchment footprint relative to the overall development, and the relatively clean nature of the modelled roof areas relative to other landuses.

- Biofiltration systems – biofiltration areas have been designed for rainwater tank overflows and runoff from roadways and parking area. Conceptually these will need to be distributed across the site as terrain and vegetation constraints dictate. A total of 636sq.m filter area 0.25m detention depth and a 0.6m filter depth have been modelled. The orthophosphate content of the filter media has been modelled at 40mg/kg.

  Sensitivity testing of the filter area has been undertaken and is detailed in Appendix D. These results have been discussed with Council staff and it was concluded that, while not being large enough to meet Council's DCP targets, setting a target filter area of 3% of the contributing catchment area appeared to be the most appropriate sizing for the biofiltration treatment devices.

  The base will be unlined to allow filtered water to infiltrate, mimicking existing hydrological processes onsite. Overflow will be directed to infiltration areas for disposal.

  The RGS geotechnical report found groundwater at the site was around 6.5m below existing ground level, which will be well clear of the base of the proposed biofilter media.

- Vegetated buffer – applied only to the bushfire perimeter road, this has been included to represent the filtering of achieved as runoff sheds onto adjacent grassed areas before infiltrating.

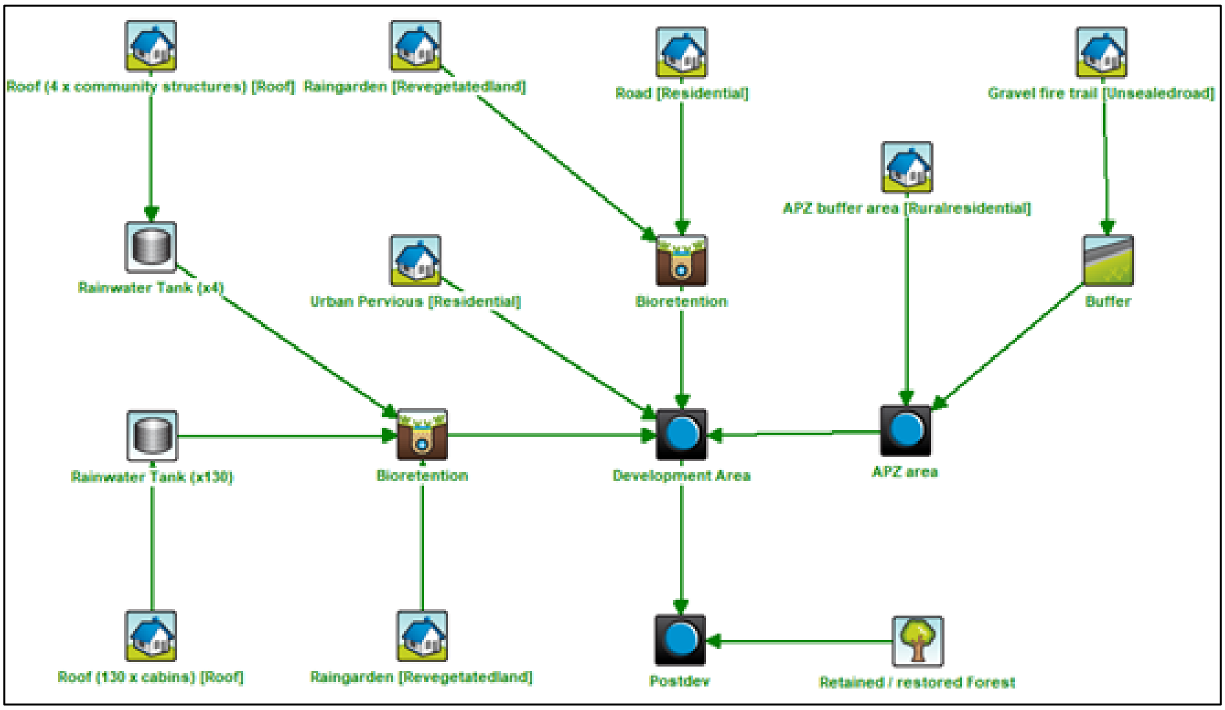


Figure 11: Proposed Development MUSIC Model

10.2.6 COMPARISON OF POLLUTANT RESULTS

Pre and post development pollutant loads are presented in the table below, to compare results to the required targets.

Table 3: Comparison of Pre and Post-Development Pollutant Loads

	Pre-Developed	Post-Developed	Treatment Train % Reduction Achieved	NorBE Compliant
TSS (kg/yr)	912	2330	71.3%	No
TP (kg/yr)	5.07	8.55	38.5%	No
TN (kg/yr)	35.4	68.1	37.1%	No
GP (kg/yr)	0	90.4	87%	-

* NorBE = Neutral or Beneficial Effect

Despite treatment measures having been optimised for the site (per Appendix D), it can be seen that the NorBE target is not met for by the proposal. This is primarily due to the very low target pollutant volumes modelled from the existing site (being a mostly forested, 100% pervious site with high infiltration sand soils).

To better understand the above results, the following table offers a breakdown of how much each section of the site is contributing the overall results.

Table 4: Contributions to Post-Development Pollutant Loads

	Roof (after treatment)	Roads (after treatment)	Fire Trail (after treatment) & APZ	Urban Pervious area	Retained / Restored Forest
Area (ha)	0.72	1.40	1.065	3.985	8.295
TSS (kg/yr)	27	127	1150	673	390
TP (kg/yr)	0.36	1.10	1.26	3.22	2.6
TN (kg/yr)	4.11	11.7	9.56	27.2	15.4
GP (kg/yr)	0	0	90.4	0	0

It can be seen that large portions of the modelled pollutant loads are being generated by the pervious areas of the site, areas that can not be practically captured and treated as rainfall will realistically be infiltrated before generating concentrated runoff.

11.0 COSTS

All stormwater infrastructure will be installed by the developer and will remain in private ownership for the life of the development. As no costs are to be incurred by Council, a detailed analysis has not been provided in this report.

12.0 OPERATION AND MAINTENANCE PLAN

Regular minor maintenance is required to ensure water treatment measures continue to operate in an effective way. These tasks should be performed every three months or after heavy storm events, but the flat nature of the site and sandy soil type means minimal sedimentation of the biofilter area is expected once the site is finalised.

Many of these tasks would be considered ‘instinctive’ every-day maintenance activities for park maintenance staff with minimal associated costs, such as watering the plants during dry periods, weeding and clearing blockages of inlet and outlet structures.

The maintenance schedule in Appendix C has been prepared as a typical template to direct grounds maintenance staff undertaking routine maintenance, and is based on Raingardens and Bioretention Tree Pits Maintenance Plan Example prepared by the Facility for Advancing Water Biofiltration, Monash University. Relevant sections have been reproduced and/or modified for the specific site conditions.

All biofilter maintenance activities will need to commence as soon as biofilters are planted and brought online and continue for the life of the development.

13.0 CONCLUSIONS

The tourist park has been designed with drainage and water quality constraints in mind, and the current proposal represents a design that balances the constraints of the site and the development outcome.

Flooding - There will be no flooding impacts on the proposed development, with the entire proposal well clear of the 2.8m FPL.

Drainage - In keeping with the existing site hydrology and with the fact there is no formal public drainage available in Mungo Brush Road, the site has been designed with infiltration as the primary discharge method. The site has been designed so that all runoff up to the 1% AEP is contained and infiltrated on the site. There should be no impacts on neighbouring properties or public infrastructure as a result of the development, and internally within the site there is adequate provision for the functionality, safety and amenity of the facility.

Water Quality - Stormwater runoff quality has been addressed on-site via a treatment train that includes the construction of a dispersed biofiltration raingarden network across the site, provision of 20kl of tank storage attached to the community buildings, and a commitment to a minimum 2kL rainwater tank with any future cabin installations. The modelling results indicate that while this treatment train has been optimised to give the best long term result possible, the Neutral or Beneficial Effect water quality targets are met not met for this proposal. This is primarily because the existing site condition (forested on sandy soils) sets an extremely low benchmark pollutant load that is not practicable to achieve if developed in any way. As the proposed treatment measures are considered industry best-practice, and have been optimised for the proposal, it is requested that Council consider the development to be of merit and approvable despite not meeting the DCP guidelines.

14.0 REFERENCES

Guidelines for Water Sensitive Design Strategies, 2019, Midcoast Council

MUSIC Version 6.0 User Manual, 2011, eWater

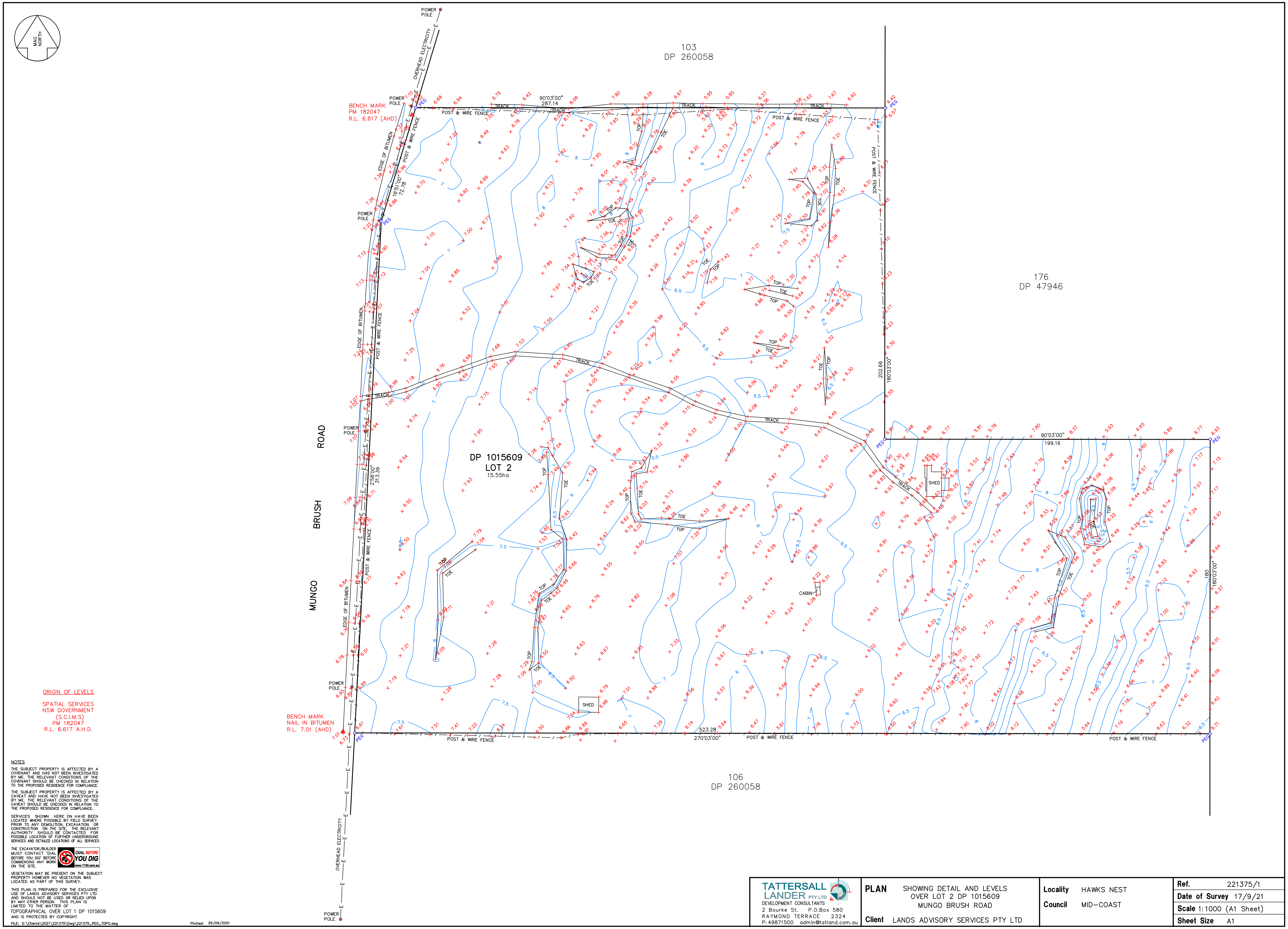
MUSIC Modelling Guidelines, 2018, Healthy Land and Water Limited & Water By Design

NSW MUSIC Modelling Guidelines, 2015, BMT WBM

Geotechnical Assessment – Lot 2 DP1015609 (288) Mungo Brush Road Hawks Nest, RGS50057.1-AB, 21 March 2023, Regional Geotechnical Solutions

WSUD Engineering Procedures: Stormwater, 2005, Melbourne Water

APPENDIX A: SITE DETAIL SURVEY



ORIGIN OF LEVELS

SPATIAL SERVICES
NSW GOVERNMENT
(S.C.I.M.S)
PM 182047
R.L. 6.617 A.H.D.

NOTES

THE SUBJECT PROPERTY IS AFFECTED BY A COVENANT AND HAS NOT BEEN INVESTIGATED BY ME. THE RELEVANT CONDITIONS OF THE COVENANT SHOULD BE CHECKED IN RELATION TO THE PROPOSED RESIDENCE FOR COMPLIANCE.

THE SUBJECT PROPERTY IS AFFECTED BY A CAVEAT AND HAVE NOT BEEN INVESTIGATED BY ME. THE RELEVANT CONDITIONS OF THE CAVEAT SHOULD BE CHECKED IN RELATION TO THE PROPOSED RESIDENCE FOR COMPLIANCE.

SERVICES SHOWN HERE ON HAVE BEEN LOCATED WHERE POSSIBLE BY FIELD SURVEY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITY SHOULD BE CONTACTED FOR POSSIBLE LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES

THE EXCAVATOR/BUILDER MUST CONTACT 'DIAL BEFORE YOU DIG' BEFORE COMMENCING ANY WORK ON THE SITE.

DIAL BEFORE YOU DIG www.1100.com.au

VEGETATION MAY BE PRESENT ON THE SUBJECT PROPERTY HOWEVER NO VEGETATION WAS LOCATED AS PART OF THIS SURVEY.

THIS PLAN IS PREPARED FOR THE EXCLUSIVE USE OF LANDS ADVISORY SERVICES PTY LTD AND SHOULD NOT BE USED OR RELIED UPON BY ANY OTHER PERSON. THIS PLAN IS LIMITED TO THE MATTER OF
TOPOGRAPHICAL OVER LOT 1 DP 1015609
AND IS PROTECTED BY COPYRIGHT.

FILE: S:\Clients\2021\221375\Dwg\221375_PEG_TOPO.dwg

Plotted: 29/09/2021

TATTERSALL LANDER PTY LTD
DEVELOPMENT CONSULTANTS
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
P: 49871500 admin@tatland.com.au

PLAN SHOWING DETAIL AND LEVELS OVER LOT 2 DP 1015609 MUNGO BRUSH ROAD

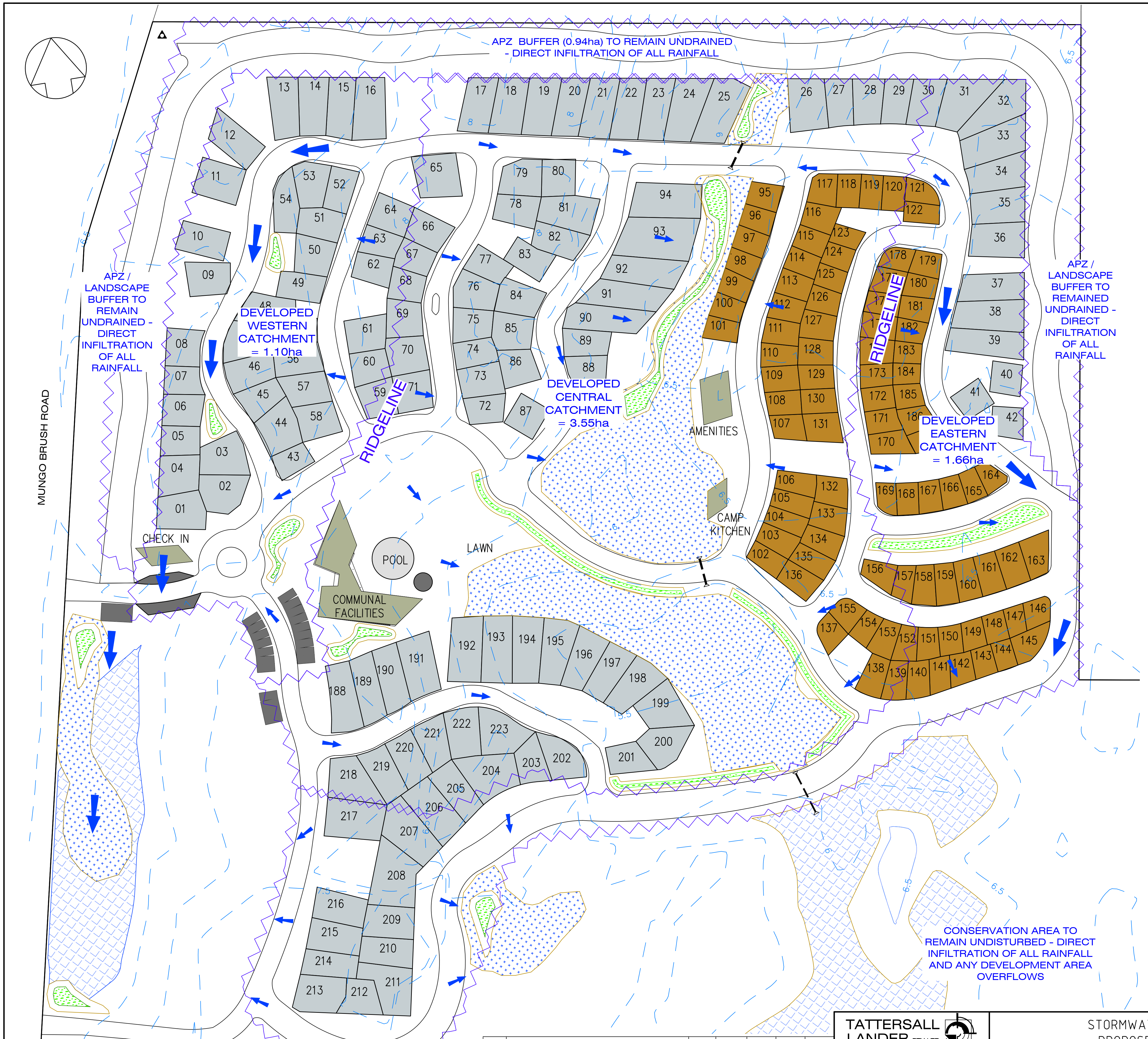
Client LANDS ADVISORY SERVICES PTY LTD

Locality HAWKS NEST

Council MID–COAST

Ref.	221375/1
Date of Survey	17/9/21
Scale	1:1000 (A1 Sheet)
Sheet Size	A1

APPENDIX B: PROPOSED LAYOUT & DETAIL PLANS



LEGEND

- CAMPING SITES
- SHORT TERM SITES
- DENOTES FLOW DIRECTION
- DENOTES CATCHMENT BOUNDARIES
- DENOTES BIOFILTRATION AREA
- DENOTES PRIMARY INFILTRATION AREA
- DENOTES SECONDARY INFILTRATION AREA 5.5-6.4m AHD APPROX 1.2ha

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
C	April 2024 Update	AV	AV	DS	BL	19/4/24
B	Revised Layout Concept	AV	AV	DS	BL	20/6/23
A	Original Issue	AV	AV	DS	BL	6/5/22

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DEVELOPMENT CONSULTANTS
ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
Fax (02) 49871733 Phone (02) 49871500

STORMWATER CONCEPT PLAN
PROPOSED TOURIST PARK
LOT 2 DP 1015609
288 MUNGO BRUSH ROAD, HAWKS NEST

COUNCIL: Midcoast
REFERENCE: 2220008
PARISH:
SHEET SIZE: A3
SCALE: 1:1,200 on A3
SHEET No.: 1 of 1
DATE: Plotted 19/4/24 6:13PM
CLIENT:
JOB No.: 221375
COMPUTER FILE : S:\Clients\2021\221375\Dwg\221375 Concept Design Plans.dwg

Xref: OVERALL BASE PLAN [OVERALL BASE PLAN.dwg]

APPENDIX C: BIOFILTER MAINTENANCE TASKS

A. Filter Media Tasks

Sediment Deposition	Remove sediment build up from the surface of bioretention swales Frequency – 3 monthly after rain
Holes or scour	Infill any holes in the filter media. Check for erosion or scour and repair, provide energy dissipation (rocks & pebbles etc) if necessary Frequency – 3 monthly after rain
Filter media surface porosity	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A symptom may be that water remains ponded in the swale for more than a few hours after a rain event. Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants Frequency – 3 monthly after rain
Litter Control	Check for litter (including organic litter) in and around bioretention swales. Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered. Frequency – 3 monthly after rain

B. Horticultural Tasks

Pests and Diseases	Assess plants for disease, pest infection, stunted growth or senescent plants. Treat or replace as necessary. Reduced plant density reduces pollutant removal and infiltration performance Frequency – 3 monthly after rain
Maintain original plant densities	Inspect condition of all plants. Replace and dead plants immediately to maintain a minimum density of 4 plants per square metre Frequency – 3 monthly after rain
Drought / Extreme Heat	In periods of prolonged drought or extreme heat, the condition of plantings and site lawn coverage should to be monitored for signs of stress. Watering may be required to ensure plant survival Frequency – As required

Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of such weeds can reduce dominate species distributions and diminish aesthetics. Weed species can also compromise the systems long term performance. Inspect for and manually remove weed species. Application of herbicide should be limited to a wand or restrictive spot spraying due to the fact that the swales are directly connected to the stormwater system Frequency – 3 monthly after rain
Grassed buffer strip	Grassed buffer strips treat runoff as it flows off the roads, before it enters the bioretention swales. Maintaining a healthy grass cover is important, but the use of fertilisers should be kept to a minimum given their proximity to the drainage network
Lawn Fertiliser	Healthy site grass coverage is important for pollutant treatment, topsoil erosion control and aesthetics. However, if not correctly used, fertilisers can damage the downstream environment. A low Phosphorus fertiliser with restricted leaching properties such as a Fused Calcium Magnesium Phosphate or TNN Industries ‘Formula 1’, or equivalent is ideal. The application of fertiliser should be restricted to a maximum of twice a year

C. Drainage Tasks

Perforated Pipe	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged. A small steady clear flow of water may be observed discharging from the perforated pipe at its connection into the downstream pit some hours after rainfall. Note that smaller rainfall events after dry weather may be completely absorbed by the filter media and not result in flow. Remote camera (eg CCTV) inspection of pipelines for blockage and structural integrity could be useful. Flushing of lines from the flushing points may be required. Frequency – 6 monthly after rain
High flow inlet pits, overflow pits and other stormwater junction pits	Ensure inflow areas and grates over pits are clear of litter and debris and in good and safe condition. A blocked grate would cause nuisance flooding of adjoining areas. Inspect for dislodged or damaged pit covers and ensure general structural integrity. Remove sediment from pits and entry sites (likely to be an irregular occurrence in mature catchment). Frequency – monthly and occasionally after rain

APPENDIX D: TREATMENT TRAIN OPTIMISATION RESULTS

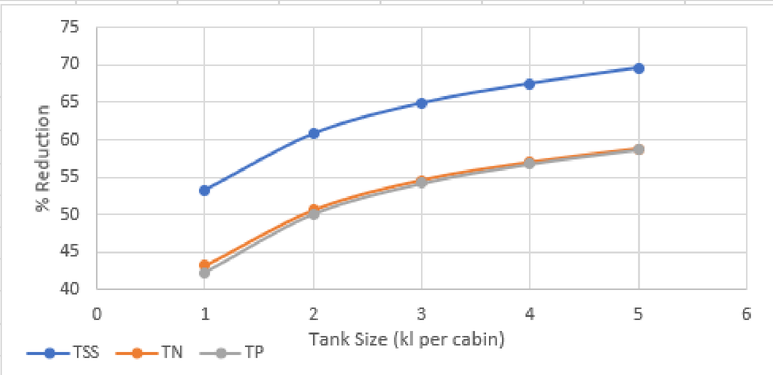
The oversizing of treatment measures in pursuit of difficult DCP targets can result in impractically expensive or nonfunctional assets that can be as bad or worse than doing no treatment at all. For example, the NorBE targets may have been able to be met on this site by a raingarden sized 15x the currently proposed measures, but this would ultimately not receive enough runoff to ensure its survival (as well as being prohibitively expensive and have an unreasonably large land take from the site).

The purpose of undertaking a sensitivity analysis is to determine at what point the cost of continued upsizing treatment measures becomes disproportionate to the additional performance achieved – i.e. to optimise the water quality treatment solutions for the site.

Rainwater tanks - A series of model runs was performed while varying only the rainwater tank sizes. The future cabins and community structures were modelled separately as they have different roof area and water reuse characteristics. The results (measured at the rainwater tank nodes) are presented below;

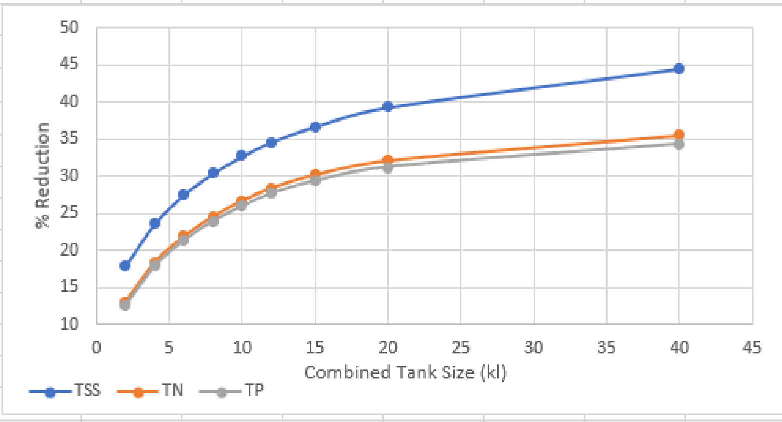
Cabin Rainwater tank sensitivity test
Roof area = 130 x 50sq.m cabins = 6500sq.m
Reuse = 0.1kl/day/cabin x 130 cabins

	% Reduction		
Tank Size x130 (kl)	TSS	TN	TP
1	53.3	43.2	42.3
2	60.8	50.6	50.1
3	64.9	54.6	54.2
4	67.5	57	56.8
5	69.6	58.8	58.7



Community Facility Rainwater tank sensitivity test
Roof area = 700sq.m
Reuse = 0.275kl/day + 180kl/yr

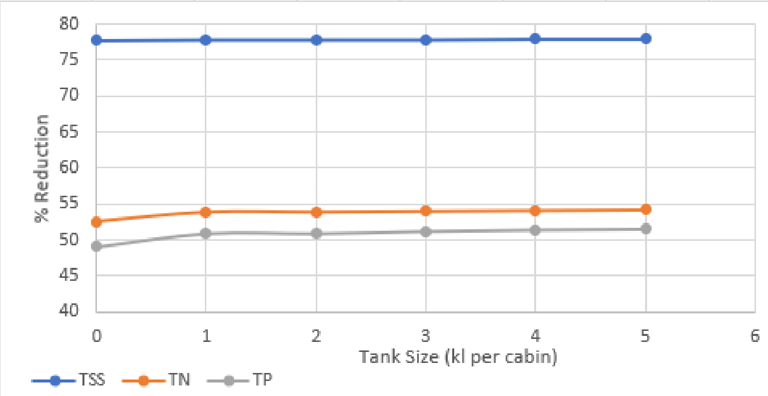
	% Reduction		
Combined Tank Size (kl)	TSS	TN	TP
2	17.9	13.1	12.6
4	23.6	18.4	17.8
6	27.5	21.9	21.3
8	30.4	24.6	23.9
10	32.7	26.7	25.9
12	34.6	28.4	27.6
15	36.7	30.2	29.3
20	39.3	32.1	31.2
40	44.5	35.5	34.3



To give an indication of the impact the rainwater tanks have on the overall site results, the charts displayed below same series of model runs with the results recorded from the overall site 'post-development' node.

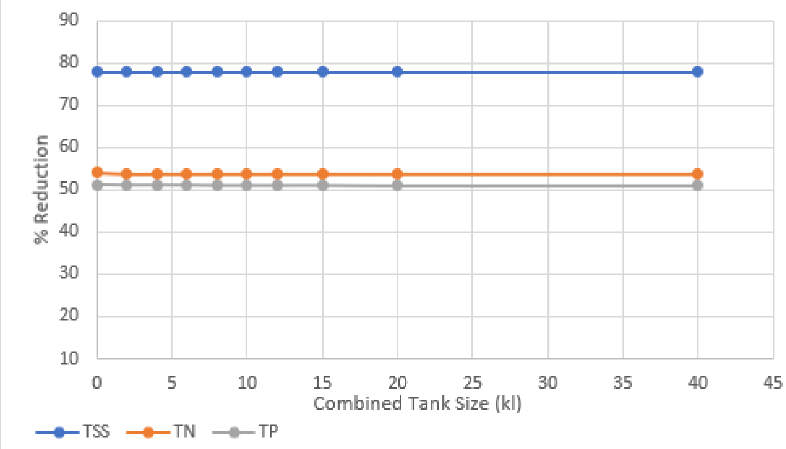
Cabin Rainwater tank sensitivity test 2 - measured at site outlet node
Roof area = 130 x 50sq.m cabins = 6500sq.m
Reuse = 0.1kl/day/cabin x 130 cabins
Raingarden assumed 3% of impervious catchment area

	% Reduction (whole site)		
Tank Size x130 (kl)	TSS	TN	TP
0	77.8	52.5	49.1
1	77.9	53.9	50.9
2	77.9	53.9	50.9
3	77.9	54	51.2
4	78	54.1	51.4
5	78	54.2	51.5



Community Facility Rainwater tank sensitivity test 2 - measured at site outlet node
Roof area = 700sq.m
Reuse = 0.275kl/day + 180kl/yr
Raingarden assumed 3% of impervious catchment area

	% Reduction (whole site)		
Combined Tank Size (kl)	TSS	TN	TP
0	77.9	54	51.2
2	77.9	53.9	51.1
4	77.9	53.9	51.1
6	77.9	53.9	51.1
8	77.9	53.9	51
10	77.9	53.9	51
12	77.9	53.9	51
15	77.9	53.9	51
20	77.9	53.9	50.9
40	77.9	53.9	50.9



Conclusion – Due mostly to the fact the roof areas will make up such a small component of the overall site area (0.72ha/15.55ha = 4.5%), and that roof areas are comparatively clean compared to other urban landuses, the sizing of rainwater tanks is largely irrelevant to the overall site results. It could even be argued that it is not justified including them at all. However, as the proponent is intending on installing tanks to be consistent with the character of the development, it has been agreed in consultation with Council staff it is appropriate to stipulate the following minimum tank sizes;

- 2kl per cabin installed on short term sites, and
- 20kl total storage installed with the community facilities (i.e. average 5kl per structure).

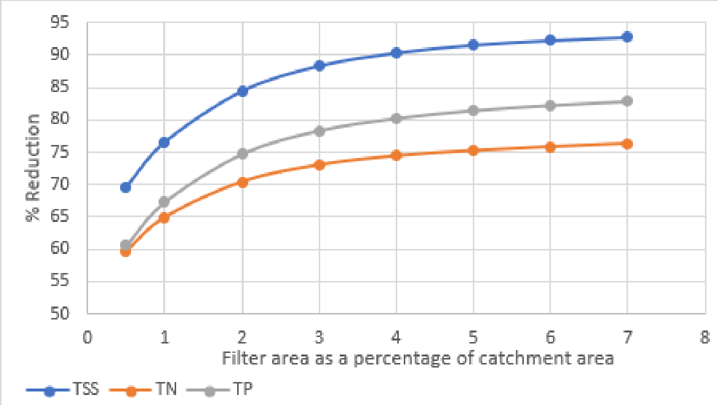
Raingardens – Another series of model runs was performed while varying only the raingarden sizes (filter and storage areas). Tank sizes were set per the adopted values noted above, and the raingardens were provisionally split between those receiving roof water via tank overflows, and those receiving runoff from the roads. The results (measured at the bioretention nodes) are presented below;

Roof area Raingarden area Sensitivity test

Catchment area = 700sq.m community facilities + 130 x 50sq.m cabins = 7200sq.m

Assumed 20kl community facility tanks + 2kl cabin tanks upstream of raingarden

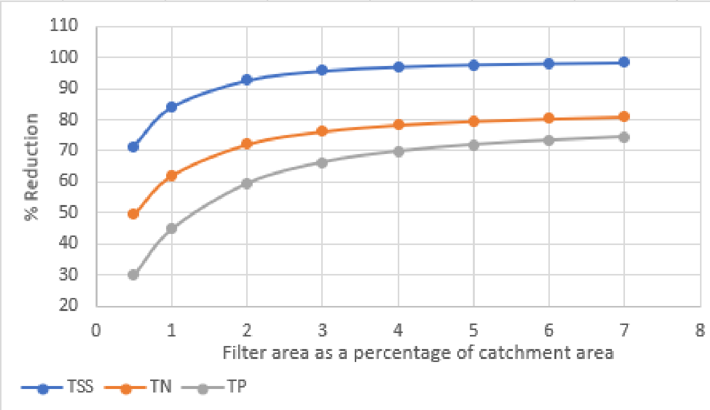
	% Reduction		
Filter area (% of catchment)	TSS	TN	TP
0.5	69.6	59.7	60.6
1	76.5	64.9	67.3
2	84.4	70.4	74.7
3	88.3	73	78.3
4	90.3	74.4	80.2
5	91.5	75.2	81.4
6	92.2	75.8	82.2
7	92.7	76.3	82.8



Road area Raingarden area Sensitivity test

Catchment area = 14,000sq.m inpervious road area

	% Reduction		
Filter area (% of catchment)	TSS	TN	TP
0.5	71.3	49.5	30.1
1	83.9	62	44.9
2	92.6	72.1	59.5
3	95.7	76.2	66.3
4	97	78.3	69.8
5	97.7	79.5	71.9
6	98.1	80.3	73.3
7	98.4	80.9	74.4

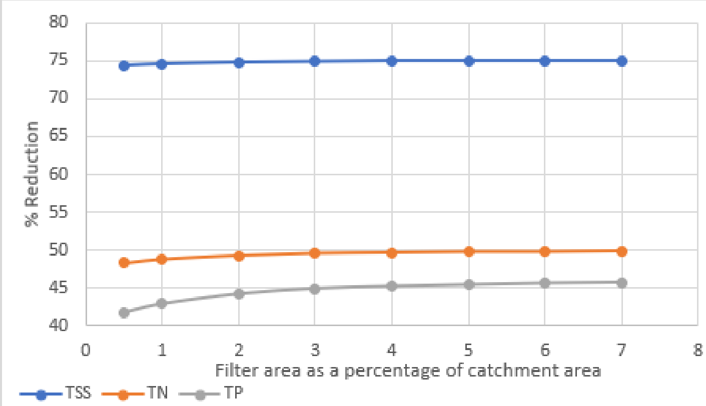


Roof area Raingarden area Sensitivity test 2 - measured at site outlet node

Catchment area = 700sq.m community facilities + 130 x 50sq.m cabins = 7200sq.m

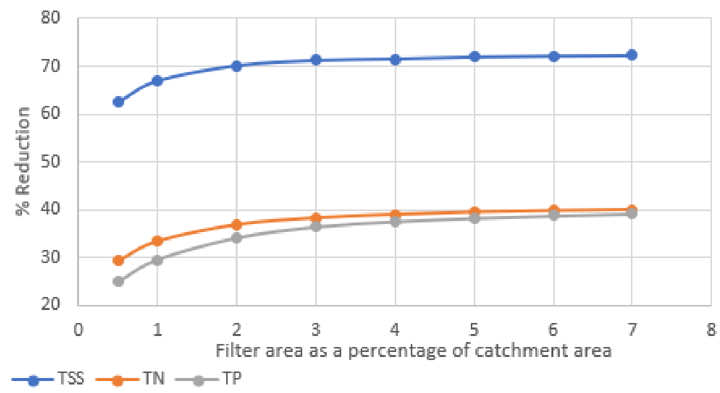
Assumed 20kl community facility tanks + 2kl cabin tanks upstream of raingarden

	% Reduction		
Filter area (% of catchment)	TSS	TN	TP
0.5	74.4	48.3	41.8
1	74.6	48.8	42.9
2	74.8	49.3	44.2
3	74.9	49.6	44.9
4	75	49.7	45.2
5	75	49.8	45.4
6	75	49.8	45.6
7	75	49.9	45.7



Road area Raingarden area Sensitivity test 2 - measured at site outlet node
Catchment area = 14,000sq.m inpervious road area

Filter area (% of catchment)	% Reduction		
	TSS	TN	TP
0.5	62.4	29.4	24.9
1	66.9	33.5	29.6
2	70.1	36.9	34.2
3	71.2	38.3	36.5
4	71.5	39	37.6
5	71.9	39.5	38.3
6	72.1	39.8	38.8
7	72.2	40	39.2



Conclusion – Similar to the rainwater tanks themselves, raingardens attached to rainwater tank overflows have limited impacts on the overall modelling results for the site. Raingardens receiving runoff from the road areas have a more noticeable impact on results, but this is still limited by the proportionally low road areas relative to the overall site (1.4ha/15.55ha = 9%).

Review of the results of the sensitivity test show it is reasonable to adopt a raingarden filter area size based on 3% of the contributing catchment area, which is generally consistent with experience on other developments. Modelling-wise, it does not matter if this is achieved as a single large raingarden, or at the other end of the scale, individual raingardens attached to each cabin. In order to find the right balance between functionality and practicality (from design, construction and maintenance perspectives), and to be sympathetic to the nature of the site, the best outcome would be a to recommend this filter area be divided up into a series of raingardens (say 5-10) across the site, scaled appropriately to be consistent with the localised catchments created by the undulating dunal nature of the topography.