

CIVIL ENGINEERING SERVICES

Northside Private Hospital, Gosford Development Application (DA) Report Civil and Stormwater Design



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APPROVALS

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CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Warren Smith and Partners (WS+P) has been engaged by Donald Cant Watts Corke (DCWC) to prepare a Development Application (DA) report for the proposed development of a new private hospital on an existing greenfield site. This report aims to address the following:-

- Proposed Site Levels;
- Bulk Earthworks;
- On-Site Detention (OSD) System and Proposed Stormwater Drainage System;
- Proposed Connection to Existing Stormwater Infrastructure;
- Water Sensitive Urban Design (WSUD) Requirements, and;
- Sediment and Erosion Control.

1.1 BACKGROUND

The proposed development is located in Gosford, approximately 75km north of the Sydney CBD. The site is bound by Racecourse Road on the north-eastern side and Faunce Street West on the south side. Please refer to Figure 1.1 for an aerial view of the proposed development site.



Figure 1.1: Aerial View of Proposed Development Site Area (Source: Six Maps)

■ Hydraulic Services ■ Fire Protection ■ Civil Engineering ■ Sydney Water Accredited Water Servicing Co-ordinator - Design Project Management - Building Plan Approvals

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The site will see the construction of a new private hospital with the following functions:-

- 14 Operating Theatres;
- 14 ICU Bays;
- 4 Levels of IPU Wards containing 56 beds each;
- Carparking for approximately 400 cars;
- Hospital Front of House, and;
- Hospital Back of House.

2. ABBREVIATIONS AND DEFINITIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
CCC	Central Coast Council
DN	Diameter Nominal (mm)
EY	Exceedances per Year
GPT	Gross Pollutant Trap
IFD	Intensity-Frequency-Duration
IL	Invert Level
L/s	Litres per second
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Detention
PSD	Permissible Site Discharge
RCP	Reinforced Concrete Pipe
RL	Reduced Level
RWT	Rainwater Reuse Tank
WS+P	Warren Smith and Partners
WSUD	Water Sensitive Urban Design

The Use of Must, Shall & Should:

In accordance with the International Organisation for Standardisation (ISO) Directives, the word “shall” is used to state that a requirement is strictly to be followed in order to conform to a Performance Requirement. Consequently, there can be no deviation from that requirement, other than a specific tolerance.

It is noted that in legislation and specifications it is common to use the word “must” to express a requirement. The word “shall” in this document should be considered as equivalent to “must” in the legislation.

The word “should” introduces a suggestion or recommendation that is not a requirement. It is not necessary that such recommendations or suggestions be followed in order to comply with the Performance Requirement.

3. EXISTING STORMWATER DRAINAGE

3.1 EXISTING DRAINAGE INFRASTRUCTURE

A desktop review and site inspection were carried out by WS+P to determine the existing drainage infrastructure within the development site. The inspection and desktop review revealed the following:-

- The existing site grades from approximately 3.8% to 12% in a north-easterly direction across the site;
- There are four (4) stormwater kerb inlet pits located on Faunce Street West, two (2) kerb inlet pits located on Racecourse Road and a number of stormwater pits located within the private road on the east side of the proposed development, and;
- There is one (1) DN450 stormwater line that traverses the site from Faunce Street West immediately north of the proposed development prior to connecting into an existing stormwater pit on the Racecourse Road.

Please refer to Figure 3.1 for an illustration of the site grading and the location of the existing stormwater infrastructure.

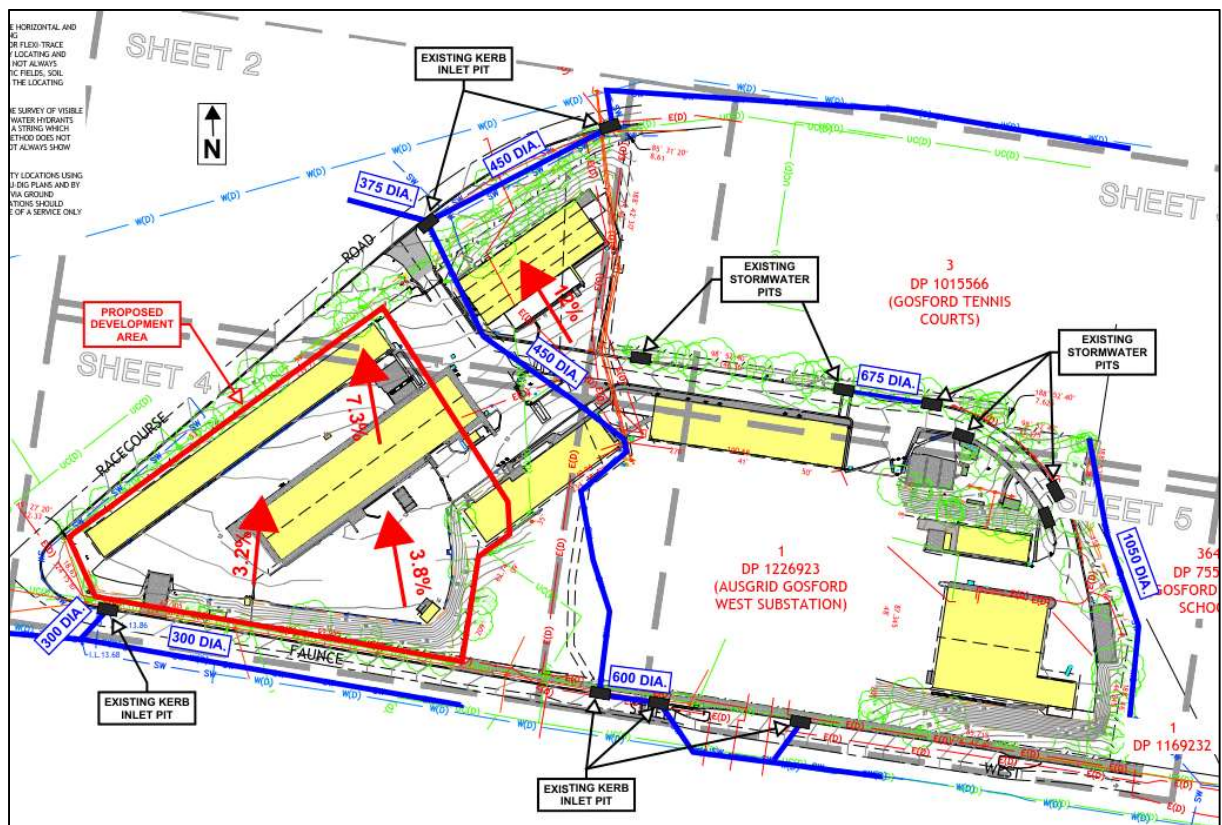


Figure 3.1: Aerial View of Existing Site and Drainage Infrastructure

4. AUTHORITY AND REGULATORY REQUIREMENTS

With reference to the following documents, the Council requirements are as outlined in the sub-sections below:-

- Central Coast Council's Gosford Development Control Plan 2013, Part 6.7 Water Cycle Management, and;
- Gosford City Council Water Cycle Management Guidelines, dated February 2007.

STORMWATER DRAINAGE AND ON SITE DETENTION (OSD) REQUIREMENTS

- Post development discharge flows are to be maintained at pre-development discharge flows for all storm events up to, and including, the 1% AEP storm event;
- The pre-development discharge flows are to be calculated based on a pervious fraction of 100%;
- The stormwater management design shall demonstrate a consideration for the existing capacity of the public drainage system;
- All stormwater runoff is to be controlled so that it causes no nuisance or concentration of flow to watercourses or neighbouring properties;
- A maximum of 50% of the volume of the stormwater retention tank/s can be claimed as part of the OSD volume;
- The maximum permissible site discharge to kerb and gutter shall not exceed 30L/s;
- Overland flows shall not exceed 0.5m³/s, and shall not be greater than 0.3m in depth, in the 1% AEP storm event, and;
- A minimum blockage factor of 50% shall be applied to all stormwater drainage as part of the hydraulic calculations.

4.1 FREEBOARD REQUIREMENTS

- Floor levels, whether habitable or non-habitable, for emergency facilities are to be set at, or above, the PMF flood level;
- All access roads, driveways and external parking areas are to be set at, or above, the PMF flood level to provide the ability to safely receive and evacuate occupants or contents without having to cross floodwaters, assuming 50% blockage of the stormwater drainage system;

4.2 WATER SENSITIVE URBAN DESIGN (WSUD) REQUIREMENTS

- At least 90% of the total roof area is to discharge to the rainwater tank, and;
- A minimum stormwater retention volume of 20m³ for 'High Density Developments', as specified in Appendix A of the Gosford City Council Water Cycle Management Guidelines, shall be provided for the proposed development.

Refer to Table 4.1 for the stormwater quality reduction targets to be achieved for the proposed site.

Table 4.1: WSUD Stormwater Quality Reduction Targets

Pollutant Type	Reduction Target (%)
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%

5. PROPOSED STORMWATER DESIGN

The total site development area is 1.2574 Ha. A breakdown of the proposed development area is presented in Table 5.1.

Table 5.1: Breakdown of Proposed Development Site Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
Roof to RWT	0.7591	-	0.7591
Ground to OSD Tank	0.2350	0.0945	0.3295
To Hydraulic System	0.0999	0.0240	0.1239
Bypass	0.0449	0.000	0.0449
Total Area (Ha)	1.1389	0.1185	1.2574

Central Coast Council requires that the runoff from the developed site must not exceed the runoff from the total site area prior to development for all storm events up to, and including, the 1% AEP storm event.

To satisfy the above condition, it is proposed that one (1) OSD tank be installed within the development area which shall provide sufficient storage to limit the discharge from the development as required. It is proposed that a pit and pipe system be installed throughout the proposed development to capture the majority of the rainfall runoff and reticulate it to the OSD tank which shall be located in Basement 1 to the north-eastern side of the site.

It is also proposed that a 40kL RWT be installed within the development site to collect roof water and reuse it for irrigation and WC flushing purposes. The RWT shall be located within the building.

Please refer to Figure 5.1 for an illustration of the proposed stormwater and OSD systems.

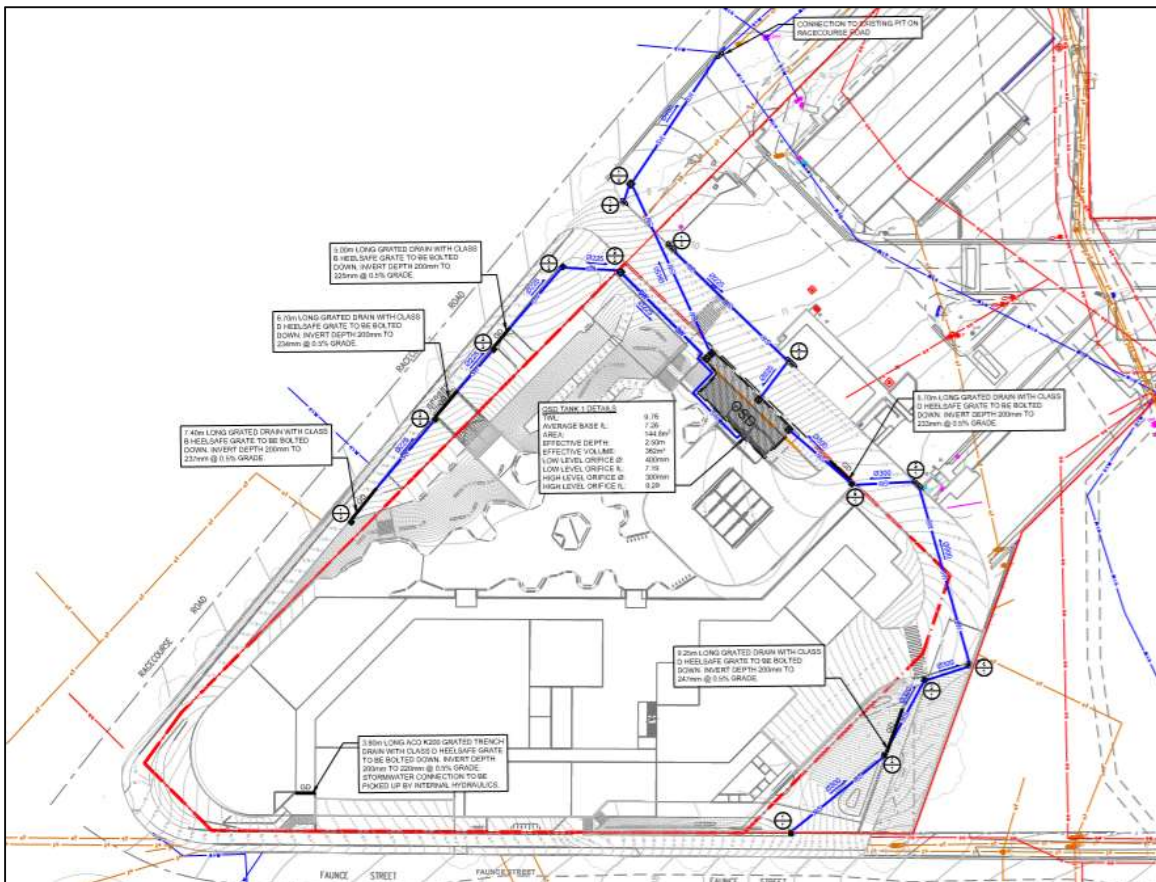


Figure 5.1: Proposed Stormwater Drainage Layout

5.1 ON-SITE DETENTION SYSTEM

5.1.1 DRAINS INPUT PARAMETERS

The drainage system shall be modelled utilising DRAINS to ensure the system is designed to meet Council's stormwater requirements. DRAINS is a stormwater drainage design and analysis program which performs hydraulic grade line analysis and generates the flows which would occur for a particular AEP storm event.

The catchment characteristic factor values which have been used in the DRAINS model are summarised below:-

- Paved (impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Soil Type - Normal 3.0
- Antecedent Moisture Condition (AMC) 3.0
- Minimum Pit Freeboard 150mm
- Blockage Factor for On-Grade Pits 50%
- Blockage Factor for Sag Pits 50%

Please refer to Table 5.2 for the OSD tank details.

Table 5.2: OSD Tank Details

Item	Detail
Total Catchment Area Draining to the OSD Tank (Ha)	1.2125 Ha
Percentage of Catchment Area Bypassing OSD Tank (%)	3.57%
Average Base IL of OSD Tank (RL mAHD)	7.26 mAHD
Low Level Orifice Diameter (mm)	400 mm
Low Level Outlet Pipe Diameter (mm)	450 mm
High Level Orifice Diameter (mm)	300mm
High Level Outlet Pipe Diameter (mm)	300 mm
OSD Top Water Level (RL mAHD)	9.76
Calculated OSD Tank Volume Effective (m ³)	362 m ³
50% of Stormwater Retention Volume (m ³)	20 m ³
Recalculated OSD Tank Volume Required (m ³)	342 m ³

5.2 RESULTS

The development area's OSD tank has been designed to ensure that the post development stormwater runoff from the site does not exceed the pre-development runoff which emanates from the site for all storm events up to, and including, the 1% AEP storm event. The pre-development case was modelled assuming an impervious fraction of 0%, in line with Central Coast Council's requirements.

Please refer to Table 5.3 for the development area's site discharge results.

Table 5.3: Development area's site discharge results.

Scenario	20% AEP Storm Event (L/s)	10% AEP Storm Event (L/s)	5% AEP Storm Event (L/s)	2% AEP Storm Event (L/s)	1% AEP Storm Event (L/s)
Pre-Development	264	334	431	553	675
Post Development	238	310	344	404	468

5.3 FLOODING AND FREEBOARD

A flood assessment was undertaken for the development site in order to determine flood affectation and flood related development controls which apply to the site. The findings indicated that the development site is not flood affected, and as such, would not be subject to flood related development controls. However, it is noted that consideration to evacuation may need to be given. Please refer to Schedule 1 for the flood assessment undertaken by GRC Hydro, dated March 2019.

6. WATER QUALITY REQUIREMENTS AND PROPOSED STORMWATER TREATMENT SYSTEM

In order to comply with the Central Coast Council's requirements for the adequate treatment of stormwater runoff, treatment solutions have been provided to remove suspended solids, hydrocarbons, and nutrients, prior to being discharged from site.

The pollutants that could potentially be generated as a result of the development are as follows:-

- Litter;
- Sediments;
- Nutrients (Phosphorus and Nitrogen), and;
- Hydrocarbons.

The development has been modelled to demonstrate the performance of the stormwater treatment system utilising a program called MUSIC. MUSIC models the proposed stormwater treatment devices and estimates their respective performance against the performance targets of the project. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

6.1 RAINFALL

A continuous simulation of ten (10) years was run with a six (6) minute time step, in accordance with the Central Coast Council Civil Works Specification Design Guidelines' minimum requirements. The time period for which the model was run is 1st January 1974 to 31st December 1984. The rainfall station utilised was 066062 Sydney Observatory.

The average potential evapotranspiration (PET) data used in the MUSIC model was based on the average Sydney PET and is presented in Table 6.1 below.

Table 6.1: Evapotranspiration Data for MUSIC Modelling

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

6.2 RAINFALL RUNOFF PROPERTIES

In accordance with the Central Coast Council Civil Works Specification Design Guidelines, dated 2018, the following Table 6.2 and Table 6.3 presents the rainfall runoff properties which have been used in the MUSIC model.

Table 6.2: MUSIC Rainfall Runoff Properties

Parameter	Unit	Value
Impervious Area Parameters		
Rainfall Threshold	mm	0.3 (for roofs) 1.5 (for landscaped areas) 1.5 (for roads)
Pervious Area Parameters		
Soil Storage Capacity	mm	200
Initial Storage Capacity	%	30
Field Capacity	mm	80
Infiltration Capacity co-efficient a		200
Infiltration Capacity co-efficient b		1.0
Groundwater Properties		
Initial depth	mm	10
Daily recharge rate	%	0.5
Daily base seepage rate	%	0.16
Daily seepage rate (%)	%	2

Table 6.3: Pollutant Concentration Parameters for MUSIC Source Nodes

Land Use Category		Concentration (mg/L-log ₁₀)					
		Total Solids	Suspended	Total Phosphorus		Total Nitrogen	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
General Urban (incl public open space)	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Standard Deviation	0.32	0.17	0.25	0.19	0.19	0.12
Sealed Roads	Mean	2.43	*	-0.30	*	0.34	*
	Standard Deviation	0.32	*	0.25	*	0.19	*
Roofs	Mean	1.30	*	-0.89	*	0.30	*
	Standard Deviation	0.32	*	0.25	*	0.19	*

*Base flows are only generated from pervious areas; therefore these parameters are not relevant to impervious areas.

6.3 MUSIC MODEL CATCHMENT AREAS AND STORMWATER TREATMENT PLAN

The MUSIC model's total catchment area to be treated is 1.2574 Ha. Please refer to Table 6.4 for a breakdown of the MUSIC model catchment areas.

Table 6.4: Breakdown of MUSIC Model Catchment

Catchment	Total Area (Ha)
To OSD Tank	
Roof Catchment to RWT	0.7591
Road Surfaces	0.2946
Landscaped Areas	0.1713
Bypass	0.0324
Total	1.2574

The proposed site treatment will utilise three (3) products by Ocean Protect. The first level of treatment will include Ocean Guards and an OceanSave treatment chamber. Ocean Guards which intercept surface runoff at the pit grates and filter the runoff prior to entering the piped stormwater system. It is proposed that all five (5) proposed grated inlet stormwater pits on site will be fitted with Ocean Guard filter baskets. The Ocean Guard is fitted with a monofilament 200 micron pore size filter bag that removes gross pollutants such as sediment, trash and debris, as well as suspended solids; please refer to Figure 6.1 for an illustration of a typical Ocean Guard.



Figure 6.1: Typical Enviropod Filter

The OceanSave intercepts flows within the piped stormwater system and removes pollutants. It is proposed that the OceanSave treatment chamber which will be located upstream of the OSD storage tank. Similar to the Ocean Guard, the Ocean Save removes gross pollutants such as sediment, trash and debris, as well as suspended solids; please refer to Figure 6.2 for an illustration of a typical OceanSave.

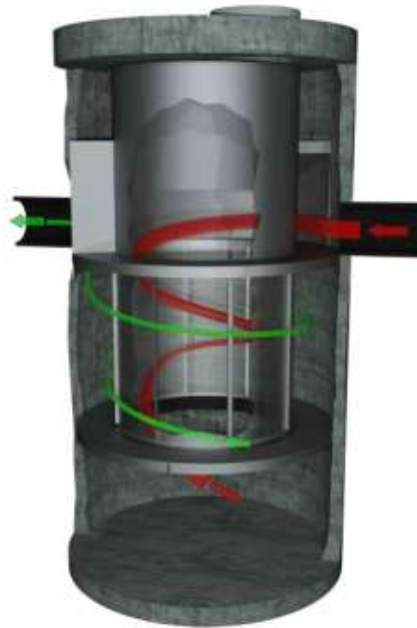


Figure 6.2: Typical OceanSave

The second level of treatment includes a stormfilter system that will be contained within a sectioned area of the OSD storage tank. To achieve the reduction targets, fourteen (14) Ocean Protect phosphorus absorption cartridges will need to be installed into the OSD tank. A Psorb Stormfilter cartridge system is provided to remove any remaining suspended sediments and nutrients which have entered the stormwater system; please refer to Figure 6.3 for an illustration of a typical Psorb stormfilter.

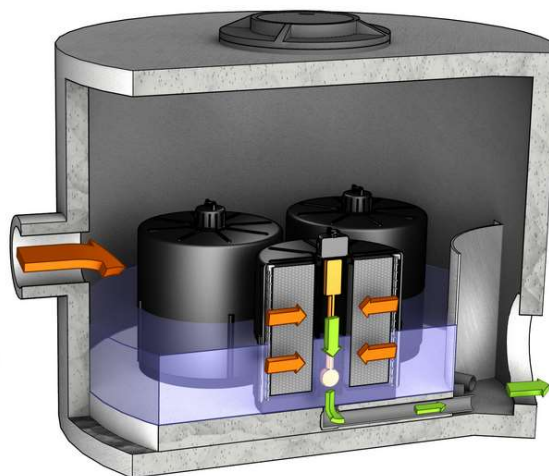


Figure 6.3: Typical PSorb Stormfilter

6.4 STORMWATER RETENTION

In accordance with the Central Coast Council Water Cycle Management Guidelines, a minimum stormwater retention volume of 20m³ is required to be provided for high density development sites.

For the proposed development site, it is proposed that a 40kL rainwater reuse tank be installed in order to retain stormwater for WC flushing and irrigation purposes. In order to calculate the proposed rainwater reuse tank size, the following average demand assumptions were taken which are presented in Table 6.5.

Table 6.5: Average Water Demand

Use	Average Water Demand
WC Flushing	0.1kL/Day/Toilet
Turf Irrigation	0.4kL/Year/m ²

Please refer to Table 6.6 for the WC flushing demand and irrigation demand calculation.

Table 6.6: WC Flushing and Irrigation Average Water Demand

Use	Average Water Demand	No. of Toilets/Area to be Irrigated	Average Water Demand
WC Flushing	0.1kL/Day/Toilet	380	38 kL/Day
Turf Irrigation	0.4kL/Year/m ²	943m ²	377.2 kL/Year

6.5 MUSIC MODEL TREATMENT RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Please refer to Figure 6.4 for the treatment plan and Table 6.7 for the treatment results.

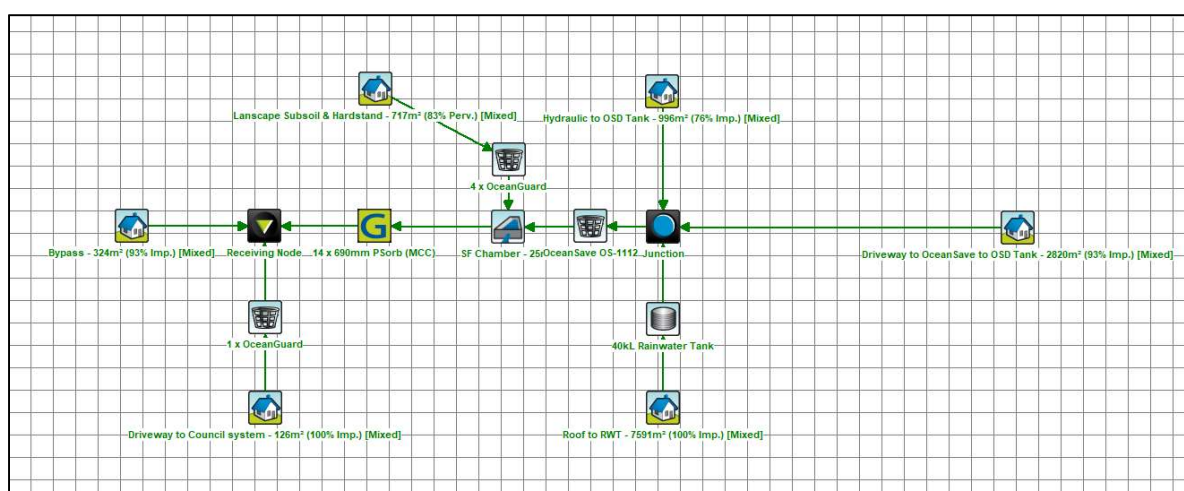


Figure 6.4: MUSIC Model Treatment Plans

Table 6.7: Percentage Based Load Reduction in Pollutant Results

Pollutant Type	Source (kg/yr)	Residual Load (kg/yr)	Reduction % Achieved
Gross Pollutants (GP)	341	8.03	97.6
Total Suspended Solids (TSS)	2830	555	80.4
Total Phosphorus (TP)	3.87	1.13	70.8
Total Nitrogen (TN)	30.7	15.2	50.6

7. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the general requirements outlined below.

7.1 SITE PROTECTION MEASURES

It is proposed to provide the following in order to inhibit the movement of sediment off the site during the demolition and construction phases.

7.1.1 SITE ACCESS

Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry consisting of a 1.5m long by 3m wide 'cattle rack'.

7.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt down slope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following:-

- Geotextile fabric buried to a maximum of 100mm below the surface;
- Overlapping any joins in the fabric, and;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event.

Please refer to Figure 7.1 for details.

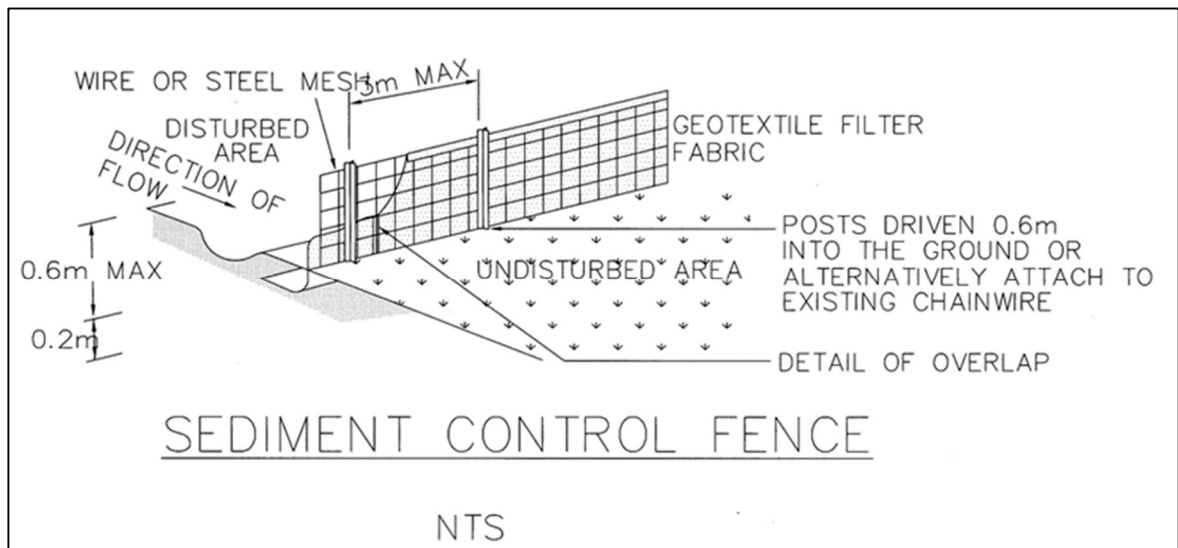


Figure 7.1: Sediment Control Fence Illustration

Existing stormwater infrastructure is also to be protected from incoming sediment using the following methods:-

- Any Council owned road kerb entry and/or gully pits will be protected by Filter Bales and EcoSocks. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

Please refer to Figure 7.2, Figure 7.3 and Figure 7.4 for details.

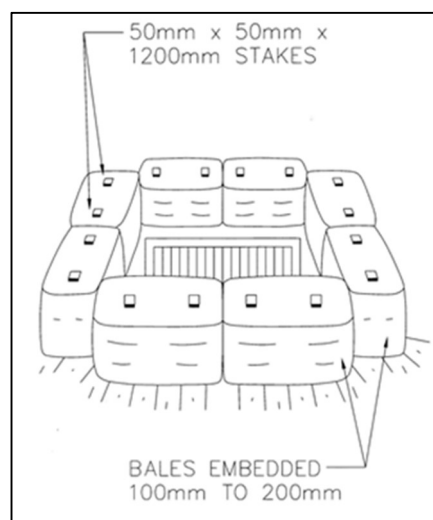


Figure 7.2: Stormwater Pit Sediment Trap (NTS)

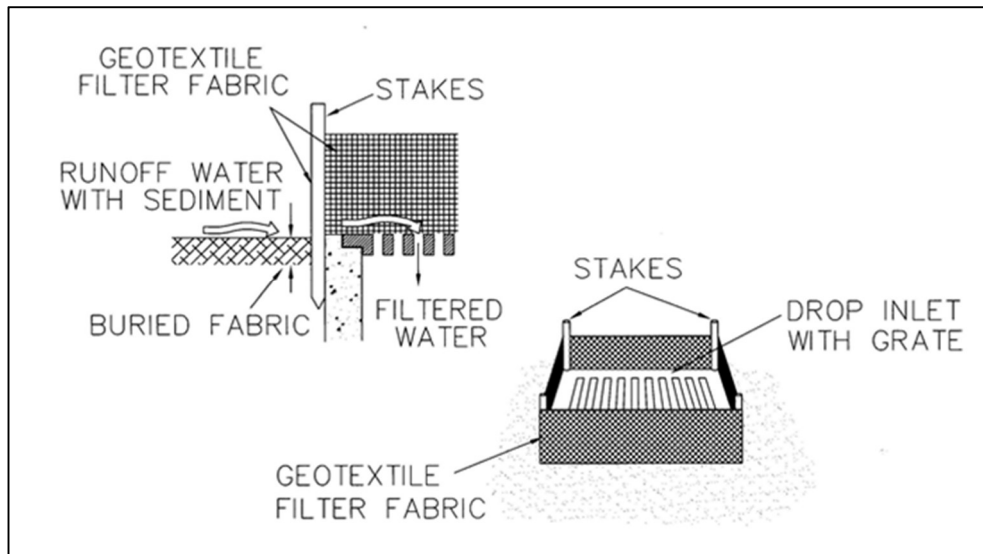


Figure 7.3: Geotextile Filter Fabric Drop Inlet Sediment Trap (NTS)

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply with environmental and regulatory requirements.

Durable, Dependable, Reusable. Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and reusable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.

Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

1. FilterBales frames are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc. 2. Filter medium (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil. 3. FilterBales have a seven (7) stage filtration system: 1. In through the filter bag 2. Through the perforated plastic structure wall 3. In through the filter cartridge bag 4. Through the bio engineered filter medium 5. Out through the filter cartridge bag 6. Out through the perforated plastic structure wall 7. Out through the filter bag 4. The filter bag is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile. 5. FilterBales work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events". During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application. 6. EcoSocks are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag. 7. FilterBales are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems		
Product Range		
Item No.	Description	
HFB001	High FilterBale , suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	Low FilterBale , suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	Directional EcoSock , can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	
Accessories		
Item No.	Description	
FCR004	WaterClean Filter Cartridges contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	Replaceable FilterBale covers , made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	Replaceable FilterBale covers , made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

Figure 7.4: Erosion Control Filter Products

7.1.3 SEDIMENT BASIN

As the total disturbed development area is greater than 2500m², a calculation has been undertaken in line with the Blue Book requirements to determine whether a sediment basin is required for the site. As the total annual soil loss for the site has been calculated to be 251m³/ha/yr, which is greater than the specified 150m³/ha/yr, it is confirmed that a sediment basin shall be required for the site. The sediment basin shall be sized in accordance with the Blue Book.

The following works are required to be carried out during installation of the sediment basins:-

- Installation of a fence around the perimeter of the basin;
- Removal of existing reeds;
- Installation of rip rap to allow for bobcat access for periodic removal of sediment;
- Installation of a perforated riser outlet pipe as per the detail shown in Figure 7.5 and;
- Connection of the riser pipe to an existing pit.

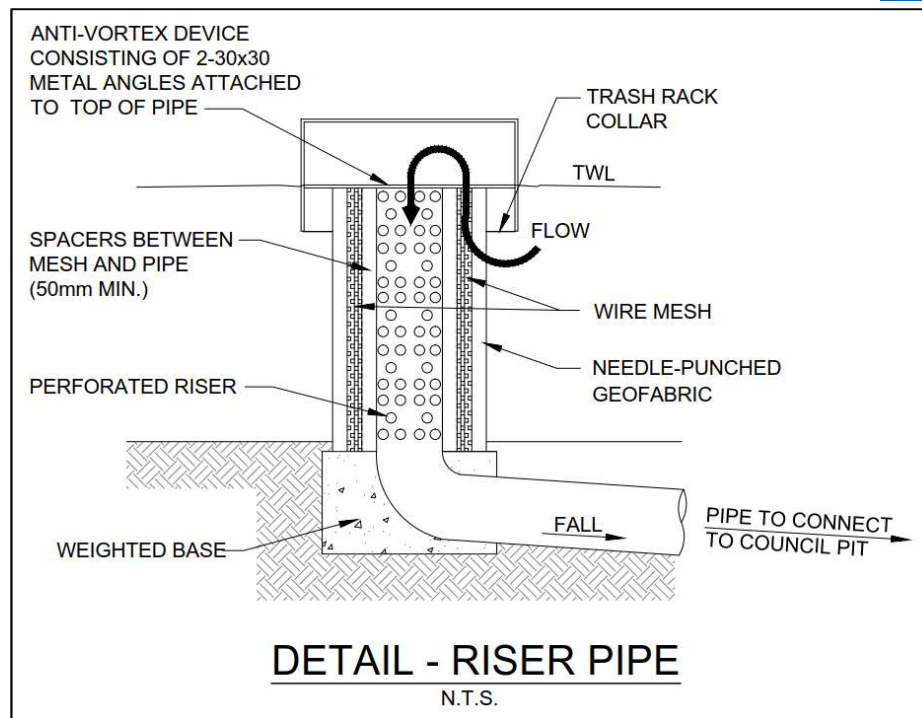


Figure 7.5: Sediment Basin Outlet Pipe Detail

7.2 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.

7.2.1 DUST CONTROL

The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with RMS and local Council Guidelines.
- Soil transport vehicles will use the single main access to the site.
- There will be no burning of any materials on site.
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by wind. The watercraft will be equipped with a pump and sprays.
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on site during the construction of the works.
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to travelling on Council Roads.
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

7.2.2 MAINTENANCE

Generally, the following maintenance measures shall be adhered to during construction:-

- It will be the responsibility of the contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary.
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site.
- Gutters and roadways will be kept clean regularly to maintain them free of sediment.
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient air quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site; and,
- Materials processing equipment suitably comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site, the adjacent public roads, footpaths and environment.

SCHEDULE 1 GRC HYDRO FLOOD ASSESSMENT

Job Number: 1800xx
Date: 29 March 2019

Michael Cahalane
Level 9, 233 Castlereagh St
SYDNEY NSW 2000

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 413 631 447
www.grchydro.com.au

Dear Michael,

**Re: Proposed Gosford Private Hospital Development – Corner of Faunce St West and Racecourse Rd – Lot 2
DP1226923**

INTRODUCTION

Thank you for inviting GRC Hydro to provide a summary of flood affectation and flood related development controls for the above referenced subject site (see Figure 1).

Figure 1: Subject Site



300 m to the north west of the Site is Narrara Creek and areas to the south of the site are elevated relative to the site. Hence the flood liability of the subject site against both mainstream and overland flow flooding is required to be assessed.

The 1993 Kinhill Flood Study Review has been looked at in regard to Narrara Creek mainstream flooding and levels in the vicinity of the subject site. Note there is a FRMP for Narrara Creek and so this will be referred to in regard to flood controls for mainstream flood affectation (if any).



GOSFORD CBD Local Overland Flow Study (2013) was reviewed in order to define overland flow. Note no subsequent Floodplain Management Plan was carried out and as such the DCP will be referred to for flood related development controls pertinent to overland flow flood affectation at the site (if any).

Figures taken from the above referenced report and relied upon for statements below are shown in Appendix A.

SUBJECT SITE FLOOD LIABILITY

Analysis shows that:

1. Narrara Creek flood level for 1% AEP event in approximately 4 mAHD, around 4 m below our site (which at its lowest is in the order of 8 mAHD);
2. Narrara Creek PMF level is approximately 6 mAHD and hence does not impact the subject site;
3. Given 1 and 2 above mainstream flooding does not impact the subject site;
4. A review of the overland flow study indicates no stormwater assets on the site nor any overland flow path. Isolated puddles are shown however these are not flooding but instead stormwater and will be dealt with by intra-lot drainage.

As such all indications are that the subject site is not flood affected and as such any works on the site would not be subject to flood related development controls . Note however that evacuation may require further consideration at a later time.

If you require any further information, please do not hesitate to contact me on 0413 631 447.

Yours Sincerely



Steve Gray
Director



APPENDIX A

Figure 2: Location of Narrara Creek Study Cross-sections

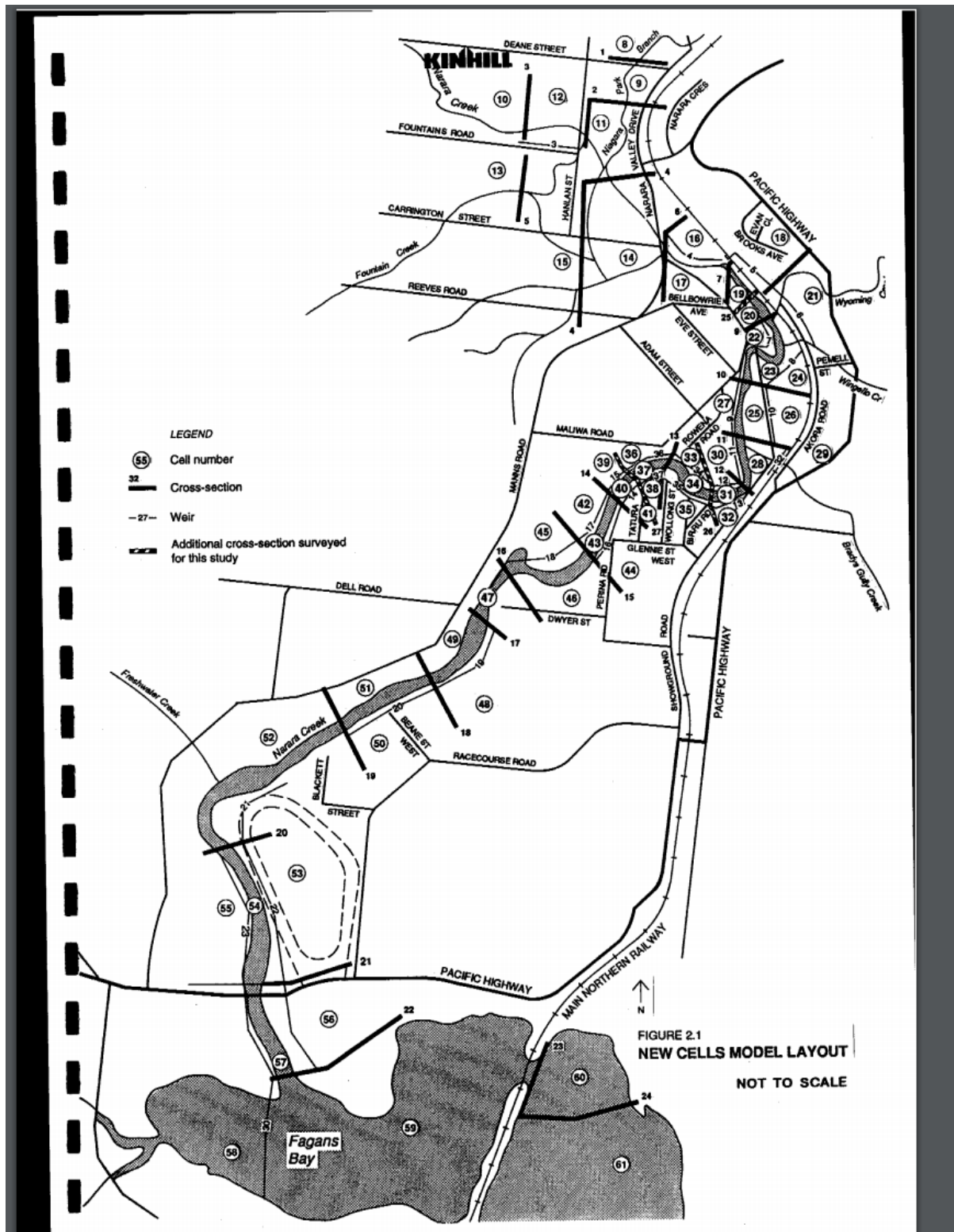


Figure 3: Narrara Creek 1% AEP Results

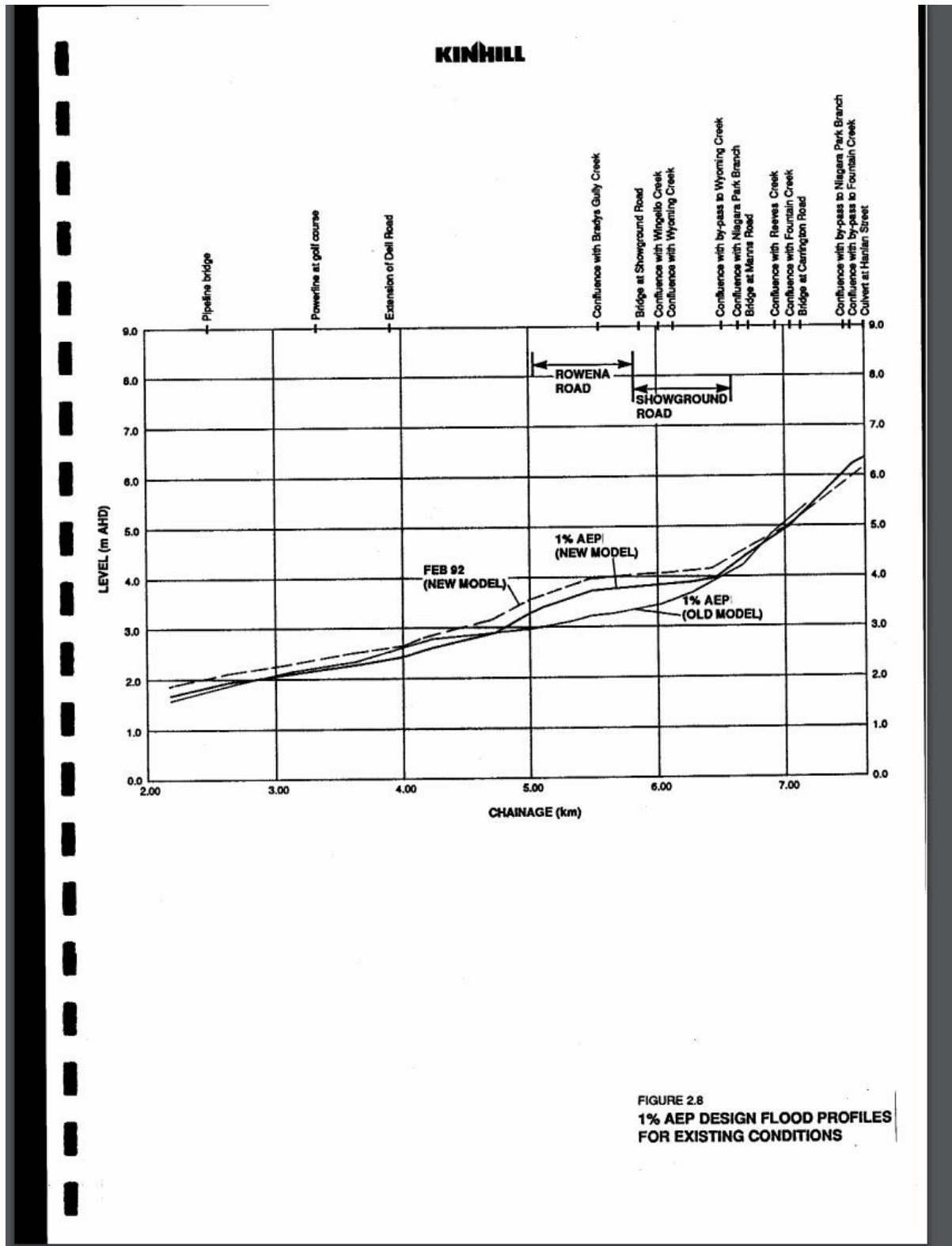


Figure 4: Narrara Creek PMF Results

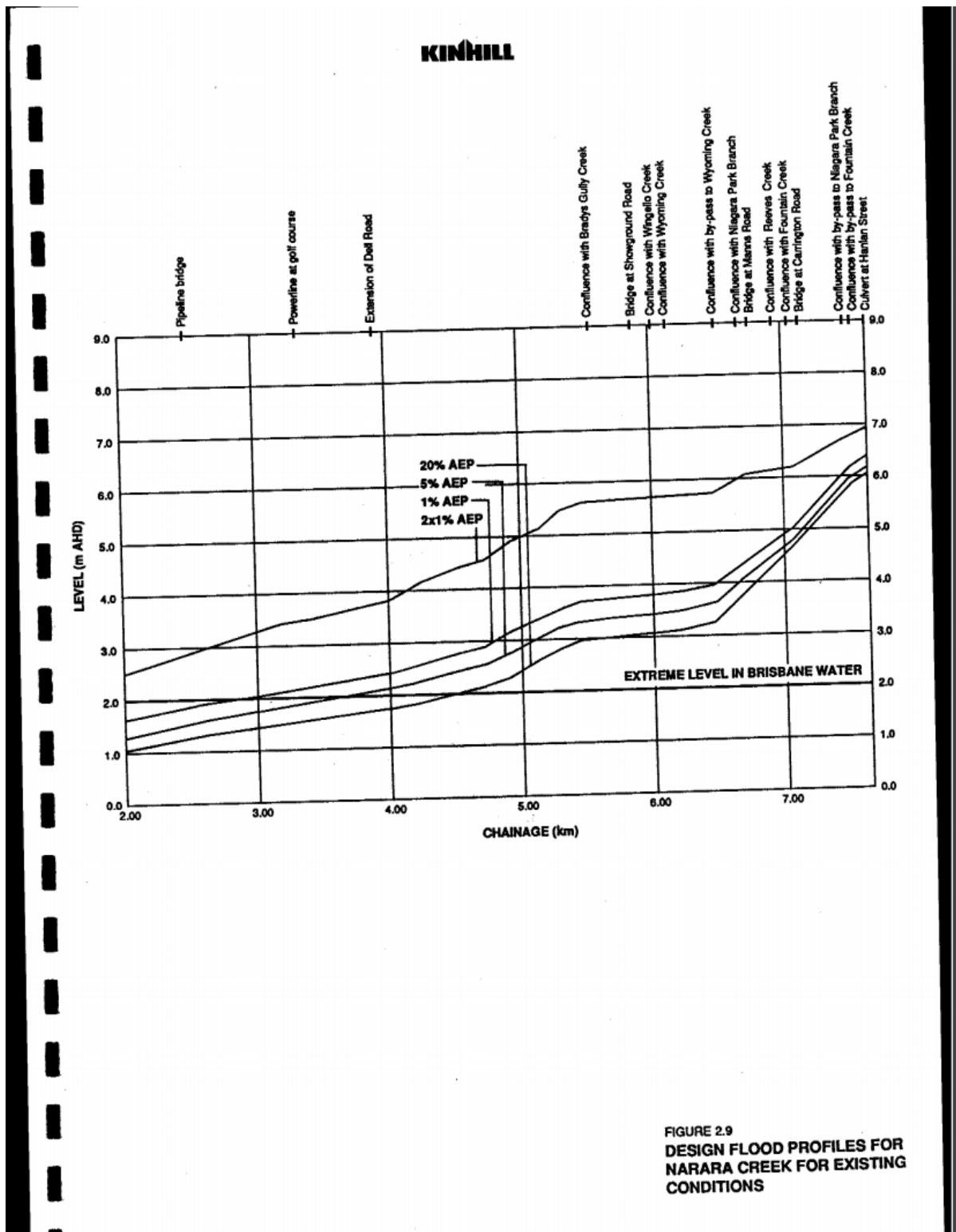


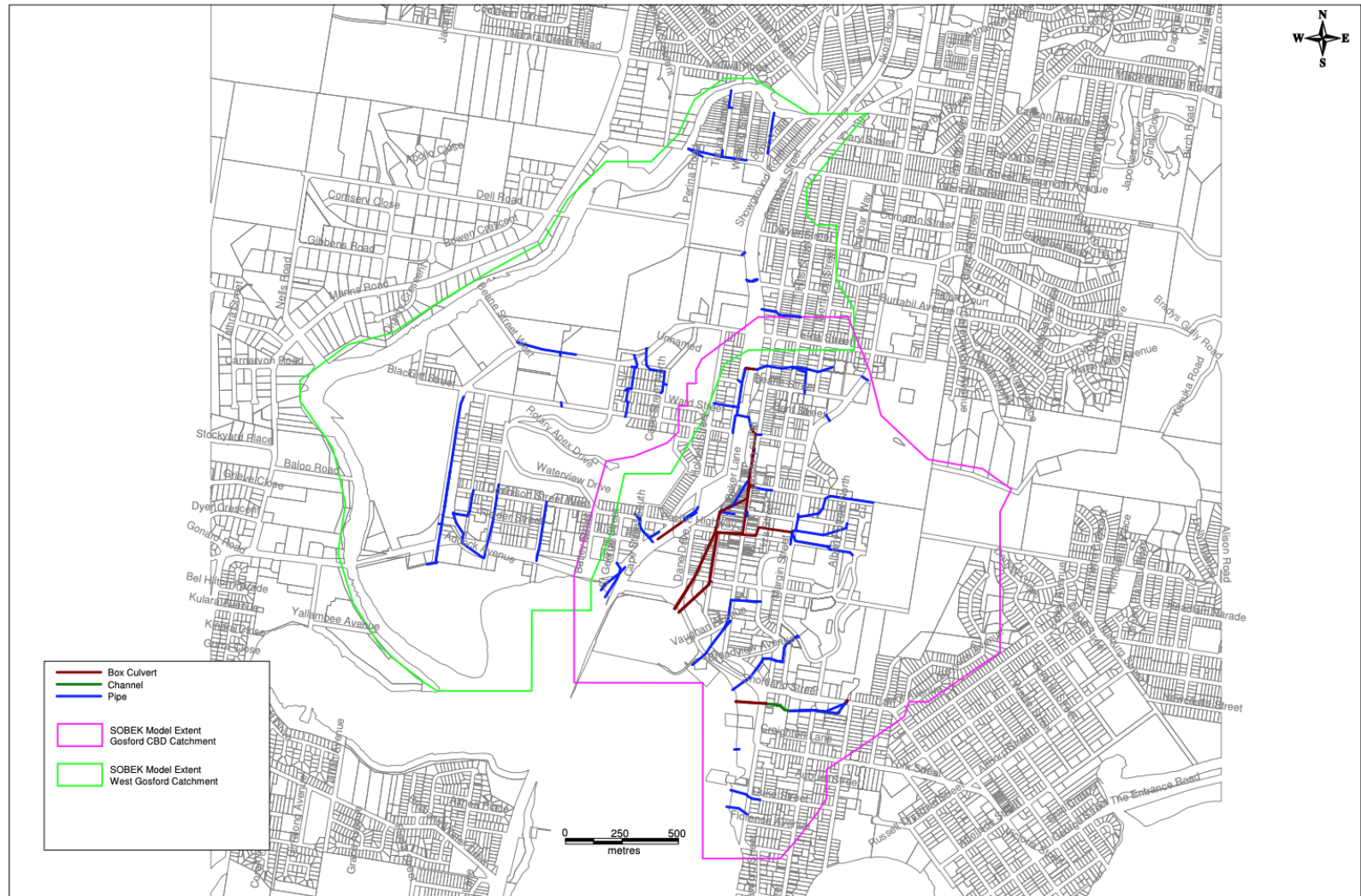


Figure 5: Typical Elevations at Subject Site





Figure 6: Stormwater Asset Diagram – None shown in Subject Site




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FIGURE 3.7
SOBEK MODEL - 1D DRAINAGE SYSTEM

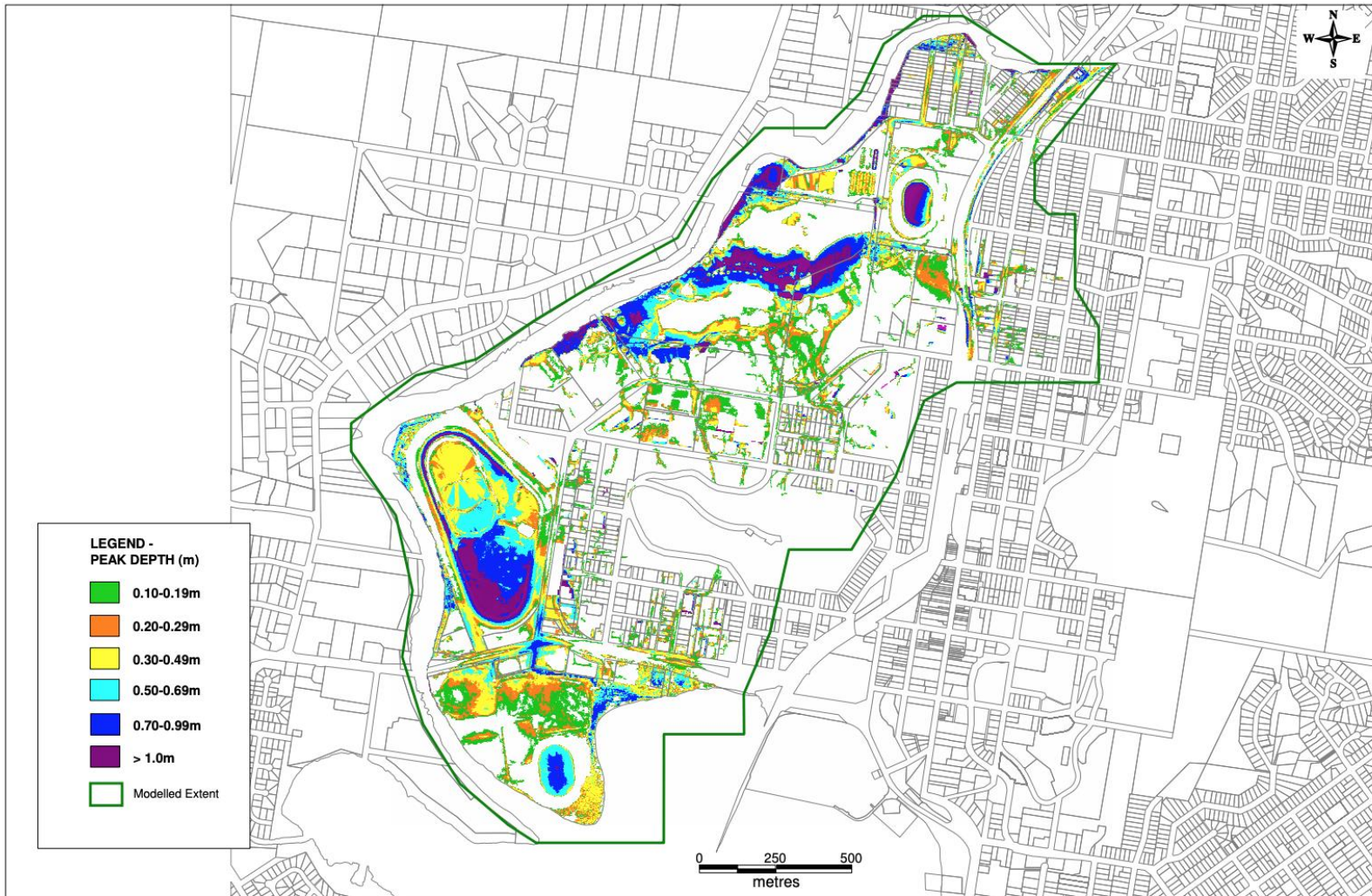


Figure 7: 1% AEP Overland Flow Flood Map





Figure 8: PMF Overland Flow Flood Map



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FIGURE 4.6
PEAK FLOOD DEPTHS - WEST GOSFORD PMF SCENARIO 3