Lot 5 Sealark Road, Callala Bay

Integrated Water Cycle Assessment

Project No. 1861
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Prepared for: The Hare Bay Consortia

Footprint (NSW) Pty Ltd
210 Jamberoo Road
Jamberoo, NSW 2533, Australia
ACN 131 571 929 ABN 44 131 571 929
Mobile: 0430 421 661
Email: ashley@footprinteng.com.au

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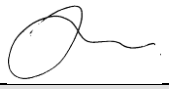
Ashley Bond			Ashley Bond					
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1.0 INTRODUCTION

Footprint (NSW) Pt. Ltd. (*Footprint*) has been engaged by 'The Hare Bay Consortia' as owners of Lot 5 Sealark Road, Callala Bay to prepare an Integrated Water Cycle and Stormwater Management Plan (IWCSMP) to be lodged in support of a planning proposal to re-zone part of the land to enable residential development.

The purpose of the IWCSMP is to:

i. Demonstrate compliance with Chapter G2 of the Shoalhaven Development Control Plan in relation to water quality;
ii. assess any downstream impacts associated with the proposed redevelopment of the subject site;
iii. ensure that water sensitive urban design (WSUD) principles are incorporated into the proposal and protect the downstream environment.

1.1. Scope of Work

The scope of works associated with preparation of the Integrated Water Cycle and Stormwater Management Plan includes;

1) Collect and review any available background information
2) Undertake modelling using MUSIC V.6
3) Model the predicted surface water hydrology and water quality (TSS, TP & TN) from the subject land for;
    a) current condition ('pre-development').
    b) post development, without stormwater treatment.
    c) post development, with stormwater treatment.
4) Prepare a conceptual stormwater management plan that achieves compliance with Chapter G2 of the Shoalhaven DCP 2014 with respect to water quality and protects water quality within the receiving body.
5) Prepare a stormwater management report detailing the methodology undertaken, any assumptions made and presenting the finding of the investigations including associated preliminary drawings detailing the location and extent of any water quality treatment devices.

2.0 SUBJECT SITE

2.1. Site Description

The subject site is described as Lot 5 DP 1225356, Sealark Road, Callala Bay and comprises an area of approximately 6.46 hectares.

The subject site adjoins Sealark Road on its' western boundary, the Jervis Bay National Park on its' northern boundary, Wowly Creek (Gully) on its' eastern boundary and existing residential development in Monarch Place to its southern boundary as shown in Figure 1.

Figure 1: Site Locality Plan (source: Six Maps)

Figure 2: Site Locality Plan with Aerial

The site generally slopes in a north-westly to south-easterly direction towards Wowly Creek. Elevations over the site range from approximately RL6.0m AHD at the north-western corner to approximately RL2.0m AHD along the eastern boundary adjacent to Wowly Creek.

The site is traversed by an open drain which discharges from two stormwater outlets under Sealark Road. This open drain discharges to Wowly Creek near the north-eastern corner of the site.

A Bangalee Forest Ecological Endangered Community (EEC) exists in the eastern portion of the site adjacent to Wowly Creek, otherwise the remainder of the site is relatively free of native vegetation and consists primarily of exotic grasses.

2.2. Flooding

Footprint was also commissioned to prepare a flood study report in support of the planning proposal for the subject site.

The results of this study are contained in the 'Lot 5 Sealark Road, Callala Bay – Flood Study Report' dated 10 January 2024, by Footprint and the pre and post development 1% AEP flood extents are shown in Figure 3 and Figure 4 respectively below.

It should be noted that the hydraulic model did not include any minor drainage system and therefore flooding within the proposed development footprint and the road as shown in Figure 4 is a result of the rainfall on grid (direct rainfall) modelling and is misrepresented as such flows would be appropriately managed through a network of pits, pipes and overland flow paths.

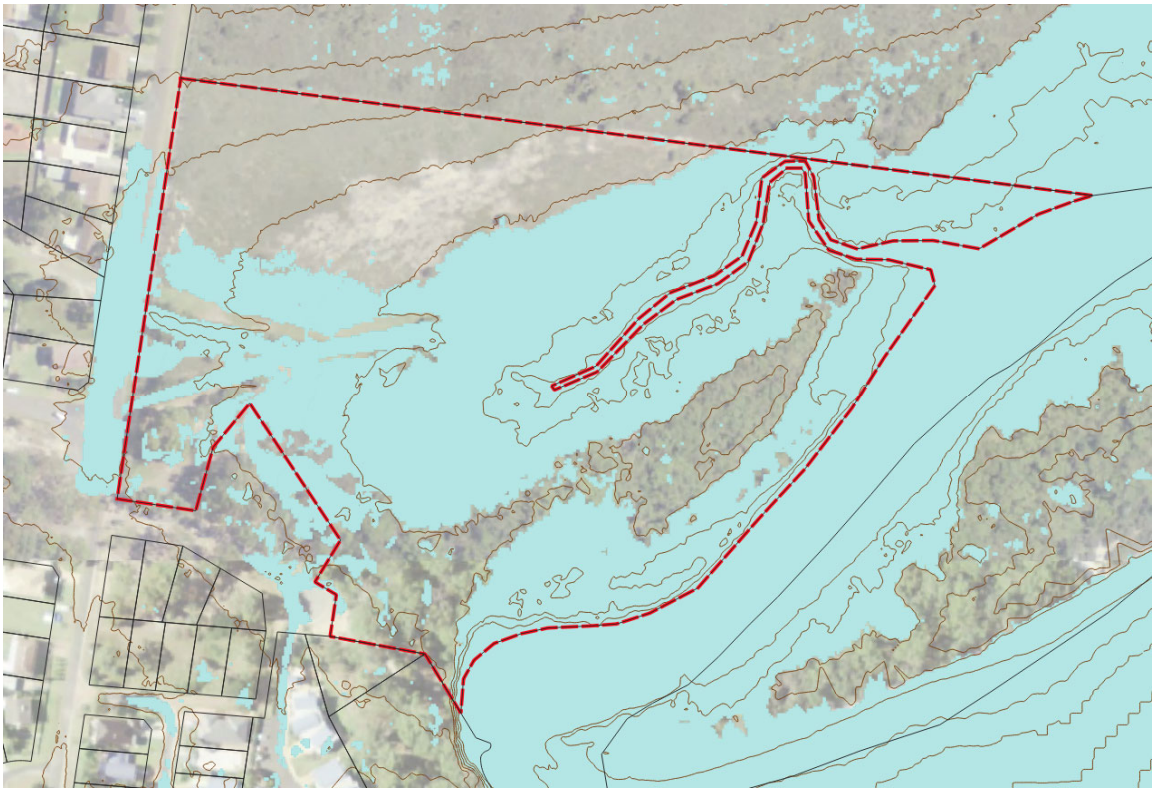


Figure 3 – Pre-Development 1% AEP Flood Extent including RCP8.5 Rainfall Increase and 360mm Seal Level Rise (refer to Flood Study Report by Footprint)

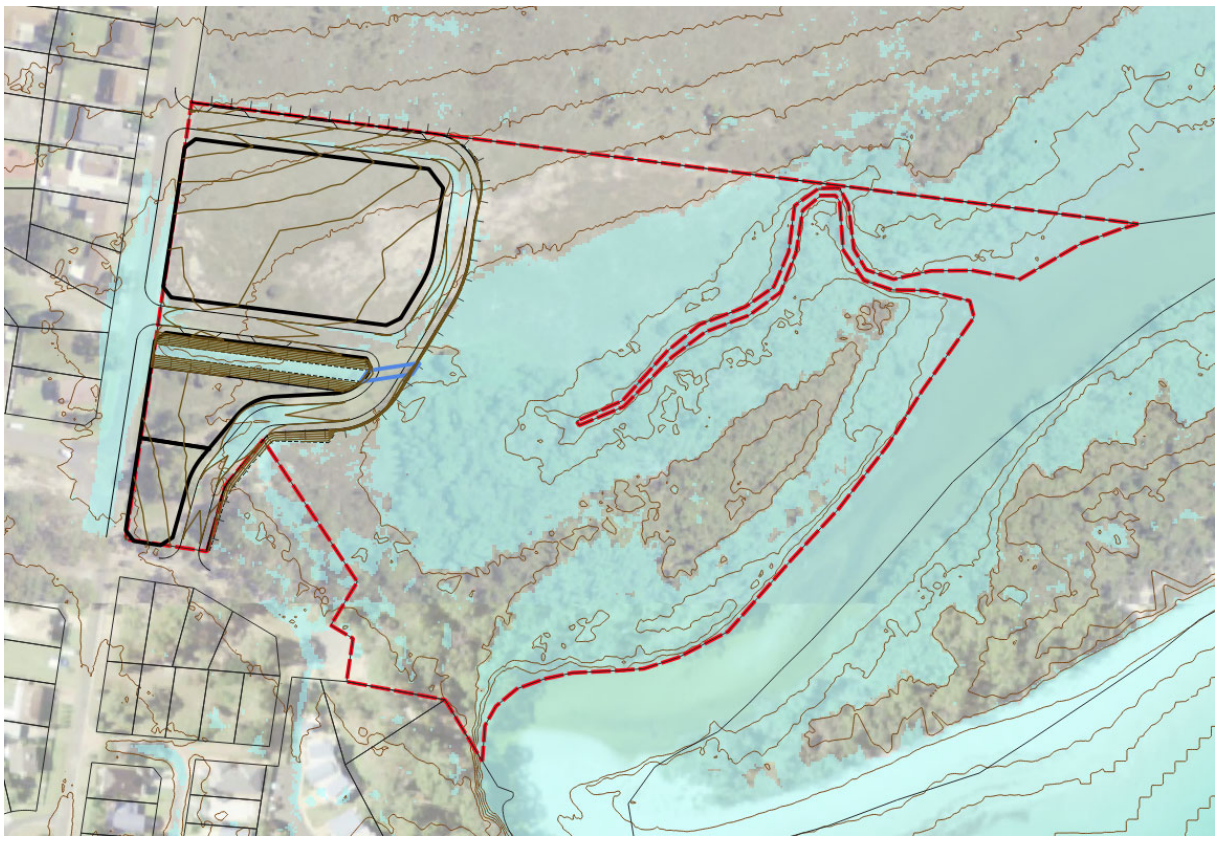


Figure 4 – Post Development 1% AEP Flood Extent including RCP8.5 Rainfall Increase and 360mm Seal Level Rise (refer to Flood Study Report by Footprint)

2.3. Soils and Geology

In accordance with the Report on Geotechnical Investigation by Terra Insight dated 17 August 2029 the geology of the site indicates the site is underlain by Wandrawandian Siltstone of the Shoalhaven Group, consisting of siltstone, silty sandstone and pebbly n parts.

Geotechnical investigations undertaken as part of the report indicate subsoil conditions comprised of a surficial layer of topsoil, underlain by 500-700mm of alluvial soil and then resuidual soil which graded into weathered rock at depth of around 1.5m.

Generally, fertility is low however there are no obvious limitations for urban development.

Acid Sulphate Soils

As per the NSW DPIE eSpade website there is no potential acid sulphate risk for the proposed developable areas of the site, although the site is within proximity of areas of known acid sulphate soil occurrence (i.e. Wowly Creek Estuary).

Geotechnical investigations by Terra Insight (17 August 2019) observed that ASS field screening showed the soils are slightly acidic but not indicative of Actual Acid Sulfate Soils, however where inconclusive for Potential Acid Sulfate Soils. The Geotechnical report concluded that the Acid Sulfate Soils testing indicates levels below the trigger level for which a formal Acid Sulfate Soils Management Plan would be required, however made recommendations regarding in-situ passive treatment should ASS be encountered.

2.4. Development Proposal

The current proposal consists of rezoning the north-western portion of the land for residential development due to existing site constraints elsewhere on the site including the presence of an Endangered Ecological Community (EEC) and flooding.

Concept engineering drawings, including an indicative subdivision layout is included in Appendix A.

The proposed development would be serviced by reticulated water and sewer, with the latter minimising the risk to downstream water quality.

3.0 LEGISLATIVE AND POLICY FRAMEWORK

The following plans and policies set the legislative framework for the subject site with regard to the management and disposal of stormwater from development sites.

3.1. SEPP (Resilience and Hazards) 2021

The proposed area to be rezoned to residential within the subject site falls within the coastal environment area, coastal use area and partly overlaps the proximity area for coastal wetlands.

Clause 2.8 of the SEPP relates to development within the proximity area for coastal wetlands and states that:

(1) Development consent must not be granted to development on land identified as "proximity area for coastal wetlands" or "proximity area for littoral rainforest" on the Coastal Wetlands and Littoral Rainforests Area Map unless the consent authority is satisfied that the proposed development will not significantly impact on—

(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or

(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.

(2) This section does not apply to land that is identified as "coastal wetlands" or "littoral rainforest" on the Coastal Wetlands and Littoral Rainforests Area Map.

Clause 2.10 of the SEPP relates to development within the coastal environment area

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following—

(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,

(b) coastal environmental values and natural coastal processes,

(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,

(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,

(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,

(f) Aboriginal cultural heritage, practices and places,

(g) the use of the surf zone.

(2) Development consent must not be granted to development on land to which this section applies unless the consent authority is satisfied that—

(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subsection (1), or

(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

(3) This section does not apply to land within the Foreshores and Waterways Area within the meaning of State Environmental Planning Policy (Biodiversity and Conservation) 2021, Chapter 6.

3.2. Shoalhaven Local Environment Plan 2014 (SLEP 2014)

Clause 7.6 of the Shoalhaven Local Environmental Plan 2014 (SLEP 2014) relate to water quality and riparian land management.

Clause 7.6 – Riparian land and watercourses

The objective of this clause is to protect and maintain the following:

(a) water quality within watercourses,

(b) the stability of the bed and banks of watercourses,

(c) aquatic and riparian habitats,

(d) ecological processes within watercourses and riparian areas.

(2) This clause applies to all of the following:

(a) land identified as "Riparian Land" on the Riparian Lands and Watercourses Map,

(b) land identified as "Watercourse Category 1", "Watercourse Category 2" or "Watercourse Category 3" on that map,

(c) all land that is within 50 metres of the top of the bank of each watercourse on land identified as "Watercourse Category 1", "Watercourse Category 2" or "Watercourse Category 3" on that map.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider:

(a) whether or not the development is likely to have any adverse impact on the following:

(i) the water quality and flows within the watercourse,

(ii) aquatic and riparian species, habitats and ecosystems of the watercourse,

(iii) the stability of the bed and banks of the watercourse,

(iv) the free passage of fish and other aquatic organisms within or along the watercourse,

(v) any future rehabilitation of the watercourse and its riparian areas, and

(b) whether or not the development is likely to increase water extraction from the watercourse, and

(c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

(a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or

(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

(5) For the purpose of this clause:

bank means the limit of the bed of a watercourse.

bed, of a watercourse, means the whole of the soil of the channel in which the watercourse flows, including the portion that is alternatively covered and left bare with an increase or diminution in the supply of water and that is adequate to contain the watercourse at its average or mean stage without reference to extraordinary freshets in the time of flood or to extreme droughts.

Clause 7.20 of the Shoalhaven Local Environmental Plan 2014 (SLEP 2014) relates to development in the Jervis Bay Region, and covers the subject site.

Clause 7.20 – Development in the Jervis Bay Region

Clause 7.20 (3) is most relevant to water quality and states:

(3) Development consent must not be granted to development in coastal sand dune area, on a rocky headland or on a flat, well-drained area along a major creekline unless the consent authority is satisfied that there will be no significant adverse impact on the natural or cultural values of the area.

3.3. Jervis Bay Settlement Strategy

Section 9.1 of the Jervis Nay Settlement Strategy (JBSS) addresses water quality and flow. The object of this section is "*to ensure that the water quality and flow of waterways and their aquatic, marine and estuarine ecosystems is not detrimentally affected as a result of new settlement in the region.*"

Actions of Section 9.1 include:

i. All development will meet the statutory requirements of the Jervis Bay Regional Environmental Plan 1996 in respect of clause 11 – Catchment Protection.

ii. New development will be located and designed so as to avoid detrimental impacts on waterbodies and watercourses, including groundwater. Where there are manageable impacts, erosion and sediment control measures and means to mitigate nutrient and other pollutants should be provided on the development site and be excluded from areas set aside for the protection of natural or cultural attributes (eg riparian areas, habitat corridors, Aboriginal places/sites and so on).

iii. New development will be designed so that domestic effluent management does not have a detrimental impact on water quality and flow, meets the Interim Environmental Objectives for the Jervis Bay Catchment (EPA, 1999, and is consistent with the relevant State government guidelines.
iv. New development, including infrastructure (e.g. stormwater controls), will be located, designed and constructed in a manner that does not degrade land based or aquatic ecosystems or processes.
v. Infrastructure works will not have a detrimental impact on the water quality of receiving waters in the region. In order to achieve this outcome, best practice soil and water management will be implemented when constructing various infrastructure, and the number of artificial barriers to flow and impediments to movements of aquatic biota will be minimised.

Section 9.9 of the JBSS addresses urban stormwater management. The objective of this section is "*to ensure the protection of life and property and water quality, by providing best practice stormwater management in new and existing development in the region*"

Actions of Section 9.9 include:

i. A hierarchy of sizes and types of stormwater infrastructure will be provided. This infrastructure should, as far as practicable, be contained within the developable area and excluded from areas set aside for protection of the environmental and cultural attributes (eg. riparian areas, habitat corridors etc).
ii. Stormwater infrastructure associated with new development in the region should be designed and constructed in a manner that does not degrade existing natural land-based or aquatic ecosystems or processes. Wherever possible, stormwater should be treated as close to the source as possible prior to any proposed discharges to natural systems.
iii. Monitoring programs to investigate and assess the effectiveness of stormwater controls will be considered and, where appropriate, implemented in association the new development in the region. A community education campaign targeted at improving attitudes and practices in relation to stormwater will also be developed and implemented as per the Shoalhaven Urban Stormwater Management Plan.
iv. The provisions of the Shoalhaven Urban Stormwater Management Plan will be incorporated into relevant planning instruments, works and development processes.

3.4. Illawarra Shoalhaven Regional Plan (ISRP) 2041

The Illawarra Shoalhaven Regional Plan is a 20 year plan that aims to protect and enhance the region's assets and plan for a sustainable future.

Strategy 17.1 of the ISRP is most relevant to this IWCM and encourages the sustainable use of water resources. It recommends that strategic planning and local plans should consider opportunities to:

- Locate, design, construct and manage new developments to minimise impacts on water catchments, including downstream impacts and groundwater sources.
- Incorporate water sensitive urban design particularly where development is likely to impact water catchments, water quality and flows.

- Encourage reuse of water in new development, for urban greening and for irrigation purposes
- Improve provision for stormwater management and water sensitive urban design.

3.5. Shoalhaven Development Control Plan 2014

Chapter G2 of the Shoalhaven DCP 2014 relates to sustainable stormwater management and erosion and sediment control.

The objectives of this Chapter are to:

i. Manage stormwater flow paths and systems to ensure the safety of people and property.
ii. Protect and enhance natural watercourses and their associated ecosystems and ecological processes.
iii. Maintain, protect and/or rehabilitate modified watercourses and their associated ecosystems and ecological processes towards a natural state.
iv. Mitigate the impacts of development on water quality and quantity.
v. Encourage the reuse of stormwater.
vi. Integrate water cycle management measures into the landscape and urban design to maximise amenity.
vii. Minimise soil erosion and sedimentation resulting from site disturbing activities.
viii. Minimise the potential impacts of development and other associated activities on the aesthetic, recreational and ecological values of receiving water.
ix. Ensure the principles of ecologically sustainable development are applied in consideration of economic, social and environmental values in water cycle management.
x. Ensure stormwater systems and infrastructure are designed, installed and maintained so as not to increase the risk to life or safety or people.
xi. Provide Green and Golden Bell Frog (GGBF) friendly stormwater detention ponds in areas where GGBF are present.
xii. Ensure stormwater systems and infrastructure are appropriately designed and installed to minimise the ongoing maintenance costs as much as possible.

Stormwater Controls

Major and Minor System Design

Design for the major and minor stormwater systems must address the requirements set out in section 5.1.1 of Chapter G2 of the Shoalhaven DCP and Council's Engineering Design Specification including:

- For residential drainage must be designed to cater for a 5 year Average Recurrence Interval (ARI) event.
- For mixed residential/commercial, commercial and industrial development, the drainage must be designed to cater for a 10 year ARI event.
- Major system drainage will be designed for a 100 year ARI event.
- Flow paths will be designed to ensure a velocity depth product of less than 0.3m^2/s for a 100 year ARI storm event.

Shoalhaven City Council Engineering Design Specification D5 (Stormwater Drainage) also specifies:

- Trunk drainage (serving catchments larger than 15 Ha) investigation and design shall:
    - use an appropriate runoff routing model to estimate design flow rates
    - use an appropriate model in the hydraulic analysis design
    - consider the effects of likely blockage
    - provide adequate scour protection at discharge points
- Major Structures shall:
    - Be designed for the 100 year ARI without afflux in urban areas
    - Provide a minimum clearance of 0.3m between the 100 year ARI level and the underside of an major structure to allow passage of debris

Climate Change Controls

- Climate change impacts, such as changes to rainfall intensity, shall be considered in system design as per relevant policies and/or Australian Rainfall and Runoff Guidelines.
- Sea level rise shall be considered in system design as per relevant policies and/or Australian Rainfall and Runoff Guidelines.

Onsite Stormwater Detention

The Shoalhaven DCP, Chapter G2: Sustainable Stormwater Management and Erosion/Sediment Control states that Onsite Stormwater Detention (OSD) may be required.

Detention of stormwater is necessary to maintain the capacity of existing stormwater infrastructure, provide protection of downstream infrastructure and limit flooding impacts.

Any detention at the site discharge point is unlikely to have a significant impact on downstream flood levels (given the proximity to the ocean outlet) and with no downstream infrastructure there is limited benefits of providing OSD in this case. It is acknowledged that Council cannot commit to omitting OSD at the Planning Proposal Stage and it is therefore understood that the need for on-site detention associated with the proposed development will be assessed on merit at the Development Assessment stage.

Stormwater Quality and Waterway Protection Controls

Chapter G2 of the Shoalhaven DCP contains a range of specific stormwater quality and quantity requirements which are summarised below.

Erosion and Sediment control

A conceptual soil and water management plan will be prepared for the development in accordance with the Managing Urban Stormwater: Soils and Construction series.

Stormwater Retention and Reuse

This section applies to all development that is not subject to BASIX.

9-10mm depth of retention is to be provided for the difference in impervious area over the development.

Stormwater quality and stream erosion protection

For areas outside Sydney's drinking water supply catchments, pollutant load reduction must be a minimum percentage reduction of the post development average annual load of pollutants in accordance with the Table 1 and the following:

- For greenfield sites or site draining to a natural stream of third order or lower, the 1.5 year ARI pre-development peak discharge must be maintained; and
- For development discharging to a stream, the post development duration of stream forming flows must be no greater than a stream erosion index of 2; and
- For development discharging to a tidal area or natural watercourse, outlet must be designed to limit erosion and sedimentation at the discharge point; and
- For development discharging to St Georges Basin, Swan Lake, Lake Conjola, Burrill Lake, Lake Tabourie, Willinga Lake and Wollumboola Lake, a higher Total Phosphorus reduction target of 65% must be achieved; and
- For development discharging to an area of significant biodiversity value, the post-development residual pollutant concentrations must not exceed the ecological trigger values listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality; and
- Uncoated metal (i.e. copper etc) roofs, facades and/or downpipes will not be supported due to heavy metal concentrations in stormwater runoff from these surfaces being harmful to receiving waterways.

Table 1 - Pollutant Load Reduction

Pollutant	Post Development Average Annual Load Reduction
Gross Pollutants (GP)	End of stormwater network solution is to achieve the following: Litter: Retention of litter greater than 40mm for flows up to the 4 exceedances per year (EY) event (3-month ARI peak flow). Coarse sediment: Retention of sediment coarser than 0.125mm for flows up to the 4EY peak flow.
Total Suspended Solids (TSS)	80%
Total Phosphorous (TP)	45%
Total Nitrogen (TN)	45%

3.6. Summary

The above plans and policies all have similar requirements to ensure that stormwater runoff from development has no net impact on the environment and these requirements can be summarised as follows;

i. maintain or improve water quality
ii. maintain the natural flow regime.

4.0 OVERVIEW OF WSUD AND RECOMMENDED TREATMENT MEASURES

4.1. The Water Sensitive Urban Design (WSUD) Philosophy

WSUD is a holistic approach to the planning and design of urban development that aims to minimise the negative impacts on the natural water cycle and protect the health of aquatic ecosystems. It promotes the integration of stormwater, water supply and sewage management at the development scale. It represents a fundamental change in the way urban development is conceived, planned, designed and built. Rather than using traditional approaches to impose a single form of urban development across all locations, WSUD considers ways in which urban infrastructure and the built form can be integrated with a site's natural features. In addition, WSUD seeks to optimise the use of water as a resource.

One of the major benefits of implementing WSUD is that it enables the management of not only water quality, but of the hydrology of the catchment in which it is applied. Typically, when urban development occurs in an area that was previously dominated by vegetation, increases in both hard surfaces, and the efficiency of the drainage system are usually a result. This leads to not only increased flows, but also for more rapid delivery of those flows and the associated pollutants into the receiving environment. The WSUD approach seeks to sever the connection between the hard surfaces and the drainage system, leading to both a reduction in flow volumes through increased infiltration and/or retention, and also a slowing down of water travelling to the drainage system. This in turn results in a reduction of flow velocities and provides opportunities for settlement and biological removal of pollutants.

The key principles of WSUD are to:

- Protect existing natural hydrological and ecological processes.
- Maintain the natural hydrological behaviour of catchments.
- Protect water quality of surface and ground waters.
- Minimise the demand on the reticulated water supply system.
- Minimise sewerage discharges to the natural environment.
- Integrate water into the landscape to enhance visual, social, cultural and ecological values.

4.2. Overview of Recommended Treatment Measures

The following treatment measures have been recommended for implementation as part of the proposed development.

4.2.1. Gross Pollutant Traps

Gross pollutant traps are treatment devices that use physical processes (i.e. screening, sedimentation, separation) to trap solid waste such as litter and coarse sediment. They are commonly used a primary treatment because they mostly remove large, non-biodegradable pollutants.

Since gross pollutant traps tend not to be effective in removing nutrients, they are most often used as part of the treatment train with other stormwater treatment measure such as wetlands and bioretention systems.

4.2.2. Bioretention Basins

Bioretention Basins are vegetated areas designed to allow water to pool temporarily before percolating through an engineered filter media. As water percolates through the bioretention soil media, sediment and nutrients become trapped within the upper layers.

Water flow rate is controlled by the filter media which also provides a growing media for plants. Ground cover vegetation helps to break up sediment deposited in the top layer of the soil media and prevent erosion during storm events. Vegetation roots within the media act to maintain the porosity of the soil and promote nutrient uptake.

4.2.3. Rainwater Tanks

The core WSUD roles of using rainwater tanks are to conserve water through substituting potable water supply, protect urban streams by reducing stormwater runoff volumes (particularly for small, frequent storms) and reducing the loads of some stormwater pollutants entering the waterways by loss of water through consumption.

The consumption of water from rainwater tanks also reduces the hydraulic loading on downstream stormwater treatment devices, potentially making them more efficient. The maximum benefits of rainwater tanks are realised when the collected water is regularly used.

5.0 STORMWATER QUALITY MODELLING

5.1. Modelling Approach

In order to determine if the development proposal will achieve a neutral or beneficial effect (NORBE) on the receiving waters it is necessary to estimate how the proposed changes in land use together with any treatment measures used to mitigate impacts associated with the development proposal will affect water quality and quantity.

A wide range of stormwater treatment measures are available to improve water quality runoff from new and existing developments. Computer modelling is used to assist in selecting the most effective combination of treatment measures for a given situation.

It then becomes necessary to assess if the proposed land use changes and the beneficial treatment provided by the stormwater treatment measures will lead to a neutral or beneficial effect on water quality. The configuration of a stormwater treatment train and assessment of impacts on hydrology and water quality is complex. The industry has adopted the use of water quality modelling as means of assessing the impact of proposed developments on water quality and quantity and effectiveness of any proposed treatment measures.

The model adopted on this project is MUSIC Version 6.3 (the Model for Urban Stormwater Improvement Conceptualisation) which has been developed by the Cooperative Research Centre for Catchment Hydrology. MUSIC uses a continuous simulation approach to model water quality and is suitable for simulating catchment areas of up to 100 km^2.

By simulating the performance of stormwater management systems, MUSIC can be used to determine if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRCCH, 2004). The water quality constituents modelled in MUSIC of relevance to this report include Total Suspended Solids, Total Phosphorus and Total Nitrogen (TSS, TP & TN).

MUSIC allows hydrology (hydrographs and cumulative flow) and water quality (TSS, TN and TP loads) to be compared under different land use and stormwater treatment scenarios. It enables decision makers to determine if the proposed development is likely to result in a NORBE.

5.2. Model Inputs

MUSIC simulates catchment processes of rainfall, storage of rainfall in the soil, seepage and evapotranspiration from the soil to emulate the rainfall runoff process. Therefore, it is necessary to use appropriate data on rainfall, evapotranspiration and soils before you can simulate the rainfall runoff process with any rigour. Using localised data helps to minimise the assumptions made and maximise rigour and accuracy of the modelling process. The following sections describe the assumptions made and sources of data used to construct the MUSIC models.

5.2.1. Rainfall Data

A total of three pluviograph (rainfall measured every 6 minutes) rainfall data stations exist in the vicinity of the subject site as depicted in Figure 5.

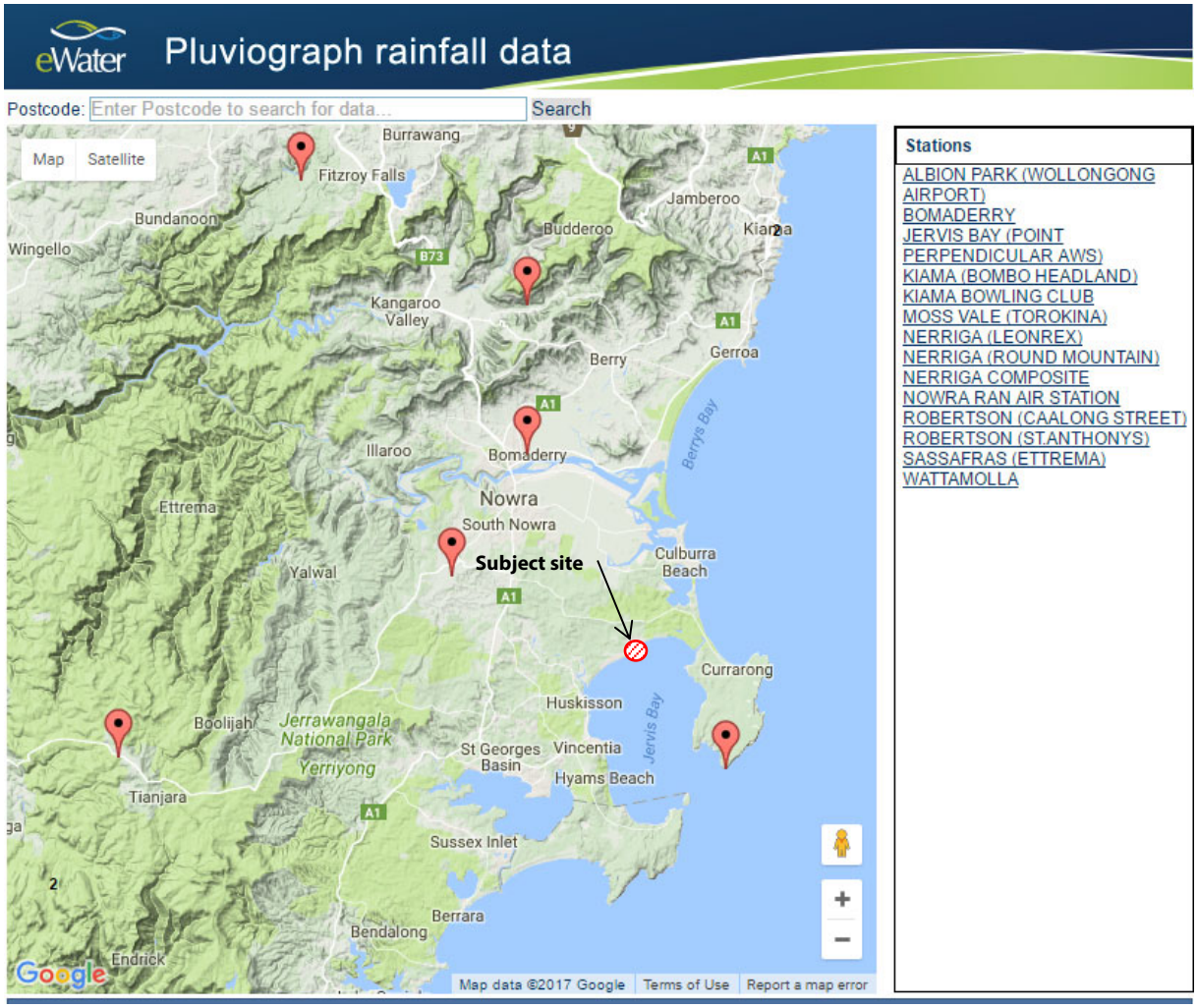


Figure 5 - Pluviograph Rainfall Data Stations

The data available from each station is summarised in Table 2.

Table 2 - Summary of Nearby Pluviograph Rainfall Data Stations

Station No.	Station Name	Distance and Orientation from Subject Site	Period of Data Set
068076	Nowra RAN Air Station	18km WNW	08/1964 – 12/1997
068151	Jervis Bay (Point Perpendicular AWS)	13km SSE	10/2001 – 05/2008
068136	Bomaderry	20km NNW	01/1969 – 10/1972

The Nowra RAN Air Station was adopted as it has the longest period of available data and is situated closest to, and in a similar microclimate to the subject site.

The historical statistics for the Nowra RAN Air Station are provided in Table 3.

Table 3 – Rainfall Statistics

Rainfall Statistic	Annual Rainfall Depth (mm)
Mean	1133.1
5th percentile	549.9
10th percentile	592.8
90th percentile	1750.7
95th percentile	1925.3

The period 1966 – 1975 (10 years) was used for modelling. This period has an average annual rainfall depth of 1128.9mm which compares favourably to the mean rainfall depth for the station. Further the data period contains both a very dry year (1968 – 463mm which is the lowest on record) and a very wet year (1974 – 1928mm which closely approximates a 95th percentile rainfall depth).

This period of data was reviewed for completeness and found to contain a minor period of missing data. The annual average rainfall depth for the 10 year long 6 minute rainfall template used in the MUSIC model for modelling is 1098mm/annum. In comparison to the rainfall statistics shown in Table 3 the MUSIC rainfall template has an average rainfall depth equal to 97% of the mean annual rainfall depth. Given the length of the record to be used and the nature of the "comparative" assessment to be undertaken (i.e. using the same rainfall template to assess both pre and post development scenarios) the data is considered to be of suitable quality and integrity.

5.2.2. Potential Areal Evapotranspiration

Pan evaporation data was obtained from the Bureau of Meteorology (Station 068076 – Nowra RAN Air Station).

Analysis of this data showed an annual total pan evaporation of 1200mm/year. This was compared to the National potential evapotranspiration (PET) atlas available from the Bureau of Meteorology which showed annual Areal PET to be in the order of 1200mm/year. Given that Areal PET is approximately equal to pan evaporation there is no need to convert the pan data and it can be used as Areal PET data for the purposes of modelling in MUSIC.

The Areal PET data adopted is shown in Figure 6.

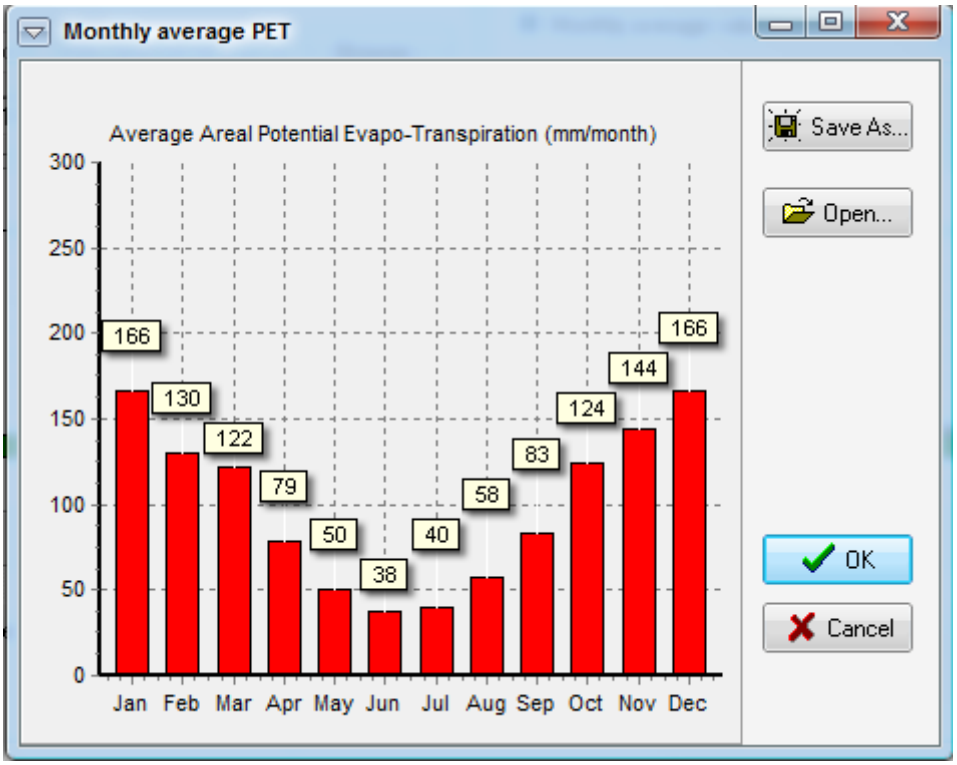


Figure 6 - Graph of Areal PET data adopted

5.2.3. Hydrological Parameters

MUSIC uses a watershed model similar in nature to the tipping bucket type model developed originally by Boughton. The following values were adopted for use in the model:

Table 4 - Values of Hydrological Parameters Adopted in MUSIC

Parameter	Value Adopted	Justification or source of data
Rainfall threshold	0.3mm	Value adopted for roofs based on Table 4.3 – WaterNSW (2023)
	1.5mm	Value adopted for roads and carparks based on Table 4.3 – WaterNSW (2023)
	1.0mm	Value adopted for all other land-use types based on Table 4.3 – WaterNSW (2023)
Depth of soil	1.0m	Default Value
Soil storage capacity	54mm	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)
Field Capacity	51mm	Based on Sandy Clay soil profile from Soils Landscape (eSpade) and Table 4.4 – WaterNSW (2023)
Daily baseflow rate	25%	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)
Daily Groundwater recharge rate	25%	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)
Daily deep seepage rate	0%	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)
Infiltration parameter a	180mm/d	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)
Infiltration parameter b	3.0	Based on Silty Clay soil profile from Report on Geotechnical Investigations, Terra Insight (2019)

5.2.4. Pollutant Load Rates

Pollutant concentrations (in the form of event mean concentrations (EMC's) for the range of land uses on the site are based on typical values obtained from the WaterNSW Standard (2023).

The adopted values are shown in Table 5 and Table 6 for base flow and storm flow concentrations respectively.

Table 5 – Adopted Base Flow Concentration Parameters

Landuse/surface type:	Concentration (mg/L-log$_{10}$)					
	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Residential	1.20	0.17	-0.85	0.19	0.11	0.12
Rural Residential	1.15	0.17	-1.22	0.19	-0.05	0.12
Roofs	N/A	N/A	N/A	N/A	N/A	N/A
Revegetated Land	1.15	0.17	-1.22	0.19	-0.05	0.12
Sealed Roads	1.20	0.17	-0.85	-0.19	0.11	0.12

"

Table 6 – Adopted Storm Flow Concentration Parameters

Landuse/surface type:	Concentration (mg/L-log$_{10}$)					
	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Residential	2.15	0.32	-0.60	0.25	0.30	0.19
Rural Residential	1.95	0.32	-0.66	0.25	0.30	0.19
Roofs	1.30	0.32	-0.89	0.25	0.30	0.19
Revegetated Land	1.95	0.32	-0.66	0.25	0.30	0.19
Sealed Roads	2.43	0.32	-0.30	0.25	0.34	0.19

5.2.5. Effective Impervious Area

Effective Impervious Area (EIA) factors for the different land use/surface types present on the subject site have been adapted from Table 4.2 WaterNSW (2023) and Table 5.2 of Chapter D5 of the Shoalhaven Engineering Guideline and are shown in Table 7.

It should be noted that the definition of an effective impervious area in MUSIC is one that is directly connected to the stormwater system and is a measure of the area of land that is effective in generating runoff that flows directly to the stormwater drainage system.

Table 7 - Surface Type EIA Factors

Surface Type	EIA Factor
Roofs	1.0 x TA
Sealed Roads	1.0 x TA
Sealed Road Corridors	0.5 X TA
Residential Land (non-roof component)	0.10 x TA
Revegetated Land	0 x TA

TA = Total Site/Catchment/Surface Area.

5.3. Landuse Assumptions

The current state of the site was determined using a combination of an assessment of current aerial photography (Six Maps) and a visual inspection.

For the purposes of determining land use only the areas within the footprint of proposed urban rezoning/development were included as areas outside this footprint will not change (i.e. the Environmental Conservation Area).

Areas of the existing site that are proposed for urban rezoning/development are currently predominately slashed and maintained year-round. The existing drainage lines off Sealark Road are generally infested with Typha and other weeds.

On the basis of the above the entire development footprint area was classified as 100% pervious 'rural-residential' land use reflecting the proximity of the site to the existing urban fringe and the current maintenance regime undertaken.

Post development land use categories were defined based on the planning proposal zoning. Lot areas were classified as 'residential', whilst the drainage channel was classified as revegetated land, which by coincidence has the same pollutant concentration parameters as rural residential land and therefore maintains the status quo.

The adopted pre and post development land use is shown on Drawing 1968-C09 in Appendix A.

5.4. Pre-Development Modelling

5.4.1. Model Configuration

The configuration of the pre-development MUSIC model is shown in Figure 7 and consists of a single source node representing the development footprint. The model also includes SEI nodes to assist in determination of Stream Erosion Index (SEI) compliance.

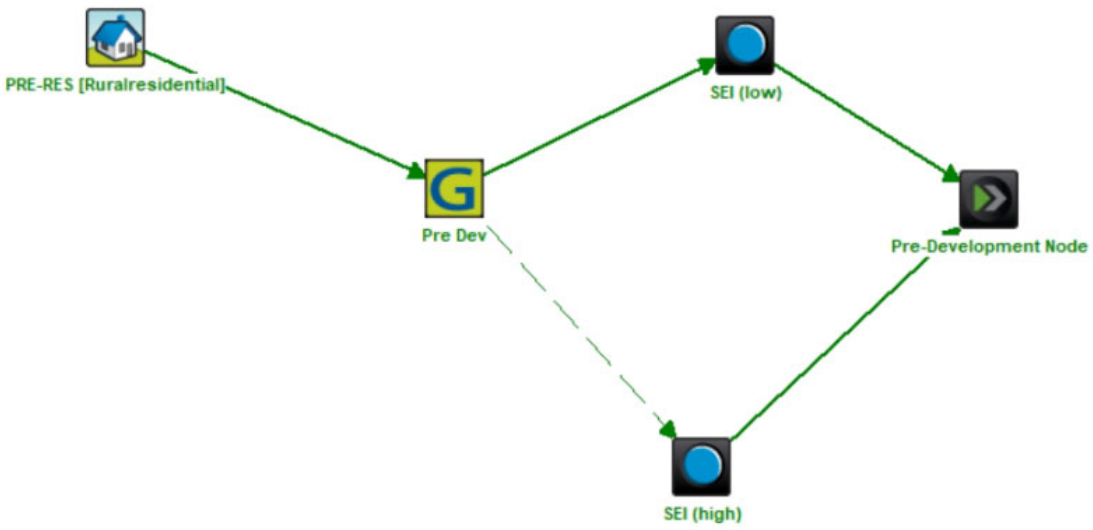


Figure 7 - Pre-Development MUSIC Model Configuration

5.4.2. Results

The results of the pre-development modelling, expressed as mean annual loads, are summarised in Table 8.

Table 8 - Pre-Development Pollutant Loads

Parameter	Total
Flow (ML/yr)	7.72
TSS (kg/yr)	910
TP (kg/yr)	1.97
TN (kg/yr)	17.0
GP (kg/yr)	0

"

5.5. Post Development Modelling

5.5.1. Overview

The proposed water quality treatment train consists of:

i. On lot measures including;
   a. 3.5KL rainwater tanks, discharging into
   b. 1.2m x 1.2m Ocean Protect Filterra Bioretention Pits

ii. Public Road corridor measures including;
   a. 3 x Ocean Protect Oceansave GPT's, sized to suit each location (GPTs A, B and C)
   b. 2 x Ocean Protect Filterra Bioscape Bioretention Basins to treat road runoff on either side of the drainage channel (Bioretention A and B)

The location and configuration of proposed public road corridor measures are shown on Drawing 1698-C08 in Appendix A. Each lot would be serviced by an interallotment drainage system to collect stormwater runoff from the lots and direct these to discharge points in either the drainage channel or floodplain clear of the road drainage system (not shown on the drawing)

Information of the Ocean Protect Filterra Bioretention Systems is included in Appendix B.

5.5.2. Model Configuration

The configuration of the post development MUSIC model is shown in

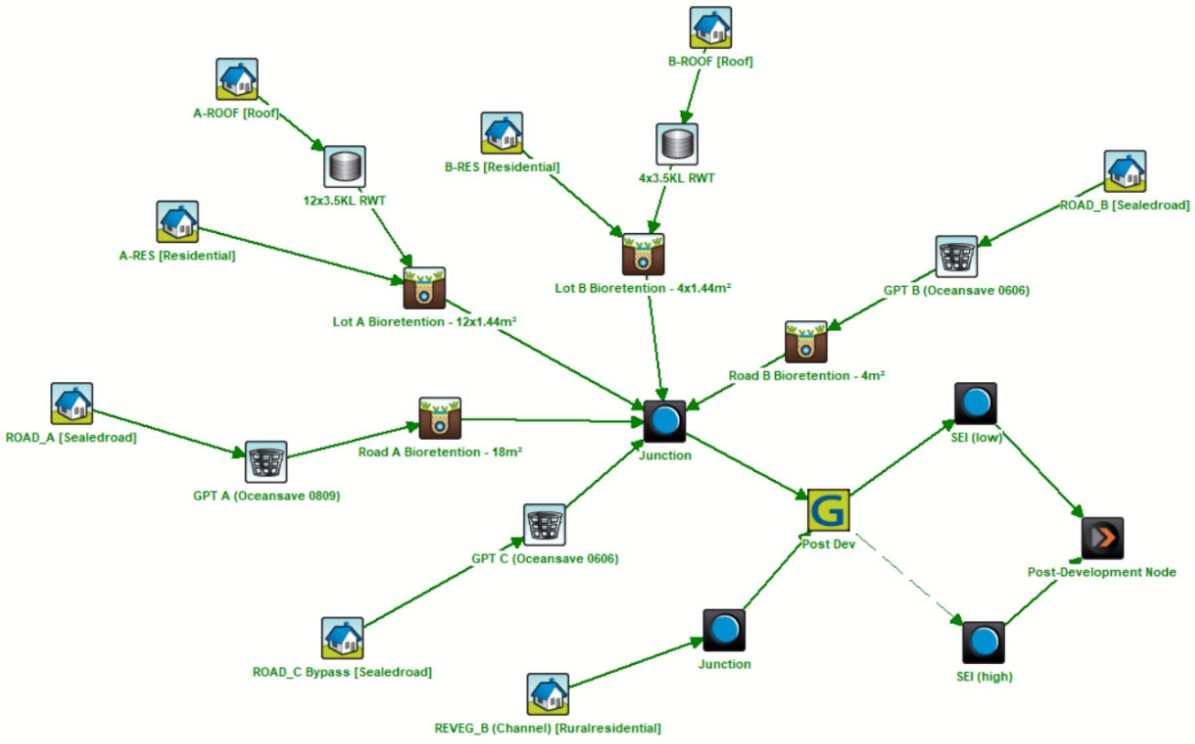


Figure 8. The model consists of residential, road and natural source nodes along with SEI nodes.

Rainwater tanks were applied to roof runoff from new dwellings. For the purposes of modelling 50% of residential areas were assumed to contain roofs with the remainder hardstand (10%) and soft landscaped.

The MUSIC input values adopted for the Ocean Protect Filterra bioretention basins, Oceansave GPT's and Rainwater Tanks are shown in Table 9, Table 10 and Table 11 respectively.

For the purpose of the assessment all lots were assumed to contain single detached dwelling, except for Lots B and C which were assumed to contain 4 dwellings total.

Table 9- Adopted Bioretention Basin Parameters

Parameter	**Value Adopted**	**Justification or source of data**
Low Flow Bypass	0m^3/s	All flows connected to bioretention basins
High Flow Bypass	On Lot – 100 m^3/s Bio A – 0.026 m^3/s Bio B – 0.010 m3/s	Estimated 4EY flow from contributing area in accordance with Shoalhaven DCP (2014)
Extended Detention Depth	0.15m	Value recommended by Ocean Protect. Less than the maximum value of 0.3m specified in Shoalhaven DCP (2014).
Surface Area	As per Filter Area	Conservatively assumes vertical sided basins
Filter Area	On Lot – 1.44m^2/lot Bio A – 18m^2 Bio B – 4m^2	Approximately 0.3% of contributing catchment area as per Ocean Protect recommendations and sized to satisfy relevant performance requirements
Unlined Filter Media Perimeter	0.01m	Water NSW (2019) recommends value as close to zero as possible
Saturated Hydraulic Conductivity	3550mm/hr	As per Ocean Protect specifications
Filter Depth	0.53m	As per Ocean Protect specifications
TN Content of Filter Media	500mg/kg	As per Ocean Protect specifications
Orthophosphate Content of Filter Media	1.0	As per Ocean Protect specifications
Exfiltration Rate	0mm/hr	Base to be lined and there will therefore be no exfiltration
Base Lined?	Yes	
Vegetated with Effective Nutrient Removal Plants?	Yes	Bioretention basins to be planted with deep rooted plants which aid in the effective removal of nutrients.
Overflow Weir Width	Lots – 1m/lot BioA & B – 2m	Indicative of 1200x1200mm and 900X900mm pits respectively
Underdrain Present?	Yes	Bioretention Basin to have subsoil drainage systems
Submerged zone with Carbon Present	No	

Table 10- Adopted GPT Parameters

Parameter"	Value Adopted"	Justification or source of data"
Low Flow Bypass	0m^3/s	All road flows connected to GPT's
High Flow Bypass	GPT A – 0.068m^3/s GPT B – 0.028 m^3/s GPT C – 0.028 m^3/s	As per Ocean Protect specifications for each nominated GPT model
Transfer Functions - GP	0, 0 100, 0	As per Ocean Protect specifications
Transfer Functions - TSS	0, 0 1000, 300	As per Ocean Protect specifications
Transfer Functions – TP	0, 0 100, 70	As per Ocean Protect specifications
Transfer Functions – TN	0, 0 100, 70	As per Ocean Protect specifications

Table 11- Adopted Rainwater Parameters

Parameter"	Value Adopted"	Justification or source of data"
Low Flow Bypass	0m^3/s	All roof flows connected to rainwater tanks
High Flow Bypass	0.005m^3/s/tank	As per Water NSW (2019)
Volume below overflow Pipe	3.5KL/lot	Based on 10mm retention storage from Shoalhaven DCP (2014) and adoption a 60% impervious area for each lot.
Depth above Overflow	0.1m	MUSIC Default
Surface Area	2m^2	Estimated
Initial Volume	1KL/tank	MUSIC Default
Overflow Pipe Diameter	90mm	
Annual Reuse Demand	55kl/year/lot	As per WaterNSW (2023). Scaled by PET- Rain
Daily Reuse Demand	0.36kl/day/dwelling	As per WaterNSW (2023) for toilet and laundry uses and assuming an average Occupancy 3 people/dwelling.

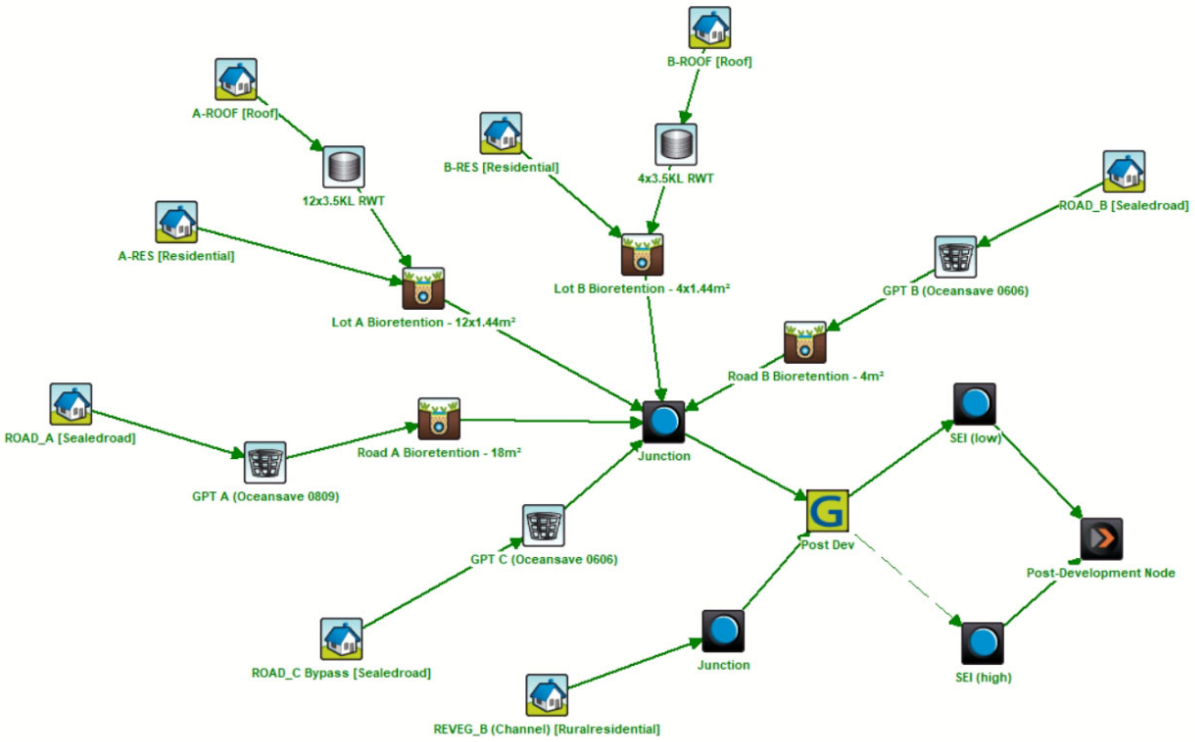


Figure 8 - Post Development Model Configuration

5.5.3. Results

The results of the post development modelling are included in Table 12.

Table 12: Post Development Pollutant Loads

Parameter	Source Load (i.e. before treatment)	Residual Load (i.e. after treatment)
Flow (ML/yr)	12.3	10.6
TSS (kg/yr)	2,170	219
TP (kg/yr)	4.16	0.807
TN (kg/yr)	27.7	10.1
GP (kg/yr)	254	0

5.5.4. Comparison of Results to DCP Targets

The post development results were compared to the targets specified in the Shoalhaven DCP (refer to Section 3.5) as shown in Table 13. The results demonstrate that the proposed water quality treatment measures achieve compliance with Council's targets, and typically well exceed the targets specified.

Table 13: Comparison of Results to DCP Targets

Parameter	Source Load (i.e. before treatment)	Residual Load (i.e. after treatment)	Post Development Average Annual Load Reduction	DCP Target	Complies
Flow (ML/yr)	12.3	10.6	13.9%	N/A	N/A
TSS (kg/yr)	2,170	219	89.9%	80%	Yes
TP (kg/yr)	4.16	0.807	80.6%	45%	Yes
TN (kg/yr)	27.7	10.1	63.5%	45%	Yes
GP (kg/yr)	254	0	100%		Yes

5.5.5. Comparison of Results to NorBE

The pre and post development average annual pollutant loads results were compared to the NorBE criteria and are included in Table 14. The results show that the proposed development will result in a significant net reduction in pollutants exported from the site thereby satisfying the NorBE criteria.

Table 14: Comparison to NorBE Average Annual Pollutant Load Criteria

Parameter	Pre Dev. Source Load	Post Dev. Residual Load (i.e. after treatment)	Change in Load Pre to Post Dev.	% Change in Load Pre to Post Dev.	NorBE Criteria	Complies
Flow (ML/yr)	7.72	10.6	+2.88	+63%		N/A
TSS (kg/yr)	910	219	-691	-76%	-10%	Yes
TP (kg/yr)	1.97	0.807	-1.16	-59%	-10%	Yes
TN (kg/yr)	17.0	10.1	-6.3	-41%	-10%	Yes
GP (kg/yr)	0	0	0	0%	+0%	Yes

The pre and post development TP and TN concentrations were also compared for pre and post development scenarios in accordance with the methodology specified in Water NSW (2019) and the results are shown in Figure 9 and Figure 10 respectively.

The results show that for both pollutants the post development concentration (in blue) is less than the pre-development concentration (in red) over the entire frequency range indicating that this aspect of the NorBE criteria is also satisfied.

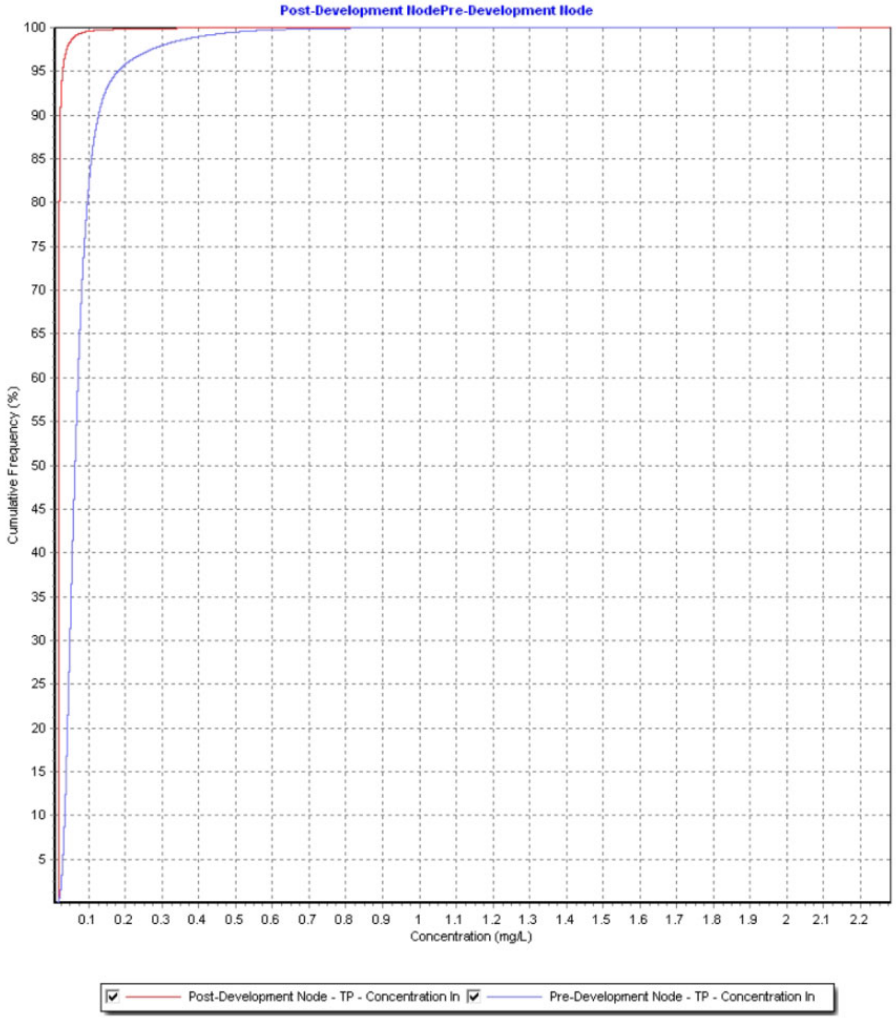


Figure 9: Comparison of Pre and Post Development TP concentrations

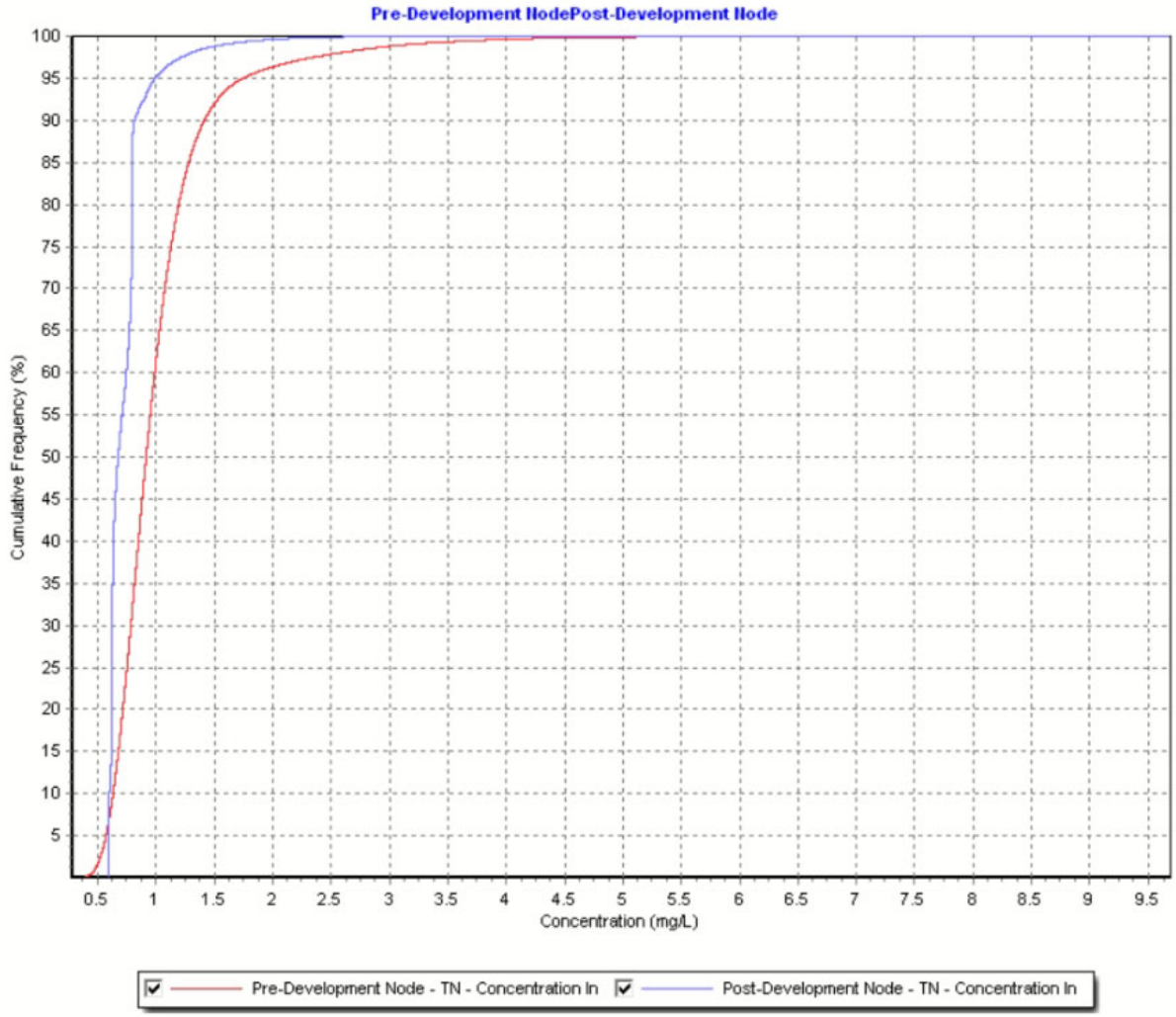


Figure 10: Comparison of Pre and Post Development TN concentrations

5.6. Impact of Development on Surface Hydrology

Section 3.4.1 of Supporting Document 1: Sustainable Stormwater Technical Guidelines states that:

- For development discharging to a natural stream of 3rd order or lower that is not tidal, the post development duration of stream forming flows must be no greater than 2 times the pre-development duration of stream forming flows at this site discharge point (i.e. a stream erosion index of 2)

In the absence of any information in Council's guideline documents stream forming flows are estimated to be 50% of the 2 year ARI peak, in accordance with standard engineering practice. Using the Probabilistic Rational Method the 2-year ARI flow is estimated at 0.226m3/s as per the calculations provided below.

From Equation 1.5 of ARR Volume 1, Book 4 (1987):

$t_c = 0.76A^{0.38} = 0.76 \times (1.478/100)^{0.38} = 0.15hrs = 9\ minutes$

From 2019 IFD data for the site:

$I_2 = I_{0.5EY} = 88mm/hr$

From Equation 1.5 of ARR Volume 1, Book 4 (1987):

$C_2 = C10 \times FF_2 = 0.8 \times 0.78 = 0.624$

and:

$Q_2 = CIA/360 = 0.624 \times 88 \times 1.478/360 = 0.226m^3/s$

50% of the 2-year ARI flow rate (i.e. 0.113m3/s) was input into the generic node in the pre and post development MUSIC model and the average annual flow volumes above this limit were extracted from the model and the results are shown in Table 15.

Table 15: Comparison of Stream Erosion Index

Scenario	**Average Annual Volume Above Limit of Stream Forming Flow (ML/year)**
Pre-Development	0.55
Post Development	0.47

The results show that the post development volume above the SEI threshold limit of 0.113m^3/s is 8% lower than the pre-development volume thereby satisfy the SEI criteria.

6.0 CONCLUSION

This report considered the impact on water quality and quantity associated with the proposed rezoning and subsequent redevelopment of the land for residential purposes.

In order to assess the impact of the development on water quality computer modelling was undertaken using MUSIC in order to estimate how the proposed changes in land use together with any treatment measures used to mitigate impacts associated with the development proposal will affect water quality and quantity.

In addition to a predevelopment model which provided present day baseline results, a post development scenario was modelled including a combination residential lot, sealed roads and a drainage channel representing the concept subdivision and development plan prepared as part of the Planning Proposal.

Stormwater treatment measures employed on the site consisted of rainwater tanks and bioretention basins for the treatment of lot and road based runoff (with the addition of GPT's to act as primary treatment for road based runoff).

The results of the pre and post development water quality modelling showed that the development can comply with Council's DCP and NorBE criteria and therefore should achieve a long-term beneficial effect on water quality, water quantity and the receiving environment, subject to implementation of the recommended controls outlined in the report.

Furthermore, the modelling demonstrated that stream forming flows were predicted to be very close to the pre-development state thereby minimising the potential for stream erosion.

7.0 REFERENCES

Terra Insight (2019) *Sealark Road, Callal Bay NSW Lot 5 DP1225356, Report on Geotechnical Investigations*. Report TERRA19258.Rep1.Rev0, dated 17 August 2019.

Fletcher et al (2004) *Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures – A Review and Gap Analysis,* Cooperative Research Centre for Catchment Hydrology.

Landcom (2004) *Managing Urban Stormwater; Soils and Construction – Volume 1 (4th Edition)*

SCA (2011) *Neutral of Beneficial Effect on Water Quality Guideline*, Sydney Catchment Authority

WaterNSW (2023) *Using MUSIC in Sydney Drinking Water* Catchment, WaterNSW

APPENDIX A
Preliminary Civil Design Drawings

LOT 5 SEALARK ROAD, CALLALA BAY
PLANNING PROPOSAL

PRELIMINARY CIVIL DESIGN DRAWINGS

LOCALITY PLAN
NOT TO SCALE

SHEET INDEX

DRAWING No.	DESCRIPTION
1861–C01	TITLE SHEET
1861–C02	GENERAL ARRANGEMENT PLAN
1861–C03	PRELIMINARY EARTHWORKS PLAN
1861–C04	PRELIMINARY EARTHWORKS SECTIONS
1861–C05	ROAD 1 LONGITUDINAL SECTION & CROSS SECTIONS – SHEET 1 OF 2
1861–C06	ROAD 1 CROSS SECTIONS SHEET 2 OF 2
1861–C07	ROAD 2 LONGITUDINAL SECTION & CROSS SECTIONS
1861–C08	PRELIMINARY STORMWATER MANAGEMENT PLAN
1861–C09	WATER QUALITY PRE AND POST DEVELOPMENT LAND USE PLAN
1861–C10	INDICATIVE SUBDIVISION PLAN

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE–ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	RE–ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE–ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE–ISSUED FOR PLANNING PROPOSAL	18/10/21
1	FOR PLANNING PROPOSAL	30/10/20

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
N.T.S	A1

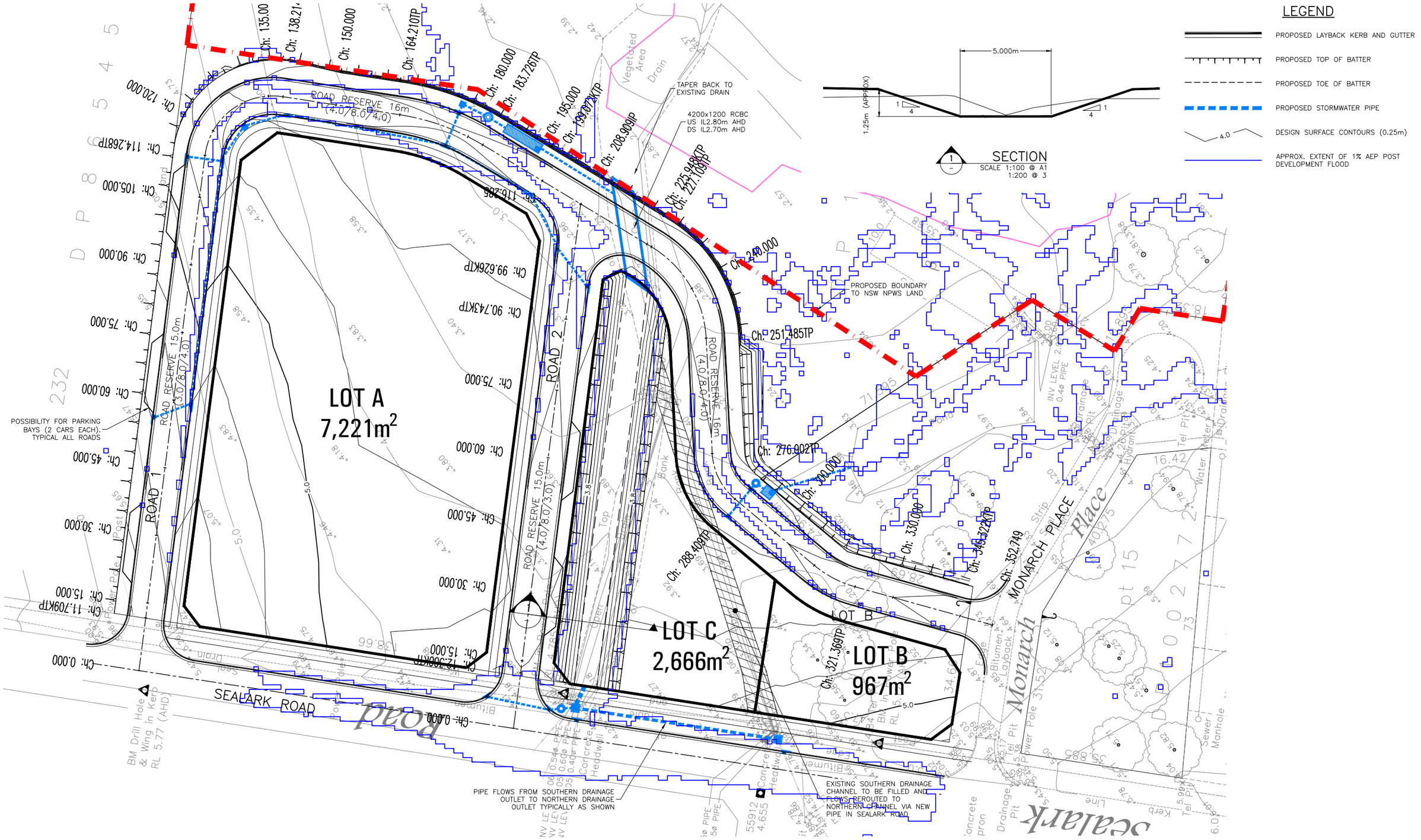
CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	JAN '24
CHECKED:	AB

footprint
sustainable engineering
a. 15 meehan drive
kiama downs nsw 2533
p. 02 4237 6770
f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY
PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
TITLE SHEET

DRAWING NO. 1861-C01
ISSUE. 7
SHEET 1 OF 10



LEGEND

- PROPOSED LAYBACK KERB AND GUTTER
- PROPOSED TOP OF BATTER
- PROPOSED TOE OF BATTER
- PROPOSED STORMWATER PIPE
- DESIGN SURFACE CONTOURS (0.25m)
- APPROX. EXTENT OF 1% AEP POST DEVELOPMENT FLOOD

1 SECTION
SCALE 1:100 @ A1
1:200 @ 3

GENERAL ARRANGEMENT PLAN

SCALE 1:400 @ A1, 1:800 @ A3

8 4 0 8 16 1:400

Original sheet size A1

North

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	ISSUED FOR CONSULTANT REVIEW	15/05/24
4	RE-ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	22/10/20

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

footprint
sustainable engineering
a. 15 meehan drive
kiama downs nsw 2533
p. 02 4237 6770
f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
GENERAL ARRANGEMENT PLAN

DRAWING NO. 1861-C06
ISSUE. 7
SHEET 2 OF 10

Levels Table				
	Number	Minimum Level	Maximum Level	Color
CUT	1	−1.084	−0.750	
CUT	2	−0.750	−0.500	
CUT	3	−0.500	−0.250	
CUT	4	−0.250	0.000	
FILL	5	0.000	0.250	
FILL	6	0.250	0.500	
FILL	7	0.500	0.750	
FILL	8	0.750	1.830	

CUT AND FILL SUMMARY

TOTAL CUT	485m³
TOTAL FILL	11,220m³
NET	10,735m³ (FILL)

PRELIMINARY EARTHWORKS PLAN

SCALE 1:400 @ A1, 1:800 @ A3

8 4 0 8 16 1:400

Original sheet size A1

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	RE-ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	30/10/20

FOR PLANNING PROPOSAL

NOT FOR CONSTRUCTION

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

footprint
sustainable engineering
a. 15 meehan drive
kiama downs nsw 2533
p. 02 4237 6770
f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY

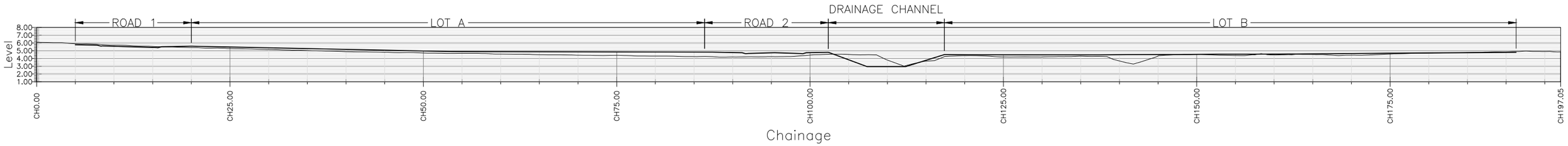
PLANNING PROPOSAL

PRELIMINARY CIVIL DESIGN

PRELIMINARY EARTHWORKS PLAN

DRAWING NO. 1861-C03

ISSUE. 7



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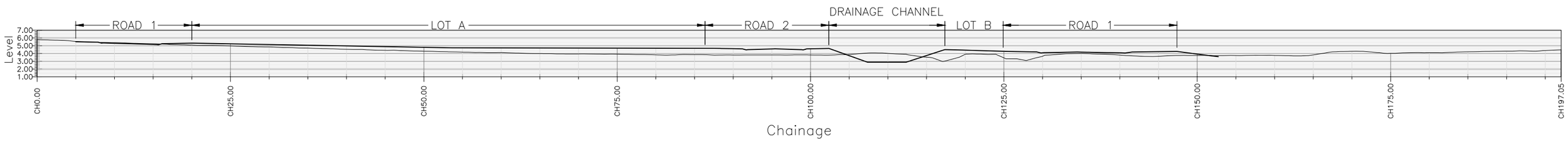

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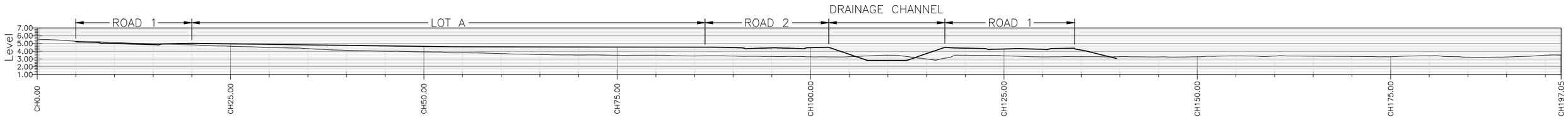

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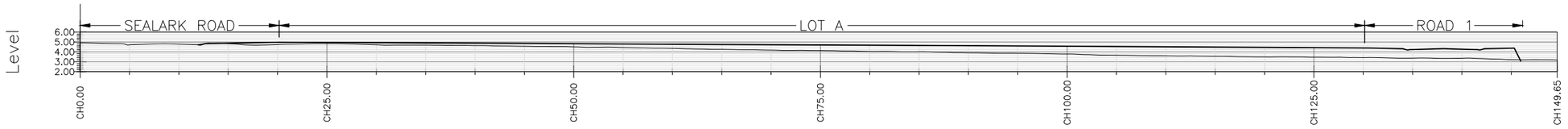
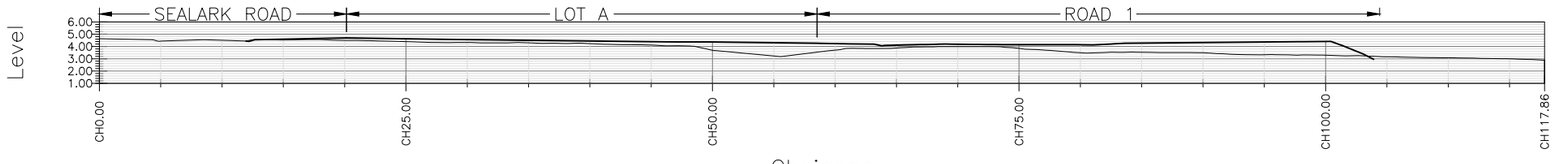


D C03 SECTION
SCALE 1:250 @ A1, 1:500 @ A3



EXISTING SURFACE
DESIGN SURFACE

E C03 SECTION
SCALE 1:250 @ A1, 1:500 @ A3

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	FOR PLANNING PROPOSAL	12/01/24

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

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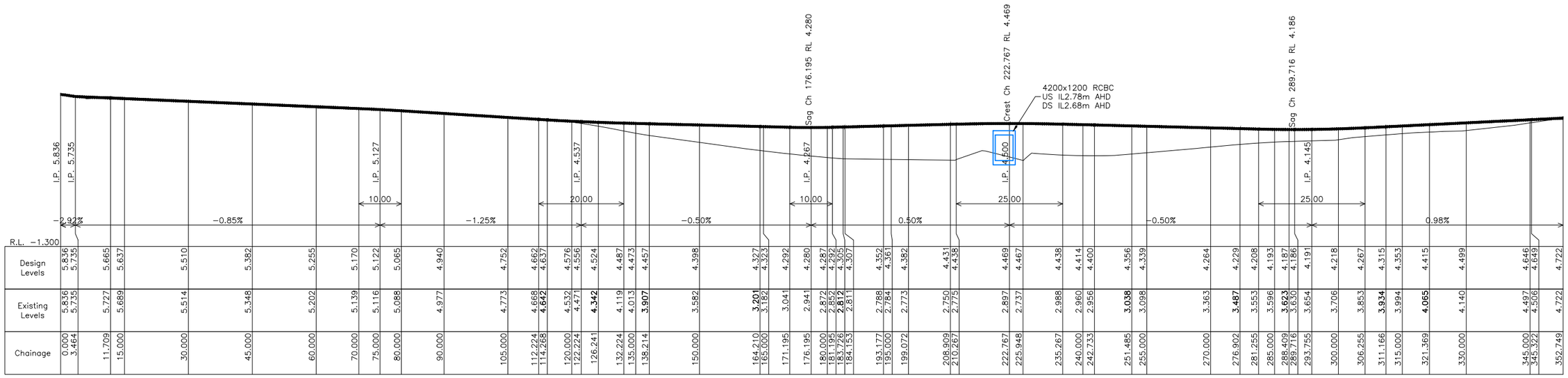
a. 15 meehan drive
kiama downs nsw 2533
p. 02 4237 6770
f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY

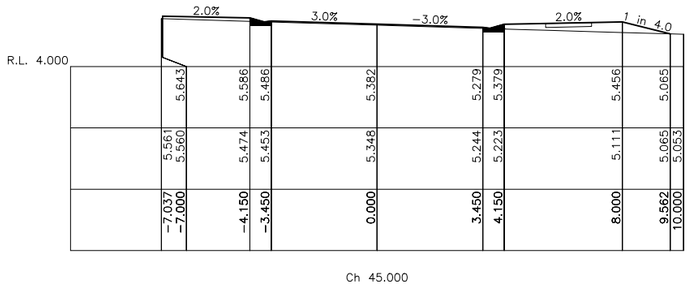
PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
PRELIMINARY EARTHWORKS SECTIONS

DRAWING NO. 1861-C04
ISSUE. 7

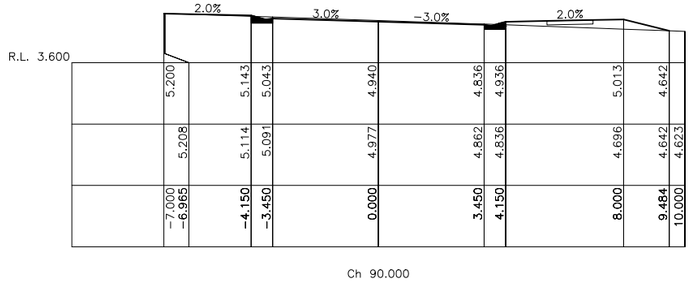


ROAD 1 LONGITUDINAL SECTION

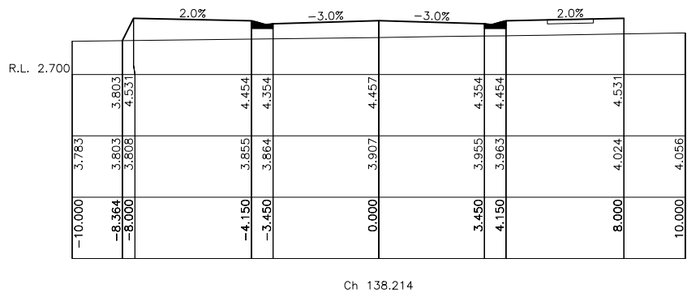
SCALES H 1:500 @ A1, 1:1000 @ A3
V 1:100 @ A1, 1:200 @ A3



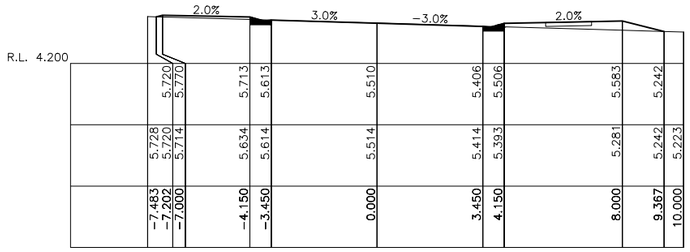
Ch 45.000



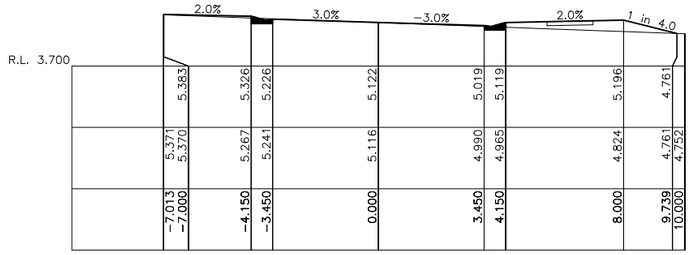
Ch 90.000



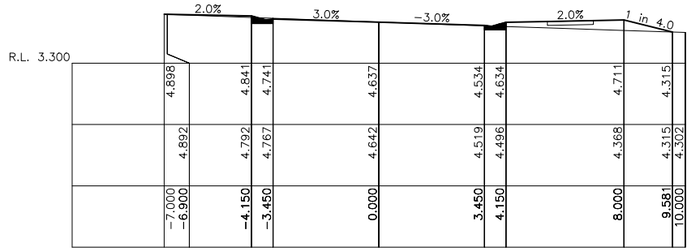
Ch 138.214



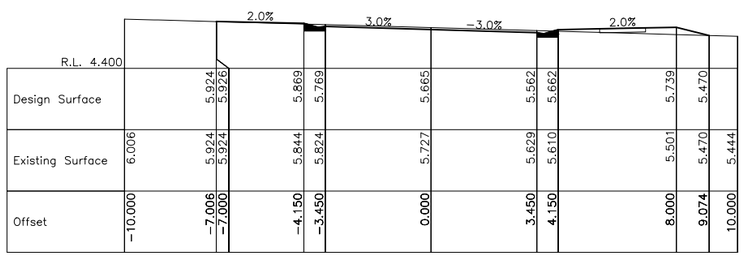
Ch 30.000



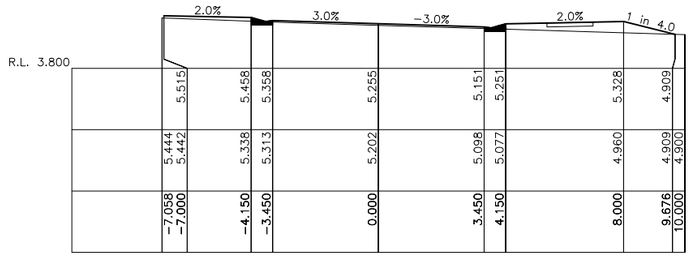
Ch 75.000



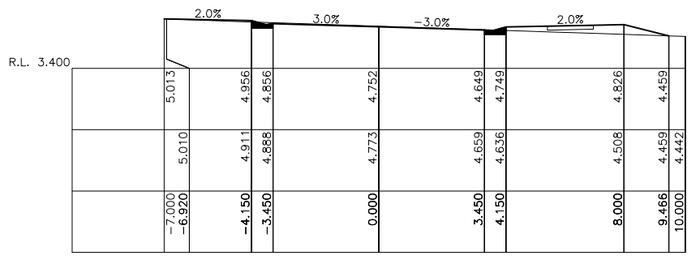
Ch 114.268



Ch 11.709



Ch 60.000



Ch 105.000

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	RE-ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	30/10/20

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
1:100 UNO	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

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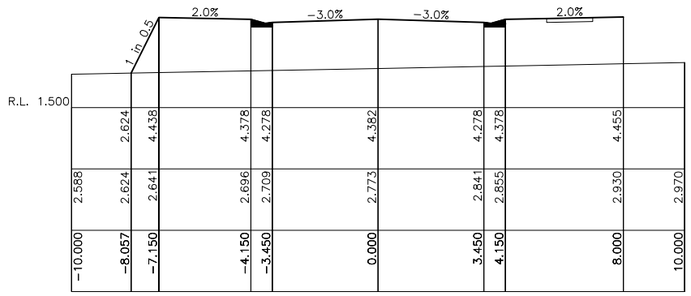
f. 02 4237 8962

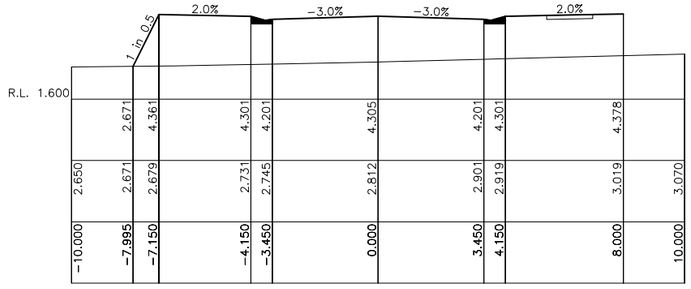
LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
ROAD 1 LONGITUDINAL SECTION & CROSS SECTIONS - SHEET 1 OF 2

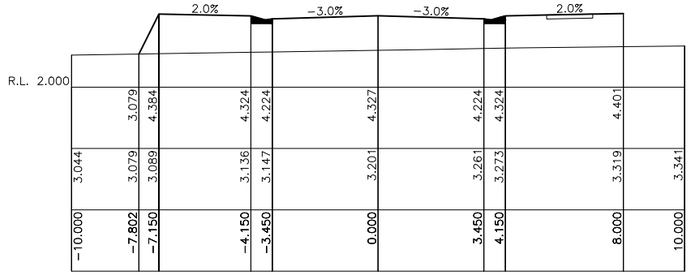
DRAWING NO. 1861-C05
ISSUE. 7
SHEET 5 OF 10



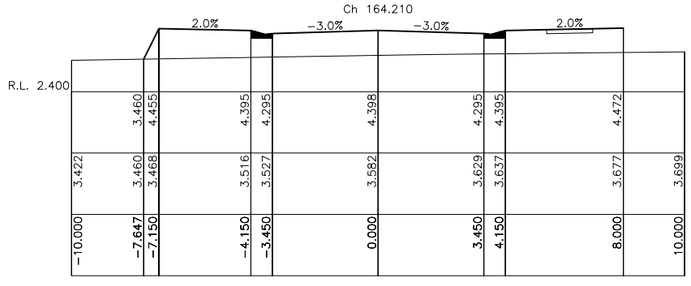
Ch 199.072



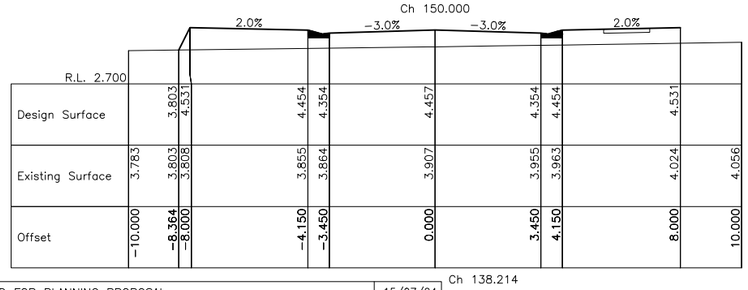
Ch 183.726



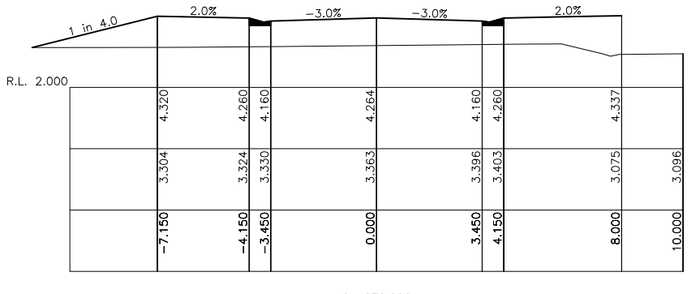
Ch 164.210



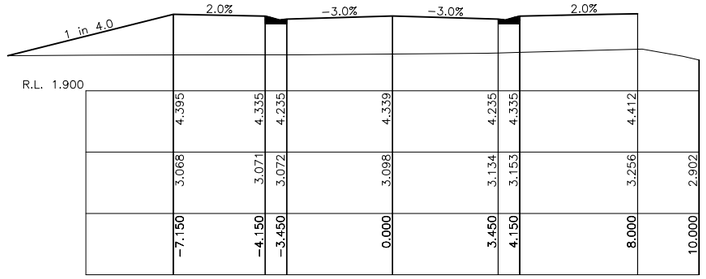
Ch 150.000



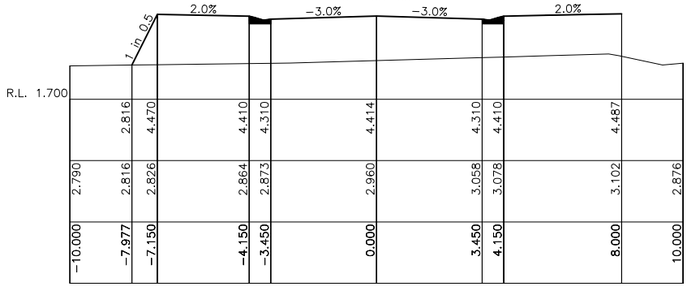
Ch 138.214



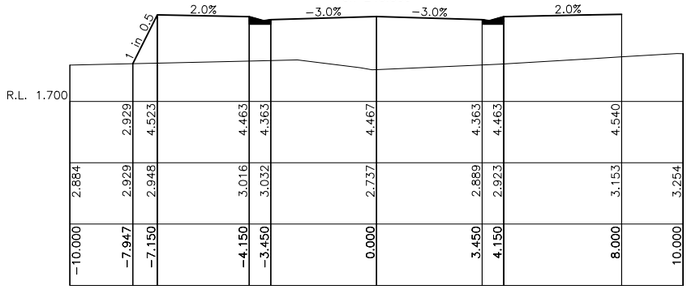
Ch 270.000



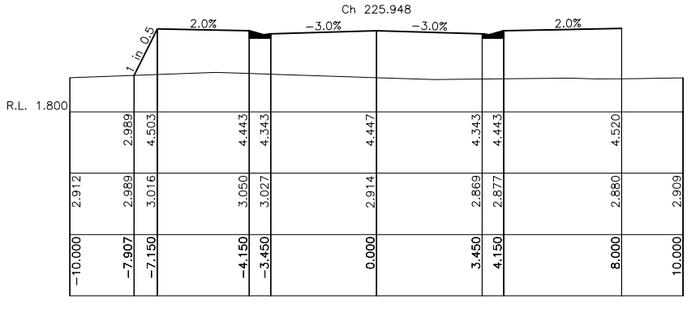
Ch 255.000



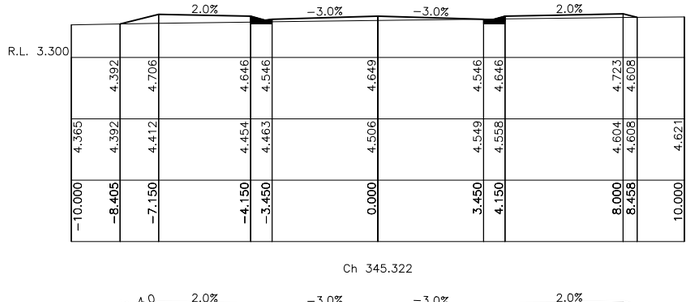
Ch 240.000



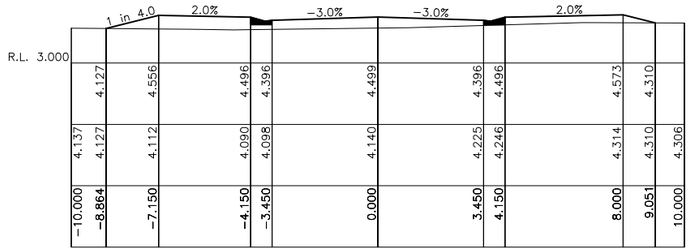
Ch 225.948



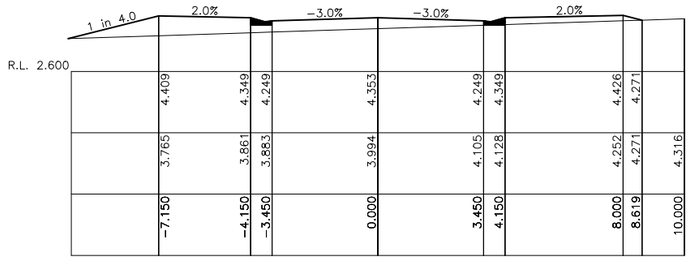
Ch 212.231



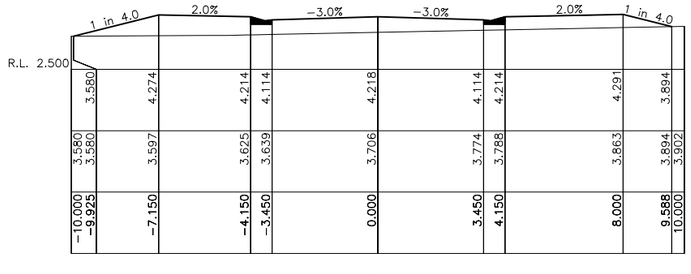
Ch 345.322



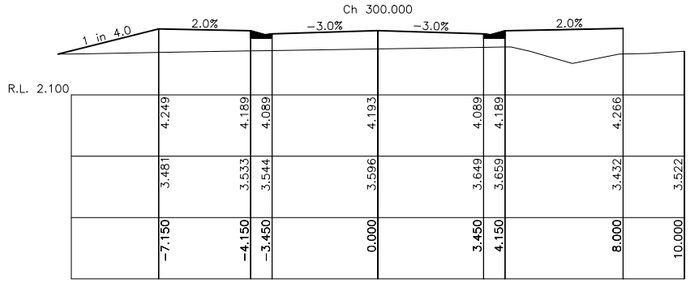
Ch 330.000



Ch 315.000



Ch 300.000



Ch 285.000

7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	RE-ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	30/10/20
ISSUE	DESCRIPTION	DATE

FOR PLANNING PROPOSAL

NOT FOR CONSTRUCTION

SCALES	ORIGINAL
1:200 NAT	A3

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC' 23
CHECKED:	AB

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f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL

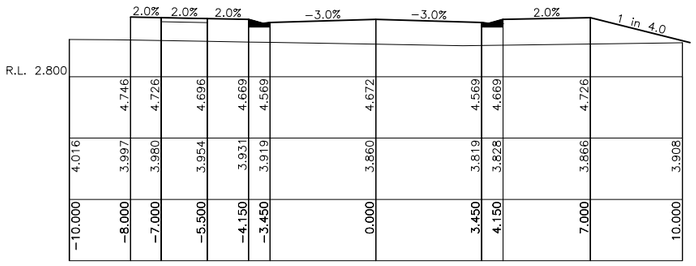
PRELIMINARY CIVIL DESIGN

ROAD 1 CROSS SECTIONS - SHEET 2 OF 2

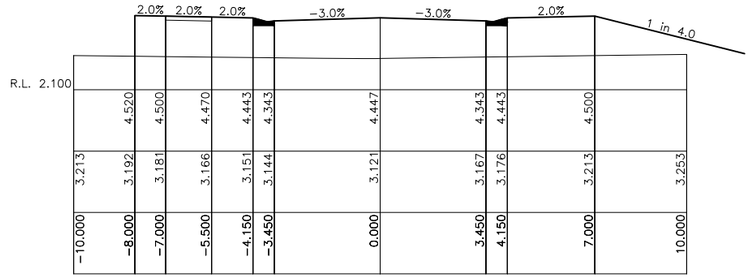
DRAWING NO. 1861-C06

ISSUE. 7

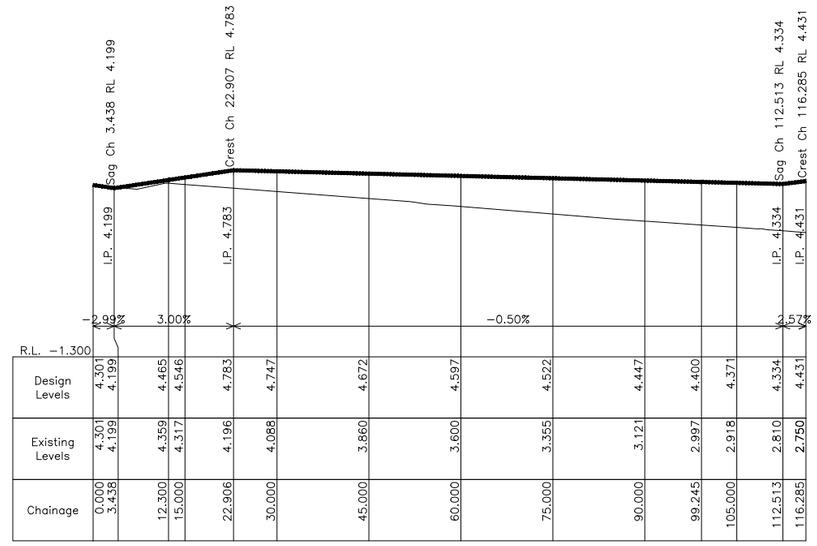
SHEET 6 OF 10



Ch 45.000

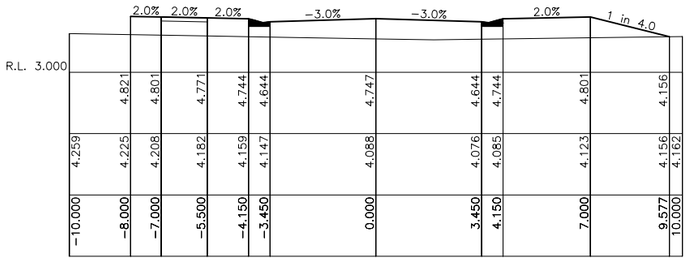


Ch 90.000

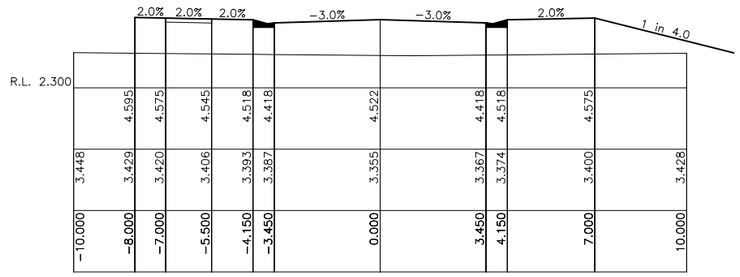


ROAD 2 LONGITUDINAL SECTION

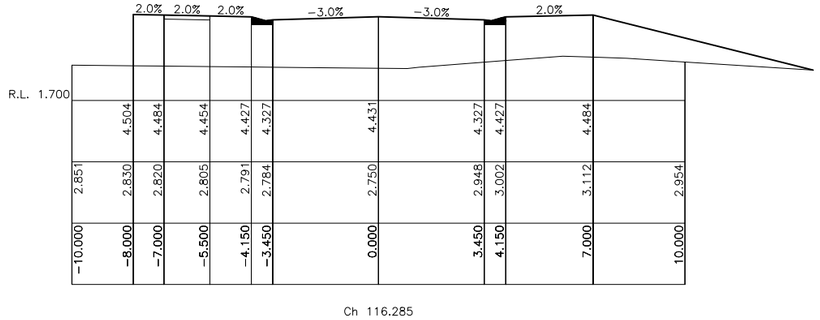
SCALES H 1:500 @ A1, 1:1000 @ A3
V 1:100 @ A1, 1:200 @ A3



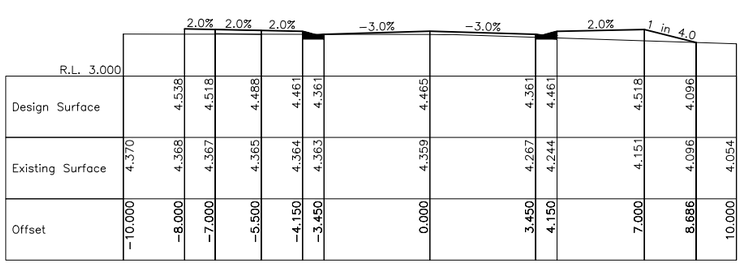
Ch 30.000



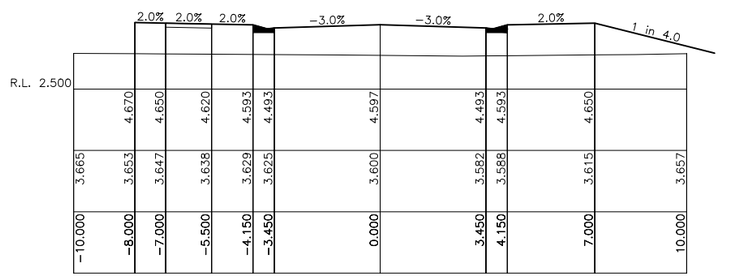
Ch 75.000



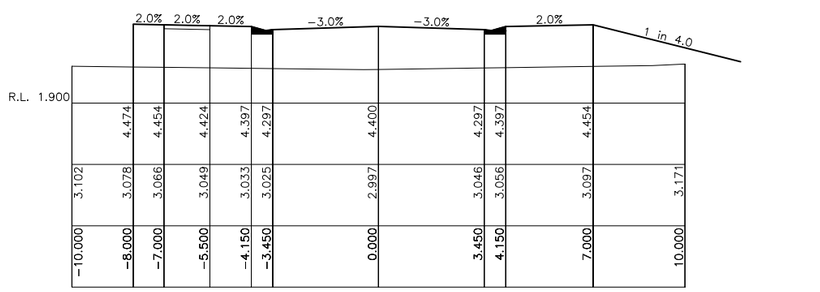
Ch 116.285



Ch 12.300



Ch 60.000



Ch 99.245

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	FOR PLANNING PROPOSAL	12/01/24

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
1:100 UNO	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

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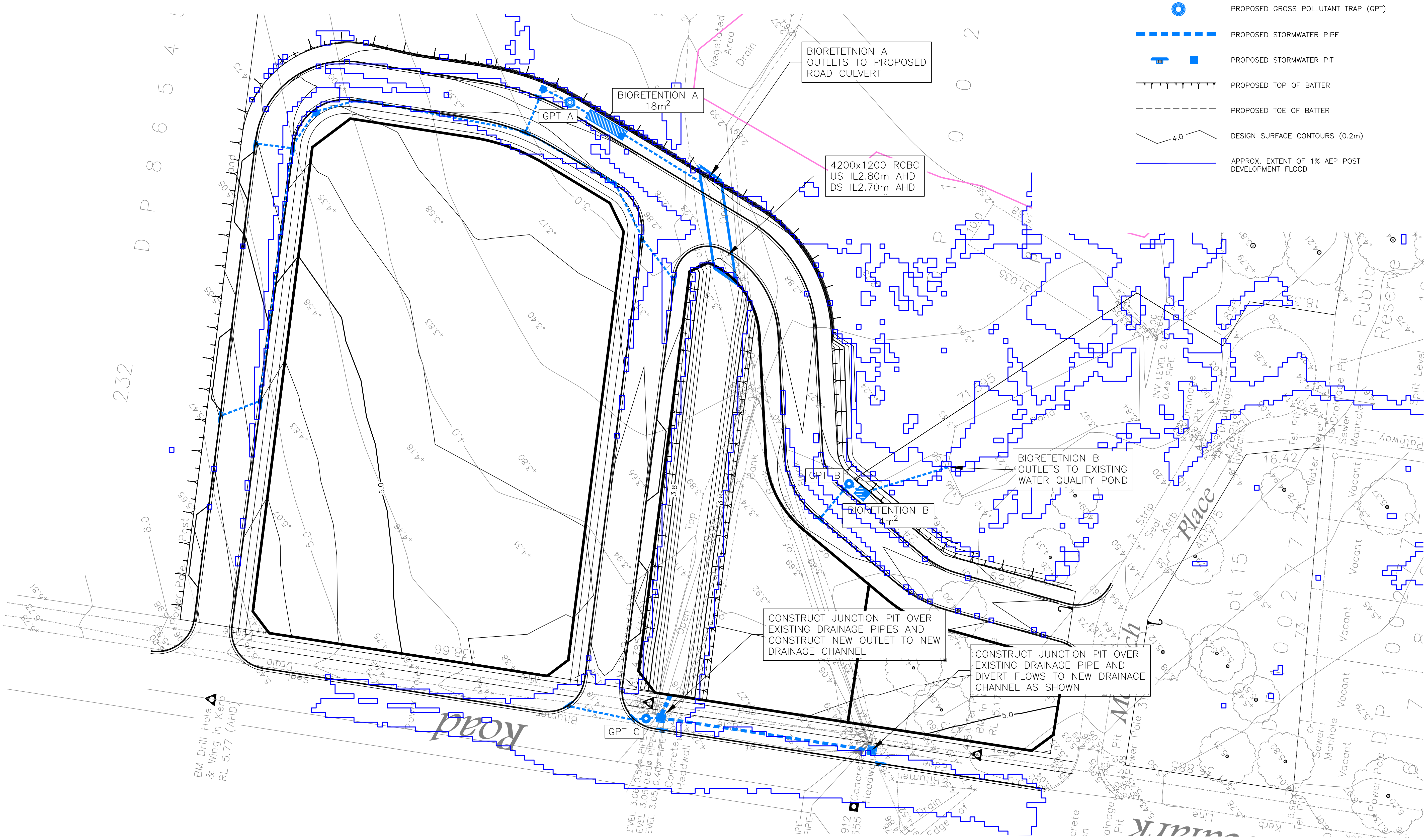
LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
ROAD 2 LONGITUDINAL SECTION & CROSS SECTIONS

DRAWING NO. 1861-C07
ISSUE. 7
SHEET 7 OF 10



LEGEND

- PROPOSED BIORETENTION BASIN
- PROPOSED GROSS POLLUTANT TRAP (GPT)
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER PIT
- PROPOSED TOP OF BATTER
- PROPOSED TOE OF BATTER
- DESIGN SURFACE CONTOURS (0.2m)
- APPROX. EXTENT OF 1% AEP POST DEVELOPMENT FLOOD

STORMWATER MANAGEMENT PLAN

SCALE 1:400 @ A1, 1:800 @ A3

8 4 0 8 16 1:400

Original sheet size A1

North

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
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3	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE-ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	30/10/20

FOR PLANNING PROPOSAL

NOT FOR CONSTRUCTION

FOOTPRINT (NSW) PTY. LTD. AUTHORISE THE USE OF THIS DRAWING ONLY FOR THE PURPOSE DEMONSTRATED BY THE STATUS STAMP SHOWN ABOVE.

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

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LOT 5 SEALARK ROAD, CALLALA BAY

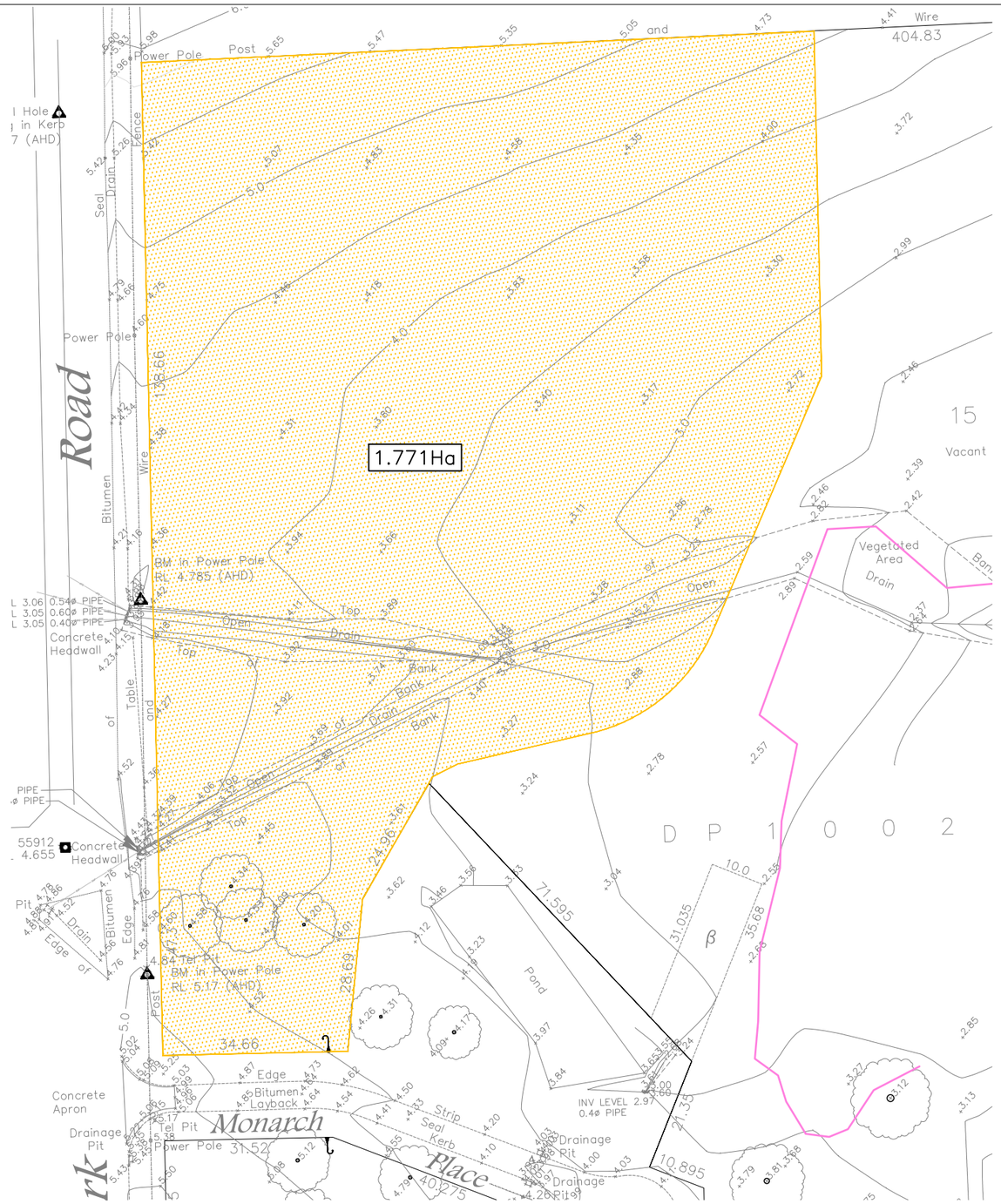
PLANNING PROPOSAL

PRELIMINARY CIVIL DESIGN

PRELIMINARY STORMWATER MANAGEMENT PLAN

DRAWING NO. 1861-C08

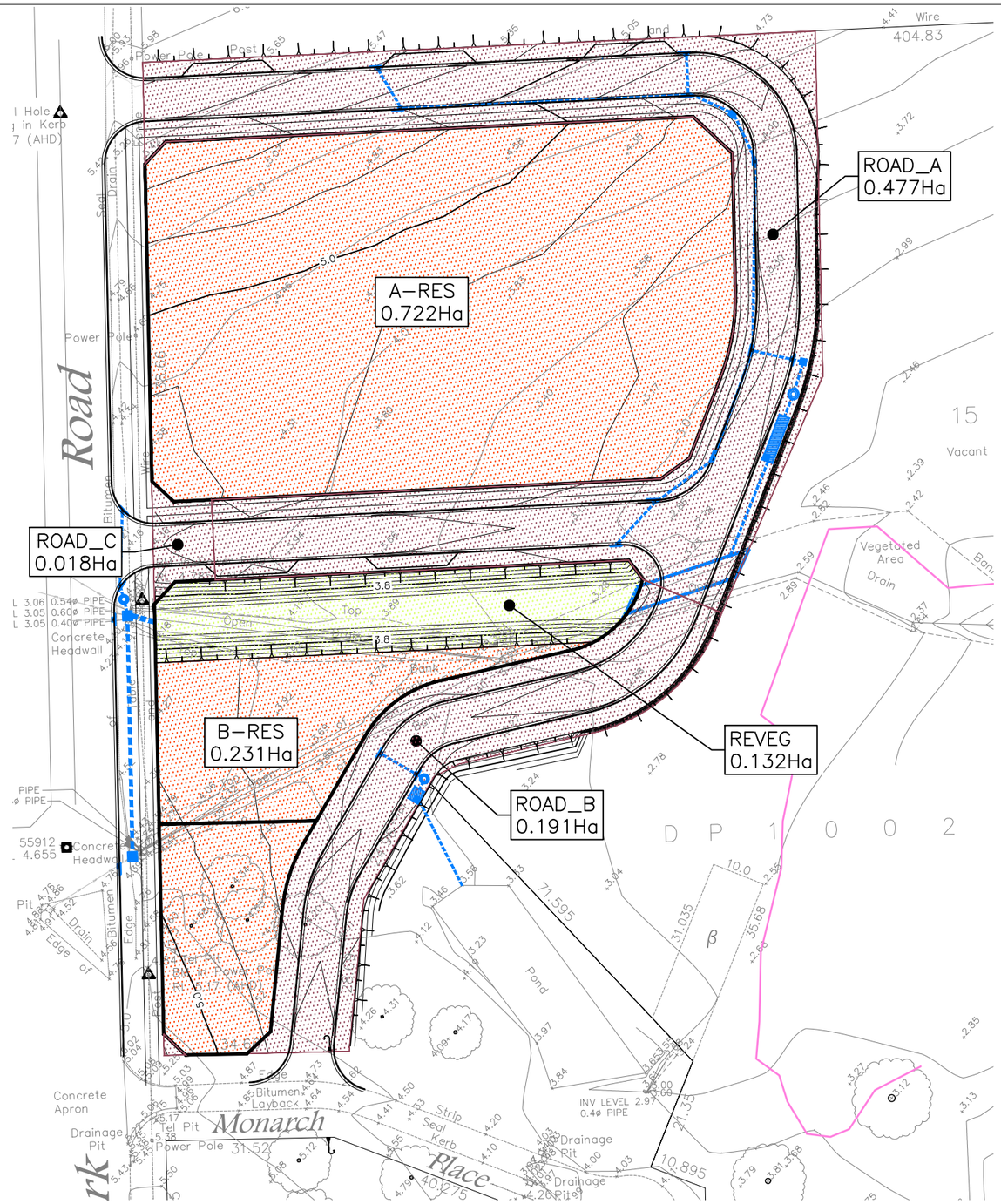
ISSUE. 7



PRE–DEVELOPMENT – SUB–CATCHMENTS

LEGEND

RURAL RESIDENTIAL LANDUSE



POST–DEVELOPMENT – SUB–CATCHMENTS

LEGEND

REVEGETATED AREAS (RURAL RESIDENTIAL)

RESIDENTIAL LANDUSE

ROAD RESERVE

8 4 0 8 16 1:800

Original sheet size A3

North

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE–ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	RE–ISSUED FOR PLANNING PROPOSAL	12/01/24
3	RE–ISSUED FOR PLANNING PROPOSAL	22/11/21
2	RE–ISSUED FOR PLANNING PROPOSAL	22/11/21
1	FOR PLANNING PROPOSAL	30/10/20

FOR PLANNING PROPOSAL

NOT FOR CONSTRUCTION

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC' 23
CHECKED:	AB

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LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL

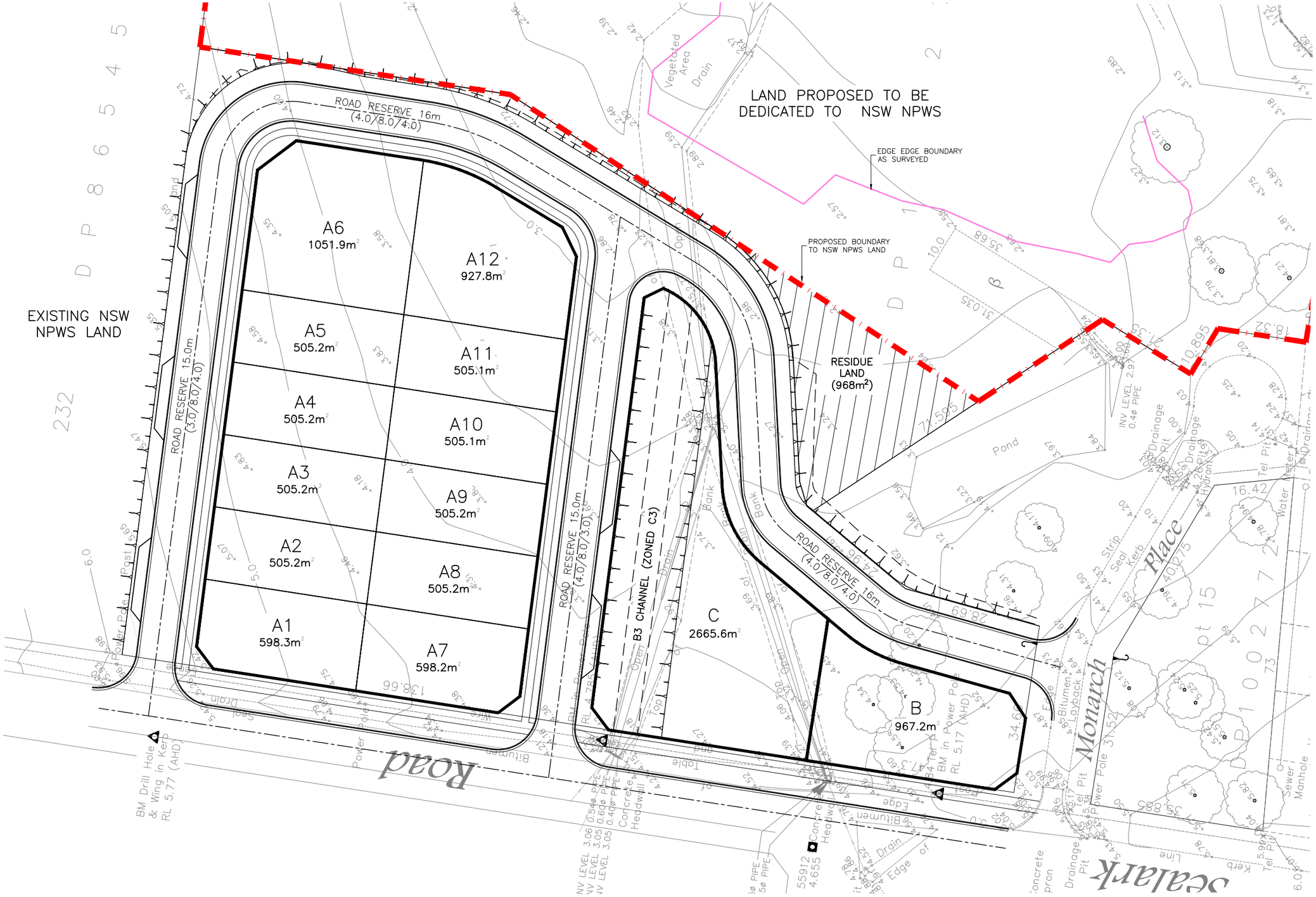
PRELIMINARY CIVIL DESIGN

WATER QUALITY PRE AND POST DEVELOPMENT LAND USE PLAN

DRAWING NO. 1861-C09

ISSUE. 7

SHEET 9 OF 10



INDICATIVE SUBDIVISION PLAN

SCALE 1:400 @ A1, 1:800 @ A3

8 4 0 8 16 1:400

Original sheet size A1

North

ISSUE	DESCRIPTION	DATE
7	ISSUED FOR PLANNING PROPOSAL	15/07/24
6	RE-ISSUED FOR CONSULTANT REVIEW	02/06/24
5	FOR CONSULTANT REVIEW	15/05/24
4	FOR PLANNING PROPOSAL	12/01/24

FOR PLANNING PROPOSAL
NOT FOR CONSTRUCTION

SCALES	ORIGINAL
AS NOTED	A1

CLIENT: HARE BAY CONSORTIA

SURVEYOR:	ALLEN PRICE
DATUM:	AHD
AZIMUTH:	GDA 94, MGA56
DRAWN:	AB
DESIGNED:	AB
DESIGNED DATE:	DEC '23
CHECKED:	AB

footprint
sustainable engineering
a. 15 meehan drive
kiama downs nsw 2533
p. 02 4237 6770
f. 02 4237 8962

LOT 5 SEALARK ROAD, CALLALA BAY

PLANNING PROPOSAL
PRELIMINARY CIVIL DESIGN
INDICATIVE SUBDIVISION PLAN

DRAWING NO. 1861-C10
ISSUE. 7
SHEET 10 OF 10

APPENDIX B

Ocean Protect Filterra System Information

Filterra®

High flow biofiltration

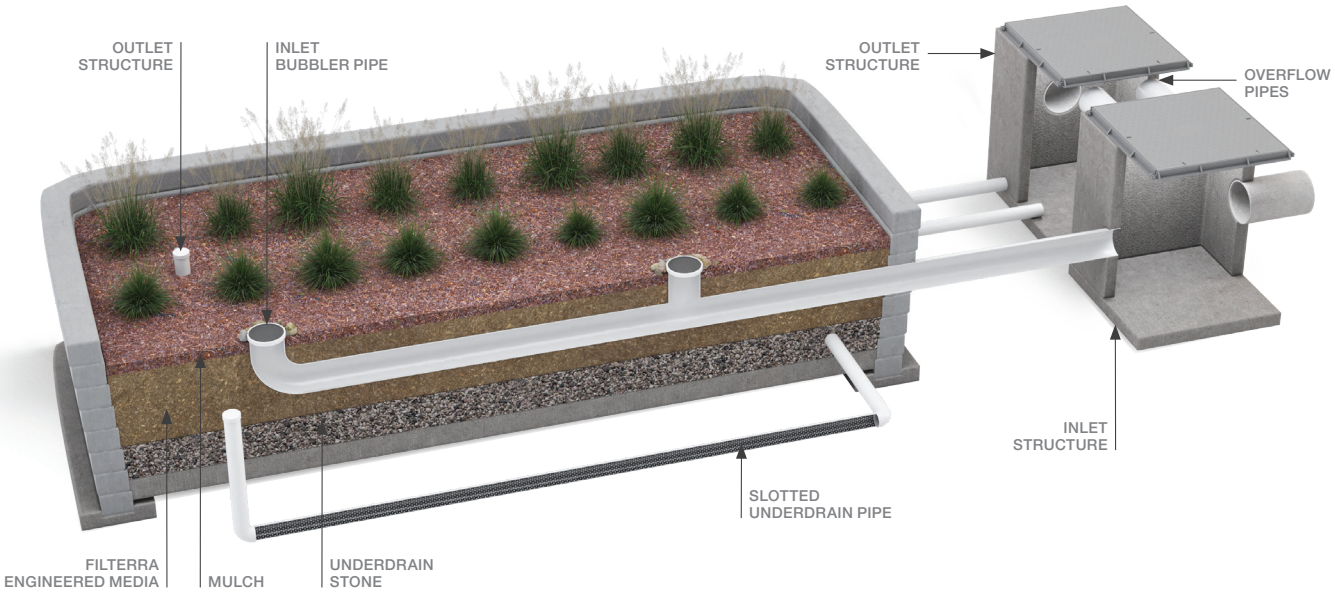
Filterra® biofiltration systems are optimised for high flow treatment and pollution removal.

Whilst similar to a typical biofiltration system (using 'sandy loam' filter media), Filterra biofiltration systems utilise a filter media blend that treats flows at a significantly higher flow rate than typical biofiltration filter media and the media is produced to strict quality control procedures. Filterra biofiltration systems can also achieve local stormwater pollution reduction targets with significantly less area (typically 0.3% of upstream area) relative to typical biofiltration systems (with 'sandy loam' media, typically 0.8 to 1.5% of upstream area).

How does it work?

During a storm, stormwater enters the Filterra biofiltration system through a pipe, kerb inlet, or sheet flow and ponds over the mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch layer trap and degrade metals and hydrocarbons. The mulch also provides a water retention function for the system's vegetation.

Stormwater then flows through the engineered high flow media filtering fine pollutants and nutrients. Organic material in the media removes dissolved metals and acts as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).



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Features

- High treatment flow rate (design flow rate of 3550mm/hour)
- Vegetation and ‘natural’ appearance (and treatment processes)
- Highly effective pollution removal
- Flow retention within vegetation, mulch and filter media
- Available in a range of configurations and sizes
- No confined space access requirements
- Multiple ‘cells’ for larger ‘bioscape’ systems

Benefits

- Reduced size (relative to conventional biofiltration systems)
- Low cost and easy installation, establishment and maintenance
- Landscaping augments site amenity and provides habitat and localised ‘cooling’ benefits
- No confined space access requirements

Configurations and Applications

The Filterra® biofiltration system can be arranged in a couple of ways such that it suits the site specific requirements for flow rate, hydraulics, accessibility and footprint restrictions.The standard configurations offered by Ocean Protect include pre-cast concrete tree-pits and BioScape in-situ construction. Filterra® is ideal for tight, highly developed sites, urban development projects, commercial parking lots, residential streets, and streetscapes.

Maintenance

As required for typical biofiltration systems, typical maintenance activities for Filterra® biofiltration systems includes overall system inspection, pruning of vegetation (as required) and removal of litter. The mulch layer for Filterra® biofiltration systems also should be replaced approximately every 6 to 12 months.

Speak to the team at Ocean Protect who can help you maintain your Filterra® biofiltration systems.

OceanSave®

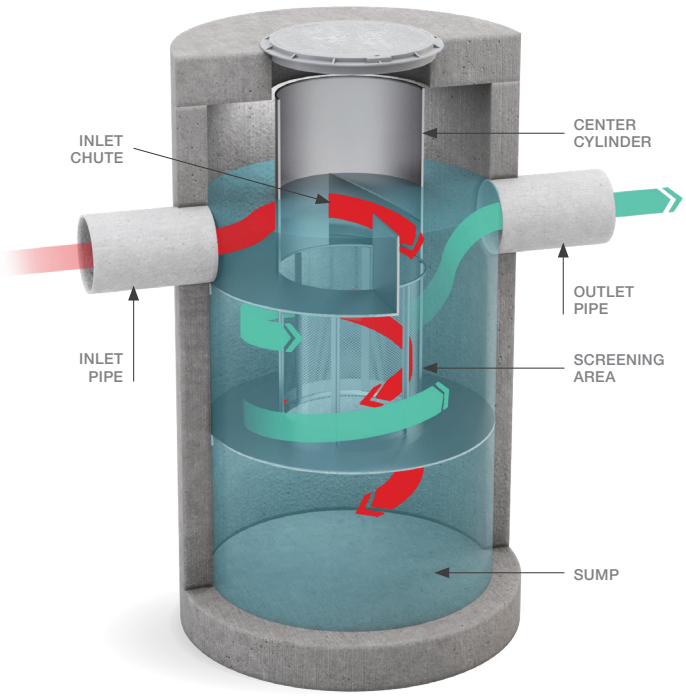
Full capture, high-capacity gross pollutant trap

The OceanSave® is a vortex type engineered stormwater treatment asset designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff as either a stand-alone technology or as part of a 'treatment train' (with stormwater treatment assets located downstream to provide further treatment).

The innovative screen design and specially designed internal configuration allows for higher flows than other similar technologies whilst ensuring floatables, settleable solids and neutrally buoyant pollutants are retained without screen blinding.

How does it work?

- One or more inlet pipes within a 130-degree range of the outlet pipe direct stormwater flow through a chute to the treatment chamber
- The specially designed inlet initiates a vortex at a higher flows than other similar sized vortex separators
- The specially designed screen in conjunction with swirling flow ensures screen blinding is eliminated unlike other direct screening devices
- The forces created by the vortex allow for pollutants to concentrate in the centre where they can either settle into the sump or remain floating within the screening area
- Neutrally buoyant material will also be trapped and retained
- A hydrocarbon baffle ensures that free hydrocarbons and oils are retained and prevented from escaping
- Flows that exceed the treatable flow rate are diverted to the outlet via an internal weir
- Treated and bypass flows exit via the outlet pipe



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OceanSave®

Features

- Vortex separator
- Innovative screen and internal configuration
- Easy to remove sectional screen panels
- Large separate storage sump
- Internal bypass and optional additional external bypass via a diversion box or pits
- Multiple pipe inlets

Benefits

- Superior pollutant removal
- Eliminates blinding and clogging
- No scour or resuspension of previously captured pollutants
- Flexibility in design
- Easy installation and maintenance
- Accepted technology

Configurations and Applications

The OceanSave® range covers most applications and needs. The fully trafficable precast concrete system can be arranged both on-line or off-line with low flow diversion. A range of diameters ensures your treatable flow rate requirement will be satisfied. This design flexibility makes the system ideal for a wide range of applications such as:

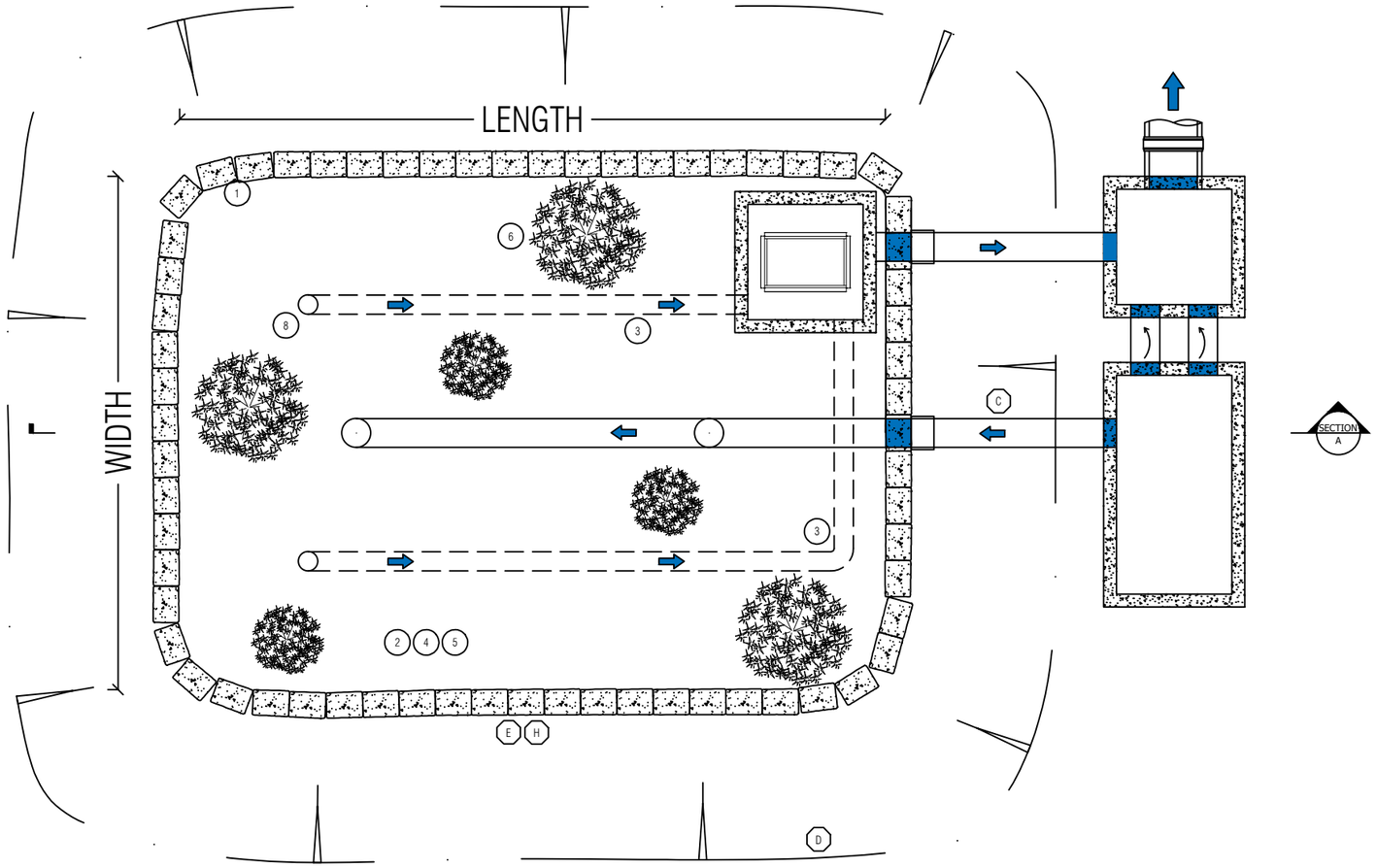
- Commercial, industrial and residential development, infill and redevelopment and stormwater quality retrofit applications
- Special projects, including highways, airports, seaports and military installations
- Pre-treatment for subsequent stormwater treatment assets (e.g. StormFilter®, biofiltration)

Maintenance

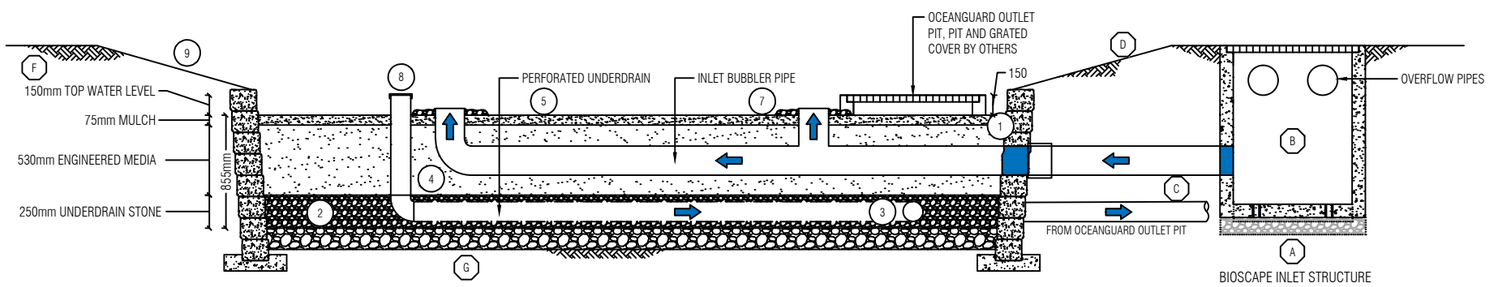
The key maintenance activity for the OceanSave® is the removal of accumulated sediment and gross pollutants (typically approximately every year) and inspection and cleaning of the screen (typically approximately every two years).

Speak to the team at Ocean Protect who can help you maintain your OceanSave®.

NOT FOR CONSTRUCTION



PLAN



SECTION A-A

(PLANTING NOT SHOWN FOR CLARITY)

SITE SPECIFIC REQUIREMENTS		
COUNT	DESCRIPTION	INSTALLED BY
	FILTERRA SURFACE AREA (m^2)	OCEAN PROTECT
	MULCH VOLUME (m^3)	OCEAN PROTECT
	FILTERRA MEDIA DEPTH (mm)	OCEAN PROTECT
	VOLUME OF UNDERDRAIN STONE (m^3)	OCEAN PROTECT
	FILTERRA LINER (m)	OCEAN PROTECT

PLANTING SCHEDULE	
COUNT	FILTERRA BIOSCAPE SYSTEM PLANT PALETTE

GENERAL NOTES

- CONTRACTOR SHALL CONTACT OCEAN PROTECT TO COORDINATE DELIVERY AND INSTALLATION OF FILTERRA BIOSCAPE SYSTEM. OCEAN PROTECT ACTIVIATION CAN ONLY OCCUR ONCE CONTRACTOR RESPONSIBILTIES ARE COMPLETE.
- PERFORM FILTERRA BIOSCAPE SYSTEM EXCAVATION ONLY AFTER ALL THE CONTRIBUTING DRAINAGE AREAS ARE PERMANENTLY STABILISED. IF FILTERRA BIOSCAPE SYSTEM IS IN AN AREA PREVIOUSLY USED AS EROSION AND SEDIMENT CONTROL FACILITIES PLEASE CONTACT OCEAN PROTECT. DO NOT STOCKPILE MATERIALS OR STORE EQUIPMENT IN THIS AREA. CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO PREVENT CONSTRUCTION-RELATED EROSION RUNOFF FROM ENTERING THE FILTERRA MEDIA BAY.
- FILTERRA SHALL BE INSTALLED OFFLINE AS EARLY AS POSSIBLE AFTER SITE STABILISATION TO ALLOW FOR SOIL MATURITY AND SYSTEM ESTABLISHMENT.
- CONTRACTOR SHALL COORDINATE WITH OCEAN PROTECT BEFORE THE FILTERRA BIOSCAPE SYSTEM IS EXCAVATED TO MINIMISE THE TIME BETWEEN EXCAVATION AND COMPLETION OF THE FILTERRA BIOSCAPE SYSTEM. ONCE EXCAVATED, ANY STANDING WATER THAT ACCUMULATES IN THE EXCAVATED AREA MUST BE REMOVED BY THE CONTRACTOR BEFORE OCEAN PROTECT CAN COMMENCE THE FILTERRA BIOSCAPE SYSTEM. ANY ADDITIONAL EXCAVATION WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.
- CONTRACTOR SHALL PROVIDE ACCESS TO THE EXCAVATED AREA(S) FOR OCEAN PROTECT TO USE DURING THE CONSTRUCTION OF THE FILTERRA BIOSCAPE SYSTEM(S). ACCESS SHALL NOT PROHIBIT LIGHT DUTY EQUIPMENT THAT MAY BE USED TO INSTALL THE COMPONENTS (STONE, MEDIA, ETC). THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY RE-STABILIZATION THAT MAY BE REQUIRED AFTER THE FILTERRA BIOSCAPE SYSTEM INSTALLATION/ACTIVATION.
- OCEAN PROTECT AND/OR ITS REPRESENTATIVES SHALL BE RESPONSIBLE FOR THE LIST ENTITLED 'OCEAN PROTECT INSTALLATION RESPONSIBILITIES'.
- NO FLOW SHALL ENTER THE FILTERRA SYSTEM UNLESS OCEAN PROTECT HAS ACTIVATED THE SYSTEM AND CONFIRMED ESTABLISHMENT
- IF FILTERRA IS WITHIN AN OVERLAND FLOW PATH, PLEASE CONTACT OCEAN PROTECT

CONTRACTOR WORKS AND INSTALLATION RESPONSIBILITIES

A. CONTRACTOR TO PLACE FILTERRA INLET STRUCTURE ON BEDDING AS SPECIFIED BY THE ENGINEER. OCEAN PROTECT SUGGESTS AS A MINIMUM TO USE 150MM BEDDING STONE ON COMPACTED SUB-GRADE TO 90% DENSITY. UNSUTIABLE MATERIAL SHALL BE REPLACED AS ADVISED BY THE ENGINEER.

B. CONTRACTOR SHALL PROVIDE AND INSTALL DRAINAGE ITEMS TO, FROM AND INCLUDING THE INLET AND OUTLET STUCTURES AS PER THE APPROVED SITE PLANS.

C. OCEAN PROTECT CAN PROVIDE COUPLERS AT THE FILTERRA INTERFACE FOR CONNECTION TO THE INLET DIVERSION PIPES. ALL DRAINAGE TO AND FROM THE FILTERRA MUST ALLOW FOR POSITIVE FLOW.

D. CONTRACTOR TO PROVIDE BATTER ACCORDING TO DIMENSION AND SLOPE SHOWN ON PLANS. SLOPE FROM SHOULDER TO FILTERRA BIOSCAPE SYSTEM SURFACE PERIMETER SHALL NOT EXCEED 3:1. TURF IS REQUIRED TO STABILISE SIDE SLOPES SHOWN ON DETAIL AND ON PLAN SHEETS.

E. CONTRACTOR TO EXCAVATE MEDIA AREA CORRESPONDING TO THE SIZE OF THE FILTERRA BIOSCAPE SYSTEM SURFACE AREA AS SHOWN ON DETAIL AND ON PLAN SHEETS.

F. CONTRACTOR SHALL EXCAVATE VERTICALLY FROM BOTTOM OF UNDERDRAIN STONE OR DRAINAGE STONE IF REQUIRED, TO ELEVATION OF MULCH AS SHOWN ON THIS DETAIL.

G. CONTRACTOR TO CONFIRM DEPTH OF EXCAVATION. IF THE EXCAVATION HAS BEEN MADE TOO DEEP AND ADDTITIONAL UNDERDRAIN STONE NEEDS TO BE USED TO RAISE THE BASE OF THE FILTERRA, THIS COST SHALL BE TAKEN ON BY THE CONTRACTOR.

H. RETAINING WALLS AND ADDITIONAL EROSION CONTROL AROUND THE FILTERRA BIOSCAPE SYSTEM. RETAINED OFFLINE FROM FILTERRA

OCEAN PROTECT SUPPLY AND INSTALLATION RESPONSIBILITIES

1. GEOTEXTILE FABRIC ALONG THE PERIMETER OF THE FILTERRA BIOSCAPE SYSTEM EXCAVATION.
2. UNDERDRAIN STONE. TYPICALLY 250mm THICK (50mm UNDER THE PIPING 150mm AROUND THE PIPING AND 50mm ABOVE THE PIPING)
3. 150mm UNDERDRAIN PIPING UNLESS OTHERWISE APPROVED BY OCEAN PROTECT, ASSOCIATED PIPING AND FITTINGS/ELBOWS TO CONNECT TO THE PIPING/FITTING(S) THAT IS PROVIDED BY CONTRACTOR (SEE CONTRACTOR INSTALLATION RESPONSIBILITIES THIS DETAIL).
4. 530mm FILTERRA MEDIA.
5. 75mm DOUBLE SHREDDED HARDWOOD MULCH OVER ENTIRE FILTERRA BIOSCAPE SYSTEM SURFACE AREA.
6. PLANTINGS OF PLANTS SELECTED BY ENGINEER THAT MATCH OCEAN PROTECTS APPROVED PLANTING LIST.
7. FLOW DISSIPATION APRON AROUND ALL FLOW ENTRY POINTS AS DESIGNED AND INDICATED ON THIS DETAIL
8. CLEAN-OUT ADAPTER,PLUG AND PIPING.
9. ACTIVATING THE SYSTEM

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OCEAN PROTECT

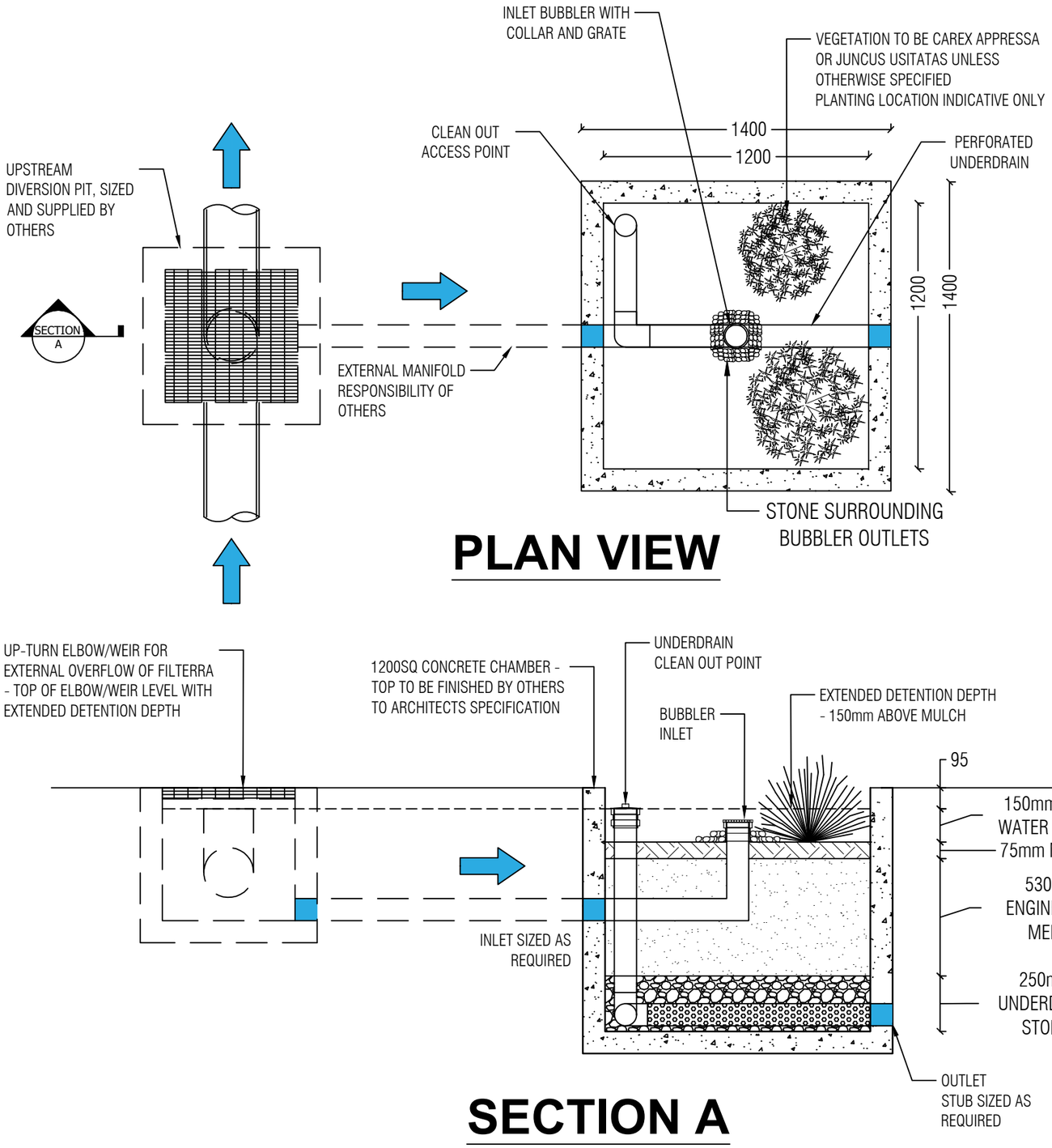
FILTERRA BIOSCAPE SYSTEM WITH BIOSCAPE INLET STRUCTURE

SPECIFICATION DRAWING

LAST MODIFIED: 24-05-19

NOT FOR CONSTRUCTION

EXTERNAL OFFLINE REQUIRED IF INCOMING PIPES ARE LARGER THAN Ø150mm



SITE SPECIFIC REQUIREMENTS		
COUNT	DESCRIPTION	INSTALLED BY
1.44	FILTERRA SURFACE AREA (m^2)	OCEAN PROTECT
0.11	MULCH VOLUME (m^3)	OCEAN PROTECT
530	FILTERRA MEDIA DEPTH (mm)	OCEAN PROTECT
0.36	VOLUME OF UNDERDRAIN STONE (m^3)	OCEAN PROTECT
N/A	FILTERRA LINER (m)	OCEAN PROTECT

STRUCTURE ID:			
PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE			
OUTLET PIPE			
TREATABLE FLOW RATE:		1.4L/s	
MAXIMUM AREA DRAINING TO FILTERRA UNIT:		480m^2	

GENERAL NOTES

1. OCEAN PROTECT TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. PLANT, MULCH, AND DISSIPATION ROCK ARE SUPPLIED BY OCEAN PROTECT AND DELIVERED AT TIME OF SYSTEM ACTIVATION. PLANT SELECTION SHALL BE DONE BY THE CERTIFYING ENGINEER IN ACCORDANCE WITH THE OCEAN PROTECT PLANT LIST.
3. INTERNAL PIPES AND FITTINGS SUPPLIED AND INSTALLED BY OCEAN PROTECT.
4. SITE SPECIFIC PRODUCTION DRAWING WILL BE PROVIDED ON PLACEMENT OF ORDER.
5. FILTERRA WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
6. STRUCTURE SHALL BE IN ACCORDANCE WITH AS3600.

INSTALLATION NOTES

1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY CERTIFYING ENGINEER.
2. CONTRACTOR TO PROVIDE ALL EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING DETAIL PROVIDED SEPARATELY).
3. CONTRACTOR TO APPLY SEALANT TO ALL JOINTS AND TO PROVIDE, INSTALL AND GROUT INLET AND OUTLET PIPES.
4. CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO PROTECT CONSTURCTION RELATED SEDIMENT RUN-OFF FROM ENTERING THE FILTERRA MEDIA
5. OCEAN PROTECT IS RESPONSIBLE FOR ACTIVATION OF THE SYSTEM AND INSTALLATION OF THE SELECTED PLANT FROM THE OCEAN PROTECT FILTERRA PLANT LIST. ACTIVATION ONLY OCCURS WHEN THE SITE IS FULLY STABILIZED, FINAL PAVEMENT INSTALLED AND SWEPT CLEAN OF CONSTRUCTION SEDIMENT.

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OCEAN PROTECT
FILTERRA BIORETENTION
1212 PRECAST PIT EXTERNAL OFFLINE
SPECIFICATION DRAWING

LAST MODIFIED: 02-11-21