C&M CONSULTING ENGINEERS

ENGINEERING REPORT
FOR
PROPOSED RESIDENTIAL DEVELOPMENT
AT
45-49 WARRIEWOOD RD, WARRIEWOOD

REPORT NO. R02192
Revision C

25 September 2020

PROJECT DETAILS

Property Address: 45-49 Warriewood Rd, Warriewood

Development Proposal: Residential Development

REPORT CERTIFICATION

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DOCUMENT CONTROL

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Contents

1. INTRODUCTION

1.1 General

This engineering report has been prepared to support the proposed Development Application to Northern Beaches Council (Council) for a residential development at 45-49 Warriewood Road, Warriewood.

The proposed infrastructure works include roads (both new and upgrade of an existing), stormwater drainage, bulk earthworks, site accesses, retaining walls, on-site detention, water quality measures, and other associated works. These will be designed to comply with the principles outlined in Council's DCPs and Standards.

This report should be read in conjunction with the accompanying Engineering Drawings, PN02292 and other planning reports and drawings. Reduced scale of engineering drawings are included in Appendix A.

The following issues have been addressed in this report:

- General engineering issues,
- Access and car parking,
- Stormwater management and,
- Utility services.

The following information and documents were used for this report:

- Northern Beaches Council – Pittwater 21 DCP, 2018
- Northern Beaches Council – Warriewood Valley Roads Masterplan, 2018
- Northern Beaches Council – Warriewood Valley Water Management Specification, 2001
- Northern Beaches Council – Pre-lodgement Notes, PLM2019/0109
- Engineers Australia - Australian Runoff Quality – A Guide to Water Sensitive Urban Design", (2006),
- Engineers Australia - Australian Rainfall & Runoff, 1987
- Sydney Water HYDRA Diagram;
- Agility Gas Diagram;
- Energy Australia Electrical Infrastructure Plans / Diagrams;
- Telstra Service Diagrams.

1.2 Engineering Objectives and Targets

The engineering objectives are to create a well linked and highly accessible layout to provide a development that responds to the topography and site constraints, and to provide a safe and environmentally friendly development.

From the planning, policy and legislation, the following principles will guide the development in relation to engineering works:

- Provision of roads system that meets Council's Warriewood Valley Roads Masterplan,
- Provision of water sensitive urban design principles and improve stormwater runoff quality discharging from the site to Narrabeen Creek
- Provision of a safe access links to the adjoining neighbourhood by well linked cycleways and paths,
- Respond to the existing drainage system in Warriewood Road,
- Sympathetic to the terrain and landform and responsive to the existing environmental constraints,
- Develop a high quality infrastructure that integrates well with landform and drainage system
- Meet triple bottom line benchmarks encompassing social, ecological, and economic factors.

Site specific design objectives and targets have been established on the basis of the review of relevant policy, legislation and guidelines.

Issue	Site-Applicable Target or Management Objective
Site Works	- Sympathetic to the existing landform and surrounding built-form. - Minimise excessive cut or fill. - Responsive to the existing environmental constraints- Narrabeen Creek.
Accesses and Carpark	- Provide simple and efficient layout for public safety. - Provide safe and functional access system without compromising streetscape qualities. - Provide enough car parking spaces for the demand.
Mainstream Flooding	- Ensure the development has adequate freeboard from Narrabeen Creek flooding. - Incorporate Flood Risk Management.
Overland Flow	- Provide safe conveyancing of stormwater through the site.
Flow management	- Provide OSD system to the requirement of Council to control stormwater runoff and minimise discharge impacts on adjoining properties and into the natural drainage system before, during and after construction. - Minimise alteration to natural flow paths and discharge points. - Closely match pre-development frequency of runoff events. - To provide for the disposal of stormwater from the site in an efficient, equitable and environmentally sensible way.
Stormwater Quality	- Manage stormwater to remove as much total Phosphorus and Nitrogen, at least 80% of Total Suspended Solids and 70% of Litter and 90% of hydrocarbons from runoff.
Water conservation	- Provide efficient sized rainwater tank for both irrigation of landscape areas and toilet flushing.
Services	- Provide site with essential services.

Table 1 – Engineering Objectives and Targets

1.3 SITE

The site is located at 45-49 Warriewood, Warriewood. It comprises an area of 2.154 hectares by Title consisting two (2) separate allotments: Lot 1 & 2 in DP 349085. It is located on the southern side of Warriewood Road and bounded by Narrabeen Creek to the south.

The site has a gently rolling slope in a southerly direction from Warriewood Road (gradients are generally 5-7%) then flattens towards the creek.

Areal view of the existing site is shown in Figure 1 below.

Figure 1 – Areal View of the site

There is 1.822m wide drainage reserve (Lot 2 in DP972209) along the eastern boundary of Lot 2 with an open channel. On the upstream of the channel in Warriewood Road, there is an existing 525mm diameter stormwater pipe with a headwall.

2. GENERAL ENGINEERING ISSUES

2.1 Site Earth Works

The proposed development includes subdivision of 3 individual lots (Lots 1 & 2 in DP 349085 and Lot 2 in DP972209) into 14 lots comprising:

- 11 Torrens Title lots,
- 1 Superlot with Strata development,
- 1 lot for Road Reserve, and
- 1 Residue Lot (Drainage Reserve along Narrabeen Creek).

The site is affected by the 1 in 100 year ARI flooding of Narrabeen Creek. As per BMT's[1] recommendation the site is proposed to fill to the planning level.

It is inevitable that construction of a residential development on a sloping land requires excavation and filling of the site. To minimise the excessive alteration of the existing topography and sympathetic to its surrounding built form, the buildings have been stepped. The average alteration of the final levels, therefore, would be less than 1m.

Drawing 02192_231 shows the extent of cut and fill.

The earthworks will be done under strict supervision of a geotechnical engineer to meet AS3798.

[1] Reference 4

3. ROADS, SITE ACCESS AND PARKING

3.1 Road Planning

A separate Traffic report prepared by TEF Consulting is included in the Development Application. Issues relating to traffic should refer to the report.

This Section addresses issues relating to road works in the aspects of civil engineering works either identified in the traffic report or are deemed necessary relate to this type of development.

Proposed extension of Lorikeet Grove is classified as Local Street and the existing Warriewood Rd is classified as Collector Street in accordance with Warriewood Valley Roads Masterplan[2]. Tables 2 below summarises composition of Local Streets and Collector Streets.

Local Streets	
Traffic Volume	2000 vehicles per day – approximate upper limit.
Maximum Number of Dwellings	200
Design Speed	40km/h
Speed Limit	50km/h
Traffic Lane Width	Total 7.5m carriageway to cater for traffic, parking, cyclists.
Cycle Lane Width	Share roadway with vehicles.
Parking Lane Width	No parking lane marked, park adjacent to kerb.
Bus Bay Width	N/A
Verge Width	4.25m on both sides of carriageway to cater for street tree planting.
Footpath Width	1.5m footpath one side of carriageway.
Total Road Reserve Width	16.0m minimum
Collector Streets	
Traffic Volume	5,000 vehicles per day – approximate upper limit.
Design Speed	50km/h
Speed Limit	50km/h
Traffic Lane Width	3.7m
Cycle Lane Width	Share roadway with vehicles.
Indented Parking Lane Width	2.1m
Indented Bus Bay Width	3.0m
Shared Path Width	2.1m shared path on both sides of the carriageway.
Total Road Reserve Width	20m minimum

Table 2 – Road System

[2] Reference 1

3.2 Warriewood Road Reconstruction

The existing Warriewood Road fronting the site requires a half road reconstruction to reflect Collector Street.

The new kerbline is set 10.9m from the existing kerb on the northern side with the centreline of the road located at 5.1m from the northern side kerb. The proposed reconstruction includes 3.7m wide carriageway and 2.1m indented car parking bays totalling 5.8m wide reconstruction.

The proposed work is shown on Drawings 02192_201 and 02192_401.

3.3 Internal Accesses and Off Street Parking

The proposed new access points to the site will be from Lorikeet Grove to the requirements of the AS2890.1 and 2.

The basement access, parking, isle widths, and turning provisions have been designed in accordance with AS2890.1 - Off Street Car parking.

4. STORMWATER MANAGEMENT

4.1 Introduction

4.1.1 Background

The objective is to provide stormwater management, which ensure that the proposed development is safe from the mainstream flooding; local overland flows and does not adversely impact on the stormwater flows and water quality of waterways within, adjacent and downstream of the site.

Conceptual design of the drainage system has been included in the Engineering Drawings in Appendix A. Detailed design will be provided as part of the Construction Certificate application.

4.1.2 Key Issues

The key issues and the mitigating measures to be employed within the proposed development site are:

- ***Mainstream Flooding*** *– The site is affected by flooding of Narrabeen Creek located to the south of the site. To avoid impacting on the development, the site has been filled to the flood planning level without affecting the flood levels in the creek. The flood planning level is described in Section 4.2.*

- ***Local Overland Flows*** *– In urbanised situation, the excess runoff from the major storm events is conveyed by roads, overland flow paths and channels. The site contains overland flow path in a form of open channel that drains the upstream properties. To limit impact on the site, we have proposed to pipe for the 1 in 100 year storm events with overland flow provision. The design and operation of the proposed system is described in Section 4.3.*

- ***Stormwater Flow*** *- Increased impervious surfaces (such as roads, roofs, carparks, etc) have the potential to increase the stormwater flows from the site during storm events. To avoid impacting on the downstream drainage system, the site stormwater system has been designed to safely convey the flows through the site and within the capacity of the downstream system. The design and operation of the proposed system is described in Section 4.4.*

- ***Water Quality*** *- Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in stormwater runoff. To limit impact on the downstream water quality, water quality control devices will be provided prior to discharging to the downstream waterways. The design and operation of the proposed system is described in Section 4.5*

4.2 Mainstream Flooding

4.2.1 Narrabeen Creek

BMT Pty Ltd has prepared Narrabeen Creek Flood Risk Management Plan[3] for the development and submitted as part of the current DA submission. The report is included in Appendix D.

The BMT's flood report (Report) indicates that the site is classified as Flood Category 1 – High Hazard. This is due to that the southern portion of the site is inundated by the 1 in 100 year ARI flood.

The Report estimates the 1 in 100 year flood level within the site and recommends Flood Planning Levels for the development as well as levels for Lorikeet Grove.

Table 3 below summarises the findings and recommendations:

Design Event (AEP)	Peak Flood Level (m AHD)	
	Existing	Developed
20%	3.90	3.89 (+0.01)
10%	3.96	3.96 (0.0)
5%	4.03	4.03 (0.0)
2%	4.09	4.09 (0.0)
1%	4.13	4.13 (0.0)
1% + Climate Change	4.21	4.21 (0.0)
PMF	4.89	4.89 (0.0)

Table 3 – Narrabeen Creek Flood Levels
Note: Bracketed value is change in peak flood level from the existing conditions

The Flood Planning Level (FPL) for the site was calculated by adding a 0.5m freeboard allowance to the simulated 1% AEP+CC existing peak flood level. The FPL for the site is 4.71 m AHD (4.21 m AHD + 0.5 m freeboard).

All habitable floor areas will be at or above the FPL. The proposed Lorikeet Grove will be above the 1% AEP+CC.

[3] Appendix D

4.3 Overland Flow Flooding

As mentioned in Section 1.3 above, the development associated with the existing drainage reserve located to the east of the site. Its upstream catchment is drained by the existing 525mm diameter pipe discharging to the open channel in the drainage reserve. The catchment of this pipe is approximately 4.5 hectares. With 65% imperviousness and using XPRAFTS, the estimated peaks for the 1 in 20 year ARI and 1 in 100 year ARI are 1.4m^3/s and 3.3m^3/s respectively. External catchment is shown in Figure 2 below.

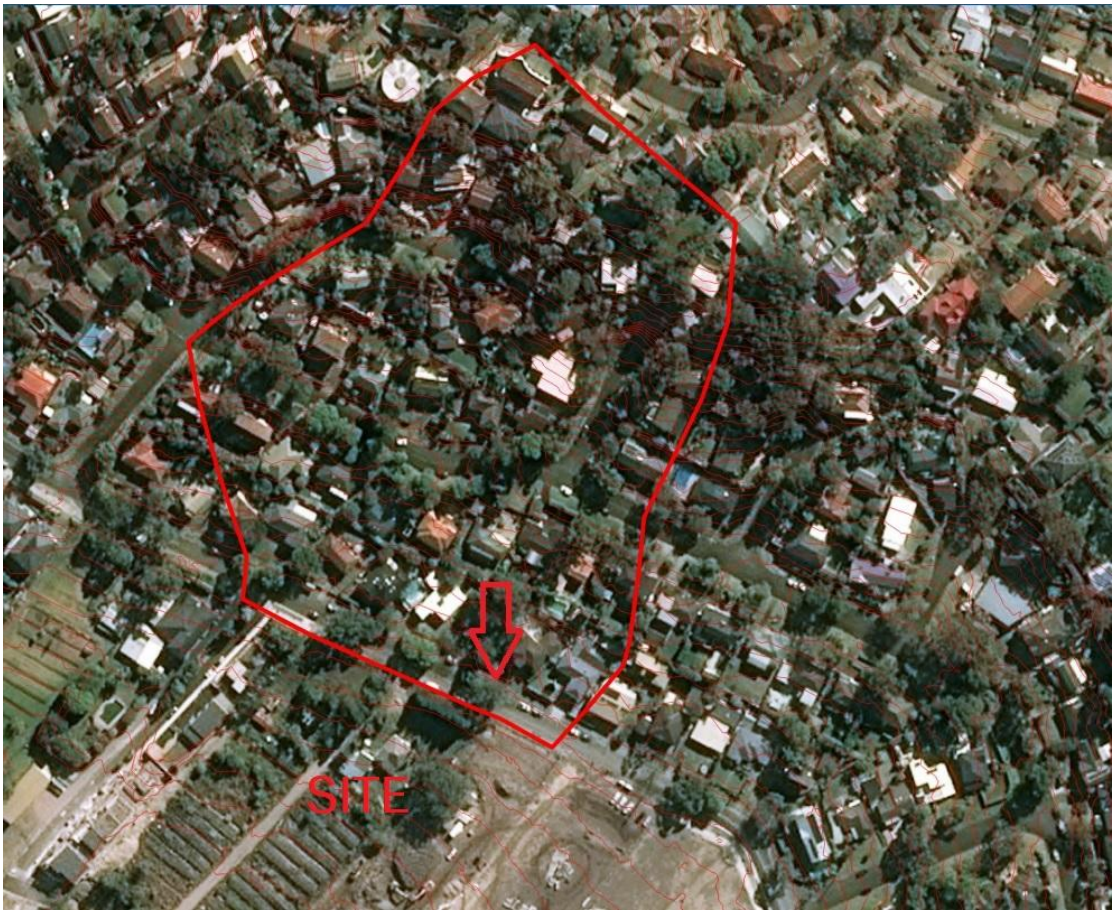

Figure 2 – Upstream Catchment

The proposed pipe in the drainage reserve is 900mm pipe which has a capacity of 3.4m^3/s at an effective hydraulic grade of 2.5%. This is approximate peak flows of the 1 in 100 year ARI.

XPRAFTS hydrology model is included in the DA submission.

4.4 Stormwater Quantity Control

4.4.1 Design Guidelines

The site based stormwater management and planning elements are to be designed and constructed in accordance with the following:

Guidelines: Warriewood Valley Water Management Specification 2001[4]

The proposed development increases the total impervious area of the existing site and therefore may increase the discharge rate to the downstream waterways. The main objective is to achieve a natural water balance which seeks to approximate the pre-development site conditions to maintain existing conditions as well as controlling erosion and sediment removal.

The site is located within Sector 2 in the Guideline, where the RAFTS model was based on 50% imperviousness ratio over the whole site. Council however recommended using 65% imperviousness ratio for the development portion of the site[5] .

4.4.2 Proposed Drainage System

The drainage system for the development will be designed to collect all surface runoff flows from impermeable surfaces such as roads, buildings and hard surface areas to the designated conveyancing system to the downstream drainage system in a safe manner.

The drainage system proposed for the development includes:

- A piped system to collect minor storm events from the developed areas;
- Diversion pipe for the upstream external catchment;
- Overland flow path to direct the major storm safely through the site;
- Gross pollutant traps at each inlet pits;
- On-site detention (OSD) tank to attenuate developed flows to mimic existing flows;
- Stormwater quality control measures to reduce nutrient runoff to pre-development levels.

The development of the above infrastructure has been conceptually designed and presented in the Engineering Drawings in Appendix A.

[4] Reference 2
[5] Pre-lodgement Notes, PLM2019/0109

4.4.3 Sizing of the OSD Tank

Since the imperviousness ratio has changed for the site the OSD calculations have been performed using the hydrologic model, XP-RAFTS for the Permissible Site Discharge (PSD) and Site Storage Requirements (SSR) for the 2 year ARI to 100 year ARI.

The parameters used in the RAFTS model are same as used in the Warriewood Valley Water Management Specification for Sector 2. The parameters are re-produced in Table 4 below.

Base Condition Parameters								Developed Condition Parameters							
Area (ha) #1	Area (ha) #2	%Im #1	%Im #2	Slp % #1	Slp % #2	Pern #1	Pern #2	Area (ha) #1	Area (ha) #2	%Im #1	%Im #2	Slp % #1	Slp % #2	Pern #1	Pern #2
4.3	0.001	5	100	4.4	4.4	0.07	0.015	2.14	2.14	5	100	4.4	4.4	0.025	0.015

Table 4 – RAFTS Parameters used in the model

Table 5 below shows catchment configuration for the developed condition.

Catchment	Area (Ha)		
	Total	Impervious	Pervious
SITE	0.93	0.744	0.186
BYPASS (Developed)	0.178	0.1	0.078
LORIKEET Gr [(1)]	0.133	0.1	0.033
ENVIROMENTAL AREA[(2)]	0.91	0	0.91
DRAINAGE RESERVE[(2)]	0.053	0	0.053
TOTAL	**2.204**	**0.944**	**1.260**

Table 5 – Developed Catchments

NOTE 1 – Lorikeet Gr road area is included as bypass since it is located below the OSD.
NOTE 2 – Environmental Area and Drainage Reserve have not been included as they have no additional impervious area and bypassing the OSD.

From the modelling, a 260m^2 x 1.8m deep underground tank is required to detain developed flows to mimic the existing. Discharge is controlled by a 230mm diameter orifice and a 200mm wide internal weir. Full details of the OSD system are shown on Drawing 02192_621.

Table 6 below shows the performance of the proposed OSD system.

ARI	Ex Q	De Q	WITH OSD		
			Q	Stage	Storage
2	0.182	0.401	0.18		
5	0.275	0.532	0.247		
10	0.337	0.616	0.313		
20	0.418	0.721	0.405		
50	0.497	0.798	0.487		
100	0.577	0.896	0.575	5.136	365

Table 6– PSD and OSD Performance – RAFTS

The results show that there would be up to 120% increase in peak flows due to the development. With the proposed drainage system it can achieve its main function of safely conveying stormwater through the site without any adverse impact both on site and downstream of the site.

XPRAFTS hydrology model is included in the DA submission.

4.5 Stormwater Quality Control

4.5.1 Design Guidelines

The site based stormwater management and planning elements are to be designed and constructed in accordance with the following:

Guidelines: Warriewood Valley Water Management Specification 2001

The main objective for stormwater quality is to detail the pollutant load modelling for the existing (pre) and post development conditions and the proposed measures to reduce pollutant loads. As a minimum, a 'no worsening' of existing runoff quality is required. Consideration of three scenarios is to be made:

- A wet year (90%ile rainfall),
- An average year (50%ile rainfall) and
- A dry year (10%ile rainfall)

4.5.2 Water Quality Control Measures

There are a number of measures that can reduce pollutant loadings, varying in effectiveness depending on land use type, topography and the control target.

As recommended by Warriewood Valley Water Management Specification, we are proposing infiltration system within the residue lot south of proposed Lorikeet Gr. This method will replenish groundwater where the endangered ecological community (EEC) that is present on site will greatly benefit.

In addition to infiltration system, all stormwater pits will be installed with 'Oceanguard' filter basket to control gross pollutants and suspended solids.

The measures proposed for the redevelopment are summarised in Table 7.

Measures	Descriptions
Infiltration Basin	▪ An infiltration basin is a vertical filtration system that filters stormwater through a prescribed media (e.g. sandy loam) and recharges groundwater. ▪ The standard infiltration basin in this study has a detention depth of 0.3m and the filter media depth of 0.3m.
Gross Pollutant Traps	▪ An Oceanguard (*Enviropod)* is a catch basin insert installed inside inlet pits. It is effective in removing trash, debris and other pollutants from runoff. ▪ Oceanguards proposed for the project utilise a 200 micron filter system. These filter baskets will be installed in the most surface inlet pits for the proposed development including each Torrens titled lots fronting Lorikeet Grove.
Rainwater Tank	▪ Rainwater tanks are effective in the removal of pollutant loads at source. The pollutant removal process occurs by harvesting runoff for reuse, thereby limiting the nutrients that are discharged into the waterways. ▪ It is proposed to provide a rainwater reuse tank system with a minimum effective volume of 72kL. This is made up with 50KL for the units and 2kl/lot for Torrens titled lots. These will be plumbed for landscape irrigation and toilet flushing. ▪ Rainwater re-use rate for irrigation used is 0.4kL/year/m^2 of landscape area as PET-Rain. For Torrens titles lots 25kL/year/lot as PET-Rain. For toilet flushing, a nominal rate of 0.08kL/day/dwelling is used. Above rates are industrial standard rates used in Australia.

Table 7– Description of Stormwater Quality Improvement Devices (SQID)

4.5.3 Strategy Effectiveness

The effectiveness of the proposed water quality measures has been assessed using numerical modelling. The results were assessed against the established Council requirements to determine the effectiveness of the proposed strategy.

4.5.4 MUSIC Program

The water quality model adopted for this project is the MUSIC (Model for Urban Stormwater Improvement Conceptualisation version 6) water quality numerical model developed by the MUSIC Development Team of the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is an event basis model, and will simulate the performance of a group of stormwater management measures, configured in series or in parallel to form a “treatment train”.

As per the Warriewood Valley Water Management Specification 2001, the models have adopted a daily timestep. The specification requires the consideration of three scenarios to be made:

- A wet year (90%ile rainfall),
- An average year (50%ile rainfall) and
- A dry year (10%ile rainfall)

A separate MUSIC model was done for each of the 3 scenarios to compare the pre-development with the post-development pollutant load rates and to ensure no increases in the post-developed state. The base models were acquired from Council and have used the specific council source nodes. The first model is for the year of 1984 which was a ‘wet year’, the second was for the year of 1998 which was an ‘average year’ and the final model was for the year of 2002 whish was a ‘dry year’

Catchment characteristics were defined using a combination of roof areas and non-roof catchments with varying imperviousness ratios to replicate the catchment for the development condition. The respective catchment areas are shown in Table 8.

The MUSIC model layout are shown in Appendix B of this report.

4.5.5 Event Mean Concentration

MUSIC uses different event mean concentrations (EMC) to determine the pollutant loads generated by different land uses. The standard EMCs adopted within MUSIC were based on research undertaken by Duncan (1999) through the CRCCH and the results are reproduced in Australian Runoff Quality – A Guide to Water Sensitive Urban Design (ARQ). Table 8 summarises the parameters used for the development site.

Land Use	Mean Base Flow Concentration Parameters Log_{10} (mg/L)			Mean Storm Flow Concentration Parameters Log_{10} (mg/L)		
	TSS	TP	TN	TSS	TP	TN
Roof Areas	Not Applicable*Note 1			1.300	-0.890	0.300
Impervious Areas	1.200	-0.850	0.110	2.150	-0.600	0.300
Pervious Areas	1.200	-0.850	0.110	2.150	-0.600	0.300

Table 8– EMC Parameters used in MUSIC

*Note 1 – Roof areas consists of 100% impervious area so there is no base flow generated from this area.

4.5.6 Configuration

Tables 9 and 10 provide the treatment configurations used in the MUSIC model:

Land Use	Developed Conditions	
	Area (m^2)	Imperviousness (%)
Catchment 1		
Roof	1300	100
Ground	4300	55
Catchment 2		
Roof	970	100
Ground	2750	55
Catchment 3		
Roof	700	100
Ground	1090	45
Catchment 4 – Lorikeet Gr		
Road	1330	85

Table 9– MUSIC Catchment Areas

Since Council requirement is no increase from the existing the catchments south of Lorikeet Gr where no development proposed has been excluded in the modelling.

Stormwater Quality Improvement Device (SQID)	Quantity Of SQID
Infiltration Basin	350m^2 with 250m^2 filter area
Oceanguards	40 x 200micron
Rainwater Tanks	50kL and 11x2kL for lots

Table 10 - Stormwater Quality Improvement Devices (SQID)

4.5.7 Results

The results of the MUSIC modelling are shown in Table 11 below. The total pollutant loads from the development are expressed in kilograms per year.

Parameters	Pre	Post	Change
YEAR 1984 - Wet Year			
Flow (ML/yr)	5.54	5.27	
Total Suspended Solids (kg/yr)	393	149	-244
Total Phosphorus (kg/yr)	1.00	0.748	-0.252
Total Nitrogen (kg/yr)	9.56	8.61	-0.95
Gross Pollutants (kg/yr)	148	0	-148
YEAR 1998 - Average Year			
Flow (ML/yr)	13.4	12.1	
Total Suspended Solids (kg/yr)	921	562	-359
Total Phosphorus (kg/yr)	2.35	2.30	-0.05
Total Nitrogen (kg/yr)	22.7	20.3	-2.4
Gross Pollutants (kg/yr)	165	0	-165
YEAR 2002 - Dry Year			
Flow (ML/yr)	4.0	3.50	
Total Suspended Solids (kg/yr)	322	149	-173
Total Phosphorus (kg/yr)	0.801	0.644	-0.157
Total Nitrogen (kg/yr)	7.47	6.07	-1.4
Gross Pollutants (kg/yr)	109	0	-109

Table 11 – Results of MUSIC Modelling

The above results show that in all instances, the post development pollutant loads were less than the pre-developed pollutant loads. Therefore, by implementing the proposed treatment train measures within the proposed development there will be no detrimental effect on the quality of stormwater discharging to Narrabeen Creek.

4.5.8 Water Balance (Rainwater Harvesting and Reuse)

A rainwater harvest and reuse strategy has been provided for the development. The development adopts a WSUD strategy to reduce the loading placed on water and wastewater infrastructure. This strategy will give opportunities to reduce demand on potable water and to reduce wastewater discharged from the site.

Rainwater will only be harvested from the roof areas. Rainwater tanks for the development consists of a 25KL tank for each Strata Titled building and 2KL tank each for Torrens Titled lots. These roof areas will provide suitable catchment for rainwater harvesting with the harvested water being used a non-potable water source for irrigation and toilet flushing.

A MUSIC model for the proposed harvesting system was developed to perform a water balance to determine the most efficient rainwater tank size for the roof catchment areas available to achieve the objective.

The following were input into the water balance model:

- Roof Area – 4060 m^2.
- Landscape Area - 1175m^2.
- Total Dwelling - 47
- For Irrigation - Rainwater re-use rate used is 0.4kL/year/m^2 of landscape area as PET-Rain. For Torrens titles lots 25kL/year/lot as PET-Rain.
- For toilet flushing - a nominal rate of 0.08kL/day/dwelling is used.

Parameters	% Re-use Demand
YEAR 1984 - Wet Year	
Tank #1	75.5
Tank #2	72.0
Tank #3	83.4
YEAR 1998 - Average Year	
Tank #1	74.8
Tank #2	68
Tank #3	89.3
YEAR 2002 - Dry Year	
Tank #1	69.5
Tank #2	61.8
Tank #3	81

Table 12 – Results of Water Balance

The results are summarised in the above graph and indicate that an average of 75% reduction in potable water usage can be achieved by harvesting rainwater from the roof areas and providing a minimum rainwater tank storage of 72 kl for the harvested rainwater.

5. UTILITY SERVICES

5.1 Water Supply

There is a DN100 CICL watermain in Warriewood Road and a DN100 oPVC in Lorikeet Grove which will be extended as part of the development.

Therefore water does not pose any implication on the development.

5.2 Sewerage

The site contains a DN1800 trunk sewermain but is unlikely that connection is made to this main.

There is however a DN400 RC pipe near Narrabeen Creek. We expect that there should be sufficient sewer capacity available to service the site.

The sewer reticulation for the development will be done to the requirement of Sydney Water by a Water Servicing Coordinator.

5.3 Gas

There is a DN32 medium pressure gas main (300kPa) in Warriewood Road and Lorikeet Grove. Both mains are available for the development.

5.4 Electricity and Telecommunication

Electricity and telecommunications services are readily available from Warriewood Rd and Lorikeet Grove and we expect that these have sufficient capacity to adequately service the proposed development. These should not present any restrictions to the proposed development.

6. CONCLUSION

This engineering report has been prepared to support the proposed Development Application to Northern Beaches Council for a Residential Development at 45-49 Warriewood Rd, Warriewood.

The development as proposed, in the aspects of engineering, is functionally effective, safe, and environmentally sustainable. This high standard has been achieved by implementing Council DCP and various Planning Instruments and Standards including the WSUD principles in the planning and design of the development.

Whilst it is inevitable that development will have an impact of the existing stormwater runoff characteristics of a site due to changes in impervious areas and changes in landform, adequate stormwater management practices can be implemented that minimise the impact of development on the existing stormwater system.

The results provided in this report indicate that the condition of the downstream stormwater system will be improved by implementation of OSD and water quality measures in accordance with Council's requirements.

The stormwater and WSUD system provided for the development can only operate adequately if the system is regularly maintained during the operational life of the system. The Operation and Maintenance Schedule is included in Appendix E.

It should be noted that the results shown in this report are limited to use for Development Application purposes only. During the detailed design stages, a further refinement of the modelling based on the detail design of the development will be necessary.

It is recommended that the proposal of this report be adopted as the proposals in the report are in accordance with Council's DCPs and also to the requirements of a various Australian Standards.

REFERENCES

1. Northern Beaches Council – Warriewood Valley Roads Masterplan, 2018

2. Northern Beaches Council – Warriewood Valley Water Management Specification, 2001

3. Northern Beaches Council – Pittwater 21 DCP, 2018

4. BMT – 45 Warriewood Road, Warriewood Flood Impact Assessment

5. Archidrome – Architectural Drawings for 45-49 Warriewood Rd, Warriewood

6. CPS – Landscape Plan of 45-49 Warriewood Rd, Warriewood

7. Institution Of Engineers, Australia - "Australian Rainfall and Runoff", 1987, 3rd Edition

8. Engineers Australia - Australian Runoff Quality – A Guide to Water Sensitive Urban Design, 2006

9. Austroads – Guide to Road Design

10. AS 2890.1 - Off Street Car Parking

APPENDIX A

ENGINEERING DRAWINGS

A1

45 - 49 WARRIEWOOD ROAD, WARRIEWOOD

CIVIL ENGINEERING WORKS

DRAWING INDEX:

DRAWING No.	DRAWING TITLE
02192_100	COVER SHEET, DRAWING INDEX & LOCALITY
02192_110	GENERAL NOTES & LEGEND
02192_120	LOT LAYOUT PLAN
02192_201	GENERAL ARRANGEMENT PLAN - GROUND
02192_202	GENERAL ARRANGEMENT PLAN - BASEMENT
02192_231	BULK EARTHWORKS PLAN
02192_301	ROAD LONGITUDINAL SECTIONS
02192_401	TYPICAL SECTION
02192_621	STORMWATER OSD TANK DETAILS - SHEET 1
02192_622	STORMWATER OSD TANK DETAILS - SHEET 2
02192_623	STORMWATER INFILTRATION BASIN DETAILS
02192_651	STORMWATER DETAILS
02192_701	SEDIMENT & EROSION CONTROL PLAN
02192_702	SEDIMENT & EROSION CONTROL DETAILS

LOCALITY PLAN

NOT FOR CONSTRUCTION

CAD FILENAME: Q:\C&M\Projects\02101-02200\PN-02192 - WARRIEWOOD ROAD 45-49, WARRIEWOOD\ACAD\02192_100.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
01	T.T.	28/02/2020	E.S.	ISSUE FOR COORDINATION

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PROJECT VERIFIER'S SIGNATURE: DATE:

CLIENT

CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT

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DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	NILL

45-49 WARRIEWOOD RD, WARRIEWOOD

COVER SHEET, DRAWING INDEX & LOCALITY

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_100	02

A1

GENERAL NOTES:

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH NORTHERN BEACHES COUNCIL'S CIVIL WORKS SPECIFICATION.
2. ANY CHANGES MADE BY THE CONSTRUCTOR TO ANY LEVEL, DIMENSION, LOCATION, POSITION, ALIGNMENT ETC., OF ANY OF THE WORKS SHOWN ON THE DRAWINGS WITHOUT THE WRITTEN CONSENT OF C&M CONSULTING ENGINEERS PTY. LTD. AND OR THE PRINCIPAL CERTIFYING AUTHORITY IS DONE SO AT THE CONSTRUCTORS OWN RISK.
3. THE CONSTRUCTOR SHALL ALLOW TO LIAISE WITH AND PROVIDE SUFFICIENT NOTICE TO THE PRINCIPAL CERTIFYING AUTHORITY TO ENSURE THAT ALL WORKS ARE INSPECTED TO ENABLE COMPLIANCE CERTIFICATES TO BE ISSUED THROUGHOUT THE CONSTRUCTION PERIOD. THE CONSTRUCTOR SHALL LIAISE WITH THE PRINCIPAL CERTIFYING AUTHORITY PRIOR TO ANY CONSTRUCTION WORKS COMMENCING AND PREPARE AN INSPECTION AND TEST PLAN WITH A MUTUALLY AGREED WITNESS AND HOLD POINTS FOR THE CONSTRUCTION WORKS.
4. IF THE PRINCIPAL CERTIFYING AUTHORITY IS NOT NORTHERN BEACHES COUNCIL, THEN THE CONSTRUCTOR MUST CONTACT NORTHERN BEACHES WORKS DIVISION TO ENABLE THEIR INSPECTION OF ALL WORKS (INCLUDING EROSION AND SEDIMENT CONTROL MEASURES) WITHIN THE ROAD RESERVE AREA.
5. THE CONSTRUCTOR SHALL USE A SUITABLY QUALIFIED SURVEYOR TO SET OUT ALL WORKS. THE SURVEYOR SHALL ISSUE A CERTIFICATE TO THE PRINCIPAL CERTIFYING AUTHORITY CERTIFYING THAT THE WORKS HAVE BEEN SET OUT IN ACCORDANCE WITH THE APPROVED DRAWINGS PRIOR TO THE WORKS BEING CONSTRUCTED.
6. ALL NEW WORKS SHALL MAKE A SMOOTH CONNECTION WITH ANY FORMATIONS, STRUCTURES, ETC.
7. THE WORKS SHALL BE CONSTRUCTED IN SUCH A MANNER THAT THERE IS MINIMUM DISTURBANCE TO EXISTING TREES AND VEGETATION.
8. ALL BOUNDARY LOCATIONS, DIMENSIONS, BEARINGS, AREAS, ETC., SHOWN ON THE DRAWINGS ARE APPROXIMATE ONLY AND ARE SUBJECT TO A FINAL SURVEY AND REGISTRATION OF THE FINAL PLAN OF SUBDIVISION WITH LAND AND PROPERTY INFORMATION NSW.
9. THE PUBLIC FOOTWAY AND ROADWAY FRONTING THE SITE SHALL BE MAINTAINED IN A SAFE AND UNOBSTRUCTED MANNER AT ALL TIMES DURING THE CONSTRUCTION WORKS.
10. THE CONSTRUCTOR SHALL BE RESPONSIBLE FOR REPAIRING TO THE SATISFACTION OF THE ASSET OWNER, ANY DAMAGE CAUSED TO ANY EXISTING INFRASTRUCTURE WITHIN THE ROAD RESERVE, INCLUDING BUT NOT LIMITED TO KERBS, GUTTERS, FOOTPATHS, VEHICULAR CROSSINGS, STREET SIGNS, SERVICE FITTING COVERS, ETC.
11. THE SITE SHALL BE KEPT IN A TIDY CONDITION AT ALL TIMES. LITTER RUBBISH AND BUILDING RUBBLE SHALL BE PLACED IN CONTAINERS OR BINS AND REGULARLY REMOVED FROM SITE AS REQUIRED.

SEDIMENT & EROSION CONTROL NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED, PLACED AND MAINTAINED IN ACCORDANCE WITH NORTHERN BEACHES COUNCIL'S GUIDELINES AND THE DEPARTMENT OF HOUSING'S "MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION" MANUAL.
2. NO CONSTRUCTION WORKS ARE TO COMMENCE ON SITE UNTIL ALL EROSION AND SEDIMENT CONTROL MEASURES ARE IN PLACE AND HAVE BEEN INSPECTED AND APPROVED BY THE PRINCIPAL CERTIFYING AUTHORITY.
3. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REGULARLY INSPECTED, IN PARTICULAR AFTER STORMS, AND REPAIRED OR MAINTAINED AS REQUIRED TO ENSURE THE MEASURES CORRECT AND EFFICIENT FUNCTION THROUGHOUT THE DURATION OF THE WORKS, UNTIL SUCH TIME AS THE PRINCIPAL CERTIFYING AUTHORITY AUTHORISES THE REMOVAL OF SUCH MEASURES.
4. ALL STOCKPILES SHALL BE CLEAR OF ALL TREES AND DRAINAGE LINES (INCLUDING OVERLAND FLOW PATHS) AND PROTECTED FROM EROSION.
5. DUST CONTROL MEASURES SHALL BE IMPLEMENTED CONTINUOUSLY DURING CONSTRUCTION WORKS.

KERBING NOTES:

1. ALL KERBS, GUTTERS, EDGE STRIPS, LAYBACKS AND CROSSINGS TO BE BUILT ON A MINIMUM OF 100mm THICK SUBBASE. THE SUBBASE SHALL BE EXTENDED 150mm BEHIND BACK OF KERB.
2. CONCRETE SHALL BE OF 25MPa COMPRESSIVE STRENGTH (F'c) AT 28 DAYS.
3. EXPANSION JOINTS OF APPROVED BITUMEN IMPREGNATED JOINTING MATERIAL OR EQUIVALENT SHALL BE PLACED AT 12m INTERVALS, AT JUNCTIONS WITH EXISTING WORK, KERB TRANSITIONS AND ADJACENT TO GULLY PITS. WEAKENED PLANE JOINTS (DUMMY JOINTS) SHALL BE CUT AT 3m INTERVALS.

EARTHWORKS NOTES:

1. THE CONTRACTOR SHALL STRIP THE MATERIAL CLASSIFIED AS TOPSOIL OR MATERIAL CONTAINING ORGANIC MATTER TO A LEVEL APPROVED BY THE CONTRACTOR'S GEOTECHNICAL ENGINEER AND THE SUPERINTENDENT. THE STRIPPED TOPSOIL SHOULD BE REMOVED AND STOCKPILED PRIOR TO ANY EARTHWORKS OPERATIONS.
2. THE MAXIMUM HEIGHT OF TOPSOIL STOCKPILES SHALL NOT EXCEED 2.5M AND THE MAXIMUM BATTER SLOPE SHALL NOT EXCEED 2H : 1V.
3. ALL EARTHWORKS OPERATIONS SHALL BE CARRIED OUT TO LEVEL 1 SUPERVISION IN ACCORDANCE WITH AS3798 - 2007. THE CONTRACTOR SHALL ISSUE A WRITTEN LETTER FROM THE GEOTECHNICAL CONSULTANT THAT THEY HAVE BEEN ENGAGED ACCORDINGLY AND TAKES FULL RESPONSIBILITY OF THE EARTHWORKS OPERATION.
4. THE CONTRACTOR SHALL OVER-EXCAVATE TO REMOVE ALL UNACCEPTABLE FILL MATERIAL CONTAINING DELETERIOUS MATERIALS SUCH AS ORGANIC MATTER AND CONSTRUCTION MATERIALS. ALL OVER-EXCAVATED AREAS SHALL BE REPLACED WITH SUITABLE MATERIAL WITH A CBR AT LEAST EQUAL TO THE SPECIFIED SUBGRADE CBR, SOURCED FROM ON SITE, IF AVAILABLE, OR IMPORTED.
5. WET MATERIAL WILL NOT BE REGARDED AS UNSUITABLE. SHOULD WET MATERIAL BE ENCOUNTERED, THE CONTRACTOR SHALL DRY THE MATERIAL SUFFICIENTLY BY RE-WORKING, OR SPREADING IT TO ALLOW DRYING. ALL ASSOCIATED COSTS SHALL BE BORNE BY THE CONTRACTOR.
6. ALL EXCESS EARTHWORKS MATERIALS, INCLUDING EXCESS MATERIALS FROM THE STORMWATER AND SERVICE TRENCH EXCAVATIONS SHALL BE REMOVED AND LEGALLY DISPOSED OF OFF-SITE BY THE CONTRACTOR AT THE CONTRACTOR'S COST.
7. ALL BATTER SLOPES SHALL BE A MAXIMUM OF 1V:5H (U.N.O.)
8. UNLESS NOTED OTHERWISE OR APPROVED ALL FILL MUST BE CONSTITUTED OF VIRGIN EXCAVATED NATURAL MATERIAL (VENM).
9. THE CONTRACTOR SHALL EXCAVATE AND/OR PLACE AND COMPACT FILL TO CONFORM TO THE LINES, GRADES, CROSS SECTIONS, AND DIMENSIONS SHOWN ON THE DRAWINGS, ALLOWING FOR PAVEMENT/SLAB AND TOPSOIL LAYERS.
10. FREQUENCIES OF COMPACTION TESTS FOR EARTHWORKS SHALL BE AS FOLLOWS (WHICHEVER IS GREATER NUMBER):
    a. 1 TEST PER LAYER PER MATERIAL TYPE PER 2500 m^2, OR
    b. 1 TEST PER 500m^3, OR
    c. 3 TESTS PER LOT (MATERIAL TYPE AND MOISTURE).
12. COMPACTION REQUIREMENTS FOR EARTHWORKS SHALL BE AS FOLLOWS:
    a. GENERAL FILL : 95% OF SMDD
    b. TOP 500MM UNDER PAVEMENT OR STRUCTURE: 100% OF SMDD
    c. BACKFILL WITHIN 2M OF STRUCTURES: 100% OF SMDD
13. MOISTURE CONTENT TO BE IN THE RANGE OF - 2% TO +2% OF THE OPTIMUM MOISTURE CONTENT.
14. ALL COMPACTION TEST RESULTS SHALL BE PROVIDED TO THE SUPERINTENDENT.
15. ALL SITE REGRADED AREAS AFTER FORMATION, SHALL BE COVERED WITH A 150MM SELECT TOPSOIL LAYER. TOPSOIL STOCKPILED PRIOR TO EARTHWORKS OPERATIONS CAN BE REUSED FOR THIS PURPOSE PROVIDED ANY DELETERIOUS MATERIAL IS REMOVED PRIOR TO PLACING.
16. ALL DISTURBED AND DENUDED AREAS SHALL BE REGRASSED WITHIN 7 DAYS AFTER THE COMPLETION OF EARTHWORKS FORMATION.

STORMWATER NOTES:

1. STORMWATER DESIGN CRITERIA:
   MINOR STORM ARI: 20 YEARS
   MAJOR STORM ARI: 100 YEARS
   IFD DATA LOCALITY: FRENCHS FOREST
2. PIPES DN375 AND LARGER TO BE STEEL REINFORCED CONCRETE PIPES CLASS '2' APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS U.N.O.
3. PIPES DN300 AND SMALLER SHALL BE GRADE SH (SEWER GRADE) uPVC WITH RUBBER RING JOINTS.
4. EQUIVALENT STRENGTH FIBRE REINFORCED CONCRETE PIPES MAY BE USED UP TO DN450.
5. PIPES FOR SUB-SOIL DRAINS SHALL BE SLOTTED 100MM DIAMETER CLASS 1000 WRAPPED IN GEOFABRIC, U.O.N, COMPLYING WITH THE REQUIREMENTS OF AS2439.
6. PRECAST PITS, WHERE ALLOWED, AND THE INSITU BASE SHALL COMPLY WITH THE REQUIREMENT OF THE MANUFACTURER.
7. ALL MILD STEEL FIXTURES INCLUDING GRATES, FRAMES, STEP IRONS, LADDERS, ETC., SHALL BE HOT DIP GALVANISED. GALVANISING SHALL COMPLY WITH THE REQUIREMENTS OF AS 1214 OR AS 1650, AS APPROPRIATE.
8. GEOFABRIC FILTER SHALL BE PERMEABLE, NON-WOVEN FABRIC MANUFACTURED FROM A POLYMER SUCH AS POLYPROPYLENE OR POLYESTER OF MASS NOT LESS THAN 135G/M2.
9. THE MINIMUM TRENCH WIDTHS SHALL BE AS FOLLOWS:
   CONCRETE AND FRC PIPES: EXTERNAL PIPE DIAMETER PLUS 400MM.
   uPVC PIPE: EXTERNAL DIAMETER OF PIPE PLUS 200MM.
   SUBSOIL PIPE: 250MM.
10. ALL PIPES SHALL BE PLACED CENTRALLY WITHIN THE TRENCH WITH EQUAL CLEARANCE EACH SIDE.
11. PIPE BEDDING MATERIAL SHALL BE CLEAN COARSE RIVER SAND WITH DEPTH AS FOLLOWS:
    CONCRETE AND FRC PIPES: 100MM (175MM IN ROCK)
    UPVC PIPE: 75MM (100MM IN ROCK)
    SUBSOIL DRAINS: 50MM
12. ALL PIPES SHALL BE BACKFILLED WITH GRANULAR MATERIAL SUCH AS QUARRY FINES OR COARSE RIVER SAND TO A MINIMUM OF 150MM ABOVE THE PIPE. THE GRANULAR MATERIAL SHALL BE PLACED IN 150MM THICK MAXIMUM LAYERS AND COMPACTED TO ACHIEVE A DENSITY INDEX (ID) OF 70%. FREQUENCIES OF COMPACTION TESTS FOR TRENCHES SHALL BE 1 TEST PER 2 LAYERS PER 40 LINEAR METRE.
13. BACKFILL THE REMAINDER OF THE TRENCH ABOVE THE SAND TO SUBGRADE LEVEL WITH TRENCH MATERIAL. PLACE AND COMPACT MATERIALS IN LAYERS NOT EXCEEDING 150MM LOOSE THICKNESS. MATERIAL LOWER THAN 500MM BELOW SUBGRADE LEVEL SHALL BE COMPACTED TO AT LEAST 95% OF STANDARD MAXIMUM DRY DENSITY. THE TOP 500MM BELOW PAVEMENT SUBGRADE LEVELS SHALL BE COMPACTED TO AT LEAST 100% STANDARD MAXIMUM DRY DENSITY.
14. FILTER MATERIAL FOR SUBSOIL SHALL BE COARSE SAND OR CRUSHED STONE COMPLYING WITH ONE OF THE GRADINGS IN THE TABLE BELOW. WHERE NOTED ON THE DRAWINGS THE 7MM CRUSHED ROCK FILTER MATERIAL SHALL BE ENCLOSED WITHIN FILTER FABRIC SHEET AS SPECIFIED. FILTER MATERIAL SHALL BE PLACED IN 250MM LAYERS AND COMPACTED TO DENSITY INDEX (ID) OF 60%.

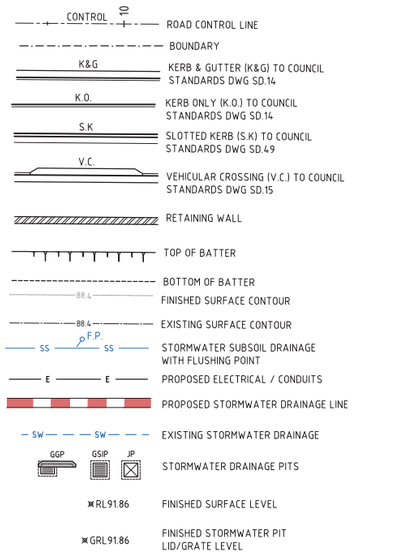
AS SIEVE SIZE (mm)	SAND	7mm ROCK
9.5	100	100
6.7	-	75-100
4.75	90-100	20-55
2.36	75-100	0-15
1.18	50-90	
0.6	20-60	
0.3	10-30	
0.15	2-10	
0.075	0-3	0-2

15. UNLESS OTHERWISE DETAILED OR PERMITTED, THE MINIMUM GRADE OF ALL PIPE WORKS SHALL BE 1.0%, AND HAVE MINIMUM 300mm COVER.

SERVICES NOTES:

1. IT IS THE CONSTRUCTORS RESPONSIBILITY TO NOTIFY THE RELEVANT SERVICES AUTHORITIES OF THE WORKS AND VERIFY THE LOCATION OF ALL EXISTING SERVICES PRIOR TO ANY CONSTRUCTION ACTIVITIES COMMENCING.
2. THE CONSTRUCTOR SHALL LIAISE AND COORDINATE THE TIMING OF THE CONSTRUCTION OF THE WORKS WITH THE RELEVANT SERVICES AUTHORITIES AND/OR OTHER CONSTRUCTORS INSTALLING SERVICES CONCURRENTLY AT THIS SITE.
3. THE LOCATION OF ALL EXISTING SERVICES SHOWN ON THE DRAWINGS ARE APPROXIMATE ONLY AND HAVE BEEN TAKEN FROM INFORMATION PROVIDED BY THE RELEVANT SERVICE AUTHORITIES.
4. THE CONSTRUCTOR SHALL BE RESPONSIBLE FOR ALL DAMAGE CAUSED TO EXISTING SERVICES AS A RESULT OF THE CONSTRUCTION WORKS.

LEGEND



PAVEMENT NOTES:

1. FOR RIGID PAVEMENT REFER TO CONCRETE PAVEMENT NOTES.
2. BASE MATERIAL, UNLESS NOTED OTHERWISE, SHALL BE UNBOUND DGB20 MATERIAL AS SPECIFIED IN THE RTA 3051.
3. SUBBASE MATERIAL, UNLESS NOTED OTHERWISE, SHALL BE UNBOUND DGS40 MATERIAL AS SPECIFIED IN THE RTA 3051.
4. SELECT MATERIAL, IF SPECIFIED, SHALL BE CRUSHED ROCK, NATURAL GRAVELS OR SUITABLE SOILS, AND THE MATERIALS SHALL BE FREE OF ORGANIC MATTER AND OTHER OBJECTIONABLE OR DELETERIOUS SUBSTANCES. THE MATERIALS SHALL HAVE A MAXIMUM PARTICLE SIZE OF 75MM, AND SHALL HAVE A MINIMUM CBR OF 15% AT 100% STANDARD MAXIMUM DRY DENSITY.
5. FREQUENCIES OF COMPACTION TESTS FOR PAVEMENT CONSTRUCTION SHALL BE AS FOLLOWS (TESTS PER LAYER AND WHICHEVER IS GREATER NUMBER):
   a. 1 TEST PER 50m LENGTH OF ROAD, OR
   b. 1 TEST PER 400m2.
6. COMPACTION REQUIREMENTS FOR PAVEMENT CONSTRUCTION SHALL BE AS FOLLOWS:
   a. BASE AND SUBBASE: 98% OF MMDD TO AS 1289 E2.1
   b. SELECT AND SUBGRADE: 100% OF SMDD
7. THE PRIMER TO BE USED SHALL BE MEDIUM CURING CUTBACK BITUMEN COMPLYING WITH THE REQUIREMENTS OF AS 2157. THE GRADE OF CUTBACK BITUMEN SHOULD BE AMC 0.
8. AGGREGATES FOR THE SEAL SHALL BE ONE-SIZED OF THE NOMINAL SIZE AND CLASS SPECIFIED ON DRAWING. THESE AGGREGATES SHALL BE PRECOATED WITH A BITUMEN BASED PRECOATING MATERIAL.
9. UNLESS OTHERWISE SPECIFIED OR DIRECTED, BITUMINOUS EMULSION FOR TACK COATING SHALL BE DESIGNATION CRS/170 COMPLYING WITH THE REQUIREMENTS OF AS 1160.
10. ASPHALTIC CONCRETE AS SPECIFIED ON THE DRAWING SHALL COMPLY WITH AS 2150 -ASPHALT (HOT-MIXED).
11. UNLESS OTHERWISE NOMINATED IN THE DRAWINGS, BINDER SHALL BE CLASS 320 BITUMEN COMPLYING WITH THE REQUIREMENTS OF AS 2008.
12. ANY OTHER BITUMEN TYPE WHERE CALLED UP IN THE DRAWING SHALL MEET THE REQUIREMENTS AS SET OUT IN THE RMS MATERIALS SPECIFICATIONS 3252 OR 3253.

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REV.	DES.	DATE	VER.	DESCRIPTION
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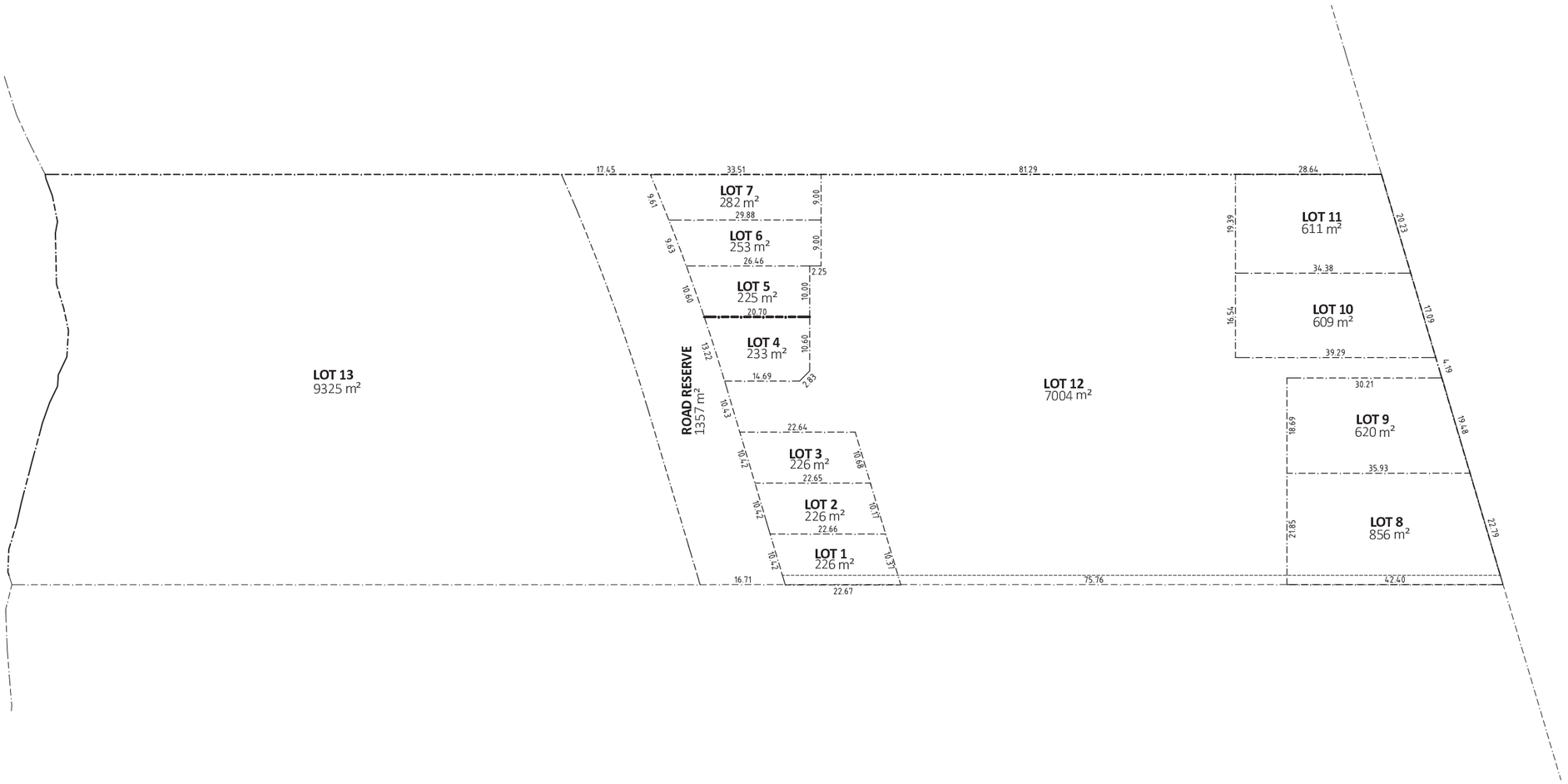
DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	NILL

45-49 WARRIEWOOD RD, WARRIEWOOD

GENERAL NOTES AND LEGEND

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192__110	02

A1



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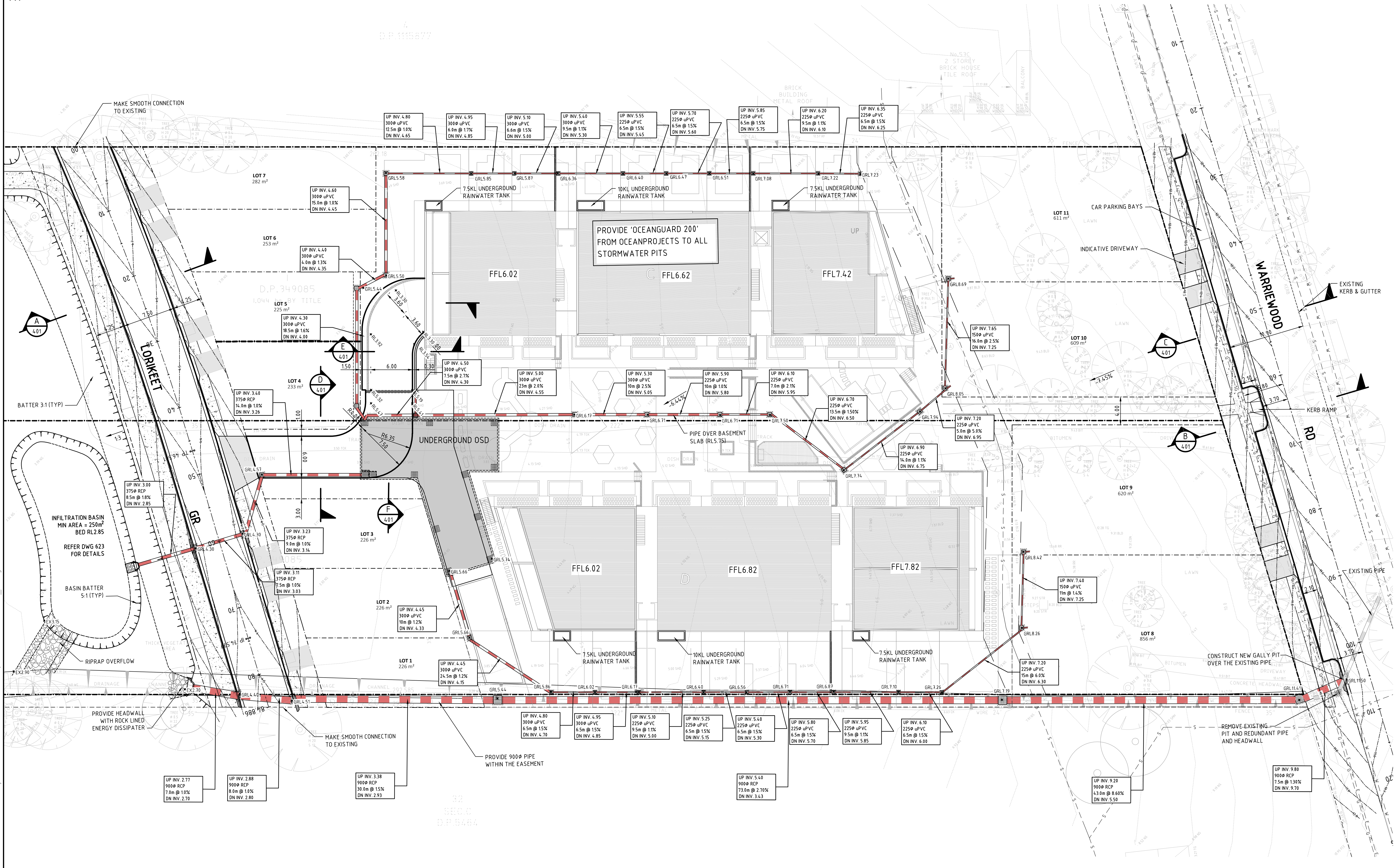
VERIFIER	E.S.	SCALE @ A1	1:500

45-49 WARRIEWOOD RD, WARRIEWOOD

LOT LAYOUT PLAN

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_120	02

A1



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03	T.T.	24/09/2020	E.S.	INFILTRATION BASIN SHAPE MODIFIED TO COUNCIL REQUIREMENT
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
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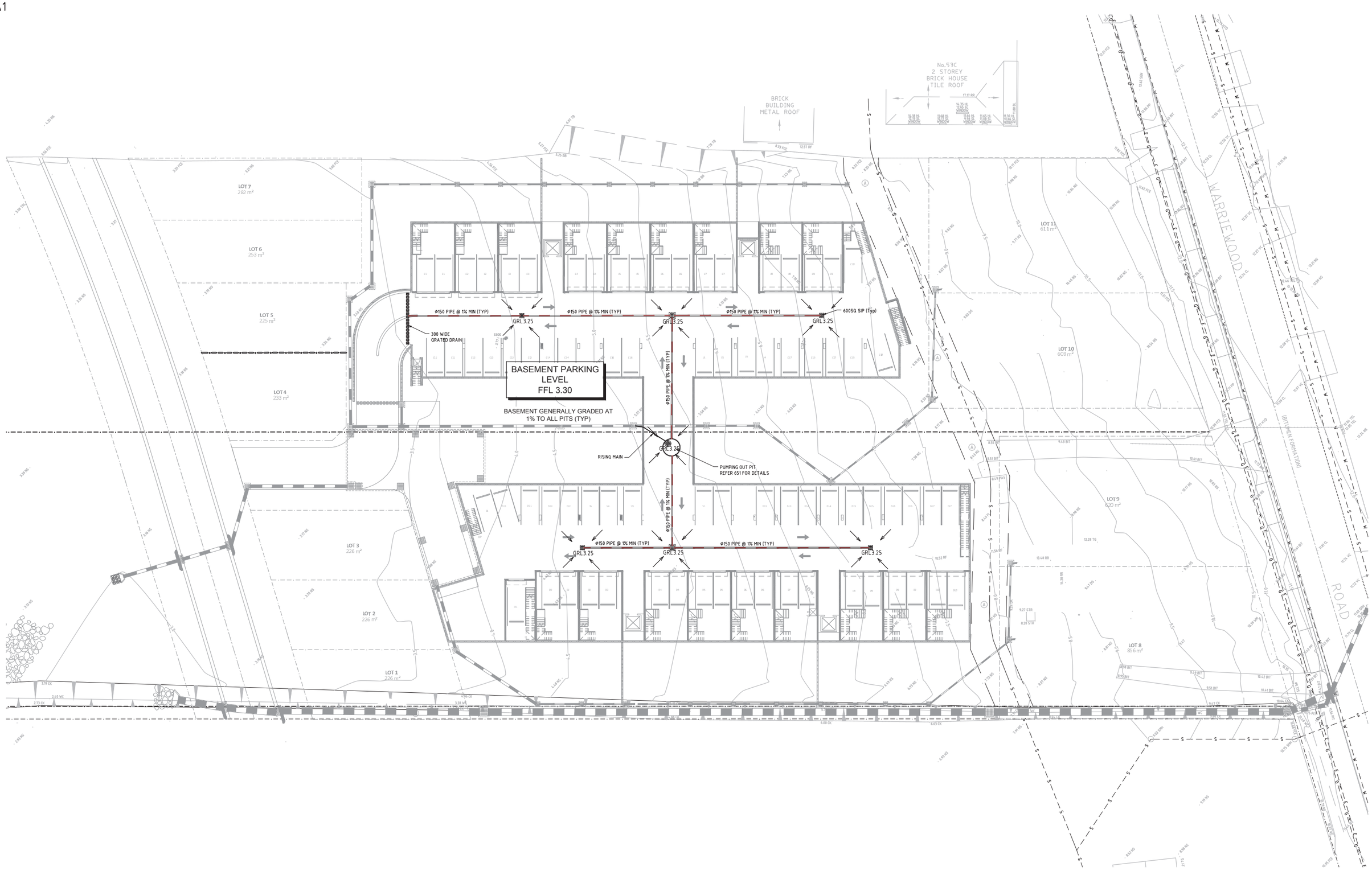
DESIGNER: T.T. | DATE: JAN 2020
ENGINEER: E.S. | LGA: NORTHERN BEACHES
VERIFIER: E.S. | SCALE @ A1: 1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

GENERAL ARRANGEMENT PLAN - GROUND LEVEL

STATUS: DEVELOPMENT APPLICATION | DRAWING No. 02192_201 | REVISION 03

A1



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VERIFIER	E.S.	SCALE @ A1	1:250

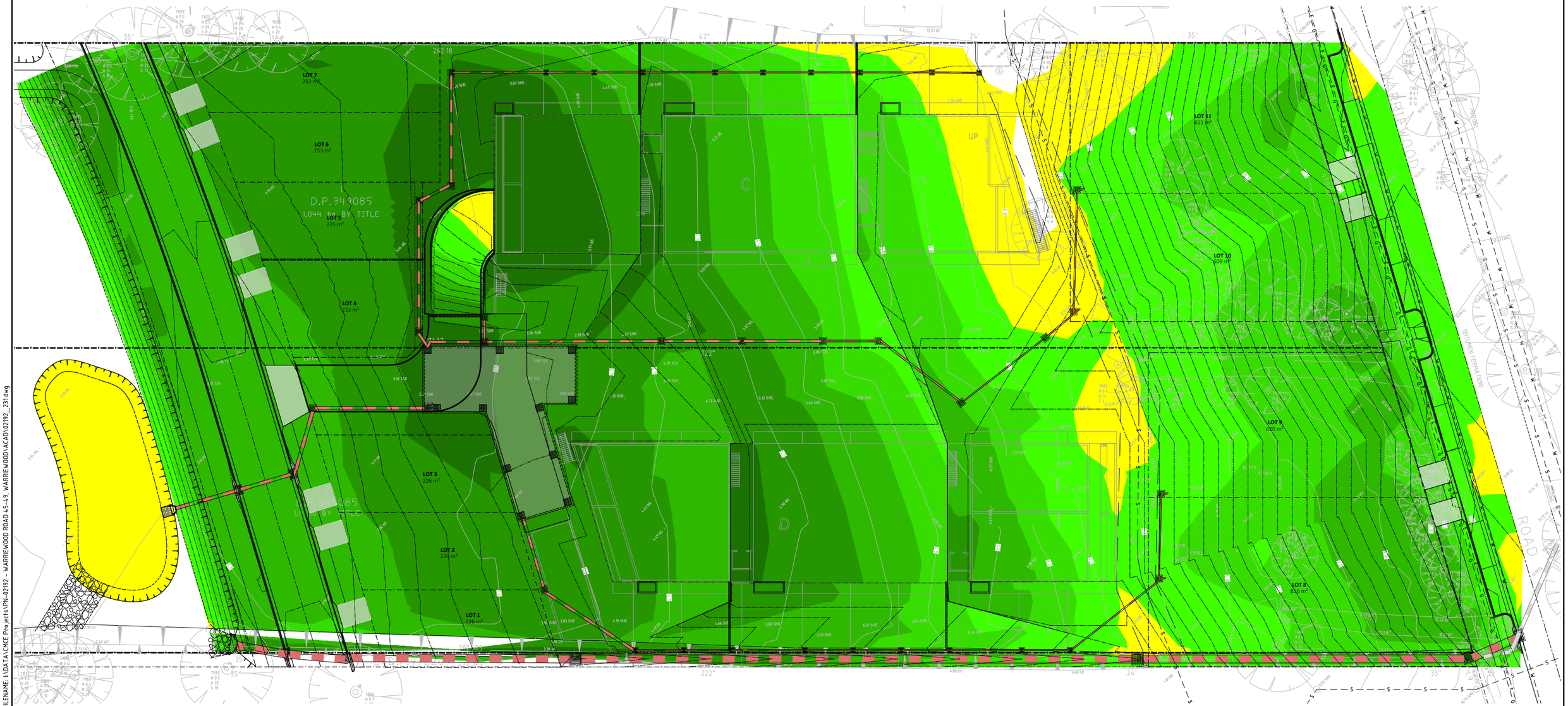
45-49 WARRIEWOOD RD, WARRIEWOOD

GENERAL ARRANGEMENT PLAN - BASEMENT

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_202	02

A1

Levels Table				
No.	From Depth	To Depth	Colour	Depth Range Volume
1	-0.857	0.000		141m³
2	0.000	0.500		6075m³
3	0.500	1.000		4645m³
4	1.000	1.500		3031m³
5	1.500	2.000		1356m³
6	2.000	3.000		137m³



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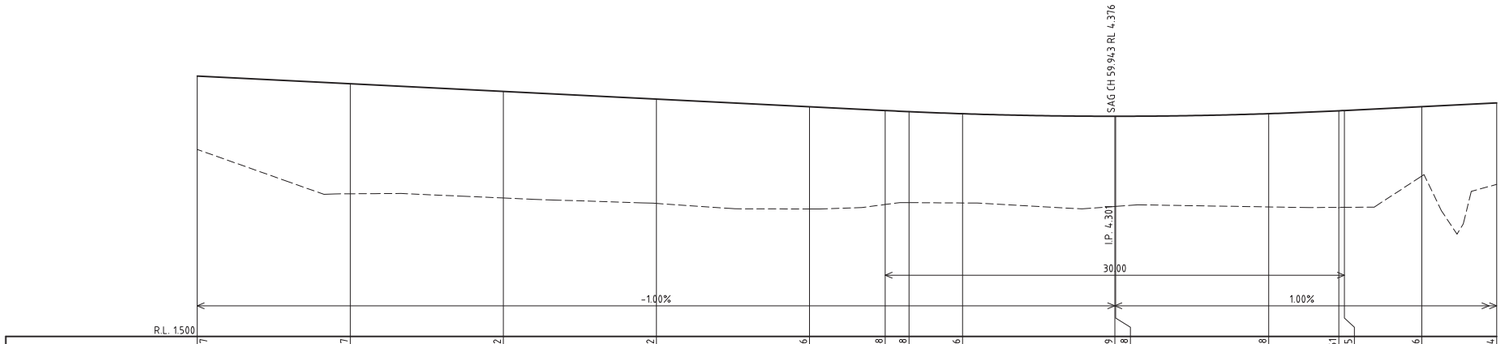
VERIFIER	E.S.	SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

BULK EARTHWORKS PLAN

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_231	03



A1

CUT / FILL DEPTHS ALONG CONTROL LINE	+0.957	+1.437	+1.392	+1.362	+1.336	+1.228	+1.188	+1.166	+1.179	+1.178	+1.218	+1.261	+1.265	+0.906	+1.064
DESIGN SURFACE LEVEL ALONG CONTROL LINE	4.900	4.800	4.700	4.600	4.500	4.451	4.436	4.409	4.376	4.376	4.409	4.447	4.451	4.501	4.550
EXISTING SURFACE LEVEL ALONG CONTROL LINE	3.943	3.363	3.308	3.238	3.164	3.223	3.248	3.243	3.197	3.198	3.191	3.186	3.186	3.595	3.486
CHAINAGE ALONG CONTROL LINE	0.000	10.000	20.000	30.000	40.000	44.943	46.501	50.000	59.943	60.000	70.000	74.577	74.943	80.000	84.886

LORIKEET ROAD - LONGITUDINAL SECTION

SCALE 1:200 (H) & 1:40 (V)

CUT / FILL DEPTHS ALONG CONTROL LINE	+0.000	+0.023	+0.013	+0.010	-0.013	-0.047	+0.067	+0.015	-0.004	+0.073	+0.111	+0.089	+0.079	-0.038	+0.059	-0.099	-0.052	+0.187	-0.103	-0.081	+0.011	-0.001	-0.001	+0.000
DESIGN SURFACE LEVEL ALONG CONTROL LINE	12.654	12.678	12.700	12.699	12.687	12.663	12.564	12.527	12.434	12.304	12.174	12.044	11.914	11.784	11.654	11.599	11.547	11.540	11.565	11.572	11.739	11.854	11.854	11.997
EXISTING SURFACE LEVEL ALONG CONTROL LINE	12.654	12.655	12.687	12.689	12.700	12.710	12.497	12.512	12.438	12.231	12.063	11.955	11.835	11.822	11.595	11.698	11.599	11.353	11.668	11.653	11.728	11.855	11.855	11.997
CHAINAGE ALONG CONTROL LINE	0.000	2.375	6.723	7.375	10.000	12.375	20.000	22.855	30.000	40.000	50.000	60.000	70.000	80.000	90.000	94.253	100.000	103.323	109.253	110.000	120.000	124.253	124.254	129.046

WARRIEWOOD ROAD - LONGITUDINAL SECTION

SCALE 1:200 (H) & 1:40 (V)

CAD FILENAME: Q:\C&M\Projects\02101-02200\PN-02192 - WARRIEWOOD ROAD 45-49, WARRIEWOOD\ACAD\02192__301.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
01	T.T.	28/02/2020	E.S.	ISSUE FOR COORDINATION

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DATE: . . . .

CLIENT

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DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	AS NOTED

45-49 WARRIEWOOD RD, WARRIEWOOD

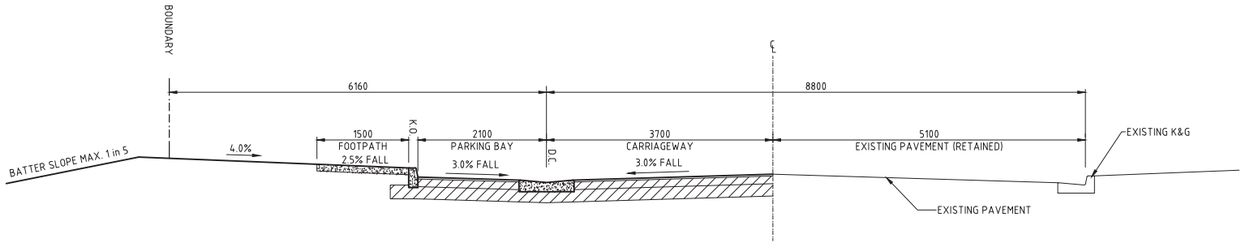
ROAD LONGITUDINAL SECTIONS

STATUS DEVELOPMENT APPLICATION

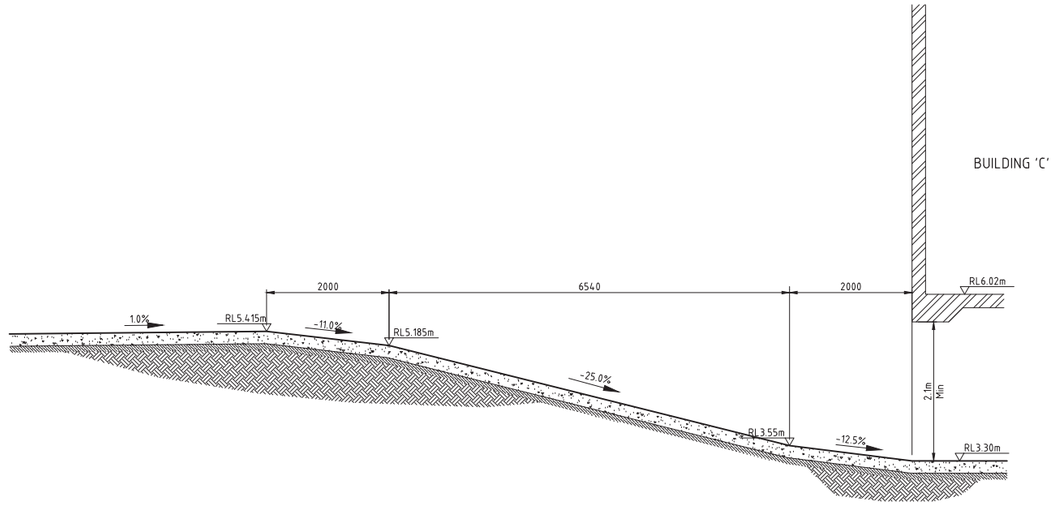
DRAWING No. 02192__301

REVISION 02

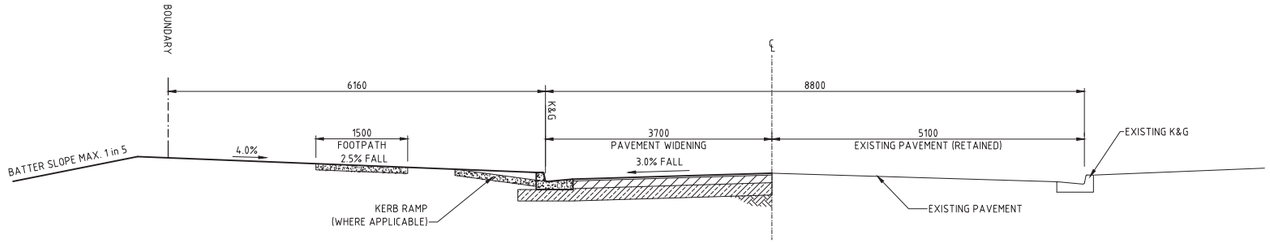
A1



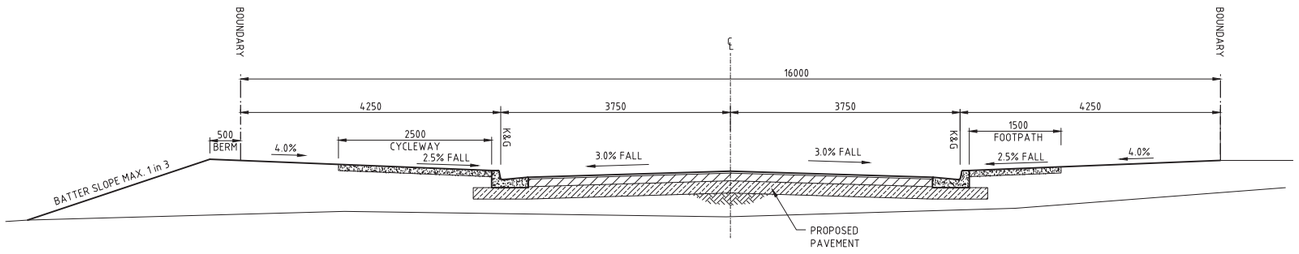
SECTION C 201 WARRIEWOOD RD WITH PARKING
SCALE 1:50



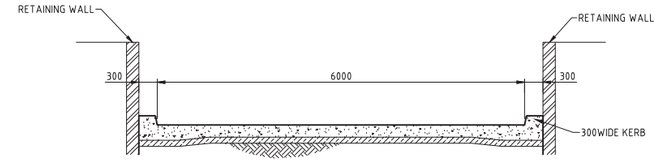
SECTION F 201 BASEMENT RAMP
SCALE 1:50



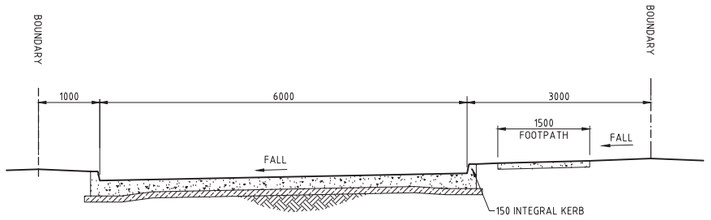
SECTION B 201 WARRIEWOOD ROAD
SCALE 1:50



SECTION A 201 LORRIKEET ST
SCALE 1:50



SECTION E 201
SCALE 1:50



SECTION D 201
SCALE 1:50

0 1000 2000 3000 4000 5000mm
1000 500
SCALE 1:50

CAD FILENAME: Q:\C&M\Projects\02101-0220\VPN-02192 - WARRIEWOOD ROAD 45-49, WARRIEWOOD\ACAD\02192_401.dwg

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CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT

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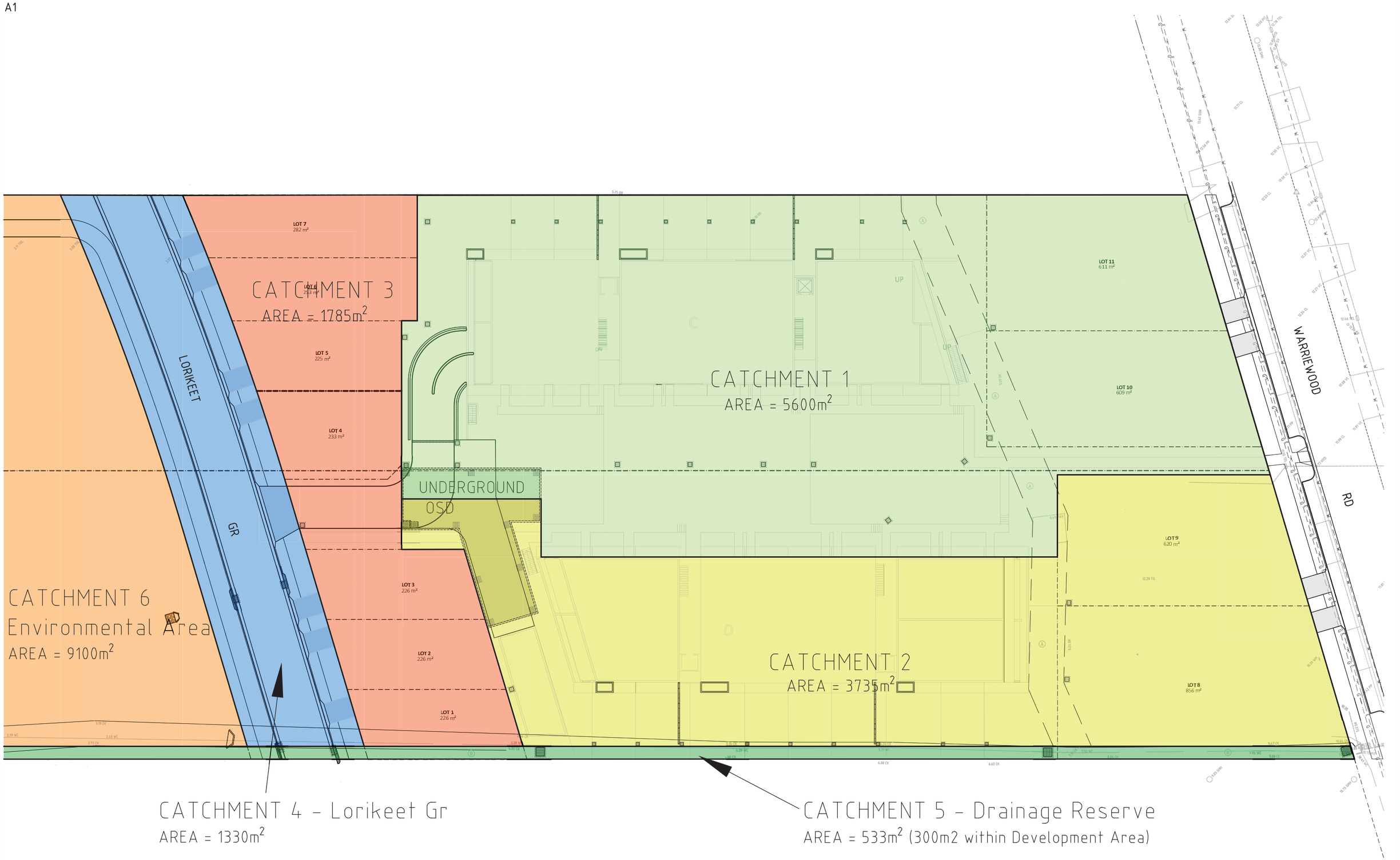
DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	1:50

45-49 WARRIEWOOD RD, WARRIEWOOD

TYPICAL SECTIONS

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_201	02

A1



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REV.	DES.	DATE	VER.	DESCRIPTION
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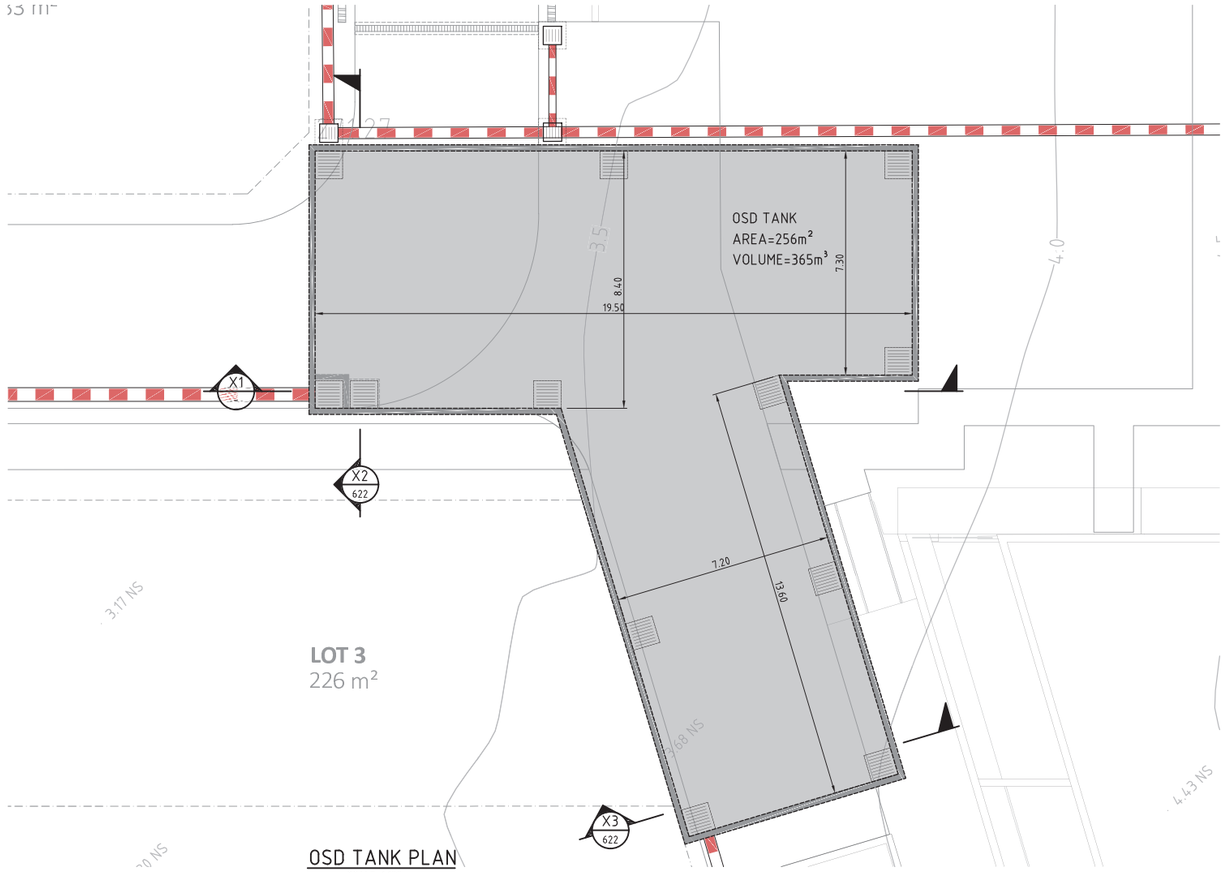
ENGINEER	E.S.
VERIFIER	E.S.
DATE	JAN 2020
LGA	NORTHERN BEACHES
SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

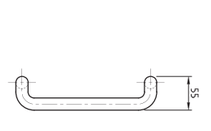
CATCHMENT PLAN

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_601	02

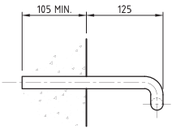
A1



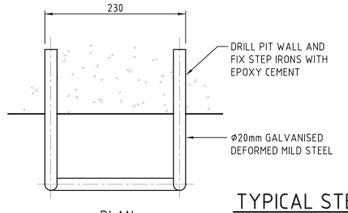
OSD TANK PLAN
SCALE 1:100



FRONT ELEVATION
SCALE 1:5

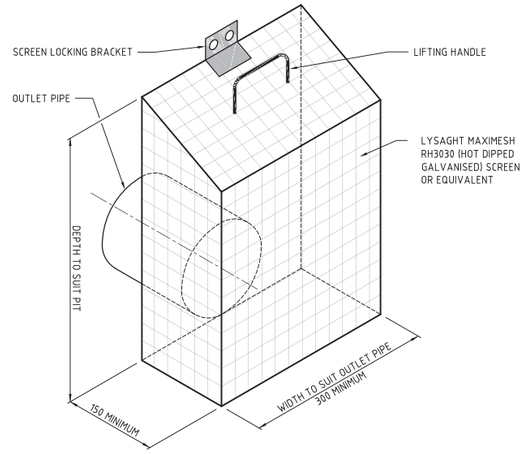


SIDE ELEVATION
SCALE 1:5

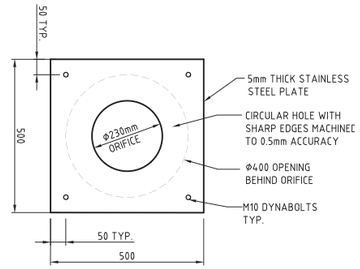


PLAN
SCALE 1:5

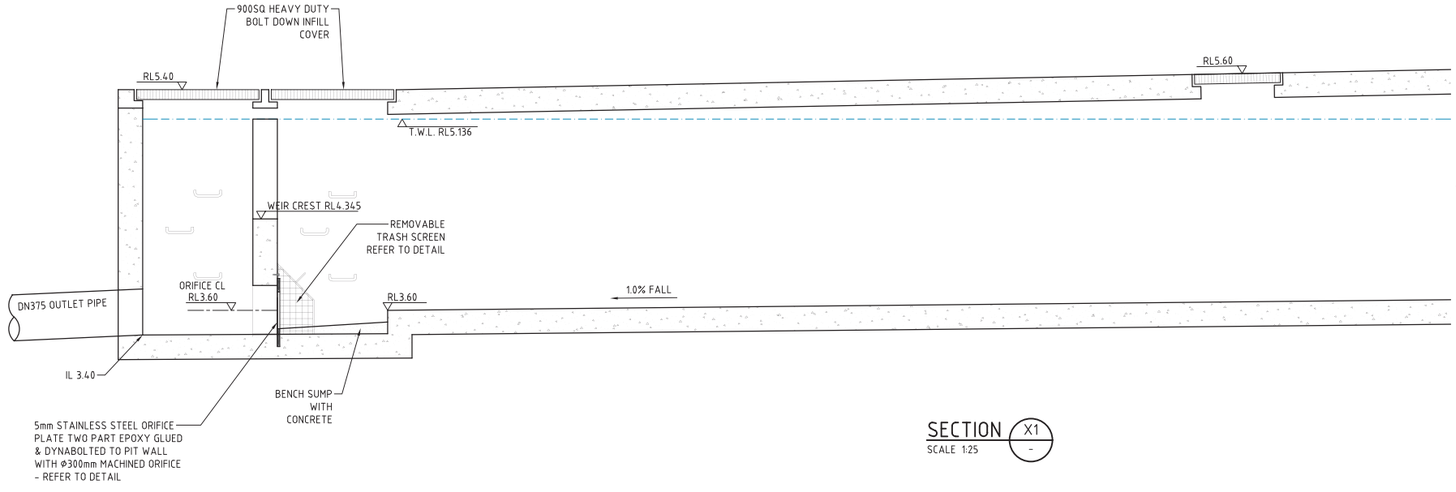
TYPICAL STEP IRON DETAIL
SCALE 1:5



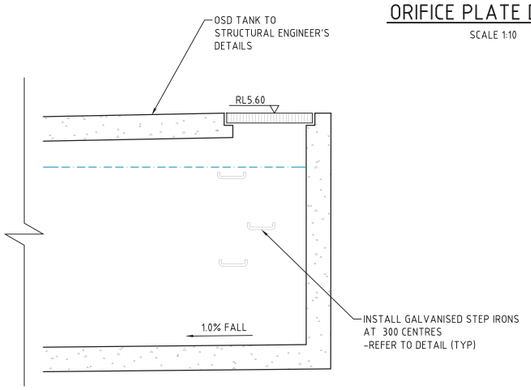
TRASH SCREEN DETAIL (TYPICAL)
SCALE 1:5

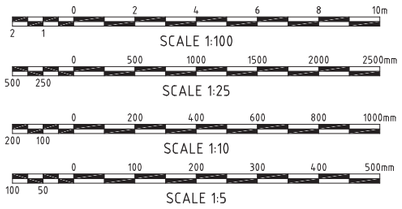


ORIFICE PLATE DETAIL
SCALE 1:10



SECTION X1
SCALE 1:25





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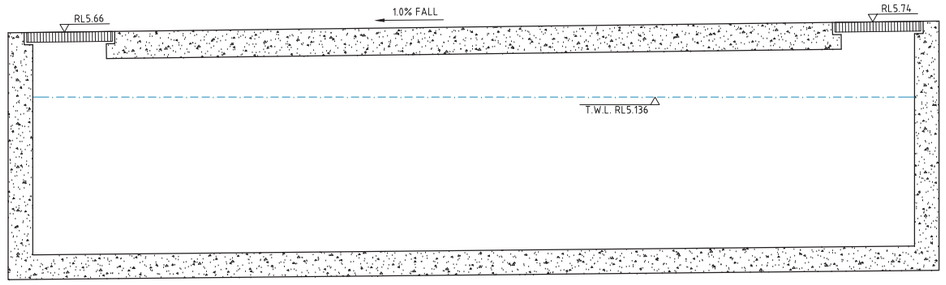
DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

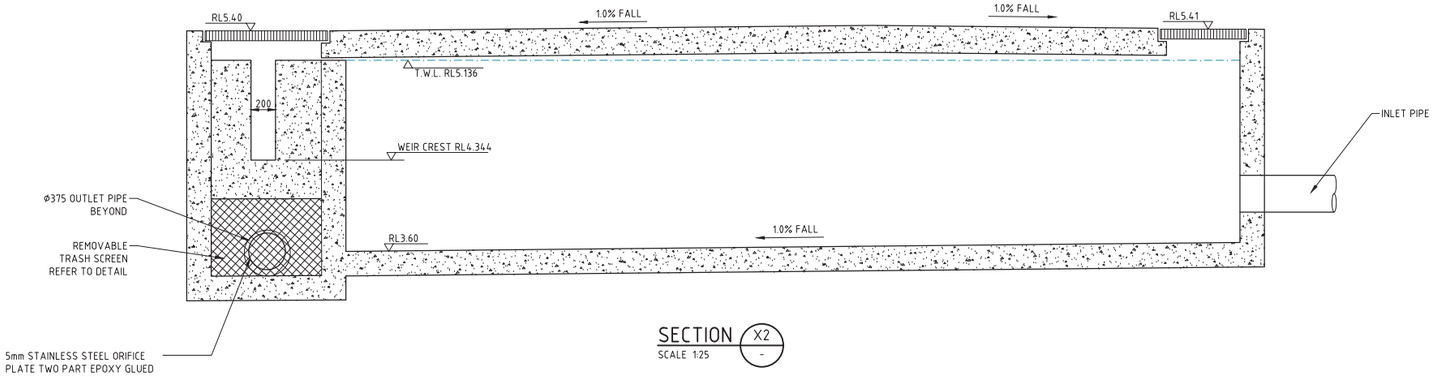
STORMWATER OSD TANK DETAILS - SHEET 1

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_621	02

A1



SECTION X3
SCALE 1:25



SECTION X2
SCALE 1:25

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500 250
SCALE 1:25

CAD FILENAME: Q:\C&M\Projects\02101-02200\PN-02192 - WARRIEWOOD ROAD 45-49, WARRIEWOOD\ACAD\02192_621.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
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ABN 21 118 134 240

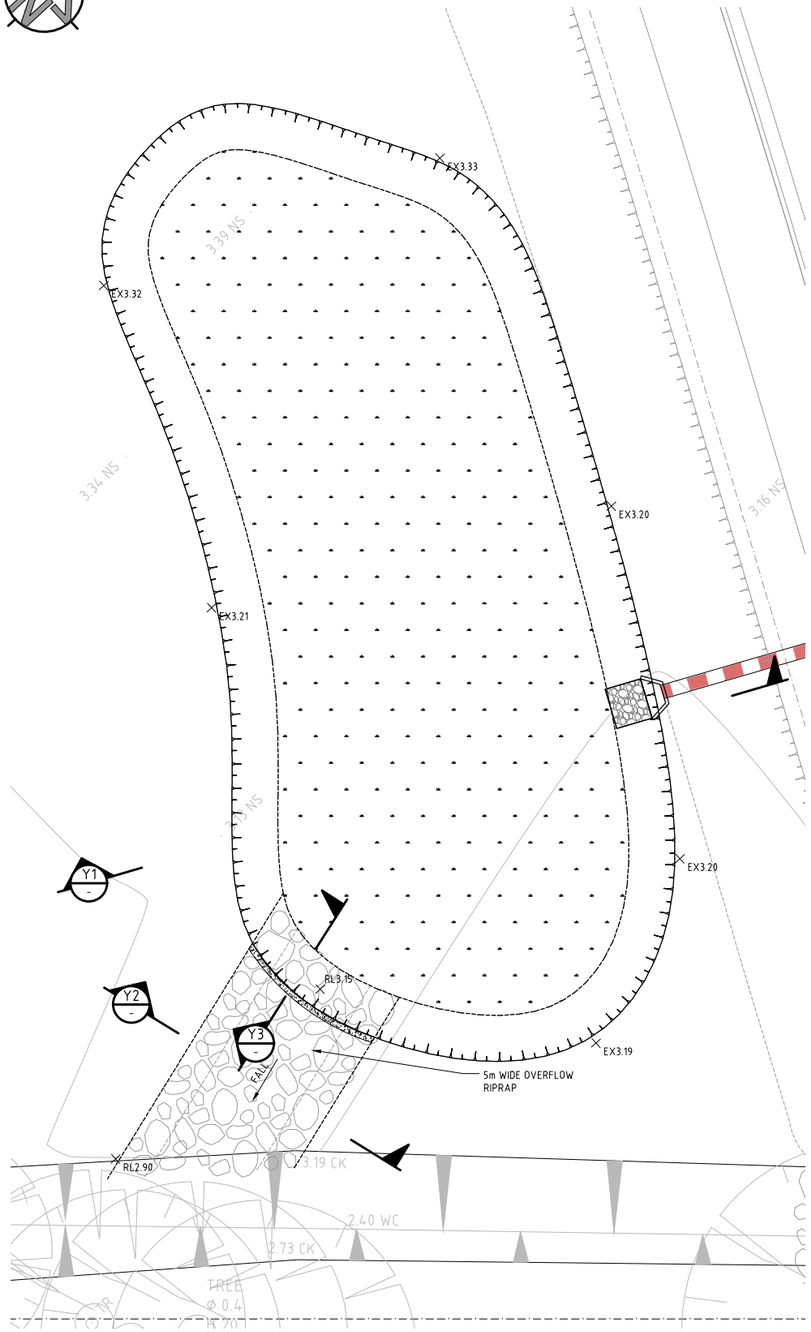
DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

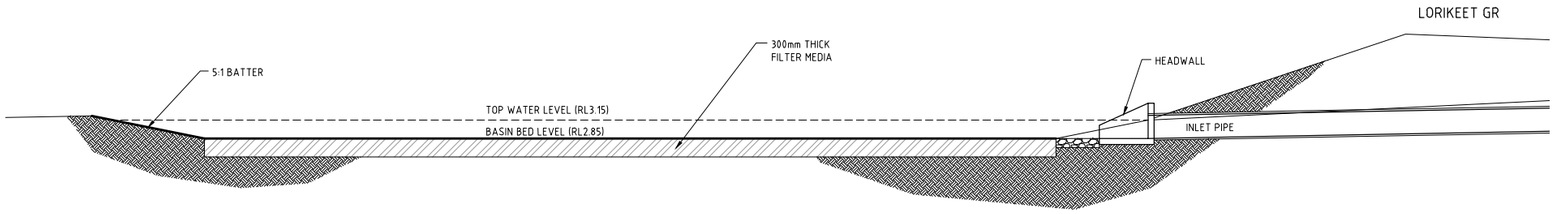
STORMWATER OSD TANK DETAILS - SHEET 2

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_622	02

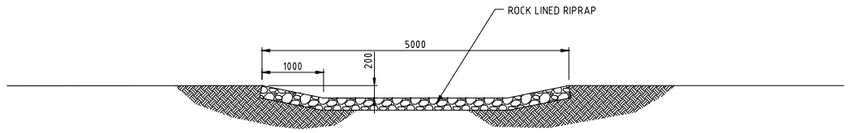
A1



INFILTRATION BASIN
SCALE 1:100



SECTION Y1
SCALE 1:50



SECTION Y2
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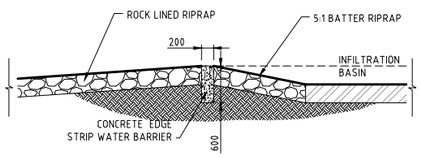

SECTION Y3
SCALE 1:50

INFILTRATION SYSTEM NOTES

FILTER MATERIAL

- THE FILTER MATERIAL IS TO CONSIST OF A SANDY-LOAM SOIL. THE SATURATED HYDRAULIC CONDUCTIVITY FOR THE MEDIUM IS TO BE 200mm/hr WITH ±10% VARIATION UNDER COMPACTION (METHOD AS DESCRIBED IN AS 4419).
- ORGANIC MATERIAL CONTENT OF APPROXIMATELY 10% AS MEASURED IN ACCORDANCE WITH AS1289 SHALL BE ADDED TO TOP 150MM OF THE FILTRATION LAYER.
- THE PH OF THE MATERIAL SHALL BE BETWEEN 6 AND 7.
- THE SALT CONTENT OF THE SOIL MIXTURE FOR THE FILTRATION LAYER (AS MEASURED BY EC1:5) SHOULD BE LESS THAN 0.63 DS/M (630µS/CM).
- SILT/CLAY (<0.075MM) CONTENT SHALL NOT BE MORE THAN 3%.

0 2 4 6 8 10m
2 1
SCALE 1:100

0 1000 2000 3000 4000 5000mm
1000 500
SCALE 1:50

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REV.	DES.	DATE	VER.	DESCRIPTION
03	T.T.	24/09/2020	E.S.	INFILTRATION BASIN SHAPE MODIFIED TO COUNCIL REQUIREMENT
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
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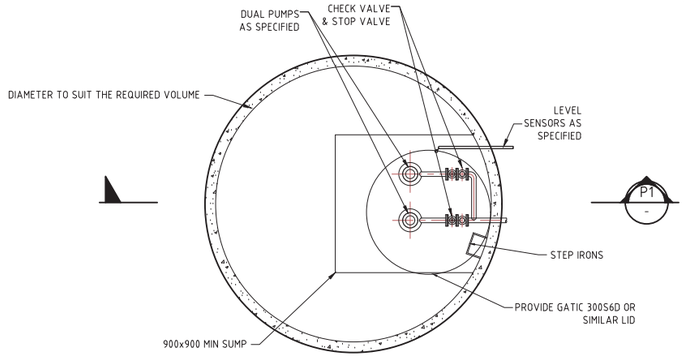
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

STORMWATER INFILTRATION BASIN DETAILS

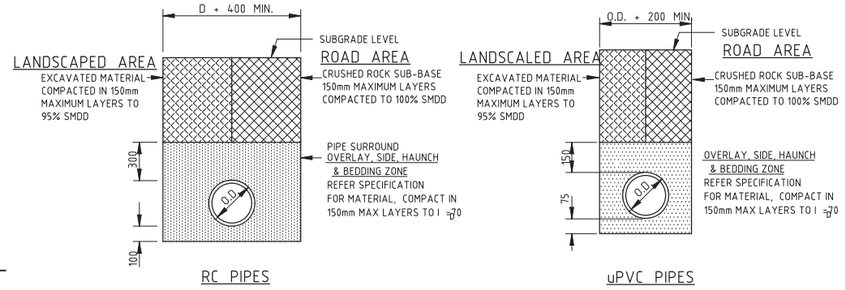
STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_623	03

A1



PUMP-OUT PIT AND WELL

SCALE 1:20

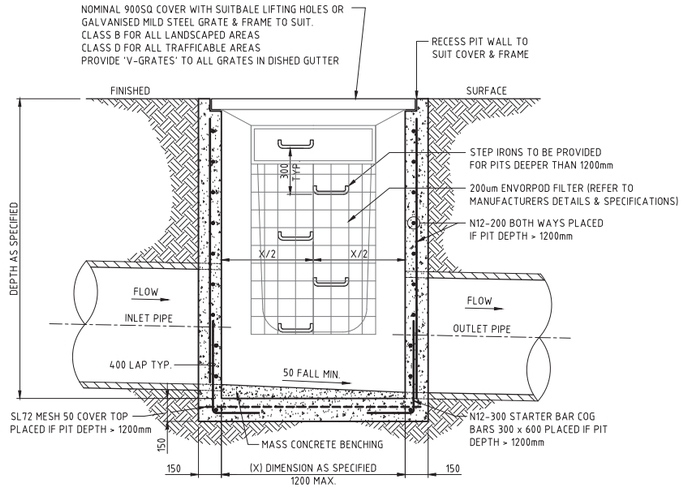


STORMWATER PIPES BACKFILL CONDITIONS

NTS

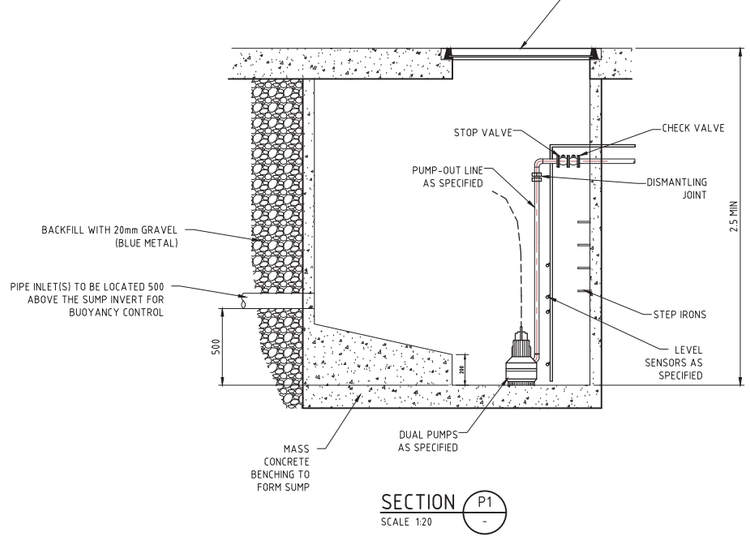
NOTES

1. FOR MATERIALS AND COMPACTION REQUIREMENTS REFER SPECIFICATION
2. "O.D." IS OUTSIDE PIPE DIAMETER
3. PIPES SHALL BE PLACED CENTRALLY WITHIN THE TRENCH WITH EQUAL CLEARANCE ON EACH SIDE TO THE TRENCH WALL.



GRATED PIT WITH ENVIROPOD

SCALE 1:20



SECTION P1

SCALE 1:20

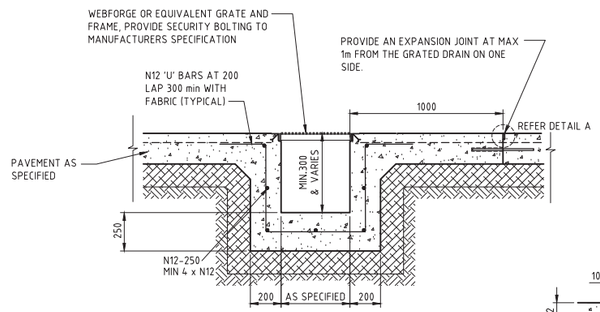
PUMP-OUT SYSTEM SPECIFICATION:

ALL COMPONENTS OF THE PUMP-OUT SYSTEM SHALL BE INSTALLED TO THE MANUFACTURER'S SPECIFICATION CONSISTING OF THE FOLLOWING MINIMUM COMPONENTS:

- PUMPS: DUAL PUMPS (CLASS 1 ZONE 2) INSTALLED TO OPERATE WITH AN ALTERNATING DUTY AND STANDBY ARRANGEMENT
- PUMP DUTIES AND TANK SIZE (FOR EACH PUMP PIT):

PUMP DUTY (EACH)	TANK STORAGE
2 PUMPS	90MIN 100 YR
10 L/s @ 7m HEAD	20 m3

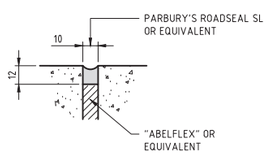
- COVERS: HEAVY DUTY CAST-IRON SEALED INFILL COVER
- SENSORS: LEVEL SENSORS FOR PUMP ON, PUMP OFF, HIGH LEVEL ALARM AND LOW LEVEL ALARM
- SWITCHGEAR HOUSING: VANDALPROOF CABINET LOCATED ADJACENT TO THE PUMPING STATION IN A LOCATION TO BE APPROVED BY THE ARCHITECT
- CONTROLS: FMC MONITORING AND CONTROL UNIT
- INDICATORS: POWER ON LIGHT, PUMP RUN LIGHT, FLASHING LIGHT AND AUDIBLE ALARMS, VOLTMETER, AMMETER, HOURS RUN METER
- POWER SUPPLY: THE CONTRACTOR SHALL PROVIDE ALL NECESSARY POWER SUPPLY AND METERING TO THE PUMP-OUT SYSTEM AND SHALL BE RESPONSIBLE FOR MAKING ALL APPLICATIONS AND PAYING ALL FEES AND CHARGES TO THE ELECTRICITY SUPPLY AUTHORITY



TYPICAL GRATED DRAIN

SCALE 1:20

NOTE:
MIN. 1% FALL IN GRATED DRAIN TO PIT



DETAIL A

N.T.S.

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REV.	DES.	DATE	VER.	DESCRIPTION
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
01	T.T.	28/02/2020	E.S.	ISSUE FOR COORDINATION

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PROJECT VERIFIER'S SIGNATURE: DATE:

CLIENT

CIVIL AND HYDRAULIC ENGINEERING DESIGN AND PROJECT MANAGEMENT

SUITE 26
11 - 13 BROOKHOLLOW AVE
NORWEST NSW 2153

PHONE: (02) 9680 3100
FAX: (02) 9634 6989

ABN 21 118 134 240

DESIGNER	T.T.
DATE	JAN 2020
ENGINEER	E.S.
LGA	NORTHERN BEACHES
VERIFIER	E.S.
SCALE @ A1	1:20

45-49 WARRIEWOOD RD, WARRIEWOOD

STORMWATER DETAILS

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192__651	02

A1

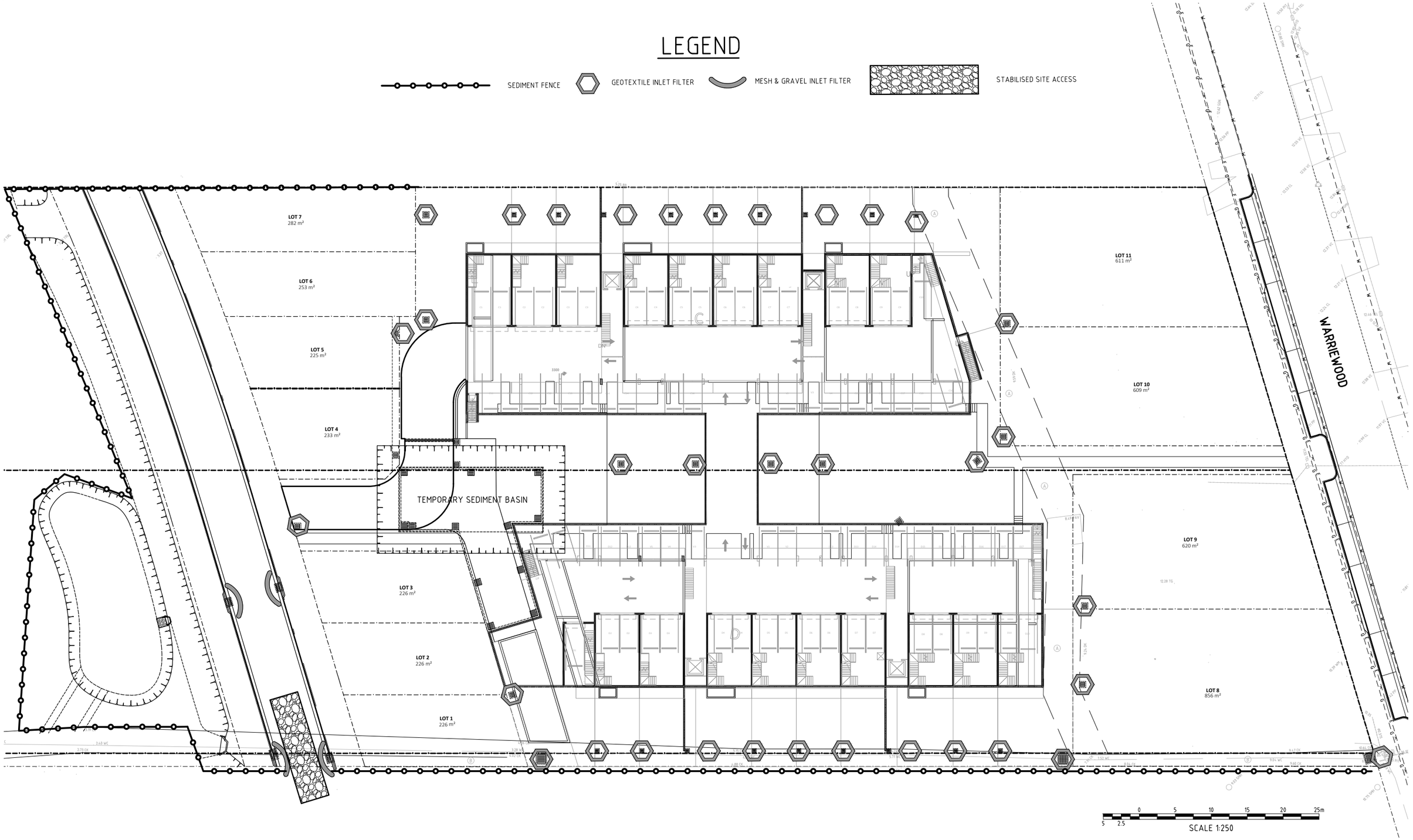
LEGEND

SEDIMENT FENCE

GEOTEXTILE INLET FILTER

MESH & GRAVEL INLET FILTER

STABILISED SITE ACCESS



CAD FILENAME: I:\DATA\CMCE Projects\PN-02192 - WARRIEWOOD ROAD 45-49, WARRIEWOOD\ACAD\02192_701.dwg

REV.	DES.	DATE	VER.	DESCRIPTION
03	T.T.	24/09/2020	E.S.	INFILTRATION BASIN SHAPE MODIFIED TO COUNCIL REQUIREMENT
02	T.T.	16/03/2020	E.S.	ISSUE FOR DA
01	T.T.	28/02/2020	E.S.	ISSUE FOR COORDINATION

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NORWEST NSW 2153

PHONE: (02) 9680 3100
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ABN 21 118 134 240

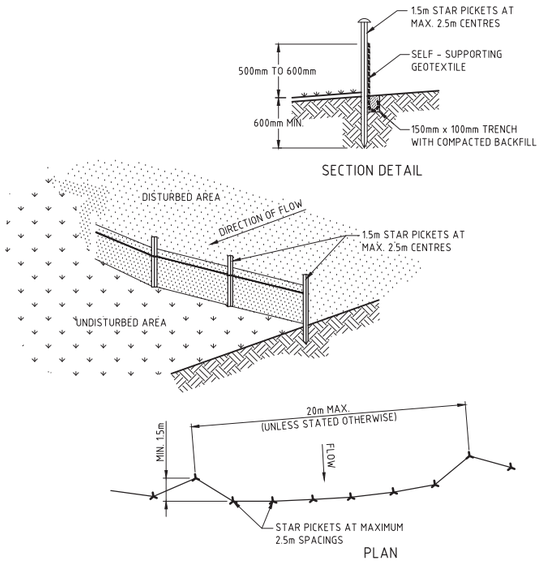
DESIGNER	T.T.	DATE	JAN 2020
ENGINEER	E.S.	LGA	NORTHERN BEACHES
VERIFIER	E.S.	SCALE @ A1	1:250

45-49 WARRIEWOOD RD, WARRIEWOOD

SEDIMENT & EROSION CONTROL PLAN

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_701	03

A1

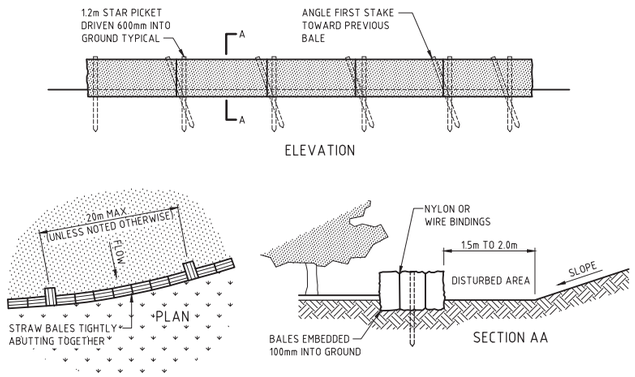


CONSTRUCTION NOTES:

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 150mm 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 THE 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.

SEDIMENT FENCE DETAIL

NOT TO SCALE

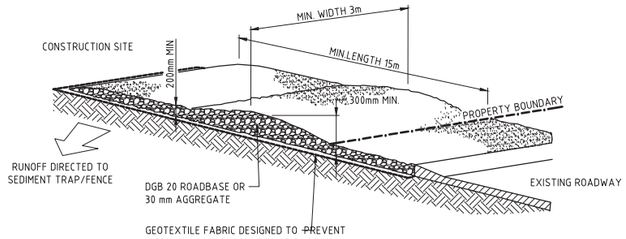


CONSTRUCTION NOTES:

1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES. STRAWS ARE TO BE PLACED PARALLEL TO GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm INTO THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE THE BALES ARE PLACED 1.0m TO 2.0m DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAMME THAT ENSURES THE INTEGRITY OF THE BALES IS RETAINED - THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.

STRAW BALE FILTER DETAIL

NOT TO SCALE



GEOTEXTILE FABRIC DESIGNED TO PREVENT INTERMIXING OF SUBGRADE AND BASE MATERIALS AND TO MAINTAIN GOOD PROPERTIES OF THE SUB-BASE LAYERS.

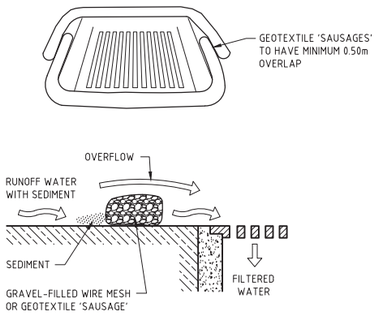
GEOFABRIC MAY BE A WOVEN OR NEEDLE-PUNCHED PRODUCT WITH A MINIMUM CBR BURST STRENGTH (AS3706.4-90) OF 2500 N

CONSTRUCTION NOTES:

1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15m LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3m WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

STABILISED SITE ACCESS DETAIL

NOT TO SCALE



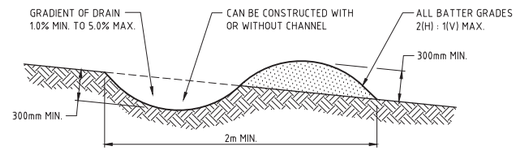
CONSTRUCTION NOTES:

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

GEOTEXTILE INLET FILTER DETAIL

FOR PITS WITHIN PAVEMENT AREAS

NOT TO SCALE



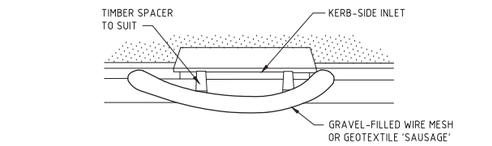
NOTE: ONLY TO BE USED AS TEMPORARY BANK WHERE UPSLOPE LENGTH IS 80 METRES.

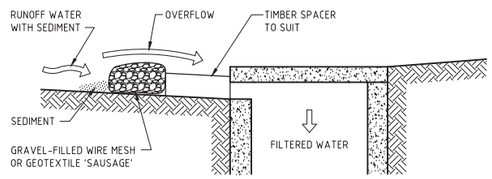
CONSTRUCTION NOTES:

1. BUILD WITH GRADIENTS BETWEEN 1% AND 5%.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE - WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE THE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.

TEMPORARY DIVERSION CHANNEL (LOW FLOW)

NOT TO SCALE



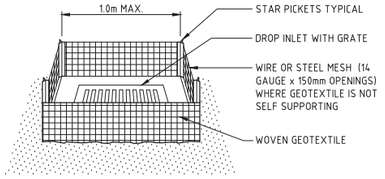


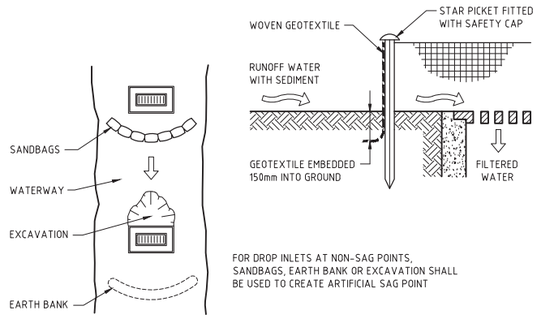
CONSTRUCTION NOTES:

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH x 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

MESH AND GRAVEL INLET FILTER DETAIL

NOT TO SCALE





FOR DROP INLETS AT NON-SAG POINTS, SANDBAGS, EARTH BANK OR EXCAVATION SHALL BE USED TO CREATE ARTIFICIAL SAG POINT

CONSTRUCTION NOTES:

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
3. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

GEOTEXTILE INLET FILTER DETAIL

FOR PITS WITHIN LANDSCAPED AREAS

NOT TO SCALE

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REV.	DES.	DATE	VER.	DESCRIPTION
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DESIGNER	T.T.
DATE	JAN 2020
ENGINEER	E.S.
LGA	NORTHERN BEACHES
VERIFIER	E.S.
SCALE @ A1	NILL

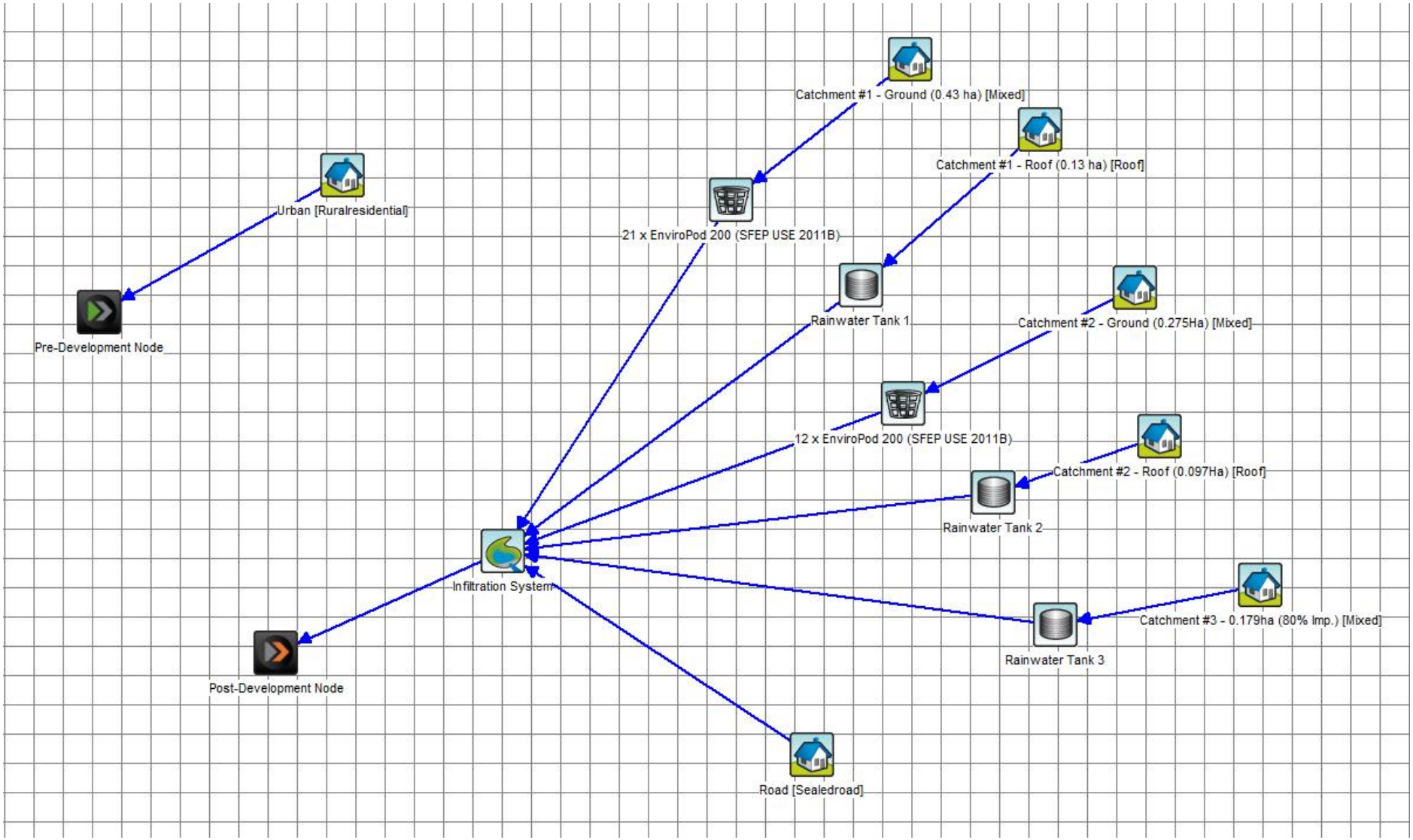
45-49 WARRIEWOOD RD, WARRIEWOOD

SEDIMENT & EROSION CONTROL DETAILS

STATUS	DRAWING No.	REVISION
DEVELOPMENT APPLICATION	02192_702	02

APPENDIX B

MUSIC LAYOUT


Catchment #1 - Ground (0.43 ha) [Mixed]
Catchment #1 - Roof (0.13 ha) [Roof]
Urban [Ruralresidential]
21 x EnviroPod 200 (SFEP USE 2011B)
Rainwater Tank 1
Pre-Development Node
Catchment #2 - Ground (0.275Ha) [Mixed]
12 x EnviroPod 200 (SFEP USE 2011B)
Catchment #2 - Roof (0.097Ha) [Roof]
Rainwater Tank 2
Infiltration System
Catchment #3 - 0.179ha (80% Imp.) [Mixed]
Rainwater Tank 3
Post-Development Node
Road [Sealedroad]

APPENDIX C

PRELODGEMENT NOTES

northern beaches council

PRELODGEMENT NOTES

Application No:	PLM2019/0109
Meeting Date:	6/06/2019
Property Address:	45-49 Warriewood Road WARRIEWOOD (Buffer Areas 1F and 1G)
Proposal:	Subdivision of the site into 44 residential lots
Attendees for Council:	Claire Ryan (Principal Planner – Development Assessment) Rebecca Englund (Principal Planner – Development Assessment) Rob Barbuto (Principal Engineer – Major Developments) Lea Lennon (Senior Urban Designer) Joseph Tramonte (Senior Landscape Architect) Ruby Ardren (Project Leader – Water Management) Valerie Tulk (Special Floodplain Engineer) Dean McNatty (Team Leader – Stormwater)
Apologies:	Matthew Edmonds (Manager – Development Assessment) Patrick Bastawrous (Traffic Engineer) Brendan Smith (Team Leader – Biodiversity)
Attendees for applicant:	Sanjeev Loura (Owner) Tarun Chadha (Architect) Ben Tesoriero (Town Planner) Tyson Ek-Moller (Town Planner)

General comments/limitations of these notes

These notes have been prepared by Council on the basis of information provided by the applicant and a consultation meeting with Council staff. Council provides this service for guidance purposes only. These notes are an account of the specific issues discussed and conclusions reached at the pre-lodgement meeting. These notes are not a complete set of planning and related comments for the proposed development. Matters discussed and comments offered by Council will in no way fetter Council's discretion as the Consent Authority. A determination can only be made following the lodgement and full assessment of the development application.

In addition to the comments made within these notes, it is a requirement of the applicant to address ALL relevant pieces of legislation including (but not limited to) any SEPP and any applicable clauses of Pittwater Local Environment Plan 2014 and Pittwater 21 Development Control Plan within the supporting documentation of a development application including the Statement of Environmental Effects.

You are advised to carefully review these notes. If there is an area of concern or non-compliance that cannot be supported by Council, you are strongly advised to review and reconsider the appropriateness of the design of your development for your site and the adverse impacts that may arise as a result of your development prior to the lodgement of any development application.

SPECIFIC ISSUES RAISED BY APPLICANT FOR DISCUSSION

Issues Raised	Council Response
Road layout Feedback is sought in relation to the internal road layout	Council is concerned with what is perceived as an unnecessary duplication of roadways, noting that the internal central road serves little to no purpose in the overall subdivision pattern. Council considers that a better result could be achieved with the deletion of the internal central road (and the associated cul-de-sac), with total reliance upon the perimeter loop road. Adjustments would then be required to ensure that the design of the loop road meets the provisions of the *Warriewood Valley Roads Masterplan* and Council's *Waste Management Policy* with regard to access for garbage vehicles.
Dwelling design Feedback is sought in relation to the design of the proposed dwellings	<u>Warriewood Road</u> The proposed dwellings fronting Warriewood Road do not appropriately mimic the scale of the low density development on the high side of Warriewood Road, resulting in inconsistency with the requirements of clause C6.10 of P21 DCP. You are encouraged to explore semi-detached housing, with clear and meaningful breaks between every two dwellings. The setbacks to Warriewood Road are also inconsistent with the requirements of D16.6 of P21 DCP, noting that two dwellings are well forward of the 6.5m minimum setback and that the width of the proposed articulation zones exceeds 25% of the width of the frontage of the dwelling. The utilisation of the loop road and the removal of the cul-de-sac should also remove reliance upon the secondary access driveway that is proposed to service the dwellings fronting Warriewood Road, providing for greater setbacks between the secondary frontage of the dwelling and the internal road. The 1m setback to the 3 storey unarticulated façade currently proposed is unacceptable. The dwellings/lots marked 7 and 8 should be removed to facilitate a direct connection between all lots fronting Warriewood Road and the internal loop road.

	<u>Internal Road</u> Council is supportive of the single garage design and tandem parking arrangement currently proposed. However, there is insufficient spatial separation between the attached dwellings, inconsistent with the provisions of C6.8 of P21 DCP which require a clear and meaningful break between buildings. The deletion of the internal central road will also facilitate more usable areas of private open space at the rear of each dwelling, rather than requiring private open space fronting roadways. This will also enable the removal of high front fences currently proposed, to achieve a streetscape more in keeping with the remainder of the land release area. The design of the northern dwellings, which vary in height and number of storeys, is preferred when compared to the southern dwellings, which have a continual 3 storey presentation along the length of the site. The garbage and tree enclosures located with a nil setback to the street are not supported. <u>Lorikeet Grove</u> Concern is raised in regards to the bulk of the proposed semi-detached houses fronting Lorikeet Grove. Whilst access from the internal road is supported, further refinement is required to the facades presenting to Lorikeet Grove to reduce the massing and apparent size of the 3 storey structures proposed.
43 Warriewood Road Advice is sought in relation to Council's intentions for the development of 43 Warriewood Road.	To ensure orderly development and connectivity through Buffer Area 1a to 1m, Council requires 43 Warriewood Road (Buffer Area 1H) to be incorporated into the development of the subject site. This land is critical to the proposal to facilitate access from Lorikeet Grove. Please contact Council's Property Team for further advise in this regard.

PITTWATER LOCAL ENVIRONMENTAL PLAN 2014 (PLEP 2014)

Note: PLEP 2014 can be viewed at the NSW Government Legislation Website

Zoning and Permissibility	
Definition of proposed development:	Subdivision and Dwelling Houses
Zone:	R3 Medium Density Residential
Permissibility:	Permitted with consent

Part 4 – Principal development standards
4.3 Height of buildings
Comment: It is assumed that each of the proposed new dwellings will comply with the building height development standard prescribed by subclause 2F of clause 4.3 of PLEP 2014.

Part 6 – Urban release areas
6.1 Warriewood Valley Release Area
With 44 dwellings, the proposal is consistent with the dwelling yield prescribed for Buffer Areas 1F, 1G and 1H (being 31-45 dwellings). As currently proposed, the development presents as an overdevelopment of the site. You are strongly encouraged to remove the dwellings/lots marked 7 and 8, with further refinement of the maximum yield likely as a result of the design changes required to achieve consistency with the provisions of P21 DCP and the recommendations contained within these notes.

Part 7 - Additional local provisions
7.1 Acid sulphate soils
A preliminary acid sulphate soil assessment and an acid sulphate soils management plan is required to accompany any future application, particularly noting the likely presence of acid sulphate soils within the creekline corridor.
7.3 Flood planning
The site is subject to flooding in both the FPL and PMF event. Any future application will be required to address the provisions of this clause, in addition to the specific requirements of clause C6.1 of P21 DCP and the Water Management Specification. See further comments from Council's Flood Team, further in this report.
7.6 Biodiversity
The site contains areas of Swamp Sclerophyll Coastal Forest Endangered Ecological Community, and is subject to the provisions of this clause. See further comments from Council's Biodiversity and Riparian Teams, further in this report.
7.7 Geotechnical hazards
Given the extent of earthworks required, the application is to be supported by a geotechnical risk management report identifying consistency with this clause and clause B8.1 of P21 DCP.

Furthermore, the geotechnical risk management report could be used to provide information of ground water levels on the site, specifically in and around the EEC.
7.10 Essential services
The application is to demonstrate that each lot has adequate access to all essential services, being the supply of water and electricity, the disposal and management of sewerage, stormwater drainage and suitable vehicular access. Concern is raised with regard to vehicle access, noting that without the incorporation of 43 Warriewood Road, it is unlikely that access can be legally obtained in the short-medium term.

PITTWATER 21 DEVELOPMENT CONTROL PLAN (P21 DCP)

Note: P21 DCP can be accessed via Council's website: www.northernbeaches.nsw.gov.au

Section C6: Design criteria for Warriewood Valley Release Area
C6.1 Integrated Water Cycle Management
The prelodgement application was not supported by any information relating to the proposed water management solution for the site. The relevant teams have provided general commentary further in the report.
C6.2 Natural Environment and Landscape
Given the presence of the EEC in the vicinity of the creekline, some of the provisions of clause C6.2 of P21 DCP will not be relevant. The application should ensure that the impacts upon the EEC are avoided or minimised, and the cleared areas within the EEC should be revegetated to compensate for impacts elsewhere on the site.
C6.4 The Road System and Pedestrian and Cyclist Network
The proposal is to demonstrate consistency with the provisions of clause C6.4 of P21 DCP, the *Warriewood Valley Roads Masterplan* and the *Warriewood Valley Landscape Masterplan*. Internal Road: The internal loop road should be designed as a 'Local Street'; however the 'Access Street' requirements may be accepted subject to adequate landscaping and appropriate setbacks to dwellings. Visitor parking should be evenly distributed throughout the site, and a one-way loop system is not supported. Warriewood Road: The design of the half road reconstruction of Warriewood Road is to align with the roads works approved in relation to both adjoining properties and comply with the Warriewood Valley Roads Masterplan. Council would prefer if all properties fronting Warriewood Road obtained vehicular access from the internal road. It is noted that this could be readily achieved if the dwellings/lots marked 7 and 8 were removed. Lorikeet Grove: Lorikeet Grove is to align with the location of those sections of Lorikeet Grove approved on adjoining sites, and is to be designed in accordance with the Roads Masterplan. The proposed indented parking bay along Lorikeet Grove is not supported. Shared Path: The location of the shared path on both adjoining sites has now been confirmed and approved. Details of the design and levels of these connections are viewable on Council's website via the Application Tracking service. When passing through the EEC, the cycle pathway should be

elevated on piers and should be sited to avoid impacts upon vegetation of waterbodies. The location of the cycle path should be reviewed by the project ecologist.

C6.5 Utilities, Services and Infrastructure Provision

Services:

Services should be located within the road verge, in a common trench below the footpath, to minimise impacts upon canopy trees.

Subdivision:

The application is silent with respect to the type of subdivision proposed. Council strongly advises that the proposed subdivision should be in the form of a Community Title subdivision.

C6.7 Landscape Area (Sector, Buffer Area or Development Site)

A minimum of 35% of the total site is to be landscaped area. Please be advised that 'landscaped area' differs from impervious area, as considered in the *Warriewood Valley Water Management Specification*. Furthermore, all roads and pathways (even those proposed to be dedicated to Council) are to be considered as part of this calculation.

C6.8 Residential Development Subdivision Principles

Concern is raised in relation to the design of the proposed dwellings and inconsistency with the provisions of this clause. See further comments above.

C6.10 Additional Specifications for Development of Buffer Area 1a to 1m

The proposed lack of inclusion of 43 Warriewood Road is inconsistent with the provisions and outcomes of this development control:

- Development occurs in an orderly manner,
- Continuation of the multifunctional creekline corridor, including cyclist and pedestrian access,
- To ensure that lots with a width of less than 60m are amalgamated to facilitate orderly planning and development outcomes and the efficient use of land, and
- To ensure consistency with the 'Indicative Layout Plan'.

Furthermore, as above, the design of the development fronting Warriewood Road is inconsistent with the requirement for built form to reflect the streetscape of Warriewood Road.

Section D16: Warriewood Valley Release Area

D16.1 Character as viewed from a public place

Concern is raised in relation to the presentation proposed dwellings, specifically:

- The housing typology fronting Warriewood Road is not considered to appropriately respond to the housing typology on the other side of the street,
- Insufficient spatial separation between dwellings, with no landscaping between buildings,
- The dwellings are generally unarticulated, with 3 storey blank facades presenting to the higher order streets.

D16.5 Landscaped Area for Newly Created Individual Allotments

Each lot is to strictly comply with the minimum landscaped area requirements of this control. Furthermore, the application should demonstrate how each lot can achieve consistency with the landscaping requirements (ie: the provision of canopy trees) prescribed.

D16.6 Front Building Line
A number of dwellings do not conform to the minimum setback requirements prescribed by this development control.
D16.7 Side and Rear Building Line
A number of dwellings do not conform to the minimum setback requirements prescribed by this development control.
D16.9 Solar Access
The application is required to demonstrate that each proposed dwelling will receive a minimum of 2 hours of direct sunlight to areas of private open space and windows of living areas between 9am and 3pm in midwinter.
D16.11 Form of construction including retaining walls, terracing and undercroft areas
The application does not demonstrate the extent of cut and fill required to facilitate the proposed development, and the design appears to assume that the site is flat. Further detail is required in this regard, particularly where retaining walls are required along common boundaries and in the vicinity of existing and proposed canopy trees.

Specialist Advice	
Referral Body	**Comments**
Natural Environment - Biodiversity	The applicant should ensure that required bushfire asset protection zones are maintained outside of the retained vegetation (an Endangered Ecological Community) in the south-west of the property. Any proposed flood storage and or water management infrastructure should be installed outside of the retained vegetation. In accordance with the Biodiversity Conservation Act 2016, a Biodiversity Development Assessment Report (BDAR) (formerly a Flora and Fauna Assessment) must be prepared to address any proposed impacts upon native vegetation within the site. The BDAR report must account for any direct and potential indirect impacts (e.g. changes in hydrology, weed invasion) upon native vegetation and habitats resulting from the proposal. The BDAR should include assessments of significance (5 part test) for threatened species matters occurring or with potential to occur on the site. A vegetation management plan must be prepared to guide weed removal and management within areas of retained vegetation including the riparian zone. Existing cleared and disturbed patches within the retained areas (including trails) must be revegetated the local native species guided by the Vegetation Management Plan.

Specialist Advice	
Flooding	The property at 45 – 49 Warriewood Rd, Warriewood is affected by the low, medium and high flood risk precincts, as well as Flood Life Hazard Categories H1-H5, as shown on the attached maps. The 1% AEP flood level including climate change predicted by the Narrabeen Lagoon Flood Study (2013) is 3.90m AHD*, and the Probable Maximum Flood level is 4.88m AHD. Freeboard is 0.5m, so the Flood Planning Level (FPL) is 0.5m above the 1% AEP flood level. *Note: The FPL has marginally increased in the time since the last advice was provided. It is understood that all of the portion of the property east of Lorikeet Grove is to be filled to above the FPL, which would modify the Flood Life Hazard Category and flood levels quoted above. If the proposed ground levels in the area where homes are proposed are above the post-development FPL, then the homes themselves would not be affected by flood related development controls, and a shelter in place refuge above the PMF would not be required. Flooding and evacuation would still need to be addressed though. The development needs to satisfy requirements set out in the *Warriewood Valley Urban Land Release Water Management Specification*, as well as the relevant provisions of PLEP 2014 and P21 DCP. Flood modelling would need to be undertaken to assess the pre- and post-development scenarios (including any basins and/or compensatory Works), and the Flood Management Report would need to identify any impact on this property as well as surrounding properties. Floods models are to include the PMF, 1% AEP, 20% AEP and 50% AEP events. Flood levels and velocities are to be shown to 2 decimal places. Flood impact mapping is to be presented. Calculations for pre- and post-development storage are to be presented. The DCP requirements include: a. There is no net loss of flood storage below the 1% AEP flood level;

Specialist Advice	
	b. There are no adverse changes in flood levels and velocities caused by alterations to the flood conveyance; c. There are no adverse effects on surrounding properties; and d. It is sited to minimise exposure to flood hazard.
Water Management	<u>Water Management Report</u> A thorough Water Management Report will be necessary. The requirements are detailed in the *Warriewood Valley Water Management Specification;* some key points that are often missed or misinterpreted are outlined below: 1. All water management facilities must be located outside the inner 25m riparian creek corridor. If they are located in the private buffer (outer 25m creek corridor), they must be situated above the 20%AEP. Flood maps should be provided that demonstrate this. 2. Assessment of existing conditions. There is a gauge at Mona Vale managed by Manly Hydraulics Lab and I believe there is a suitable five year period of data in the 1990's. There may be a more recent and longer period of suitable data available now. Please do not use data from Terrey Hills, as rainfall events there differ significantly from Warriewood. 3. An assessment of existing water quality in Narrabeen Creek (this is required for DA). 4. A water quality monitoring strategy covering the period prior to (if unable to obtain data on existing conditions), during and following construction up until issue of the occupation certificate. Major SQIDs should be monitored for one year following commissioning. 5. Proprietary devices such as filtration cartridges cannot be used in place of infiltration. Infiltration is necessary to replenish groundwater, a significant source of water for the Endangered Ecological Community on the site. 6. Water quality management. To demonstrate compliance with the relevant stormwater performance requirements, a model (preferably MUSIC) or an equivalent, widely accepted model or methodology must be provided. Should MUSIC be used, modelling shall be undertaken in accordance with draft NSW

Specialist Advice	
	Water Sensitive Urban Design Guidelines unless alternative modelling parameters are justified on the basis of local studies. Model data files should be submitted with a summary of the elements, parameters and assumptions used in the model. 7. A maintenance plan is required for all water quality infrastructure (and OSDs). 8. Division of responsibility for the maintenance of water management systems should be equitable. 9. All facilities should be accessible by maintenance vehicles and equipment. 10. Outlets to the creek should be designed so that flow enters the creek in a direction similar to the flow of the creek (no more than 30 degrees is recommended). 11. Impervious area. OSD calculations are based on 50% of the *total* site being impervious, including the riparian corridor. There are different requirements for landscaped area. The developed dwelling lots must be a maximum of 65% impervious. The inner creekline corridor (25m from creek centreline) must be vegetated. The outer creekline corridor (private buffer) from 25-50m from the creek centreline may be up to 25% impervious surfaces including roads and pedestrian/cycle ways. Water management facilities may also be in the private buffer. 12. A catchment plan should be provided that shows the areas contributing flows to each OSD. Please ensure impervious vs pervious finishes are clearly differentiated eg. do not describe an area as 'courtyard' when this could include a combination of deep soil and paved areas. 13. Rainwater tanks cannot be oversized to provide OSD storage. 14. Due to the EEC the creek invert level should not be changed (overbank flows should not be altered). The creek currently consists of a pool, riffle and then another pool. The riffle should be maintained. Rehabilitation of the aquatic and riparian habitat is to be undertaken. The roadway should be removed and compaction of the soil reduced. Weeds are to be removed (including all Coral trees) and creek banks stabilised where required as a result of the weed removal. It is recommended that

Specialist Advice	
	rocks are placed to blend with the current stacked rock on the creek bank towards the boundary with 53C. Any outlets must have substantial rip rap surrounding them to prevent erosion of the creek. Significant vegetation in the riparian area (inner 25m creekline corridor) must be retained and indicated in the Flora and Fauna report and Biodiversity/ Vegetation Management Plan. <u>Issues specific to this site</u> 1. The EEC on 45-49 Warriewood Road relies on overbank flows from the creek.Due to the reliance of the EEC on overbank flows there are significant constraints on cutting into the creek for flood storage, as this will change the creek invert level. 2. The EEC is groundwater dependent vegetation. It is believed that groundwater flows originate from 53A Warriewood Road and generally flow on a diagonal path from the north-western corner of that property across to the EEC on 45-49 and 41 Warriewood Road. A groundwater monitoring plan will be required to determine the level and area of groundwater and establish the quantity and patterns of flow. The key will be determining whether proposed construction work and development will impact groundwater flows in the short and/or long term and what impact this might have on the EEC. Please note: Water level monitoring should be undertaken on a regular basis for a period of six months from monitoring bores installed at the site upslope of the EEC. Monitoring results should include a rainfall hyetograph to indicate the sensitivity of groundwater levels to periods of rainfall. A minimum of three bores should be installed to allow triangulation of water levels, determination of the hydraulic gradient and interpretation of flow direction. 3. Due to past use of the site for market gardening, particularly 49 Warriewood Road where there are large numbers of greenhouses, a groundwater contamination assessment is required. If contaminants are found above ANZECC guidelines, a groundwater management plan should be prepared.

Specialist Advice	
Engineering	1. The applicant we need to prepare an upstream overland flow study using the DRAINS program. It has been identified that there are significant overland flow heading from the west towards the site. As there is a sag pit that fronts the site a large volume of stormwater will enter the site. The applicant is advised that as the overland flow may inhibit development potential of the site that a stormwater drainage line be installed in the current location of the open swale (eastern side boundary). The pipe is to be designed to cater for the 1 in 20 year ARI flows that are generated from the upstream catchment(s) and Warriewood Road with an overland flow path /swale provided above the line to cater for flows up to the 1 in 100 year ARI storm event. The discharge point of this line is to be designed to have minimal impact on the adjoining riparian area. 2. On site stormwater detention is to be provided in accordance with Councils *Warriewood Valley Urban Land Release Water Management Specification*, in particular Appendix A "On site detention requirements" 3. The subdivision layout is to allow for the continuation of the adjoining shared pedestrian pathways in accordance with Councils *Warriewood Valley Roads Masterplan*. The road and footpath design is also to be in accordance with this document.
Traffic	<u>Warriewood Road</u> - The frontage to Warriewood Road requires a half road construction. - Kerb and Guttering (vertical faced kerb only will be permitted) with the face of the kerb located 10.9m from face of existing kerb on the northern side. - Plans need to show a cross-section where the centreline of the road is located 5.1m from the existing kerb on the northern side, as well as a proposed 3.7m traffic lane, and 2.1m indented parking bay. - As the traffic lane is 3.7m which is reduced from the required 4.2m for a sub-arterial road, the shared path is to be increased to 2.5m shared path and is to be located directly adjacent to kerb and fully within the

Specialist Advice	
	Public Road Reserve where practicable. If the shared path of the adjacent sites is less than 2.5m then a transition is to be provided increasing to the full path width. - Where otherwise available, access to properties fronting Warriewood Road should be accessed internally. <u>Lorikeet Grove</u> To be designed as a Local Road in accordance with the *Warriewood Valley Roads Masterplan*, to align with existing/proposed connections on adjoining sites. <u>Central Road</u> Proposed 6.2m wide central road is not acceptable, as road needs to be designed as a Local Road or Access Road in accordance with the WVRMP, minimum 7.5m carriageway with parking permitted on both sides of the road, and 1.5m wide footpath on one side of the road. <u>Laneways</u> Laneway (for rear vehicular access only) may be considered if designed in accordance with the WVRMP. No parking is permitted in the laneway. Laneway must be constructed as a Shared Zone in accordance with the RMS standards. One way traffic laneway cannot be considered as length exceeds 40m and 6 number of dwellings. <u>Access driveway</u> Access driveway off turning circle for rear parking to dwellings fronting Warriewood Road too close to vehicle path and must be setback further from the roadway. <u>Waste Vehicle Access</u> The turning area in Central Road must be designed to cater for safe movements by a waste collection vehicle minimum 9.7m in length, to accommodate the existing vehicle type for all turning movements. May need to check with Waste Services regarding type of vehicles they will be using in the future and the minimum length required.
Urban Design	The deletion of the central road to allow for internal courtyard common open space should provide a variety of places for adequate circulation, rest and play. Areas of large shaded trees (possibly deciduous) are encouraged to allow for shade in

Specialist Advice	
	summer and solar gain in winter and the change of seasons. The 1 metre wide allocation for the boundary deep soil zone for mature plantings will be insufficient. A minimum 2 metres should be allowed for to encourage not only mature planting but low to mid-range height landscaping response. The bin receptacles provided to the front landscaped area are not a preferred solution for the bin storage areas. Bin storage should be internal to the site and not be part of the front landscaped area of the apartments. The preference is for minimised built form additional to the entrances and facades to the units. As cars and hardstand driveway and pedestrian paths will dominate this forecourt area, strategies that provide a green landscaped response that complements the hardstand will be required in future applications. Overall the development has maximised the yield to achieve 44 dwellings The minimum requirement is 31 and it is suggested a more reasonable and less intense development could be achieved by the reduction of the number of dwellings proposed. The separation requirements outlined above will see the loss of several of the building blocks to allow for this pattern of built form across the site.
Landscape Architect	The subdivision proposal does not satisfy all the road verge requirements contained collectively in the *Warriewood Valley Roads Masterplan* and *Warriewood Valley Landscape Masterplan*. ***Sharepath and Footpath requirements:*** To satisfy the Warriewood Valley Landscape Masterplan and Design Guidelines, the following pedestrian and sharepath network are required: *Warriewood Rd* A 2.1m wide footpath is required along Warriewood Rd and shall be shown on subdivision plans, and shall be co-ordinated to align with the proposed 2.1m footpath for the adjoining properties. Where appropriate, the footpath should be aligned to abut the kerb to increase deep soil area for street tree planting. *Lorikeet Grove*

Specialist Advice	
	A 1.5m wide footpath is required to one side of Lorikeet Grove and shall be shown on subdivision plans, and shall be co-ordinated to align with the proposed 1.5m footpath for the adjoining properties. *Creekline Corridor* A 2.5m wide sharepath is required within the outer creekline corridor, and shall be shown on subdivision plans, and shall be co-ordinated to align with the proposed footpath for the adjoining properties. Within the creekline corridor, the proposal must demonstrate the location and connectivity of a 2.5m width sharepath above the 20% AEP flood level. ***Landscaping*** Planting within the existing or proposed public road reserve is to be in accordance with the *Warriewood Valley Landscape Masterplan and Design Guidelines (Public Domain).* Landscape Plans are required to demonstrate the proposal for extensive landscaping within the 50 metre creekline riparian corridor. The 50 metre corridor consists of an inner 25 metre public creekline corridor that is solely comprised of a native flora/fauna vegetation corridor adjoining the creekline, and an outer 25 metre private landscaped buffer setback. The Creekline Corridor landscape plans for the inner creekline corridor must be prepared illustrating the following: extensive stands of Casuarina glauca, and groves of Eucalyptus robusta with other native feature trees and indigenous understorey and ground covers are to comprise a minimum of 75 % of the total creekline corridor area. In areas of low use, native groundcovers should be used as an alternative to lawn.
Stormwater	Council's records indicate that the subject site is burdened by a public open drainage system which conveys runoff from Warriewood Road. it is recommended that the following details are submitted with any application.

Specialist Advice	
	- Accurately locate and confirm dimensions of this drainage system and plot to scale on the DA site plans that outline the proposal. The locating should be carried out by a registered surveyor. - All structures are to be located clear of this drainage system. - Overland flow management – Refer to Development Engineering comments. The following details should be submitted with the application should the applicant propose to modify, relocate, upgrade or remove the public drainage system: - Hydraulic design & construction plans and an accompanying report detailing the Council drainage system upgrade are to be prepared by a Civil Engineer registered on the NPER. Hydrological and Hydraulic technical guidelines as specified in Council's Engineering Design Specification -AUSPEC ONE are to be used in the preparation of the Hydraulic design plans and report.
Waste	<u>Road Design</u> - The pavement width of the outer loop road does not comply with the requirements of the Waste DCP. *Minimum pavement width for roads to be accessed by waste collection vehicles is 6.0metres.* - Minimum footpath/naturestrip width (the distance between the property boundary and the kerb) to be 1.5 metres. *This is to allow residents to present bins and other wastes at the kerbside for collection without blocking the footpath.* <u>Access for waste collection vehicles.</u> - Public road access required to provide waste collection services to this community association. *Completion of access via Lorikeet Grove required prior to waste services being provided*. <u>General Information</u> - Compliance with all aspects of Waste DCP required. - Residents will be required to place bins and other wastes at the kerbside for collection.

Specialist Advice	
	- Positive covenant to be placed on community lot for access by waste collection vehicle. Wording will be provided by Council. - Waste collection clauses to be placed in Community Management Statement. Wording will be provided by Council.

Documentation to accompany the Development Application

- Completed Application Form and payment of fees
- Electronic copies (USB)
- Statement of Environmental Effects
- Cost of works estimate/ Quote
- Site Plan
- Floor Plan
- Elevations and sections
- A4 Notification Plans (excluding internal layouts)
- Survey Plan
- Demolition Plan
- Excavation and fill Plan
- Waste Management Plan (Construction & Demolition & Ongoing)
- Certified Shadow Diagrams
- BASIX Certificates
- Schedule of colours and materials
- Landscape Plan and Landscape Design Statement
- Arboricultural Impact Assessment Report
- Subdivision Plans
- Road Design Plan
- Erosion and Sediment Control Plan / Soil and Water Management Plan
- Stormwater Management Plan / Stormwater Plans and On-site Stormwater Detention (OSD) Checklist
- Water Management Report and signed Water Management Specification Checklist
- Operation and Maintenance Manual for water management infrastructure
- Stormwater Drainage Assets Plan
- Geotechnical Report
- Bushfire Report
- Acid Sulfate Soil Report
- Flood Risk Assessment Report
- Water Table Report
- Overland Flows Study
- Biodiversity Development Assessment Report
- Vegetation Management Plan
- Traffic and Parking Report
- Construction Traffic Management Plan
- Integrated Development Fees
- Preliminary Contaminated Land Report
- Landscaped area and impervious area calculation diagrams

Please refer to Development Application Checklist for further detail.

Concluding Comments

These notes are in response to a prelodgement meeting held on 6 June 2019 to discuss the development of 45-49 Warriewood Road, Warriewood. These notes are based on discussions at the prelodgement meeting and the following information provided to Council:

- A01 to A20, prepared by Archidrome, dated 23 May 2019.

Council has reviewed the information presented and acknowledges the additional justification provided during the prelodgement meeting. However, at this stage, Council is not in a position to support the proposal, largely due to:

- Duplication of internal roads and inconsistency with the *Warriewood Valley Roads Masterplan* with regard to the width of the road pavement and the road verges,
- Unsuitable dwelling design, and
- Insufficient landscaped treatment.

Generally, the proposal presents as an overdevelopment of the site, hitting the maximum dwelling yield without the incorporation of a residential flat building, being the housing typology anticipated with the higher yield.

Council also maintains concerns regarding the lack of information regarding the water management solution for the site, and the potential impacts upon the EEC. The size and design of the water management infrastructure will dictate the development potential/capacity of the site, and as such, the water management solution should be resolved as soon as possible.

APPENDIX D

FLOOD IMPACT ASSESSMENT (BY BMT)

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Broadmeadow NSW 2292
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Our Ref: JDE: L.N20951.002.docx

5 April 2018

Forge Venture Management
Via email: james.brooks@forgevm.com

Attention: James Brooks

Dear James,

RE: 45 WARRIEWOOD ROAD, WARRIEWOOD FLOOD IMPACT ASSESSMENT

BMT was commissioned by Forge Venture Management to provide a flood impact assessment for the proposed development at 45-49 Warriewood Road, Warriewood (herein referred to as the site). This report has been prepared to accompany the Development Application (DA) for the site.

The proposed development is comprised of the subdivision and civil works of Lot 2 DP349085 and Lot 1 DO349085 45-49 Warriewood Road, Warriewood (see Figure 1). The site is located adjacent to Narrabeen Creek (flowing along the southern boundary of the site) and is classified as Flood Category 1 – High Hazard, with the southern portion of the site being inundated by floodwaters in the 1% AEP flood event.

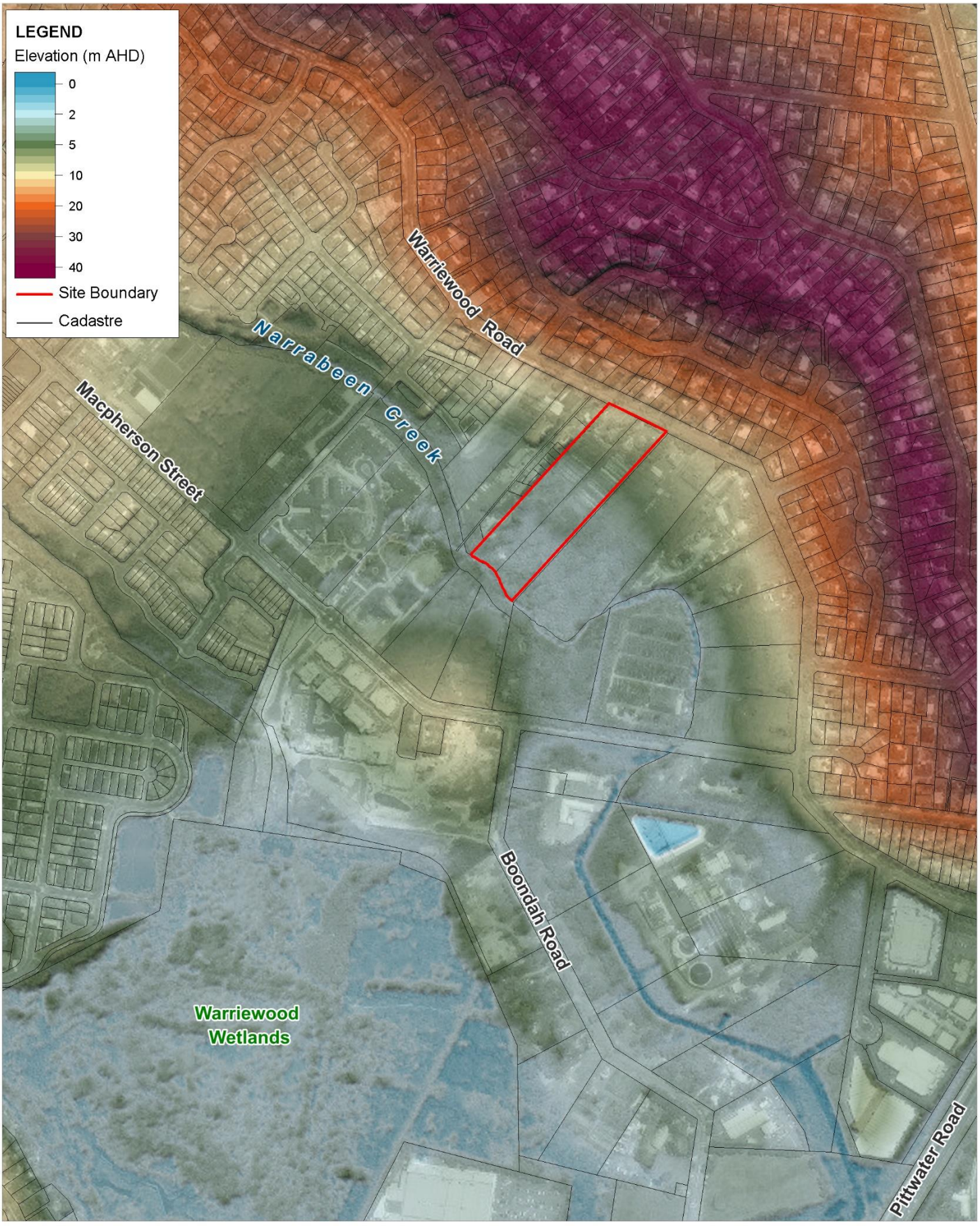
Council Requirements

In accordance with Pittwater Council's (enforced under Northern Beaches City Council) DCP, the following flood planning restrictions are applicable to the site:

- No adverse flood impact on surrounding properties or on flooding processes for any event up to the Probable Maximum Flood (PMF) event;
- No net decrease in the floodplain volume of a floodway or flood storage area within the property for any flood event up to the 1% AEP event; and
- The development cannot create any additional flood prone lots (i.e. all lots need to be above the flood planning event + 0.5m freeboard allowance). The flood planning event to be considered is the 1% AEP event + 2100 sea level rise (0.9m) + 30% increase in rainfall intensity event.

The Flood Category 1 classification includes properties that are located within Primary Floodplain Areas where the lowest point of the property is affected at the Flood Planning Level (FPL).

Assessment of the FPL for the site is discussed further below.



Title:
Site Locality

Figure: **1**

Rev: **A**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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Existing Flood Risk

Background

BMT previously completed a flood study of the Narrabeen Lagoon catchment on behalf of Pittwater and Warringah Councils in 2013. This study included the hydraulic modelling of the Narrabeen Lagoon catchment including the reach of Narrabeen Creek adjacent to the study site.

The original model developed as part of the Narrabeen Lagoon Flood Study (BMT WBM, 2013) was a detailed two-dimensional TUFLOW hydraulic computer model of the catchment with a 6 m grid resolution, for the simulation of catchment-wide design flood behaviour. The model was calibrated to previous major flood events in the catchment including April 1988 and March 2011. Due to the relatively coarse grid resolution, the reach of Narrabeen Creek between Jubilee Avenue and Macpherson Street was modelled as a 1D channel embedded within the 2D representation of the wider floodplain.

To better represent the existing design flood behaviour and enable the assessment of the channel modification proposed as part of the earthworks for the site, a refined local model of the Narrabeen Creek catchment was developed with a 2 m grid resolution, extending from 60 m downstream of Brands Lane to 130 m downstream of Macpherson Street, as shown in Figure 2. The refined model consisted of an upstream flow time series and downstream water level time series, both of which were extracted from the original Narrabeen Lagoon catchment-wide TUFLOW model. The model topography was defined by a combination of LiDAR data and site survey provided by Forge Venture Management and Craig and Rhodes (site survey provided from a previous flood impact assessment completed for 41 Warriewood Road). The modelled reach of Narrabeen Creek was converted to a 2D representation based on the available survey data.

The refined model was used to determine flooding extents and behaviour for a range of design flood events, including the 20% AEP, 10% AEP, 5% AEP, 1% AEP and PMF events, as well as the 1% AEP design event with climate change (2100 sea level rise and 30% increase in rainfall intensity, herein referred to as 1% AEP+CC event).

The 2-hour storm duration was identified as the critical design event duration at the site, with the exception of the PMF event which had a critical duration of 5-hours due to the backwater influence of Narrabeen Lagoon.

Baseline Flood Behaviour

The baseline model topography is a combination of LiDAR data and site survey provided by CMS Surveyors (15843detail 1.dwg), and also includes the finished landforms for the 29-31 Warriewood Road development currently under construction (as defined in 3D surface model 170925.dwg provided by Craig and Rhodes) and 51C Warriewood Road development (based on PW5197583 Stamped Approved Plans provided by Council). This baseline approach is consistent with previous flood impact assessments undertaken by BMT in the Narrabeen Creek corridor.

Modelled existing peak flood levels at selected locations (as presented in Figure 2) are provided in Table 1, for the full range of design flood events considered. The existing 1% AEP, 1% AEP+CC and PMF design flood conditions are shown in Appendix A – Baseline/Existing Design Flood Behaviour (Figure A-1 – Figure A-3).

Title:
Refined Model Configuration

Figure: 2

Rev: A

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Approx. Scale

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Table 1 Simulated Existing Peak Flood Levels

Design Event (AEP)	Peak Flood Level (m AHD)		
	Location 1 (L1)	Location 2 (L2)	Location 3 (L3)
20%	3.42	3.90	3.46
10%	3.52	3.96	3.55
5%	3.60	4.03	3.63
2%	3.67	4.09	3.70
1%	3.73	4.13	3.76
1% + Climate Change	3.84	4.21	3.86
PMF	4.88	4.89	4.88

It is evident that the design peak flood levels are relatively consistent across L1 and L3, with increases in peak levels at L2 at the upstream boundary of the site. During all events the capacity of Narrabeen Creek is exceeded, causing overbank flows to fill low-lying floodplain storage areas. This includes a small portion of the proposed development area along the proposed Lorikeet Grove roadway at the southern extremity of the development.

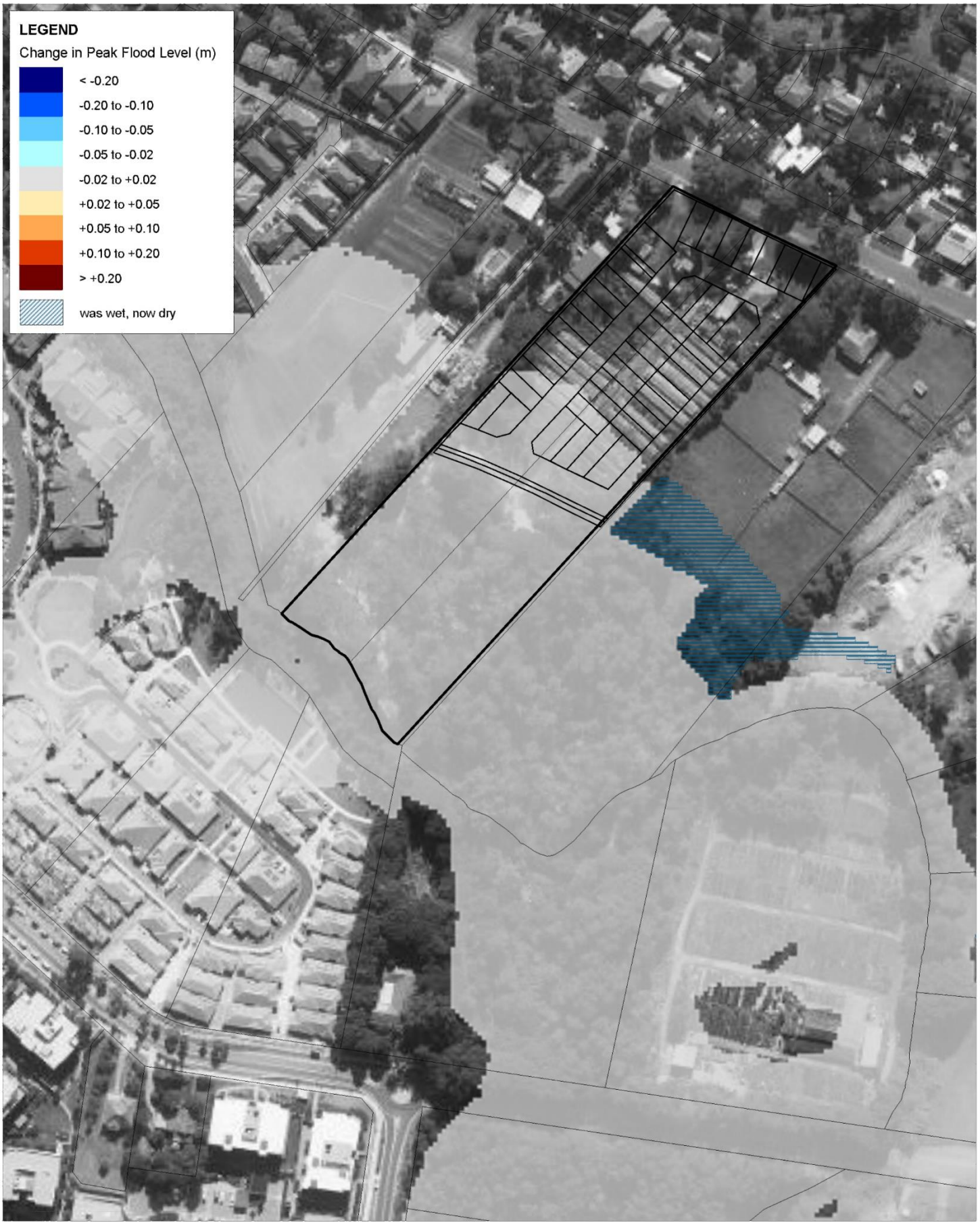
The peak flood levels in the lower sections of Narrabeen Creek are dominated by the Narrabeen Lagoon water levels. The limit of the 1% AEP Narrabeen Lagoon water level influence on Narrabeen Creek is approximately Macpherson Street Bridge. Upstream of the bridge, peak flood levels are driven by the local Narrabeen Creek channel capacity and catchment flows. As such, it is evident that an increase in rainfall as modelled in the 1% AEP climate change scenario results in minor increases in peak flood levels across the site.

During the PMF event, more extensive inundation across the site and broader area occurs, filling overbank areas from the low-lying floodplain as the conveyance of the creek is exceeded. Gradual inundation of the southern portion of the site occurs before extending to the northern portion of the site.

Baseline Sensitivity Test

A sensitivity test was undertaken on the existing/baseline 1% AEP condition to determine the change in baseline peak flood levels associated with the inclusion of the 41 Warriewood Rd development (DA approved but not yet to be constructed) in the baseline topography. The change in the 1% AEP baseline peak flood level associated with the inclusion of the 41 Warriewood Rd development is shown in Figure 3.

The two baseline catchment conditions result in largely similar 1% AEP peak flood levels across the site. As shown in Figure 3, the area that was previously wet on 41 Warriewood Rd is dry due to the increased ground elevations. As this area is mostly defined as flood fringe, there are no significant changes in baseline 1% AEP peak flood levels, with only slight (< 0.01 m) reductions in the existing 1% AEP peak flood levels on the neighbouring lot to the east. As such, the peak flood levels across the proposed development site are not overly sensitive to the adopted baseline landform of 41 Warriewood Rd.



Title:

Change in Peak Flood Levels at the 1% AEP Event Sensitivity Test Between Baseline Conditions

Figure: 3

Rev: A

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Hydraulic Categorisation

Hydraulic categorisation is one of the tools used to identify flood behaviour and risk. Outcomes of the categorisation are primarily used to inform future land use planning.

There are no prescriptive methods for determining what parts of the floodplain constitute floodway, flood storages and flood fringes. Descriptions of these terms within the Floodplain Development Manual (FDM) (NSW Government, 2005) are essentially qualitative in nature and emphasis is placed on the need for site specific consideration when determining appropriate methods for hydraulic category classification. The hydraulic categories as defined in the FDM, and the advised general guidelines to assist in the delineation of flooding and flood storage areas, are:

- **Floodway -** Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- **Flood Storage -** Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.
- **Flood Fringe -** Remaining area of flood prone land, after floodway and flood storage areas have been defined. Blockage or filling of this area will not significantly affect the flood pattern or flood levels.

The adopted hydraulic classification is consistent with Council's DCP and is defined in Table 2.

Table 2 Hydraulic Categories

Floodway	Velocity * Depth > 0.5	Areas and flow paths where a significant proportion of floodwaters are conveyed (including all bank-to-bank creek sections).
Flood Storage	Velocity * Depth < 0.5 and Depth > 0.5 metres	Areas where floodwaters accumulate before being conveyed downstream. These areas are important for detention and attenuation of flood peaks.
Flood Fringe	Velocity * Depth < 0.5 and Depth < 0.5 metres	Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.

The existing 1% AEP hydraulic categories are shown in Appendix A – Baseline/Existing Design Flood Behaviour (Figure A-4). As shown, most of the inundated portion of the study site is classified as flood storage, with some areas of flood fringe along the northern edge of the flood extent and western boundary and some localised areas of floodway in the southern section of the lot along Narrabeen Creek.

Flood Impact Assessment

Modelling Approach

To represent the post-development catchment conditions, the TUFLOW model terrain was modified to include the finished ground levels for the proposed development. The surface was created using the design surface data (30949-CI-100 Warriewood BE (NO flood storage)_v2013.dwg) supplied by Wood & Grieve Engineers, as shown in Figure B-1 in Appendix B – Post-Development Design Flood Behaviour. The proposed earthworks include filling of the northern portion of the site for the construction of a 44-lot residential development and associated roads. To the south of the lots, bordering the floodplain, is a proposed cycleway and Lorikeet Grove, road linking the study site to the neighbouring 41 Warriewood Road to the east. The low-lying floodplain area in the southern portion of the site is largely unchanged from existing conditions with only minor changes to flood storage areas. Topographical modifications are largely isolated to the northern portion of the site.

Modelling Results

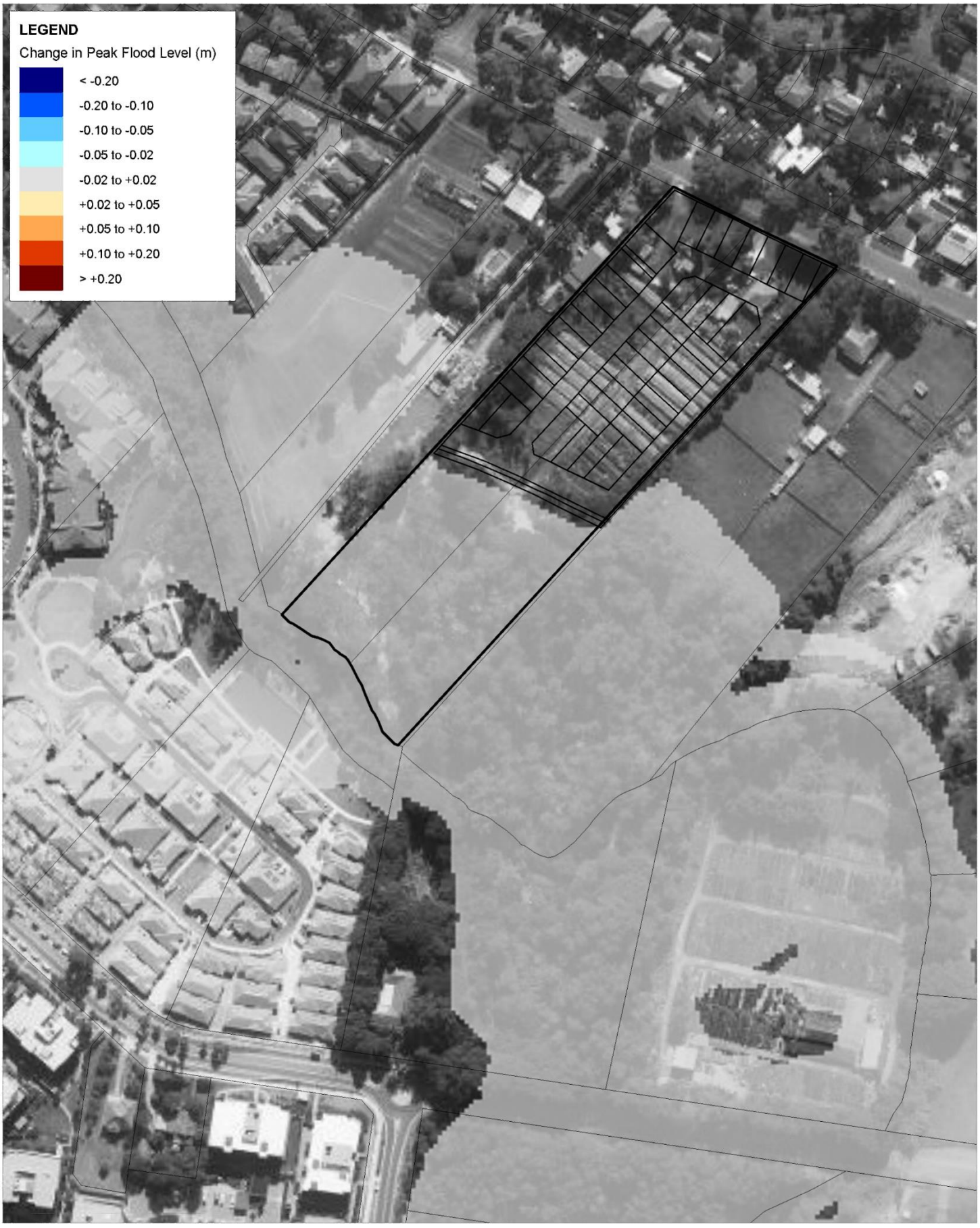
Modelled post-development peak flood levels at selected locations (as presented in Figure 2) are provided in Table 3, for the full range of design flood events considered. The post-development 1% AEP, 1% AEP+CC and PMF design flood conditions at the site are presented in Appendix B – Post-Development Design Flood Behaviour (Figure B-1 – Figure B-3).

Table 3 Simulated Post-Development Peak Flood Levels

Design Event (AEP)	Peak Flood Level (m AHD)		
	Location 1 (L1)	Location 2 (L2)	Location 3 (L3)
20%	3.43 (+0.01)	3.89 (-0.01)	3.47 (+0.01)
10%	3.53 (+0.01)	3.96 (0.0)	3.55 (0.0)
5%	3.61 (+0.01)	4.03 (0.0)	3.64 (+0.01)
2%	3.68 (+0.01)	4.09 (0.0)	3.71 (+0.01)
1%	3.73 (0.0)	4.13 (0.0)	3.76 (0.0)
1% + Climate Change	3.84 (0.0)	4.21 (0.0)	3.87 (+0.01)
PMF	4.88 (0.0)	4.89 (0.0)	4.88 (0.0)

Note: Bracketed value is change in peak flood level from base design conditions

The peak flood level impacts for the 1% AEP, 1%AEP+CC and PMF design flood events are presented in Figure 4 to Figure 6, respectively. Overall, it is evident that the proposed development has negligible impacts on simulated existing condition peak design flood levels. Changes in modelled peak flood levels are generally limited to ±0.01m for all design events.



Title:

Change in Peak Flood Levels at the 1% AEP Event

Figure: 4

Rev: A

N

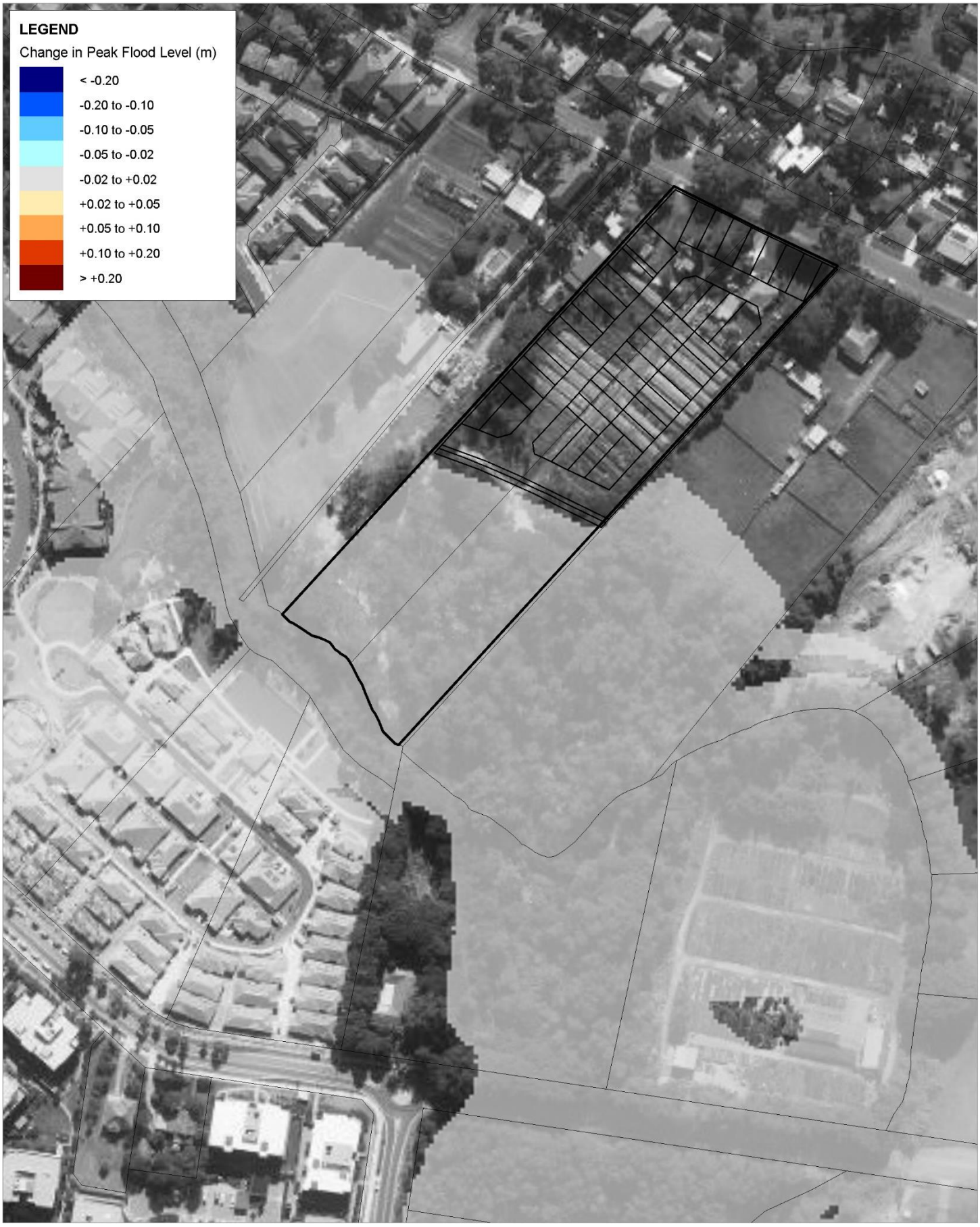
0 50 100m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_011_Level_Impact_1%AEP_DEV001a.WOR



Title:

Change in Peak Flood Levels at the 1% AEP Event + 2100 Sea Level Rise +30% Increase Rainfall Intensity

Figure: 5

Rev: A

N

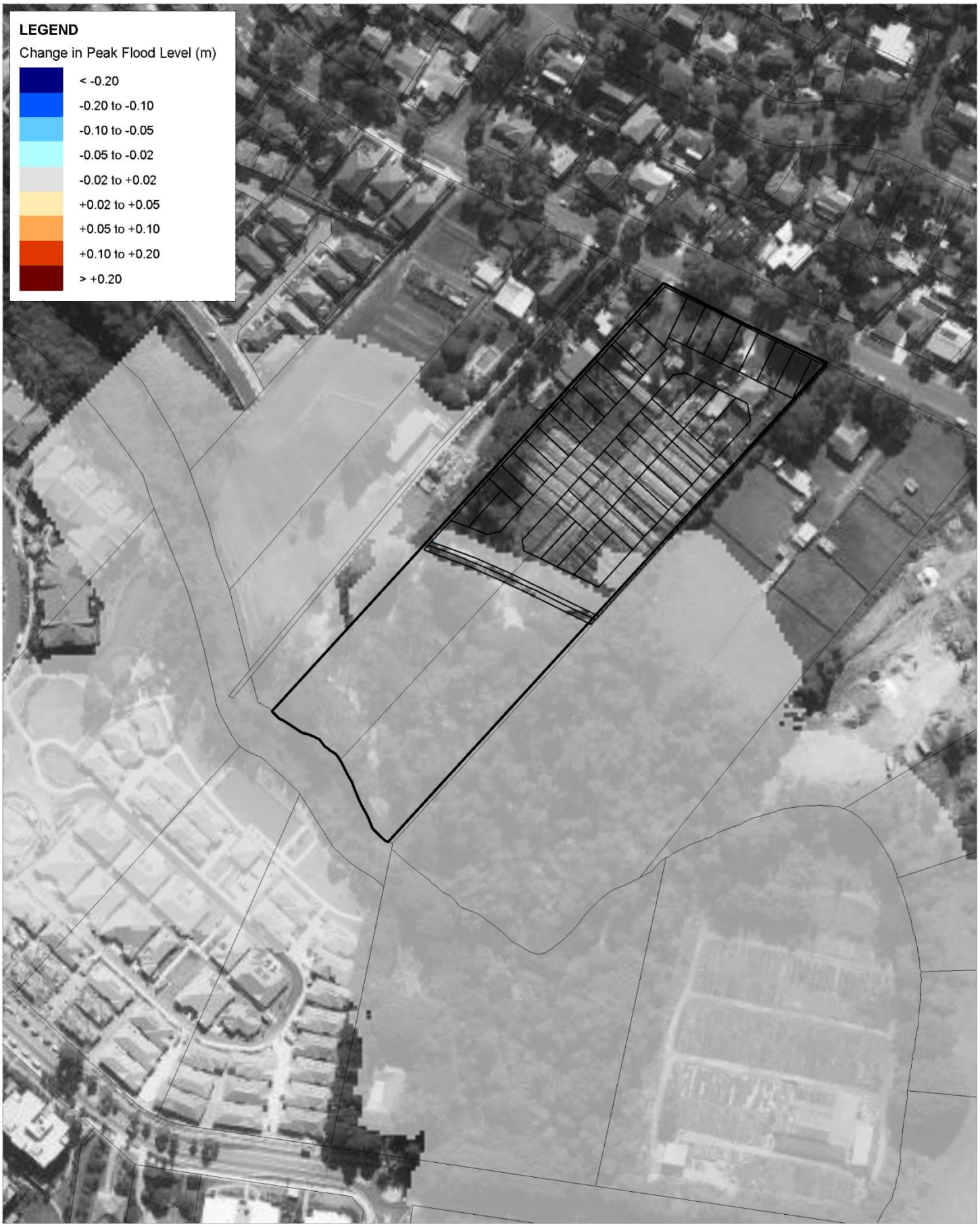
0 50 100m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_012_Level_Impact_1%AEPCC_DEV001a.WOR



Title:

Change in Peak Flood Levels at the PMF Event

Figure: 6

Rev: A

N

0 50 100m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_013_Level_Impact_PMF_DEV001a.WOR

1% AEP Event

The simulated 1% AEP post-development flood conditions are largely similar to the existing flood conditions in that floodwaters exceed the capacity of Narrabeen Creek and spill into the adjacent floodplain, inundating the southern portion of the site. As the proposed development does not encroach or modify the existing Narrabeen Creek channel or floodway alignments, there are no changes to the overall flow capacity of the channel. As noted above, the proposed earthworks include filling within the northern portion of the floodplain, along the northern fringe of inundation from Narrabeen Creek. The filling only encroaches on a small portion of flood storage within the northern floodplain and as such, the existing flood conditions are essentially preserved in the post-development modelling. This is evident in the flood impact mapping presented in Figure 4, whereby negligible changes to peak flood levels are demonstrated both upstream and downstream of the proposed development.

There are minor changes to the hydraulic categorisation during the post-development 1% AEP flood conditions. As shown in Figure B-6 in Appendix B – Post-Development Design Flood Behaviour, there is a slight increase in the area classed as floodway within the Narrabeen Creek alignment to the south of the development. There is no additional flood storage or flood fringe areas.

1% AEP Event +CC

At the 1% AEP+CC event, the modelled impact shows negligible change in the peak flood levels (<0.01 m) at the site as shown in Figure 5, as the majority of the proposed development remains outside of the flood extent (similar to the 1% AEP flood behaviour detailed above). Minor increases in peak flood levels are experienced downstream of the proposed development (< 0.01 m) as a result of the loss in flood storage and altered flood extent. The conveyance dominated system allows for minor changes to the local topography outside of the creek/floodway alignment without significant impacts to peak flood levels, despite minor reductions to the available flood storage volume on-site.

PMF Event

Flood impacts are not typically assessed at the PMF event, which is used principally to assess risk to life and flood emergency response requirements. However, the flood modelling indicates that the impacts of the proposed development on the PMF are negligible and do not adversely impact neighbouring properties, as shown in Figure 6. During the PMF event, the majority of the proposed development remains outside of the flood extent with the exception of the most south-eastern lot and the Lorikeet Grove roadway.

Planning Considerations

With regard to the aforementioned flood planning considerations applicable to the site, the flood impact assessment has shown that:

- There are no adverse flood impacts on surrounding properties or on flooding processes for any event up to the Probable Maximum Flood (PMF) event, other than a localised minor increase in peak flood levels of less than 0.01 m in the adjacent floodplain to the south of the proposed development and in the floodplain to the east,
- There is a slight decrease in the combined 1% AEP event flood storage volume as a result of the proposed earthworks. However, this slight reduction in storage volume has a negligible impact on simulated peak flood levels;

- The adopted Flood Planning Level (FPL) for the site was calculated by adding a 0.5m freeboard allowance to the simulated 1% AEP+CC existing peak flood level at location L2 at the upstream limit of the site (refer Table 1 and Figure 2). The adopted FPL for the site is 4.71 m AHD (4.21 m AHD + 0.5 m freeboard), and
- There are no flood prone lots (i.e. lots located below the FPL) created within the proposed development during the modelled planning events.

Flood Emergency Response

Given the small size of the upstream catchment there will be no flood warning available at the site. Therefore, people on-site will have to react and respond to flood events as and when they occur, which is similar for all other flood affected locations in the area. However, the proposed fill platform of the development means that flood inundation of the developed portion of the site is highly unlikely. From the range of design events considered within this assessment only the PMF event results in some flooding within the proposed development site. As demonstrated in Figure B-4, the vast majority of the lots and all of the likely building locations are flood-free at the PMF. The exception to this is the most south-eastern lot which results in some inundation during the PMF event, with up to 0.2 m of floodwater across the single lot.

During the PMF event, Lorikeet Grove is inundated to a depth of up to 0.6 m. This does not occur during the 1% AEP or 1% AEP+CC events. This may impact on the evacuation of residents in the southernmost lots facing Lorikeet Dr via vehicle during the PMF event, however, these lots largely remain flood free at the PMF and the increasing elevations toward Warriewood Road would provide an uphill evacuation route for any flood affected residents.

Conclusions

The objective of the study was to undertake a detailed flood impact assessment for a proposed development at 45-49 Warriewood Road, Warriewood.

Central to this was the development of a refined 2D TUFLOW model with a 2 m grid resolution. The boundary conditions for the refined model were based on the TUFLOW model (6 m grid resolution) of the Narrabeen Lagoon catchment developed as part of the Narrabeen Lagoon Flood Study (BMT WBM, 2013).

Specifically, the modelling undertaken for the proposed development aimed to:

- Confirm existing flooding conditions across the site, including flood levels, flows and velocities, to establish baseline conditions for impact assessment, and the flood planning requirements for the proposed development; and
- Identify the potential flood impacts of the proposed development over a range of design flood magnitudes.

The results of the modelling and flood impact assessment have confirmed:

- There are negligible adverse flood impacts on surrounding properties or on flooding processes for any event up to the Probable Maximum Flood (PMF) event;
- No additional flood prone lots are created within the proposed subdivision; and

- All lots, apart from the south eastern corner lot, are flood-free at the PMF event.

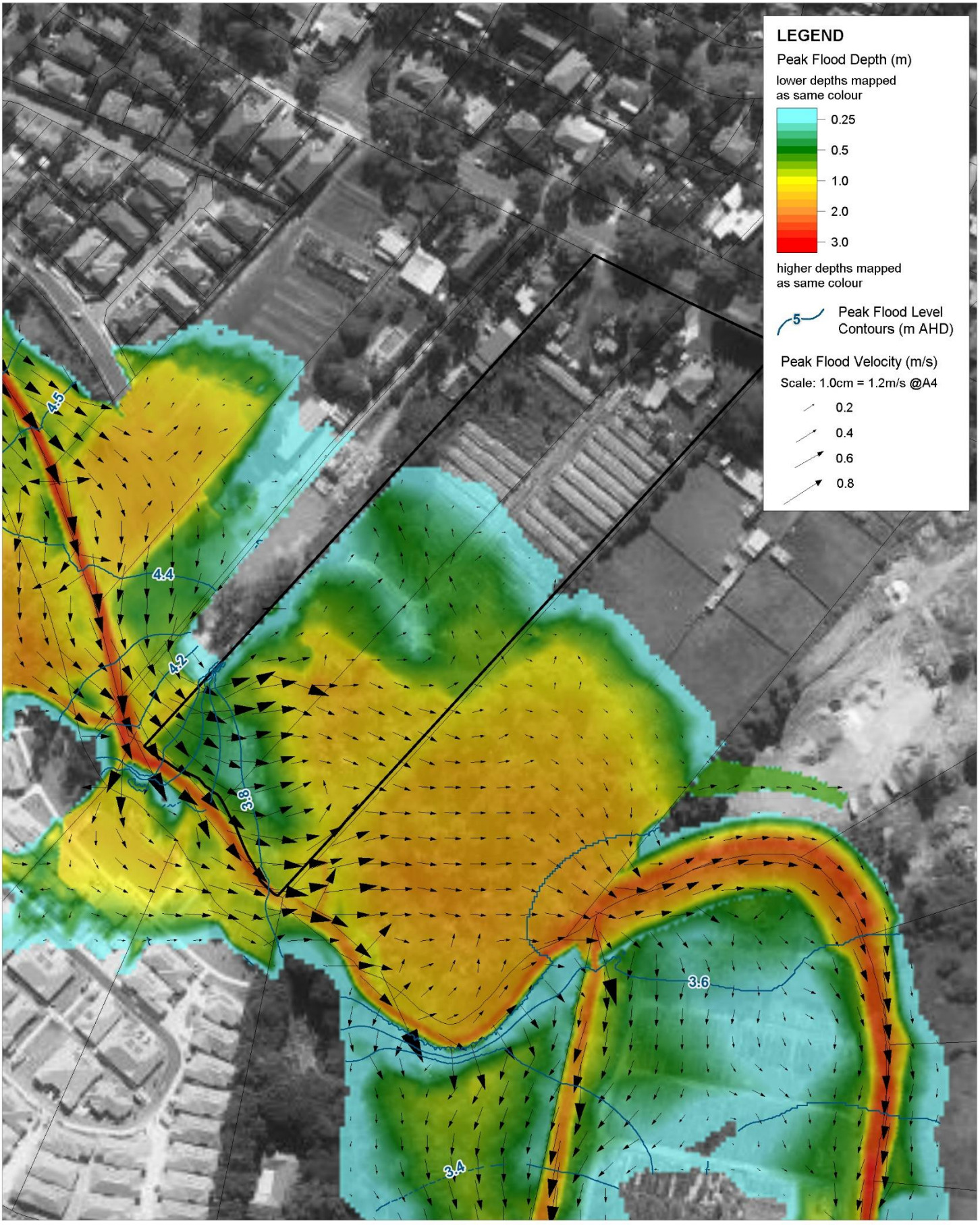
The proposed development does encroach on the 1% AEP flood storage area and results in a minor decrease in the overall 1% AEP flood storage volume on the site. However, the model results show that this minor loss of flood storage does not result in peak flood level impacts on surrounding properties.

We trust the above information satisfies your requirements. Please do not hesitate to contact the undersigned if further information is required.

Yours Faithfully
BMT WBM

Joshua Eggleton
Senior Environmental Engineer

Appendix A – Baseline/Existing Design Flood Behaviour



Title:

Existing 1% AEP Modelled Peak Flood Conditions

Figure: **A-1**

Rev: **A**

N

0 m 37.5 m 75 m

Approx. Scale

BMT

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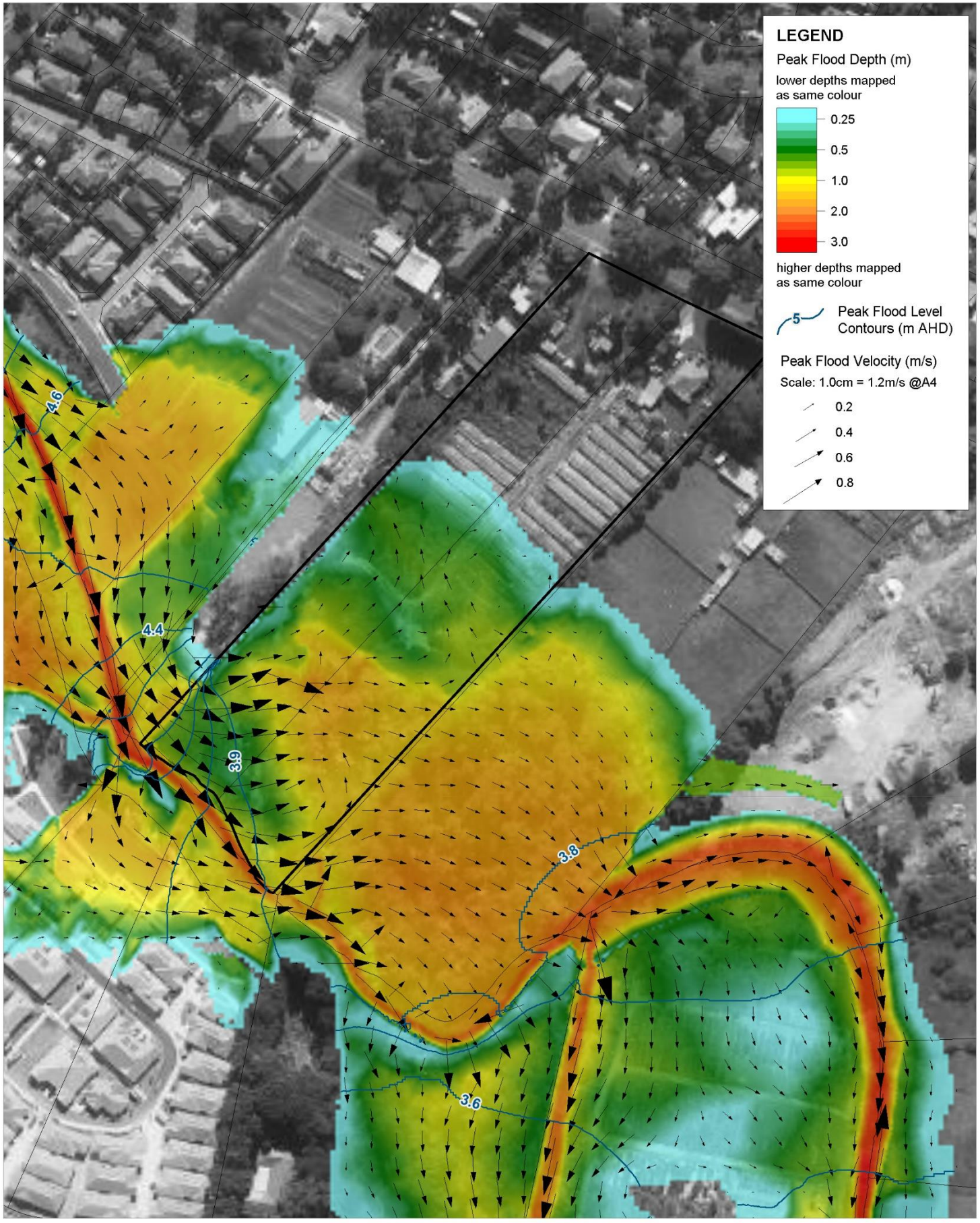
Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_003_100y_EXG001.WOR



Title:

Existing 1% AEP + 2100 Sea Level Rise + 30% Increase Rainfall Intensity Modelled Peak Flood Conditions

Figure: **A-2**

Rev: **A**

N

0 m 37.5 m 75 m

Approx. Scale

BMT

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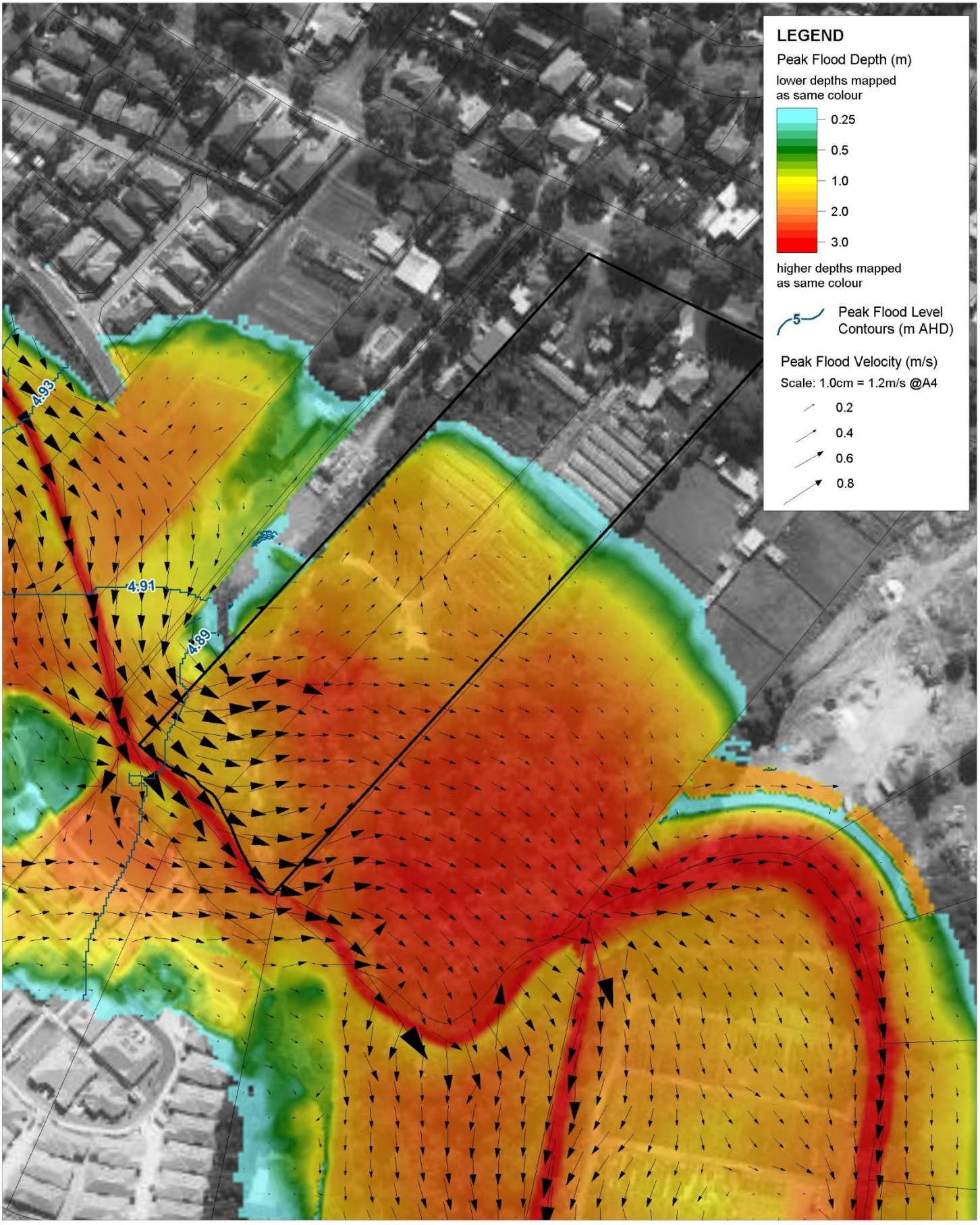


Title:

Existing PMF Modelled Peak Flood Conditions

Figure: **A-3**

Rev: **A**

N

0 m 37.5 m 75 m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_007_PMF_EXG001.WOR

Title:
Existing 1% AEP Hydraulic Categories

Figure: **A-4**

Rev: **A**

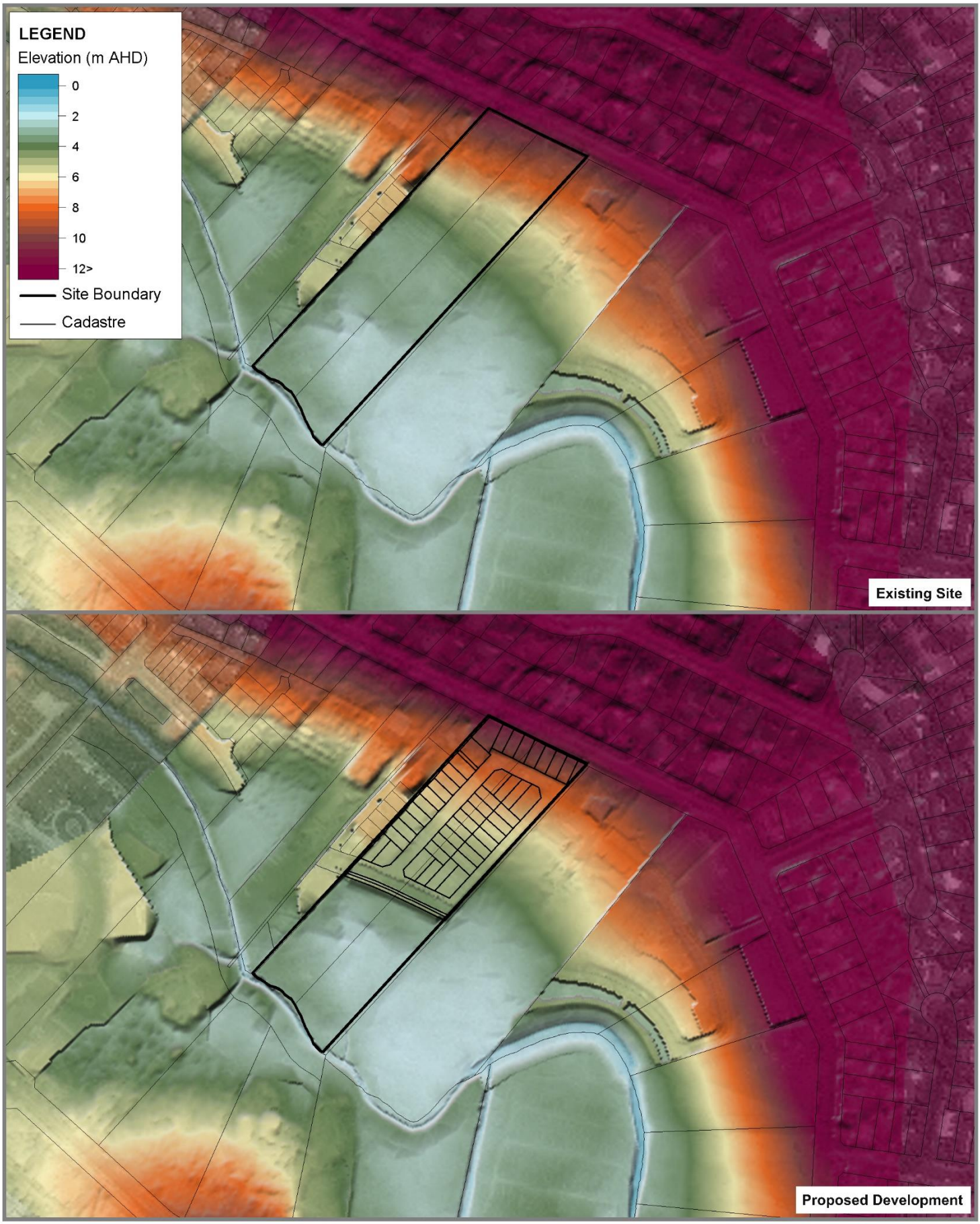
N

0 m 37.5 m 75 m
Approx. Scale

BMT
www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_009_HydCat_1%AEP_EXG001

Appendix B – Post-Development Design Flood Behaviour



Title:
Comparison of Pre and Post-Development Topography

Figure: **B-1**

Rev: **A**

N

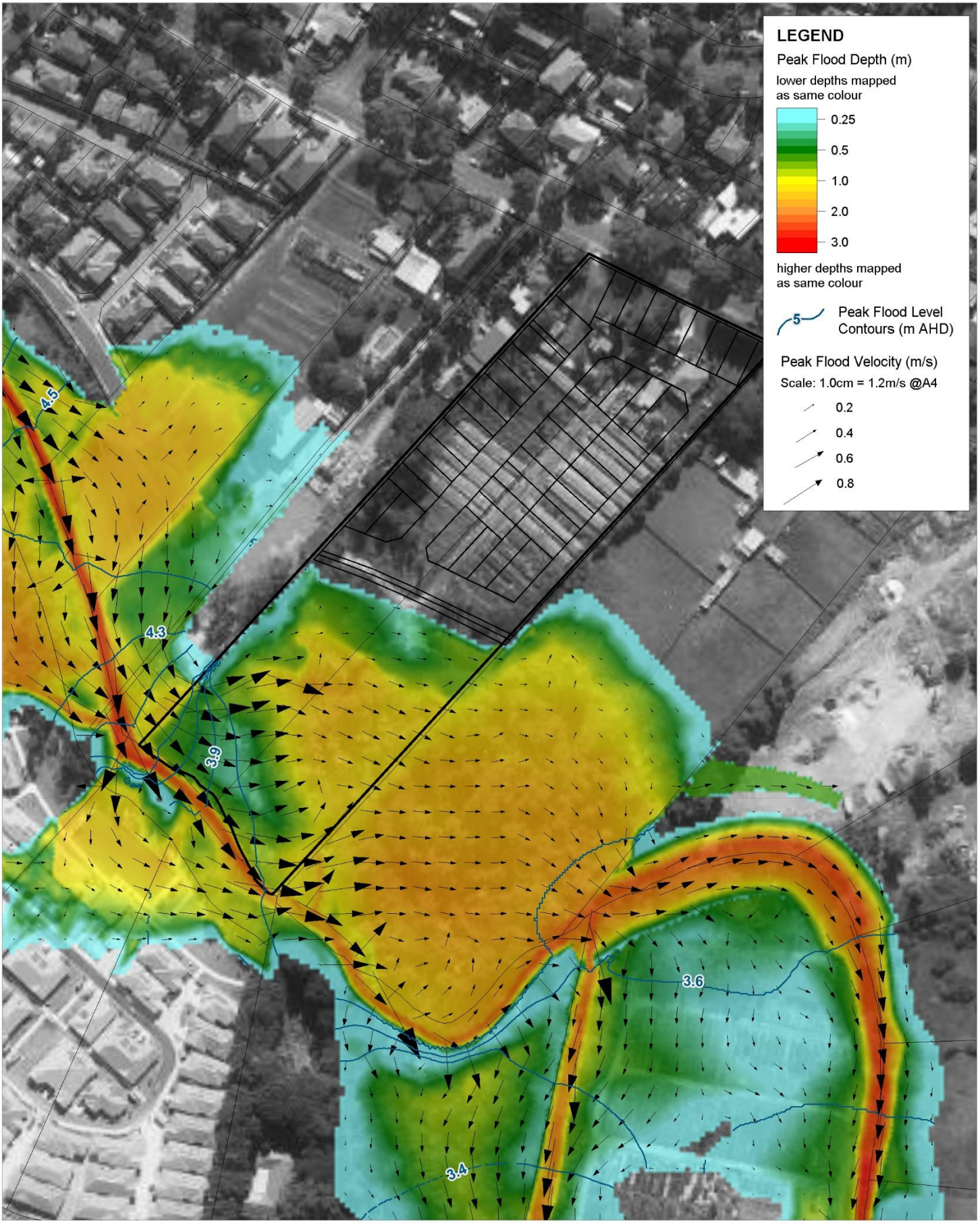
0 75 150m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\DRG_012_DEM_EXG&DEV.WOR



Title:

Post Development 1% AEP Modelled Peak Flood Conditions

Figure: **B-2**

Rev: **A**

N

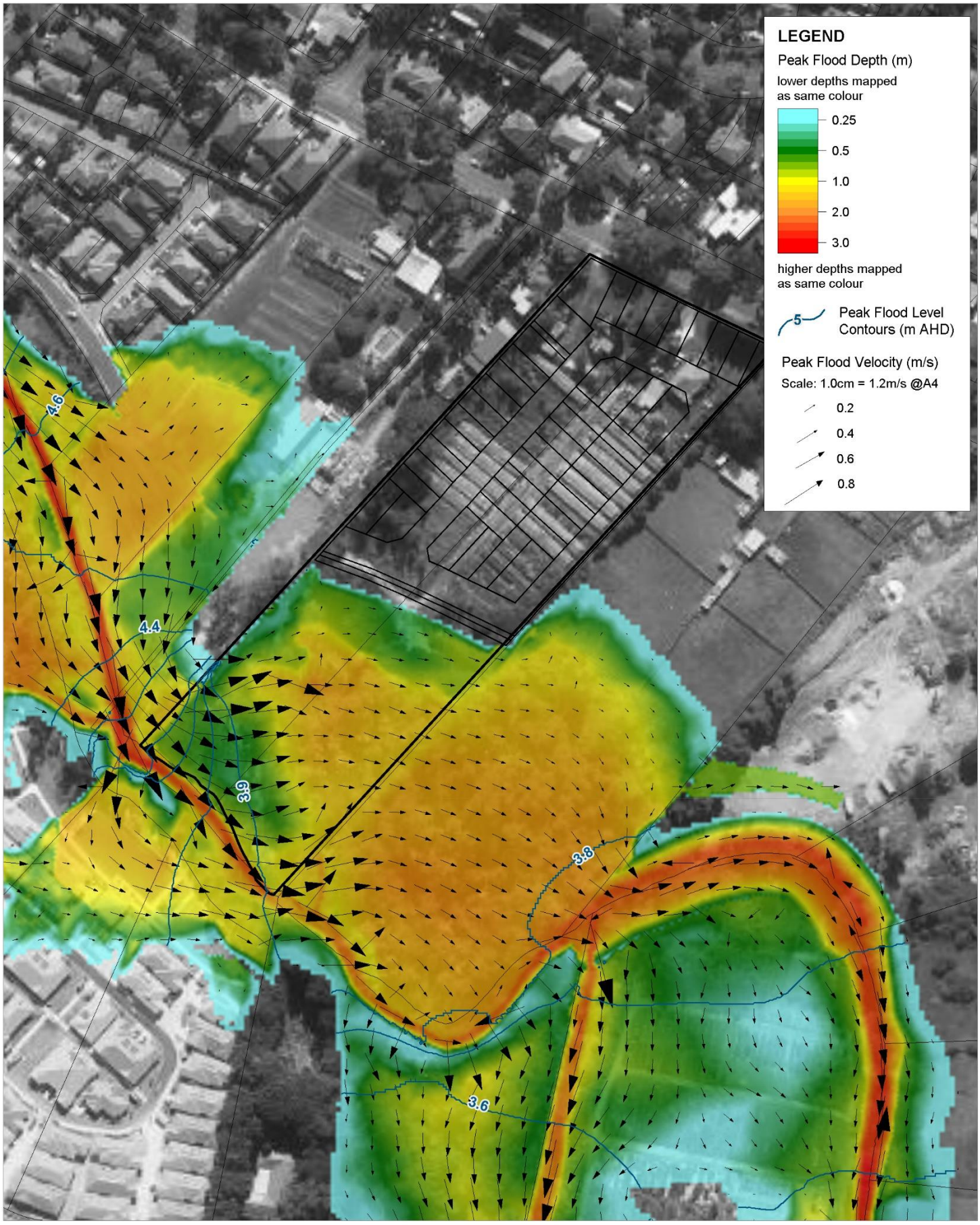
0 m 37.5 m 75 m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_016_100y_DEV001a.WOR



Title:

Post Development 1% AEP + 2100 Sea Level Rise + 30% Increase Rainfall Intensity Modelled Peak Flood Conditions

Figure: **B-3**

Rev: **A**

N

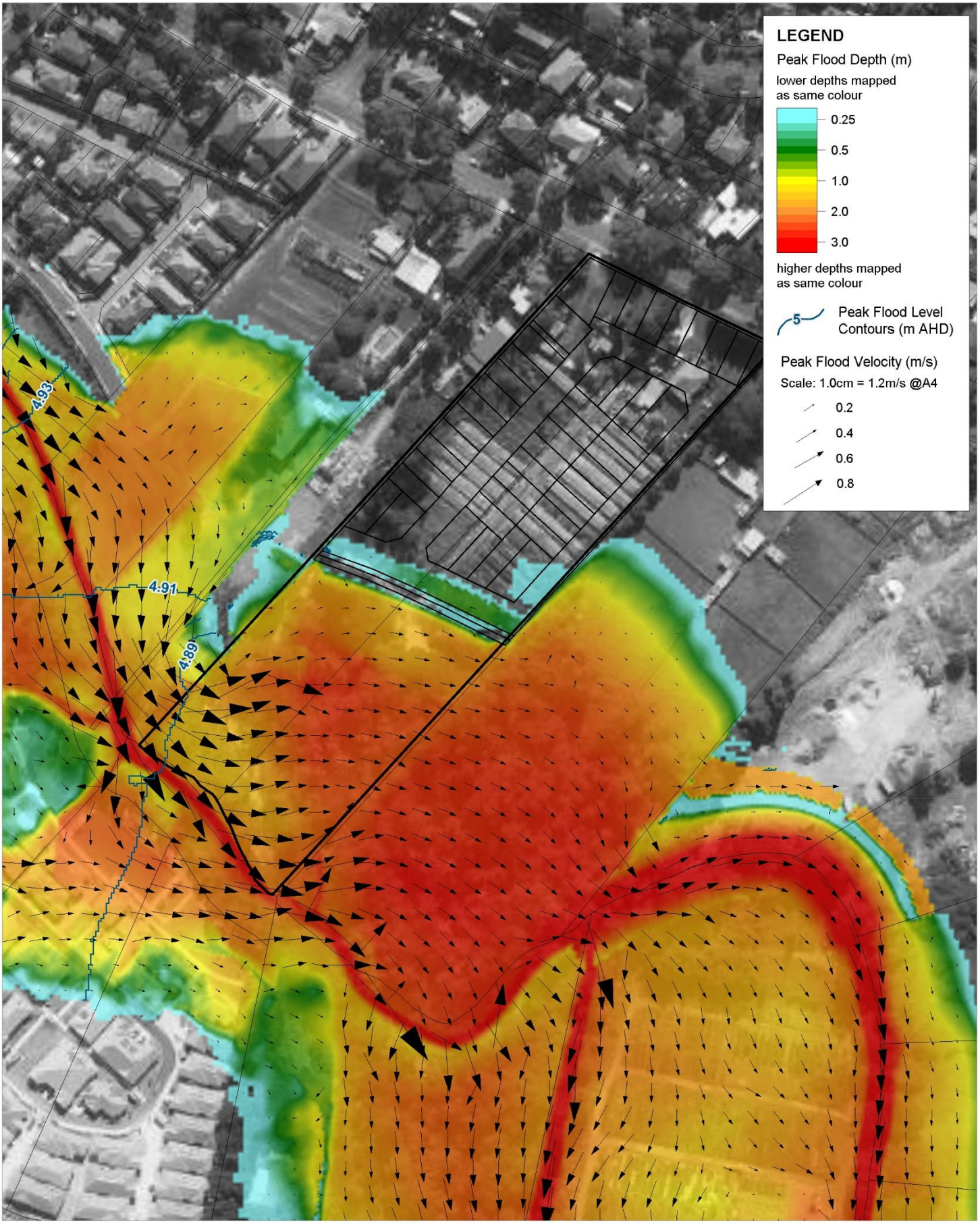
0 m 37.5 m 75 m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_014_100y+CC_DEV001a.WOR



Title:

Post Development PMF Modelled Peak Flood Conditions

Figure: **B-4**

Rev: **A**

N

0 m 37.5 m 75 m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_015_PMF_DEV001a.WOR

Title:

Post Development 1% AEP Hydraulic Categories

Figure: **B-5**

Rev: **A**

N

0 m 37.5 m 75 m

Approx. Scale

BMT

www.bmt.org

Filepath: K:\N20951_45WarriewoodRd_FIA\MapInfo\Workspaces\Figures\DRG_018_HydCat_1%AEP_DEV001a.WOR

APPENDIX E

STORMWATER MAINTENANCE SCHEDULE

MAINTENANCE SCHEDULE

FOR

STORMWATER DRAINAGE, ON-SITE STORMWATER DETENTION SYSTEMS AND STORMWATER TREATMENT DEVICE

45-49 WARRIEWOOD RD, WARRIEWOOD

REVISION B

MARCH 2020

C&M Consulting Engineers Pty Ltd
Suite 26, 11-13 Brookhollow Ave, NSW, 2153
P (02) 9680 3100 F (02) 9634 6989

PROPERTY DETAILS

Property Address: 45-49 Warriewood Rd, Warriewood

Development: Residential Development

DOCUMENT CERTIFICATION

Document prepared by:

EDWARD SHIN
Civil Engineer – Director
B.E.(Civil) , MIEAust, CPEng,
RPEQ, NER (Civil)

DISCLAIMER

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DOCUMENT CONTROL

REVISION	ISSUE DATE	ISSUED TO	ISSUED FOR
A	March 2020	Northern Beaches Council	DA Application

MAINTENANCE SCHEDULE FOR STORMWATER DRAINAGE, ON-SITE STORMWATER DETENTION SYSTEMS AND STORMWATER TREATMENT DEVICE AT:

45-49 WARRIEWOOD RD, WARRIEWOOD

INTRODUCTION

The following Maintenance Schedule has been prepared to provide advice to the owners, occupiers and strata manager of 45-49 Warriewood Rd, Warriewood, to assist them with maintaining the Stormwater Drainage, On-site Stormwater Detention System and Stormwater Treatment Device installed at this property to ensure the systems operates properly for a long term.

DESCRIPTION OF STORMWATER DRAINAGE AND ON-SITE STORMWATER DETENTION SYSTEM AT THIS SITE

Stormwater at the site is collected by a system of roof drains, downpipes, grated drains and pits which direct stormwater away from the site.

The roof is drained via roof drains and downpipes. The ground/site areas are drained by a conventional drainage system consisting of a series of pits, pipes and subsoil drains.

All the pits have installed with 'Oceanguard'. Oceanguards will trap silt and debris that enter the stormwater system.

The drainage systems are connected to common on-site stormwater detention (OSD) system in a form of underground tank located under the main entry road.

The OSD system then discharge to an infiltration basin located on the southern side of Lorikeet Grove, where secondary treatment of runoff occurs before discharging to Narrabeen Creek. The system has been designed to remove the majority of the suspended sediments, nutrients and oils and hydrocarbons that may be present in the stormwater.

ROUTINE MAINTENANCE REQUIRED

To ensure the long-term working order of the stormwater drainage, on-site detention systems and water quality control devices, it is important that the systems are regularly inspected approximately every six (6) months AND after any heavy rainfall. If something looks extraordinary, you are not sure if it has been damaged or is working properly, then we recommend that you contact a Licensed Plumber to inspect the drainage system.

Important – The on-site stormwater detention tank and the pits are classified as a "Confined Space" in accordance with the Work Cover Authority of NSW Occupational Health & Safety Regulation 2001. Entry to the confined space must be conducted strictly in accordance with the requirements of "Division 9 – Working in Confined Spaces" of the Work Cover Authority of NSW Occupational Health & Safety Regulation 2001.

The checklist in Appendix C should be used for each maintenance. A copy of the completed checklist should be kept as a record of the maintenance work carried out.

APPENDIX A

CIVIL ENGINEERING DRAWINGS (WORK AS CONSTRUCTED)

(TO BE PROVIDED AFTER CONSTRUCTION)

APPENDIX B

OCEANGUARD OPERATIONS AND MAINTENANCE

OCEAN PROTECT

OceanGuard™

Operations & Maintenance Manual

Table of Contents

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes as recommended by the manufacturer.

The OceanGuard technology is a gully pit basket designed to fit within new and existing gully pits to remove pollution from stormwater runoff. The system has a choice of Filtration liners, designed to remove gross pollutants, total suspended solids and attached pollutants as either a standalone technology or as part of a treatment train with our StormFilter or Jellyfish Filtration products. OceanGuard pit baskets are highly effective, easy to install and simple to maintain.

Why do I need to perform maintenance?

Adhering to the maintenance schedule of each stormwater treatment device is essential to ensuring that it functions properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up), but most of all ensures the long term effective operation of the OceanGuard.

Health and Safety

Access to pits containing an OceanGuard typically requires removing (heavy) access covers/grates, but typically it is not necessary to enter into a confined space. Pollutants collected by the OceanGuard will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or sharp objects such as broken glass and syringes. For these reasons, there should be no primary contact with the waste collect and all aspects of maintaining and cleaning your OceanGuard require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel, as a result it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the OceanGuard pit insert, precautions should be taken in order to minimise (or when possible prevent) contact with sediment and other captured pollutants by maintenance personnel. In order to achieve this the following personal protective equipment (PPE) is recommended:

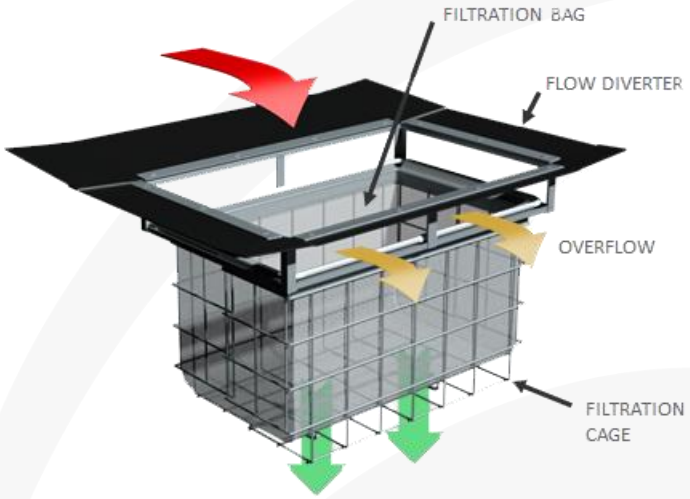
- Puncture resistant gloves
- Steel capped safety boots,
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

The OceanGuard pit insert is designed to be maintained from surface level, without the need to enter the pit. However depending on the installation configuration, location and site specific maintenance requirements it may be necessary to enter a confined space occasionally. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification for confined space entry.

How does it Work?

OceanGuard is designed to intercept stormwater as it enters the stormwater pits throughout a site. The OceanGuard has diversion panels that sit flush with the pit walls, this ensures that as stormwater enters at the top of the pit it is directed to the middle of the insert where the Filtration bag is situated. The filtration bag allows for screening to occur removing 100% of pollutants greater than the opening of the filtration material (200micron, 1600micron bags available).



During larger rain events the large flows overflow slots in the flow diverter of the OceanGuard ensure that the conveyance of stormwater is not impeded thus eliminating the potential for surface flooding. As the flow subsides, the captured pollutants are held in the OceanGuard Filtration bag dry. The waste then starts to dry which reduces the magnitude of organic material decomposition transitioning between maintenance intervals.

Maintenance Procedures

To ensure that each OceanGuard pit insert achieves optimal performance, it is advisable that regular maintenance is performed. Typically the OceanGuard requires 2-4 minor services annually, pending the outcome of these inspections additional maintenance servicing may be required.

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the OceanGuard.

	Description of Typical Activities	Frequency
Minor Service	Filter bag inspection and evaluation Removal of capture pollutants Disposal of material	2-4 Times Annually
Major Service	Filter Bag Replacement Support frame rectification	As required

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Minor Service

This service is designed to return the OceanGuard device back to optimal operating performance. This type of service can be undertaken either by hand or with the assistance of a Vacuum unit.

Hand Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Use two lifting hooks to remove the filtration bag
4. Empty the contents of the filtration bag into a disposal container
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Vacuum Maintenance

1. Establish a safe working area around the pit insert
2. Remove access cover/grate
3. Vacuum captured pollutants from the filtration bag
4. Remove filtration bag
5. Inspect and evaluate the filtration bag
6. Inspect and evaluate remaining OceanGuard components (i.e. flow diverter, filtration cage and supporting frame)
7. Rejuvenate filtration bag by removing pollutant build up with a stiff brush, additionally the filtration bag can be washed using high pressure water
8. Re-install filtration bag and replace access cover/grate

Major Service (Filter Bag Replacement)

For the OceanGuard system, a major service is a reactionary process based on the outcomes from the minor service.

Trigger Event from Minor Service	Maintenance Action
Filtration bag inspection reveals damage	Replace the filtration bag[1]
Component inspection reveals damage	Perform rectification works and if necessary replace components[1]

[1] Replacement filtration bags and components are available for purchase from Ocean Protect.

Additional Reasons of Maintenance

Occasionally, events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, all OceanGuard pits that potentially received flow should be inspected and cleaned. Specifically all captured pollutants from within the filtration bag should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event. All filtration bags should be rejuvenated (replaced if required) and re-installed.

Blockages

The OceanGuards internal high flow bypass functionality is designed to minimise the potential of blockages/flooding. In the unlikely event that flooding occurs around the stormwater pit the following steps should be undertaken to assist in diagnosing the issue and implementing the appropriate response.

1. Inspect the OceanGuard flow diverter, ensuring that they are free of debris and pollutants
2. Perform a minor service on the OceanGuard
3. Remove the OceanGuard insert to access the pit and inspect both the inlet and outlet pipes, ensuring they are free of debris and pollutants

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the OceanGuard pit insert after a major storm event. The inspection should focus on checking for damage and higher than normal sediment accumulation that may result from localised erosion. Where necessary damaged components should be replaced and accumulated pollutants disposed.

Disposal of Waste Materials

The accumulated pollutants found in the OceanGuard must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the filtration bag has been contaminated with any unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our OceanGuard system we offer long term pay-as-you-go contracts, pre-paid once off servicing and replacement filter bags.

For more information please visit www.OceanProtect.com.au

APPENDIX C

STORMWATER DRAINAGE MAINTENANCE CHECKLIST

STORMWATER DRAINAGE MAINTENANCE CHECKLIST

**(COPY AND COMPLETE THIS CHECKLIST FOR EVERY MAINTENANCE CHECK –
KEEP A COPY OF THE COMPLETED CHECKLIST ON FILE AS A RECORD OF MAINTENANCE)**

Location: 45-49 Warriewood Rd, Warriewood

Inspected By: _____ Date of Visit: _____

Estimated Time Since Last Inspection: _____ (Months) Weather Conditions: _____

INSPECTION ITEM	Frequency	Responsibility	ACTION REQUIRED			ACTION COMPLETED BY	
			Y	N	DETAILS	SIGNATURE	DATE
Stormwater Pits							
Is litter or debris present within the pit?	6 Monthly or after a major storm	Owner / Maintenance Contractor			Remove litter and debris and dispose of lawfully		
Is the grate/cover fixed correctly to the stormwater pit?	6 Monthly or after a major storm	Owner / Maintenance Contractor			Repair fixings		
Is the grate/cover damaged?	6 Monthly or after a major storm	Owner / Maintenance Contractor			Replace or repair grate/cover		

INSPECTION ITEM	Frequency	Responsibility	ACTION REQUIRED			ACTION COMPLETED BY	
			Y	N	DETAILS	SIGNATURE	DATE
On-site Stormwater Detention System(s)							
Check that all detention areas and/or structures are clear of any debris and leaf litter.	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean as required		
Check that all grates are clear of any debris and leaf litter	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean as required		
Remove screen over the outlet and ensure that there is no blockage or damage to the steel orifice plate	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean and repair as required		
Remove screen over the outlet and ensure that the orifice plate is mounted securely	6 Monthly or after a major storm	Owner / Maintenance Contractor			Tighten fixings and seal any gaps as required		
Inspect screen for damage and corrosion or rusting, clean screen and re-install ensuring that the screen is correctly positioned and secure	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean, repair and replace screen as required		

INSPECTION ITEM	Frequency	Responsibility	ACTION REQUIRED			ACTION COMPLETED BY	
			Y	N	DETAILS	SIGNATURE	DATE
Inspect the weir ensure that it is clear of any debris and leaf litter	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean as required		
Inspect the discharge control pit walls for any cracking or spalling	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean and repair as required		
Inspect the outlet pipe from the discharge control pit (behind the orifice plate)	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean and remove any blockage as required		
Inspect step irons for corrosion or rusting	6 Monthly or after a major storm	Owner / Maintenance Contractor			Repair and replace as required		
Inspect step irons to see if fixings are secure	6 Monthly or after a major storm	Owner / Maintenance Contractor			Repair and replace as required		
Inspect the return pit or storage walls for any cracking or spalling and sediment or sludge build-up	6 Monthly or after a major storm	Owner / Maintenance Contractor			Clean and repair as required		
Inspect storages for subsidence (especially near pits or grates)	6 Monthly or after a major storm	Owner / Maintenance Contractor			Repair as required		
Inspect and test pumps in rainwater holding component of the tank to ensure they are working correctly and service as required	6 Monthly or after a major storm	Owner / Maintenance Contractor			Remove any silt, litter or debris from around the pump inlet		

INSPECTION ITEM	Frequency	Responsibility	ACTION REQUIRED			ACTION COMPLETED BY	
			Y	N	DETAILS	SIGNATURE	DATE
Infiltration System							
Inspect headwall (at the basin inlets) for litter and debris	6 Monthly or after a major storm	Maintenance Contractor			Remove litter and debris and dispose of lawfully		
Inspect rock rip-rap and scour protection at headwalls to ensure that rocks have not been displaced	6 Monthly or after a major storm	Maintenance Contractor			Replace and reset rocks as required		
Inspect infiltration basin spillway to ensure that the rocks have not been displaced	6 Monthly or after a major storm	Maintenance Contractor			Replace and reset rocks as required		
Inspect for sediment build up on the surface of the basin that may be preventing filtration or plant growth	6 Monthly or after a major storm	Maintenance Contractor			Remove the sediment as required and dispose of lawfully		
Inspect for erosion of the basin surface	6 Monthly or after a major storm	Maintenance Contractor			Replace eroded material and replant as required		
Inspect for damaged or dead plants	6 Monthly or after a major storm	Maintenance Contractor			Remove and replant as required		

INSPECTION ITEM	Frequency	Responsibility	ACTION REQUIRED			ACTION COMPLETED BY	
			Y	N	DETAILS	SIGNATURE	DATE
Inspect for weeds	6 Monthly or after a major storm	Maintenance Contractor			Remove as required		
Inspect for overgown vegetation that may tend to clog the filter media,	6 Monthly or after a major storm	Maintenance Contractor			Mow or slash grass and vegetation as required		
Comments or Recommendations							