1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

CLIFTON YAMBA MHE

STAGED SOIL & WATER MANAGEMENT PLAN

Manufactured Housing Estate (MHE) Development

110 – 120 Carrs Drive, Yamba

LOT 2 DP733507 and Lot 32 DP1280863

FOR:

CLIFTON YAMBA LAND PTY LTD

ATF YAMBA LAND TRUST

JANUARY 2024

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

Manage-Design-Engineer DOCUMENT CONTROL

PROJECT: CLIFTON YAMBA MHE

CLIENT: CLIFTON YAMBA LAND PTY LTD
ATF YAMBA LAND TRUST

AUTHOR: Andrew Smith

REVISION HISTORY

REVISION	DATE	CHECKED BY	
		NAME	SIGNATURE
0	31/01/24	Troy Ryden	

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

CONTENTS

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

1.0 INTRODUCTION

Manage-Design-Engineer Pty Ltd (MDE) has been engaged by Clifton Yamba Land Pty Ltd ATF Yamba Land Trust to undertake detailed design, documentation and project management for a proposed 216 lot Manufactured Housing Estate at 110-120 Carrs Drive Yamba (LOT 2 DP733507 and Lot 32 DP1280863). The location of the site is highlighted in Figure 1 below.

The project involves bulk earthworks, roadworks, stormwater drainage, sewer reticulation, water reticulation and telecommunications & electrical reticulation to service the proposed 216 Lot manufactured house dwellings and communal facilities and associated structures. It is anticipated that construction of civil works and subsequent dwelling and communal facilities will be undertaken in multiple stages over a 3-5 year period.

FIGURE 1 – PROPOSED MHE DEVELOPMENT SITE

The Development Application design package for the proposed estate was submitted to Council on 18 April 2023 and included a detailed Stormwater Management Plan demonstrating the proposed estate's compliance with Clarence Valley Council's stormwater quality and quantity objectives which are set out in the Residential Zones Development Control Plan Part H – Sustainable Water Controls.

The purpose of this plan is to outline how the development will achieve required quality and quantity objectives throughout construction and staged release of the estate prior to the complete implementation of the ultimate stormwater management system as set out in the Stormwater Management Plan and Manage-Design-Engineer's (MDE's) proposed stormwater drainage design plans. Both the DA Stormwater Management Plan and MDE's Stormwater Drainage Design Plans are included in **Appendix A** for reference.

2.0 DEVELOPMENT STAGING

The Clifton Yamba MHE development will ultimately comprise of 216 dwelling sites and a communal facility consisting of a club house, swimming pool, bowls green and other communal facilities. Due to the size of the estate, a staged delivery of

dwellings is proposed over 12 stages plus a communal facilities stage. The anticipated staged delivery is detailed in the staging plan included in **Appendix B**.

Typically civil and building construction works will follow the same staging sequence however delivery of more than one stage area may occur in a single works package from time to time, subject to market demand.

Vegetation clearing and bulk earthworks will be completed as one package of works over the entire development footprint prior to any civil infrastructure or building works.

3.0 ULTIMATE STORMWATER MANAGEMENT

The Development Application design documentation clearly outlines the proposed stormwater drainage network and infrastructure required to ensure the proposed development meets the required drainage, water quality and water quantity standards.

MDE's Stormwater Management Plan (SWMP) details the ultimate development scenario and provides model outputs demonstrating compliance with Clarence Valley Council's DCP. A copy of the SWMP is included in **Appendix A.**

4.0 INTERIM STAGED STORMWATER MANAGEMENT

Due to the staged delivery of the proposed estate, the ultimate stormwater management network detailed in MDE's DA documentation will not be completed until approximately 3-5 years following commencement of site works. Prior to this time, stormwater discharge quality and quantity from the site will need to be managed to ensure relevant standards are maintained.

At any point in time prior to completion of the development, the site will consist of varying areas of completed stages, partially complete stages and stages in which bulk earthworks have been completed but civil and building works are yet to commence.

In general, the following will apply to management of stormwater flows from these three areas:

(a) Development stages that have had all civil, building and landscape works completed will be managed in accordance with the ultimate stormwater management strategy outlined in MDE's Stormwater Management Plan i.e. stormwater runoff will be captured and conveyed via a pit and pipe network to either a detention tank or basin prior to discharge from site.

(b) Development stages that are partially complete (civil and/or building works are underway) will be managed in accordance with industry best practice through the use of temporary erosion and sediment control devices (silt fence, hay bale sediment traps, temporary ground stabilisation such as topsoil and seeding, hydromulching, dust fencing, clean water cutoff drains, dirty water diversion drains, rock check dams, pit inlet filters, polymer soil binders etc) and temporary sediment basins. The contracted Civil Contractor or Building Contractor with possession of that stage of works will be responsible for implementation and maintenance of these devices during the construction of their works. These measures are to be implemented in accordance with detailed Erosion and Sediment Control plans produced for each stage of works and 'Managing Urban Stormwater: Soils and Construction V1 Ed4', otherwise known as 'The Blue Book'.

(c) Development stages in which bulk earthworks are complete but where civil or building works have not yet commenced will be managed as per Item (b) above however it will be the responsibility of the developer to ensure implementation and maintenance of these devices prior to any civil or building works.

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

As part of the Development Application Bulk Earthworks design package, Manage-Design-Engineer have detailed an erosion and sediment control plan which is to be implemented during and on completion of the Bulk Earthworks operation. The plan along with details of the erosion and sediment control devices are included in **Appendix C**. This plan incorporates sediment control fencing, temporary stormwater cutoff drains, proposed stockpile sites, a stabilised site access and temporary stormwater sediment basins. The plan also includes a number of ESC notes stipulating additional stabilisation measures for bulk earthworks areas, the timing required for these works and the management of both site spoil stockpiles and temporary sediment basins.

While this plan is intended to provide a comprehensive guide for the control and management of stormwater flows and sediment on site, it is considered the minimum standard and it is anticipated that additional measures may be required to suit actual site conditions and constraints. The process of site Erosion and Sediment control management is dynamic and it is expected that the civil contractor, in conjunction with the certifying engineer, will undertake any necessary additional works, amendments or adjustments to actual on site measures in order to comply with industry standards.

During the detailed civil design phase of the project following Development Approval, each detailed design package will include a similar stage specific Erosion and Sediment Control plan for management of each stage of works prior to implementation of final stormwater management devices. Again these plans are intended to provide sufficient measure for the control of site erosion and sediment however these measures should be reviewed and assessed on implementation to ensure all relevant standards are met.

5.0 IMPLEMNTATION OF ULTIMATE STORMWATER MANAGEMENT DEVICES

The stormwater management devices detailed in MDE's Stormwater Management Plan are intended to operate on completion of works. Implementation of these devices in their ultimate form prior to completion of works could result in damage to devices and overloading of the treatment train with excess sediment. It is therefor recommended that completed bio retention basins, buried detention tanks and stormwater quality pit inserts not be brought online until such time as 80% of the contributing catchment has been permanently stabilised.

In order to achieve this, it may be necessary to ensure that stormwater drainage infrastructure is not connected to an ultimate device despite stormwater drainage pit and pipe infrastructure being constructed i.e. during building construction works. **Appendix D** contains a sketch plan of the 9 stormwater catchment areas within the development and the 12 development stage areas overlaid. It is clear from this sketch that the staged delivery of the estate will not coincide with the stormwater catchment areas, and therefor there is some disconnect between the staged delivery of dwellings and the ultimate stormwater management devices.

The following table summarises the staged delivery of the development and the corresponding stormwater catchment area (or part thereof) along with the end of line stormwater management device and the stage at which the device has a contributing catchment that is at least 80% fully developed:

STORMWATER CATCHMENT	CORRESPONDING STORMWATER MANAGEMENT DEVICE	CORRESPONDING CONTRIBUTING DEVELOPMENT STAGES	DEVELOPMENT STAGE AT WHICH 80% OF CATCHMENT IS FULLY DEVELOPED
Catchment 1	Bio Retention Basin 1	Stage 1 – 100% of Catchment	Stage 1
Catchment 2	Bio Retention Basin 2	Stage 1 – 100% of Catchment	Stage 1
Catchment 3	Bio Retention Basin 3	Stage 2 – 72% of Catchment Stage 12 – 28% of Catchment	Stage 12
Catchment 4	Bio Retention Basin 4	Stage 2 – 20% of Catchment	Stage 11

	Bio Retention Basin 3	Stage 3 – 18% of Catchment CF Stage – 7% of Catchment Stage 10 – 14% of Catchment Stage 11 – 41% of Catchment	
Catchment 5	Bio Retention Basin 5	Stage 3 – 17% of Catchment Stage 4 – 38% of Catchment Stage 5 – 8% of Catchment Stage 9 – 37% of Catchment	Stage 9
Catchment 6	Bio Retention Basin 5	Stage 5 – 68% of Catchment Stage 8 – 32% of Catchment	Stage 8
Catchment 7	Bio Retention Basin 5	Stage 5 – 36% of Catchment Stage 6 – 64% of Catchment	Stage 6
Catchment 8	Detention Tank 1	CF Stage – 45% of Catchment Stage 3 – 13.5% of Catchment Stage 4 – 9.5% of Catchment Stage 10 – 32% of Catchment	Stage 10
Catchment 9	Detention Tank 2	Stage 7 – 59% of Catchment Stage 8 – 32.5% of Catchment Stage 9 – 8.5% of Catchment	Stage 8

As detailed in the table above, it is not until the latter stages of the development that the majority of stormwater management devices have a contributing catchment that is at least 80% permanently stabilised.

To ensure that the development is able to meet it's water quality and quantity discharge requirements at all times throughout the staged construction of the development, it is recommended that the following be undertaken:

- Where a catchment area contributing to a stormwater management device has not reached 80% permanent stabilisation, only areas that are permanently stabilised should be discharged to the stormwater management device. Other areas that are not yet completed should have stormwater runoff directed to temporary sediment basins to avoid discharge to permanent devices. This can be achieved through stormwater cutoff drains, erosion and sedimentation control devices and management of infrastructure e.g. sealing of upstream ends of partially completed stormwater lines
- Erosion and sedimentation control devices should be installed and maintained in all areas that have not reached 80% permanent stabilisation, as previously outlined in Section 4 above
- As is industry standard, future stages of the estate that have had bulk earthworks completed but are not planned for immediate civil or building works, should have some form of surface treatment applied to ensure stabilisation of the surface prior to construction works commencing e.g. application of polymer soil binder, hydromulch or topsoil and seed.

Should for any reason development of the estate cease for a period of greater than 6 months, it is recommended that undeveloped areas be permanently stabilised with topsoil and seed and basins be completed in line with the ultimate design.

6.0 CONCLUSION

This Staged Soil and Water Management Plan has been developed by MDE for the proposed 216 lot Manufactured Housing Estate at 110-120 Carrs Drive Yamba.

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

The development proposal for the project includes a Stormwater Management Plan that details the required stormwater management and treatment devices required to ensure compliance of the completed development with the required stormwater quality and quantity discharge rates.

Staging of the delivery of the estate does not necessarily coincide with the stormwater catchment areas contributing to each of the proposed 7 stormwater management devices. It is therefor necessary that the site be managed to ensure that (a) stormwater management devices are not overloaded with sediment and (b) required quality and quantity discharge rates are not exceeded.

This will be achieved by implementing the stormwater management strategies for the various stages of the development according to their level of completion, as outlined in Section 4 above. The completion of the ultimate stormwater management device, including bio retention filter media and planting for bio retention basins, is to be undertaken once 80% of the contributing catchment has been fully stabilised in line with the table under Section 5 of this report.

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

APPENDIX A – DA Stormwater Management Plan and Stormwater Design Plans

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

STORMWATER MANAGEMENT PLAN

PROPOSED MANUFACTURED HOUSING ESTATE

LOT 2 DP 733507 & LOT 32 DP 1280863

110-120 CARRS DRIVE

YAMBA NSW 2464

FOR:

CLIFTON YAMBA LAND PTY LTD

JANUARY 2024

MANAGE DESIGN ENGINEER

Development & Construction Management ▪ Civil Design

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

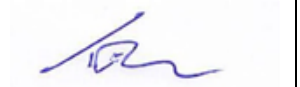
Manage-Design-Engineer DOCUMENT CONTROL

PROJECT: Yamba MHE – 110 to 120 Carrs Drive Yamba

CLIENT: Clifton Yamba Land Pty Ltd

AUTHOR: Andrew Smith

REVISION HISTORY

REVISION	DATE	CHECKED BY	
		NAME	SIGNATURE
0	25/8/2022	Troy Ryden	
1	31/01/2024	Troy Ryden	

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

TABLE OF CONTENTS

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

1 INTRODUCTION

Manage-Design-Engineer Pty Ltd have been engaged to undertake a Stormwater Management Plan (SWMP) for a proposed 216 dwelling Manufactured Housing Estate at Lot 2 DP 733507 and Lot 32 DP 128063, also known as 110-120 Carrs Drive Yamba.

This report summarises the stormwater management strategy for the proposed development and should be read in conjunction with the Statement of Environmental Effects and the associated design drawings.

2 SITE DESCRIPTION

The proposed development site covers a total area of approximately 17.7Ha, with a development footprint of approximately 10Ha over the eastern portion of the property. The developable area of the site was historically cleared for agricultural purposes but has been revegetated with regrowth over roughly the past decade. A copy of the proposed site Masterplan and Stormwater Management Drawings have been provided in **Appendix A**.

The existing site is relatively flat with a gentle fall to the west toward Oyster Channel and the South toward a second order stream that runs parallel to the Southern boundary of the site. The property is prone to flooding and as such the proposed development will involve filling of the site to raise levels in the order of 1.8m-3.2m.

Geotech Investigations Pty Ltd were engaged during the DA design phase to undertake a Preliminary Geotechnical Investigation and report, which is included as **Appendix B**. The geotechnical investigation found that the 1:100,000 Series Geological Survey of NSW for the Grafton Area shows the site to be located over quaternary aged Pleistocene tidal-delta Plains, which typically comprise ‘silt, sands, shells, indurated sands and minor clays’. Bore logs produced during the on site investigation show that the site contains up to 500mm of topsoil and firm to stiff clay material over sand of varying degrees of compaction. Furthermore groundwater was encountered at depths of 0.5 to 1.2m below existing surface levels. It is noted that the site works were undertaken following a period of extremely wet weather which may have elevated groundwater levels at the time of the works.

The below aerial shows the location of the subject site.

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

Image 1 - Site Locality

3 PROPOSED DEVELOPMENT

The proposed development is for a 216 dwelling Manufactured Housing Estate as described in the Statement of Environmental Effects. The following development characteristics are relevant to the site stormwater management:

- The development footprint will be filled to raise site levels in order to achieve minimum finished floor levels required for dwellings of RL 3.5m AHD
- The developed portion of the site will grade to the South and West
- There is an existing second order stream running from East to West through the site. This second order stream will be retained within a 40m riparian corridor i.e. 20m corridor either side of the top of stream bank.
- The development will incorporate a conventional pit and pipe drainage system for the conveyance of stormwater within the site.
- The maximum site coverage for each dwelling site under the Local Government Regulation is 2/3 of the dwelling lot area
- The internal road typically comprises a 6m wide concrete pavement with 1.5m wide landscaped verges within a 9m wide road reserve

The design criteria for stormwater management are outlined in the Clarence Valley Council Residential Zones Development Control Plan 2011 Part H – Sustainable Water Controls and Council's 'Draft Guidelines In Preparing MUSIC Model V6' document.

The following table summarises the requirements for treatment of stormwater runoff and the post development water quality targets:

CONTAMINANT	POST DEVELOPMENT REDUCTION TARGET
Gross Pollutants (>5mm)	80% of average annual load retained
Total Phosphorus	65% of average annual load retained
Total Nitrogen	50% of annual load retained
Total Suspended Solids	85% of annual load retained

Table H1 of the DCP states that stormwater runoff volumes and frequency is to be reduced or maintained to the pre development volumes and frequency through application of harvesting, retention, infiltration and detention as appropriate. Due to the size and nature of the proposed development, the requirements of section 12.02 of the NRLG Handbook of Stormwater Drainage Design are also applicable. Specifically on site detention is to demonstrate the required reduction in post development runoff for the 5, 10, 20, 50 and 100 year ARI events through DRAINS modelling.

4 STORMWATER MANAGEMENT STRATEGY

4.1 OVERVIEW

The proposed development requires filling of the site to a height of approximately 1.8-3.2m above the existing natural surface level, corresponding with final dwelling site bulk earthowrks finished surface levels of between RL3.5m to RL4.1m. The requirement to fill provides an opportunity to effectively control the grade of the finished surface and efficiently manage flows within the site.

Table 3.1 of the NRLG Handbook of Stormwater Drainage Design requires minor systems to be designed for the 1 in 5 year rainfall event and the 1 in 100 year event for the major system. A conventional stormwater pit and pipe system drainage network will be provided to convey minor system flows up to the 1 in 5 year event with larger flows, up to the 1 in 100 year event, conveyed via overland flow paths contained within the V profile concrete pavements. All flows will be directed to a number of stormwater bio basins and buried infiltration tanks (Atlantis Flo Tank or equivalent) situated at the southern and western extents of the development. All of these detention and treatment devices discharge via a controlled outlet to the existing second order stream location along the Southern boundary of the site.

Bio basins and buried infiltration tanks positioned adjacent the existing second order stream will be located in the outer 50% of the dedicated riparian corridor. Use of this area for stormwater detention is permissible under a controlled activity approval as outlined in the Department of Primary Industries Guideline for Riparian Corridors on Waterfront Land (refer to **Appendix C**).

The basins and infiltration tanks will both serve a dual purpose of providing stormwater detention and treatment functions. Open basins will incorporate both a low flow piped outlet arrangement as well as a high flow weir to limit post development flows to the pre developed rates. Buried infiltration tanks will be provided with both a low and high flow outlet pipe, which again have been designed to achieve pre development discharge rates.

Treatment of stormwater runoff will occur in both the open basins and buried infiltration tanks through the provision of an extended stormwater detention zone below the invert level of the low flow outlet pipes. The extended detention zone allows stormwater to temporarily pond within the basin or infiltration tank and subsequently permeate down through filter media into underlying sandy soils. The bioretention zone within the basins will be vegetated to assist in nutrient removal. The existing sandy soil profile that has been identified at this site during the Geotechnical Investigation is ideal for the above arrangement and will allow effective infiltration of stormwater from the basins and buried tanks into the underlying soil profile and ultimately the water table. Reference is made to the bore logs provided in the Geotechnical Report in **Appendix B** which details fine sand encountered typically at 300-500mm below the existing natural surface.

To ensure effective infiltration is achieved, the area below basins and buried tanks will be prepared by removing any topsoil or organic material down to a depth where the naturally occurring fine sand is encountered. Clean drainage sand will then be placed up to the underside of the basins and tanks to provide a suitable drainage path for detained stormwater to permeate into the groundwater layer.

4.2 MODELLING

The proposed land use changes and associated increase in impervious areas will lead to increases in the frequency, volume and flowrate of stormwater runoff as well as higher loads of water borne contaminants. Conceptual models were developed using DRAINS and MUSIC software to determine the required size and most efficient configuration of basins and buried infiltration tanks to ensure the required quality and quantity targets are achieved.

In the post developed scenario, the development consists of 9 catchment areas. These are summarised in the table below and documented in the Stormwater Catchment plan included in **Appendix A.**

POST DEVELOPED CATCHMENT	AREA (Ha)
Catchment 1 (Basin 1)	0.4114
Catchment 2 (Basin 2)	0.1609
Catchment 3 (Basin 3/4)	0.7037
Catchment 4 (Basin 4)	1.4184
Catchment 5 (Basin 5)	0.9035
Catchment 6 (Basin 5)	0.7579
Catchment 7 (Basin 5)	0.8544
Catchment 8 (Tank 1)	1.4926
Catchment 9 (Tank 2)	1.3655
	8.07

Table 4.1 – Catchment Area Summary

The proposed development site is currently vegetated having previously been used as grazing land. It has therefor been assumed that the pre developed site is 100% pervious.

Post development, the site will contain a series of concrete roads and dwellings that will reduce the total pervious area while increasing the impervious area. Under the Local Government Regulation 2005 (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings), the maximum site coverage for each dwelling site is 2/3 of the site area. Similarly, the road network

consists of a 6m wide pavement with a 1.5m vegetated verge on each side of the pavement resulting in an impervious area of 2/3 of the total road reserve. It has therefor been assumed that each catchment, regardless of whether it contains roads, dwelling lots or a combination of both will be 70% impervious and 30% pervious.

4.2.1 STORMWATER DETENTION – DRAINS MODELLING

A DRAINS model was developed to design the size and outlet configuration of basins and buried tanks to achieve the required on site detention. Schematics and a summary of the results from the DRAINS model are included in **Appendix D**. Details of the size and outlet configuration of each detention basin and tank is presented below:

CATCHMENT	TANK / BASIN	Catchment Area (Ha)	1% AEP STORAGE VOLUME (m3)	Depth to Weir (m)	Depth to Top of Bank (m)	Low Flow Outlet Orifice Diamater (mm)	Extended Detention Depth	High Flow Outlet
1	BIO-BASIN 1	0.4114	134	0.9	1.2	250	400	Weir
2	BIO-BASIN 2	0.1609	44	0.9	1.2	175	400	Weir
3 & 4	BIO-BASIN 3/4	2.1221	506	0.9	1.2	Triple 350	400	Weir
5, 6 & 7	BIO-BASIN 5	2.5158	681	0.9	1.2	Triple 375	400	Weir
8	OSD TANK 1	1.4926	311	NA	NA	400	100	430mm dia Orifice
9	OSD TANK 2	1.3655	305	NA	NA	350	100	430mm dia Orifice

Table 4.2 – Basin and Tank Geometry

Note that the volumes presented above for the 1% AEP Storage Volume for basins relates to the volume of each basin below the high flow weir.

The peak flows for the pre development and post development scenarios are presented in the following table. These results demonstrate that an adequate level of stormwater flowrate attenuation is achieved.

	DESIGN STORM EVENT (ARI)	5	10	20	50	100
CATCHMENT	**BASIN / TANK**					
1	BIO-BASIN 1	0.0700	0.0750	0.0830	0.1440	0.1510
2	BIO-BASIN 2	0.0320	0.0340	0.0370	0.0440	0.0610
3 & 4	BIO-BASIN 3	0.4300	0.4700	0.5280	0.6890	0.8390
5, 6 & 7	BIO-BASIN 4	0.4930	0.5400	0.6000	0.7830	0.9450
8	OSD TANK 1	0.2800	0.3080	0.3920	0.5100	0.5930
9	OSD TANK 2	0.2260	0.2730	0.3640	0.4730	0.5400
TOTAL POST DEVELOPED FLOWRATE (m3/s)		**1.531**	**1.7**	**2.004**	**2.613**	**3.129**
TOTAL PRE DEVELOPED FLOWRATE (m3/s)		**1.56**	**1.91**	**2.27**	**2.8**	**3.24**

Table 4.3 – Peak Flowrates

4.1.1 STORMWATER TREATMENT – MUSIC MODELLING

Both the basins and buried infiltration tanks provide a stormwater treatment function through the provision of an extended detention zone. Stormwater runoff will be retained within this zone and then infiltrate down through filter layers and eventually into the naturally occurring sands and the water table. The following table summarises the dimensions of the Bio Filtration zone and extended detention areas for each treatment device:

CATCHMENT	TANK / BASIN	Catchment Area (Ha)	Bio Filtration Floor Area (m2)	Extended Detention Depth (mm)
1	BIO-BASIN 1	0.411	80	400 (300mm modelled)
2	BIO-BASIN 2	0.161	35	400 (300mm modelled)
3 & 4	BIO-BASIN 3/4	2.122	210	400 (300mm modelled)
5, 6 & 7	BIO-BASIN 5	2.515	274	400 (300mm modelled)
8	OSD TANK 1	1.493	250	100
9	OSD TANK 2	1.365	235	100

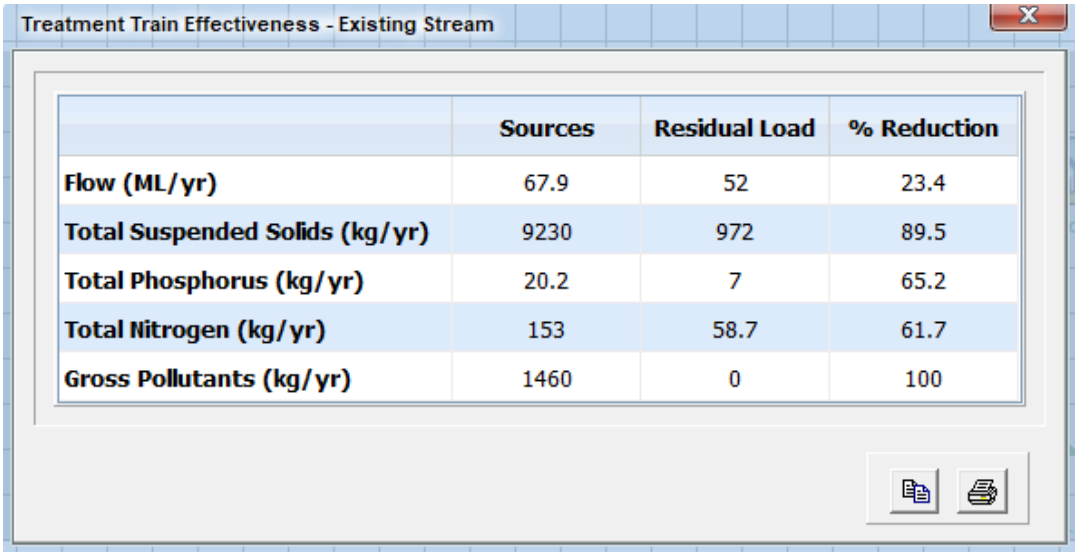
Table 4.4 – Extended Detention Details

Parameters for the development of the MUSIC model have been input in accordance with Clarence Valley Council's Draft Guideline in Preparing MUSIC Model V6. Note that the basins were modelled with low flow outlet IL's positioned 400mm above the floor of the basin however Council's guidelines stipulate a maximum 300mnm extended detention depth for modelling. The reduced extended detention depth has been adopted in the MUSIC model.

Basins will be vegetated with appropriate native groundcover species to aid in the removal of nutrients from runoff. Buried Atlantis cells will have an impermeable liner to the top and sides of the outer cells and a geofabric liner to the base. The impermeable liner will prevent any ingress of subsurface water and fill material into the cells while the geofabric lining to the base will allow infiltration of the extended detention flows into the existing soil profile. Typical basin and buried tank details are provided in the Civil Engineering drawings.

The design also incorporates proprietary Stormsack pit inserts by SPEL Stormwater (Refer **Appendix F**) for the catchments contributing to buried tanks constructed from Atlantis cells. Pit inserts within the pit and pipe networks have been nominated within roadways for these catchments primarily to allow the capture and removal of gross pollutants and suspended solids prior to runoff reaching the cells. All buried tanks will be provided with clean out pits and inspection Openings to ensure any solids that do enter the system can be removed.

A MUSIC model was developed to quantify the pollutant removal for each device with results summarised in Table 4.4 below and the results, schematic and MUSIC Link Report included as **Appendix E**.



	Sources	Residual Load	% Reduction
Flow (ML/yr)	67.9	52	23.4
Total Suspended Solids (kg/yr)	9230	972	89.5
Total Phosphorus (kg/yr)	20.2	7	65.2
Total Nitrogen (kg/yr)	153	58.7	61.7
Gross Pollutants (kg/yr)	1460	0	100

Table 4.5 MUSIC Model Results

The above results demonstrate that through the combination of buried infiltration tanks, bio basins and pit inserts that the required stormwater quality objectives are met.

5 OPEN CHANNEL & CULVERT DESIGN

5.1 MODEL ASSUMPTIONS

Following submission of a Development Application for the proposed MHE development at 110-120 Carrs Drive, a request for further information was received from Clarence Valley Council on 22 June 2023. Item 23 of the request for further information specifically related to the design and design assumptions for the proposed open drainage channel incorporating the existing second order stream, the existing culvert under Carrs Drive and the proposed new culvert under the development entry road.

A DRAINS models was developed to address the RFI items, with the civil engineering design plans updated to show relevant Q20, Q50 & Q100 flow depths within the drainage channel.

The following assumptions have been made in the development of the models:

- An external catchment area of 16Ha has been incorporated into the model for the area to the east of Carrs Drive that contributes flows to the existing second order stream within the proposed development site

- A time of concentration for this external catchment of 22.7 minutes was calculated in line with Section 4.02.4.a of the NRLG Handbook of Stormwater Drainage Design. The Time of Concentration coefficient used in the model was reduced to 20 minutes.
- The flows generated by the proposed development that contribute to the flows within the drainage channel have been modelled using the post developed flow model used to size the development detention basins. These flows have been modelled to enter the drainage channel in the locations proposed by the Civil Design in line with outlet structure design locations.
- The grade of the existing second order stream has been modelled at 0.15%. Site survey data shows that this channel is extremely flat.
- The profile of the embankment to the north of the drainage channel has been modelled in line with the development earthworks design. The profile to the south has been modelled in line with available survey data which indicates very flat grades of approximately 1.25% grading back to the channel
- It has been assumed that the ultimate finished surface level of Carrs Drive will be a minimum of RL1.7m, consistent with the minimum FSL requirements stipulated by Council for other development approvals within Carrs Drive in order to ensure the centreline of the Carrs Drive pavement is no lower than the 1:20 year ARI Flood Level.

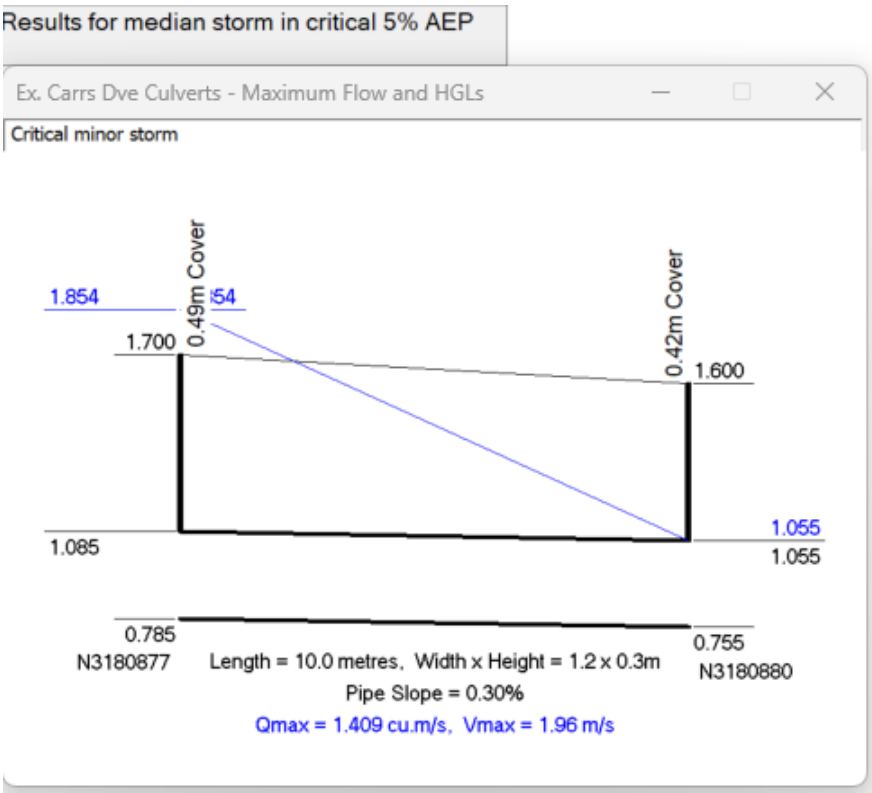
5.2 MODEL RESULTS

DRAINS model results for the culvert and channel designs have been provided in **Appendix G**. The following sections discuss the design requirements and modelling results for each of the two culverts and the open channel within the proposed riparian corridor running from East to West through the development site.

5.2.1 CARRS DRIVE CULVERT

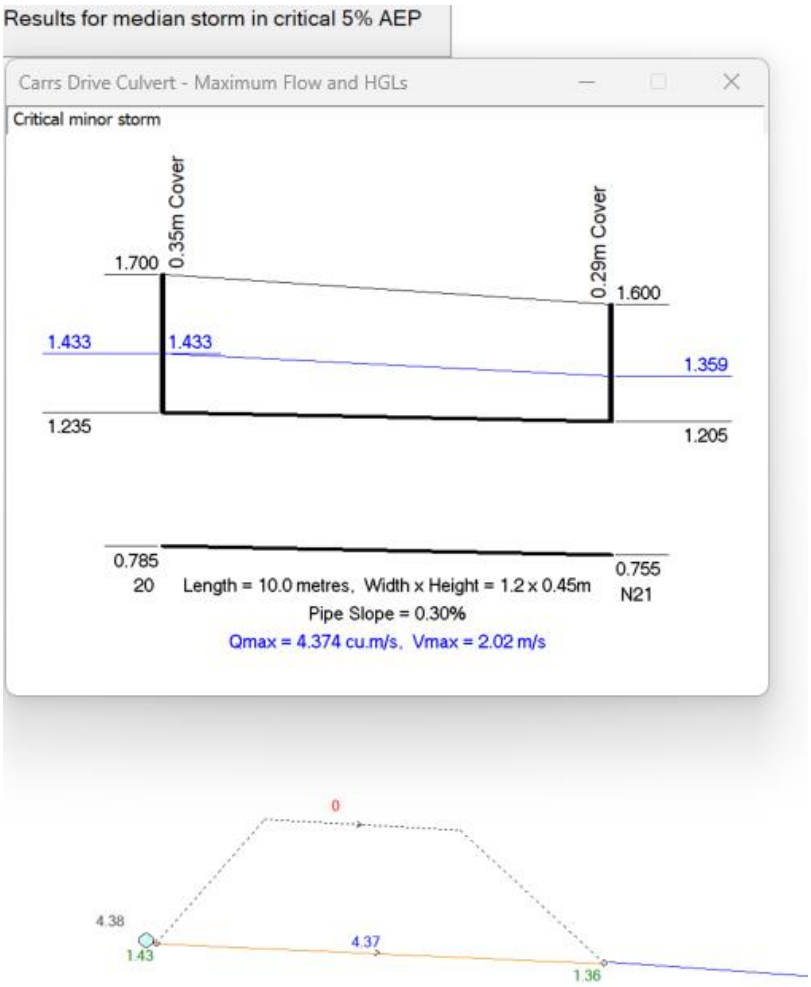
Currently a twin 300mm high x 1200mm wide culvert runs beneath Carrs Drive allowing flows from the eastern side of the road, the external 16Ha catchment, to flow into the second order stream and out to Oyster Channel. Drains modelling of this existing culvert for the 5% AEP (1:20 Year ARI) event shows this culvert to be undersized, with water levels at 1.85m RL at the culvert inlet. This would result in flows overtopping the proposed Carrs Drive pavement (with the centreline set at RL1.7m). The below screen shot shows the results of the analysis with the majority of flows overtopping the Carrs Drive pavement:

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



In the ultimate scenario, a total of 4 culvert cells is required, with each cell 1200mm wide x 450mm high. While this configuration still results in the inlet of the culvert being submerged, water levels reach approximately 1.4m AHD which is roughly 300mm below the nominal level of pavement centreline. It should be noted that no detailed design of Carrs Drive has been undertaken and the nominal centreline level of RL1.7m is a minimum level. It is likely that the detailed design of Carrs Drive will require a higher level to facilitate longitudinal drainage and other design requirements. The results of the DRAINS model analysis of the 4 cell culvert are shown in the screen shot below for the 5% AEP storm event:

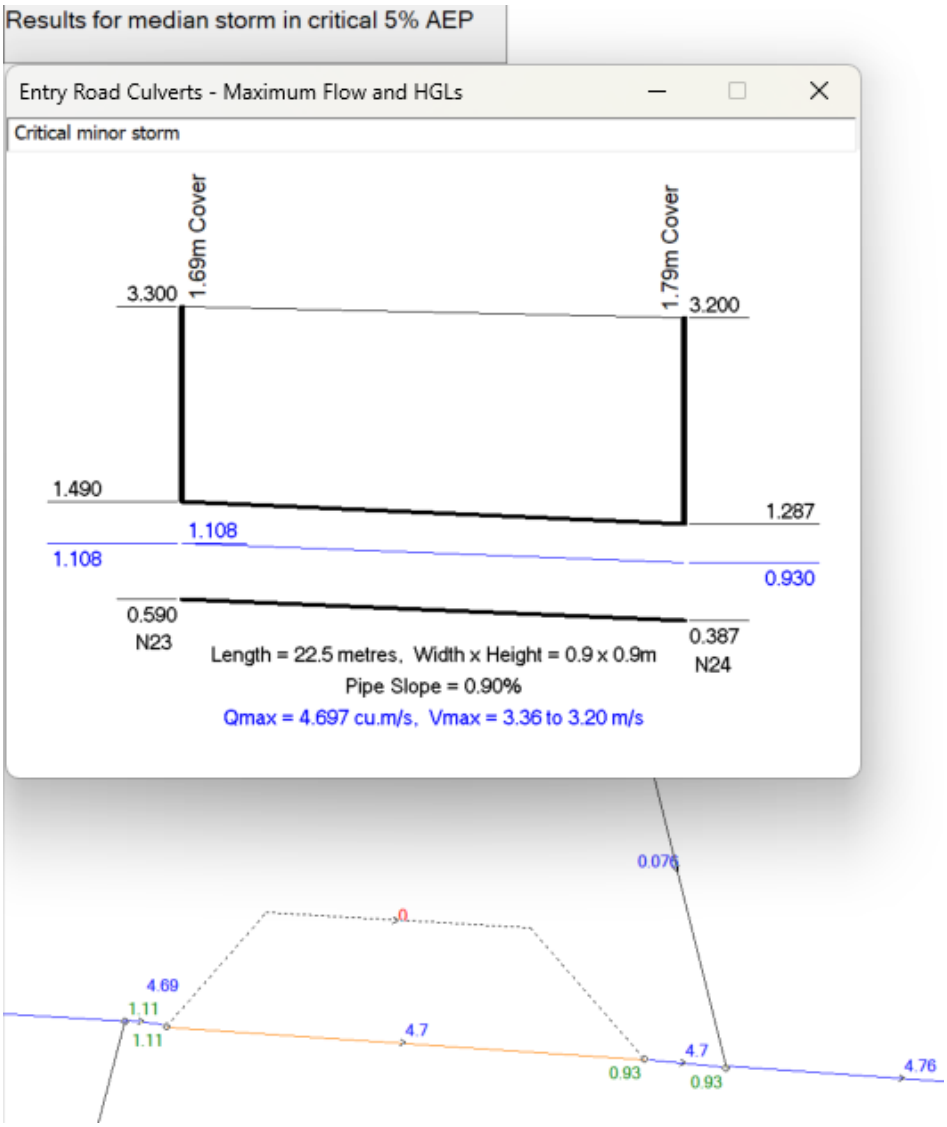
Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



5.2.2 DEVELOPMENT ACCESS ROAD CULVERT

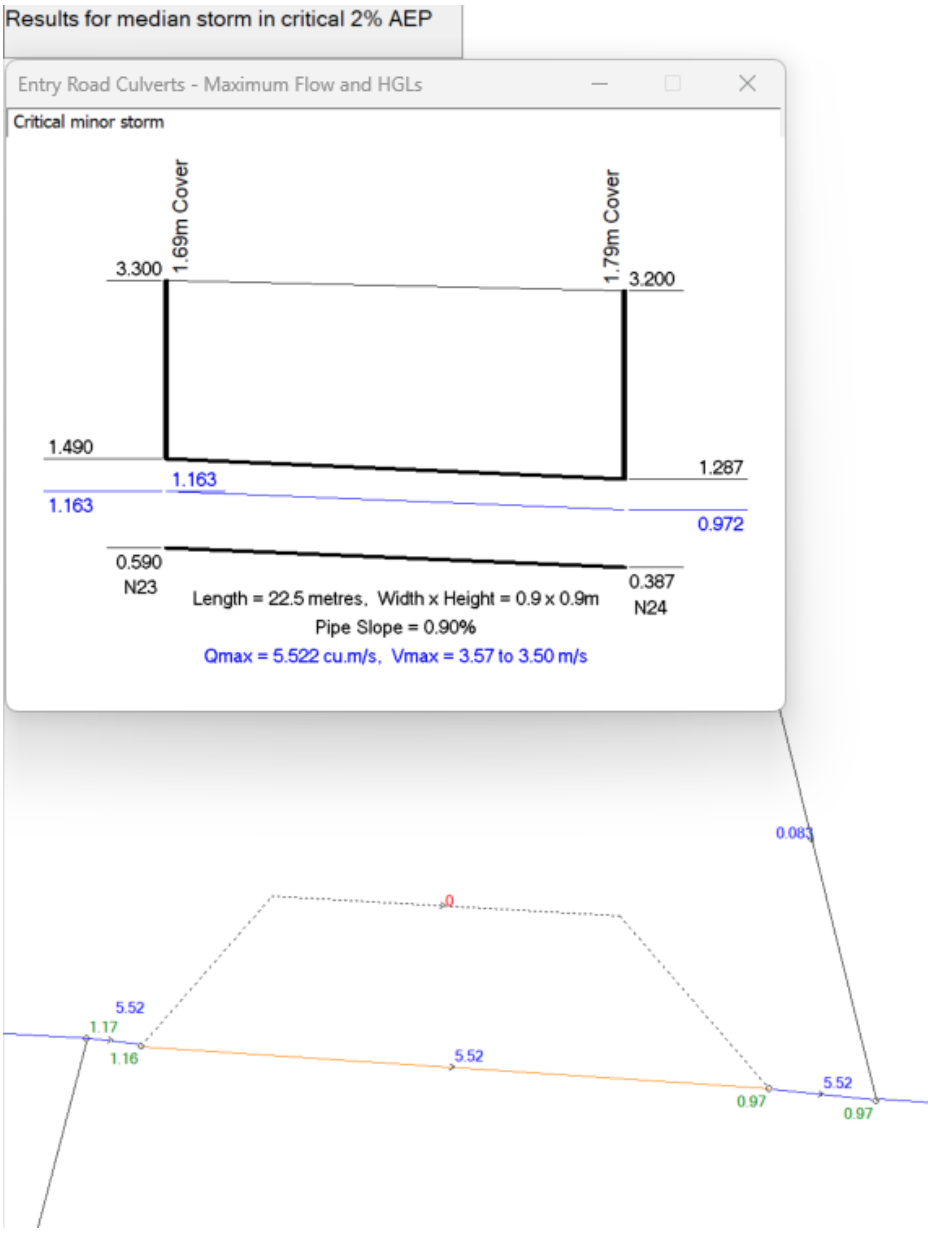
Internally a triple cell 900mm wide x 900mm high culvert configuration is required under the proposed access road to the MHE development. Council's Request for Information item 23 (b) specifically required details on the dpeths and velocities of flows over the access road, if any. Model results presented below show the 5% AEP, 2% AEP and 1% AEP analysis. In all scenarios, the proposed culvert sizes are sufficient to convey flows through the culvert with no overtopping of the entry road. Furthermore, for the 2% AEP event the minimum required freeboard of 300mm to the top of the culvert is achieved.

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

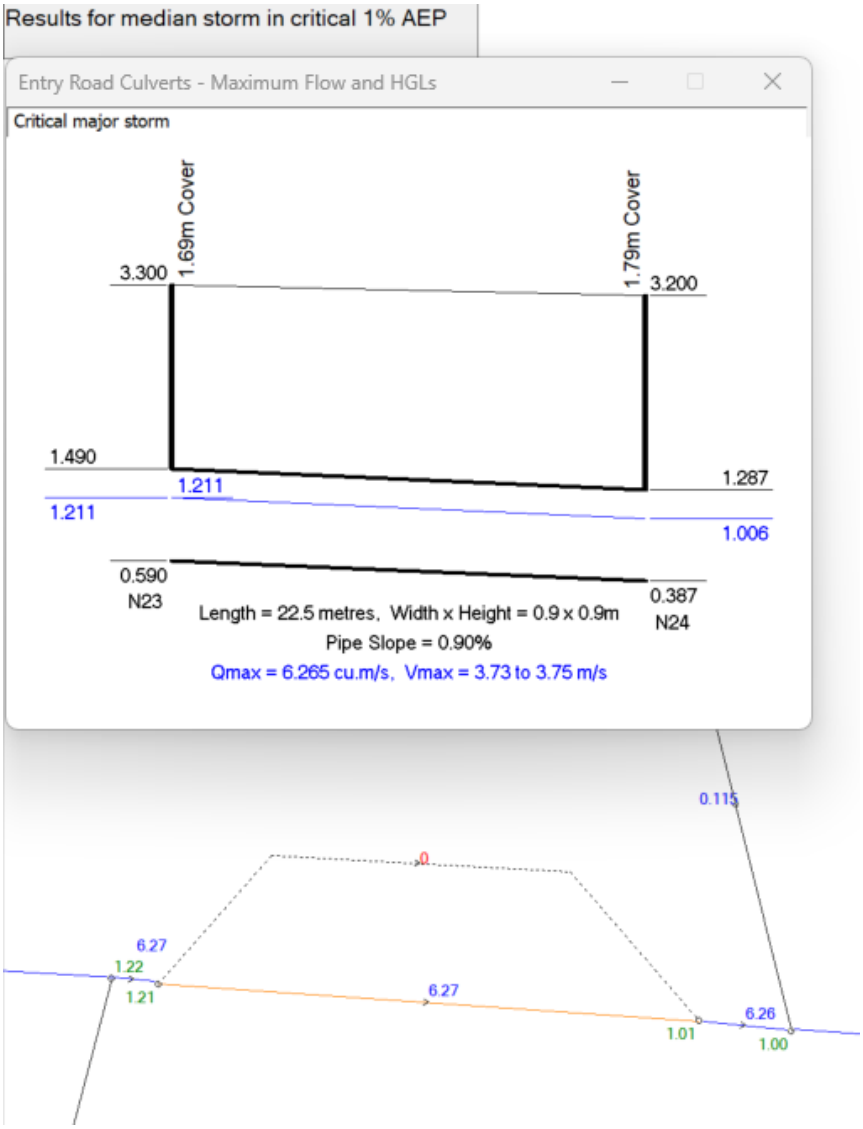


5% AEP Model Results for Internal Culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



2% AEP Model Results for Internal Culvert

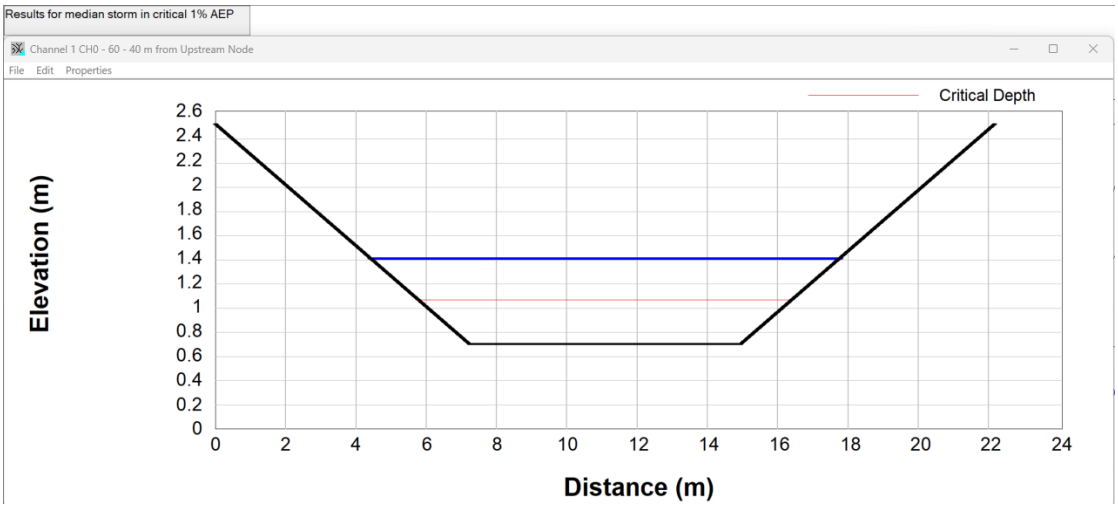


1% AEP Model Results for Internal Culvert

5.2.3 Open Channel Design and Capacity

The proposed development incorporates a pit and pipe stormwater network and stormwater treatment and detention devices that all ultimately discharge to the existing second order stream that runs east to west, generally along the southern boundary of the property. Drawings D31 and D32 of MDE's Civil Engineering DA Civil Engineering Plan set detail the existing profile of the second order stream, which is to be retained, as well as proposed earthworks batters within the 40m wide riparian corridor. The stream and proposed culvert structures have been modelled using DRAINS software to demonstrate the suitability of the proposed channel to convey stormwater flows through the site prior to discharging into Oyster Channel.

Modelling was completed for the Q20 (5% AEP), Q50 (2% AEP) and Q100 (1% AEP) storm events. Model results show that maximum channel flow depths of up to 750mm for the 1% AEP scenario and that these proposed channel profile is sufficiently adequate to convey these flows.



Flow depths at CH40 of the proposed open channel / existing second order stream for the 1% AEP event

Model results are included in Appendix G with the Q20, Q50 and Q100 flow depths nominated on the Open Channel Typical Sections in Drawing D32 of the Civil Engineering plan set, as requested in RFI item 23(b).

6 CONCLUSION

Manage-Design-Engineer Pty Ltd were engaged to undertake a Stormwater Management Plan for the proposed 216 Dwelling MHE Development at 110-120 Carrs Drive Yamba.

Conceptual models were developed using MUSIC and DRAINS software to determine the Bio Retention infrastructure necessary to ensure that the ultimate development meets the required stormwater quantity and quality discharge parameters set out in Clarence Valley Council's Residential Zones Development Control Plan 2011 Part H – Sustainable Water Controls, Council's 'Draft Guidelines In Preparing MUSIC Model V6' document and the Northern Rivers Local Government Handbook of Stormwater Design.

Furthermore a second DRAINS model was developed to confirm the required size and capacity of proposed culverts and open channel that runs from East to West through the development site.

Model results confirm that a total of 5 Bio Retention Basins and 2 buried detention tanks are necessary to meet the quantity and quality discharge parameters. These devices have been detailed in the Civil Engineering drawing set that forms part of the DA package.

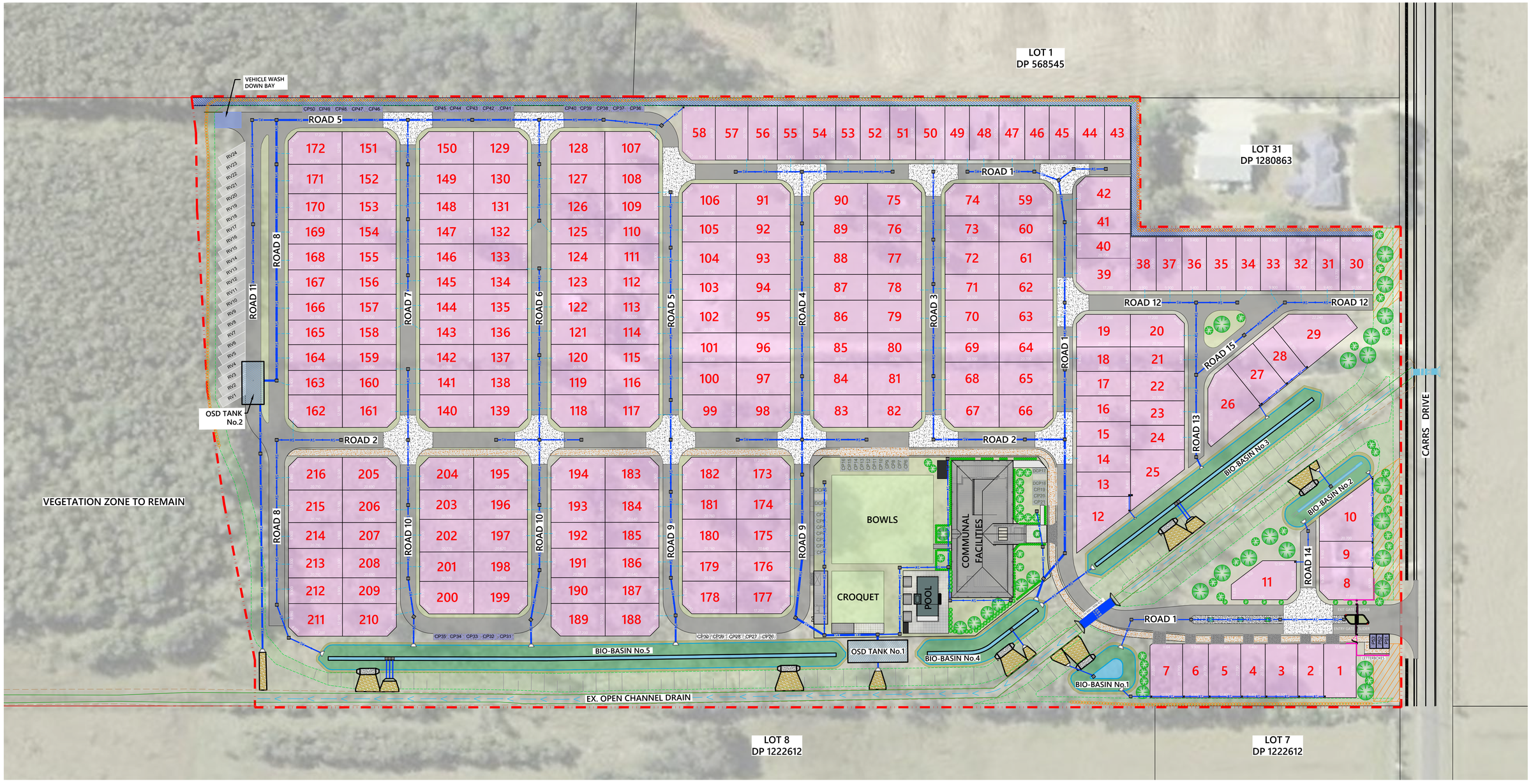
Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

Drains modelling demonstrates that flows are effectively conveyed within the proposed open channel and that culvert structures under Carrs Drive and the proposed development access road are also sized sufficiently to convey these flows.

Andrew Smith
RPEng | RPEQ
Manage-Design-Engineer Pty Ltd

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

APPENDIX A – SITE MASTERPLAN AND STORMWATER MANAGEMENT DRAWINGS



SITE PLAN

SCALE 1:750

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

20 10 0 10 20 30 40
Horizontal Scale 1:750 (A1)
1:1500 (A3)

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: SITE PLAN

DWG No: D02 | SHEET: 02 OF 43 | REV: 1

ARCHITECTURAL INFORMATION FOR CLUB HOUSE
SUPPLIED BY MARK SHAPIRO ARCHITECTS
DRAWING NUMBER DA1002WIP REV 2

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

PLANS TO BE PRINTED IN COLOUR

GENERAL ARRANGEMENT PLAN
SCALE 1:600

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- DESIGN CONTOURS
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- PROPOSED LOW PRESSURE SEWER Ø40mm LINE
- PROPOSED LOW PRESSURE SEWER Ø50mm LINE
- PROPOSED LOW PRESSURE SEWER Ø63mm LINE
- PROPOSED LOW PRESSURE SEWER Ø90mm LINE
- GRAVITY SEWER Ø150mm
- WATERMAIN Ø100mm
- LOW PRESSURE SEWER ISOLATION VALVE
- PROPOSED FLUSHING POINT
- SEWER HOUSE CONNECTION
- LOW PRESSURE SEWER FLOW METER
- LOW PRESSURE SEWER BOUNDARY KIT
- AQUATEC LOW PRESSURE SEWER CHAMBER
- WATER MAIN TEE
- WATER METER
- HEADWALL
- DUAL PILLAR HYDRANT
- SLUICE VALVE
- STORMWATER DRAINAGE PIT
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

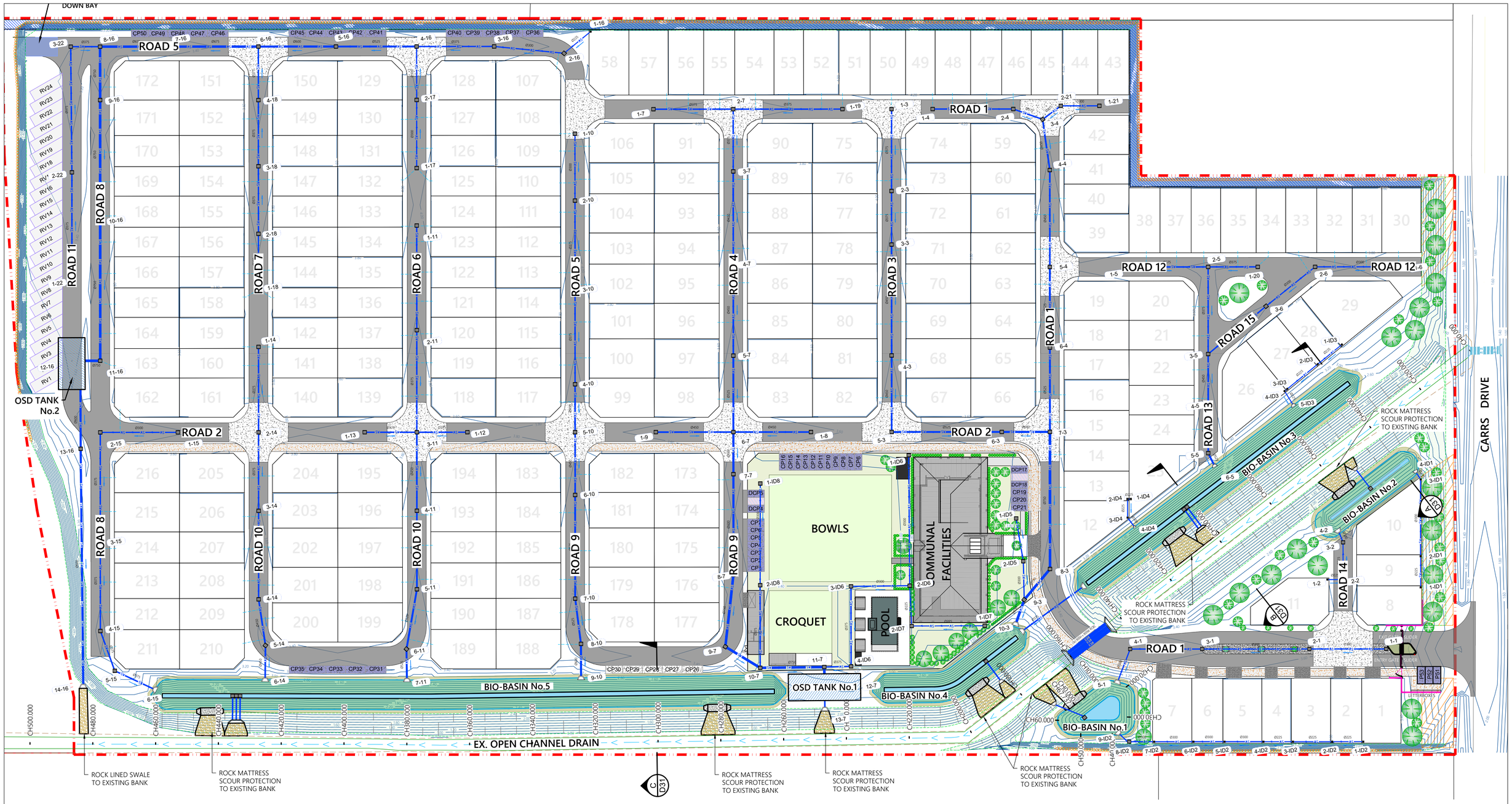
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: ROADWORKS & DRAINAGE PLAN

DWG No: D03 | SHEET: 03 OF 43 | REV: 1



OPEN CHANNEL DETAIL PLAN
SCALE 1:600

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ARCHITECTURAL INFORMATION FOR CLUB HOUSE SUPPLIED BY MARK SHAPIRO ARCHITECTS DRAWING NUMBER DA1002WIP REV 2

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

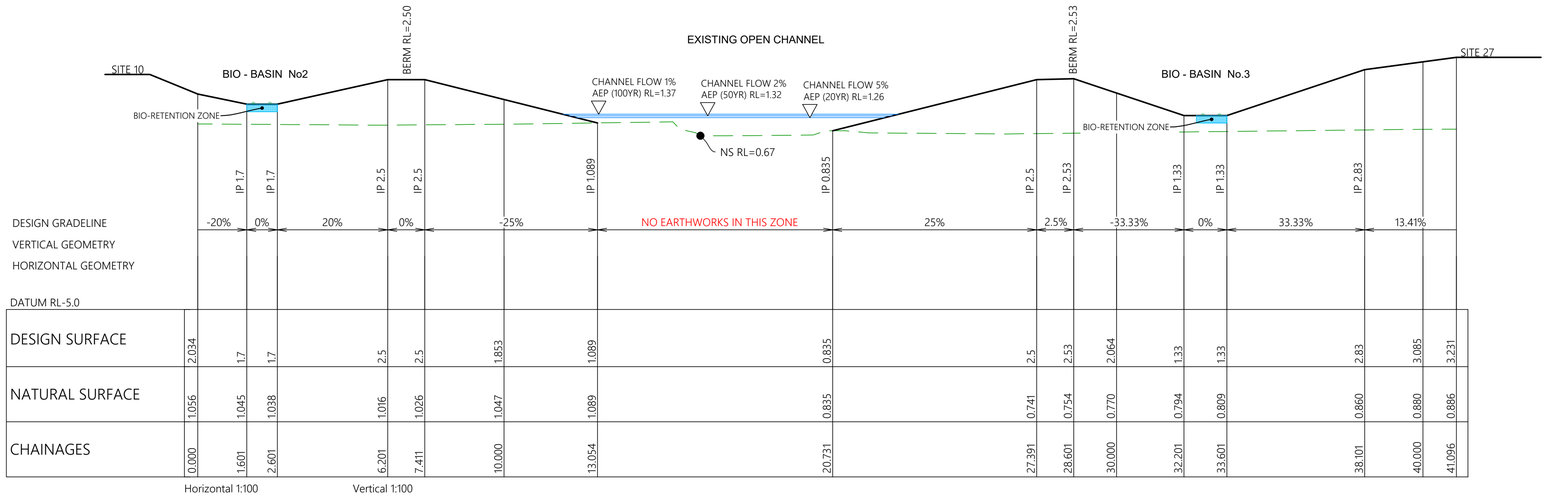
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: OPEN CHANNEL DETAIL PLAN

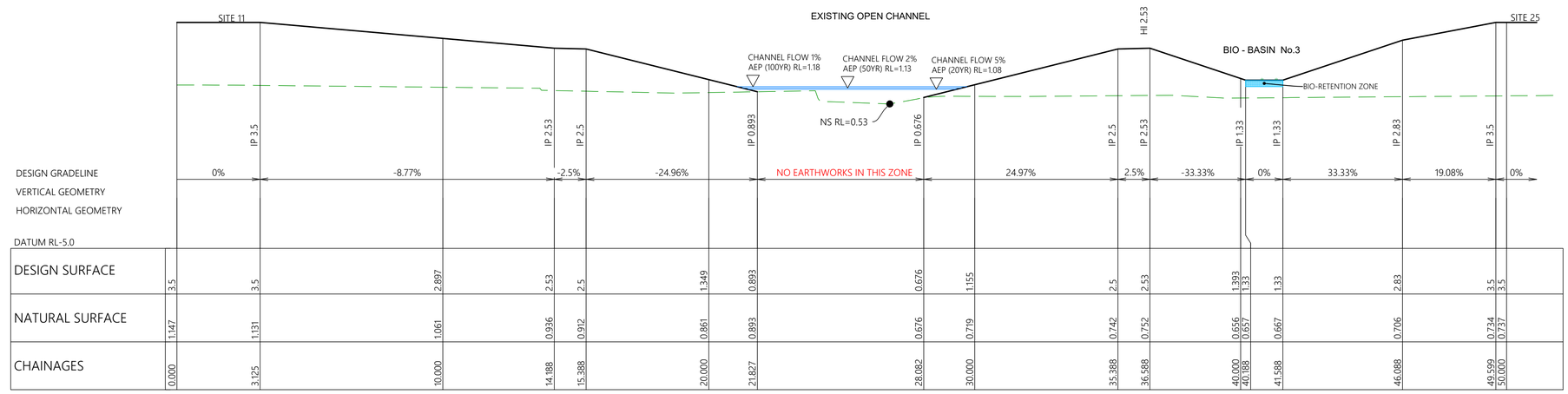
DWG No: D31 | SHEET: 31 OF 43 | REV: 1



NOTE: FOR DETAILED CHANNEL FLOW ANALYSIS REFER TO STORMWATER MANAGEMENT REPORT BY MANAGE DESIGN ENGINEER PTY LTD AND ASSOCIATED DRAINS MODEL DATA

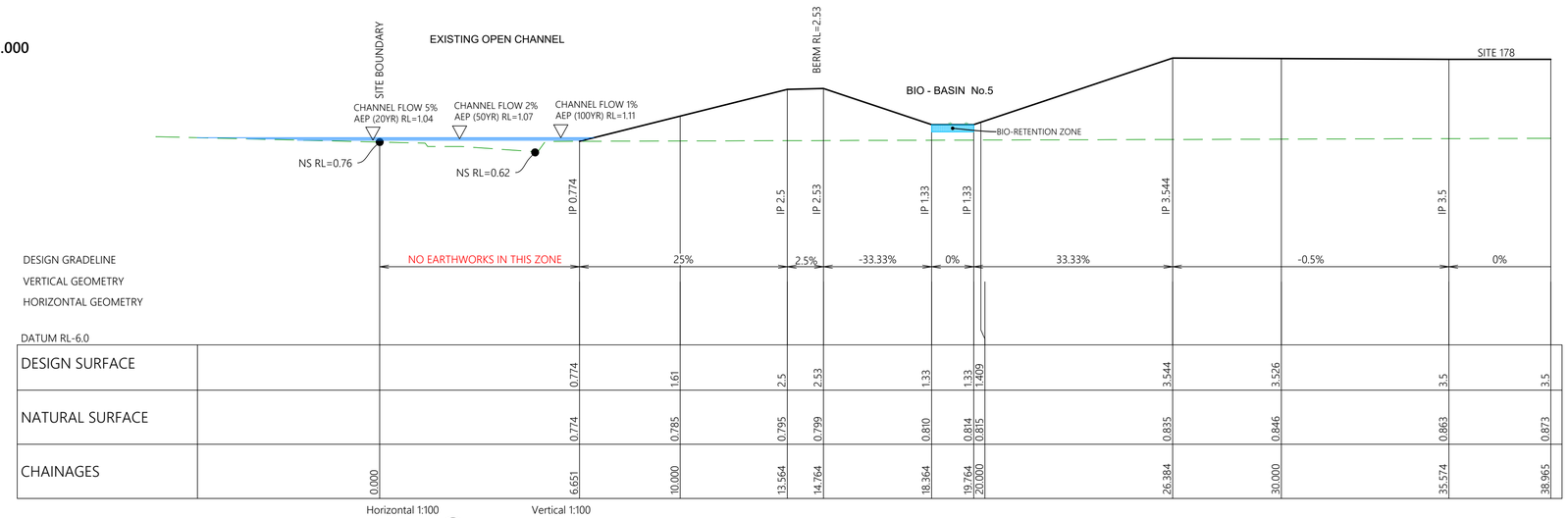
SECTION A / D31

EXISTING OPEN CHANNEL - CH 40.000



SECTION B / D31

EXISTING OPEN CHANNEL - CH 100.000



SECTION C / D31

EXISTING OPEN CHANNEL - CH 300.000

Horizontal Scale 1:100 (A1)
1:200 (A3)

Vertical Scale 1:100 (A1)
1:200 (A3)

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

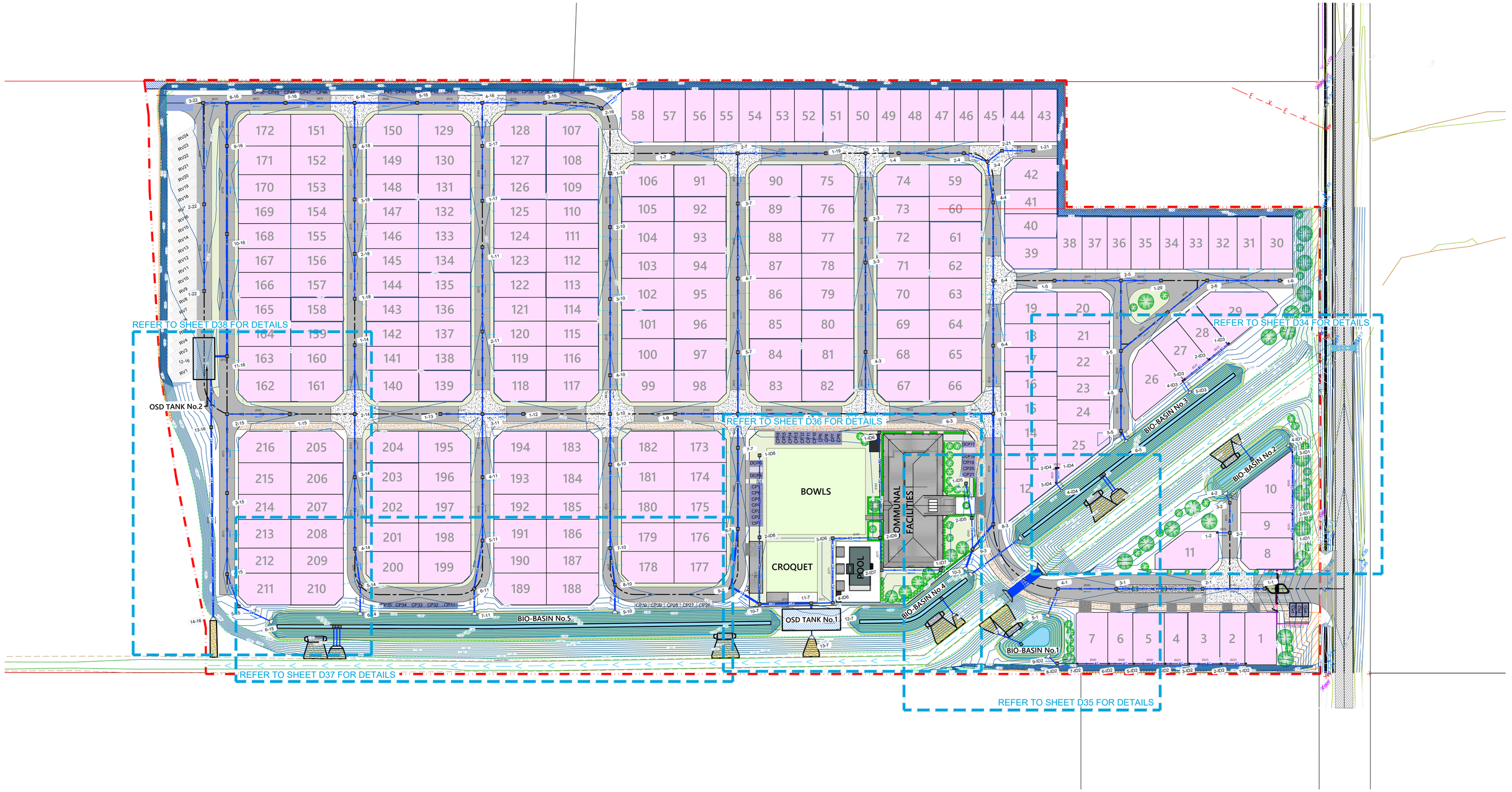
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: OPEN CHANNEL TYPICAL SECTIONS

DWG No: D32 | SHEET: 32 OF 43 | REV: 1



STORMWATER MANAGEMENT PLAN

SCALE 1:750

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ARCHITECTURAL INFORMATION FOR CLUB HOUSE SUPPLIED BY MARK SHAPIRO ARCHITECTS DRAWING NUMBER DA1002WIP REV 2

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

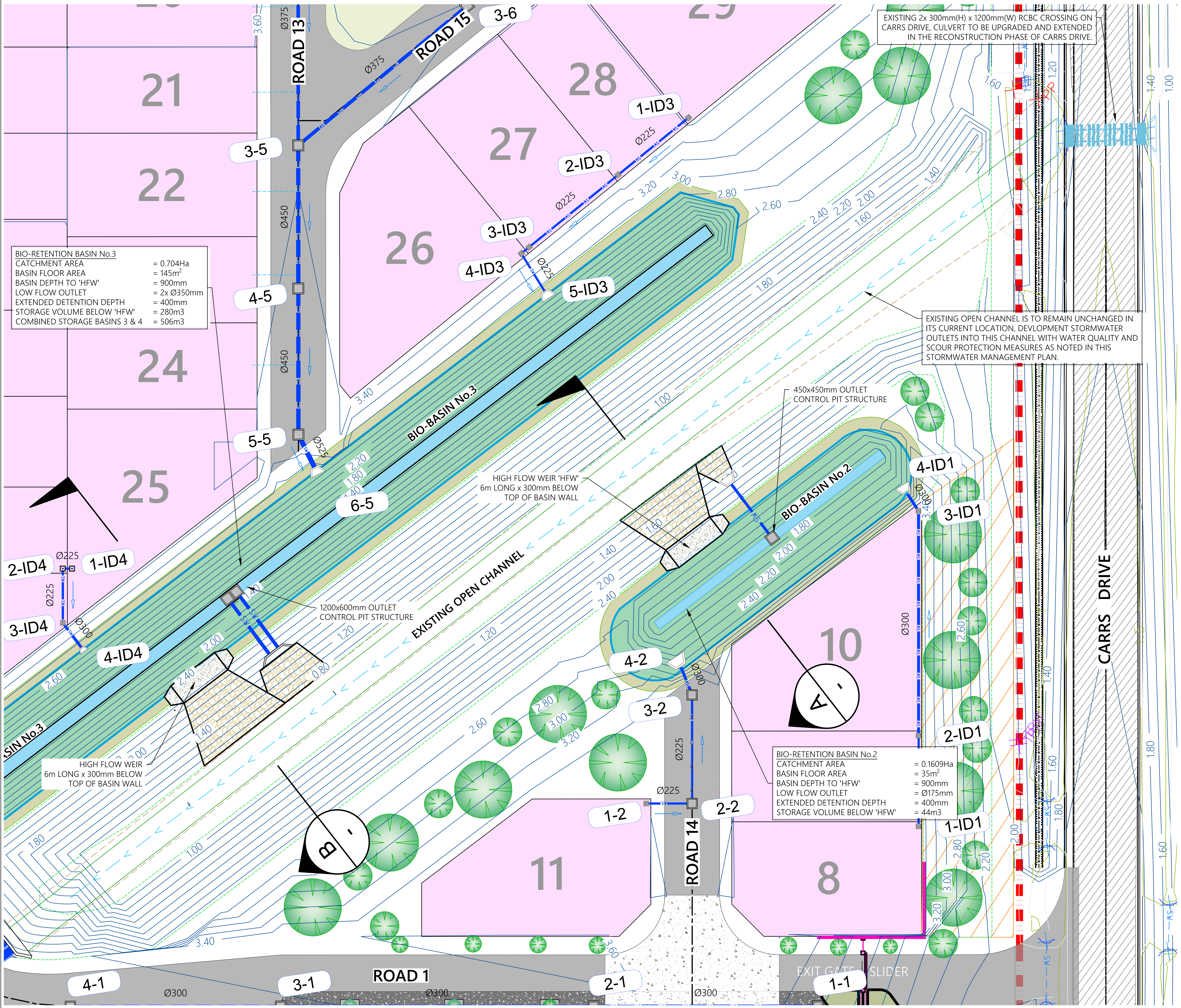
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

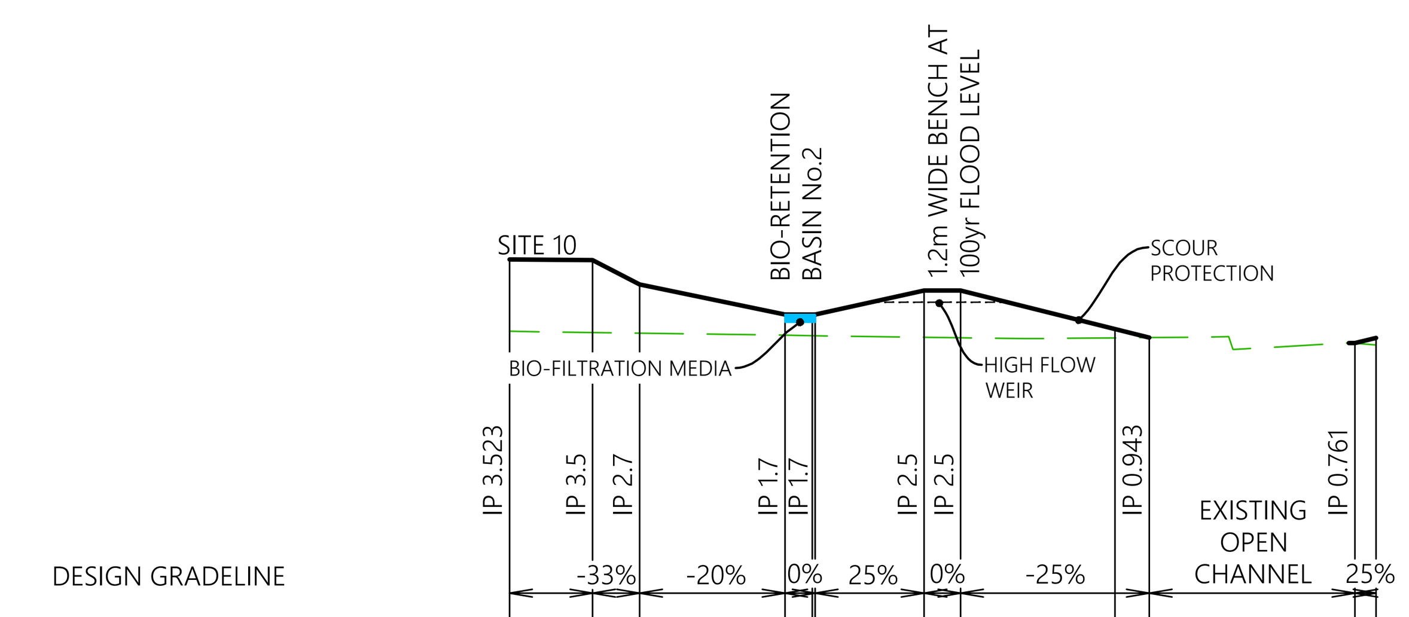
DA CIVIL DRAWING

DRAWING TITLE: STORMWATER MANAGEMENT PLAN

DWG No: D33 | SHEET: 33 OF 43 | REV: 1



Horizontal Scale 1:250 (A1)
1:500 (A3)

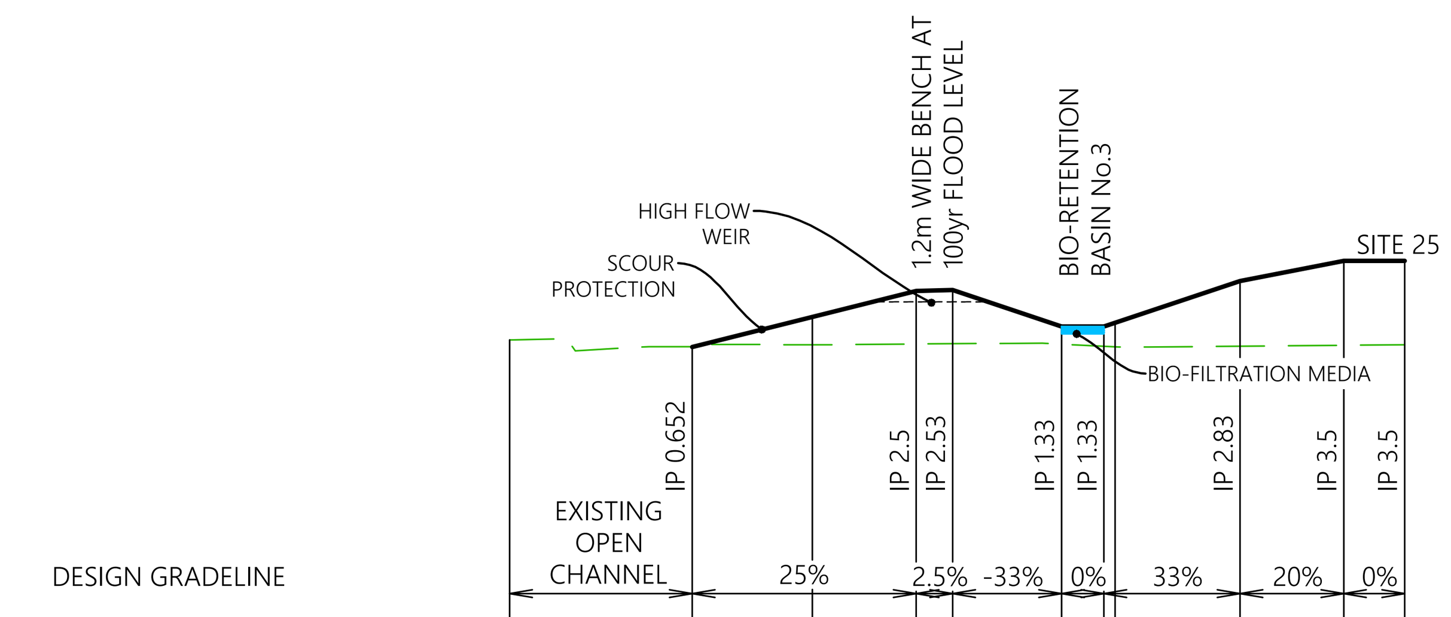


DESIGN GRADELINE
VERTICAL GEOMETRY
HORIZONTAL GEOMETRY
DATUM RL-14.0

CUT / FILL	-2.371	-2.388	-1.611	-0.68	-0.693	-0.694	-1.546	-1.563	-0.294	0	0	-0.237
DESIGN SURFACE	3.523	3.5	2.7	1.7	1.7	1.7	2.5	2.5	1.227	0.943	0.761	0.934
NATURAL SURFACE	1.151	1.112	1.089	1.020	1.007	1.006	0.954	0.937	0.933	0.943	0.761	0.698
CHAINAGES	0.000	2.748	4.299	9.099	10.000	10.099	13.699	14.909	20.000	21.138	27.932	28.626

Horizontal 1:250 Vertical 1:250

SECTION-A (BIO-BASIN No.2)

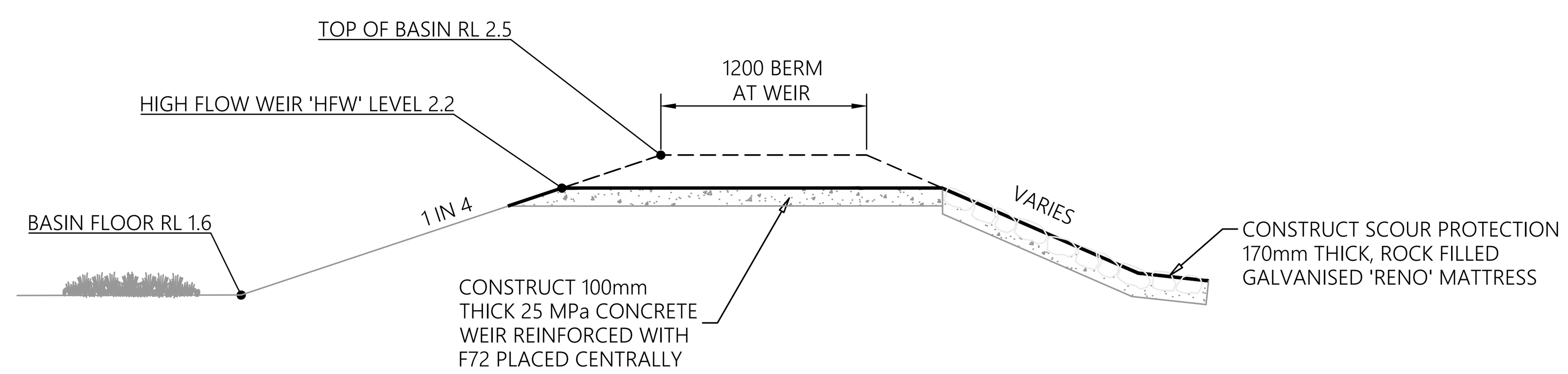


DESIGN GRADELINE
VERTICAL GEOMETRY
HORIZONTAL GEOMETRY
DATUM RL-14.0

CUT / FILL	0	0	-0.92	-1.753	-1.774	-0.584	-0.659	-0.8	-2.154	-2.797	-2.781
DESIGN SURFACE	0.884	0.652	1.642	2.5	2.53	1.33	1.33	1.451	2.83	3.5	3.5
NATURAL SURFACE	0.884	0.652	0.723	0.747	0.756	0.746	0.671	0.651	0.676	0.703	0.719
CHAINAGES	0.000	6.033	10.000	13.436	14.636	18.236	19.636	20.000	24.136	27.556	29.567

Horizontal 1:250 Vertical 1:250

SECTION-B (BIO-BASIN No.3)



TYPICAL - HIGH FLOW WEIR DETAIL
N.T.S

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ARCHITECTURAL INFORMATION FOR CLUB HOUSE SUPPLIED BY MARK SHAPIRO ARCHITECTS DRAWING NUMBER DA1002WIP REV 2

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED:	T.RYDEN	DATE:	JAN 2024
DRAWN:	A.SCHMID	SCALE:	AS SHOWN
SURVEYING:	MACRO SURVEYING	SHEET SIZE:	A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT
CLIFTON YAMBA LAND PTY LTD

TITLE
110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

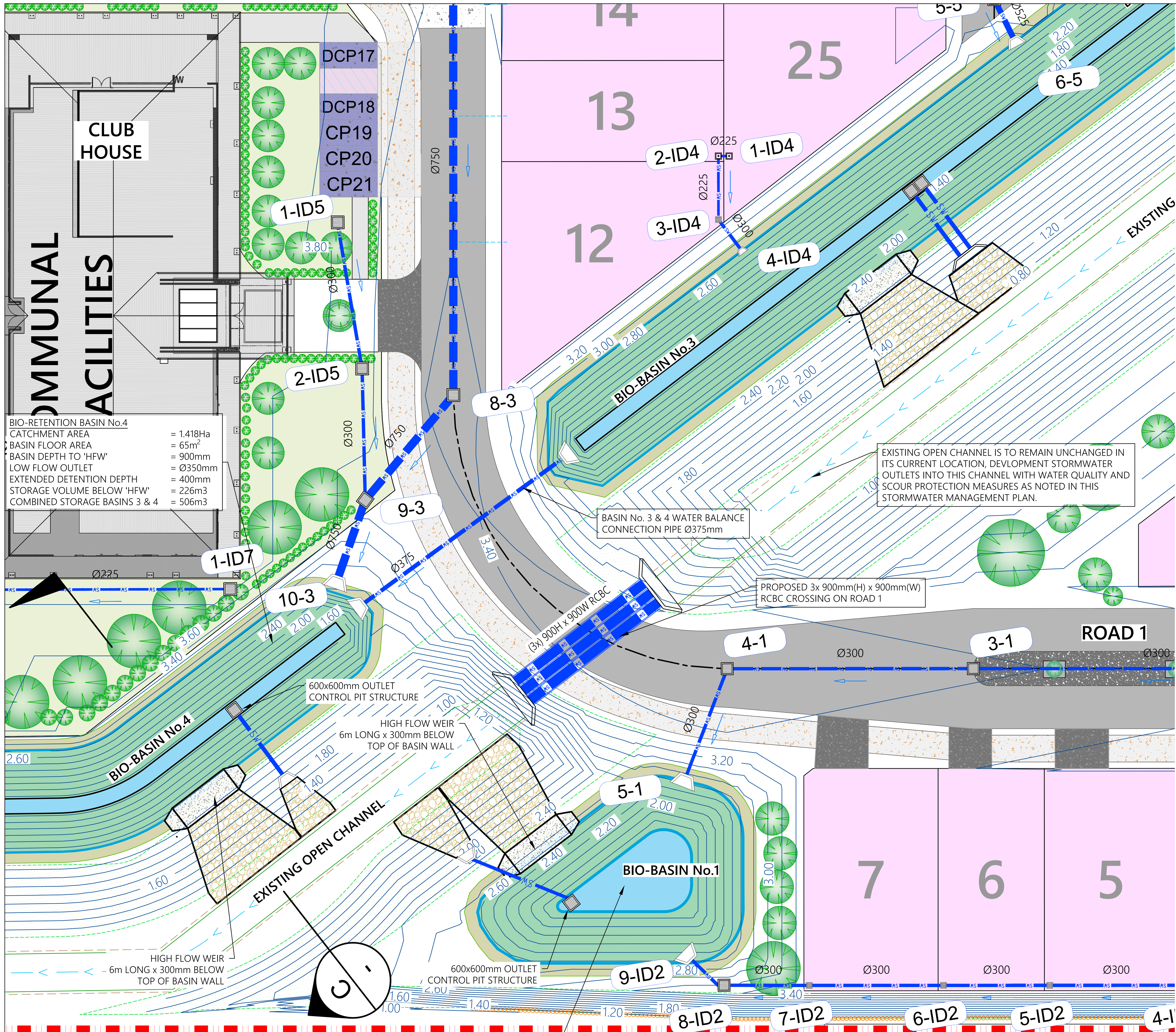
CLIFTON YAMBA

PROJECT
PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE:
STORMWATER MANAGEMENT PLAN - SHEET 1

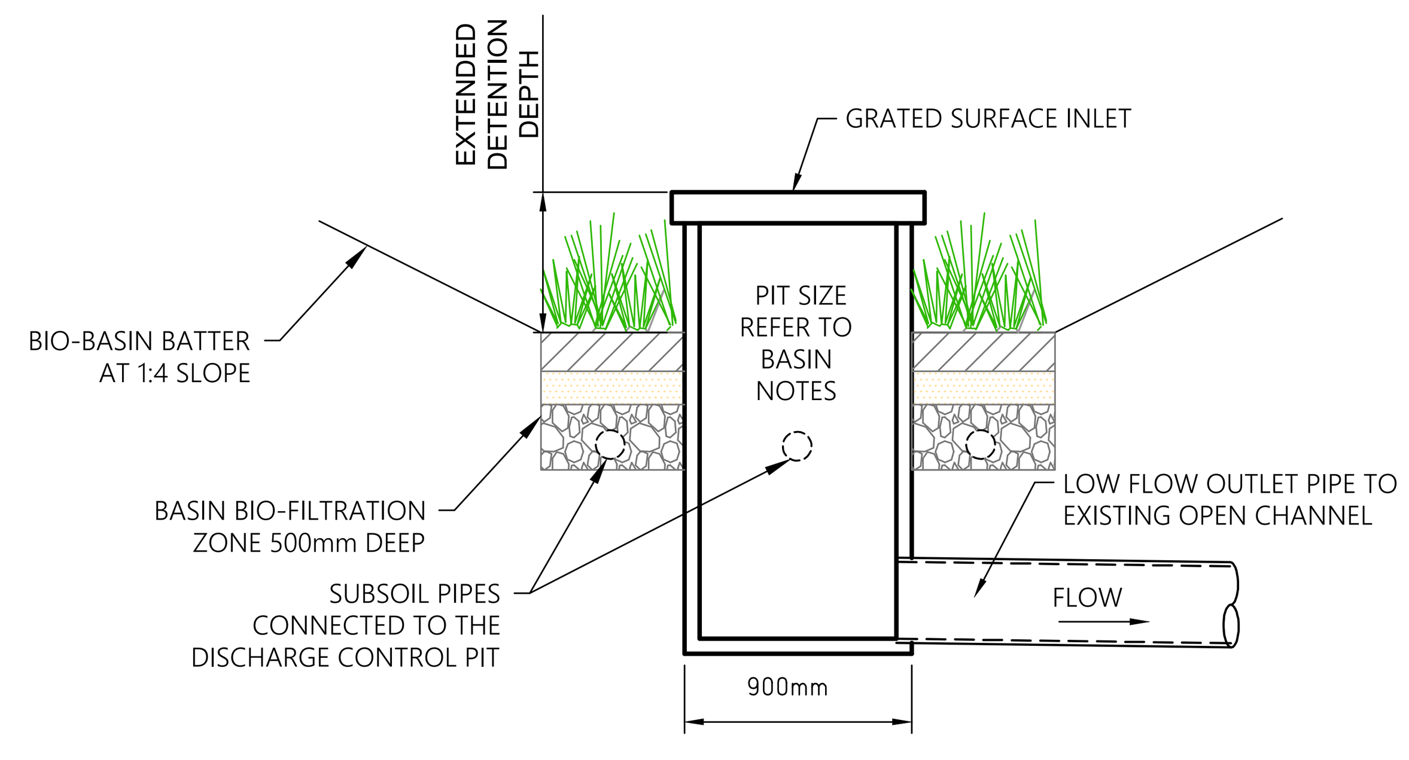
DWG No: D34 SHEET: 34 OF 43 REV: 1



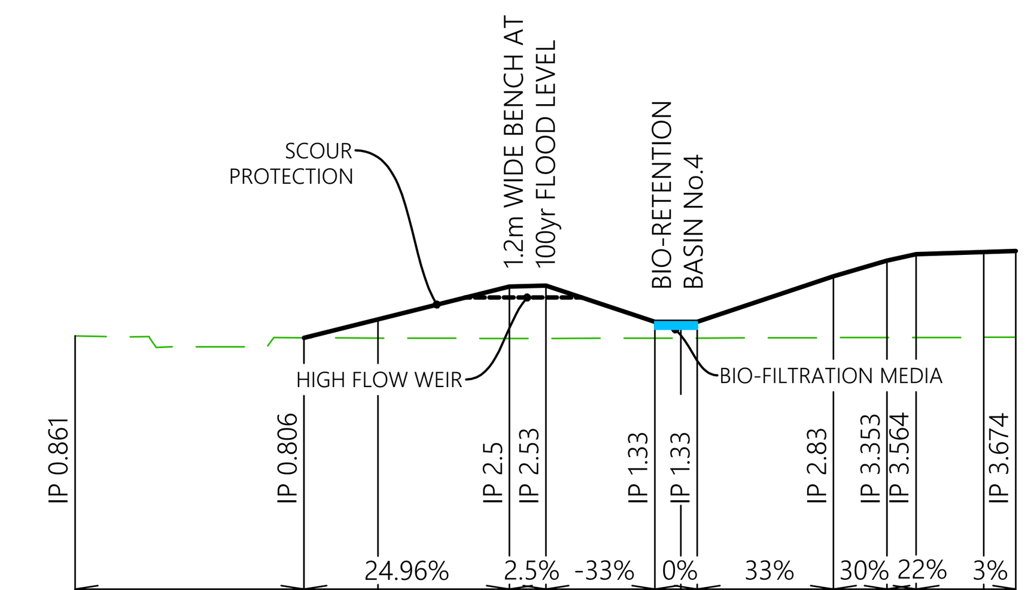
BIO-RETENTION BASIN No.1

CATCHMENT AREA	= 0.411Ha
BASIN FLOOR AREA	= 80m²
BASIN DEPTH TO 'HFW'	= 900mm
LOW FLOW OUTLET	= Ø300mm
EXTENDED DETENTION DEPTH	= 400mm
STORAGE VOLUME BELOW 'HFW'	= 134m3

Horizontal Scale 1:250 (A1)
1:500 (A3)



TYPICAL - BIO-RETENTION DISCHARGE CONTROL PIT
N.T.S



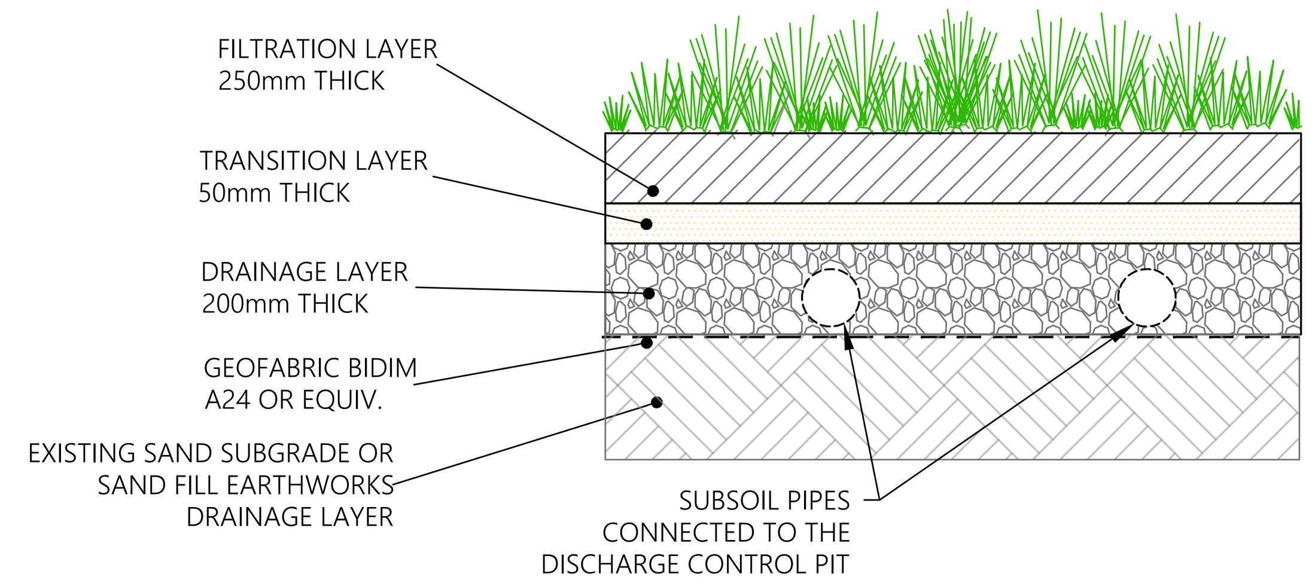
DESIGN GRADELINE		24.96%	2.5%	-33%	0%	33%	30%	22%	3%

VERTICAL GEOMETRY
HORIZONTAL GEOMETRY
DATUM RL-14.0

CUT / FILL	0	0	-0.619	-1.719	-1.746	-0.538	-0.535	-0.534	-2.023	-2.541	-2.75	-2.819	-2.852
DESIGN SURFACE	0.861	0.806	1.416	2.5	2.53	1.33	1.33	1.33	2.83	3.353	3.564	3.638	3.674
NATURAL SURFACE	0.861	0.806	0.797	0.781	0.784	0.792	0.795	0.796	0.807	0.811	0.814	0.819	0.822
CHAINAGES	0.000	7.558	10.000	14.343	15.543	19.143	20.000	20.543	25.043	26.811	27.768	30.000	31.062

Horizontal 1:250 Vertical 1:250

SECTION-C (BIO-BASIN No.4)



TYPICAL BIO-FILTRATION ZONE PROFILE (400mm THICK)
N.T.S

FILTER MEDIA - GENERAL DESCRIPTION

THE MATERIAL CAN BE OF SILICEOUS OR CALCAREOUS ORIGIN.
THE MATERIAL MUST BE TESTED FOR DESIRED HYDRAULIC CONDUCTIVITY USING THE AUSTRALIAN STANDARD (AS4419-2003).

REFER TYPICAL SPECIFICATION BELOW.

SPECIFICATION FOR BIORETENTION FILTER MEDIA:

BIORETENTION FILTER MEDIA SHALL COMPRISE OF TWO LAYERS

1. THE FILTRATION LAYER IS TO BE 250mm THICK AND CONFORM TO THE FOLLOWING SOIL SPECIFICATIONS.

pH	5.5 - 7.5	(pH 1:5 IN WATER)
ELECTRICAL CONDUCTIVITY (dS/cm)	< 1.2	
TOTAL SALTS (ppm)	< 600	
CLAY	2 - 4%	(<0.002mm)
SILT	4 - 8%	(0.002 - 0.05mm)
VERY FINE SAND	5 - 10%	(0.05 - 0.15mm)
FINE SAND	10 - 25%	(0.15 - 0.25mm)
MEDIUM TO COARSE SAND	60 - 70%	(0.25 - 1.0mm)
COARSE SAND	7 - 10%	(1.0 - 2.0mm)
FINE GRAVEL	< 3%	(2.0 - 3.4mm)
HYDRAULIC CONDUCTIVITY (mm/hr)	200 (+/- 20%)	

THE FILTRATION LAYER WILL BE AMELIORATED TO PROVIDE ADEQUATE INITIAL GROWTH. THIS LAYER IS TO CONSIST OF PREMIXED ZEOLITE 20% BY VOLUME PRIOR TO DELIVERY AND PLACEMENT. PRIOR TO PLANTING THE FOLLOWING SHALL BE PLACED INTO THE TOP 75MM.

AGRICULTURAL LIME - RATE TO BE DETERMINED DEPENDING ON SELECTED FILTER MATERIAL	10-30 kg/100sq.m INDICATIVE RANGE
SUPERPHOSPHATE AT	2 kg/100sq.m
MAGNESIUM SULPHATE AT	3 kg/100sq.m
POTASSIUM SULPHATE AT	2 kg/sq.m
TRACE ELEMENTS MIX	1 kg/100sq.m
FERTILISER NPK16.4.14 AT	4 kg/100sq.m

2. TRANSITION LAYER IS TO BE 50mm THICK WELL GRADED COARSE SAND

3. THE DRAINAGE LAYER IS TO BE 200mm THICK WITH 5-7mm WASHED AGGREGATE

* THERE SHOULD BE NO GEOFABRIC INTERFACE BETWEEN THE TWO LAYERS, ONLY AT THE INTERFACE WITH THE SAND SUBGRADE

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ARCHITECTURAL INFORMATION FOR CLUB HOUSE SUPPLIED BY MARK SHAPIRO ARCHITECTS DRAWING NUMBER DA1002WIP REV 2

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN DATE: JAN 2024
DRAWN: A.SCHMID SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

www.md-engineer.com.au

CLIENT
CLIFTON YAMBA LAND PTY LTD

TITLE
110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

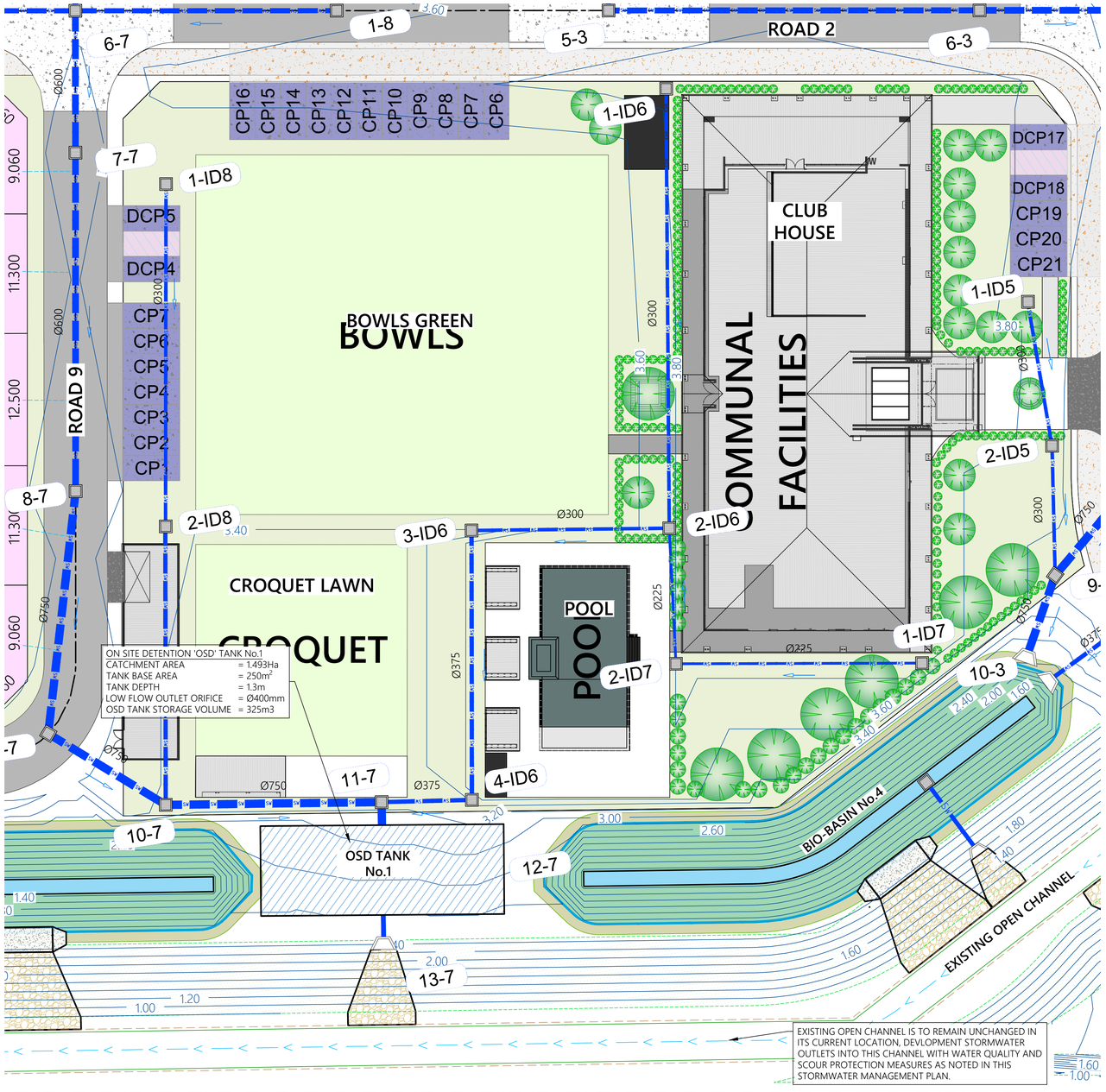
CLIFTON YAMBA

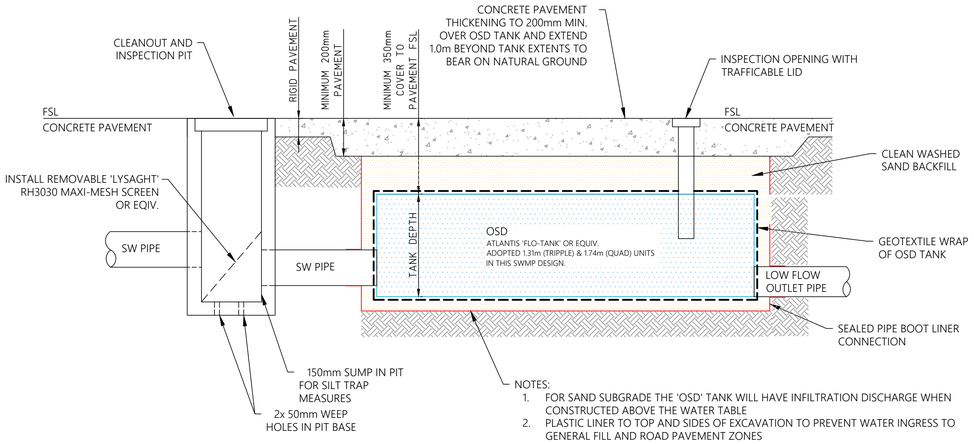
PROJECT
PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE:
STORMWATER MANAGEMENT PLAN - SHEET 2

DWG No: D35 SHEET: 35 OF 43 REV: 1





TYPICAL DETAIL - SECTION VIEW
OSD ATLANTIS 'FLO-TANK'
N.T.S

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ARCHITECTURAL INFORMATION FOR CLUB HOUSE SUPPLIED BY MARK SHAPIRO ARCHITECTS DRAWING NUMBER DA1002WIP REV 2

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

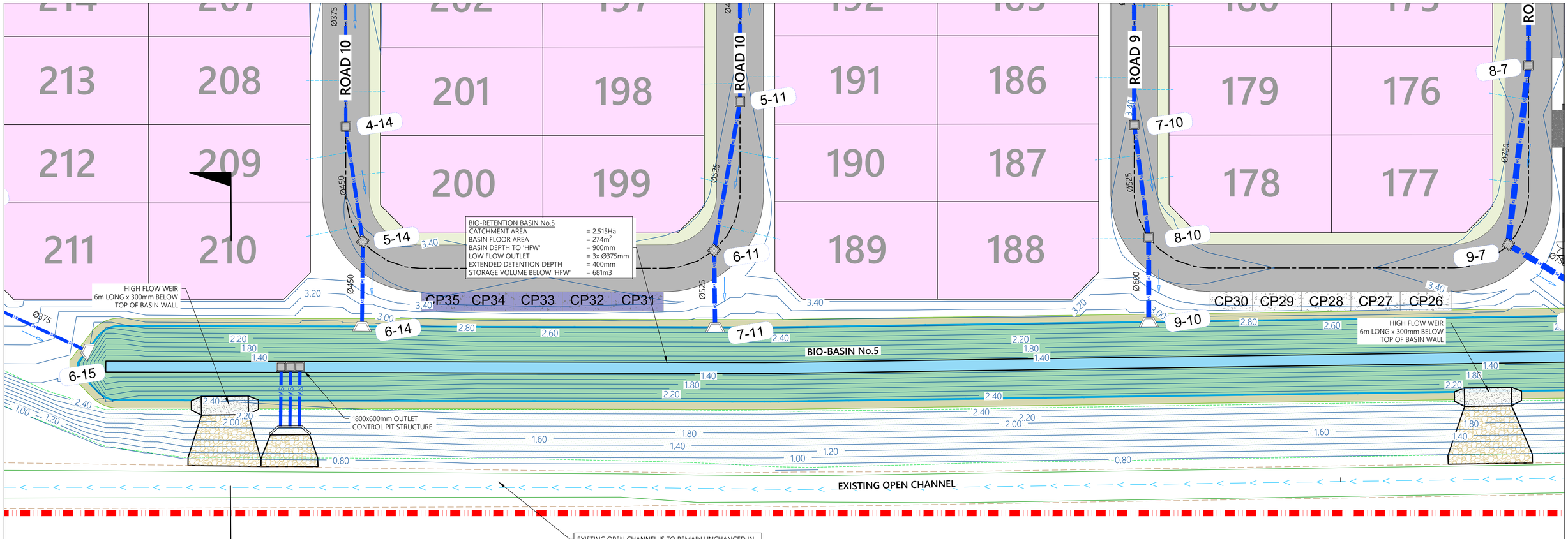
CLIFTON YAMBA

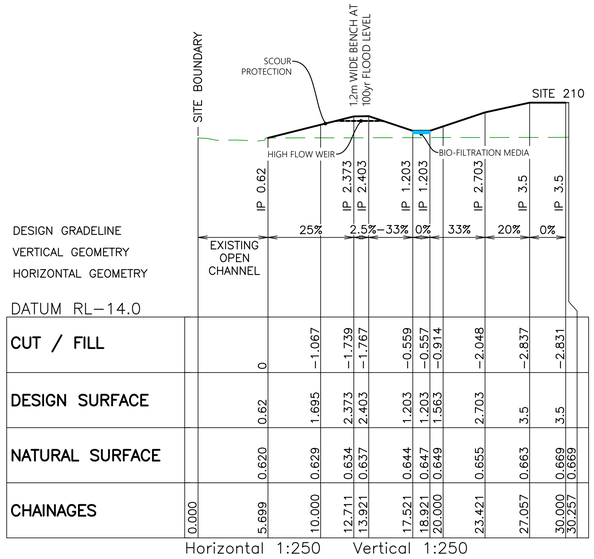
PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: STORMWATER MANAGEMENT PLAN - SHEET 3

DWG No: D36 | SHEET: 36 OF 43 | REV: 1





SECTION-D (BIO-BASIN No.5)

LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

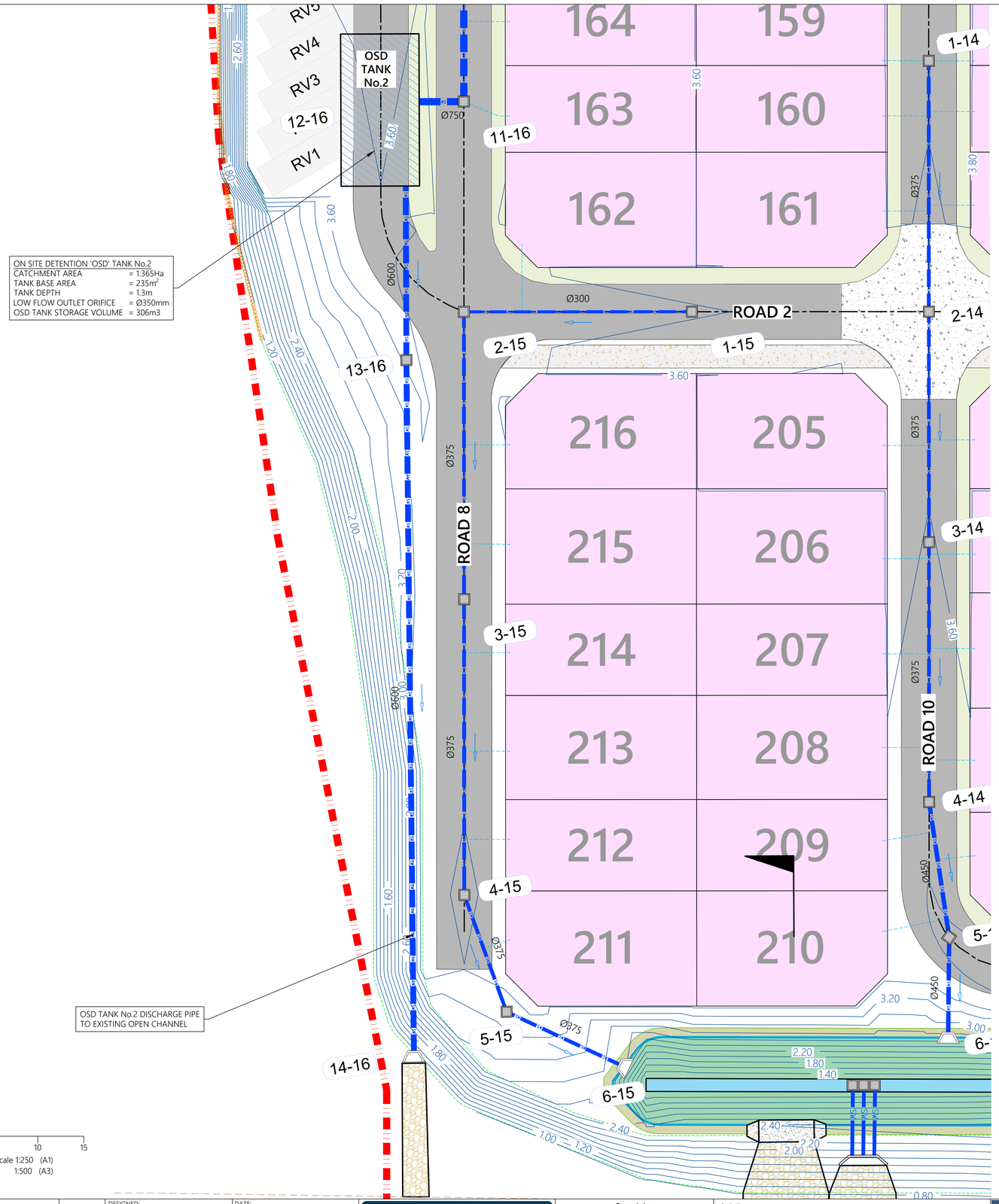
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: STORMWATER MANAGEMENT PLAN - SHEET 4

DWG No: D37 | SHEET: 37 OF 43 | REV: 1



LEGEND

- DEVELOPMENT BOUNDARY
- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- STORMWATER DRAINAGE PIT
- HEADWALL
- PROPOSED MHE ALLOTMENT
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- VISITOR AND RECREATIONAL VEHICLE PARKING
- SCOUR PROTECTION
- BIO-BASIN BREM
- BIO-BASIN GRASSED AREA
- BIO-BASIN WEIR
- BIO-BASIN FLOOR
- GRASSED AREA

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: STORMWATER MANAGEMENT PLAN - SHEET 5

DWG No: D38 | SHEET: 38 OF 43 | REV: 1

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

APPENDIX B – GEOTECHNICAL INVESTIGATION REPORT

REPORT ON

PRFELIMINARY GEOTECHNICAL INVESTIGATION

FOR

PROPOSED MANUFACTURED HOUSING ESTATE AT

CARRS DRIVE, YAMBA, NSW

DESCRIBED AS LOT 2 ON DP 733507

PREPARED FOR

CLIFTON YAMBA LANDPTY LTD

ATF YAMBA LAND TRUST

PROJECT REF: GI 5952-b

DATE: 20 MAY 2022

DRILLING ENVIRONMENTAL GEOTECHNICAL

P: 07 5523 3979
F: 07 5523 3981
E: admin@geotechinvestigations.com
www.geotechinvestigations.com

Geotech Investigations Pty Ltd ACN:154555478
OFFICE: Unit 3 / 42 Machinery Drive
Tweed Heads South NSW 2486
POSTAL: PO Box 6885
Tweed Heads South NSW 2486

Document Details

Project Number	GI 5952
Report Title	Report on Preliminary Geotechnical Investigation Proposed Manufactured Housing Estate
Site Address	Carrs Road, Yamba, NSW described as Lot 2 on DP 733507
Prepared for	Clifton Yamba Land Pty Ltd ATF Yamba Land Trust

Revision	Date	Prepared By	Checked by	Approved for Issue
Final	7/7/21	A O'Carroll	J Walle	J Walle
Revision A	20/05/22	J Walle		J Walle

Report Distribution

Revision	Recipient	Method
Final	Richard Volpe chesney@cliftonlifestyle.com.au Andrew Smith andrew@md-engineer.com.au	Email
Revision A	Andrew Smith andrew@md-engineer.com.au	Email

This document was prepared in accordance with the scope of services described in Geotech Investigations Pty Ltd proposal and trading conditions as agreed with the client. This report is issued for the specific client, project and purpose(s) as described in the report, and should not be used or relied upon for other projects or purposes on the site or other sites.

The undersigned, for and on behalf of Geotechnical Investigations Pty Ltd, confirm that this document and all attached drawings, logs, and test results prepared by Geotech Investigations Pty Ltd have been checked and reviewed for errors, omissions and inaccuracies.

Yours faithfully
For and on behalf of
Geotech Investigations Pty Ltd

Andrew O'Carroll *BEng (Civil),*
Geotechnical Engineer

James Walle *RPEQ (15701), RPEng (Civil), BEng (Civil)*
Senior Geotechnical Engineer

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

As requested by Clifton Yamba Land Pty Ltd ATF Yamba Land Trust, Geotech Investigations Pty Ltd (GI) has completed a preliminary geotechnical investigation for the proposed Manufactured Housing Estate at Carrs Road, Yamba, NSW described as Lot 2 on DP 733507.

1.1 Scope of Works

It is understood the purpose of the investigation is to provide a broadscale investigation of the subject site to highlight if any significant geotechnical constraints are likely to be encountered as part of the future development. The report was aimed to assist the proposed owner / developer in their Due Diligence (DD) stage and not provide design advice for the construction / design stage of the development.

The investigation was limited due to access constraints of the majority of the site.

The scope of the geotechnical services provided by GI was directed towards evaluating the following items. The report was to detail information regarding the project, site, and investigation, and provide comments on:-

1) General
    - Summary of subsurface conditions, topsoil depths and groundwater.
    - Present results of laboratory tests, if any.
    - Highlight anticipated construction difficulties.
2) Earthworks
    - Site preparation required prior to the placement of fill.
    - Topsoil stripping depths.
    - Filling procedures.
    - Comments on soft soils and possible preloading requirements.
3) Broadscale Foundation Recommendations
    - Broadscale high-level footing recommendations.
    - Broadscale Typical Site Classification in accordance with AS2870-2011.

2. PROPOSED DEVELOPMENT

The following documents have been provided to GI to assist with the investigation:-

- Concept Plan by Manage Design Engineer Pty Ltd (MDE), referenced: Concept Plan DWG No: SK03 Rev: 6 dated 12 May 2022, attached as Appendix A.

Based on the concept site plans, refer Figure 1, and discussions with MDE representatives, the proposed development is to include the following:-

- Clearing and preparation of part of the site to allow for bulk filling, mostly towards the eastern half.
- Bulk fill to achieve design levels between RL 3.4 to 3.6 m Australian Height Datum (AHD) indicating up 2 to 2.5 m of fill is required.
- Construction of a 'Riparian Corridor' (20 m in width) entering the central portion of the eastern front boundary and traversing towards the western boundary.
- A series of internal roads and entrances will be required as part of the development along with associated Civil infrastructure.
- The construction of lightly loaded, typically single level residential type buildings.

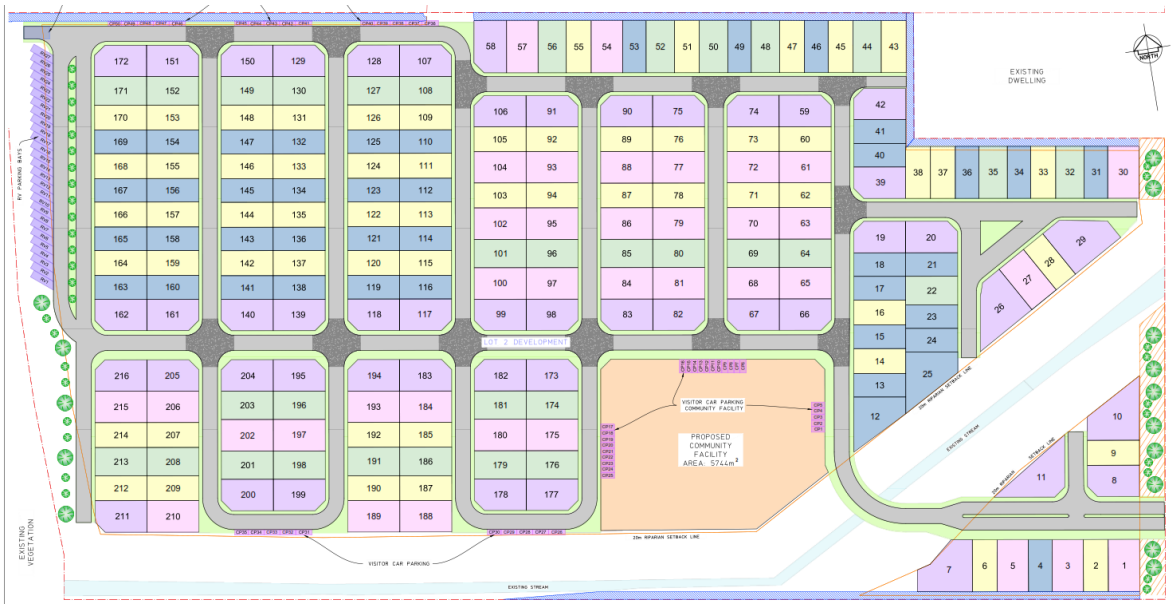


Figure 1 – Concept Site Plan

3. SITE DESCRIPTION

The subject site which is approximately 16 ha in overall area is located on the western side of Carrs Drive, approximately 1.2 km south of the intersection with Yamba Road. The site and surrounds are typically low-lying alluvial floodplains with the western boundary backing onto Oyster Channel, forming part of the tributaries of the Clarence River.

The majority of the site is covered with vegetation consisting recent regrowth and some matured trees, shrubs and grasses. The eastern area abutting the road frontage comprised maintained grass with an existing dwelling and gardens.

Drainage was considered poor across the majority of areas observed during the site investigations.

Pictures of the site are shown below in Figures 2 to 4.

Figure 2: Looking west to existing dwelling

Figure 3: Looking south along the front eastern boundary

Figure 4: Looking north along the front eastern boundary

4. FIELD WORK METHODOLOGY

Fieldwork was initially undertaken on the 1st July 2021, and comprised the drilling and sampling of two (2) boreholes, designated BH 1 to BH 2, using a vehicle mounted auger rig using spiral flight auguring techniques to termination between 2.8 m. Dynamic Cone Penetrometer tests (DCPs) were completed adjacent to each borehole to provide an estimate of the relative density of the sands encountered.

Additional fieldwork was then undertaken on the 6th and 7th of July 2021 and comprised the drilling and sampling of two (2) deep boreholes, designated BH 3 to BH 4. The boreholes were carried out using a truck mounted hydraulic drilling rig with spiral flight auguring techniques to approximately 1.5 m depth, then mud circulation drilling to the terminated depths between 10.9 m and 12.4 m. Standard Penetrometer Tests (SPTs) were completed within each borehole to provide an estimate of the relative density of the sands encountered. The approximate locations of the boreholes are shown on the attached Site Plan S01 in Appendix B along with GPS co-ordinates provided on the attached engineering logs in Appendix C.

This investigation has been carried out in accordance with AS 1726 – 2017[1] in terms of soil description, with the fieldwork supervised by an experienced geotechnical engineer, who positioned and logged the boreholes. At the completion of drilling, the boreholes were backfilled with drill spoil.

5. GEOTECHNICAL CONDITIONS

5.1 Regional Geology

The Geological Survey of NSW, 1:100,000 series Grafton Area shows the site to be located over quaternary aged Pleistocene tidal-delta Plains, which typically comprise *'silt, sands, shells, indurated sands and minor clays'.*

5.2 Subsurface Conditions

The results of the fieldwork are summarised in Table 1 below with more detailed descriptions presented on the Engineering Logs attached in Appendix C, along with explanatory notes.

Table 1: Summary of Subsurface Conditions *(depth below existing surface level)* (2)

Material Descriptions	BH 1 (m)	BH 2 (m)	BH 3 (m)	BH 4 (m)
Alluvial "Topsoil"(1)				
- Sandy CLAY	0 to 0.2	0 to 0.3	0 to 0.2	NE
Alluvial				
- Firm / stiff CLAY	0.2 to 0.3	0.3 to 0.5	0.2 to 0.3	NE
- Loose or worse (SPT 'N' < 10) SAND	2.3 to 2.8	1.0 to 2.8	1.0 to 5.5	0 to 5.4
- Medium Dense (SPT 10 < 'N' < 30) SAND	0.3 to 2.3	0.5 to 1.0	0.3 to 1.0	5.4 to 7.0
	NE	NE	5.5 to 11.1	NE
- Dense (SPT 30 < 'N' < 50) SAND	NE	NE	11.1 to 12.4	NE
- Very Dense (SPT 'N' > 50) SAND	NE	NE	NE	7.0 to 10.9
Terminated Depth (m)	2.8	2.8	12.4	10.9

Notes: NE – Not Encountered (1) Topsoil is described as soils containing vegetation

(2) Strengths were estimated and guessed in some occasions, refer to engineering logs for more details.

[1] Australian Standard AS 1726-2017 *'Geotechnical site investigations'*, Standards Australia

5.3 Groundwater

Groundwater seepage was observed during augering at depths between 0.5 m and 1.2 m below the existing surface levels, as detailed below in Table 2.

Table 2: Summary of Subsurface Conditions *(depth below existing surface level)*

Groundwater	BH 1 (m)	BH 2 (m)	BH 3 (m)	BH 4 (m)
Depth Below Surface Level	0.6	0.5	0.6	1.2

It should be noted that groundwater is affected by climatic conditions, soil permeability and tidal effects, and will therefore vary over time. Where groundwater is critical, it is suggested that a groundwater monitoring well be installed, and levels monitored over a period of time to identify variations prior to excavations.

6. RESULTS AND RECOMMENDATIONS

6.1 Key Geotechnical Constraints

Some of the key geotechnical constraints outlined within this report are summarised below:-

- Ground preparation works.
- The presence of shallow groundwater.
- Site trafficability.
- Variable depth of existing topsoil.

6.2 Earthworks

6.2.1 Summary of Earthworks

Earthworks are understood to involve:-

- Clearing and preparation of the front 450 m (approximately) of the site to allow for bulk filling to achieve estimated design levels of up to RL 3.6 m AHD. This will require bulk fill of up to about 2 to 2.5 m. Should additional earthworks of greater than +/- 1 m be proposed, this office must be contacted to provide further advice.
- Construction of a 'Riparian Corridor' (20 m in width). Although details are not known, it is anticipated that the corridor will comprise excavations and some surface batter shaping.
- A series of internal roads and entrances will be required as part of the development along with associated Civil infrastructure.

6.2.2 Topsoil Stripping and Subgrade Preparation

Based on the recent boreholes completed by GI, the stripping depth over the site will typically be in the order of 100 to 200 mm. The variation will result from a combination of surface vegetation and

in particular the root regrowth of the specific plants / trees, drainage and the weather conditions prior to the site strip.

It was noted and observed during the investigations that an alluvial soft to firm clay layer typically between 100 mm and 500 mm in thickness is located below the organic type topsoil. In conjunction with the shallow water table encountered, it is anticipated that the exposed alluvial clay layer will not be suitable to pass a 'test roll' and cause trafficability issues during construction. Therefore, GI suggests that a 'bridging layer' be considered over the alluvial clay layer as part of the earthwork's methodology, as detailed below in Section 6.2.3. This will have both environmental and cost benefits by reducing the extent of disturbance to the natural ground and limiting both the export and import volumes of structural fill required.

Furthermore, haul roads and areas of high plant traffic (i.e. turn-around and egress / ingress areas) will most likely require a crushed rock or similar layer placed to assist with high traffic movement on the exposed clay.

6.2.3 Bulk Filling Operations

Generally, all earthworks are to be carried out in accordance with AS 3798 – 2007[2]. The following earthworks procedures can be used as a preliminary guide for placing fill to support the bulk fill:-

- Following clearing and grubbing, strip site of organic / deleterious materials. Any building remnants or uncontrolled fill also will be required to be stripped.

  HOLD POINT # 1: Strip inspection required by GI.

- Placement and compaction of a 500 mm layer of clean sand material spanning the alluvial clay subgrade.

- **HOLD POINT # 2:** A test roll completed on the 'bridging layer' in the presence of a suitably qualified Geotechnical Engineer prior to additional fill being placed which will identify any further weak spots.

- Fill material should comprise similar properties to the site's natural soils and surrounding environment, hence it is recommended that **clean cohesionless sands** are used as bulk fill materials. This can often be more expensive upfront, however construction costs of placement (thicker layers) and compaction along with foundation costs of the houses / structures can often offset these initial costs and should be considered where possible. Alternative fill materials can be considered and specified by the design engineer.

- Fill material should be placed in layers not exceeding 250 mm loose thickness, however is dependent on fill material and compaction equipment. Typically for residential type developments in accordance with AS 3798, non-cohesionless material should be compacted to achieve a minimum 95% Maximum Dry Density (MDD) based on the Standard compaction

[2] Australian Standard AS 3798-2007 *'Guidelines on earthworks for residential and commercial developments'*, Standards Australia

test and material moisture controlled to within +/- 2% of Optimum Moisture Content (OMC) and cohesionless material compacted to 70 % Density Index or 98 % standard compaction.

- Compaction should be tested as per AS 3798 – 2007 Table 8.1 by a NATA accredited soils laboratory.
- All fill must be inspected and tested in accordance with Level 1 guidelines as set out in AS 3798.

6.2.4 Groundwater Control

As identified above in Section 5.3, groundwater seepage and anticipated standing groundwater was encountered at shallow depths (i.e. typically around 0.6 m depth below existing surface levels).

The groundwater will rise and fluctuate depending on tidal influences and rain events at the site and it is expected that the groundwater could rise to surface level at times of flooding, which needs to be considered in both the detailed design and construction phase of the project. The activities and problems associated with groundwater include:-

- Where excavations (such as service trenches) are proposed to extend near or below the water table, suitable methods of excavation and localised dewatering needs to be considered.
- Temporary retention (such as 'shore-boxes') will be required where excavations of the groundwater is required.
- Fill placement in areas within 0.5 to 1.0 m of the groundwater (at the time of placement). Fill areas may pump the groundwater into the placed fill causing heaving and compaction difficulties.

6.3 Temporary and Long Term Batter Slopes

The riparian zone is anticipated to be positioned at the 'natural' surface level (i.e. requiring no new fill), with long term batter slopes anticipated. Long term batter slopes of the 'controlled' fill sands above the ground water should be sloped at 1V:4H minimum for a maximum vertical height of 3 m. Steeper batter slopes for various fill materials can be considered.

Some slumping and erosion of the batter face may occur and to minimise this risk, compaction must extend past the final batter slope and be trimmed back to compacted material. The batter must also be protected from erosion with scour protection using suitable vegetation.

Temporary batter slopes (1 week in dry conditions) of the bulk fill and natural soils above the ground water may be based on 1V:1H for a maximum vertical height of 1.5 m. GI must be notified for any deeper trench excavations.

6.4 Site Settlements

Based on the subsurface investigation, the development area is underlain with a thin layer of clay and very loose to loose sands grading to medium dense then dense (or better) sands extending to approximately 10.9 to 12.4 m depth where the deeper boreholes were terminated. The upper stratum comprised a medium dense alluvial sand layer in some of the boreholes, however this was subject to variation between the testing locations.

Settlements of sands is relatively immediate as a result of surcharge loads. Considering the depth of fill to be placed over the site, the resultant settlements of the underlying alluvial sands would be considered negligible (less than 20 to 30 mm). These settlements will occur as the layers of fill surcharge is placed and will not impact the developments infrastructure or future structures. The fill material type / quality and compaction effort of the fill material will have some impact on these structures and will need to be considered in the design. GI can be contacted for further advice if required.

6.5 Broadscale Foundation Recommendations

6.5.1 Broadscale Indicative Shrink-Swell Movements and Site Classification

Following the placement of fill material, the allotments will be classified as **'Class P'** in accordance with the provisions of AS 2870. However, as the proposed new fill material is to be placed and compacted as 'controlled' fill, the sites may be reclassified.

A Site Classification is provided to allow the determination of appropriate footing sizes and slab details to be designed, and is based on the soil profile, the soil reactivity, and the climatic conditions at the site. The soil profile is identified by the site investigation drilling and in-situ testing, while the soil reactivity is determined from laboratory testing to provide the Shrink-Swell Index (I_{SS}). On the majority of sites, this information is used to calculate the characteristic surface movement (y_S), which is an estimation of the amount of movement at the surface of the site, subject to normal seasonal wetting and drying.

Following the proposed bulk earthworks, the subsurface materials will likely comprise recently placed **clean sand fill** (i.e. inert materials), and as such, shrink-swell movements will be minimal. Considering potential settlements due to self-weight of the fill and the surcharge from the individual dwellings, the allotments will most likely be reclassified as 'Class S' (slightly reactive) or 'Class M' (moderately reactive) in accordance with AS 2870. Additional geotechnical investigations will be required following the completion of the 'controlled' fill building platform/s.

6.5.2 Indicative High-Level Footings

Generally, provided the new fill has been placed in accordance with Section 6, the preliminary footing design for footings found in the compacted 'controlled' sands may typically be based on an allowable bearing pressure of 100 kPa. However, this will be dependent on the extent of fill material and strength of the underlying alluvial soils following the completion of the earthworks.

Additional geotechnical investigations will be required following the completion of the 'controlled' fill building platform/s for site specific footing recommendations.

7. LIMITS OF INVESTIGATION

This report has been written with the express intent of providing subsurface information for due diligence purposes, or as otherwise directed by the client and/or other members of the consulting team. Sub-surface conditions relevant to construction works should be assessed by contractors who can make interpretation of the factual data provided as engineering logs and test results, and perform any additional tests as necessary for their own purposes.

There are always some variations in sub-surface conditions across a site that cannot be defined even by exhaustive investigation. Hence, it is unlikely that the measurements and values obtained from sampling and testing during the investigation will represent the extremes of conditions which exist within the site.

Should conditions exposed at the site during excavation vary significantly from the interpretation provided in this report, based on the project specific factors cited in the introductory scope of the report, GI must be informed and have the opportunity to review any of the findings of this report.

The investigation was very limited due to the restricted access of a large portion of the site.

Further, sub-surface conditions, including groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

APPENDIX A

CONCEPTUAL SITE PLANS BY MDE

10 5 0 10 20 30 40
Horizontal Scale 1:600 (A1)
1:1200 (A3)

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY FOR SITE PLANNING PURPOSES ONLY
NOT FOR CONSTRUCTION

REVISION 6 - MASTERPLAN YAMBA 2 & 3

12th MAY 2022

AMEND LOT WIDTH TO ADD AN ADDITIONAL 2 LOTS

MIX OF PRODUCT

- LOTS 9.4m WIDTH = 42 LOTS (20%)
- LOTS 9.9m WIDTH = 58 LOTS (26%)
- LOTS 11.3m WIDTH = 32 LOTS (15%)
- LOTS 12.5m WIDTH = 84 LOTS (39%)

27 x RV / CARAVAN STORAGE BAYS
50 x VISITOR CAR PARKING

ALL DWELLING ENTITLEMENTS DEPTHS AT 20.70m

SITE YIELD = 216 LOTS

LEGEND

- CADASTRAL BOUNDARY
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- PROPOSED MHE ALLOTMENT 9.4m LOT WIDTH
- PROPOSED MHE ALLOTMENT 9.9m LOT WIDTH
- PROPOSED MHE ALLOTMENT 11.3m LOT WIDTH
- PROPOSED MHE ALLOTMENT 12.5m LOT WIDTH
- PROPOSED MHE ALLOTMENT 12.5m LOT WIDTH CORNER SITE
- PROPOSED NEW COMMUNITY FACILITY AREA

ISSUE	DESCRIPTION	DATE
6	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	12.05.2022
5	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	11.05.2022
4	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	02.05.2022
3	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	07.12.2021
2	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	18.08.2021
1	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	23.07.2021
0	MASTERPLAN LAYOUT ISSUED FOR CLIENT REVIEW	28.06.2021

DESIGNED: T.RYDEN
DRAWN: A.SCHMID
SURVEYING:
DATE: MAY 2022
SCALE: AS SHOWN
SHEET SIZE: A1

NOT FOR CONSTRUCTION

MANAGE-DESIGN-ENGINEER PTY LTD
PROJECT MANAGEMENT-CIVIL ENGINEERING-DESIGN-SURVEYING
SUITE 1, 64 BALLINA STREET, LENNOX HEAD NSW 2478
PO Box 44 LENNOX HEAD NSW 2478
www.mde-engineer.com.au
ABN: 88 607 109 357

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: PROPOSED MANUFACTURED HOUSING ESTATE

PROJECT: CARRS DRIVE
YAMBA NSW
LOT 2 DP733507

CIVIL DRAWING

DRAWING TITLE: CONCEPT PLAN
MDE ADDITIONAL LOTS - YAMBA 2-3 URBAN DESIGN

DWG No: SK03 SHEET: 1 OF 1 REV: 6

APPENDIX B

SITE PLAN S01

SITE IMAGE

LOCALITY IMAGE

Locality Image courtesy of
Google Earth & NSW Globe

NORTH

GeoTech INVESTIGATIONS PTY LTD

Unit 3 / 42 Machinery Drive
PO Box 6885
Tweed Heads South NSW 2486
PH: 0755 233 979
FAX: 0755 233 981
EMAIL: admin@geotechinvestigations.com
WEB: www.geotechinvestigations.com

CLIENT: CLIFTON YAMBA LAND PTY LTD

PROJECT: NO.120 CARRS ROAD YAMBA

DRAWING REF: S01: SITE PLAN

LEGEND:
Borehole and Dynamic Cone Penetrometer Locat i on

Site Plan provided by Google Earth Image

APPROXIMATE NORTH

NORTH

DATE: 06.07.2021

OUR REF / JOB No.: GI 5952-a sp

DRAWN BY: DC

Drawing not to scale.
Printed dimensions only.

APPENDIX C

BOREHOLE PROFILES BH 1 TO BH 4
GEOTECHNICAL REPORT STANDARD NOTES

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532118	S:	6742966

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 1
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: GT-10 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD	▼	0.5		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey	F		1 1 1	ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey			2 2 3	
		1.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD		3 4 5 10 10 10 12 10 10 8 6 6	
		1.5		(SM) Silty SAND: Fine sand, Moist, Grey				
		2.0			L		5 3 3 3 3 3 3 3 3 4 4 4	
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 1 TERMINATED AT 2.8m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	Date:	01/07/21	Checked By:	AOC	Date:	7/7/21

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532082	S:	6743014

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 2
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: GT-10 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey	F		1 1 1	ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey			2 2	
	▼	0.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD		3 3 4 4 5	
		1.0		(SM) Silty SAND: Fine sand, Moist, Grey	L		4 4 3 3 3 3 3 3 3 3 3 2 2 2 2 3 3 4 4	
		1.5						
		2.0						
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 2 TERMINATED AT 2.8m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	Date:	01/07/21	Checked By:	AOC	Date:	7/7/21

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532135	S:	6742977

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D.:** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD to 1.5 m then MS (RR)	▼	0.5		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey				ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey				
		1.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD			
		1.5		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Pale grey mottled grey	L	SPT 1.5 3,2,3 N=5		
		2.0						
		2.5						
		3.0		(SP) SAND: Fine to medium sand, Trace of silt, Trace of shell grit throughout, Wet, Pale grey mottled grey	VL/L	SPT 3.0 1,-,1 N=1		
		3.5						
		4.0						
		4.5				SPT 4.5 -,-,2 N=2		
		5.0						
		5.5		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown	MD			

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D.:** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 2 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		6.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown	MD	SPT 6.0 1,13,17 N=20		ALLUVIUM
		7.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange		SPT 7.5 5,11,13 N=24		
		9.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Pale brown		SPT 9.0 7,17,0 N=17		
		10.5				SPT 10.5 9,17,21 N=35		
		11.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange	D			

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA 85 / **HOLE DIAMETER:** 110mm	**PAGE:** 3 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		11.5 12.0 12.45		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange	D	SPT 12.0 11,17,23 N=40		ALLUVIUM
		13.0 13.5 14.0 14.5 15.0 15.5 16.0						

BH 3 TERMINATED AT 12.45m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
RR	Rock Roller	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
WB	Wash Bore	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
WATER		F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
▼	Water Level			VL	Very Loose	M	Medium	VS	Vane Shear
▶	Water Seepage			L	Loose	H	High	A	Acid Sulfate Sample
»–	Partial Loss			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
–«	Complete Loss								

Logged By:	JW	**Date:**	06/07/21	**Checked By:**	AOC	**Date:**	7/7/21

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	531912	S:	6743140

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 4
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 2

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD to 1.5 m then MS (RR)	▼	0.5		(SM) Silty SAND: Fine to medium sand, Moist, Dark brown	L			FILL
		1.0		(SP) SAND: Fine sand, Trace of silt, Moist, Pale brown				
		1.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey mottled grey	L	SPT 1.5 4,3,3 N=6		ALLUVIUM
		2.0						
		2.5						
		3.0		As above:	VL / L	SPT 3.0 3,1,2 N-3		
		3.5						
		4.0						
		4.5				SPT 4.5 1,-,- N=0		
		5.0						
		5.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	MD			

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 4
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 2 of 2

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		6.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	MD			ALLUVIUM
						SPT 6.0 10,11,16 N=27		
		7.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	VD			
		7.5				SPT 7.5 17,27,25 N=52		
		8.0						
		8.5						
		9.0				SPT 9.0 11,26,29 N=55		
		9.5						
		10.9				SPT 10.5 15,23,31 N=54		

BH 4 TERMINATED AT 10.9m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
RR	Rock Roller	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
WB	Wash Bore	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
		F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WATER				VL	Very Loose	M	Medium	VS	Vane Shear
▼	Water Level			L	Loose	H	High	A	Acid Sulfate Sample
►	Water Seepage			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
»–	Partial Loss								
–«	Complete Loss								

Logged By:	JW	**Date:**	06/07/21	**Checked By:**	AOC	**Date:**	7/7/21

SCOPE These standard notes may be of assistance when understanding terms and recommendations given in this report. These notes are for general conditions and not all terms given may be of concern to the report attached. The descriptive terms adopted by Geotech Investigations Pty Ltd are given below and are largely consistent with Australian Standards AS1726-1993 'Geotechnical Site Investigations'.

CLIENT can be described and is limited to the financier of this geotechnical investigation.

LEGALITY and privacy of this document is based on communication between Geotech Investigations Pty Ltd and the client. Unless indicated otherwise the report was prepared specifically for the client involved and for the purposes indicated by the client. Use by any other party for any purpose, or by the client for a different purpose, will result in recommendations becoming invalid and Geotech Investigations Pty Ltd will hold no responsibility for problems which may arise.

GEOTECHNICAL REPORTS are predominantly derived using professional estimates determined from the results of fieldwork, in-situ and laboratory testing and experience from previous investigations in the area, from which geotechnical engineers then formulate an opinion about overall subsurface conditions. The client must be made aware that the investigations are undertaken to ensure minimal site impact using test-pits or small diameter boreholes and soil conditions on-site may vary from those encountered during the investigation.

CLIENTS RESPONSIBILITY to notify this office should there be adjustments in proposed structure/location or inconsistencies with material descriptions given in this report and those encountered on site. Geotech Investigations Pty Ltd is able to provide a range of services from on-site inspections to full project supervision to confirm recommendations given in the report.

CSIRO Publication BTF 18 'Foundation Maintenance and Footing Performance: A Homeowner's Guide' explains how to adequately maintain drainage during and post construction which lies as the responsibility of the client. Suitable drainage ensures recommendations given in this report remain valid.

INVESTIGATION METHODS adopted by Geotech Investigations Pty Ltd are designed to incorporate individual project-specific factors to obtain information on the physical properties of soil and rock around a site to design earthworks and foundations for proposed structures. The following methods of investigation currently adopted by this company are summarised below:-

HAND AUGER – investigations enable field work to be undertaken where access is limited. The materials must have sufficient cohesion to stand unsupported in an unlined borehole and there must be no large cobbles boulders or other obstructions which would prevent rotation of the auger.

TEST-PITS – investigations are carried out with an excavator or backhoe, allowing a visual inspection of sub-surface material in-situ and from samples removed. The limit of investigation is restricted by the reach of the excavator or backhoe.

CONTINUOUS SPIRAL FLIGHT AUGERING TECHNIQUES – investigations are advanced by pushing a 100mm diameter spiral into the sub-surface and withdrawing it at regular intervals to allow sampling or testing as it emerges.

WASH BORING – investigations are advanced by removing the loosened soil from the borehole by a stream of water or drilling mud issuing from the lower end of the wash pipe which is worked up and down or rotated by hand in the borehole. The water or mud carries the soil up the borehole where it overflows at ground level where the soil in suspension is allowed to settle in a pond or tank and the fluid is re-circulated or discharged to waste as required.

NON-CORE ROTARY DRILLING – investigations are advanced using a rotary bit with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from feel and rate of penetration.

ROTARY MUD DRILLING – is carried out as above using mud as support and circulating fluid for the borehole drilling. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling.

CONTINUOUS CORE DRILLING – investigations are carried out in rock material, specimens of rock in the form of cylindrical cores are recovered from the drill holes by the means of core barrel. The core barrel is provided at its lower end with a detachable core bit which carries industrial diamond chips in a matrix of metal. Rotation of the barrel by means of the drill rods causes the core bit to cut an annulus in the rock, the cuttings being washed to the surface by a stream of pumped down the hollow drill rods.

TESTING METHODS adopted by Geotech Investigations Pty Ltd to determine soil properties include but not limited to the following:-

U50 – Undisturbed samples are obtained by inserting a 50mm diameter thin-walled steel tube into the material and withdrawing with a sample of the soil in a moderately undisturbed condition.

PP – Pocket Penetrometer tests are commonly used on thin walled tube samples of cohesive soils to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils. They may also be used for the same purpose in freshly excavated trenches.

VS – Vane Shear test are commonly used in-situ or on thin walled tube samples of cohesive soils by introducing the vane into the material where the measurement of the undrained shear strength is required. Then the vane is rotated and the torsional force required to cause shearing is calculated.

DCP – Dynamic Cone Penetrometer tests are commonly used in-situ to measure the strength attributes of penetrability and compaction of sub-surface materials.

SPT – Standard Penetration Tests are commonly used to determine the density of granular deposits but are occasionally used in cohesive material as a means of determining strength and also of obtaining a relatively unmixed sample. Samples and results are obtained by driving a 50mm diameter split tube through blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. Blow counts are recorded for 150mm intervals with the sum of the number of blows required for the second and third 150mm of penetration is termed the "standard penetration resistance" or the "N-value".

GEOLOGICAL ORIGINS of sub-surface material plays a considerable role in the development of engineering parameters and have been summarised as follows:-

FILL – materials are man made deposits, which may be significantly more variable between test locations than naturally occurring soils.

RESIDUAL – soils are present in a region because of weathering over the geological time scale.

COLLUVIAL – soils have been deposited recently, on the geological time scale, as soils being transported slowly down slope due to gravitational creep.

ALLUVIAL – soils have been deposited recently, on the geological time scale, as water borne materials.

AEOLIAN – soils have been deposited recently, on the geological time scale, as wind borne materials.

SOIL DESCRIPTION is based on an assessment of disturbed samples, as recovered from boreholes and excavations, and from undisturbed materials. Soil descriptions adopted by Geotech Investigations Pty Ltd are largely consistent with AS 1726-2017 '*Geotechnical Site Investigation'.* Soil types are described according to the predominating particle size and behaviour, qualified by the grading of other particles present on the following bases detailed in Table 1.

COHESIVE SOILS ability to hold moisture known as its liquid limit is the state of a soil when it goes from a solid state to a liquid state described in Table 2

TABLE 1

Soil Classification	Particle Size
Clay	< 0.002 mm
Silt	0.002 – 0.06 mm
Sand	0.06 – 2.00 mm
Gravel	2.00 – 60.0 mm

TABLE 2

Descriptive Type	Range of Liquid Limit %
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50

Furthermore to soil description cohesive soils are described on their strength (assessed in conjunction with penetration tests) and liquid limit. Non-cohesive soil strengths are described by their density index. With descriptions for cohesive and non-cohesive soils summarised in Table 3.

TABLE 3

COHESIVE SOILS		NON-COHESIVE SOILS	
Term	**Undrained Shear Strength kPa**	**Term**	**Density Index %**
Very soft	≤ 12	Very Loose	≤15
Soft	> 12 ≤25	Loose	> 15 ≤35
Firm	> 25 ≤50	Medium Dense	> 35 ≤65
Stiff	> 50 ≤100	Dense	> 65 ≤85
Very Stiff	> 100 ≤200	Very Dense	> 85
Hard	> 200		

Description of terms used to describe material portion are summarised in Table 4.

TABLE 4

COARSE GRAINIED SOILS		FINE GRAINED SOILS	
% Fines	**Modifier**	**% Coarse**	**Modifier**
≤ 5	Omit or 'trace'	≤ 15	Omit or 'trace'
> 5 ≤12	Describe as 'with'	> 15 ≤30	Describe as 'with'
> 12	Prefix soil as 'silty/clayey'	> 30	Prefix soil as 'sandy/gravelly'

ROCK DESCRIPTIONS are determined from disturbed samples or specimens collected during field investigations. A rocks presence of defects and the effects of weathering are likely to have a great influence on engineering behaviour.

Rock Material Weathering Classification is summarised in Table 5.

TABLE 5

Term	Symbol	Definition
Residual Soils	-	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to decomposition of weathering products in pores
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh rock	FR	Rock shows no signs of decomposition or staining

Rock Material Strength Classification is summarised in Table 6.

TABLE 6

Term	Symbol	Point load index (MPa) I_s50	Field guide to strength
Extremely Low	EL	≤0.03	Easily remoulded by hand to a material with soil properties
Very Low	VL	>0.03 ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure
Low	L	>0.1 ≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling
Medium	M	>0.3 ≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
High	H	>1.0 ≤3.0	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer
Very High	VH	>3.0 ≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer
Extremely High	EH	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

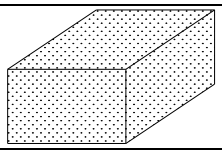
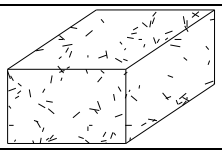
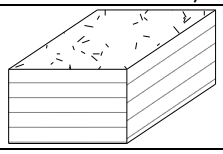
Rock Material Defect Shapes are summarised in Table 7.

TABLE 7

Term	Description
Planar	The defect does not vary in orientation.
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps.
Irregular	The defect has many sharp changes of orientation
Smooth	The defect has a flat even finish
Rough	The defect has a irregular disoriented finish

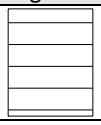
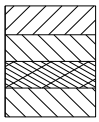
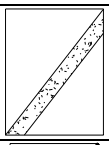
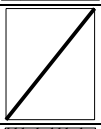
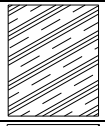
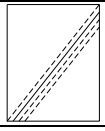
Rock Material Texture and Fabric are summarised in Table 8.

TABLE 8

Geological Description	Massive		Layered (Bedded foliate cleaved)
Diagram			
Fabric Type	Effectively homogenous and isotropic. Bulky or equi-dimensional grains uniformly distributed	Effectively homogeneous and isotropic. Elongated	Effective homogeneous with planar anisotropy. Elongated or tabular grains or pores in a layered arrangement

Rock Material Defect Type is summarised in Table 9

TABLE 9

Term	Definition	Diagram
Bedding	Signifying existence of beds or laminate. Planes dividing sedimentary rocks of the same or different lithology. Structure occurring in granite and similar rocks evident in a tendency to split more or less horizontally to the land surface	
Cross Bedding	Also called cross-lamination or false bedding. The structure commonly present in granular sedimentary rocks, which consists of tabular, irregularly lenticular or wedge-shaped bodies lying essentially parallel to the general stratification and which them selves show pronounced lamination structure in which the laminae are steeply inclined to the general bedding.	
Crushed Seam	A fracture at a more or less acute angle to applied force generally with some pulverized material along its surface	
Joint	A fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.	
Parting	A small joint in rock or a layered rock where the tendency of crystals to separate along certain planes that are not true cleavage planes.	
Sheared Zone	A fracture that results from stresses which tend to shear one part of a specimen past the adjacent part	

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

APPENDIX C – DPI GUIDELINE FOR RIPARIAN CORRIDORS

Guidelines for controlled activities on waterfront land

Riparian corridors

Published by NSW Department of Industry

Guidelines for controlled activities on waterfront land—Riparian corridors

First published May 2018.

More information

Natural Resources Access Regulator

industry.nsw.gov.au/nrar

INT19/15607

Guidelines for controlled activities on waterfront land

Contents

Natural Resources Access Regulator

The Natural Resources Access Regulator (NRAR) is an independent regulator established under the NSW *Natural Resources Access Regulator Act 2017*. The current regulatory focus of NRAR is water regulation, a key part of which is to prevent, detect and stop illegal water activities.

The NRAR seeks to ensure effective, efficient, transparent and accountable compliance and enforcement measures through the natural resources management legislation and, in doing so, maintain public confidence in the enforcement of natural resources management legislation.

Controlled activities on waterfront land

Controlled activities carried out in, on, or under waterfront land are regulated by the *Water Management Act 2000* (WM Act). The NRAR administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

This means that applicants must obtain a controlled activity approval from the NRAR before commencing the controlled activity.

What is a riparian corridor?

A riparian corridor (RC) forms a transition zone between the land, also known as the terrestrial environment, and the river or watercourse or aquatic environment. Riparian corridors perform a range of important environmental functions such as:

- providing bed and bank stability and reducing bank and channel erosion
- protecting water quality by trapping sediment, nutrients and other contaminants
- providing diversity of habitat for terrestrial, riparian and aquatic plants (flora) and animals (fauna)
- providing connectivity between wildlife habitats
- conveying flood flows and controlling the direction of flood flows
- providing an interface or buffer between developments and waterways
- providing passive recreational uses.

The protection, restoration or rehabilitation of vegetated riparian corridors is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of a watercourse.

Changes to controlled activities within riparian corridors

On 1 July 2012, new rules commenced regarding controlled activities within riparian corridors. The new rules amend the riparian corridor widths that apply to watercourses, providing more flexibility in how riparian corridors can be used and making it easier for applicants to determine the NRAR-controlled activity approval requirements. Key aspects of the changes include:

- provision of greater flexibility in the allowable uses and works permitted within riparian corridors
- the core riparian zone and vegetated buffer have been combined into a single vegetated riparian zone (VRZ)
- the width of the VRZ within the riparian corridor has been pre-determined and standardised for first, second, third and fourth-order and greater watercourses
- where suitable, applicants may undertake non-riparian corridor works or development within the

outer 50 per cent of a VRZ, as long as they offset this activity by connecting an equivalent area to the RC within the development site

- a new 'riparian corridors matrix' enables applicants to determine what activities can be considered in riparian corridors.

These changes will simplify the controlled activities application and assessment process; provide greater flexibility; help make more land available for housing; support floodplain, stormwater and bush fire management; and allow riparian corridors to be used for public amenity whilst continuing to deliver environmental outcomes required under the WM Act.

The riparian corridor consists of:

- the channel which comprises the bed and banks of the watercourse (to the highest bank) and
- the vegetated riparian zone (VRZ) adjoining the channel.

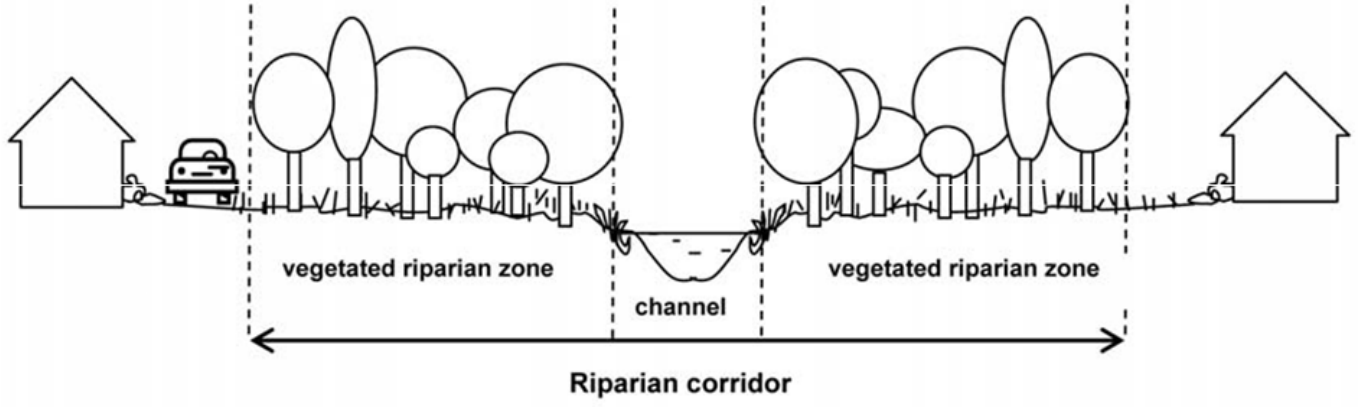


Figure 1. Riparian corridor

Riparian corridor widths

The NRAR recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses and using Hydroline Spatial Data which is published on the department's website . The width of the VRZ should be measured from the top of the highest bank on both sides of the watercourse (see Figure 2 and Table 1).

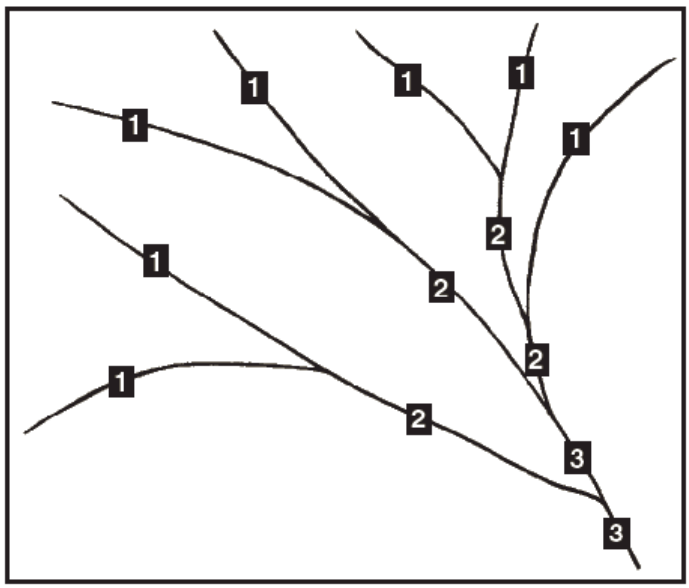


Figure 2. The Strahler System

Table 1. Recommended riparian corridor (RC) widths

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st order	10 metres	20 metres + channel width
2nd order	20 metres	40 metres + channel width
3rd order	30 metres	60 metres + channel width
4th order and greater (includes estuaries, wetlands and parts of rivers influence by tidal waters)	40 metres	80 metres + channel width

Note: Where a watercourse does not exhibit the features of a defined channel with bed and banks, the NRAR may determinethat the watercourse is not waterfront land for the purposes of the WM Act.

Objectives for riparian corridor management

The overarching objective of the controlled activities provisions of the WM Act is to establish and preserve the integrity of riparian corridors.

Ideally, the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System
- if a watercourse is present, define the RC/VRZ on a map in accordance with Table 1
- seek to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1
- seek to minimise disturbance and harm to the recommended RC/VRZ
- minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ
- locate services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings where possible.
- treat stormwater run-off before discharging into the RC/VRZ.

NRAR however, does allow for a range of works and activities on waterfront land and in riparian corridors to better meet the needs of the community, so long as they cause minimal harm as outlined in the riparian corridor matrix below.

What is the averaging rule?

Non-riparian corridor works and activities can be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate, 50 per cent of the outer vegetated riparian zone width may be used for non-riparian uses including asset protection zones, recreational areas, roads, development lots and infrastructure. However, an equivalent area connected to the riparian corridor must be offset on the site (see Figure 3) and the inner 50 per cent of the vegetated riparian zone must be fully protected and vegetated with native, endemic, riparian plant species.

Bridges, cycleways, paths, stormwater outlets and other essential services do not need to be offset, but must comply with the requirements set out in the riparian corridor matrix (Table 2) and other relevant controlled activities guidelines. Offline detention basins do not need to be offset so long as

there is anequivalent VRZ for the corresponding watercourse and they are built in compliance with *Controlled activities: Guidelines for watercourse crossings* and *Controlled activities: Guidelines for in-stream works.* [1]

If a proposed basin will not have an equivalent VRZ for the corresponding watercourse, it may still be built in the outer 50 per cent of the VRZ but must be offset.

The averaging rule should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve that riparian vegetation in accordance with the minimum riparian corridor requirements outlined in Table 1.

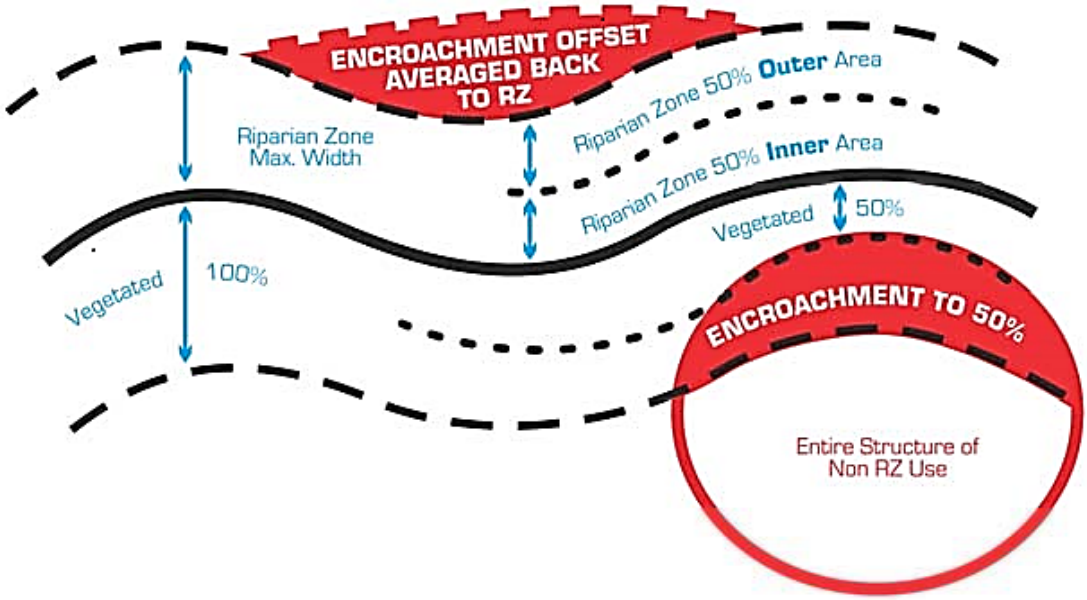


Figure 3. Averaging rule

Riparian corridor matrix

The riparian corridor matrix enables applicants to identify certain works and activities that can occur on waterfront land and in riparian corridors. Applicants should note that the matrix relates to controlled activity approvals under the WM Act only. Applicants are still required to comply with other relevant government legislation, such as threatened species, flood planning levels and fisheries guidelines.

[1] www.industry.nsw.gov.au/nrar

Table 2. Riparian corridor matrix

Stream order	Vegetated riparian zone(VRZ)	RC offsetting for non-RC users	Cycleways andpaths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10 m	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
2nd	20 m	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
3rd	30 m	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes
4th	40 m	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes

Key

Stream order: The watercourse order as classified under the Strahler System using Hydrospatial data as published on the Department's website. A full list is provided at Part 2, Schedule 2 of the Water Management (General) Regulation 2011.

Vegetated riparian zone (VRZ): The required width of the VRZ measured from the top of the high bank on each side of the watercourse.

Riparian corridor (RC) off-setting for non RC uses: Non-riparian uses, such as Asset Protection Zones are allowed within the outer 50 per cent of the VRZ, so long as offsets are provided in accordance with the averaging rule as seen in Figure 3.

Cycleways and paths: Cycleways or paths no wider than four metres total disturbance footprint can be built in the outer 50 per cent of the VRZ.

Detention basins: Detention basins can be built in the outer 50 per cent of the VRZ or online where indicated. Online basins must:

- be dry and vegetated
- be for temporary flood detention only, with no permanent water holding
- have an equivalent VRZ for the corresponding watercourse order
- not be used for water quality treatment purposes.

Stormwater outlet structures and essential services: Stormwater outlets or essential services are allowed in the RC. Works for essential services on a fourth order or greater stream are to be undertaken by directional drilling or tied to existing crossings.

Stream realignment: Indicates that a watercourse may be realigned

Road crossings: Indicates permitted road crossing methods

Applications for controlled activity approvals

Applications for controlled activities approvals should be informed by the riparian corridor matrix shown in Table 2 and prepared using the *Application for a Controlled Activity Approval* for works on waterfront land form and the Guideline for completing an application for a Controlled Activity Approval.

Other controlled activity guidelines are available on the NRAR website and outline relevant considerations for applicants when proposing activities and works on waterfront lands.

Streamlined assessment

Where applications are presented in accordance with the riparian corridor matrix (Table 2) and other controlled activity guidelines, the NRAR will assess them under a streamlined process. This may decrease the amount of time it takes the NRAR to make a determination, saving applicants time and money.

Applications that do not conform to the matrix and/or relevant controlled activity guidelines will continue to be subject to merit assessment to ensure that the proposals meet the requirements of the WM Act. All applications will still need to demonstrate that minimal harm will occur to waterfront land before the NRAR will issue a controlled activity approval.

More information

Find out more about controlled activities on the NRAR website at www.industry.nsw.gov.au/nrar

Contact us

By phone on 1800 633 362 or by email at nrar.enquiries@nrar.nsw.gov.au

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

APPENDIX D – DRAINS MODEL SCHEMATICS AND RESULTS (DETENTION BASINS)

The below screen shots are of the DRAINS model and results. The results in green represent the maximum water level in the associated element across the full range of design storms tested. Note that for the purpose of the model only, an assumed basin/tank floor level RL of 1 was adopted to simplify the modelling process.

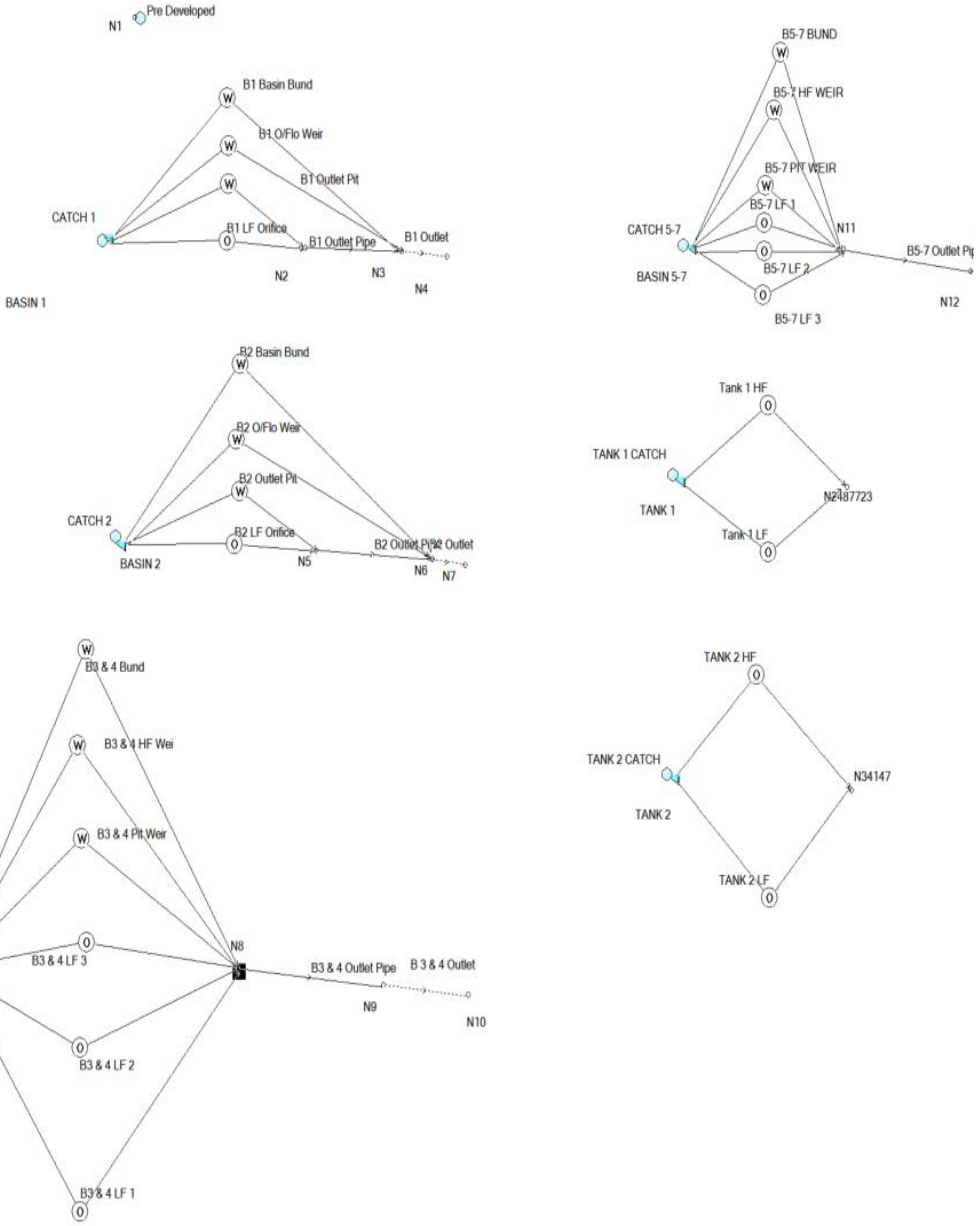
Results in red represent overland flow path flow rates i.e. flow across basin weirs.

The blue results represent the maximum flow rate through an orifice i.e. through basin low level outlets or through tank high or low flow outlet pipes.

Grey numbers represent total catchment flows, prior to detention.

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

Drains Model:



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

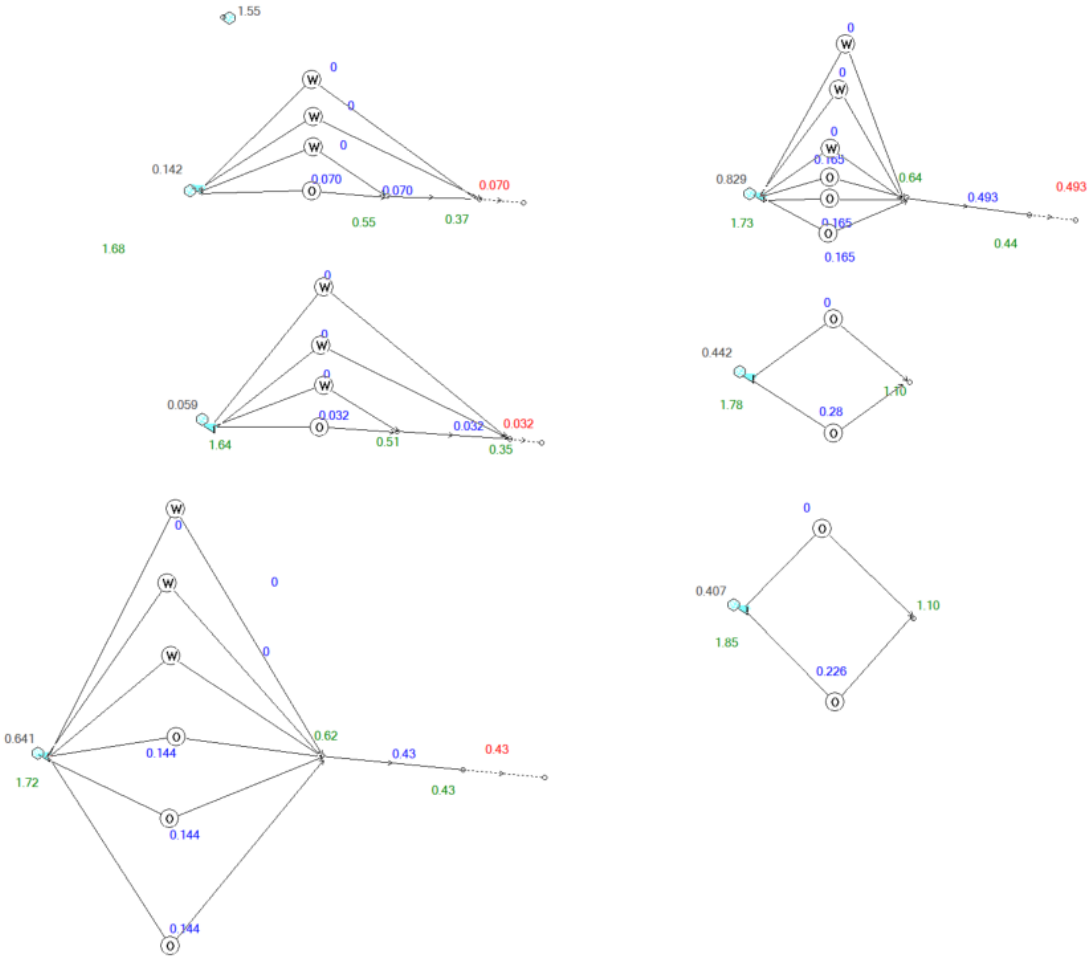
5 YEAR ARI RESULTS

Results for median storm in critical 0.2EY

Run Log for 231130 Yamba 2 DA RFI

Run Log for 231130 Yamba 2 DA RFI.drn - DRAINS run at 14:38:40 on 23/1/2024 using Watercom Drains v2023.06.8567.18365

Flows were safe in all overflow routes.



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

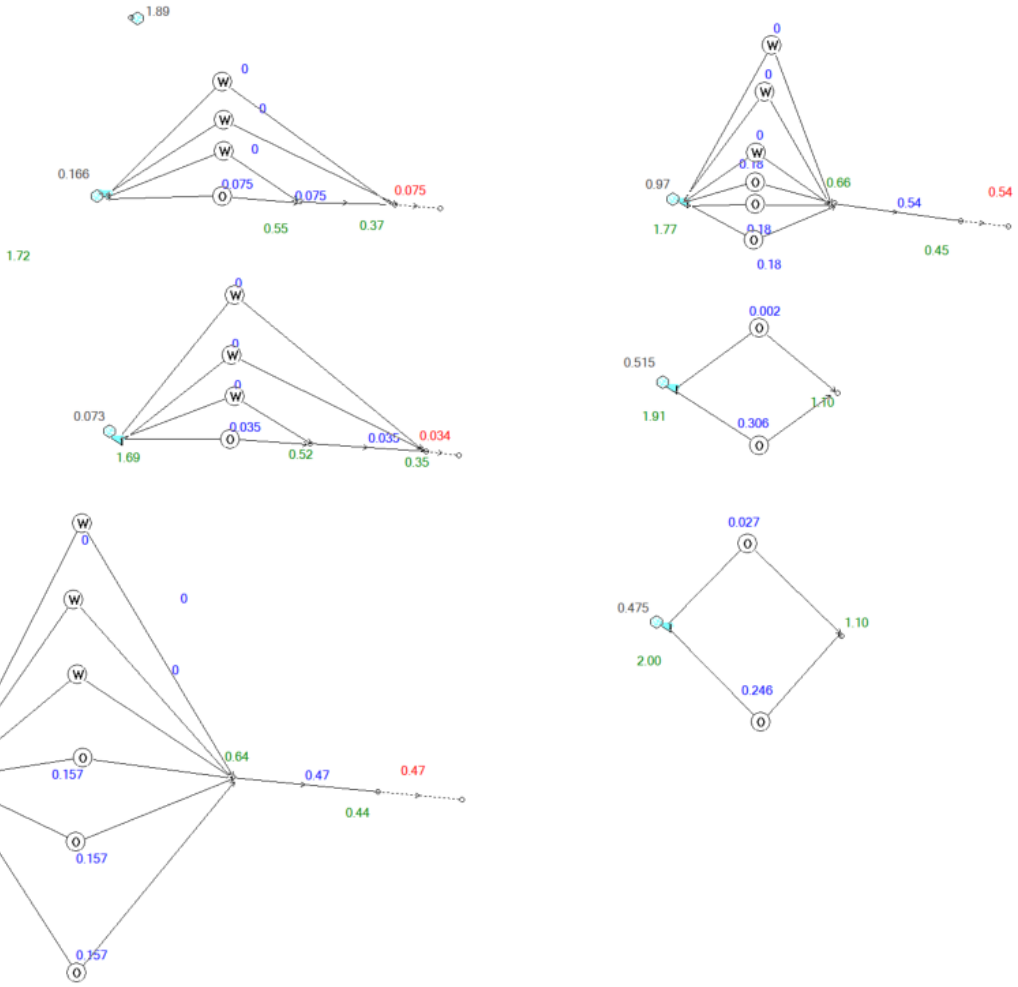
10 YEAR ARI RESULTS

Results for median storm in critical 10% AEP

Run Log for 231130 Yamba 2 DA RFI

Run Log for 231130 Yamba 2 DA RFI.drn - DRAINS run at 14:41:45 on 23/1/2024 using Watercom Drains v2023.06.8567.18365

Flows were safe in all overflow routes.



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

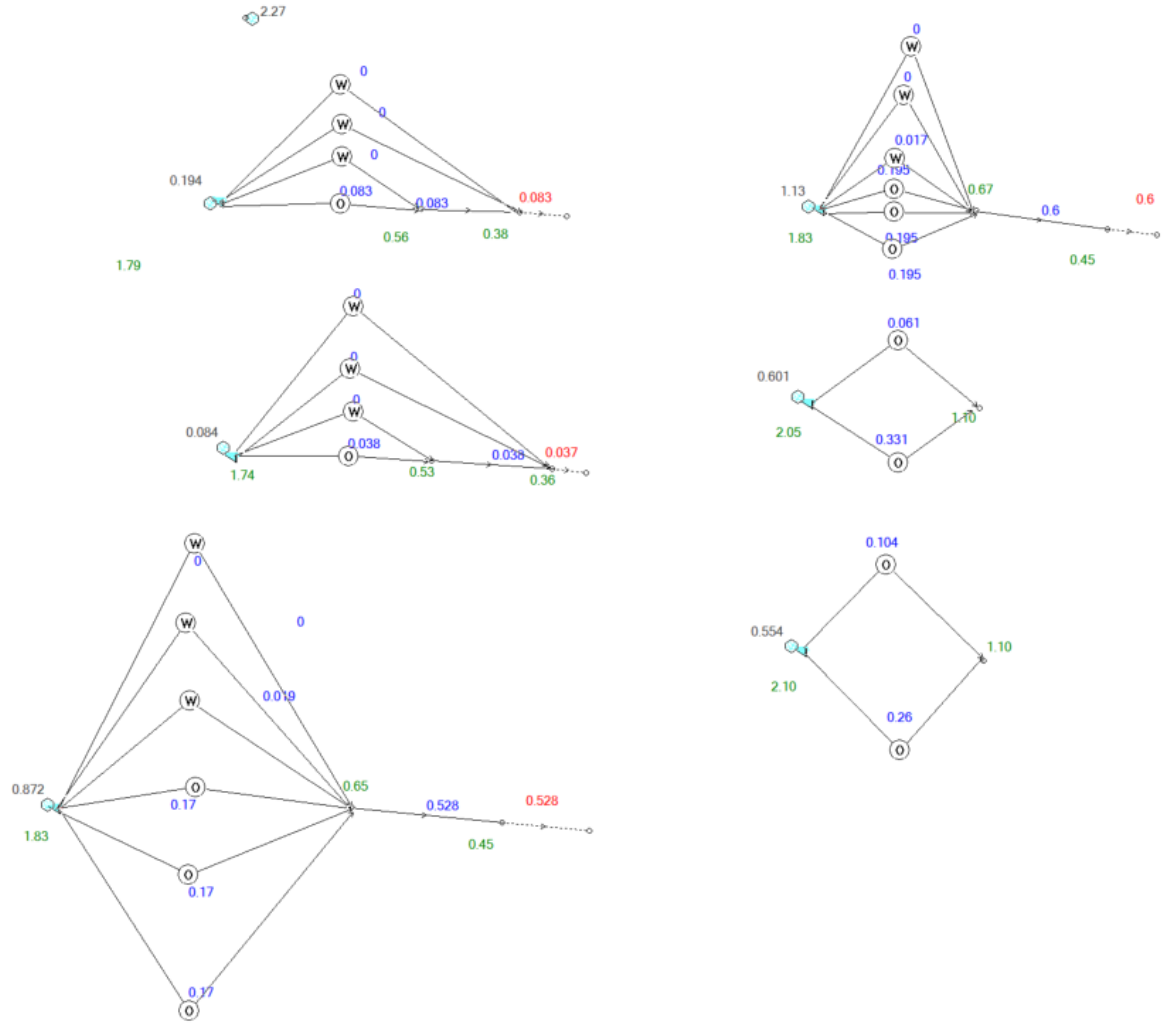
20 YEAR ARI RESULTS

Results for median storm in critical 5% AEP

Run Log for 231130 Yamba 2 DA RFI

Run Log for 231130 Yamba 2 DA RFI.drn - DRAINS run at 14:45:35 on 23/1/2024 using Watercom Drains v2023.06.8567.18365

The maximum flow in these overflow routes is unsafe: B5-7 Outlet



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

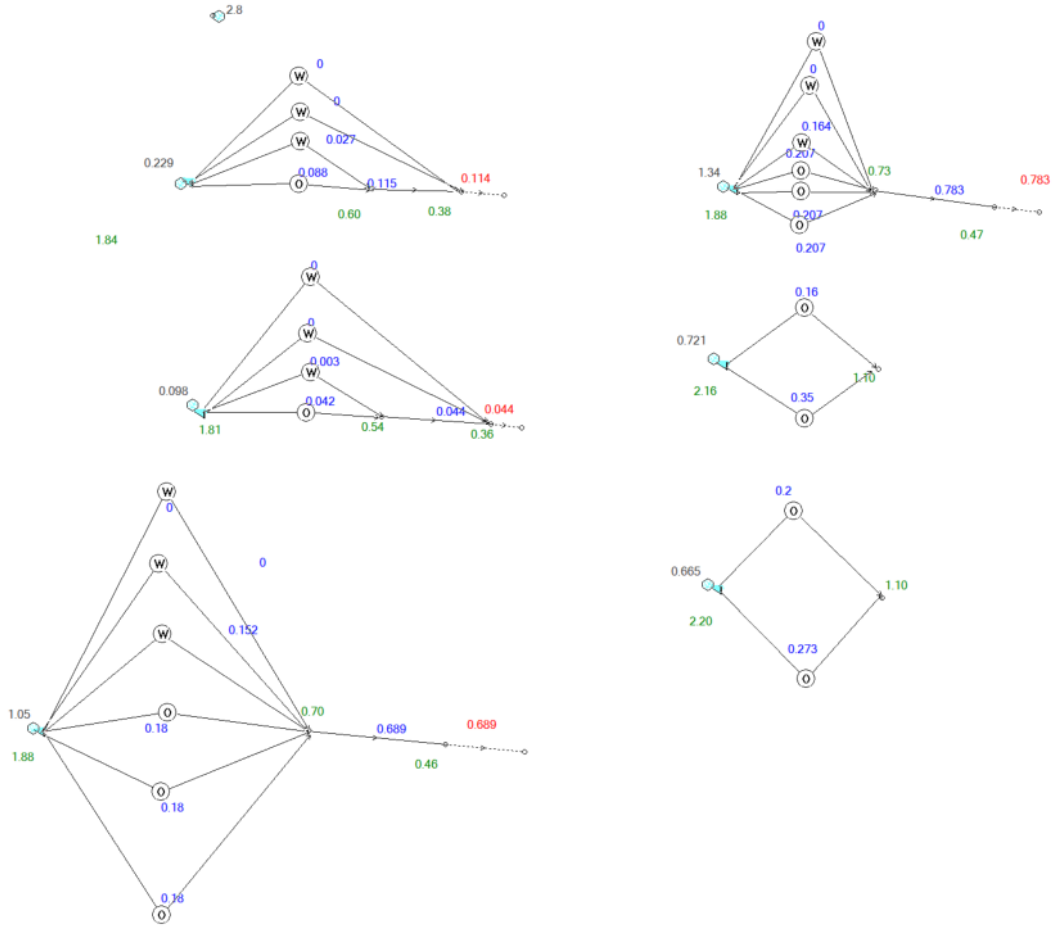
50 YEAR ARI RESULTS

Results for median storm in critical 2% AEP

Run Log for 231130 Yamba 2 DA RFI

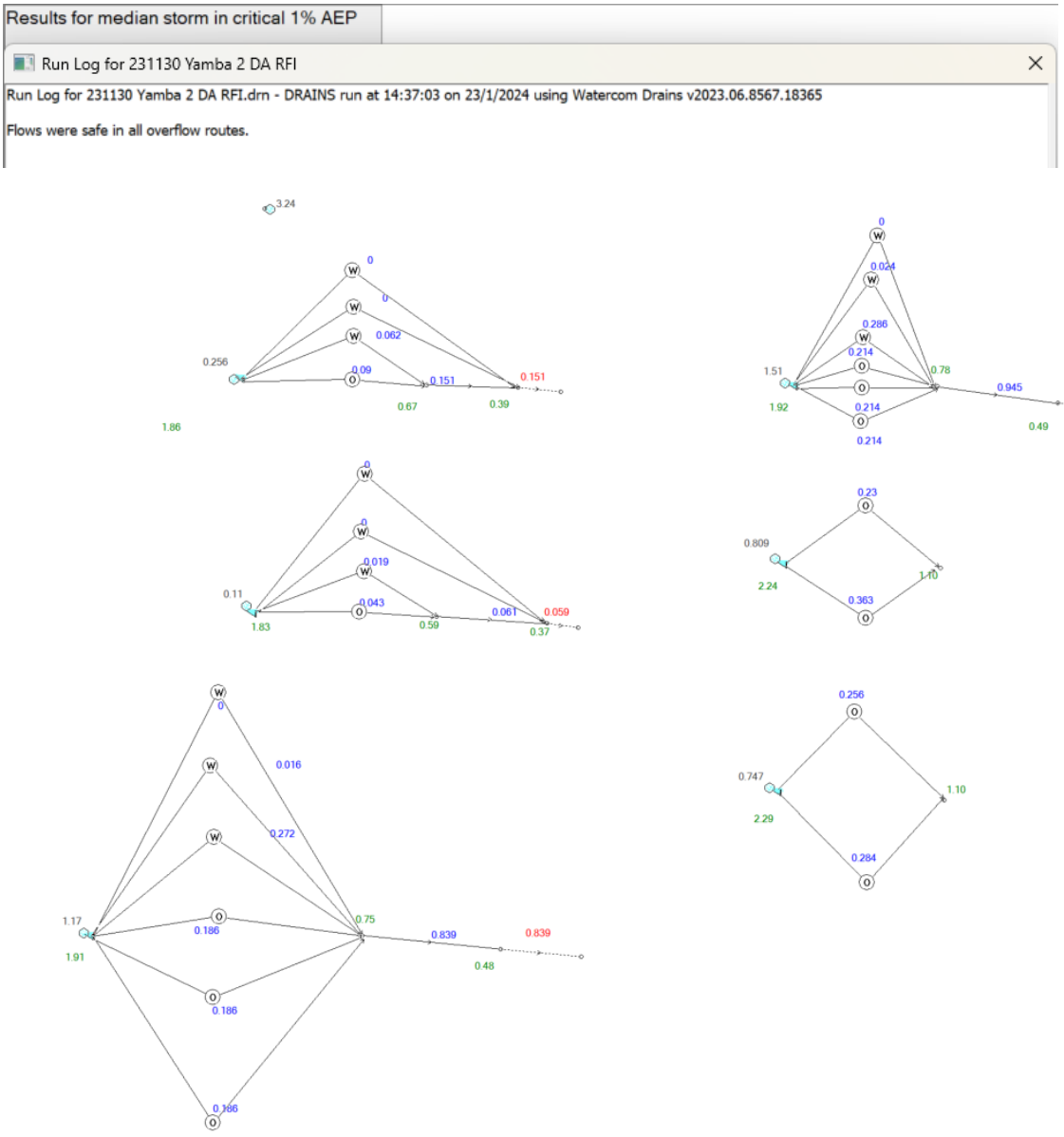
Run Log for 231130 Yamba 2 DA RFI.drn - DRAINS run at 14:52:02 on 23/1/2024 using Watercom Drains v2023.06.8567.18365

Flows were safe in all overflow routes.



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

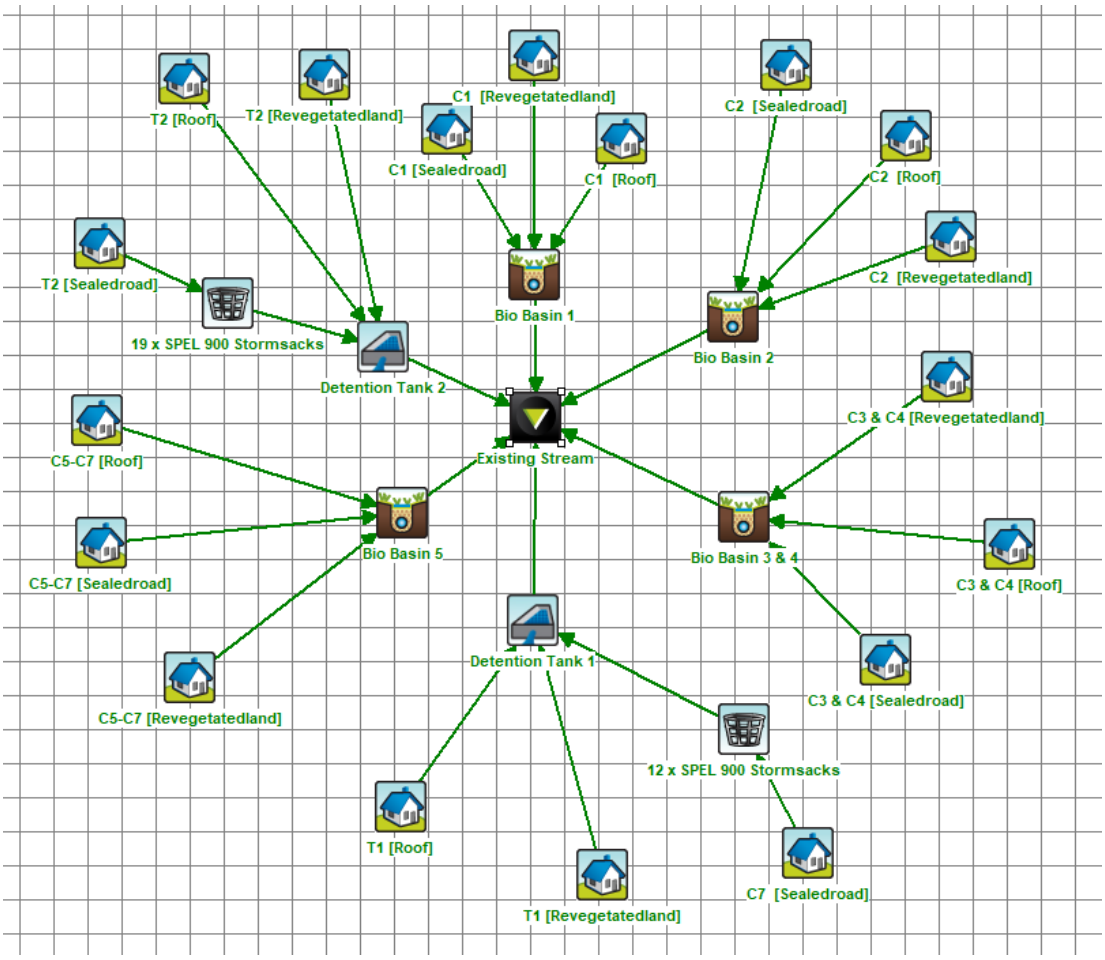
100 YEAR ARI RESULTS



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

APPENDIX E – MUSIC MODEL SCHEMATICS AND RESULTS (BIORETENTION BASINS)

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



Treatment Train Effectiveness - Existing Stream

	Sources	Residual Load	% Reduction
Flow (ML/yr)	67.9	52	23.4
Total Suspended Solids (kg/yr)	9230	972	89.5
Total Phosphorus (kg/yr)	20.2	7	65.2
Total Nitrogen (kg/yr)	153	58.7	61.7
Gross Pollutants (kg/yr)	1460	0	100

MUSIC Model & Treatment Train Effectiveness

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

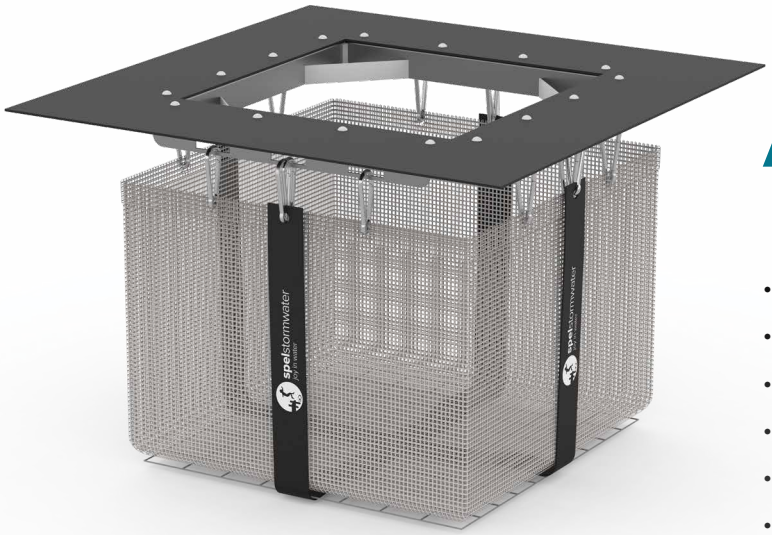
APPENDIX F – PROPRIETARY PRODUCT DETAILS

SPEL Stormsack

At Source Gross Pollutant Trap

spelstormwater
joy in water

spel.com.au



APPLICATIONS

- Council storm drain retrofits
- Commercial / retail / residential
- Litter prone urban areas
- Scrap metal / solid waste / oil storage
- Part of treatment train
- Construction sediment / erosion

BENEFITS

- Can be modelled in MUSIC in conjunction with bio-retention
- Low cost gross pollutant capture
- Quick & easy installation
- Simple maintenance
- At source capture
- Adjusts to custom pit sizes

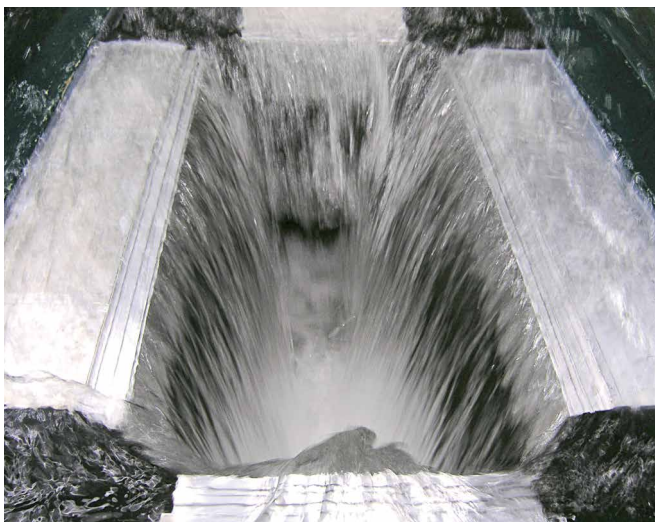
The SPEL Stormsack is specifically designed for the capture of gross pollutants: sediment, litter, and oil and grease. Ideally suited for storm drain retrofits, the SPEL Stormsack's unique design allows maintenance to be performed using conventional vacuum suction equipment.

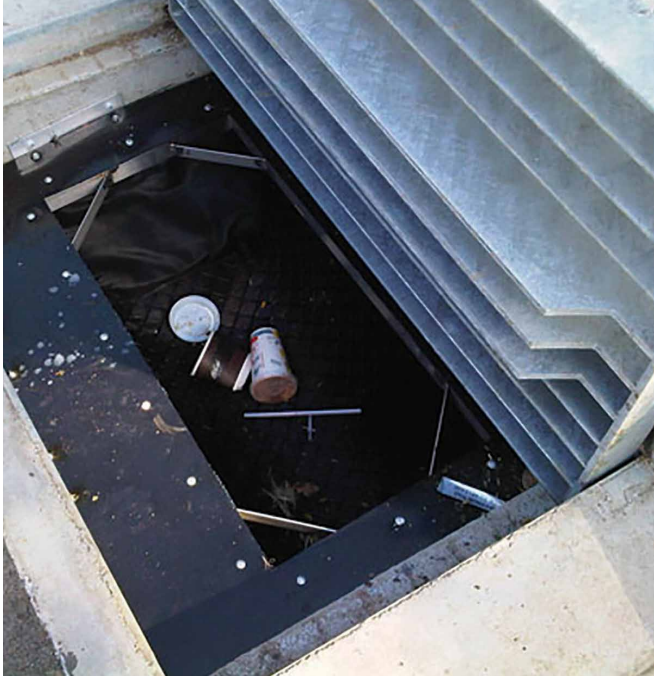
SPEL Stormsack filtration solutions are highly engineered water quality devices that are deployed directly in the stormwater system to capture contaminants close the surface for ease of maintenance. Easily retrofitted into new or existing structures, SPEL Stormsack filtration technology is a decentralized approach to stormwater treatment that essentially repurposes traditional site infrastructure and customizes it to meet specific site water quality goals. In this way, it satisfies important objectives of today's LID (Low Impact Development) criteria.

From an operations perspective, catch basins with SPEL Stormsack filters are also easier and quicker to clean out because pollutants are trapped just under the grate.

The SPEL Stormsack was introduced to the Australian market in 2012 and field testing is underway at several locations in South-east Queensland. Laboratory testing has shown capture of 99.99% of gross pollutants up to the bypass flow rate.* Further results will be provided as they become available.

Recommended minimum clearance from bottom of SPEL Stormsack to inside bottom of vault is 50mm. Typical frame adjustability range of 127mm in each direction.





HOW IT WORKS

This technology is a post developed stormwater treatment system. The SPEL Stormsack provides effective filtration of solid pollutants and debris typical of urban runoff, while utilising the existing or new storm drain infrastructure. The Stormsack is designed to rest on the flanges of conventional catch basin frames and is engineered for most hydraulic and cold climate conditions.

Installation procedures shall include removing the storm grate, cleaning the ledge of debris and solids, measuring catch basin clear opening and adjusting flanges to rest on grate support ledge. Install SPEL Stormsack with splash guard under curb opening so the adjustable flanges are resting on the grate support ledge. Install corner filler pieces. Reinstall storm grate directly on support flanges rise shall be no more than 3mm.

Maintenance: Typically the SPEL Stormsack is serviceable from the street level, and therefore maintenance does not require confined space entry into the catch basin structure. The unit is designed to be maintained in place with a vacuum hose attached to a sweeper or a vactor truck. Use only SPEL replaceable parts.

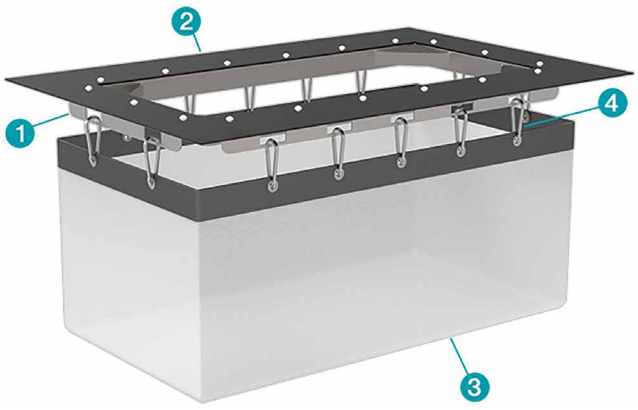
FEATURES

Pollutant	Efficiency
Gross Pollutants (GP)	100%
Total Suspended Solids (TSS)	61%
Total Phosphorus (TP)	28%
Total Nitrogen (TN)	45%

*Contact Spel to confirm approved performance for the project LGA

Application	Regulatory Issue	Target Pollutants
Council Storm Drain Retrofits	At-source litter capture	Sediment, Litter, O&G
Commercial/Retail/Residential	Stormwater Compliance	Sediment, Litter, O&G
Litter Prone Urban Areas	Cost effective litter control	Litter ≥ 5 mm
Scrap Metal/Solid Waste/Oil Storage/Etc	Industrial Multi-Sector General Permit	Gross Pollutants, O&G
Part of Treatment Train	Council Stormwater Quality Improvement Targets	Sediment, Litter, O&G
Construction Sediment/Erosion	Sediment Control Plan	Sediment/Erosion Control

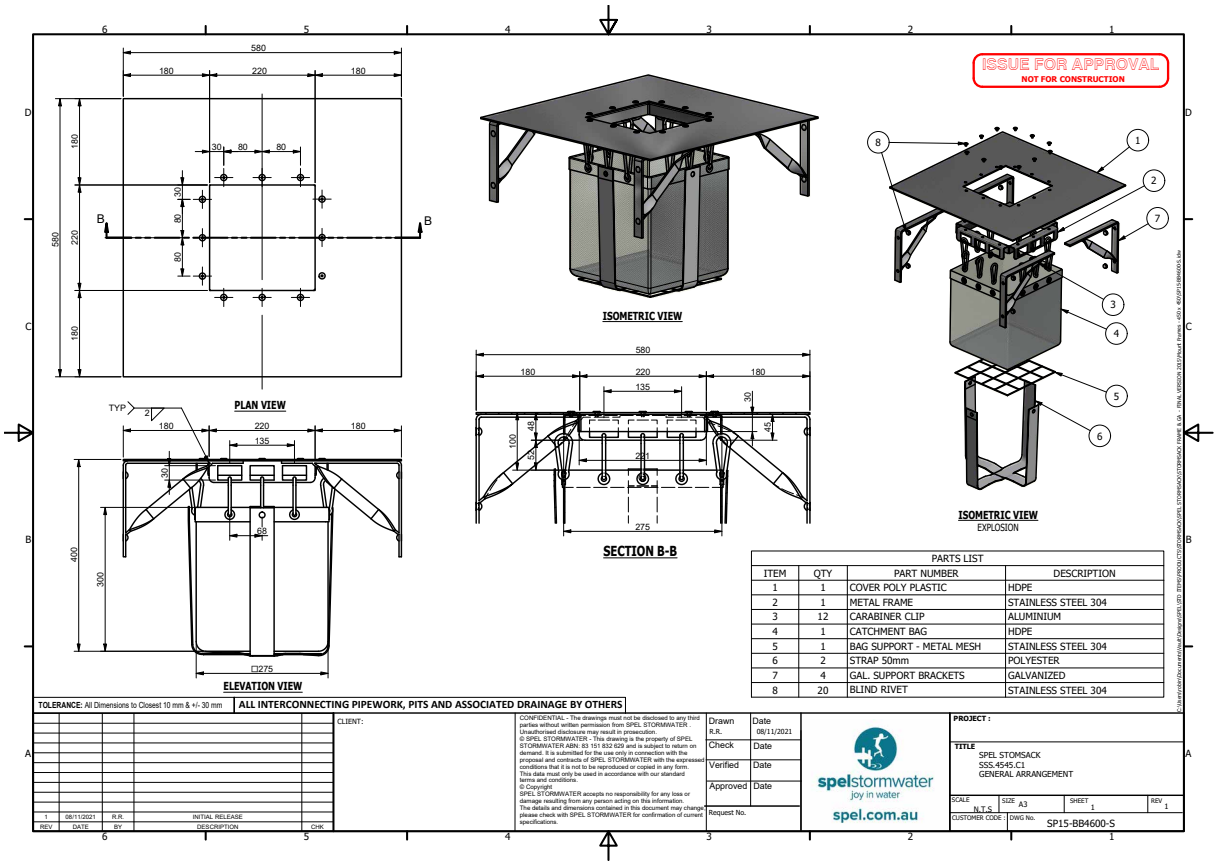
Features	
1.	1. Ultra-Durable Aluminium Frame • Available in 450x450mm, 600x600mm, 600x900mm and 900x900mm sizes • Custom pit arrangements upon request
2.	Black Poly Surround riveted to Frame • Can be cut to suit on site
3.	Reinforced Stormsack Bag • Bag has sewed eyelets • Square bottom design for even distribution
4.	Karabiners attach Bag to Frame for easy service & replacement
5.	5. Aluminium Support Angles & Fixings

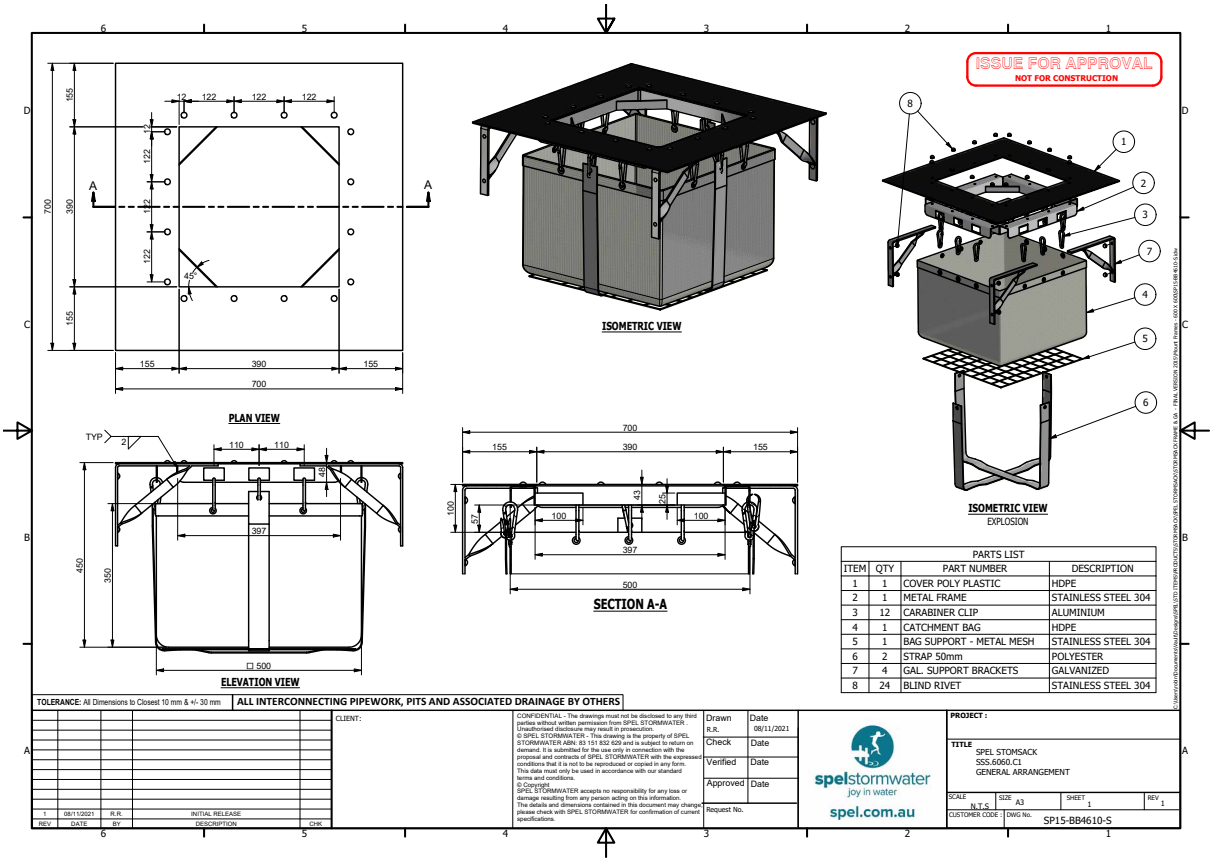


Standard SPEL Stormsack to suit Pit Sizes
450x450mm
600x600mm
900x600mm
900x900mm

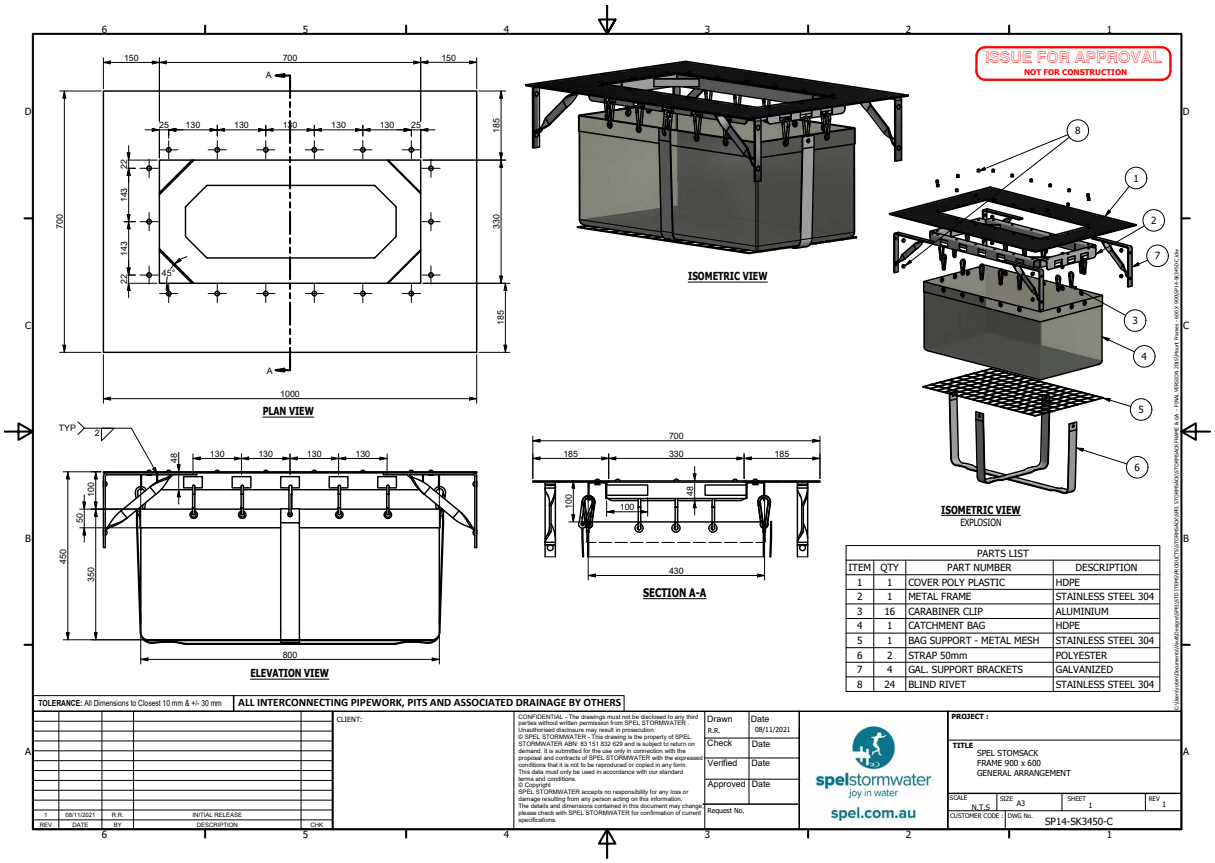
Custom sizes (i.e. 1200x900mm) can be manufactured on short lead times

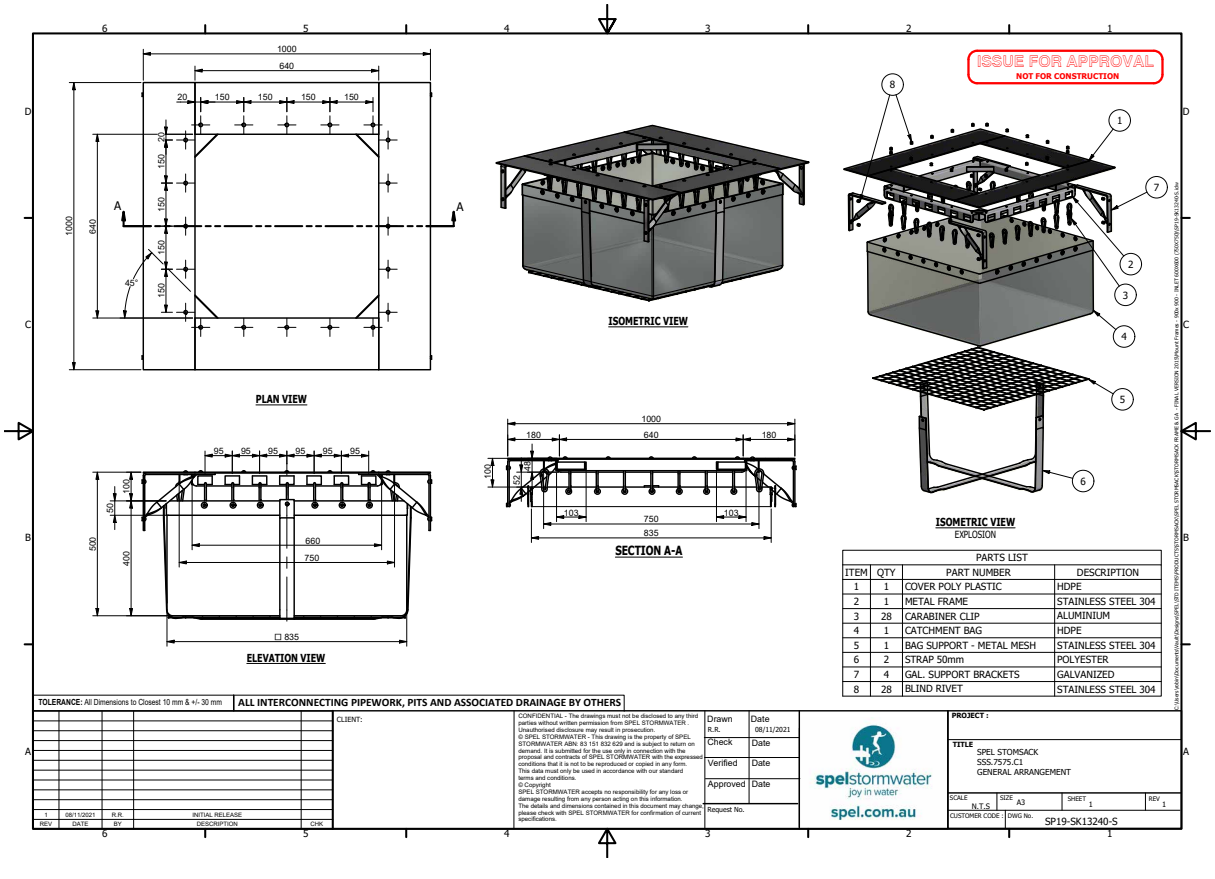
TECHNICAL DRAWINGS



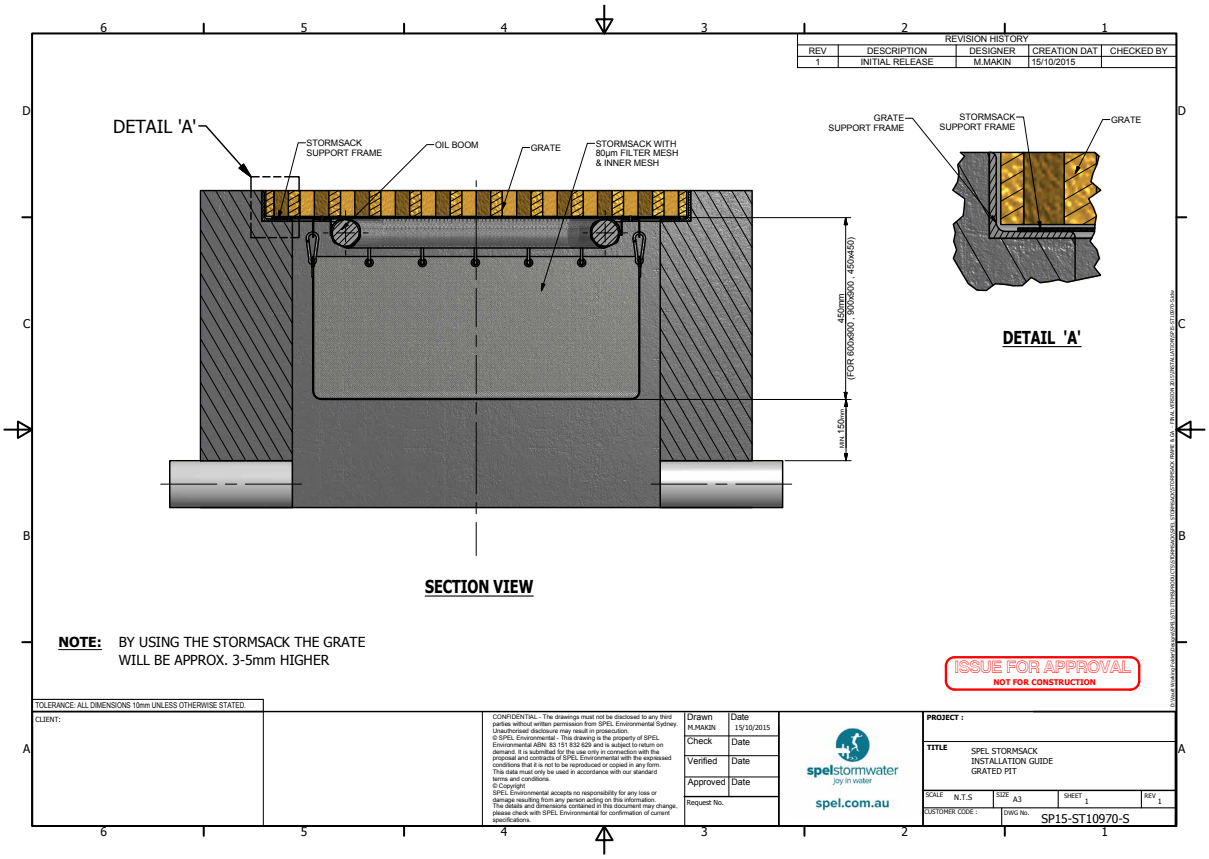


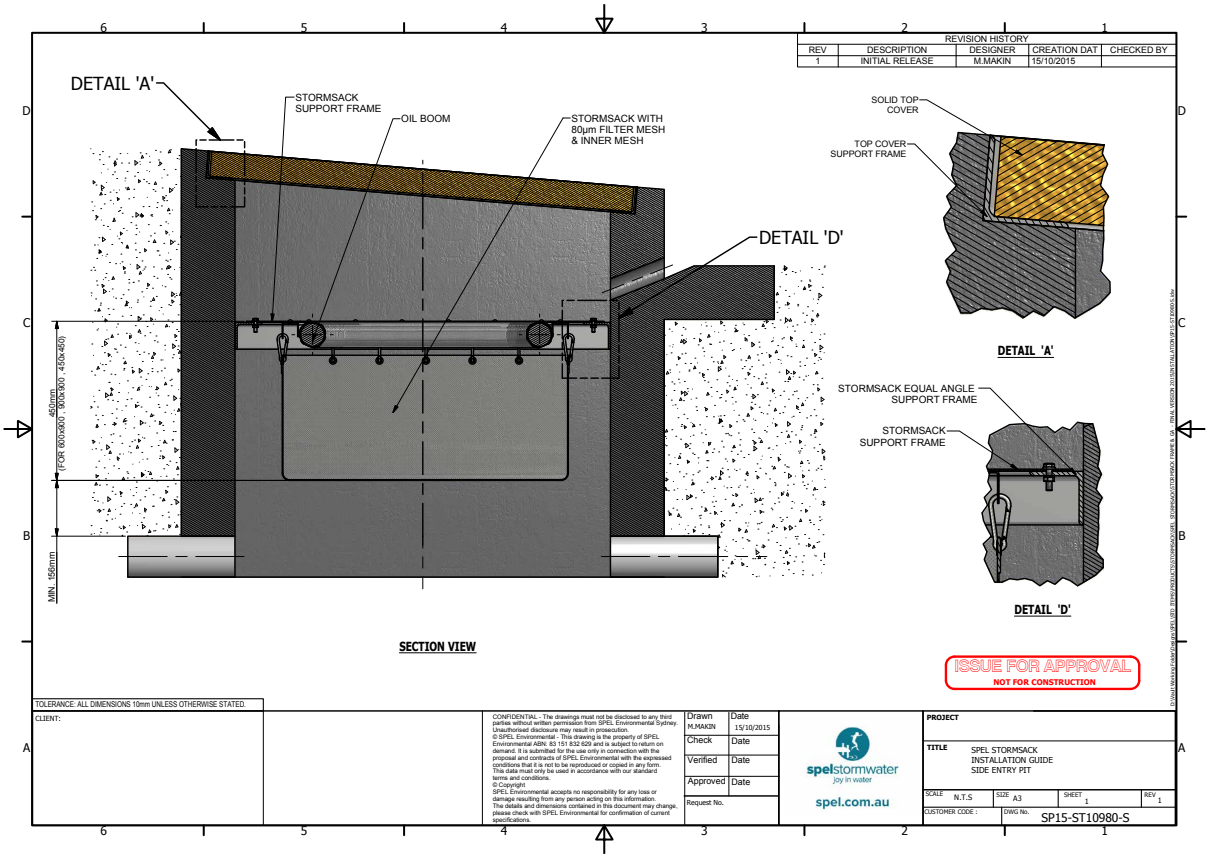
TECHNICAL DRAWINGS





INSTALLATION DETAILS





SPEL Stormsack

At Source Gross Pollutant Trap

NSW HEAD OFFICE 100 Silverwater Rd, Silverwater NSW 2128 PO Box 7138, Silverwater NSW 1811 P: +61 2 8705 0255 P: 1300 773 500 E: nsw.sales@spel.com.au	**QLD MAIN OFFICE** 130 Sandstone Pl, Parkinson QLD 4115 P: +61 7 3271 6960 P: 1300 773 500 I E: qld.sales@spel.com.au **QLD SUNSHINE COAST BRANCH** 19-27 Fred Chaplin Circuit, Bells Creek, QLD 4551 P: 1300 773 500 I E: qld.sales@spel.com.au	**VIC & TAS OFFICE** 897 Wellington Rd Rowville VIC 3178 P: +61 3 5274 1336 P: 1800 810 139 I E: sales@spel.com.au **VIC GEELONG BRANCH** 70 Technology Close, Corio, P: +61 3 5274 1336 P: 1800 810 139 I E: sales@spel.com.au
SA OFFICE 9 Hampden Road, Mount Barker SA 5251 P: 1300 773 500 E: sales@spel.com.au	**WA OFFICE** 2 Modal Crescent Canning Vale WA 6155 P: +61 8 9350 1000 P: 1800 335 550 E: sales@spel.com.au	**NZ OFFICE AUCKLAND** 100 Montgomerie Road Airport Oaks P: +64 9 276 9045 E: sales@spel.com.au
NZ OFFICE WANGANUI 43 Heads Road Wanganu New Zealand P: +64 6 349 0088 I E: sales@spel.com.au	**NZ OFFICE WELLINGTON** 41 Raiha St Porirua Wellington New Zealand P: +64 4 239 6006 I E: sales@spel.com.au	**PHILIPPINES OFFICE METRO MANILA** Unit 2210 Lumiere Residences Pasig Boulevard, Pasig City P: +61 2 8705 0255 P: 1300 773 500 E: sales@spel.com.au
SINGAPORE OFFICE 512 Chai Chee Lane, #06-04 Bedok Industrial Estate, Singapore 469028 P: +61 2 8705 0255 P: 1300 773 500 I E: sales@spel.com.au	**UK OFFICE UNITED KINGDOM** Lancaster Rd Shrewsbury SY1 3NQ UK P: +44 (0)1743 445200 I E: sales@spel.com.au	**USA OFFICE CLEVELAND** 4548 Industrial Parkway Cleveland, Ohio 44135 P: +61 2 8705 0255 P: 1300 773 500 E: sales@spel.com.au

We believe clean water is a right not a privilege and we work to ensure a joy in water experience for you with your children and grandchildren.

spelstormwater
joy in water

100 Silverwater Rd, Silverwater NSW 2128 Australia
Phone: (02) 8705 0255
Email: sales@spel.com.au
spel.com.au

Atlantis®
GREEN CITIES FOR LIFE

Product Version

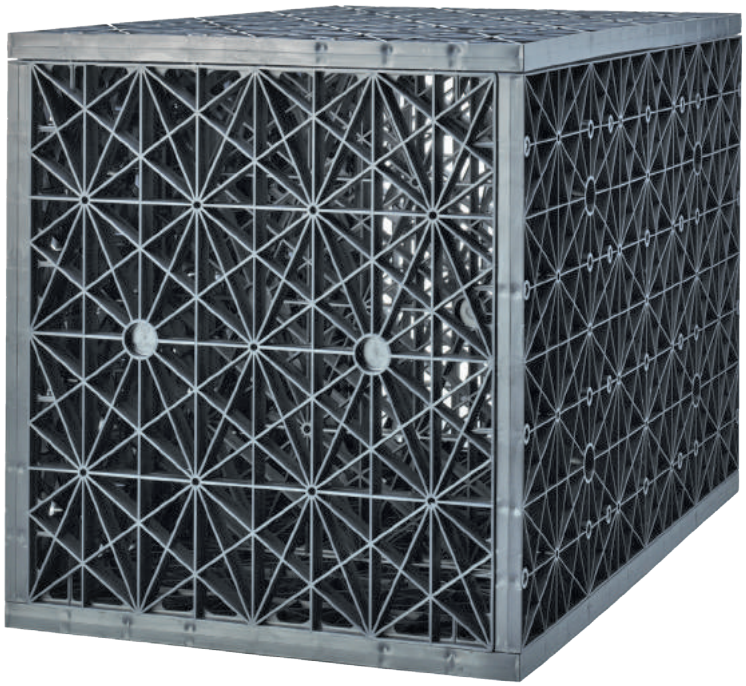
Flo-Tank® XD

Document ID

15-05-2017 PM/CU

Flo-Tank®

MODULAR UNDERGROUND TANK SYSTEM



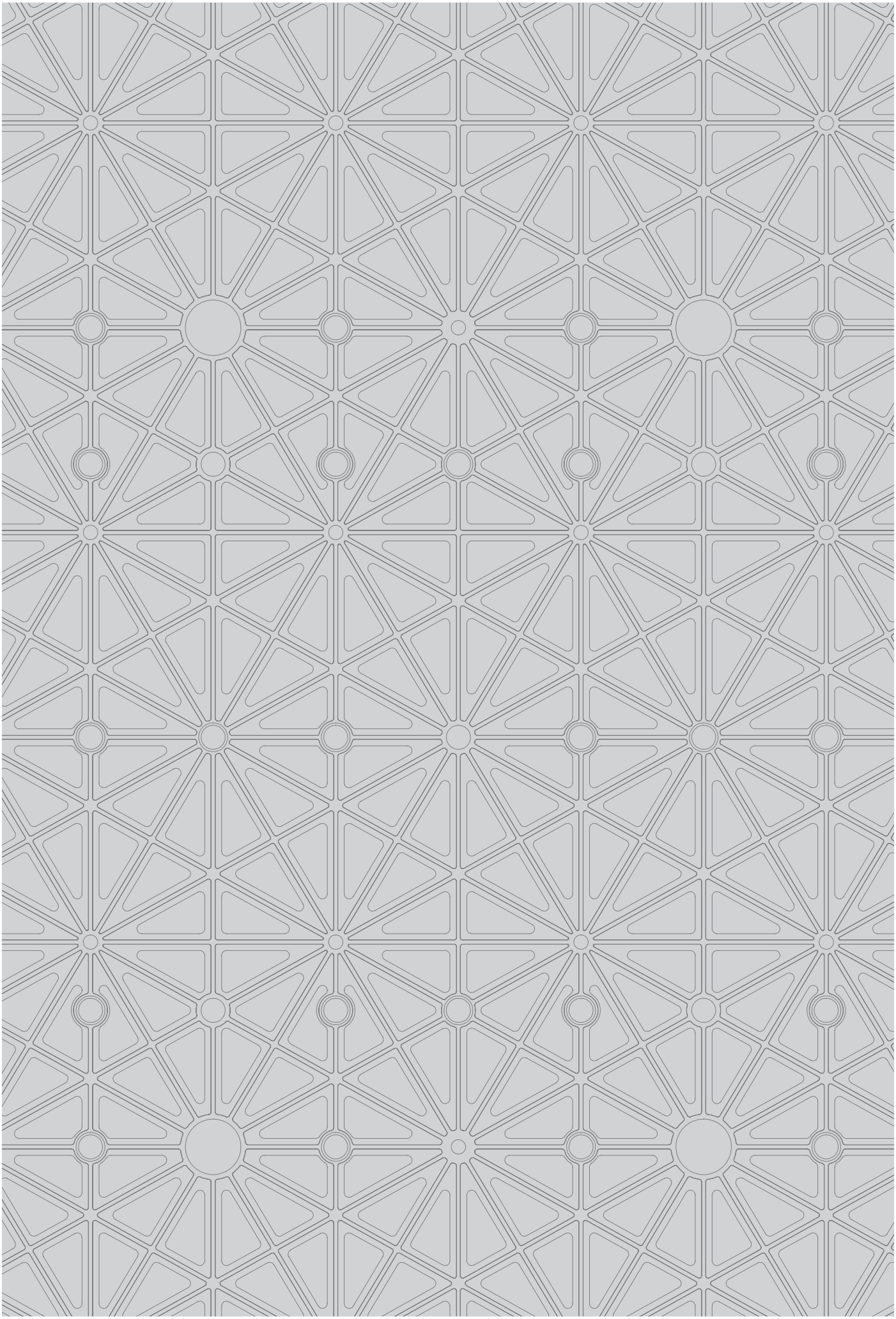
APPLICATIONS COVERED:

- Infiltration Tanks
- Re-use Tanks (Rainwater Harvesting Tank)
- O.S.D (On site Detention Tanks)

Assembly & Installation Guide

2017

www.atlantiscorporation.com.au



Contents

Additional Materials Required

Backfill Materials

- Washed River Sand (Technical specifications available upon request)
- Aggregate / Gravel 20mm (3/4”) (Technical specifications available upon request)
- Growing Media, in accordance to local guidelines.

Other Materials

- Duct Tape
- Firestone Butyl Tape or equivalent (For pipe boot connections to liner)
- Stainless Steel Pipe Clamps
- PVC Pipes

Machinery

- Hand Held Compactor
- Excavation Machinery
- Equally distributed load light vehicle (PT-30/50 Terex or similar)

Geo Membranes

- Hydrophilic Geotextile
- Geo Grid, BX-1200 or equivalent if specified by engineer.
- Plastic Liner
  - 0.75 mm (0.03”) HDPE (Suitable for welding)
  - 1 mm (0.04”)HDPP (Suitable for welding)

Pre Filtration Devices

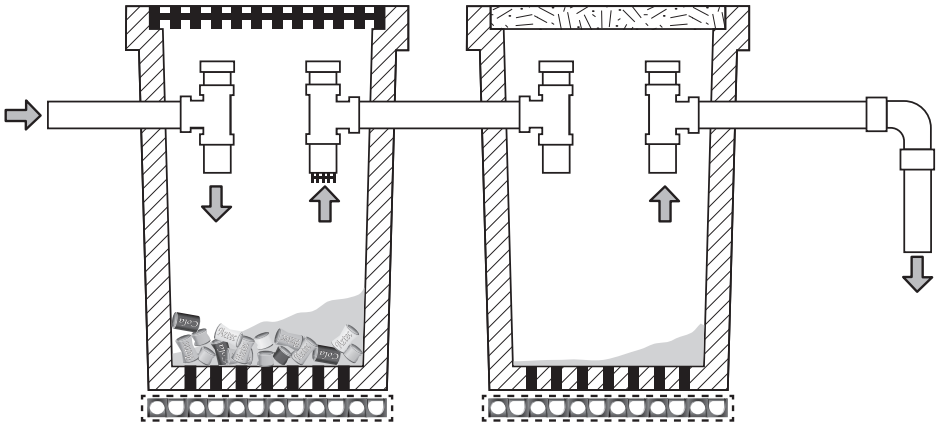
- Atlantis Flo-Screen® small
- Atlantis Flo-Screen® large
- Standard Sediment and Gross Pollutant Trap
- Expanded steel mesh, galv. /zinc coated (Maximesh RH3030 or equiv.)
- Proprietary Sediment, Grease and Gross Pollutant Traps from various manufacturers
- Infiltration Swales with Flo-Tank® or Flo-Channel® for optimum flush-out.

Atlantis Flo-Screen® filtration units

These in line filters are designed to remove gross pollutants, such as vegetation matter and silt from roofs and stormwater pits before allowing water to enter the Atlantis tank system.

Double Pit Design Sediment & Gross Pollutant Trap for Commercial Applications

This in line filter removes gross pollutants and sediments from entering the Atlantis modular tank system. It is assembled on site from standard stormwater components commonly available in the market place. This pit design is scalable to suit the flow requirements of the project.



1. THE DESIGN AND PRE-CONSTRUCTION PROCESS

I. ADHERENCE TO LOCAL DESIGN STANDARDS

The tank system has to be engineered to achieve the hydraulic function as per local requirements and national design standards (AS3500: Plumbing and Drainage for Australia and New Zealand). Hydraulic modelling and calculations are to be undertaken and the plans prepared and approved for construction.

Structural Engineering design plans must provide adequate Partial Factors of Safety for static and dynamic loads as relevant per AS4678: Earth Retaining Structures, AS2566: Buried Flexible Pipelines, AS5100: Bridge Design, AS1170: Structural Design Actions and all standards deemed appropriate for buried rainwater tanks or water channel systems. For International Design Guidelines refer to CIRIA C680: Structural design of modular geocellular drainage tanks.

For long term design strengths contact Atlantis for creep factors. Also for any other technical enquiry contact Atlantis Technical Department.

II. GEOTECHNICAL FACTORS

Geotechnical factors that must be taken into consideration include ground water tables that vary seasonally, those soils that are prone to liquefaction, ground slope stability and soil movements etc.

All necessary geotechnical testing must be done during the design stage, testing type of substrates, depth of substrate layers, slope stability, moisture content, groundwater level etc. All such documents and reports are to be provided to the design engineering team.

Where it is expected the site is contaminated with high concentrations of acid, hydrocarbons or any other chemicals of high concentration, a site specific soil test on the nature of the substrate should be undertaken. Contact Atlantis for the Material Safety Data Sheet to see if the product is suitable for the tested substrate.

III. STRUCTURAL DESIGN

The excavation for Atlantis tank modules is defined by depth and area:

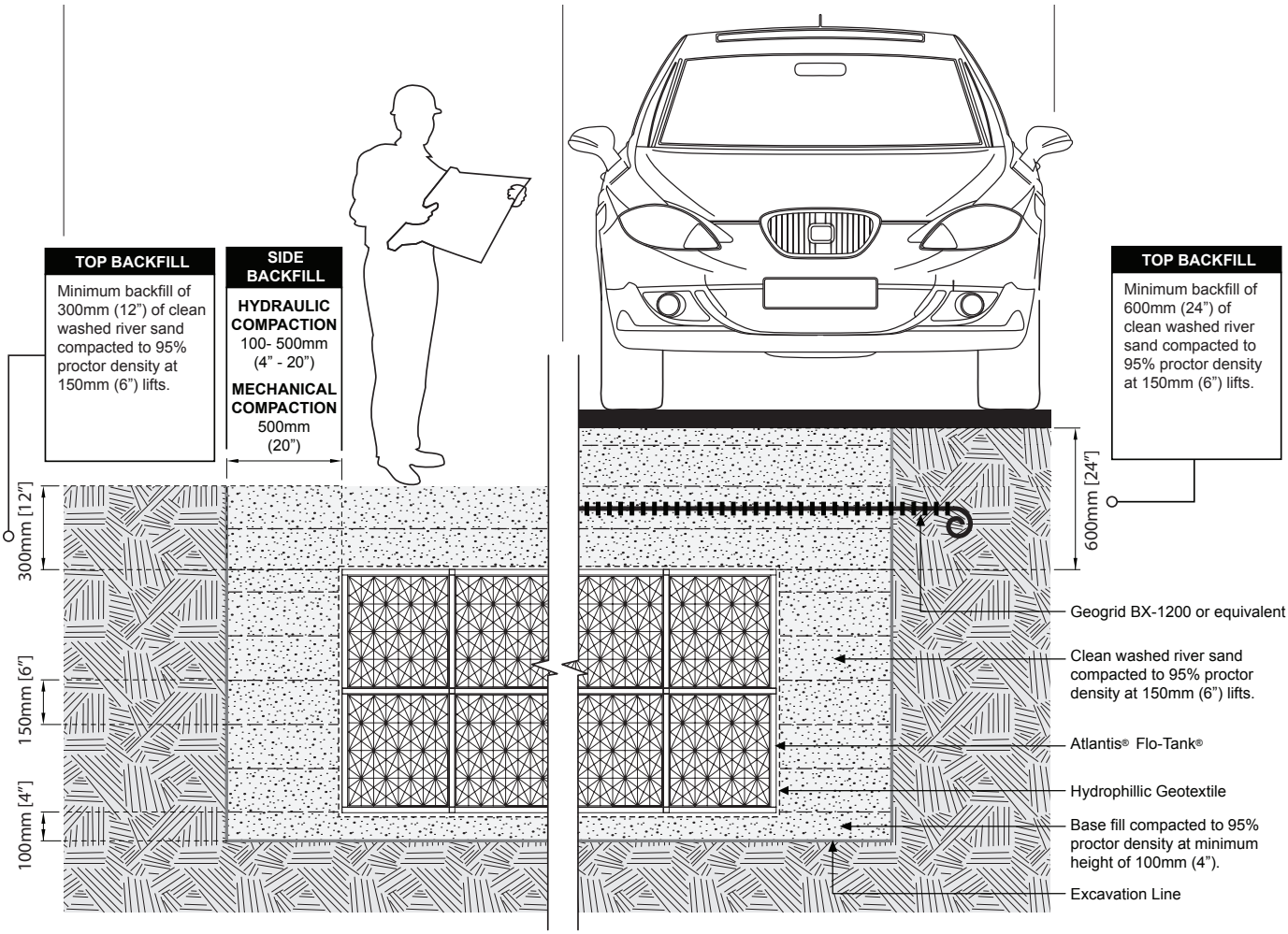
EXCAVATION DEPTH = Base Fill + Tank Height + Specified Backfill Height
EXCAVATION AREA = Tank Footprint + Minimum Side Backfill

Three factors influence the forces acting on a buried tank: i) type of load ii) the magnitude of the load and iii) the depth beneath ground level.

The soil weight and any permanent structure above the tank define the “dead load”. Traffic loads such as pedestrians, cars and trucks define the “live load”. A deeper excavation spreads the live load out more, however results in a heavier dead load due to more soil above. The shallower excavation although has a more concentrated live load will have less weight due to the soil. Looking at these factors (and several others factors in structural geotechnics), a safe working depth can be prepared.

The table below is a guideline for a standard 4 plate Atlantis Flo Tank. The traffic load is assumed for a 3 tonne, 2-axle car load. Please note that the Flo Tanks can be designed to easily withstand multiple axle trucks by increasing the top backfill depth and increasing the number of Internal plates in the Flo Tank. Please contact Atlantis Technical to help you design a system that caters for your site-specific requirements.

FILL	PEDESTRIAN TRAFFIC (MM	VEHICLE TRAFFIC (MM)
BASE	100	100
SIDE*	300	600
TOP BACKFILL**	300	600



***SIDE BACKFILL:**

For installations that have limited footprint available, 100mm (4") can be applied if approved by specifying engineer. Narrow side backfill must be compacted to 95%. For installations into reactive soils or clay a minimum of 500mm (20") side backfill is required.

****MAXIMUM BACKFILL:**

This depends on the type of Atlantis system used. Typically for a 9 plate Atlantis Flo Tank the maximum backfill is 4.0m, but there are other factors involved such as magnitude and type of load, type of backfill and its density etc. Please contact our technical department to take a look into your specific site requirements.

IV) ZONE OF INFLUENCE OF THE TANK

The zone of influence of the tank determines an area of soil, around the tank, that supports and influences it. For this reason it is important to look into the zone of influence and determine safe installation distances to structural footings and heavy traffic.

a) For Permanent surrounding structures.

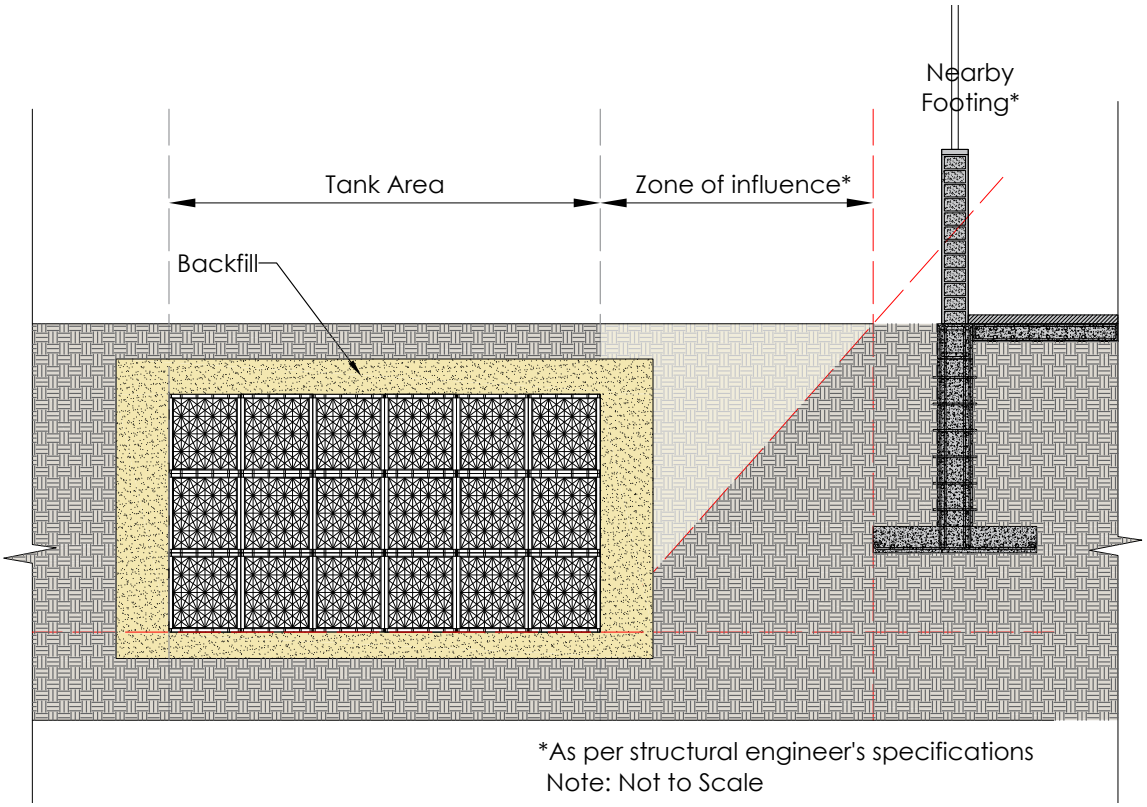
Before excavating please check soil types to determine the minimum distance of the excavation from existing structures. The table below provides a guideline for minimum setback to existing structures in different soil types. A structural engineer to be contracted to determine site specific setback between the tanks and the structural footing.

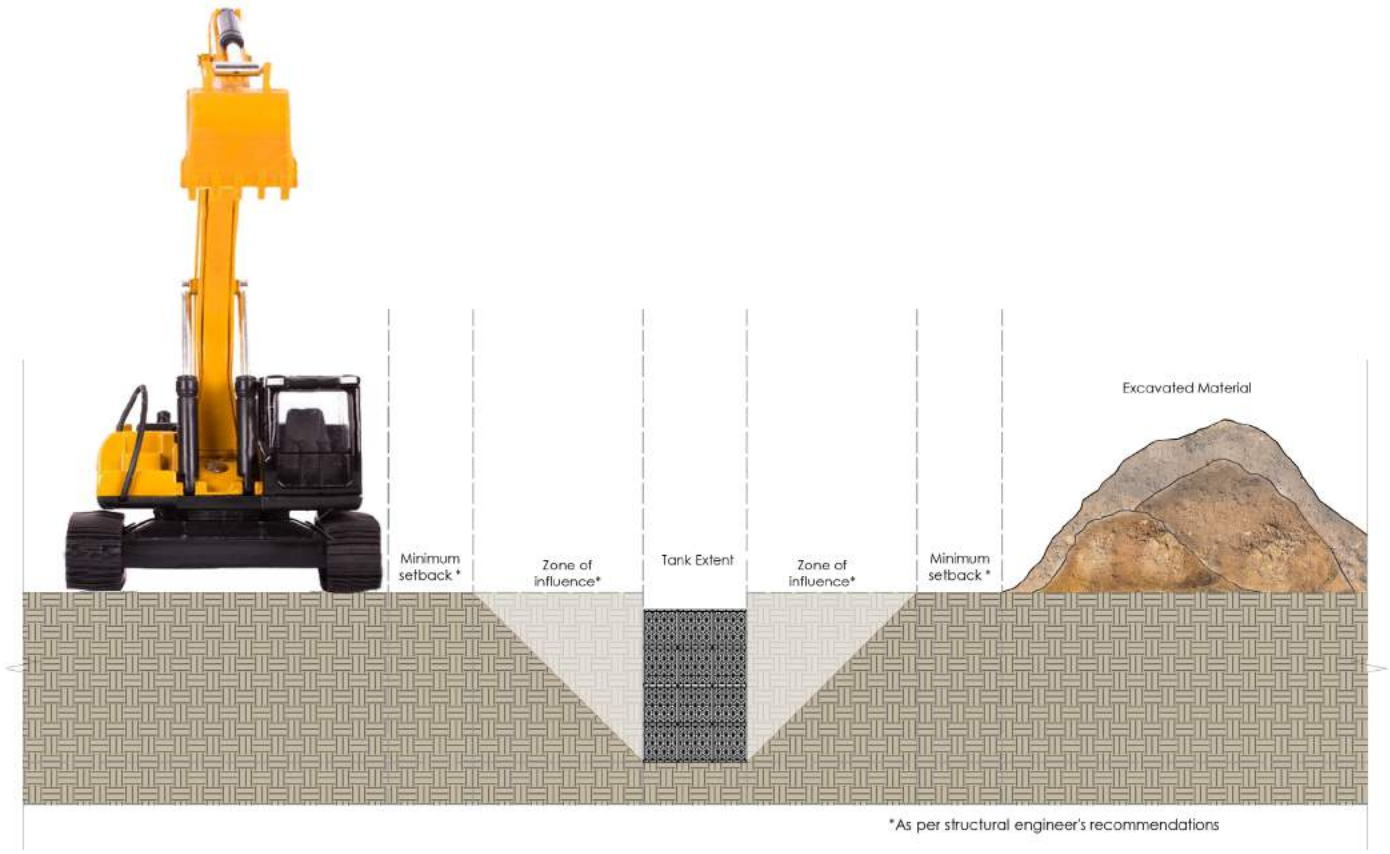
Soil Type	Typical Hydrailic Conductivity (cm/s)	Typical Hydraulic Conductivity (mm/hr) (inches/hr)	Modification Factor (U)	Minimum setback distances from structures and boundaries (m) (ft)
Sand	5.00E- 03	180 (7.08”)	0.5	1.0 (3.28 ft.)
Sand Clay	1.00E-03 - 5.00E-03	36 - 180 (1.42 - 7.08”)	1.0	2.0 (6.56 ft.)
Weathered of Fractured Rock	1.00E-04 - 1.00E-03	3.6 - 36 (.14 - 1.42”)	-	2.0 (6.56 ft.)
Medium Clay	1.00E-04 - 1.00E-03	3.6 - 36 (.14 - 1.42”)	2.0	4.0 (13.12 ft.)
Heavy Clay	1.00E-06 - 1.00E-04	0.036 - 3.6 (0.0014 - 0.14”)	2.0	5.0 (16.40 ft.)

b) For Construction equipment and machinery.

The structural engineer is to determine the zone of influence and the safe distance of heavy machinery and plants from the excavation. In some cases a ground support system may be required and designed by the structural engineer.

All construction traffic, excavated material, plants and heavy equipment are to be clear of the limits of excavation determined by the zone of influence until the project is completed and approved by engineer or project manager in charge.





2. THE CONSTRUCTION OF THE ATLANTIS SYSTEM

Review Atlantis installation procedures thoroughly, if in doubt contact Atlantis Technical support team at technical@atlantiscorp.com.au or call Atlantis on +61 2 9417 8344 on Australian Eastern Standard time between 8:30am and 5 pm Monday to Friday.
Visit the website https://www.timeanddate.com/worldclock/australia/sydney for current time difference from your location.

Carefully plan and coordinate the installation of the Atlantis system with other work on the project such as grading, excavation works, utilities installation, construction of access roads, site compaction and erosion management. The following documents shall be submitted to the builders on site: Geotechnical testing report and all relevant design information (elevation plans, site photos, hydrological/hydraulic studies etc.)

I. THE CONSTRUCTION OF THE ATLANTIS SYSTEM

Installation must be performed only by skilled and competent contractors with satisfactory record of performance and quality on underground installations. Multiple contractors may need to be employed for the overall job.

Contractors must adhere to the Atlantis installation guidelines and engineering specifications. If the plans or drawings conflict with our installation guide, please notify our technical department.

II. CONSTRUCTION & SITE TRAFFIC

Keep all construction traffic away from the limits of excavation determined by the zone of influence calculations until the project is completed and final surface materials are in place as approved by engineer or project manager in charge. Also mechanical plant and storage of materials (including excavated material) or any other heavy loads should not be located in the ‘zone of influence’ of an excavation.

III. EXCAVATION

In any excavation project, intelligent planning is mandatory. All excavations should take into account adjacent structures and how the excavation can affect existing footings, pipelines and services already buried underneath the ground. Before engaging in excavation the following must be looked at:

- Refer to a site-specific latest survey and ensure the survey includes an area beyond the site of interest and into properties directly adjacent in all sides of the excavation. This will give the location of all existing buried structures, footings, pipes & underground tanks etc.

- Contact **DBYD** (Dial Before You Dig) before excavation. For non-Australian locations contact any service that provides locations and types of all services and utilities beneath the ground.

- For geotechnical complexities such as slope stability (working excavations on slopes), material instability and groundwater pressures and how these may exacerbate the effect of the excavation on surrounding structures, a geotechnical engineer must be contacted prior to excavation. If it is found the excavation for the tanks will effect the stability of surrounding structures the excavation MUST NOT BE STARTED.

- Any ground support system must be designed by a competent person i.e. geotechnical engineer or structural engineer.

All activities of earthworks must be documented, namely:

1. Investigation and Planning: Includes surveys that determine existing services, footings, trees etc. Discussions with neighbouring sites regarding easements and the construction itself. Works-as-Expected survey.

2. Design and Specification: Engineering plans & documentation, Geotechnical investigation reports

3. Construction: Includes DBYD, meeting of relevant parties documentation.

3. MISCELLANEOUS

I. HYDROPHILIC GEOTEXTILE

For all applications, the geotextile should be HYDROPHILIC. The molecular properties of Hydrophilic geotextiles attract and absorb water. Geotextiles that are HYDROPHOBIC repel water due to the molecular structure and are not encouraged for use with Atlantis products. Having a geotextile that is hydrophobic will cause problems with flow, especially if the product is used in channelling large quantities of water.

A simple test to determine whether the geotextile is Hydrophilic is to use a square piece of geotextile 150mm (6”) in size. Take the geotextile sample and place it over a drinking cup. Use tape to secure it around the cup to form a spanned surface. Then place a few drops of water onto the surface. If the geotextile immediately attracts the water and allows the water to drain through it is Hydrophilic. If the water sits on top of the geotextile and forms droplets it is Hydrophobic. Hydrophobic geotextiles may require a head of pressure to perform however they are NOT suitable for use with Atlantis products.

For specification the designer/specifier can simply call up as “Geotextile as per Atlantis recommendations”.

II. POST CONSTRUCTION SIGNAGE

Where there is high risk of failure, damage to tanks or to other existing structures ensure there is permanent signage stating the location, extent and maximum load allowed above the tanks.

III. INFLOW WATER QUALITY

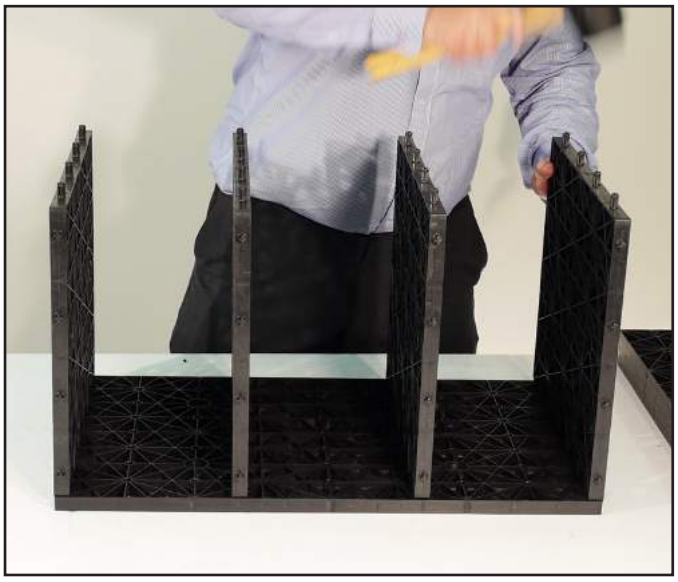
All water entering the system must be filtered, free of gross pollutants, silts, grit, sediments, oils and chemicals that can cause deterioration of the system, as the following chemicals: Benzene and derivatives, Acenaphthene Benzo-perylene, Carbon, Tetrachloride, Heptane, Kerosene Mineral Oil (White), Nitric Acid, Sulphuric Acid and Toluene chemicals are not recommended for polypropylene.

The design engineer is responsible for determining the nature of pollutants in the inflow water; they are then to devise the appropriate filtration device. Contact Atlantis Technical department to help choose the best filtration devices and techniques for the particular job.

Contact Atlantis for the maintenance schedule for our products.

Flo-Tank® Module Assembly Guide

Atlantis Flo-Tank® modules are shipped as flat pack components that need to be assembled into modules on site.



Module Assembly Time

The time required to build a 4 plate configuration Flo-Tank® modules are as follows:

Mini	=	1 minutes
Single	=	1 minutes
Double	=	2 minutes
Triple	=	4 minutes
Quad	=	6 minutes
Penta	=	7 minutes

NOTE: Completed tank modules should be staged as close to the installation area as possible, in order to avoid excessive handling.

Flo-Tank® Strength Configurations

Atlantis tank modules can be configured to suit your project design life requirements.

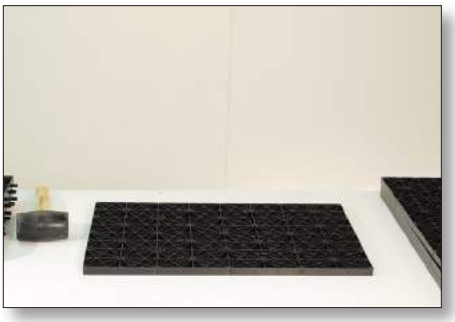
4 PLATE CONFIGURATION

5 PLATE CONFIGURATION

7 PLATE CONFIGURATION

9 PLATE CONFIGURATION

Flo-Tank® 4 plate module assembly.



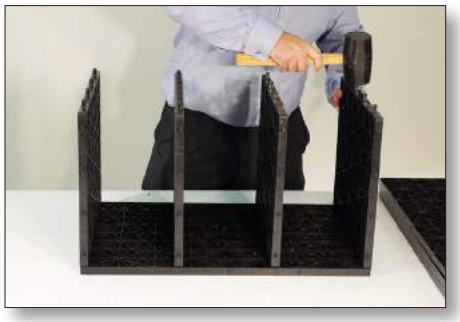
Place large plate onto work bench.

Align small plate pins with the holes on the large plate.

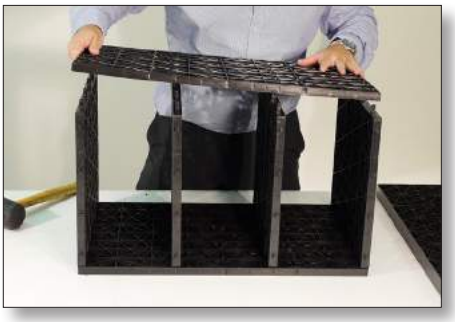
Insert small plate into large plate.

Position the 2nd small plate and insert into the large plate.

Repeat the insertion process for the small plates.

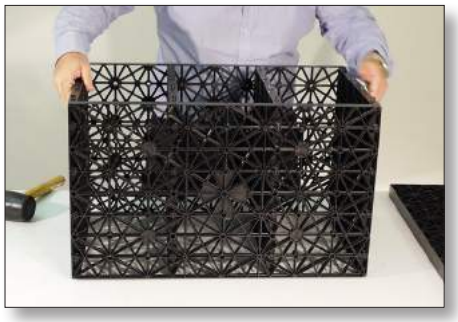


Firmly insert the small plates into the large plates.



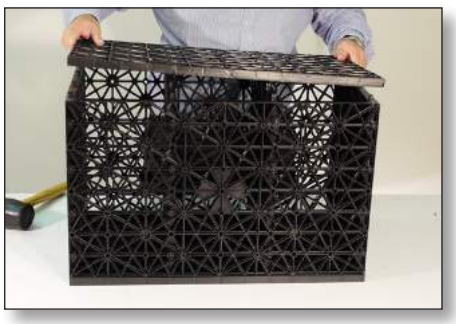
Align the pins on the small plate with the top large plate and insert into place.

Use a rubber mallet to hammer the pins to ensure a tight fit.



Flip the Flo-Tank® module onto its side.

Place the large plate on top of the semi assembled module and fit into place. Use a rubber mallet to securely fit the pins into place.

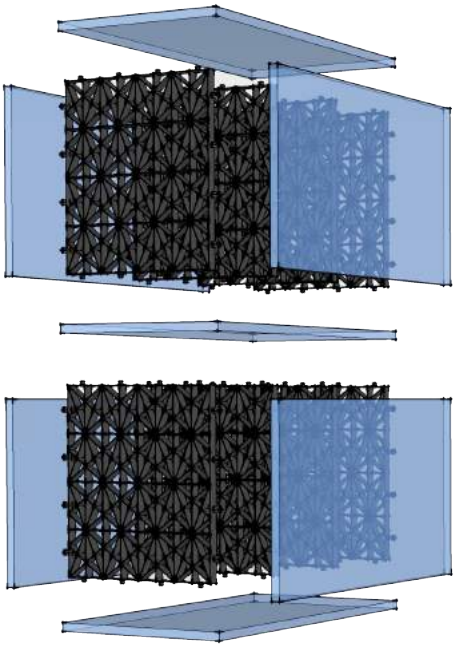


Flip the module over again and repeat the last step.

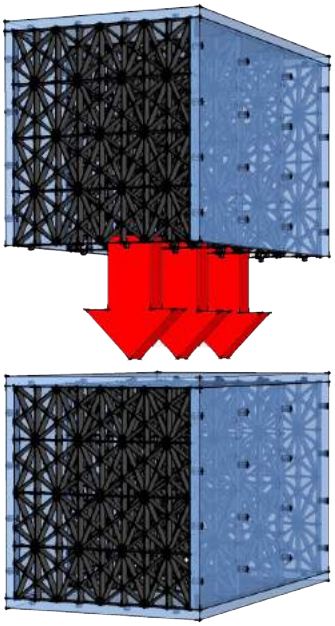
Completed Flo-Tank® module.

Flo-Tank® Double, Triple, Quad and Penta Assembly Guide.

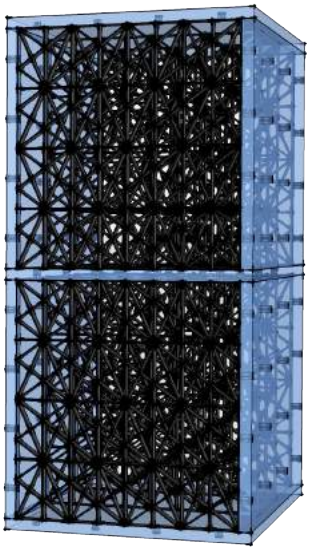
The Atlantis Flo-Tank® modules can be configured into taller modules by simply attaching an additional module on top of a single module. Tall Flo-Tank® modules use a common plate in between. The additional modules must be constructed without a bottom plate. The exposed pins are used to clip into the single module.



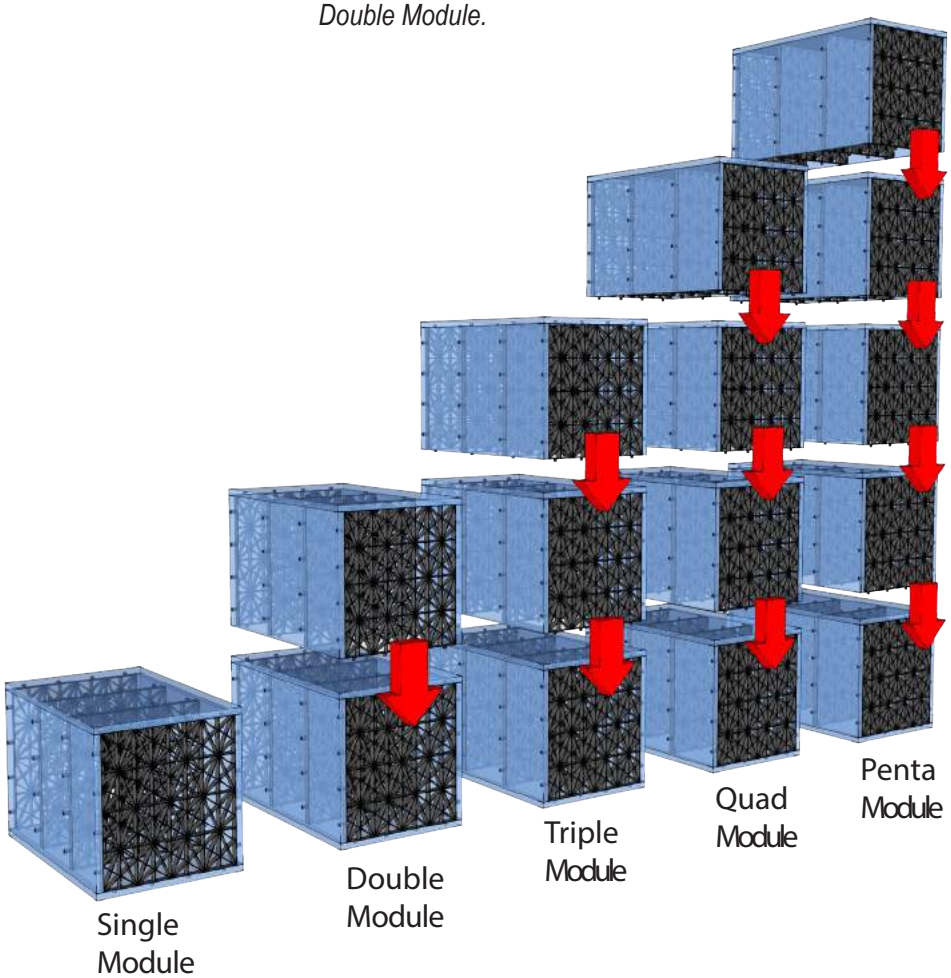
Exploded view of the Flo-Tank® Double Module.



Attaching the additional module to the Single Module to create a Double Module.



Completed Flo-Tank® Double Module.



STEP 1 - Excavate

Note: Please ensure a temporary perimeter fence is erected before excavation.

Prepare excavation as per geo technical engineer's specifications and/or as shown on engineering drawings.

Examine prepared excavation and conditions for level smoothness and compaction. Correct unsatisfactory conditions before commencement of base preparation layer.

NOTE:
Excavation size should be: tank size + minimum top, side and base backfill

STEP 1 - Excavate.

Check for the presence of soft or muddy soils. Insure the presence of a high ground water table is at least 1m (3ft) feet below the bottom of the Atlantis Tank structure at all times.

The excavation must be level before the base fill can be applied.

NOTE: Ground foundations with a clay profile are considered non-standard conditions. The design must be approved by a geotechnical engineer.

STEP 2: Prepare Base

Base Layer Installation

Apply a level base of 100mm - 200mm (4" - 8") of smooth clean washed river sand, free from lumps and debris or any other sharp materials and compact to 95% modified proctor density. Structural fill material, (sand and gravel) may be used to amend the structural capacity of the base layer.

The foundation should achieve a CBR of 3-5% and be checked by the authorised engineer.

STEP 2 - Prepare Base.

Backfill Materials

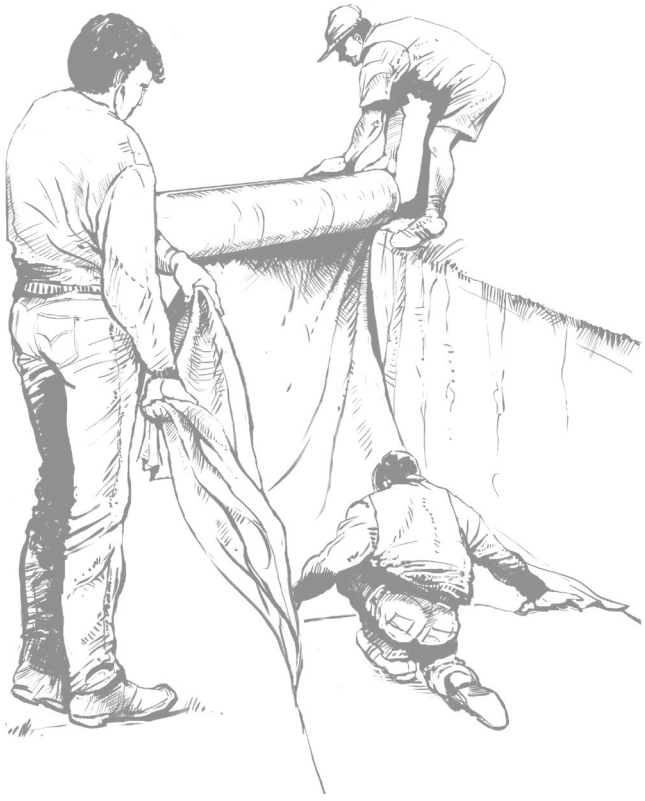
Either washed river sand or gravel of 19mm (3/4") in size is acceptable for base materials. Technical specifications are available upon request.

STEP 3: Place geotextile to wrap tank

Ensure the geotextile is hydrophilic. Refer to the geotextile guide lines for more information. Lay the geotextile into the excavation. Use sandbags or heavy objects to temporarily secure the geotextile at the top of the excavation to prevent the fabric from falling into the excavation.

Step 3 - Lay geotextile.

Over lap the edges by a minimum of 300mm (12”). Ensure 300mm of geotextile is available on the ends to wrap over the tank system.



RAINWATER & O.S.D TANKS ONLY

STEP 3 B: Laying the impermeable plastic liner along the base and up the sides.

Lay impermeable liner into the excavation and spread out evenly. Ensure the Impermeable liner is centred into position and that the minimum allowable overlap of 1m (3ft.) is available on all edges of the tank system to fold over the top of the tank system.

Take care not to tear or puncture the liner. Overlapping edges and joins should be welded by an experienced polyplastic welder. Tank configurations should have as few welded joins as possible.

STEP 3 C: Laying protective layer of geotextile

Lay geotextile fabric into the excavation as a protective layer between the impermeable liner and the Atlantis Flo-Tank® modules. Secure overlapping edges with duct tape.

STEP 4: Install Tank Modules

The boundaries of the tank is best carried out by surveyors to ensure a straight installation. The corner of the tank selected to begin the tank construction is located in the area where critical pipe connections need to be made.

Using the string lines as a guide, place the Flo-Tank® modules into the corner of the excavation following the string lines as a guide.

Continue the process of placing the Flo-Tank® modules in a sequential manner until all the modules are placed. Minor gaps (< 5mm - 1/4") between adjacent units or variations in height (< 5mm - 1/4") are acceptable.

STEP 5: Install Maintenance Ports

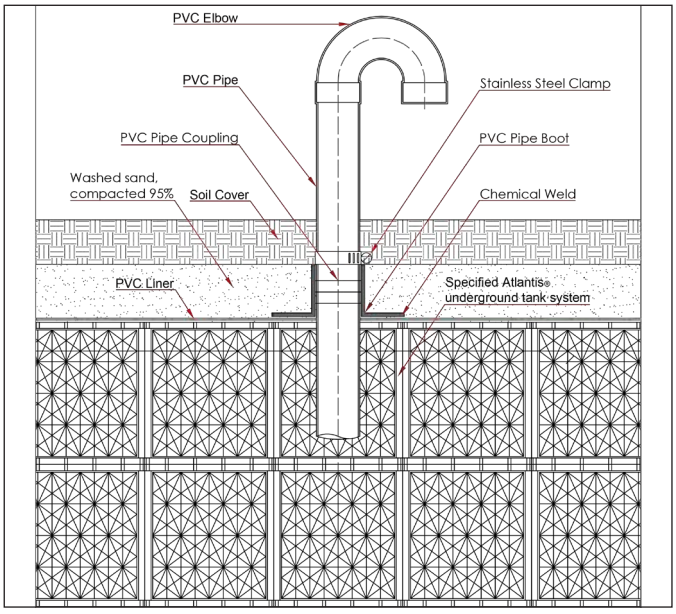
INSPECTION • MAINTENANCE • VENTILATION

Typically made from PVC pipe, these provide vertical access into the system. They should be long enough to sit on the bottom of the Flo-Tank® module, rising to the finished surface where they are capped.

For an effective and on-going underground water system a good maintenance design plan is needed.

Atlantis recommends two tools, which can help achieve a good long-term maintenance system. Ventilation ports & maintenance/inspection ports.

1. Ventilation pipes prevent vacuum formation when large quantities of water are withdrawn from the tanks. 2 x ventilation pipes can be installed in opposite sections of the tank. They should be placed in all underground tanks, whether for infiltration, detention or retention. The vent is drilled into the tanks in between the vertical plates using a reciprocating saw to cut the hole. See the section below.



The vent pipe is to be installed 1 metre from the inlet and the other on the opposite end of the tank, either near the outlet or overflow pipe.

The pipe must be 150mm diameter. It must be possible to remove the PVC elbow and use that as the maintenance access for vacuum trucks. An alternative vent pipe is a 4"-6" (100mm-150mm) diameter pipe capped with a PVC tank breather vent cap and/or slotted cover.

NOTE: When a vent is installed an overflow pipe must be used otherwise water will start escaping from the vent.

2. Maintenance ports are used as access openings for flushing the system and for inspection. Vacuum trucks can flush the system from sediment build up. These are highly recommended for large and small tank systems.

Figure 1 shows the maintenance port coming out from the Flo-Tank.

Figure 2 shows the 2D section with the pipe and concrete collar.

For large tank systems over 10,000L, it is recommended to use multiple maintenance ports: one for every 25,000L of volume. Each maintenance port will be drilled into the tanks from above and through each tank and terminate at the bottom plate of the bottom-most tank.

FIGURE 1

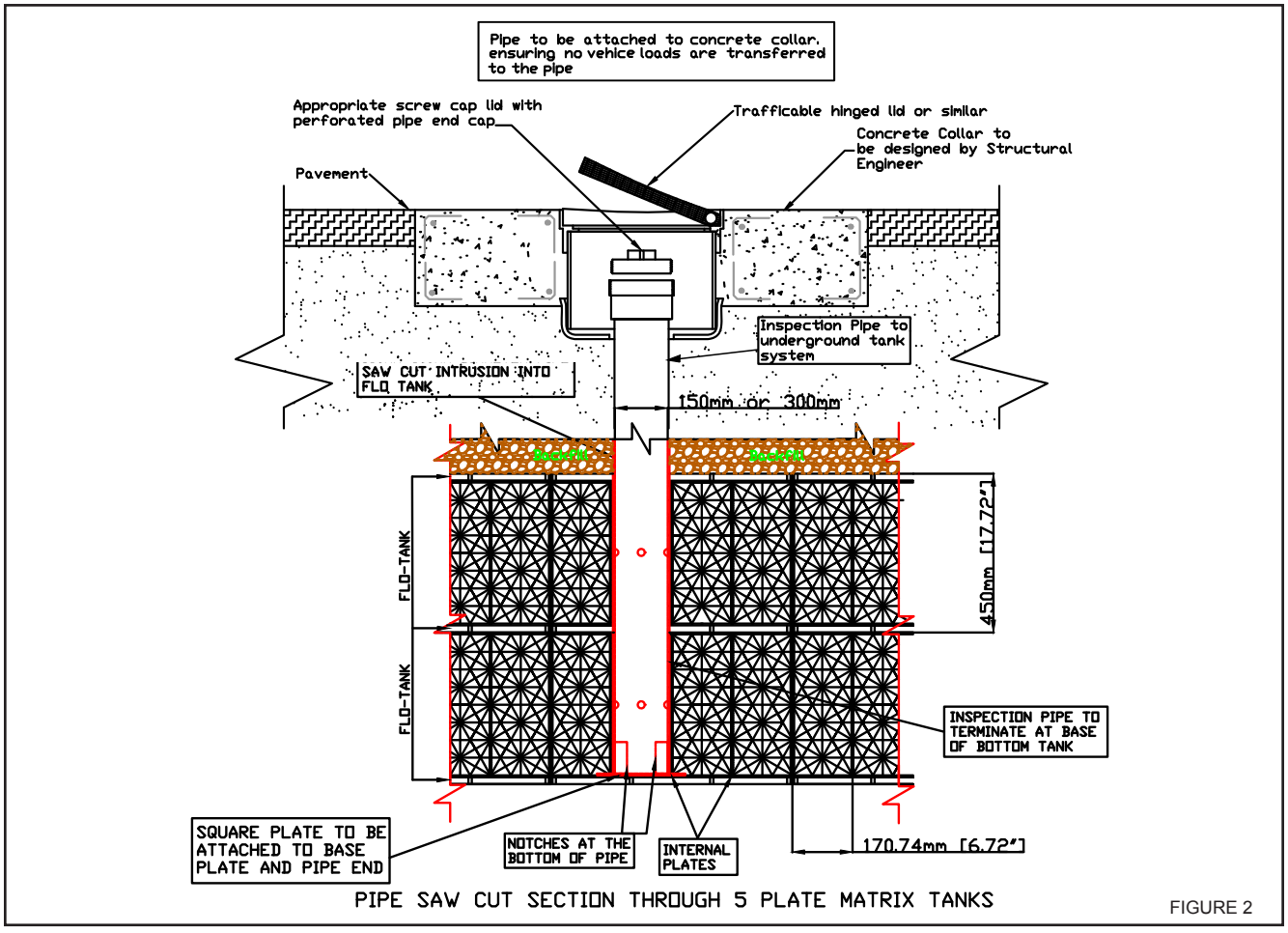


FIGURE 2

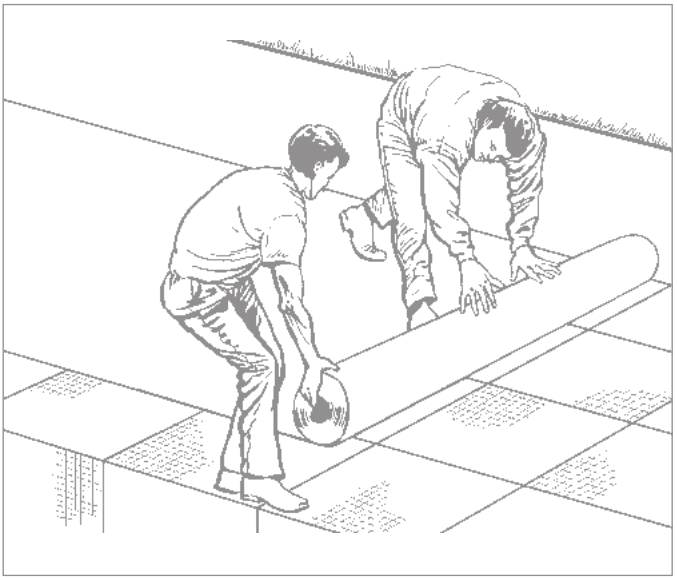
NOTE: After the installation, ensure the pipes are capped to prevent debris from entering the system.

STEP 6 A: Wrap Tank in Geotextile

Wrap Geotextile placed in Step 3, over the Flo-Tank® modules.

Seal all the seams and joins of the geotextile using duct tape. There should be a minimum of 300mm (12”) overlap at the joins and seams.

Sealing the system insures that backfill materials are kept out of the system.



Put utility tape on all corners of the tank to determine sub-surface location in the future.

RAINWATER & O.S.D TANKS ONLY

STEP 6 B: Seal System with Liner

Position and fold the Impermeable Liner over the constructed tank system and completely seal the system with quality hot welded overlaps.

Wrap tank modules in hydrophilic geotextile.

Position and fold the impermeable liner over the tank construction, overlapping the edges by 1m (3 ft.) and completely seal the system.

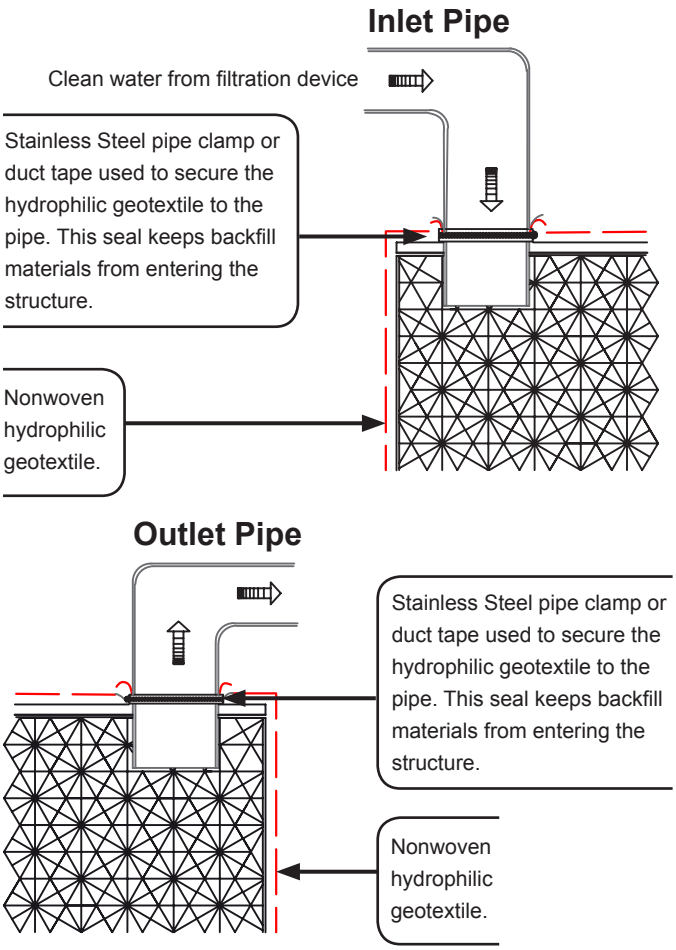
STEP 6 C: Installation of Pipe Boot

Install pipe boot to liner according to the detailed instructions found on **page 22** of this manual.

STEP 7 A: Connect Inlet / Outlet Pipes

IMPORTANT: All water entering the Atlantis system must be filtered by an approved filtration device. Raw stormwater containing gross pollutants and heavy sediments must be kept out of the Atlantis system.

Typical Pipe Inlet Outlet Connection



Pipe connections can be made anywhere on the top of the Flo-Tank® modules.
Wherever a pipe must pass through the geotextile, cut an “X” in the geotextile, pull the four flaps back over the pipe. Use duct tape to seal around the pipe, then attach stainless steel clamp to securely fasten the connection.

Inlet and outlet pipes should not be greater than 225mm (9”) in diameter.

Pipes can also be installed using a pipe boot and securing it to the membrane. (See pages 22-23)

Note: Flo-Tank® tank systems should not be activated or brought on-line until construction is completed and the site is stabilized. This will prevent construction debris and heavy sediments from contaminating the system.

Step 1 - Cut an X shape into the geotextile. Ensure the cut is slightly smaller than the pipe for a tight fit.

Step 2 - Lift the cut flaps of the geotextile.

Step 3 - Use a hole saw attachment on a power drill to cut the opening on the tank module.

Step 4 - Position the pipe into the opening.

Step 5 - Slide the pipe through the hole and into the final position.

Step 6 - Use duct tape to secure the geotextile then place stainless steel clamp to secure the connection.

STEP 8: Backfill Sides

Side backfill can range in width from 200mm (10”) to 500mm (20”) for standard applications. If you have a minimal footprint and have to limit your side fill please contact our technical department for directions.

For installations into reactive soils or clay a minimum of 500mm (20”) side backfill is required.

Step 8 - Backfill Sides

Side backfill must consist of clean washed river sand, free from lumps and debris or any other sharp materials. Backfill materials containing clay should NEVER be used.

Compact side fill in 150mm (6”) lifts and compact to 95% proctor density. Each compacted lift must be constructed on all sides of the tank structure before the next lift can be constructed. Use a powered mechanical compactor to compact the lifts. Vibration from compactor will help eliminate minor gaps between Flo-Tank® modules.

When using a mechanical compactor cover the side of the tank system with a sheet of plywood to protect the fabric and tank modules from damage. Move the plywood sheet as the compactor moves.

STEP 9: Backfill Top

When the side backfill reaches the top of the tank structure the backfill process can commence. When placing backfill materials be careful to avoid damage or displacement of the tanks and geotextile fabric. Excavator equipment shall remain clear of the excavation. Material shall not be dropped vertically on the tank from a distance greater than one-foot.

Backfill around the sides of the tank system first, compacting material to 95% proctor density with a vibratory plate compactor, in 150mm (6”) lifts. Keep the compactor clear of the tank structure, geotextile and liners.

Step 9 - Backfill Top

Exercise care when placing the first 150mm (6”) lift on Matrix® Tank. Spread material using a lightweight powered mechanical compactor or roller*. The next 150mm (6”) lift may be placed using lightweight equipment with tracks. Place at least 500mm (20”) of material and blade down to 300mm (12”), where required, then compact to 95%.

* For large scale projects, spread the backfill material with a low ground pressure skid steer loader (i.e. Posi Track)

MINIMUM BACKFILL UNDER CONCRETE SLAB for lightweight traffic load: A minimum of 100mm of top backfill can be applied when specified under a 150mm reinforced concrete slab. Seek approval from a structural engineer.

MAXIMUM BACKFILL: This depends on the type of Atlantis system used. Typically for a 9 plate Atlantis Flo Tank the maximum backfill is 4.0m, but there are other factors involved such as magnitude and type of load, type of backfill and its density etc. Please contact our technical department to take a look into your specific site requirements.

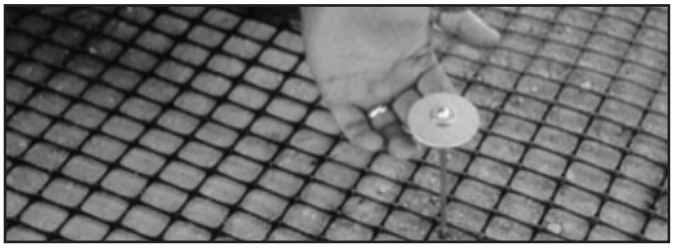
STEP 10: Place Geogrid (optional)

Geogrid is required for load-bearing applications such as systems placed below parking lots.

Geogrid should be BX-1200 or equal and should extend 1m (3ft.) beyond the excavation footprint.

STEP 10 - Install BX-1200 geogrid.

Overlap all edges by 500mm (20”) or as recommended by manufacturer or engineer. Continue backfilling to recommended levels in 150-300mm (6”-12”) lifts with compaction to 95%.



STEP 11 - Site Final Cleaning

Perform final cleaning of work and remove all excess material, debris and equipment. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

STEP 12 - Surface Materials

Place surfacing materials such as ground covers, shrubs or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

STEP 13 - Erect Perimeter Fencing

Following completion of the work, mark the perimeter of the system footprint and place temporary fencing to restrict heavy traffic or impact above the system until construction of the site is complete.

STEP 14 - Permanent Perimeter

When necessary install permanent signs that display warnings of maximum loads allowable over the tank installation.

Permanent bollards (traffic post) can also be installed to prevent any traffic from entering the tank location.

STEP 15 - System Commissioning / Bringing the System Online

Direct all site stormwater runoff away from the installation area during construction. The installation area shall not receive any run off. To maintain the area provide temporary erosion control devices and landscaping that minimizes the entry of silts and clay into the infiltration installation area.

For Rainwater Harvesting & O.S.D Detention Tanks ONLY

Step 7 B: Installation of Pipe Boot to Liner

Liner Preparation
When installing pipe boots it is important that the liner is flat against the modules without creases or wrinkles and the surface is clean and dry. The liner should now be secured against the crates in its final location.

Determine Position of Pipe and Cut Out Hole In Liner
With the pipe in place, carefully cut the liner around the pipe and remove the section of liner.

Prepare Final Position of Pipe
Slide the pipe boot over the pipe, then position pipe at its final location and fix into place with compacted backfill. It is important that the pipe does not move after the pipe boot is bonded to the liner as this movement may break the seal or damage the pipe boot causing failure.

Mark Flange Position
Slide the flange of the pipe boot against the liner, then mark the liner around the flange with a felt tip marker.

Primer Application
Slide the pipe boot back along the pipe out of the way. Then, with the application pad supplied, apply a good thick bead of primer 100mm (4”) wide around the inside of the line. Overlap the line by about 10mm (0.4”) Even out the primer with the pad as much as possible so there is a uniform thickness. Allow the primer to flash off till touch dry. This should be less than 10 minutes depending on the ambient temperature.

Position Flange
When the primer is touch dry slide the pipe boot back into place lining up the edge with the primer. Carefully remove the backing paper from one edge of the flange then push the flange against the primer making sure that there are no wrinkles in the liner or flange.

Install Flange
Tightly rub the back of the flange making sure that all of the flange is bonded to the liner. It may be a good idea to install a thin sheet of plywood or similar substance between the crates and the liner to give a firm backing. Repeat this process for the other 3 sides of the pipe boot flange always making sure that there are no wrinkles or folds in the liner or pipe boot flange. Give the flange a good firm rub making sure that there are no bubbles in the bond and that the flange is firmly bonded to the liner. Remove the plywood.

Apply Sealant to Flange
With the tube of sealant supplied, apply a bead of sealant around the outside of the flange about 15mm (0.6”) wide.

Sealing the Pipe Boot to the Pipe
Put a bead of sealant between the pipe boot and the pipe then apply a stainless steel pipe band around the pipe boot and pipe.

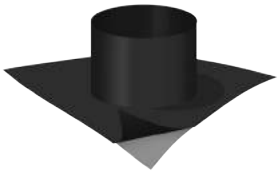
Wrap Protective Layer of Duct Tape Around Pipe Clamp
To protect the pipe boot from the sharp edges of the pipe clamp it is a good idea to run a couple of layers of duct tape around the pipe boot prior to installing the pipe clamp.

Self Adhesive Pipe Boot Instructions page

Materials needed

White marker

Box cutter



Self adhesive pipe liner booth

Sealant

Metal hose clamps

1. Clean the area where the boot is to be installed

2. Trace the edge of the boot onto the tank liner

3. Cut the opening for the pipe

4. Prepare the area of the boot flange with a polypropylene glue

5. The area is ready when the surface is dry to the touch

6. Peel the back corner of the flange to expose the sticky side

7. Mount the boot liner starting from the corner.

8. Insert the pipe and push all the way against the tank

9. Apply the sealant between the liner and the PVC pipe.

10. Move the clamp over and around the boot and tighten

DESIGN CHECKLIST

The following checklist is strictly for the use of a certified engineer who has been given the authority to design for the project in which the tanks will be used.

Atlantis system specified:

☐ Infiltration

☐ Harvesting (Reuse).
Impermeable liner required

☐ On Site Detention (OSD)
Impermeable liner required

		YES	NO
1.	**Have Project Drawings and a Geo-technical Report been provided?** **If NO:** *Please contact an engineering consulting firm to obtain a geotechnical report and relevant project sections, and then continue completing the rest of the form.*	☐	☐
2.	**Have expected loads been incorporated into the design?** Vertical Dead Load: _____ kPa / _____ psi Vertical Live Load: _____ kPa / _____ psi Vertical Combination / Uniformly distributed loads (UDL): _____ kPa / _____ psi Lateral Load: _____ kPa / _____ psi Uplift Load: _____ kPa / _____ psi Diagonal Load: _____ kN / _____ lb **According to AS4678, AS1170.1. AS 2566.1, AS 5100, AUSTROADS, BS EN 1997-1:2004 and CIRIA C680*	☐	☐
3.	**Have the following requirements been considered?** Top Cover/backfill: _____ m / _____ (ft) Setback / Adjacent structure at: _____ m / _____ (ft) **Please review minimum top cover according to AS2566.1 and AS3500 and minimum setback according to Engineers Australia (2003-2006) in Atlantis technical specification*	☐	☐
4.	**Is there presence of high water table?** **If YES:** *please specify distance from level* _____ m / _____ (ft)	☐	☐
5.	**Are there any nearby hills or steep slopes?** **If YES:** *How far from the tank perimeter?* _____ m / _____ (ft) *What is the slope gradient?* _____ **Please note that the coefficient of earth pressure may be greater in presence of nearby hills. Atlantis does not recommend tank installations near hills or steep slopes.*	☐	☐
6.	**Main soil type present on the site, identified in geotechnical report?** **Soil type:** ☐ Coarse sand ☐ Sandy loam ☐ Sandy clay ☐ Clay ☐ Other: _____	☐	☐
6.1	**Is there presence of soft soils (such as clay) and/or the tank will be used as a foundation system?** **If YES:** *Please check settlements and bearing capacity of soils.*	☐	☐
7.	**Design Life of the project:** ☐ 20 years ☐ 30 years ☐ Other: _____		
7.1	**Has a creep reduction factor been taken into account for compressive strength capacity?** ** According to AS4678*	☐	☐
7.2	**Is the tank height greater than 1.6m (5.3 ft)? and/or** **Is the tank located at depth greater than 4m (13.1 ft)?** **If YES to either:** *Creep reduction factor should be taken into account for lateral strength capacity according to CIRIAC680.*	☐	☐

		YES	NO
8.	**Pre-treatment/filtration system:** ☐ Atlantis Large / Small Filter ☐ Gross Pollutant Trap (GPT) ☐ Biofiltration ☐ Other: _____ **If NO:** *The end-user is responsible for the performance of the tanks if there is not a pre-filtration system installed/specified.* **Note**: *Sediments, debris and contaminants must be kept out of the system.*	☐	☐
9.	**Backfill material specified?** ☐ Coarse washed river sand (less than 5% fines passing 75 micron sieve) ☐ Aggregate of angular material (up to 19mm - 3/4") ☐ Other: _____ *(Material graded to AS 1141)* **If NO:** *Please seek approval from a geotechnical/structural engineer as to what backfill should be used.*	☐	☐
10.	**Has an internal plate configuration been specified?** **If YES:** *Please select from the following:* ☐ 4 Plates ☐ 5 Plates ☐ 7 Plates ☐ 9 Plates ☐ Titan Tank	☐	☐
	10.1 **Is the strength capacity of the tank greater than the loads applied on it?**	☐	☐
11.	**Project was consulted upon and approved by qualified engineers**	☐	☐

Company: _____ Date: _____

Designer: _____ Signature: _____

Note: Atlantis products are manufactured by independent factories from high quality recycled materials, carefully selected and under strict quality control procedures. The strength could vary slightly due to raw material, country of manufacture, manufacturing process and external conditions.

INSTALLATION CHECKLIST

Atlantis system specified:

☐ Infiltration

☐ Harvesting (Reuse)
- ***Impermeable liner required***
- ***Always include section 4***

☐ On Site Detention (OSD)
- ***Impermeable liner required***
- ***Always include section 4***

	YES	NO
Does the P.O./ Batch Number match the designed load specified by the authorized engineer?	☐	☐

1. EXCAVATION

Note: *Please ensure a temporary perimeter fence is erected before excavation.*		YES	NO
a.	**Is the base compacted and leveled?** **If NO:** *Correct unsatisfactory conditions before commencement of base preparation layer.*	☐	☐
d.	**Are contaminated/acid soils and/or filling present? Is the site a landfill?** **If YES:** *Design must be approved by an authorised qualified engineer*	☐	☐
c.	**Are clay/soft/muddy soils and/or high water table present?** **If YES:** *Design must be approved by an authorised structural engineer*	☐	☐

2. GROUND FOUNDATION - BASE PREPARATION

		YES	NO
a.	**Does the foundation of the excavation have a minimum CBR of 3-5% in accordance with AS 1289.6.1.1?** **If NO:** *Design must be approved by an authorised structural engineer*	☐	☐
b.	**Is the base layer minimum meeting authorised engineer's depth requirements?**	☐	☐
c.	**Is the base well compacted according to AS 1289.5 and the site graded?**	☐	☐

3. GEOTEXTILE USE

		YES	NO
a.	**Is your geotextile hydrophilic?** **If NO:** *Ensure the geotextile is hydrophilic*	☐	☐
b.	**Is there enough overlap available to fold over the top of the tank?** **If NO:** *Ensure an overlap by a minimum of 300mm (12")*	☐	☐

4. OSD & REUSE INSTALLATION

		YES	NO
a.	**Is there enough overlap for the impermeable liner?** **If NO:** *Ensure overlap is available to fold over the top of the tank. Minimum overlap of 1m (3 ft.)*	☐	☐
b.	**Is there a geotextile layer to protect the liner?** **If NO:** *Ensure a geotextile/sand protection layer* **Note:** *Please consider the use of an extra strip of geotextile on the corners to protect the liner.*	☐	☐

5. INSTALLING ATLANTIS MODULES

		YES	NO
a.	**Are string lines around the boundaries to ensure straight lines** **If NO:** *Ensure the tanks are aligned according to original design* **Note:** *Best practices recommend that boundaries of the tank should be carried out by surveyors to ensure a straight installation.*	☐	☐
b.	**Are the modules stacked firmly against each other?** **If NO:** *Gaps should not be greater than 5mm (1/4").*	☐	☐

INSTALLATION CHECKLIST (Continued)

6. INSTALLING MAINTENANCE PORTS

		YES	NO
a.	**Inspection/Vent/Flushing Ports** **If NO:** *Atlantis tanks must be vented to prevent vacuum effect and may require specific maintenance according to the authorised engineer*	☐	☐

7. BACKFILLS

		YES	NO
a.	**Backfill material: Either Coarse washed sand with less than 5% fines passing 75micron sieve or Aggregate of angular material up to 19mm (3/4") or Other granular material graded to AS 1141?** **If NO:** *Any other backfill material must be approved by the authorised engineer* **Note:** *Backfill materials containing clay should never be used*	☐	☐
b.	**Backfill sides between 200-500mm (7.87" - 19.68")?** **If YES:** *Compact according to AS 1289.5* **If NO:** *Design must be approved by a structural engineer.* **Note:** *When backfilling and compacting, make sure that you do not pinch the liner or rub the compactor against the liner. Protect it with a plywood sheet 20mm (0.8") thick*	☐	☐
c.	**Is the top backfill meeting Australian Standards (or local standards) minimum cover requirements and not exceeding 4000mm (13.12ft)?** **If YES:** *Compact according to AS 1289.5* **If NO:** *Structural engineers' approval needed.* **Note:** *Ensure an equally distributed load light vehicle (i.e. Posi Track) is used to spread and level top backfill*	☐	☐
d.	**Placing and handling the backfill material: Is the backfill material placed alongside the excavation line around the tank?**	☐	☐

8. GEOGRID (Optional)

	YES	NO
If YES: *Ensure a minimum Overlap of 1m (3ft)* **Note:** *Tensar BX 1200 or similar*	☐	☐

9.PIPING

	YES	NO
Are pipes no greater than 225mm (9")? Inlet: _____ mm / (_____ ") Outlet: _____ mm / (_____ ") Overflow: _____ mm / (_____ ") Other: _____ _____ mm / (_____ ") **If YES:** *Installed according to Atlantis installation guidelines* **If NO:** *Ensure pipes greater than 225mm (9") do not penetrate the Tank structure.* **Note:** *Overflow according to AS3500.1*	☐	☐

INSTALLATION CHECKLIST (Continued)

10. PROJECT DOCUMENTS	YES	NO
Maintenance manual provided to the end user?	☐	☐
Handover Document provided to the end user?	☐	☐

11. SITE FINAL CLEANING	YES	NO
Has cleaning been arranged?	☐	☐

12. PERMANENT PERIMETER		YES	NO
a.	**Did you install signage to prevent any traffic from entering the location?** **If NO:** *Ensure a signage is present*	☐	☐

COMMENTS *(For quality and training purposes)*	YES	NO
After the excavation: _____ *Size / cross section / design matches the site* *Other:* _____ _____ _____	☐	☐

Company: _____ Date: _____

Designer: _____ Signature: _____

Note: Atlantis products are manufactured by independent factories from high quality recycled materials, carefully selected and under strict quality control procedures. The strength could vary slightly due to raw material, country of manufacture, manufacturing process and external conditions.

END USER CHECKLIST

NOTE: The tank is solely used for its purpose to temporarily detain or permanently store potable or treated stormwater

MAINTENANCE GUIDANCE OF PRE-TREATMENT/FILTRATION SYSTEMS

1.	**Monthly/after significant storm events**	
	a. No clogging at inlet/outlet structures/trash racks	☐
	b. Clean when there is excessive sediment build up in the pre-treatment device	☐
	c. Inspect, lubricate and conduct routine test to check reliability of pump(s)	☐
	d. Check condition and conduct function test of all pump starters and their controls including level control systems	☐
	e. No obstruction of maintenance access/openings	☐
	f. Access into the tank system is secure (out of bounds to public and unauthorised personnel)	☐
2.	**Yearly as required**	
	g. De-silting of the tank has been carried out, trash screens have been cleaned	☐
	h. Inspect, service, replace, lubricate and test performance of pump(s)	☐
	i. Check condition and conduct function test of all pump starters and controls including level control systems.	☐
	j. Replace faulty and worn out parts if required.	☐

INSTALL PERMANENT SIGNAGE

Signage Should Read:
CAUTION:
UNDERGROUND STORMWATER TANK BELOW Underlining maximum vehicle loads

Flo-Tank®

MODULAR UNDERGROUND TANK SYSTEM

Atlantis Corporation International Pty Ltd

PHONE: + 612 9417 8344
FAX: + 612 9417 8311
EMAIL: info@atlantiscorp.com.au
WEB: www.atlantiscorpation.com.au

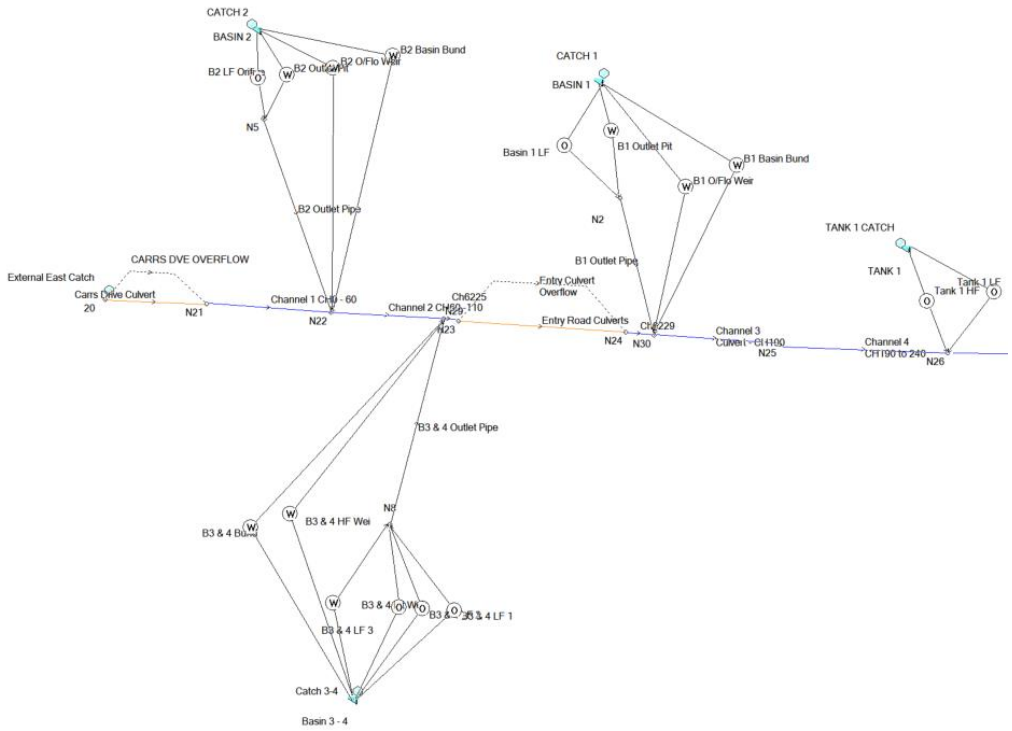
NOTE: Atlantis products are manufactured from carefully selected recycled materials that meet or exceed Atlantis material specifications and product performance requirements. The strength of the recycled plastic can vary due to raw material composition, manufacturing process and reactions to external conditions and adverse chemicals. The selected recycled materials are batch tested to ensure adherence to Atlantis material specification and product performance requirements. All trademarks and Patents are the property of Astral Property Pty Ltd.

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

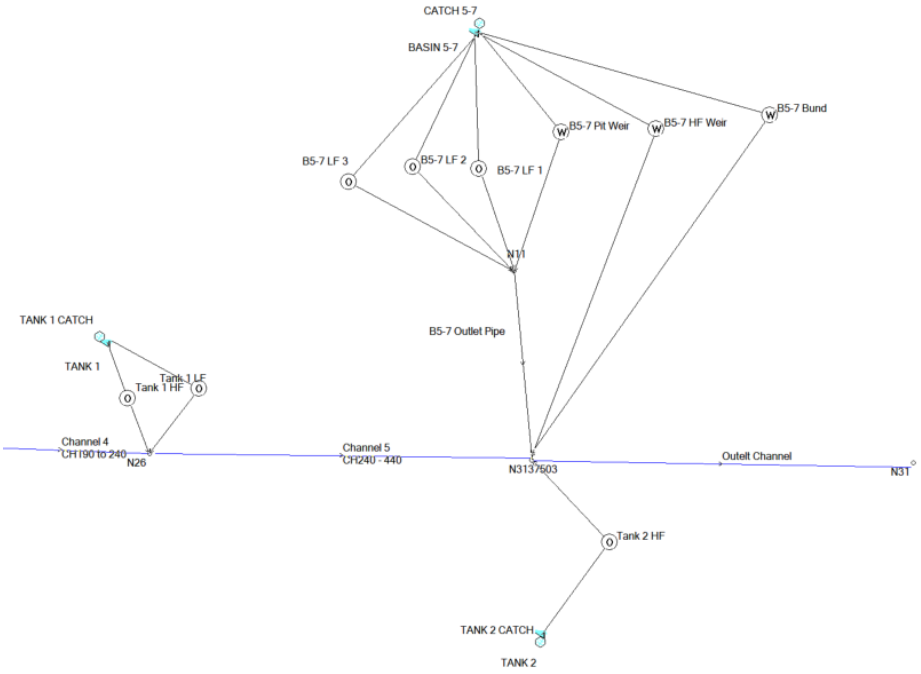
APPENDIX G – DRAINS MODEL RESULTS FOR OPEN CHANNEL AND CULVERTS

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

DRAINS MODEL



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

100 YR ARI RESULTS

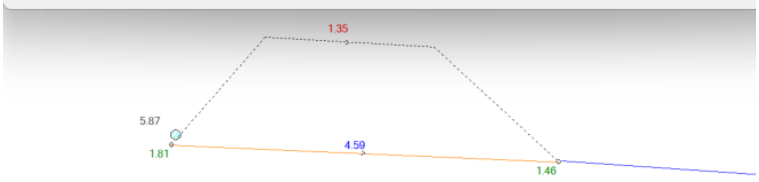
Results for median storm in critical 1% AEP

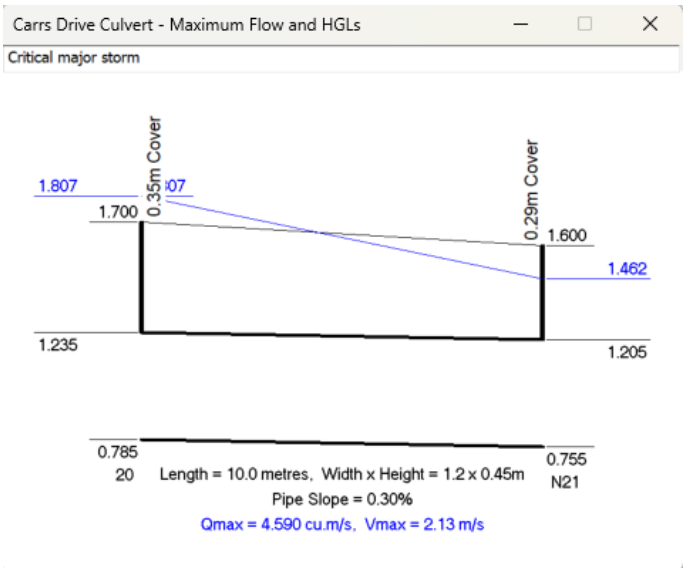
Run Log for 231130 Yamba 2 DA RFI - Culv

Run Log for 231130 Yamba 2 DA RFI - Culv.drn - DRAINS run at 15:35:05 on 31/1/2024 using Watercom Drains v2023.06.8567.18365

Flows were safe in all overflow routes.

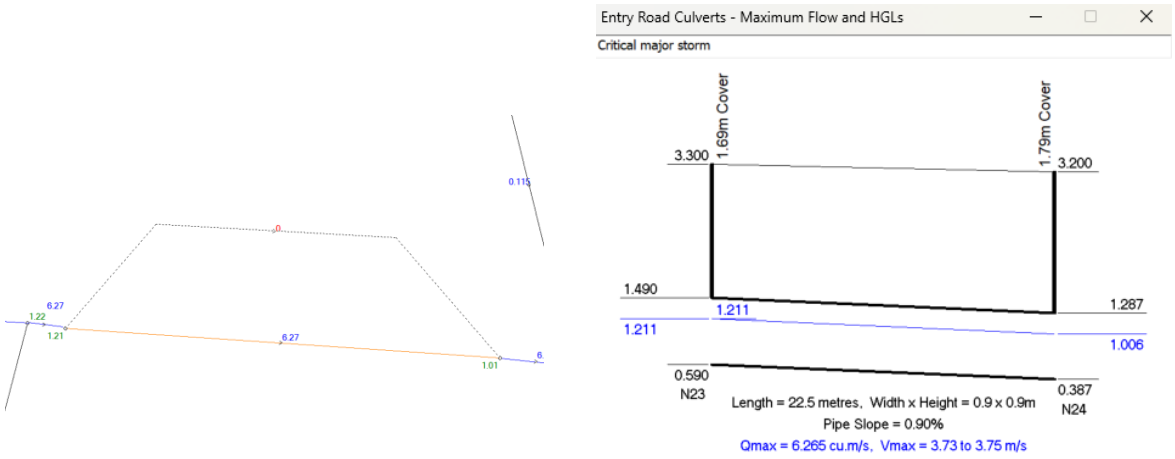
Hint: You can copy this report and paste it into a word processor.
If you need to find say a problem overflow route you can then copy its name and paste it into a search window (Ctrl-f) in DRAINS.



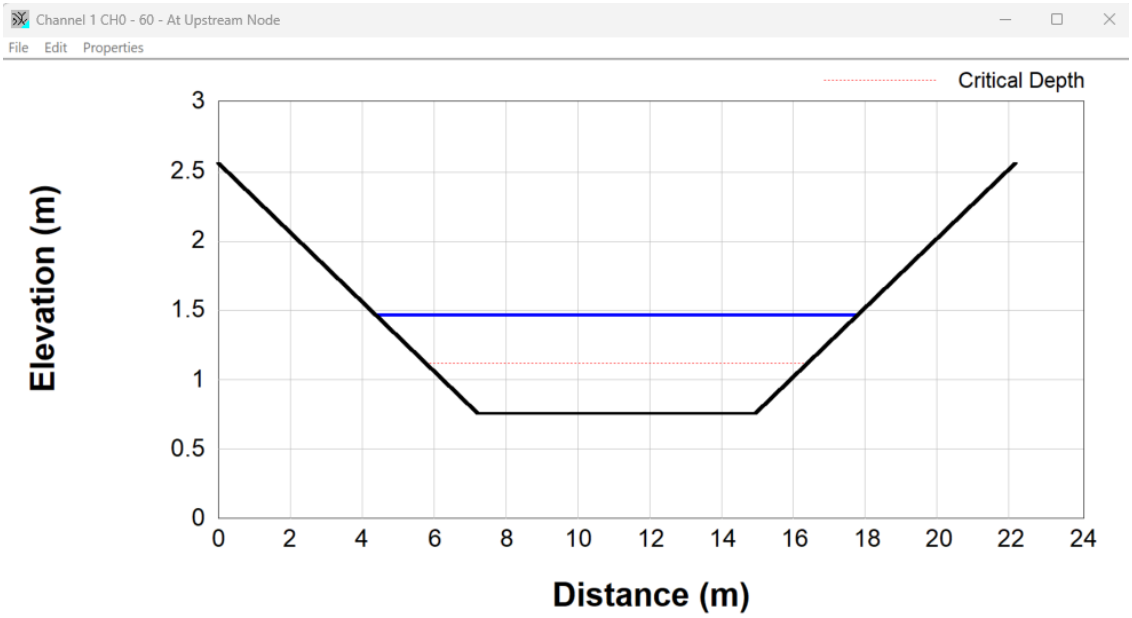


Carrs Drive Culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

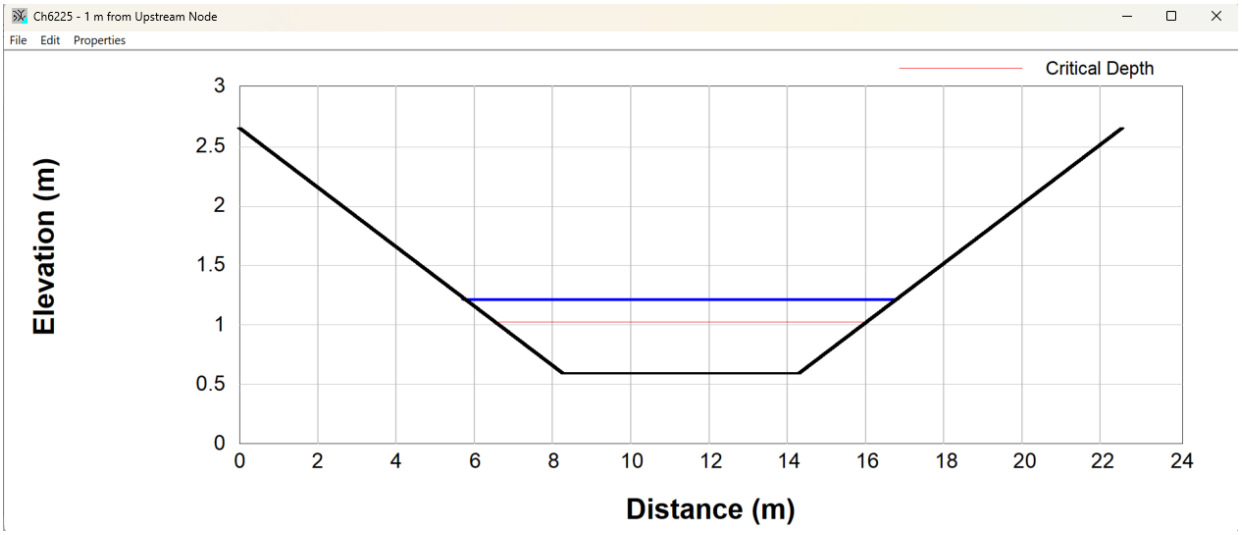


Internal Development Culvert

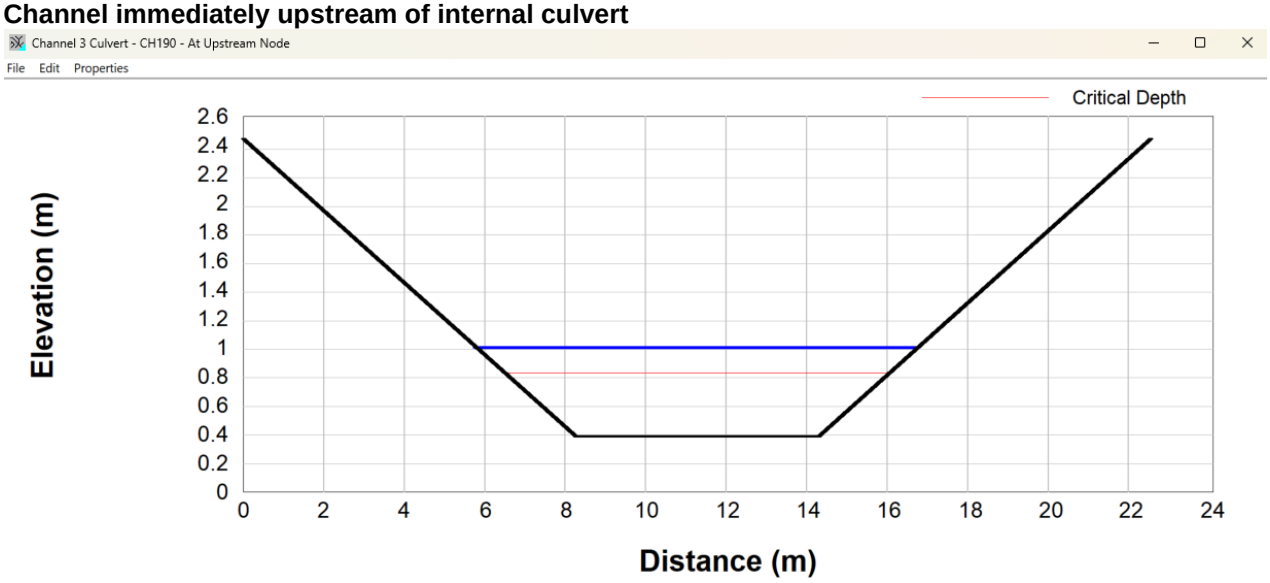


Channel immediately downstream of Carrs Drive Culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

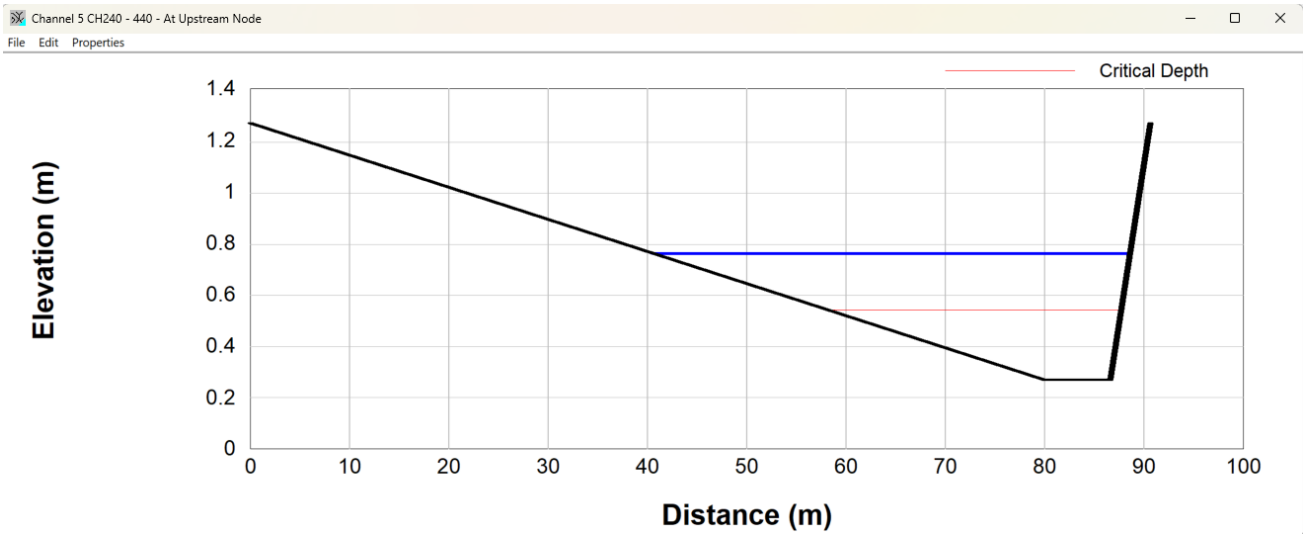


Channel immediately upstream of internal culvert



Channel Downstream of Basin 1

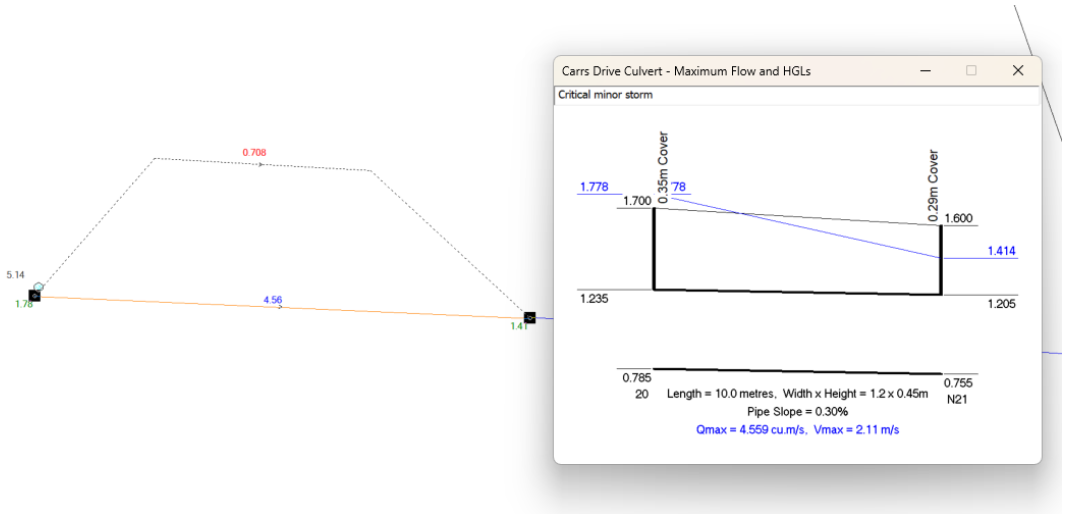
Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



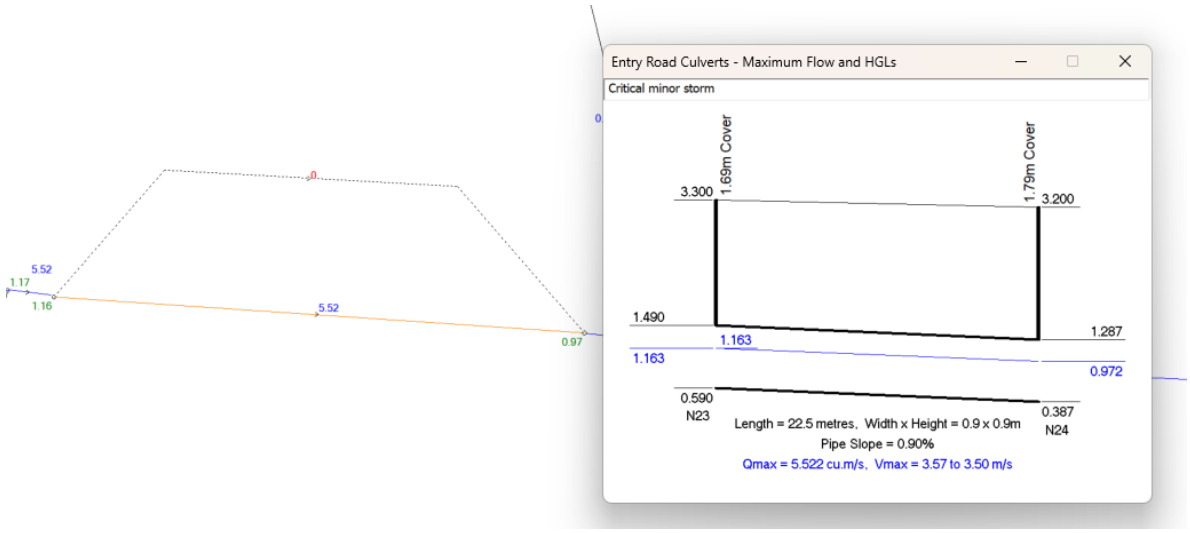
Channel Downstream of OSD Tank 1

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

50 YR ARI RESULTS

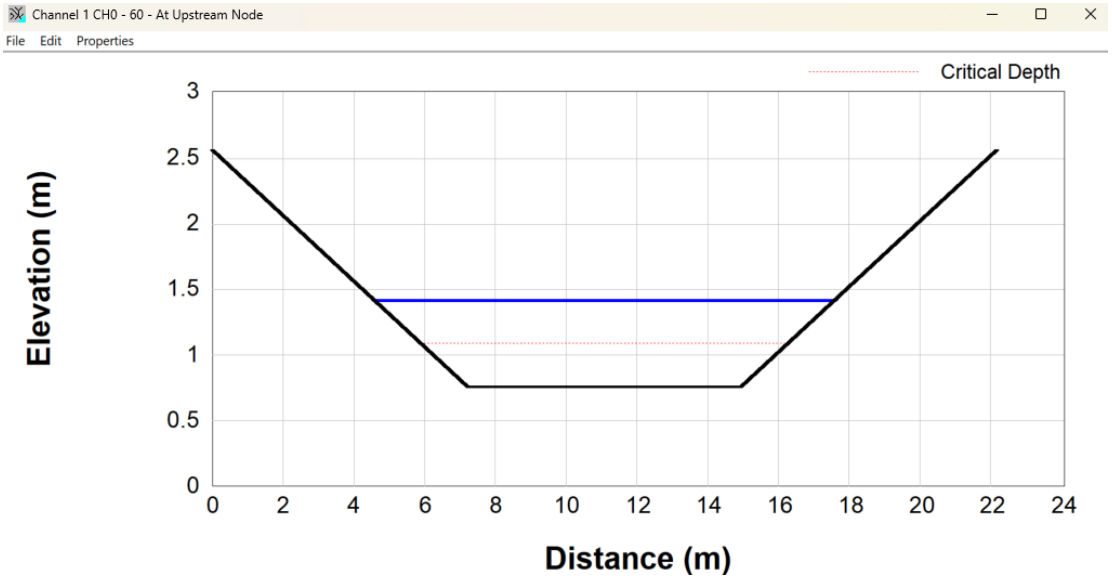


Carrs Drive Culvert

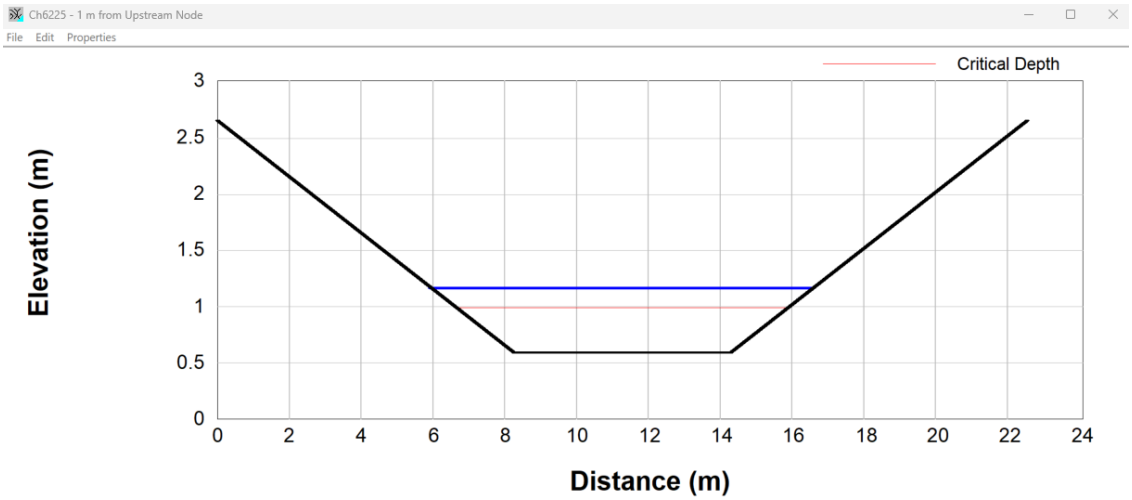


Internal Development Culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

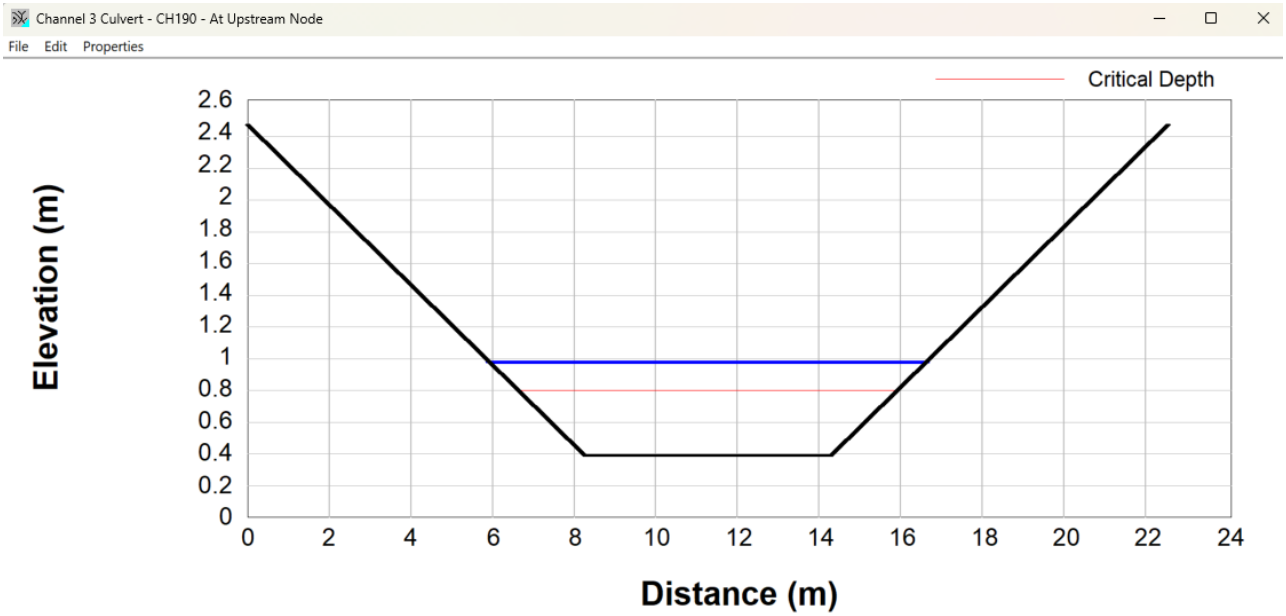


Channel immediately downstream of Carrs Drive Culvert

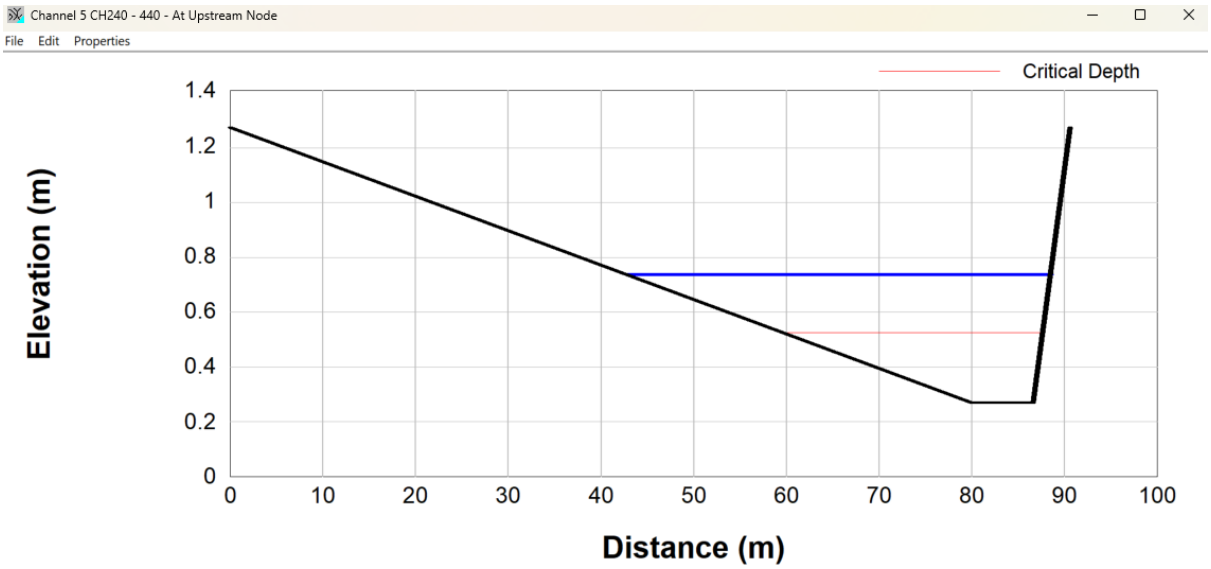


Channel immediately upstream of internal culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



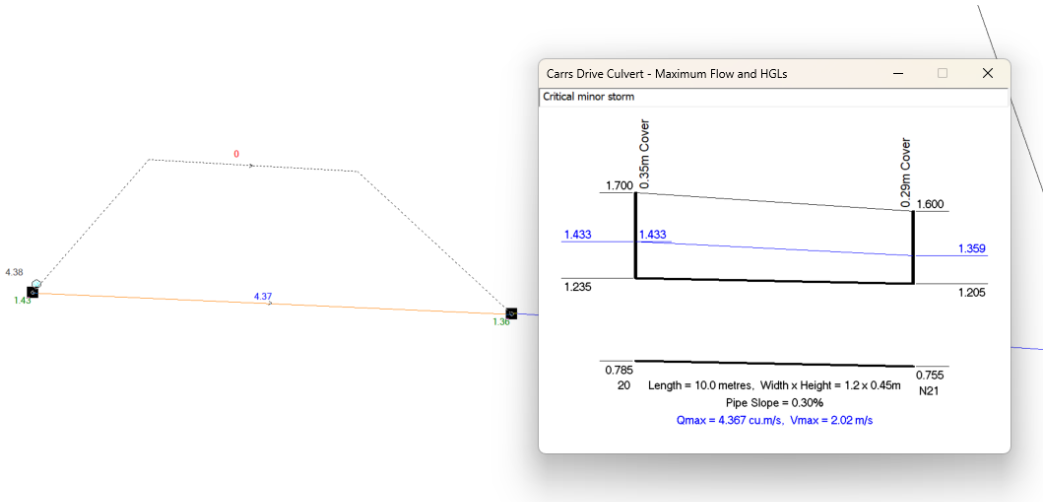
Channel Downstream of Basin 1



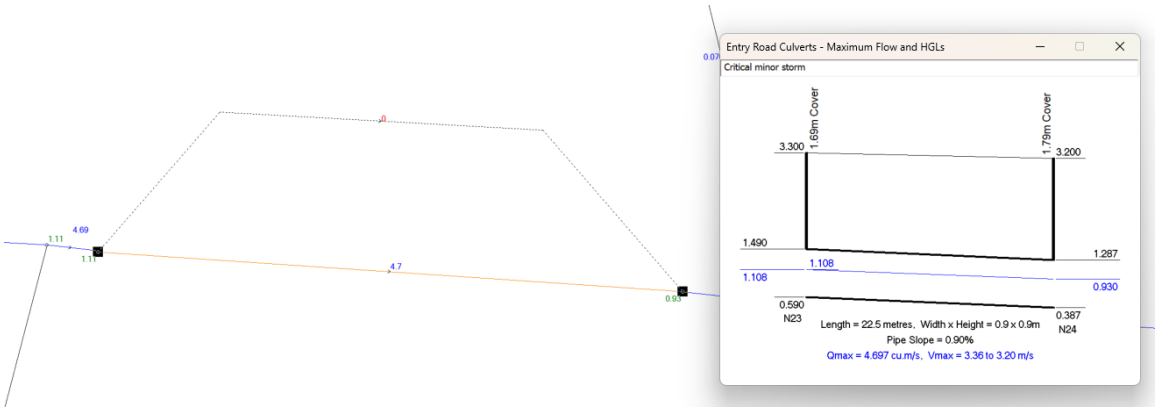
Channel Downstream of OSD Tank 1

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

20 YR ARI RESULTS

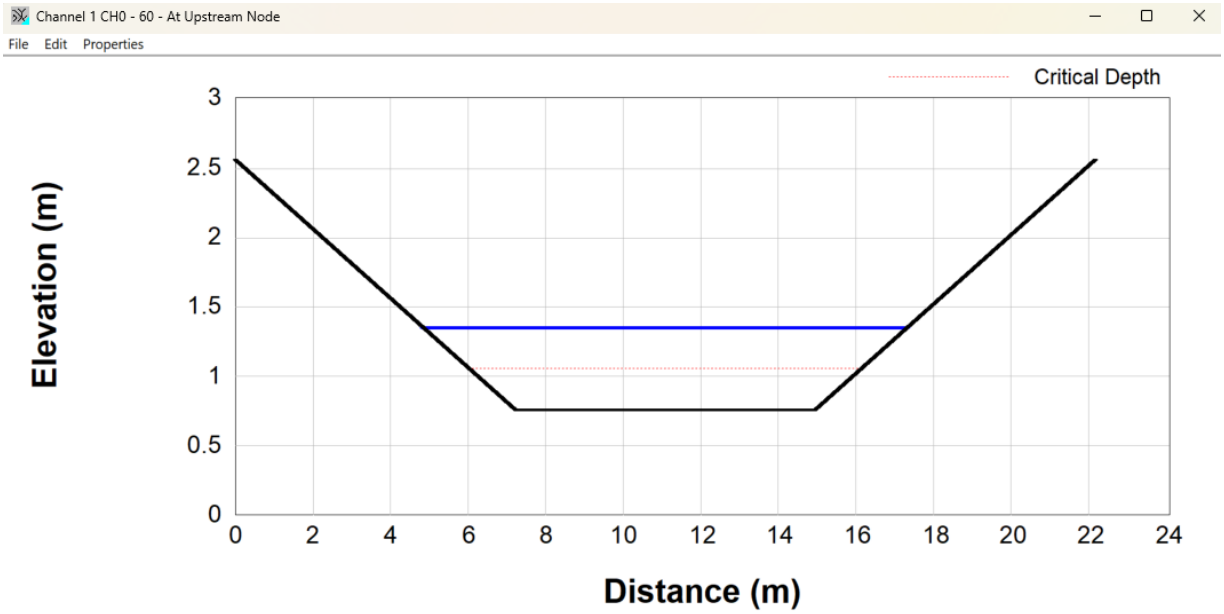


Carrs Drive Culvert

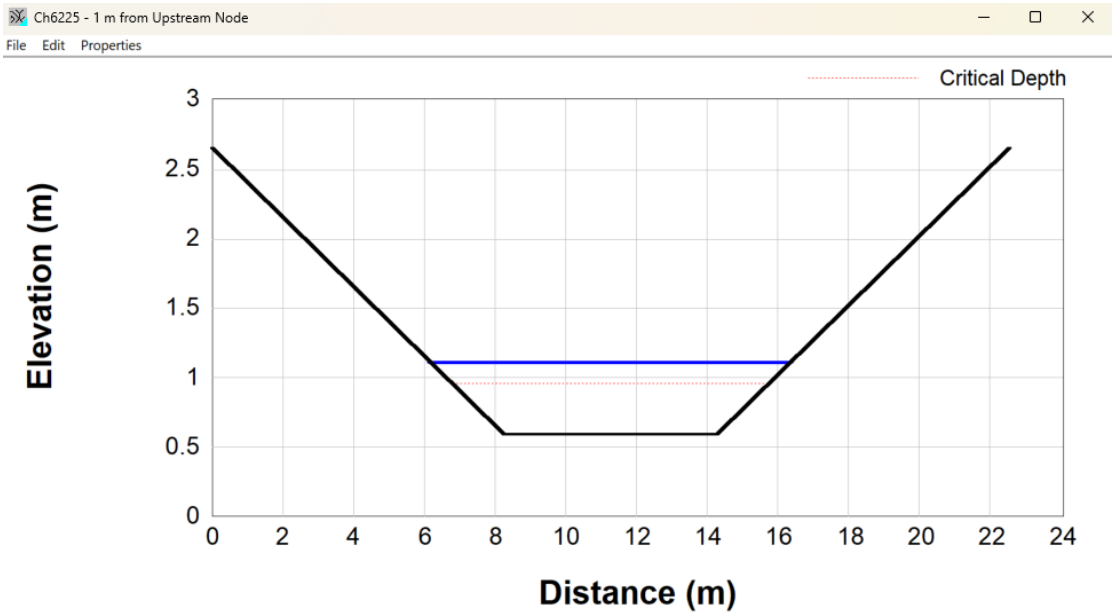


Internal Development Culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au

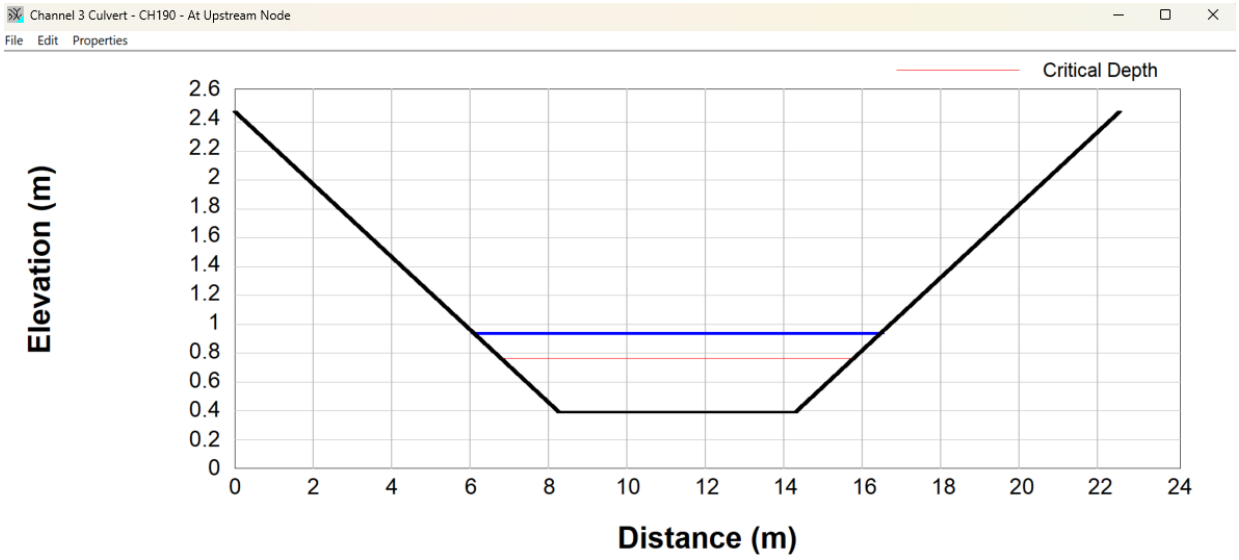


Channel immediately downstream of Carrs Drive Culvert

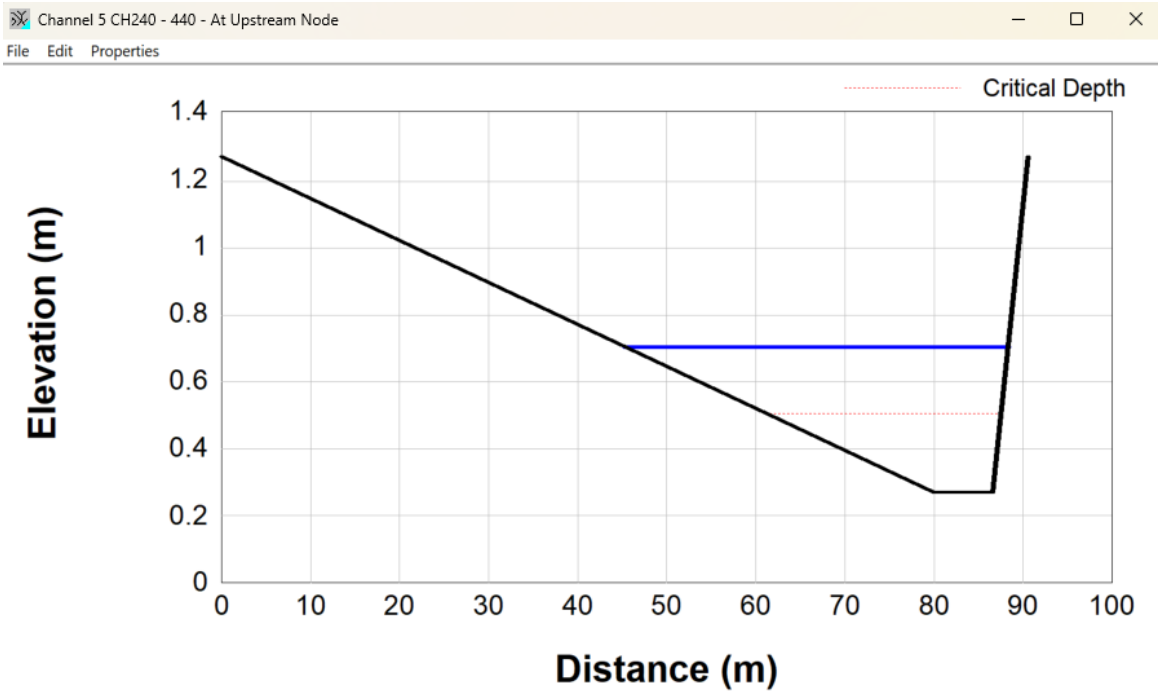


Channel immediately upstream of internal culvert

Manage-Design-Engineer Pty Ltd
PO Box 44
LENNOX HEAD NSW 2478
www.md-engineer.com.au



Channel Downstream of Basin 1



Channel Downstream of OSD Tank 1

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

APPENDIX B – Development Staging Plan

1 STAGING PLAN
1:1500

MARK SHAPIRO ARCHITECTS
T 0421 996 467
W markshapiro.com.au
E mark@markshapiro.com.au
NSW REG. 9789
ABN 646 2000 7678

ISSUE	DATE	REVISION
C	Work in Progress	DA RFI

CLIENT:
Clifton Yamba Land Pty Ltd as Trustee for Yamba Land Trust
401/407 New South Head Road, Double Bay 2028

PROJECT:
Clifton Yamba
Carrs Drive, Yamba NSW 2464

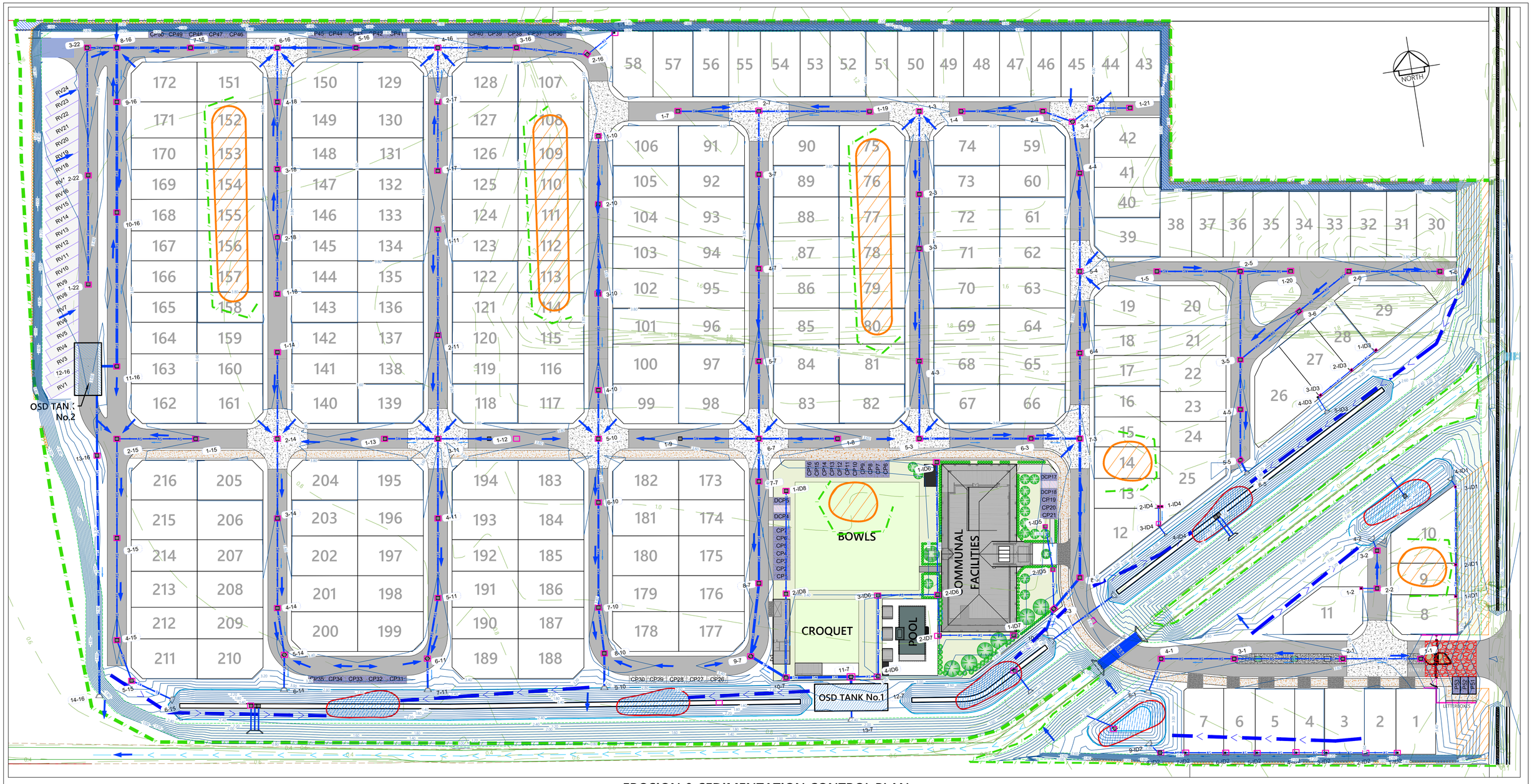
DRAWING:
STAGING PLAN

PROJECT NO:
21001
PLOTTED: 25/1/2024
DRAWING NO: **DA1003** REV: **C**

FILE: 21001 Yamba_2_DA_240123_AC24.pln

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

APPENDIX C – ESC PLAN



10 5 0 10 20 30 40
Horizontal Scale 1:600 (A1)
1:1200 (A3)

LEGEND

- GEOTEXTILE INLET FILTER FOR FIELD INLET PIT
- SEDIMENT FENCE - REFER TO SED 6-8 & 01.01 DETAILS SHEET D42
- HAY BALE SEDIMENT TRAP
- TOPSOIL WINDROW & DESIGN SWALE
- FLOW DIRECTION
- SUGGESTED STOCKPILE SITE - REFER TO SED 4-1 ON DETAILS SHEET D42
- STABILISED SITE ACCESS - REFER TO SED 09.01 ON DETAILS SHEET D42
- TEMPORARY SEDIMENT BASIN

EROSION & SEDIMENTATION CONTROL PLAN

SCALE 1:600

LEGEND

- INTERNAL LOT BOUNDARY
- BIO - BASIN TOP
- CHANNEL TOP OF BANK
- CHANNEL CENTRE LINE
- PROPOSED STORMWATER DRAINAGE
- RETAINING WALL
- 6.0 NATURAL SURFACE CONTOURS
- STORMWATER DRAINAGE PIT
- HEADWALL
- VISITOR AND RECREATIONAL VEHICLE PARKING
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'

EROSION & SEDIMENT CONTROL NOTES:

1. SOIL STOCKPILES TO BE NO HIGHER THAN 2.0 METRES (1.0m PREFERABLE) IN LOCATIONS DIRECTED BY THE SUPERINTENDENT.
2. CONSTRUCT SEDIMENT FENCE AT LOCATIONS SHOWN AND AS DIRECTED BY SITE SUPERINTENDENT. SEDIMENT FENCE OR EQUIVALENT TO BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH COUNCILS ENGINEERING REQUIREMENTS.
3. UPON COMPLETION OF FINAL EARTHWORKS OR AFTER WRITTEN DIRECTION OF COUNCIL, IMMEDIATE SOIL CONSERVATION TREATMENTS SHALL BE APPLIED SO AS TO RENDER AREAS THAT HAVE BEEN DISTURBED, EROSION PROOF IN 14 DAYS.
4. ALL PERIMETER AND SILTATION CONTROL MEASURES ARE TO BE THE FIRST STEP IN CLEARING OR EARTHWORKS.
6. TEMPORARY SEDIMENTATION BASIN TO BE FLOCCULATED AND PUMPED OUT AFTER EVERY STORM EVENT. ALL FLOCCULATED SEDIMENT TO BE REMOVED FROM THE BASIN AT THE CONCLUSION OF THE CONTRACT PERIOD.
7. ALL TEMPORARY EARTH BERMS AND DIVERSION BANKS ARE TO BE TRACK ROLLED AND SEEDED OR MULCHED FOR TEMPORARY VEGETATION COVER AS SOON AS THEY HAVE BEEN FORMED.
8. PROVIDE FILTER SAUSAGE KERB INLET SEDIMENT TRAPS OR EQUIVALENT (TO THE SATISFACTION OF THE SUPERINTENDENT) TO ALL CONSTRUCTED INLET PITS AND STORMWATER PIPING.
9. ALL TOPSOIL IS TO BE STOCKPILED ON SITE FOR RE-USE (AWAY FROM TREES AND DRAINAGE LINES). MEASURES SHALL BE APPLIED TO PREVENT EROSION FROM THE STOCKPILES.
10. SOIL/GRASS - TOPSOIL, 100mm THICK SHALL BE APPLIED TO ALL DISTURBED AREAS. ALL REMAINING EXPOSED TOPSOIL SHALL BE SEEDED IMMEDIATELY UPON COMPLETION OF THE SOIL SPREADING OPERATION.

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

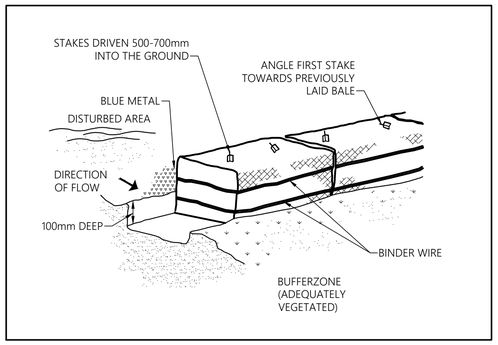
CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

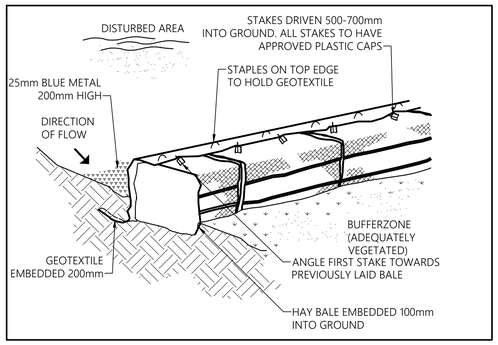
DA CIVIL DRAWING

DRAWING TITLE: EROSION & SEDIMENTATION CONTROL PLAN

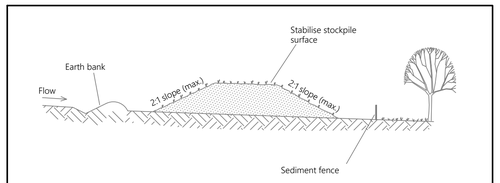
DWG No: D41 | SHEET: 41 OF 43 | REV: 1



SED_02.01: HAY BALE BARRIERS



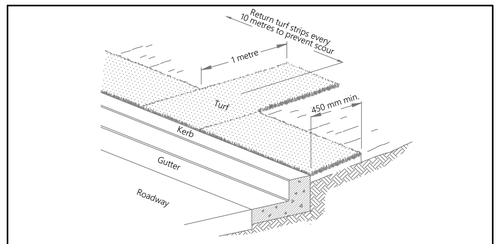
SED_02.02: HAY BALE & GEOTEXTILE FENCE



CONSTRUCTION NOTES:

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

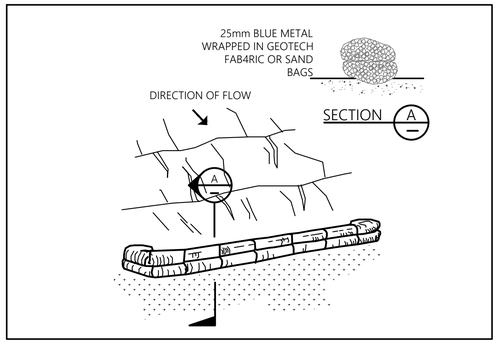
SED_4-1 STOCKPILES



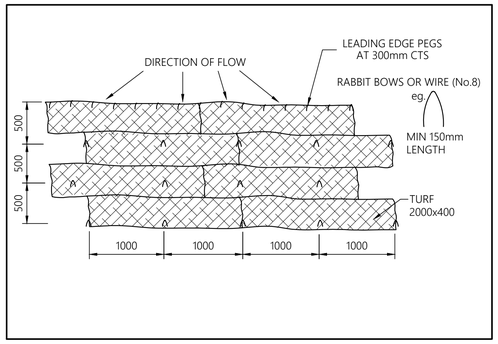
CONSTRUCTION NOTES:

1. Install a 450 mm minimum wide roll of turf on the footpath next to the kerb and at the same level as the top of the kerb.
2. Lay 1.4 metre long turf strips normal to the kerb every 10 metres.
3. Rehabilitate disturbed soil behind the turf strip following the ESCP/SWMP.

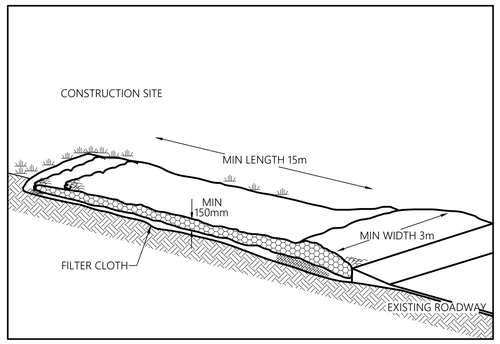
SED_6-13 KERBSIDE TURF STRIP



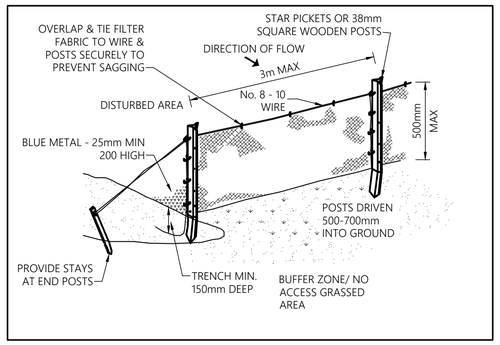
SED_03.01: ROCK GROYNE OR SAUSAGE



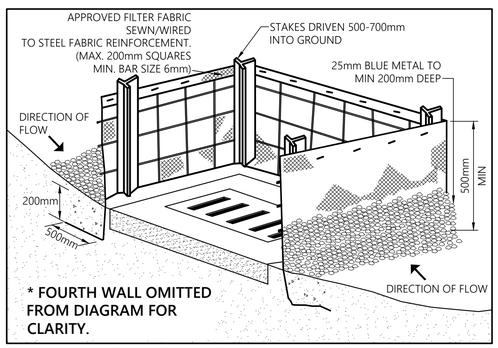
SED_07.02: TURF LAYING CONFIGURATION



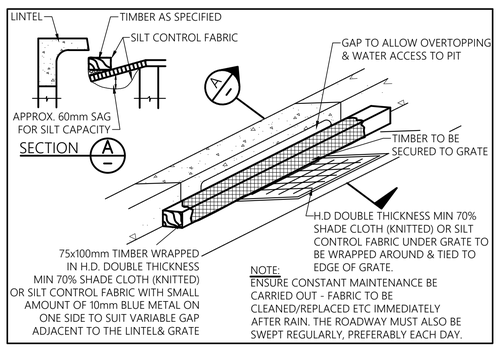
SED_09.01: STABILISED CONSTRUCTION ENTRANCE DETAILS



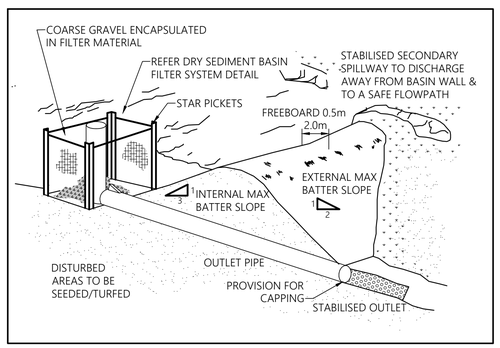
SED_01.01: SILT FENCE - TYPE 1



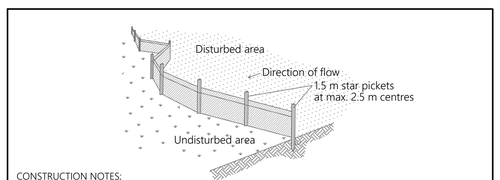
SED_11.05: STORM INLET SEDIMENT TRAP



SED_11.03: KERB INLET CONTROL



SED_10.01: SEDIMENT BASIN OUTLET



CONSTRUCTION NOTES:

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

SED_6-8 SEDIMENT FENCE NOTES

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	30.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: EROSION & SEDIMENTATION CONTROL DETAIL

DWG No: D42 | SHEET: 42 OF 43 | REV: 1

1/64 Ballina Street
(PO Box 44)
Lennox Head NSW 2478
www.mde.au

APPENDIX D – STORMWATER CATCHMENT PLAN WITH DEVELOPMENT STAGING OVERLAY

C9 - TANK 2

C4 - BASIN 3 & 4

C3 - BASIN 3 & 4

C8 - TANK 1

C6 - BASIN 5

C5 - BASIN 5

C7 - BASIN 5

C2 - BASIN 2

C1 - BASIN 1

OSD TANK No.2

OSD TANK No.1

BOWLS

COMMUNAL FACILITIES

CROQUET

POOL

ROAD 1

ROAD 2

ROAD 3

ROAD 4

ROAD 5

ROAD 6

ROAD 7

ROAD 8

ROAD 9

ROAD 10

ROAD 11

ROAD 12

ROAD 13

ROAD 15

Horizontal Scale 1:600 (A1)
1:1200 (A3)

ARCHITECTURAL INFORMATION FOR CLUB HOUSE
SUPPLIED BY MARK SHAPIRO ARCHITECTS
DRAWING NUMBER DA1002WIP REV 2

PRELIMINARY PLANS FOR DA PURPOSES ONLY NOT FOR CONSTRUCTION

PLANS TO BE PRINTED IN COLOUR

- Stage 1
- Stage 2
- CF Stage
- Stage 3
- Stage 4
- Stage 5
- Stage 6
- Stage 7
- Stage 8
- Stage 9
- Stage 10
- Stage 11
- Stage 12

ISSUE	DESCRIPTION	DATE
1	ISSUED FOR DEVELOPMENT APPLICATION - AMENDED SITE FORMATION HEIGHTS	23.01.2024
0	ISSUED FOR DEVELOPMENT APPLICATION	08.09.2022

ISSUED FOR DEVELOPMENT APPROVAL
NOT FOR CONSTRUCTION

DESIGNED: T.RYDEN | DATE: JAN 2024
DRAWN: A.SCHMID | SCALE: AS SHOWN
SURVEYING: MACRO SURVEYING | SHEET SIZE: A1

MDE Manage Design Engineer

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: 110 & 120 CARRS DRIVE, YAMBA
DEVELOPMENT APPLICATION CIVIL WORKS PLANS

CLIFTON YAMBA

PROJECT: PROPOSED MHE DEVELOPMENT
110 & 120 CARRS DRIVE
YAMBA, NSW 2464
LOT 2 DP733507 & LOT 32 DP128863

DA CIVIL DRAWING

DRAWING TITLE: CATCHMENT & STAGING PLAN

DWG No: | SHEET: OF | REV: