WOOD & GRIEVE ENGINEERS

New Maitland Hospital, Metford NSW

Stormwater Water Management Plan

Prepared for:

Health Infrastructure
NSW

Prepared by:

Ian Harris
Project No. 32489-1-CI
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Revision

Site Address: Lot 7314, DP1162607, Metford Road, Metford, NSW
Proposed Development: Hospital

Client: Health Infrastructure NSW
Local Authority Maitland City Council
Authority Reference #: N/A
Wood & Grieve Reference: 32489-1-CI-R-SMP

Ian Harris BEng (Hons)
For and on behalf of
Wood & Grieve Engineers

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01	04.07.17	Draft Issue	IH
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Contents

1. Introduction

Wood & Grieve Engineers have been commissioned by Health Infrastructure NSW to prepare this Stormwater Management Plan (SMP) in support of the Stage 1 State Significant Infrastructure application for the proposed development at Lot 7314, DP1162607 and Part Lot 401 DP755237, Metford Road, Metford, NSW

This SMP outlines the conceptual water management design for the proposed development of the new hospital on the site.

This SMP demonstrates the application of Water Sensitive Urban Design (WSUD) principles and illustrates that the proposed development complies with the Maitland City Council Standards and Guidelines for Stormwater, Australian Rainfall and Runoff, Australian Standards and best engineering practise.

The purpose of this SMP is to evaluate the stormwater management methodology associated with the proposed development plan so as to demonstrate that the appropriate strategies have been adopted.

The SMP specifically addresses the following items for both the construction and operational phases of the development:

- Flood Impacts;
- Stormwater runoff volumes and detention (Stormwater Quantity);
- Stormwater quality treatment measures (Stormwater Quality);
- Erosion and Sedimentation Control.

Groundwater matters are dealt with in the associated Surface and Ground Water Assessment prepared by GHD which has also been submitted as part of this application.

The following will be achieved with the correct application of this SMP report:

- Appropriate standards to be maintained on all aspects of stormwater management within the site,
- Pollution control to be maintained,
- Establishment of a unified, clear and concise stormwater management strategy.

The project will be delivered in two stages:.

- Stage 1 - Concept design, site clearance and preparatory works
- Stage 2 - Detailed design, construction and operation of the hospital

Stage 1 works will consist of:

- Site office and construction compound, including connection of compound to services
- Connection of temporary and permanent services for the new facility (water, sewer, power, gas)
- Removal of existing temporary fencing and installation of construction fencing and signage
- General clearance of site vegetation within the footprint of hospital construction works including tree stumps, but with retention of the majority of native vegetation around the site's perimeter in areas less impacted by historical mining activities. Asset Protection Zones (APZs) would be established for bushfire protection
- Chipping of cleared vegetation (excluding weed species) to use on site for ground stabilisation/erosion control in the period prior to commencement of Stage 2
- Offsite disposal of surplus cleared vegetation and weeds to green waste recycling facility or another beneficial reuse
- Bulk earthworks to establish the required site levels and create a stable landform in preparation for hospital construction.

- Associated in-ground infrastructure and works may include formation of building foundations, drainage works and excavation of sub-level structures
- Site stabilisation (such as establishment of erosion and sediment controls) in preparation for Stage 2
- Site management
- Construction of internal un-sealed road ways for use during construction and in preparation for final road formation in Stage 2
- Construction of a hard, un-sealed sub-base for temporary construction parking spaces and in preparation for final carpark formation in Stage 2.

2. SEAR's Requirements

This report has been prepared in response to the Secretary's Environmental Assessment Requirements – Application Number SSI 9022. The table below identifies the requirements met by this report and indicates the location within the report.

SEARs Reference	SEARs Description	Report Section
13. Drainage	Provide a stormwater concept plan detailing how water quality and quantity impacts on drainage systems would be managed.	Section 8 – Stormwater Attenuation Section 9 – Stormwater Quality Treatment
14. Flooding	Assess flood risk on site and surrounding locality (detailing the most recent flood studies for the project area) and consideration of any relevant provisions of the NSW Floodplain Development Manual (2005), including the potential effects of climate change, sea level rise and an increase in rainfall intensity.	Section 6 – Flood Impact Assessment
Stage 1 – 4 Sediment, Erosion and Dust Controls	Detail measures and procedures to minimise and manage the generation and off-site transmission of sediment, dust and fine particles.	Section 10 – Erosion and Sedimentation Control

3. Relevant Policies, Standards and Guidelines

The following listed policies, standards and guidelines were referred to in the preparation of this report:

- Maitland City Council Development Control Plan
- AS3500
- Australian Rainfall & Runoff 1987/1999;
- AS3500 parts 0-5: 2013 Plumbing and Drainage
- AS2890 parts 1-6: 2009 Parking Facilities
- AS1428 parts 1-5: 2010 Design for Access and Mobility
- Landcom Managing Urban Stormwater: Soils and Construction
- NSW Floodplain Development Manual 2005
- Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)

4. Existing Site Characteristics

4.1 Property Detail

Address:	Lot 7314 DP1162607 and Part Lot 401 DP755237, Metford Road, Metford, NSW
Total Site Area:	19.37Ha

The proposed development can be seen on the concept design drawings in Appendix A of this report.

The proposed development will consist of two multistorey hospital buildings, two car parking areas and associated connecting roads.

As can be seen in the site location aerial photo below (Figure 1), the site is bounded by Metford Road to the West and residential developments to the South. The site to the North was previously a mining site which is currently being remediated and the land to the East is a mixture of wetland and bushland.

The site has recently been remediated and is currently a mixture of bushland and cleared land.

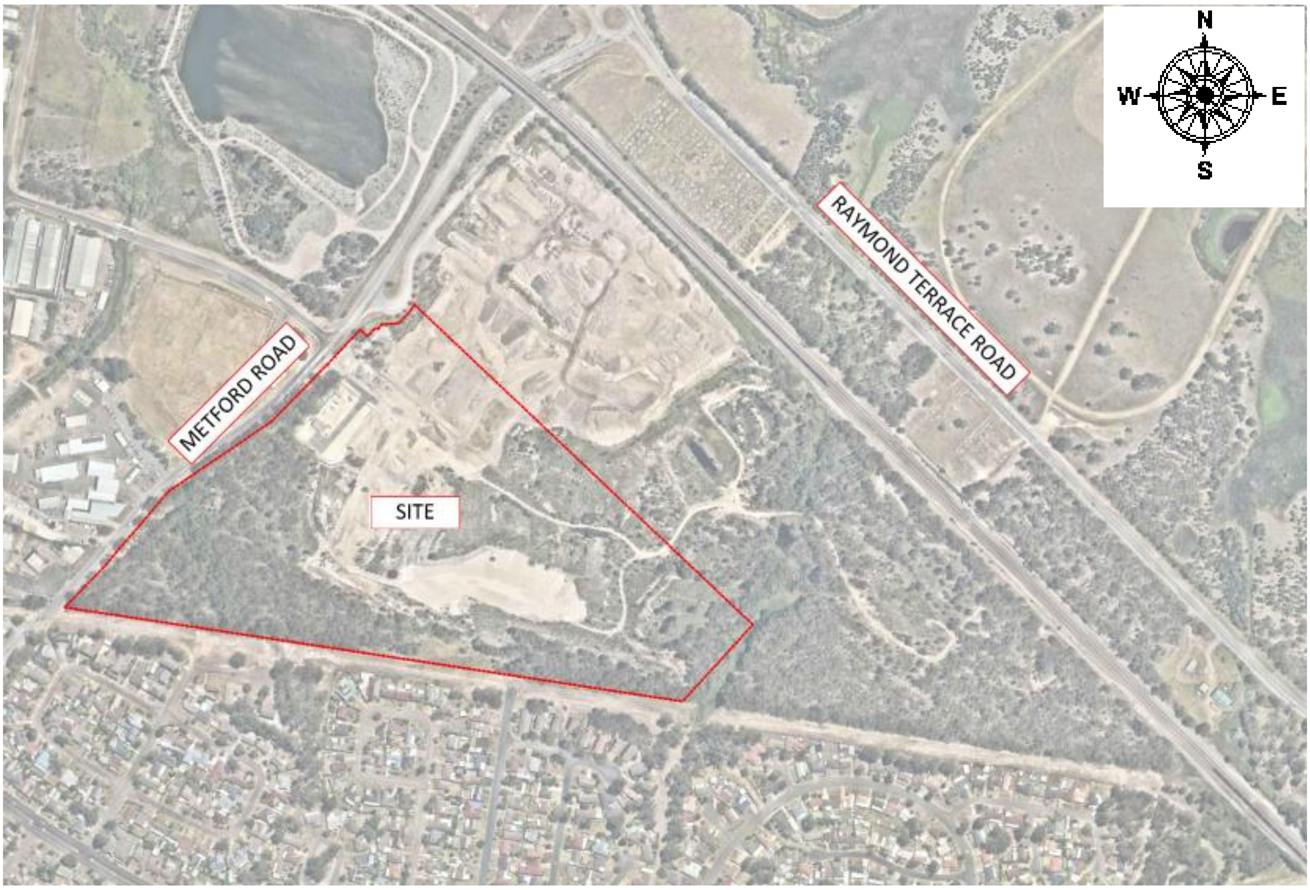

Figure 1: Site Location Plan

4.2 Topography

The site currently falls to both the East and the West with a crest located through the site. The image below (Figure 2) shows the contours on the site spaced at 2m centers.

Figure 2: Site Topography

4.3 Stormwater Catchments

4.3.1 External Catchments

Sections of the existing mining remediation site, Lot 401, DP755237, North of the site discharges stormwater runoff onto the development site along the Western Boundary. This discharged water then runs along the Western boundary in an open swale towards the existing drainage line where water is then discharged under Metford Road. The Northern catchment has been calculated as approximately 2.3Ha. This catchment can be described as undeveloped disturbed in nature.

The residential land to the South of the site also discharges onto the development site at two locations. The Western section of the catchment discharges directly into the existing drainage line; this Catchment has been calculated as approximately 16.73Ha. The Eastern section of the catchment discharges to the East of the site towards the wetlands to the North. This catchment has been calculated as approximately 36.92Ha with 12.7Ha directly affecting the site. Both southern catchments can be described as urban residential in nature.

Existing Site Characteristics

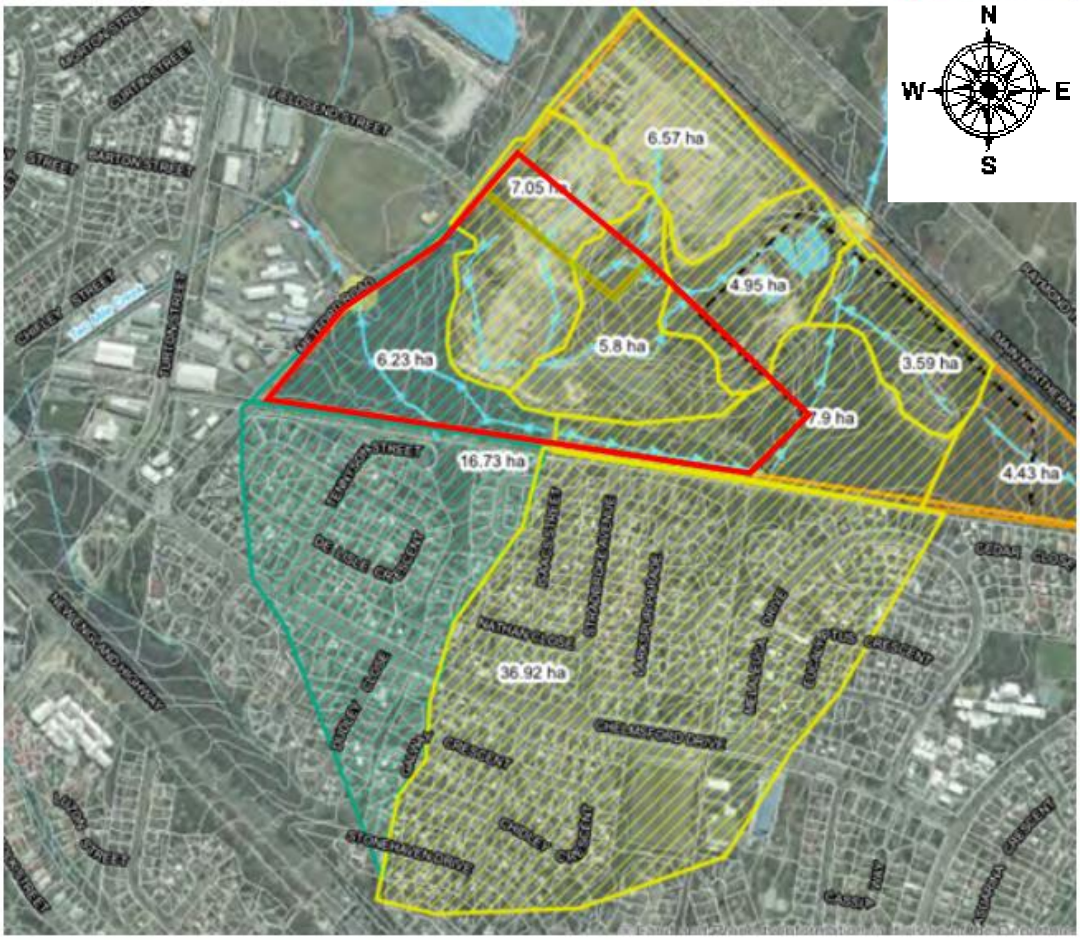

Figure 3: External Catchment Map

4.3.2 Internal Catchments

The West section of the site drains to an existing Drainage line which runs under Metford Road. The West catchment has been calculated as 62,300m².

The East section drains to the existing wetlands to the North East of the site. The East catchment has been calculated as 111,220m².

The catchment split is shown on Figure 4.

Existing Site Characteristics

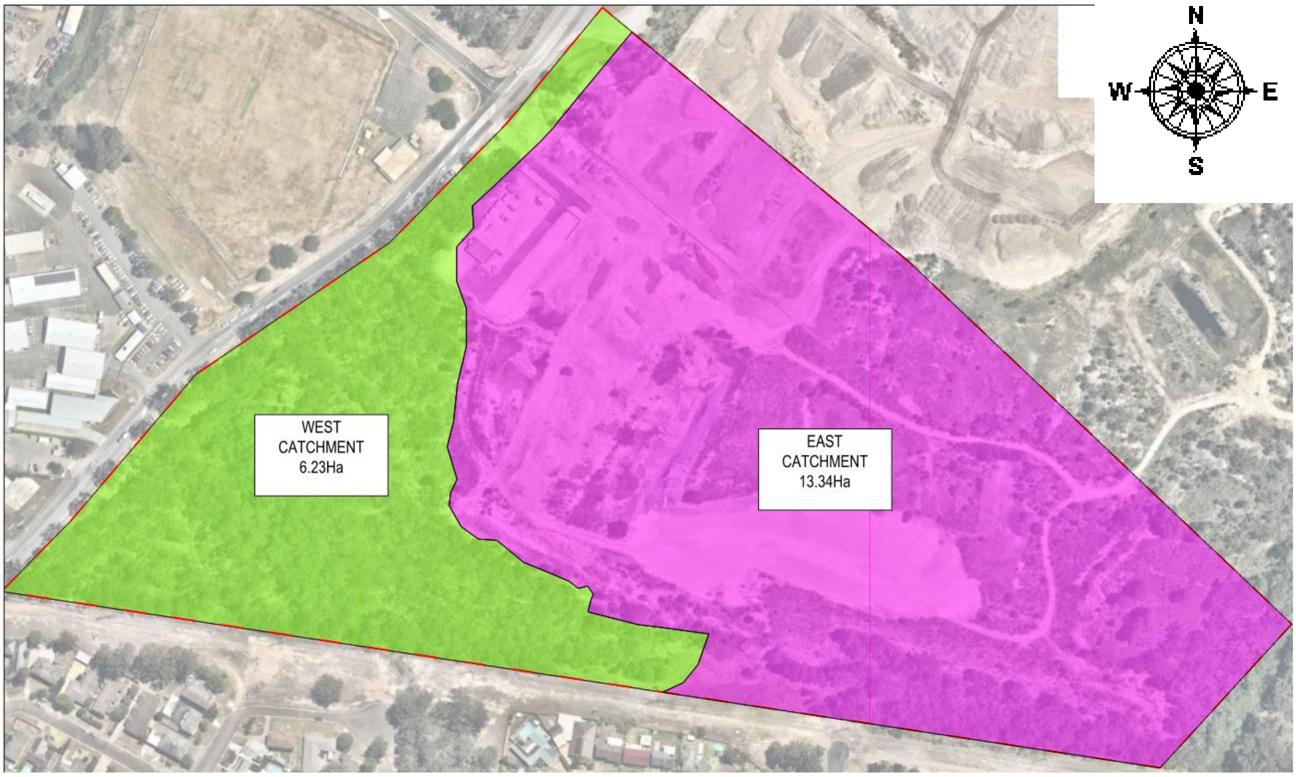

Figure 4: Internal Site Catchment

4.4 Existing Drainage line

The western catchment on the development site is currently drained via an existing Drainage line. This Drainage line also conveys flows from the southern upstream catchment. The Drainage line then discharges under Metford Road to the north west of the development site.

In line with the Department of Primary Industries – Water guidelines this Drainage line would be classed as a minor stream. The Drainage line has been assessed as a first order stream based on the criteria, starting at the top of a catchment, any watercourse which has no other watercourses flowing into it is classed as a **first order stream.**

The Department of Primary Industries – Water specifies that a public authority does not need to obtain a controlled activity approval for any controlled activities that it carries out in, on or under waterfront land. The WM Act defines a public authority as a government department or administrative office which would include Health Infrastructure NSW.

4.5 Existing Stormwater Discharge

In the current condition there is no in ground stormwater drainage network through the site. Any rainfall runoff from the site will discharge as overland flow to either the existing Drainage line or the wetland to the North East.

4.6 Existing Sedimentation Control

There was a sediment basin on the site which was historically been used to control the sediment runoff during the mine remediation works. This basin has been filled in prior to the site being handed over to Health Infrastructure and a new basin has been proposed as part of the Early Works, further to the East to ensure it is out of the proposed zone of construction.

5. Authority Requirements

5.1 Local Council

Design requirements for water management on the site has been set in the Maitland City Council Development Control Plan. These requirements are summarised in the sections below.

5.1.1 Stormwater Conveyance Requirements

The Maitland City Council Development Control Plan and Manual of Engineering Standards state the minimum requirements for the design of stormwater conveyance infrastructure.

The table below summarises the requirements for the stormwater conveyance infrastructure.

Infrastructure	Design Parameter	Design Requirement	Conveyance Method
Formalised Drainage	Minor Drainage System	10 Year ARI	In Ground (Piped)
	Major Drainage System	100 Year ARI	Overland
Open Channels	Freeboard	300mm to top of channel	Overland
	Freeboard	500mm to adjacent dwelling floor levels	Overland
Swales	Depth x Velocity	< 0.4	Overland

Table 1: Stormwater Drainage Serviceability

5.1.2 On Site Detention Requirements

The Maitland City Council Development Control Plan and Manual of Engineering Standards state the minimum requirements for the design of stormwater detention infrastructure.

The guidelines states:

- Stormwater runoff shall be designed so that peak discharges from new development are not increased beyond that of the pre-development environment for nominally the critical 1, 10 and 100 year ARI storm events.
- Where a basin is located in a flood plain the design should achieve its maximum elevation (RL) to limit inundation by flood waters. The lowest desirable level of the spillway should aim to be higher than the 20 year ARI event in the flood plain.
- All basins should incorporate permanent Gross Pollutant Traps (GPT), to collect silt, trash and litter from the road drainage system.
- The minimum slope of a dry basin floor should be 2%.
- The overflow weir shall have the capacity to maintain the 100 year ARI event.
- Temporary water depth calculated for the 20 year ARI event shall be limited to a maximum depth of 1.2m.

Authority Requirements

5.1.3 Stormwater Quality and Pollution Control

The Maitland City Council Development Control Plan and Manual of Engineering Standards state the minimum requirements for the reduction of stormwater runoff pollutants. The guidelines state the following reduction targets:

POLLUTANT	RETENTION CRITERIA
Suspended Solids	80% of average annual load
Total Phosphorus	45% of average annual load
Total Nitrogen	45% of average annual load
Gross Pollutants >5mm	70% of average annual load
Litter > 50mm	Retention up to the 3 month ARI peak flow
Oil and Grease	90% of average annual load

Figure 5: Water Quality Targets (Source: Maitland City Council – Manual of Engineering Standards)

5.2 Office of Environment & Heritage

The OEH set requirements for the management of stormwater runoff in their document " Guidelines for development adjoining land and water managed by DECCW (OEH, 2013) ". The document states "Nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before it reaches OEH land."

The recommended approaches in the guidelines state:

- Development proposals for areas adjacent to OEH land should incorporate stormwater detention and water quality systems (with appropriately managed buffer areas) within the development site.
- Stormwater should be diverted to council stormwater systems or to infiltration and subsurface discharge systems within the development site.
- The discharge of stormwater to OEH land, where the quantity and quality of stormwater differs from natural levels, must be avoided.

6. Flood Impact Assessment

When considering a new development, it is important to assess the impact of existing flooding on the proposed development and also the impact of the proposed development on existing or potential flooding both upstream and downstream of the development.

6.1 Regional Flooding

A flood study was undertaken for the Hunter River catchment by WMA on behalf of Maitland City Council in November 2015. The proposed development site is located within this catchment.

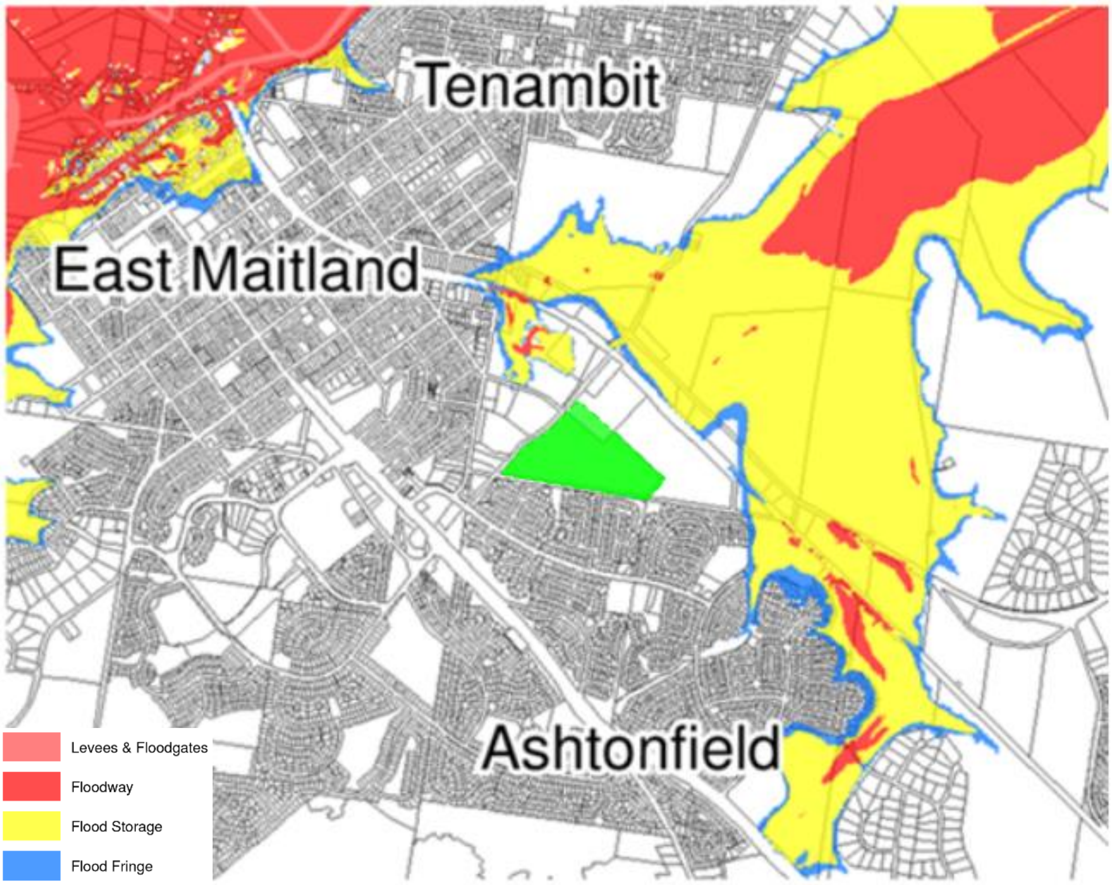

Figure 6: Hydraulic Categorisation: PMF (Source: Hunter River Floodplain Risk Management Study and Plan, 2015)

The flood mapping shows that the site is not impacted by flooding of the Hunter River. The site is protected by the rail embankment to the North.

The Hunter River Floodplain Risk Management Study and Plan indicates that the development site is not subject to any flood planning restrictions.

Access to the site can be achieved from the New England Highway to the south without travelling through flood waters in all events up to and including the PMF. Access from the North via Metford Road will be impacted by flood waters during a 100 year and PMF flood event meaning access to and from the site will be via the highway.

6.2 Local Flooding

Although the site is not impacted by regional flooding. The proximity of the site to the flood zone will have impacts on the ability for runoff from the site to discharge downstream. Modelling was previously undertaken by Robert Bird Group on behalf of Health Infrastructure NSW to assess the local flooding impacts on the site. The image below shows the results of this flood assessment.

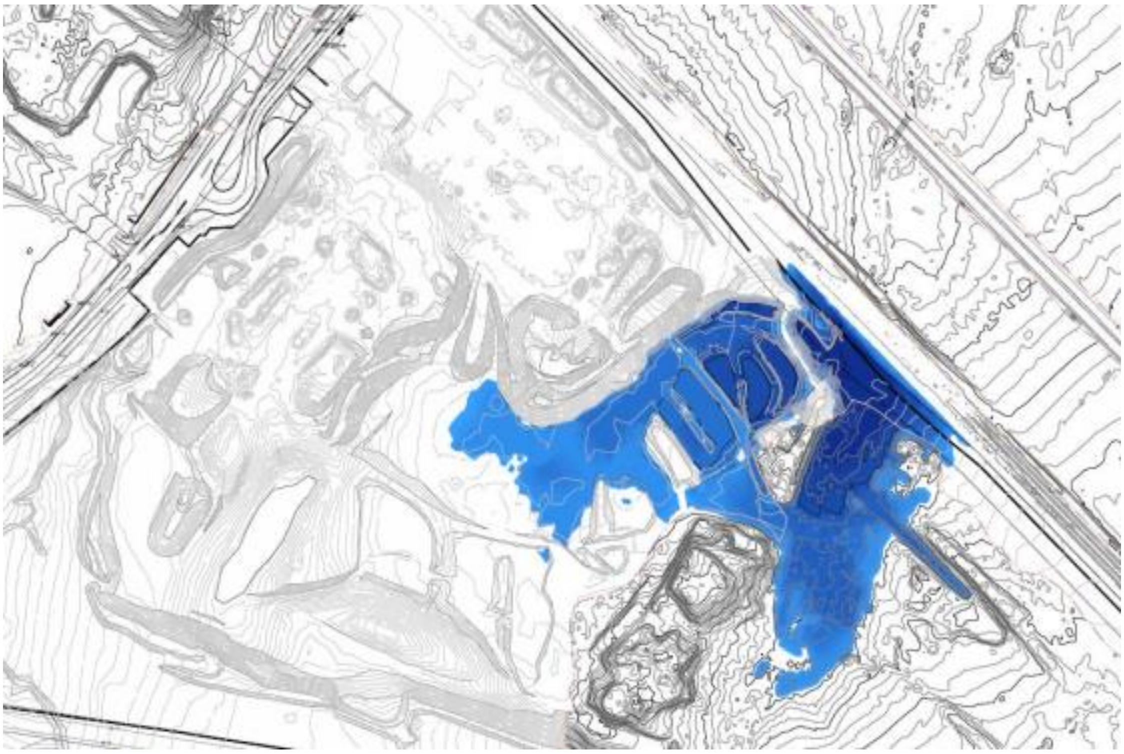

Figure 7: Local Flooding Extent (Source: Robert Bird Group Assessment, 2015)

The Robert Bird Group assessment was a DRAINS 1D tailwater level assessment with the following assumptions adopted for the analysis:

- The external suburban catchment (to the south) drains entirely into the site. This area has been taken to be 34.6ha;
- The internal site catchment area contributing to the primary drainage channel has been modelled at 29.3ha;
- A 1500mm square box culvert has been modelled crossing the rail corridor, discharging to the Tenambit Wetlands;
- A 50% blockage factor has been applied to the 1500mm box culvert; and,
- Tailwater levels adopted were modelled based on flood mapping from the Hunter River Flood Study produced by WMA 2010, as well as flood information provided by Council. Table 5.1 details the tailwater levels adopted. It is noted that Hunter River Peak Flood levels are unlikely to coincide with these local catchment peak flood levels (hence modelling is deemed conservative).

TABLE 5.1 – TAILWATER LEVEL ASSUMPTIONS	
Storm ARI (year)	Tailwater RL (m)
1	None
10	5.5
20	5.6
100	6.2

The flood assessment confirmed a 100 Year ARI flood level of RL7.8m on the site. It is noted that this flood extent does not directly impact the development site.

6.3 Development Flood Impacts

The proposed development extent will not be impacted by either Regional or Local flooding. The modelled maximum local flood level as shown on Figure 7 has been calculated as FL7.8m AHD. The minimum level of the proposed development will be approximately RL14.0m AHD meaning the development will be considerably higher than the flood levels.

Given that it can be confirmed that the development will not impact on any existing floodplain nor will flooding impact on the development there has been no further development specific flood modelling undertaken at this time.

7. Stormwater Conveyance

This section of the report discusses the systems proposed to allow for stormwater to be conveyed across the site to the legal point of discharge.

As discussed in section 3.1 of this report The Maitland City Council Development Control Plan and Manual of Engineering Standards set the minimum design parameters for the design of stormwater conveyance infrastructure through the site.

7.1 Upstream Catchment Runoff

The runoff from the Northern catchment will be impacted by the proposed development. The proposed main access road and Western car parking area will be constructed over the existing overland flow path used to convey the runoff from the Northern Catchment to the existing Drainage line. If this conveyance route was to be blocked the runoff would discharge directly onto Metford Road and increase the risk of nuisance flooding on that road.

To maintain the conveyance across the site it is proposed that a formed swale will be constructed around the eastern side of the proposed car park to allow flows to be directed around the carpark to the creek.

7.2 Building Drainage

All roof areas will be drained through either a conventional downpipe system or a syphonic system. The drainage system will be designed in accordance with AS3500.3:2003 to convey the minor design storm runoff from the roof to the in ground drainage system. Flows in excess of the design flows will surcharge the roof drainage system and discharge onto the surrounding ground where it will then be conveyed overland to the surrounding ground floor drainage network within.

The flow chart in figure below summarises the sites proposed building drainage system.

Figure 8: Building Drainage Stormwater Conveyance Flow Chart

7.3 Road and Carpark Drainage

The road and car parking areas will be drained through conventional pit and pipe gravity drainage in accordance with AS3500.3:2003 and council's stormwater drainage guidelines. Stormwater runoff will be conveyed overland to drainage inlet structures where it will then be conveyed to in ground piped drainage networks. Once in the in ground pipe network the runoff will be conveyed via gravity to water quality treatment devices, then to the stormwater detention infrastructure before discharging to the legal point of discharge.

Stormwater Conveyance

The flow chart below summarises the proposed road and carpark drainage system.

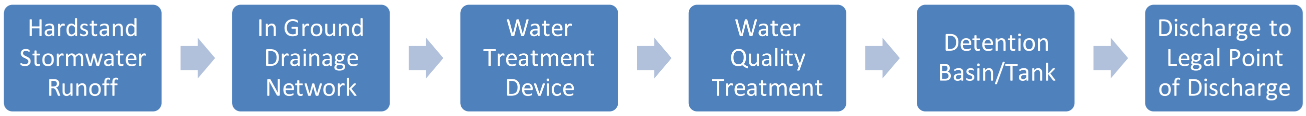

Figure 9: Road and Carpark Drainage Stormwater Conveyance Flow Chart

Both the building, road and car park runoff will use shared water treatment devices and detention in a combined drainage conveyance system. This combined system is shown in the flow chart below.

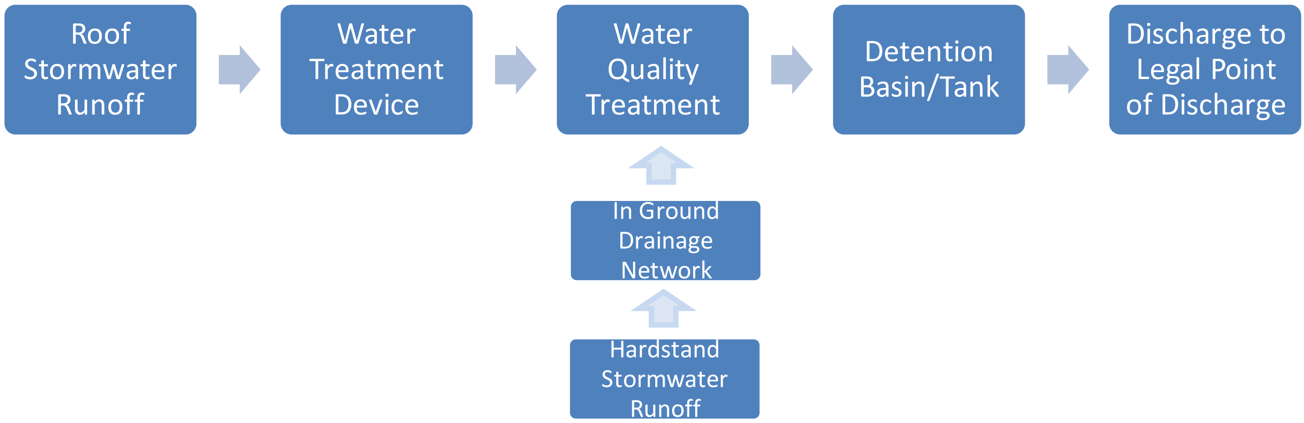

Figure 10: Combined Drainage Stormwater Conveyance Flow Chart

7.4 Legal Point of Discharge

There will be a two legal points of discharge for the development as discussed below. By detaining stormwater runoff in detention tanks the discharge flows and velocities will be restricted however concentrating the discharge from the site to two points will increase the risk of erosion at these discharge locations. To mitigate this risk erosion control measures will be put in place to reduce the flow velocities of stormwater discharge, these measure may include reno mattresses or flow spreader structures.

7.4.1 Western Catchment

The Western catchment will discharge to the existing Drainage line running through the site. A headwall will be provided on the bank of the Drainage line and adequate erosion protection provided directly downstream of this discharge point.

The table below summarises the existing discharge flows and flow velocities from the Western catchment discharge point.

Western Catchment Discharge Summary			
Catchment Area (m2)	Discharge Flows (m^3/s)		
	1 Year ARI	10 Year ARI	100 Year ARI
62,300	0.118	1.03	2.29

Table 2: Western Catchment Discharge Summary

7.4.2 Eastern Catchment

The Eastern Catchment will discharge to the existing wetland located to the North East of the site. In a similar manner to the Eastern catchment drainage system the discharge will be via a headwall with downstream erosion protection.

The table below summarises the existing discharge flows and flow velocities from the Western catchment discharge point.

Eastern Catchment Discharge Summary			
Catchment Area (m2)	Discharge Flows (m^3/s)		
	1 Year ARI	10 Year ARI	100 Year ARI
111,220	0.206	1.76	3.84

Table 3: Eastern Catchment Discharge Summary

8. Stormwater Attenuation

As discussed in section 3.2 Maitland Council's Development Control Plan and Manual of Engineering Standards requires that the post development stormwater discharge from the site be limited to that of the pre developed site. In this case the site is currently undeveloped so the discharge flows of the development will be attenuated back to a greenfield runoff condition.

This section discusses the proposed stormwater attenuation measures which will be incorporated into the development.

8.1.1 Western Catchment

The Western catchment has been calculated as having an area of 7.68Ha. Hydraulic modelling of the catchment was undertaken using DRAINS stormwater modelling software.

The table below summarises the pre development or greenfield state discharge flows for the critical 1 year, 10 year and 100 year ARI stormwater events.

Western Catchment Pre Development Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI
0.118	1.03	2.29

Table 4: Western Catchment Pre Development Discharge Flows

Following development of the site the catchment draining east will be reduced to 7.14Ha as a function of the geometric design of the development.

The table below summarises the post development Unattenuated discharge flows for the critical 1 year, 10 year and 100 year ARI stormwater events.

West Catchment Post Development Unattenuated Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI
0.263	1.3	2.73

Table 5: Western Catchment Post Development Unattenuated Discharge Flows

Attenuation for the western catchment will be provided by constructing an underground detention tank below the eastern car park area. An underground tank being selected due to the lack of available space in this area of the site to provide a surface detention system.

DRAINS has been used to initially size this detention tank. Modelling indicates that a tank of 850m^3 will be required to provide sufficient stormwater runoff storage to attenuate the post development flows back to that of the pre development.

The table below summarises the results of the DRAINS modelling.

Pre Development Discharge Flows (m^3/s)			Post Development Attenuated Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI	1 Year ARI	10 Year ARI	100 Year ARI
0.118	1.03	2.29	0.118	0.812	2.027

Table 6: Western Catchment Post Development Unattenuated Discharge Flows

Stormwater Attenuation

As can be seen in the table above the proposed attenuation measures for the eastern catchment will sufficiently attenuate the catchment discharge flows in accordance with the requirements of Maitland City Council.

8.1.2 Eastern Catchment

The Eastern catchment has been calculated as having an area of 9.67Ha. Hydraulic modelling of the catchment was undertaken using DRAINS stormwater modelling software.

The table below summarises the pre development or greenfield state discharge flows for the critical 1 year, 10 year and 100 year ARI stormwater events.

Eastern Catchment Pre Development Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI
0.206	1.76	3.84

Table 7: Eastern Catchment Pre Development Discharge Flows

Following development of the site the catchment draining east will be increased to 10.16Ha as a function of the geometric design of the development.

The table below summarises the post development Unattenuated discharge flows for the critical 1 year, 10 year and 100 year ARI stormwater events.

Eastern Catchment Post Development Unattenuated Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI
0.326	1.84	3.94

Table 8: Eastern Catchment Post Development Unattenuated Discharge Flows

Attenuation for the eastern catchment will be provided by constructing a bio-detention basin west of the eastern car park area. There is sufficient space to provide a basin in this area of the site. The basin will also act as a water treatment device as discussed later in this report.

DRAINS has been used to initially size this bio-detention basin. Modelling indicates that a basin of 630m^3 will be required to provide sufficient stormwater runoff storage to attenuate the post development flows back to that of the pre development.

The table below summarises the results of the DRAINS modelling.

Pre Development Discharge Flows (m^3/s)			Post Development Attenuated Discharge Flows (m^3/s)		
1 Year ARI	10 Year ARI	100 Year ARI	1 Year ARI	10 Year ARI	100 Year ARI
0.206	1.76	3.84	0.197	1.757	3.575

Table 9: Eastern Catchment Post Development Unattenuated Discharge Flows

As can be seen in the table above the proposed attenuation measures for the western catchment will sufficiently attenuate the catchment discharge flows in accordance with the requirements of Maitland City Council.

9. Stormwater Quality Treatment

As discussed in section 3.3 Maitland Council's Development Control Plan and Manual of Engineering Standards set targets for the reduction of water borne pollution being conveyed from the site through the stormwater drainage system.

This section of the report demonstrates the Stormwater Quality Improvement Devices (SQID's) to be implemented and the Pollutant Export Modelling undertaken to demonstrate the effectiveness of the treatment system in achieving the reduction targets set by council.

9.1 Potential Pollutants

There are a wide range of potential stormwater pollutant sources which occur from urbanised catchments, many which can be managed through appropriate stormwater quality treatment. Typical urban pollutants may include:

- Atmospheric deposition
- Erosion (including that from subdivision and building activities)
- Litter and debris
- Traffic emissions and vehicle wear
- Animal droppings
- Pesticides and fertilisers
- Application, storage and wash-off of car oil, detergents and other household and commercial solvents and chemicals
- Solids accumulation and growth in stormwater systems
- Weathering of buildings

These pollutants in urban stormwater can be placed into various categories as follows. The pollutants underlined below are able to be readily modelled:

- <u>Suspended Solids</u>
- <u>Litter</u>
- <u>Nutrients such as Nitrogen and Phosphorous</u>
- Biological oxygen demand (BOD) and chemical oxygen demand (COD) materials
- Micro-organisms
- Toxic organics
- Trace metals
- Oils and surfactants

While only the key pollutants underlined above will be examined within the modelling, the stormwater Quality Improvement Devices implemented are expected to assist in reducing a wide range of pollutants. For example, heavy metals are commonly associated with, and bound to fine sediments. Thus reducing the discharge of fine sediment during the construction and operational phases will also reduce the discharge of heavy metals to existing stormwater systems.

9.2 Pollutant Reduction System

In order to achieve the pollutant reduction targets specified in section 3.3 of this report a series of treatment devices are proposed which together form a treatment train.

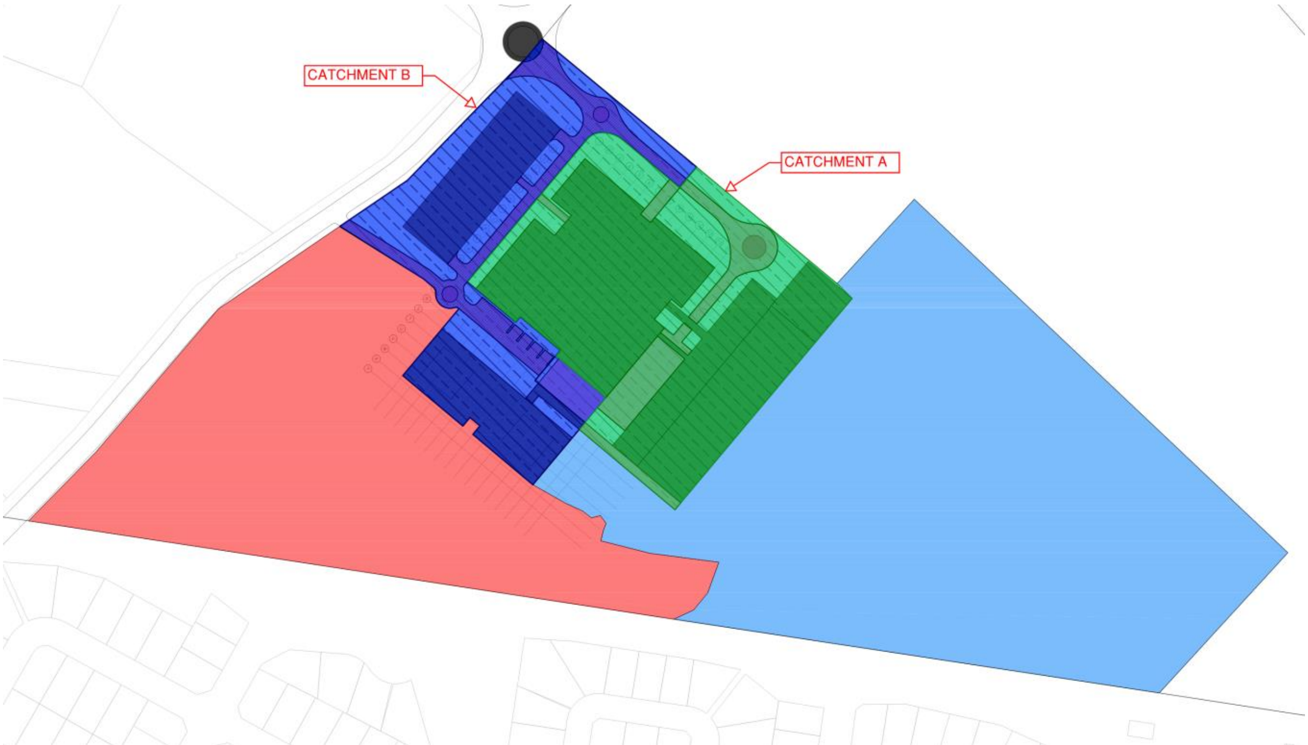

Figure 11: Sub Catchment A and Sub Catchment B areas

9.2.1 Catchment A

The pollution reduction system for the eastern catchment has be diagrammatically shown in the figure below. The treatment train varies for each discharge point.

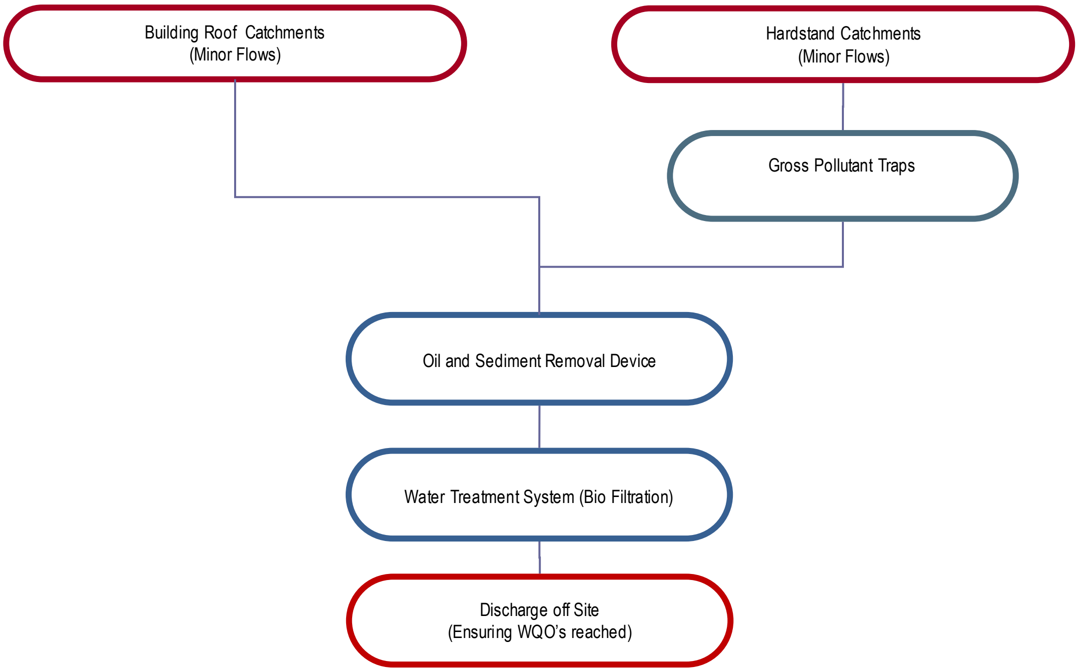

Figure 12: Proposed Water Quality Treatment Train – Catchment A

9.2.2 Catchment B

The pollution reduction system for the western catchment has been diagrammatically shown in the figure below. This system will be identical for all three points of discharge.

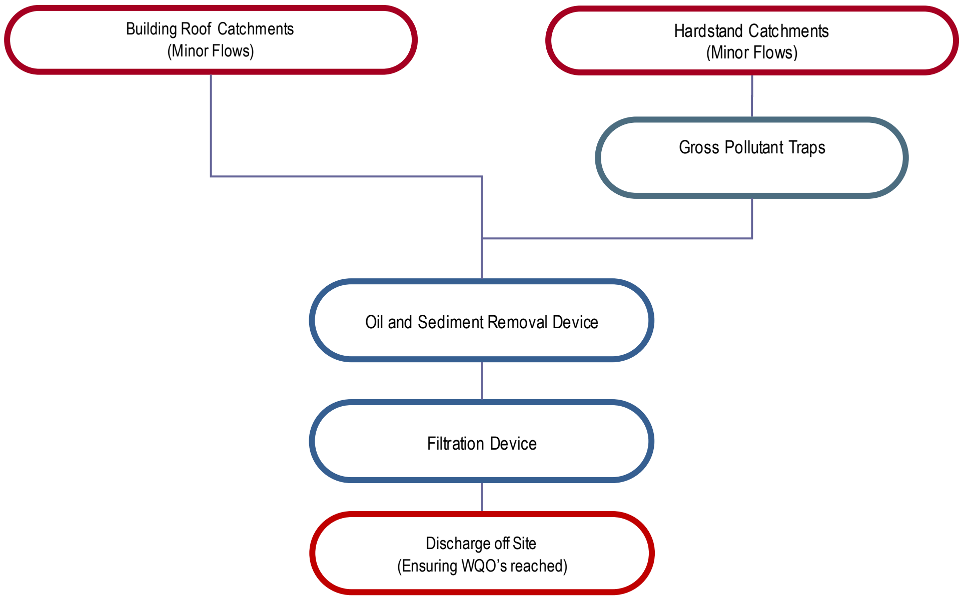

Figure 13: Proposed Water Quality Treatment Train – Catchment B

9.3 Proposed Treatment Devices

Further discussion on each element of this treatment train is provided below.

9.3.1 Stormwater360 Jellyfish

The Stormwater306 Jellyfish filter unit used filtration cartridges to remove high levels of stormwater pollutants including:

- Total Suspended Solids (TSS), median removal efficiency of 89%, including particles down to two microns
- Total Nitrogen (TN), median removal efficiency of 55%
- Total Phosphorous (TP), median removal efficiency of 65%
- Total Copper (Cu), median removal efficiency of 61%
- Total Zinc (Zn), median removal efficiency of 91%.

One Jellyfish JF-2250-4-1, 4 high flow cartridge, 1 draindown cartridge units have been proposed for the development.

The MUSIC modelling parameters for this device are set by the manufacturer, Stormwater 360.

Figure 14: Jellyfish infiltration Unit (Source: Stormwater 360)

9.3.2 Oil and Sediment Removal – HumeCeptor

The HumeCeptor unit slows incoming water to create a non-turbulent treatment environment, allow free oils and debris to rise and sediment to settle. The pollutants the unit can remove include:

- Total Suspended Solids (TSS), median removal efficiency of 80%,
- Total Nitrogen (TN), median removal efficiency of 37%
- Total Phosphorous (TP), median removal efficiency of 53%
- Total Chromium (Cr), median removal efficiency of 44%.
- Total Copper (Cu), median removal efficiency of 29%
- Total Petroleum Hydrocarbon (TPH), median removal efficiency is;
    - 65% <10 ppm (parts per million)
    - 95% 10-50 ppm (typical stormwater)
    - 99% >500ppm (emergency spills)

The MUSIC modelling parameters for this device are set by the manufacturer, Humes.

Figure 15: HumesCeptor Unit (Source: Humes)

9.3.3 EnviroPod Pit Inlet Trap (or approved equivalent)

EnviroPod's (or other similar approved equivalents) provide effective removal of TSS and gross pollutants. EnviroPod's are a filter cage system which are inserted into roadway gully pits to filter and remove pollutants before the water enters the piped drainage system. It is proposed to placed EnviroPod filters within every stormwater inlet pit.

The MUSIC modelling parameters for this device are set by the manufacturer, Stormwater 360.

Parameters	TSS	TP	TN	GP
Input (mg/L)	100	10	10	14.8
Output (mg/L)	46	7	8.7	0
Reduction (%)	54	30	13	100

Figure 16: EnviroPod Pit Inlet Trap (Source: Stormwater 360)

9.3.4 Bio-Detention (Bio-Retention)

Bio-Detention systems are vegetated areas where stormwater is passed through densely planted filter media (loamy sand) allowing the plants to absorb the collected and stored nutrients. Bio-retention basins utilise temporary ponding above the vegetated surface to increase the volume of stored water for treatment. Bio-Detention systems can take a number of forms but all have common features including the extended detention depth above the media surface, the filter media and a low level drainage media and subsoil system. These are shown in the figure below.
One Bio-Detention basin with a surface area of 280m^2 and a filter area of 280m^2 has been proposed for the development.

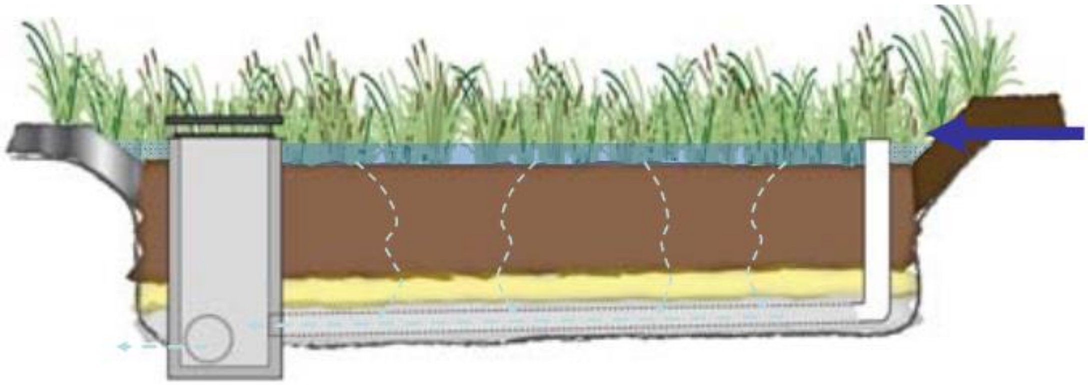

Figure 17: Typical Section of a generic Bio-Detention system (Source: Water by Design)

9.4 Pollutant Reduction Modelling

In order to demonstrate that the proposed treatment train meets the required reduction targets, pollutant reduction modelling is proposed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Software program Version 6.1 by eWater CRC. Pollutant export rates are currently only available for Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorous (TP) and Gross Pollutants (GP). Therefore only quantitative modelling for TSS, TN, TP & GP has been undertaken using MUSIC.

Modelling has only been undertaken on the post-development proposal with SQID's installed so as to demonstrate the percentage reduction for each pollutant type.

9.4.1 MUSIC Program Setup

This section explains the setup of the MUSIC model with the detailed pollutant reduction calculations being included in the MUSIC results in Appendix C.
For Music Modelling (using MUSIC 6.1.0) the following parameters have been used:

Model Parameters	
Meteorological Data:	Sydney 1959
Evaporation Data:	Sydney 1959
Time Step:	6 minute

Table 10: MUSIC modelling parameters

Catchment A modelling Parameters				
Node Description	**Area (Ha)**	**Percentage Impervious (%) / Area Impervious (Ha)**		**Land Use Rainfall and Pollutant Parameters**
Roof Catchment	1.1310	100	1.1310	Urban Roof
Road Catchment	0.4638	100	0.4638	Sealed Road
Car Park Catchment	0.9438	100	0.9438	Sealed Road
Landscaping (Urban Mixed/General)	0.6057	0	0	Urban Residential
	Total: 3.1443Ha	Effective FI 81%		

Table 11: Catchment modelling parameters –Catchment A

Catchment B modelling Parameters				
Node Description	**Area (Ha)**	**Percentage Impervious (%) / Area Impervious (Ha)**		**Land Use Rainfall and Pollutant Parameters**
Roof Catchment	0.4243	100	0.4243	Urban Roof
Road Catchment	0.4209	100	0.4209	Sealed Road
Car Park Catchment	0.4279	100	0.4279	Sealed Road
Landscaping (Urban Mixed/General)	0.7727	0	0	Urban Residential
	Total: 2.0456Ha	Effective FI 62%		

Table 12: Catchment modelling parameters –Catchment B

9.4.2 MUSIC Results & Parameters

MUSIC Runoff Generation Parameters

The following properties have been used in the MUSIC Modelling based on the Land Use Rainfall and Pollutant Parameters.

Parameter	Urban Residential
Rainfall Threshold (mm)	1 (general)
	0.3 (roof)
	1.5 (sealed roads)
Soil Capacity (mm)	54
Initial Storage (%)	10
Field Capacity	51
Infiltration Capacity Coefficient a	135
Infiltration Capacity Coefficient b	4
Initial Depth (mm)	50
Daily Recharge Rate (%)	10
Daily Drainage Rate (%)	10
Daily Deep Seepage Rate (%)	0

Table 13: Recommended MUSIC Runoff Generation Parameters

MUSIC Concentration Parameters

Land-use Type	Parameters	TSS Log10 mg/L		TP Log10 mg/L		TN Log10 mg/L	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Urban Residential	Mean	1.20	2.15	-0.85	-0.60	0.11	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
Urban Roof	Mean	N/A	1.30	N/A	-0.89	N/A	0.30
	STD Dev	N/A	0.32	N/A	0.25	N/A	0.19
Sealed Roads	Mean	1.2	2.43	-0.85	-0.30	0.11	0.34
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19

Table 14: MUSIC Concentration Parameters for Sydney Catchments

MUSIC Bio-Detention Basin Parameters

The Bio-Detention basin has been modelled with the following parameters.

Parameter	Values
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	100.00
Extended Detention Depth (m)	0.30
Surface Area (m^2)	280.00
Filter Media (m^2)	280.00
Unlined Filter Media Perimeter (m)	0.10
Saturated Hydraulic Conductivity (mm/hr)	100.00
Filter Depth (m)	0.50
TN Content of Filter Media (mg/kg)	500.00
Orthophosphate Content of Filter Media (mg/kg)	40.00
Is base lined?	No
Vegetation Properties	Vegetated With Effective Nutrient Removal Plants
Overflow Weir Width (m)	2.00
Underdrain Present	Yes
Submerged Zone with Carbon Present	No

Table 15: MUSIC Bio-Detention Parameters

MUSIC Model

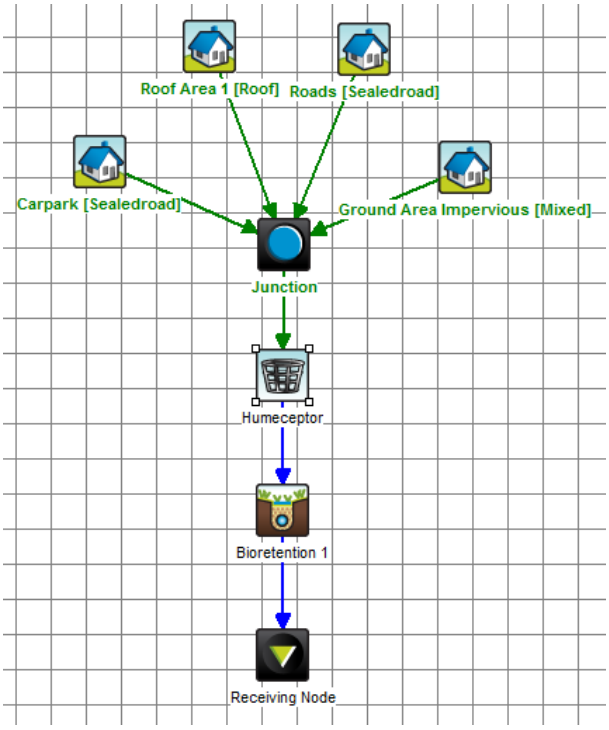

Figure 18: MUSIC Model Catchment A

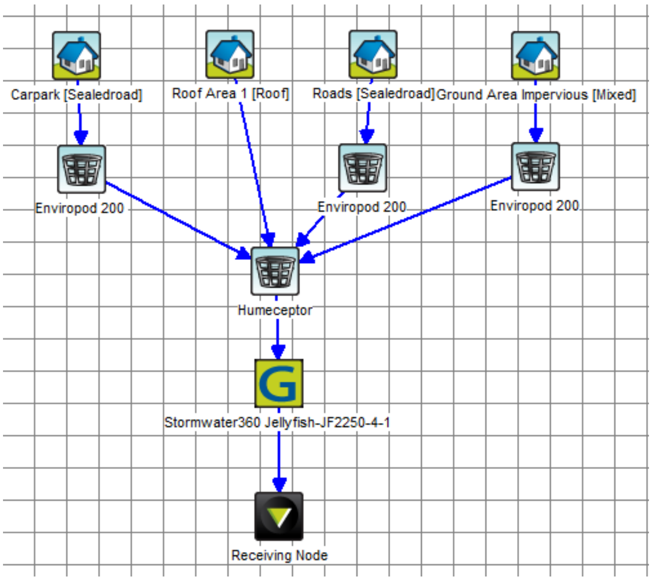

Figure 19: MUSIC Model Catchment B

MUSIC Output

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	38	37.3	1.9
Total Suspended Solids (kg/yr)	7550	617	91.8
Total Phosphorus (kg/yr)	14.3	4.82	66.3
Total Nitrogen (kg/yr)	85	45.1	47
Gross Pollutants (kg/yr)	843	0	100

Figure 20: MUSIC Results – Catchment A

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	21.6	21.6	0
Total Suspended Solids (kg/yr)	4920	385	92.2
Total Phosphorus (kg/yr)	8.82	3.37	61.8
Total Nitrogen (kg/yr)	49.7	27.2	45.3
Gross Pollutants (kg/yr)	415	7.4	98.2

Figure 21: MUSIC Results – Catchment B

9.4.3 Pollutant Reduction Results

A number of management measures have been considered with a focus on reducing polluted runoff volumes from the site. The WSUD principals proposed for stormwater treatment includes the following SQID's:

- EnviroPod Pit Inlet Filters
- Humeceptor
- Stormwater360 Jellyfish JF2250-4-1
- Bio-Detention Basin

The effectiveness of the treatment devices proposed in the above section has been modelled using MUSIC with the overall treatment train efficiency results shown in Table 16 below.

Catchment A

Indicator	Total Site Reduction	Site Targets	Target Achieved
Gross Pollutants	100%	70%	Yes
Total Suspended Solids (TSS)	91.8%	80%	Yes
Total Phosphorus (TP)	66.3%	45%	Yes
Total Nitrogen (TN)	47.0%	45%	Yes

Catchment B

Indicator	Total Site Reduction	Site Targets	Target Achieved
Gross Pollutants	98.2%	70%	Yes
Total Suspended Solids (TSS)	92.2%	80%	Yes
Total Phosphorus (TP)	61.8%	45%	Yes
Total Nitrogen (TN)	45.3%	45%	Yes

Table 16: Treatment Train Efficiencies

Stormwater Quality Treatment

The effectiveness of Humeceptor has been modelled using MUSIC with the oil and sediment removal efficiency results shown in Table 17 below.

Pollutant	Reduction Target	Reduction Achieved
Litter e.g. cans, bottles, wrapping materials, food scraps	Retention up to the 3 month ARI peak flow	100%
Hydrocarbons inc. motor fuels, oils & greases	90%	95%

Table 17: Humeceptor Treatment Train Efficiencies

From the results presented above it can be seen that the proposed SQID's mean that the stormwater quality treatment meets with the reduction targets set for the development.

10. Erosion & Sedimentation Control

Landcom have published a design guide entitled "Managing Urban Stormwater - Soils and Construction" which is regarded as the standard to which erosion and sedimentation control should be designed to within NSW. Maitland City Council specifies compliance with the Landcom design guide in their Development Engineering Standards.

The control of erosion and sedimentation describes the measures incorporated during and following construction of a new development to prevent the pollution and degradation of the downstream watercourse.

Sediment and Erosion Control Plans have been prepared as part of the application documentation and are included in Appendix A of this report.

Common control measures adopted are:

- Sedimentation fences;
- Sedimentation basins;
- Stormwater drainage inlet protection;
- Overland flow diversion swales;
- Shaker Grids and wash downs for vehicles leaving the construction site;
- Dust control measures.

The maintenance of these control measures throughout their intended lifespan will ensure that the risk of erosion and sedimentation pollution of the downstream watercourse will be minimized.

10.1 Site Establishment

During the site establishment phase of the works erosion & sediment control measures will be established for the site. These measures have been identified in the drawings included in the appendix of this report and will include:

- Establishment of sediment control fences around the extent of works to prevent sediment discharge into the surrounding water courses;
- Establishment of a shaker grid and vehicle wash down area at the site entrance to prevent the tracking of materials from the site;
- Maintenance of the existing sediment basin on site;
- Establishment of a water quality testing regime to monitor water discharging from the site to the surrounding water courses.

10.2 Early Works

During the early works the established erosion & sedimentation control measures will be maintained. In addition, dust control measures will be established during the earthworks and maintained until such time as exposed earthworks are stabilised.

All stormwater runoff will be conveyed to sedimentation ponds prior to discharge. This will also assist in dealing with the risk of chemical spills and runoff from concrete works on the site as any contaminates will be caught prior to discharge into the surrounding water courses.

Sediment basins have been sized for the Early Works using Managing Urban Stormwater - Soils and Construction.

10.3 Main Works

During the main works for the project most of the external works will be completed meaning that the risk of erosion and sedimentation contamination of the existing water courses will be reduced. However, where possible, the established erosion & sedimentation control measures will be retained until the completion of the project.

Appendix A – Civil Drawings

CIVIL ENGINEERING WORKS

Sheet List Table

Sheet Number	Sheet Title
CI-000-001	COVER SHEET
CI-070-001	SEDIMENT AND EROSION CONTROL PLAN - SITE ESTABLISHMENT
CI-070-003	SEDIMENT AND EROSION CONTROL PLAN - MAIN WORKS
CI-500-001	STORMWATER CATCHMENT PLAN - EXISTING
CI-500-002	STORMWATER CATCHMENT PLAN - PROPOSED
CI-520-001	STORMWATER MANAGEMENT PLAN
CI-546-001	STORMWATER BASIN DETAILS

NSW GOVERNMENT Health Infrastructure

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B	ISSUED FOR INFORMATION	CPO	IAH	28.07.17
A	ISSUED FOR DRAFT	JDL	IAH	30.06.17

DRAWN:	JDL
DESIGNED:	IAH
VERIFIED:	
APPROVED FOR TENDER:	
APPROVED FOR CONSTRUCTION:	

HEALTH INFRASTRUCTURE NSW

NSW GOVERNMENT Health Infrastructure

ARCHITECT/CLIENT

PROJECT: MAITLAND HOSPITAL

TITLE: SEDIMENT AND EROSION CONTROL PLAN - SITE ESTABLISHMENT

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PROJECT: MAITLAND HOSPITAL

TITLE: SEDIMENT AND EROSION CONTROL PLAN - MAIN WORKS

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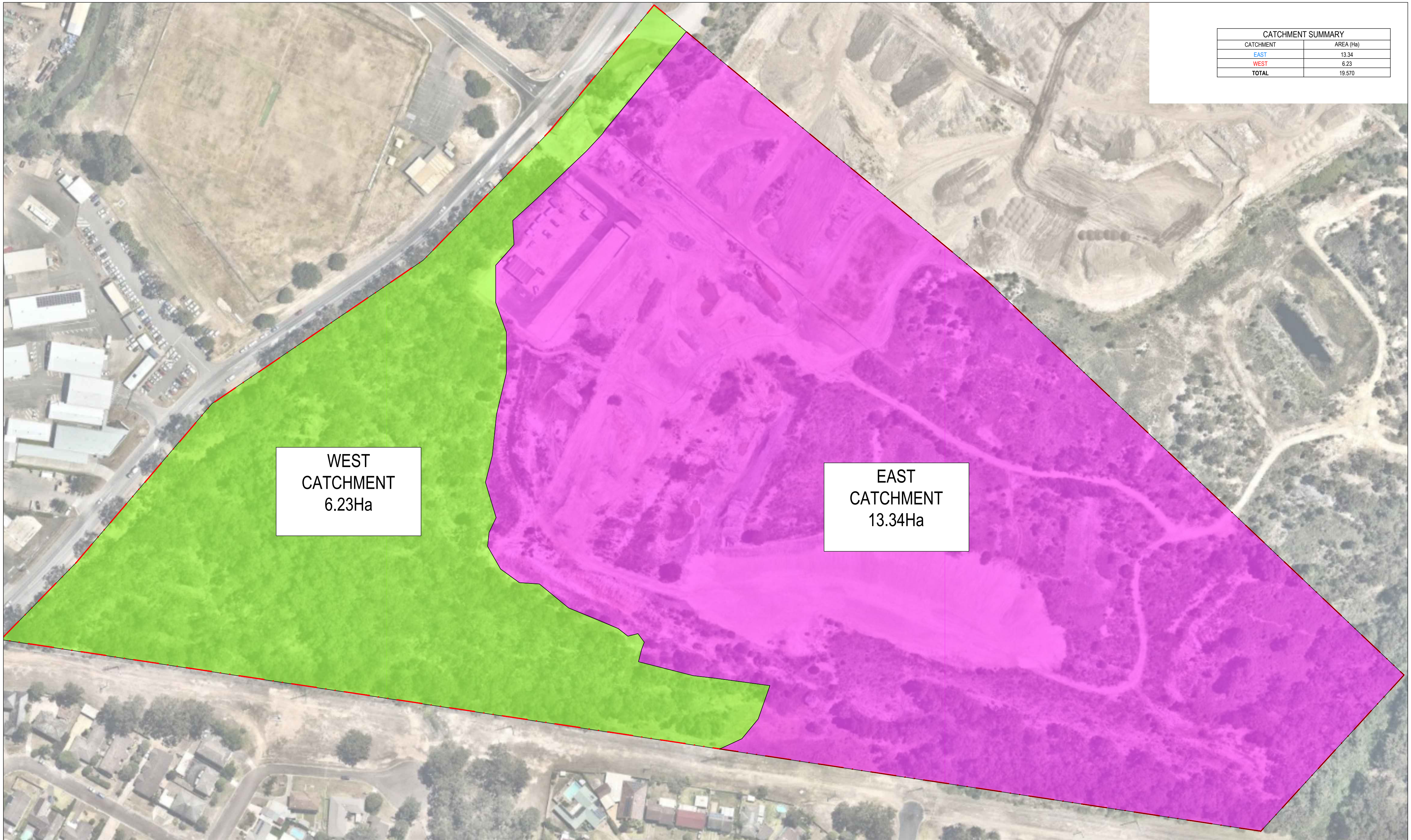

CATCHMENT SUMMARY	
CATCHMENT	AREA (Ha)
EAST	13.34
WEST	6.23
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APPROVED FOR CONSTRUCTION:	

ARCHITECT/CLIENT: HEALTH INFRASTRUCTURE NSW

NSW GOVERNMENT Health Infrastructure

PROJECT: MAITLAND HOSPITAL

TITLE: STORMWATER CATCHMENT PLAN - EXISTING

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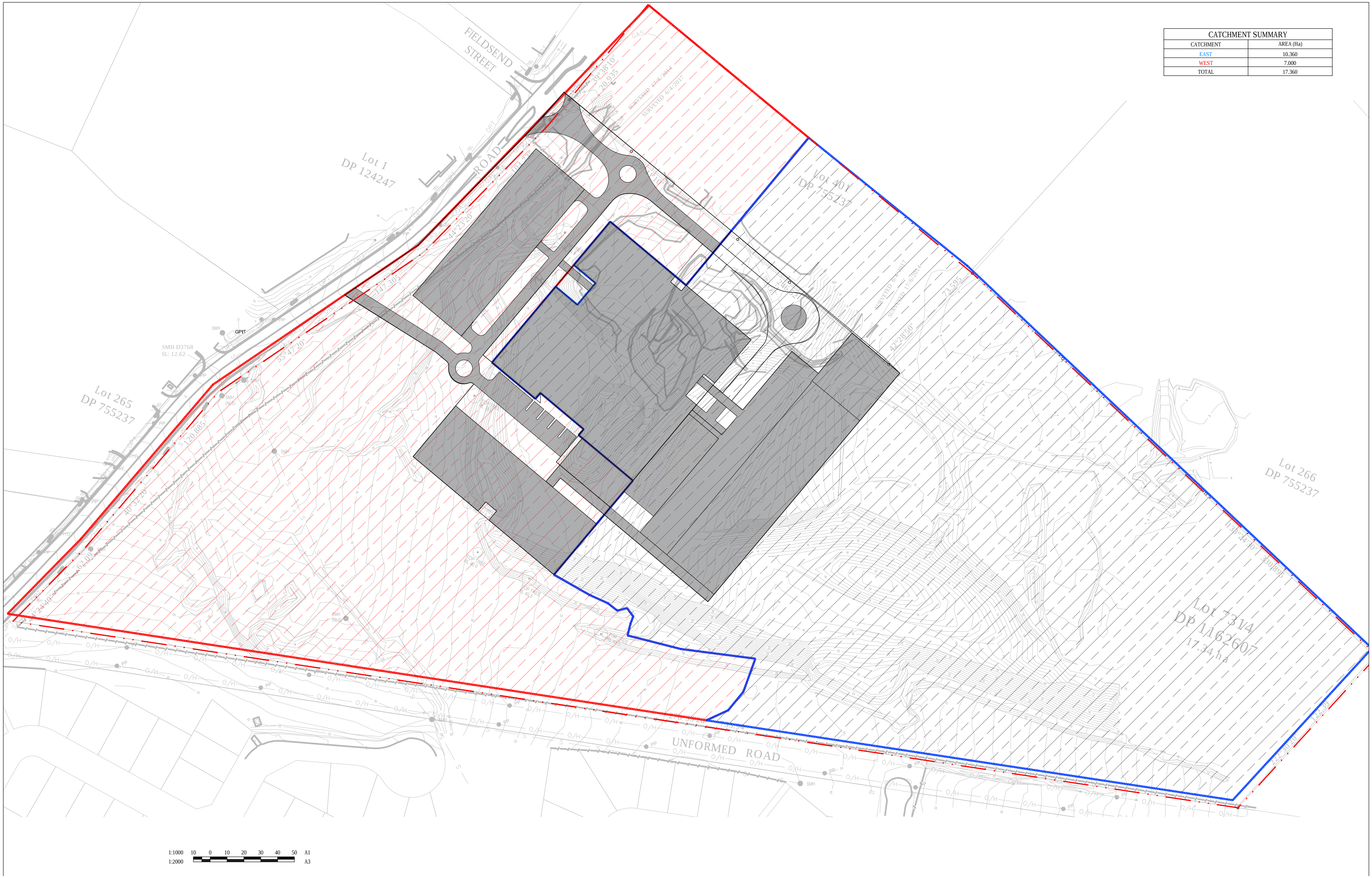

CATCHMENT SUMMARY	
CATCHMENT	AREA (Ha)
EAST	10.360
WEST	7.000
TOTAL	17.360

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HEALTH INFRASTRUCTURE NSW

Health Infrastructure

ARCHITECT/CLIENT

MAITLAND HOSPITAL

PROJECT

STORMWATER CATCHMENT PLAN - PROPOSED

TITLE

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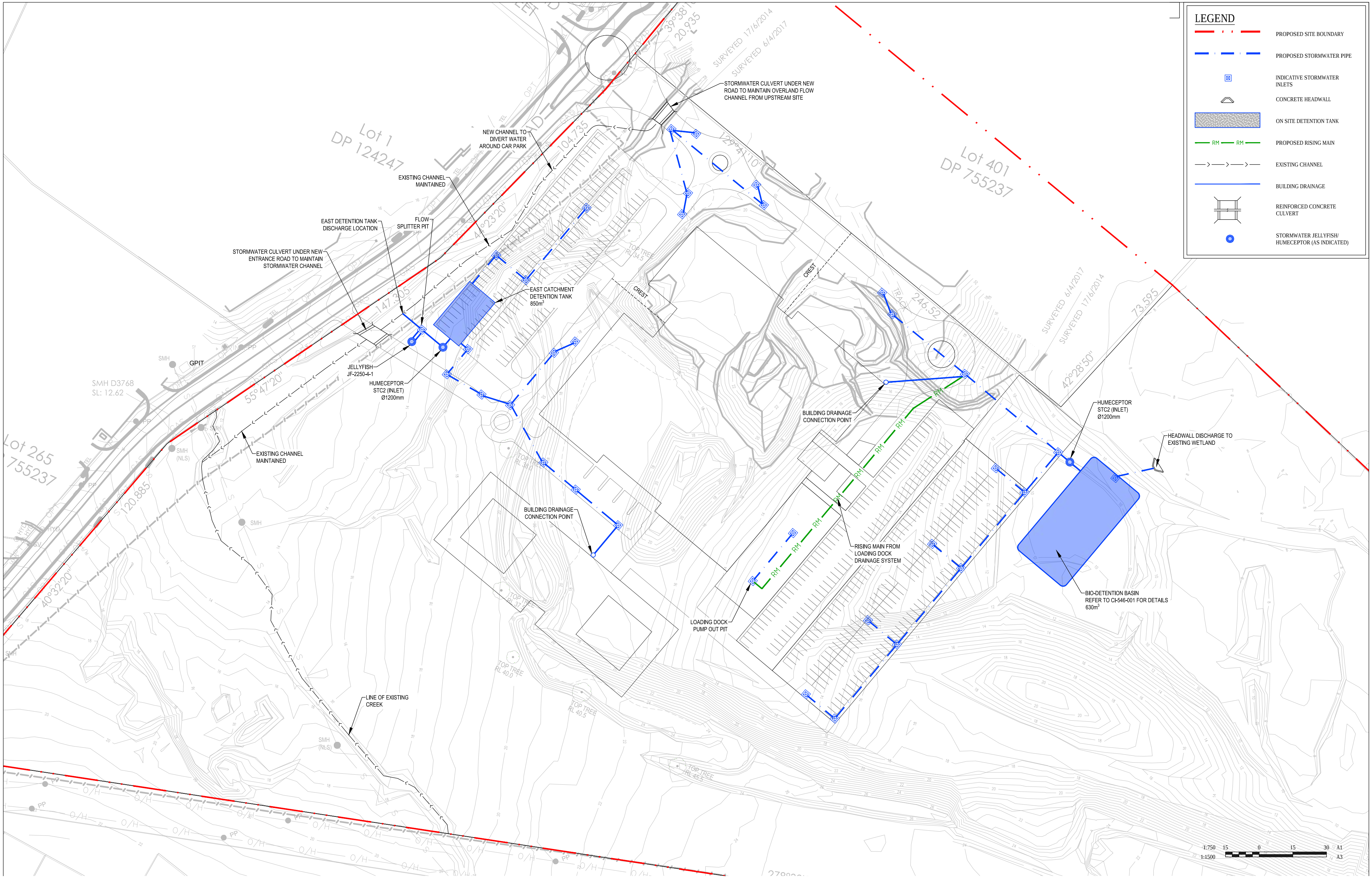

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HEALTH INFRASTRUCTURE NSW

NSW GOVERNMENT Health Infrastructure

ARCHITECT/CLIENT

PROJECT: MAITLAND HOSPITAL

TITLE: STORMWATER MANAGEMENT PLAN

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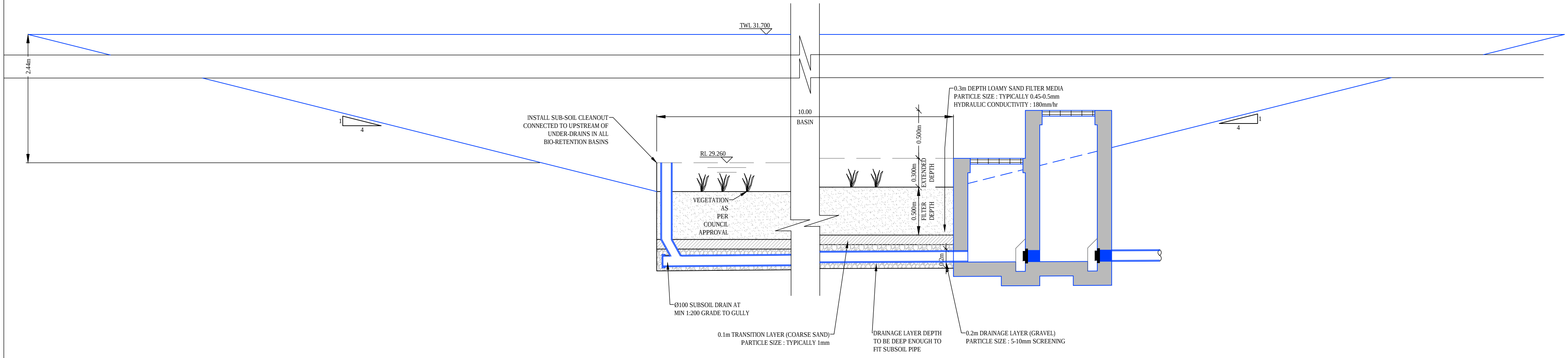

BIO-DETENTION BASIN CROSS SECTION

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HEALTH INFRASTRUCTURE NSW

NSW GOVERNMENT Health Infrastructure

ARCHITECT/CLIENT

PROJECT: MAITLAND HOSPITAL

TITLE: STORMWATER BASIN DETAILS

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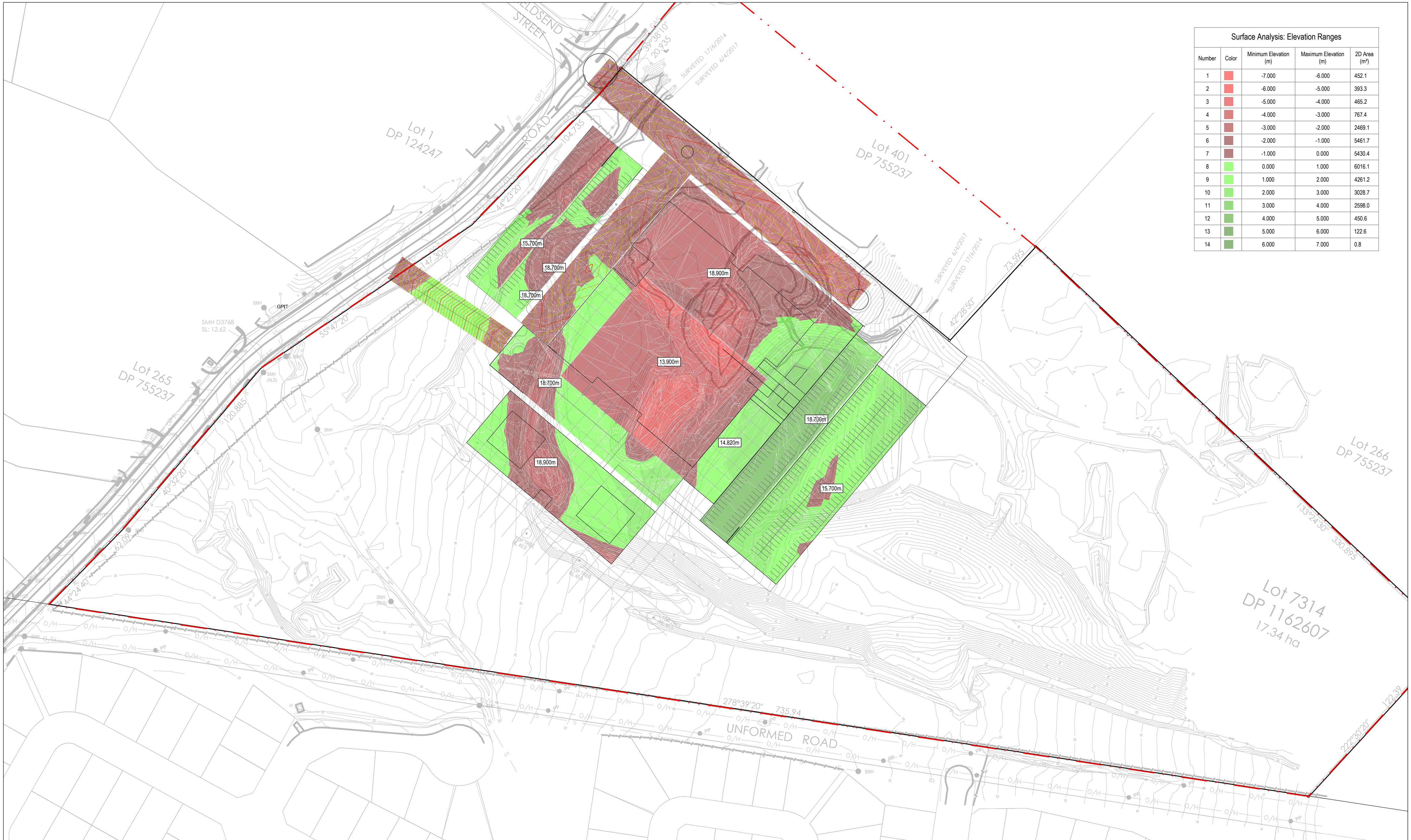
Appendix B – Early Works Plans



Surface Analysis: Elevation Ranges				
Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)
1		-7.000	-6.000	452.1
2		-6.000	-5.000	393.3
3		-5.000	-4.000	465.2
4		-4.000	-3.000	767.4
5		-3.000	-2.000	2469.1
6		-2.000	-1.000	5461.7
7		-1.000	0.000	5430.4
8		0.000	1.000	6016.1
9		1.000	2.000	4261.2
10		2.000	3.000	3028.7
11		3.000	4.000	2598.0
12		4.000	5.000	450.6
13		5.000	6.000	122.6
14		6.000	7.000	0.8

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HEALTH INFRASTRUCTURE NSW

NSW GOVERNMENT Health Infrastructure

ARCHITECT/CLIENT

PROJECT: MAITLAND HOSPITAL

TITLE: EARLY WORKS - BULK EARTHWORKS

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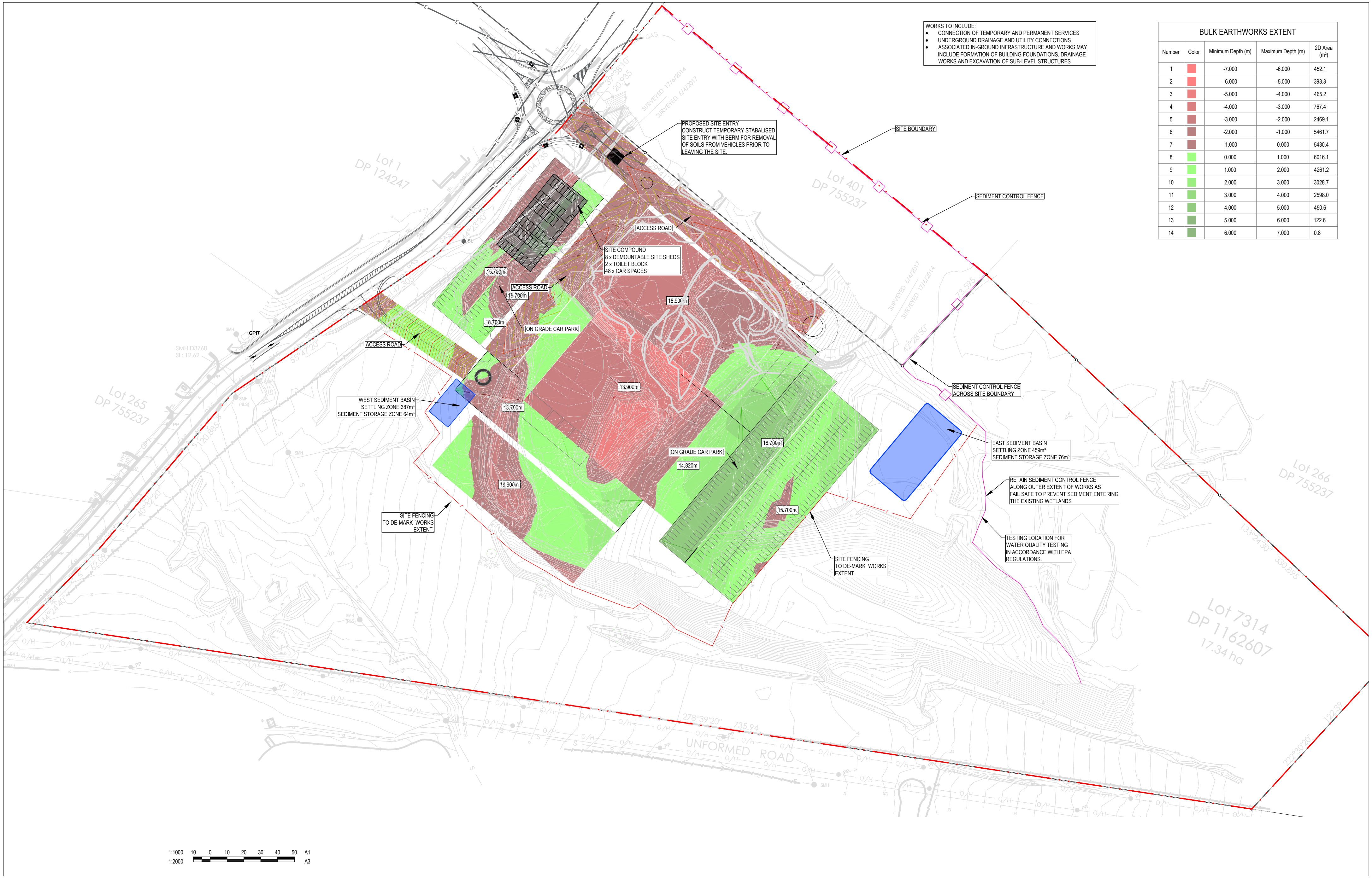
WORKS TO INCLUDE:
- CONNECTION OF TEMPORARY AND PERMANENT SERVICES
- UNDERGROUND DRAINAGE AND UTILITY CONNECTIONS
- ASSOCIATED IN-GROUND INFRASTRUCTURE AND WORKS MAY INCLUDE FORMATION OF BUILDING FOUNDATIONS, DRAINAGE WORKS AND EXCAVATION OF SUB-LEVEL STRUCTURES

BULK EARTHWORKS EXTENT				
Number	Color	Minimum Depth (m)	Maximum Depth (m)	2D Area (m^2)
1		-7.000	-6.000	452.1
2		-6.000	-5.000	393.3
3		-5.000	-4.000	465.2
4		-4.000	-3.000	767.4
5		-3.000	-2.000	2469.1
6		-2.000	-1.000	5461.7
7		-1.000	0.000	5430.4
8		0.000	1.000	6016.1
9		1.000	2.000	4261.2
10		2.000	3.000	3028.7
11		3.000	4.000	2598.0
12		4.000	5.000	450.6
13		5.000	6.000	122.6
14		6.000	7.000	0.8



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NSW GOVERNMENT Health Infrastructure

PROJECT: MAITLAND HOSPITAL

TITLE: EARLYWORKS PLAN - GENERAL ARRANGEMENT

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Appendix C – DRAINS Model Results

1 Year Design Storm Results

PIT / NODE DETAILS

Name	Type	Family	Version 13 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
Ex W	Node							0		449	-144		6		No	
Ex E	Node							0		641	-144		9		No	
N19	Node							0		454.167	-507.639		45		No	
N20	Node							0		658.333	-522.222		49		No	
E Junction	OnGrade	Standard Pits	Dummy to Catch All		1.5	13.7		0	0	787.674	-411.998	No	6952	1 x Ku	No	Existing
E Out	Node					10		0		902.083	-414.583		6925		No	
W Junction	OnGrade	Standard Pits	Dummy to Catch All		1.5	9.5		0	0	346.412	-399.942	No	6946	1 x Ku	No	Existing
W Out	Node					9		0		227.083	-398.611		6923		No	
PR W	Node					10		0		1199.2	-155.2		2784335		No	
PR E	Node					10		0		1555.6	-160		2784351		No	

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Lengt	id
E Basin Low	12	315		Orifice		150	12.15			650	-362	No			116
	13	315													
	14	315													
W Tank	8.1	440		Orifice		130	8.325			445.756	-348.341	No			2636
	9	440													
	10	440													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
C Ex W	Ex W	6.23	0	100	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C Ex E	Ex E	11.122	0	100	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				
C P W	N19	4.768	0	100	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C P E	N20	7.3682	0	100	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				
C E Basin	E Basin Low	2.815	90	10	0	5	5	5														
C W Tank	W Tank	2.373	60	40	0	5	5	5														
C PR W	PR W	7.14	20	80	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C PR E	PR E	11.122	13	87	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)
P Low	E Basin Low	E Junction	10	12	10	20	Concrete, under roads, 1% minimum slope	300	300	0.013	Existing	1	E Junction	0					
P E Junction	E Junction	E Out	10	10	9.9	1	Concrete, under roads, 1% minimum slope	1050	1070	0.013	Existing	1	E Out	0					
P W	W Tank	W Junction	10	8.1	8	1	Concrete, under roads, 1% minimum slope	450	450	0.013	Existing	1	W Junction	0					
P W Junction	W Junction	W Out	10	8	7.9	1	Concrete, under roads, 1% minimum slope	750	750	0.013	Existing	1	W Out	0					

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	etc etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	
OF Ex W	N19	W Junction	0.1				4 m wide pathway	0.3	0.15	0.4	1	0	6824	9.5
OF Ex E	N20	E Junction	0.1				4 m wide pathway	0.3	0.15	0.4	1	0	6872	9.5
OF15797	E Basin Low	E Junction	0.1	14	3	1.74	4 m wide pathway	0.3	0.15	0.4	1	0	3283268	10
OF E Junction	E Junction	E Out	0.1				4 m wide pathway	0.3	0.15	0.4	1	0	15069	9.5
OF W	W Tank	W Junction	0.1	10	4	1.74	4 m wide pathway	0.3	0.15	0.4	1	0	2614	9.5
OF W Junction	W Junction	W Out	0.1				4 m wide pathway	0.3	0.15	0.4	1	0	15087	9.5

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
P Low	Concrete, under roads, 1% minimum slope	300	0.6	-0.33	Unsafe
P E Junction	Concrete, under roads, 1% minimum slope	1070	0.6	-1.05	Unsafe
P W	Concrete, under roads, 1% minimum slope	450	0.6	-0.49	Unsafe
P W Junction	Concrete, under roads, 1% minimum slope	750	0.6	0.29	Unsafe

This model has no pipes with non-return valves

100 Year Design Storm Results

PIT / NODE DETAILS

Name	Type	Family	Version 13 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
Ex W	Node							0		449	-144		6		No	
Ex E	Node							0		641	-144		9		No	
N19	Node							0		454.167	-507.639		45		No	
N20	Node							0		658.333	-522.222		49		No	
E Junction	OnGrade	Standard Pits	Dummy to Catch All		1.5	13.7		0	0	787.674	-411.998	No	6952	1 x Ku	No	Existing
E Out	Node					10		0		902.083	-414.583		6925		No	
W Junction	OnGrade	Standard Pits	Dummy to Catch All		1.5	9.5		0	0	346.412	-399.942	No	6946	1 x Ku	No	Existing
W Out	Node					9		0		227.083	-398.611		6923		No	
PR W	Node					10		0		1199.2	-155.2		2784335		No	
PR E	Node					10		0		1555.6	-160		2784351		No	

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Lengt	id
E Basin Low	12	315		Orifice		150	12.15			650	-362	No			116
	13	315													
	14	315													
W Tank	8.1	440		Orifice		130	8.325			445.756	-348.341	No			2636
	9	440													
	10	440													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
C Ex W	Ex W	6.23	0	100	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C Ex E	Ex E	11.122	0	100	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				
C P W	N19	4.768	0	100	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C P E	N20	7.3682	0	100	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				
C E Basin	E Basin Low	2.815	90	10	0	5	5	5														
C W Tank	W Tank	2.373	60	40	0	5	5	5														
C PR W	PR W	7.14	20	80	0	0	0	0	350	350	350	2	2	2	0.025	0.025	0.025	6.95161e-310				
C PR E	PR E	11.122	13	87	0	0	0	0	400	400	400	2	2	2	0.025	0.025	0.025	6.95161e-310				

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)
P Low	E Basin Low	E Junction	10	12	10	20	Concrete, under roads, 1% minimum slope	300	300	0.013	Existing	1	E Junction	0					
P E Junction	E Junction	E Out	10	10	9.9	1	Concrete, under roads, 1% minimum slope	1050	1070	0.013	Existing	1	E Out	0					
P W	W Tank	W Junction	10	8.1	8	1	Concrete, under roads, 1% minimum slope	450	450	0.013	Existing	1	W Junction	0					
P W Junction	W Junction	W Out	10	8	7.9	1	Concrete, under roads, 1% minimum slope	750	750	0.013	Existing	1	W Out	0					

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	etc etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %		id			
OF Ex W	N19	W Junction	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		6824			9.5
OF Ex E	N20	E Junction	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		6872			9.5
OF15797	E Basin Low	E Junction	0.1	14	3	1.74	4 m wide pathway	0.3	0.15	0.4	1	0		3283268			10
OF E Junction	E Junction	E Out	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		15069			9.5
OF W	W Tank	W Junction	0.1	10	4	1.74	4 m wide pathway	0.3	0.15	0.4	1	0		2614			9.5
OF W Junction	W Junction	W Out	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		15087			9.5

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
P Low	Concrete, under roads, 1% minimum slope	300	0.6	-0.33	Unsafe
P E Junction	Concrete, under roads, 1% minimum slope	1070	0.6	-1.05	Unsafe
P W	Concrete, under roads, 1% minimum slope	450	0.6	-0.49	Unsafe
P W Junction	Concrete, under roads, 1% minimum slope	750	0.6	0.29	Unsafe

This model has no pipes with non-return valves

Appendix D – MUSIC Model Results

CATCHMENT 'A' MUSIC RESULTS

Source nodes
Location,Carpark,Roof Area 1,Ground Area Impervious,Roads
ID,2,4,6,7
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Sealedroad,Roof,Mixed,Sealedroad
Total Area (ha),0.944,1.131,0.606,0.464
Area Impervious (ha),0.944,1.131,0,0.464
Area Pervious (ha),0,0,0.606,0
Field Capacity (mm),51,51,51,51
Pervious Area Infiltration Capacity coefficient - a,135,135,135,135
Pervious Area Infiltration Capacity exponent - b,4,4,4,4
Impervious Area Rainfall Threshold (mm/day),1.5,0.3,1,1.5
Pervious Area Soil Storage Capacity (mm),54,54,54,54
Pervious Area Soil Initial Storage (% of Capacity),10,10,10,10
Groundwater Initial Depth (mm),50,50,50,50
Groundwater Daily Recharge Rate (%),10,10,10,10
Groundwater Daily Baseflow Rate (%),10,10,10,10
Groundwater Daily Deep Seepage Rate (%),0,0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),2.43,1.3,2.15,2.43
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.32,0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.3,-0.89,-0.6,-0.3
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.34,0.3,0.3,0.34
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),1.2,1.1,1.2,1.2
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.17,0.17,0.17,0.17
Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-0.85,-0.82,-0.85,-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19,0,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0.11,0.32,0.11,0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off
Flow based constituent generation - flow file, , , ,
Flow based constituent generation - base flow column, , , ,
Flow based constituent generation - pervious flow column, , , ,
Flow based constituent generation - impervious flow column, , , ,
Flow based constituent generation - unit, , , ,
OUT - Mean Annual Flow (ML/yr),12.2,16.3,3.52,6.00
OUT - TSS Mean Annual Load (kg/yr),4.51E3,421,649,2.08E3

Appendix D – MUSIC Model Results

OUT - TP Mean Annual Load (kg/yr),7.26,2.47,1.05,3.56
OUT - TN Mean Annual Load (kg/yr),29.4,34.9,7.43,14.1
OUT - Gross Pollutant Mean Annual Load (kg/yr),291,409,0.00,143
Rain In (ML/yr),14.0618,16.8473,9.02694,6.91172
ET Loss (ML/yr),1.86251,0.558069,5.5025,0.915471
Deep Seepage Loss (ML/yr),0,0,0,0
Baseflow Out (ML/yr),0,0,0,0
Imp. Stormflow Out (ML/yr),12.1993,16.2892,0,5.99624
Perv. Stormflow Out (ML/yr),0,0,3.52445,0
Total Stormflow Out (ML/yr),12.1993,16.2892,3.52445,5.99624
Total Outflow (ML/yr),12.1993,16.2892,3.52445,5.99624
Change in Soil Storage (ML/yr),0,0,-1.1E-5,0
TSS Baseflow Out (kg/yr),0,0,0,0
TSS Total Stormflow Out (kg/yr),4513.24,420.964,649.172,2084.57
TSS Total Outflow (kg/yr),4513.24,420.964,649.172,2084.57
TP Baseflow Out (kg/yr),0,0,0,0
TP Total Stormflow Out (kg/yr),7.26436,2.46665,1.04526,3.55711
TP Total Outflow (kg/yr),7.26436,2.46665,1.04526,3.55711
TN Baseflow Out (kg/yr),0,0,0,0
TN Total Stormflow Out (kg/yr),29.3506,34.9087,7.43301,14.0784
TN Total Outflow (kg/yr),29.3506,34.9087,7.43301,14.0784
GP Total Outflow (kg/yr),291.187,408.671,0,143.126

No Imported Data Source nodes

USTM treatment nodes
Location,Bioretention 1
ID,5
Node Type,BioRetentionNodeV4
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),100
Inlet pond volume,
Area (sqm),280
Initial Volume (m^3),
Extended detention depth (m),0.3
Number of Rainwater tanks,
Permanent Pool Volume (cubic metres),
Proportion vegetated,
Equivalent Pipe Diameter (mm),
Overflow weir width (m),2
Notional Detention Time (hrs),
Orifice Discharge Coefficient,
Weir Coefficient,1.7
Number of CSTR Cells,3
Total Suspended Solids - k (m/yr),8000
Total Suspended Solids - C* (mg/L),20
Total Suspended Solids - C** (mg/L),
Total Phosphorus - k (m/yr),6000
Total Phosphorus - C* (mg/L),0.13
Total Phosphorus - C** (mg/L),
Total Nitrogen - k (m/yr),500
Total Nitrogen - C* (mg/L),1.4
Total Nitrogen - C** (mg/L),
Threshold Hydraulic Loading for C** (m/yr),

Horizontal Flow Coefficient,3
Reuse Enabled,Off
Max drawdown height (m),
Annual Demand Enabled,Off
Annual Demand Value (ML/year),
Annual Demand Distribution,
Annual Demand Monthly Distribution: Jan,
Annual Demand Monthly Distribution: Feb,
Annual Demand Monthly Distribution: Mar,
Annual Demand Monthly Distribution: Apr,
Annual Demand Monthly Distribution: May,
Annual Demand Monthly Distribution: Jun,
Annual Demand Monthly Distribution: Jul,
Annual Demand Monthly Distribution: Aug,
Annual Demand Monthly Distribution: Sep,
Annual Demand Monthly Distribution: Oct,
Annual Demand Monthly Distribution: Nov,
Annual Demand Monthly Distribution: Dec,
Daily Demand Enabled,Off
Daily Demand Value (ML/day),
Custom Demand Enabled,Off
Custom Demand Time Series File,
Custom Demand Time Series Units,
Filter area (sqm),280
Filter perimeter (m),0.1
Filter depth (m),0.5
Filter Median Particle Diameter (mm),
Saturated Hydraulic Conductivity (mm/hr),100
Infiltration Media Porosity,0.35
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Vegetation Type,Vegetated with Effective Nutrient Removal Plants
Total Nitrogen Content in Filter (mg/kg),500
Orthophosphate Content in Filter (mg/kg),40
Is Base Lined?,No
Is Underdrain Present?,Yes
Is Submerged Zone Present?,No
Submerged Zone Depth (m),
B for Media Soil Texture,13
Proportion of upstream impervious area treated,
Exfiltration Rate (mm/hr),0
Evaporative Loss as % of PET,100
Depth in metres below the drain pipe,
TSS A Coefficient,
TSS B Coefficient,
TP A Coefficient,
TP B Coefficient,
TN A Coefficient,
TN B Coefficient,
Sfc,0.61
S*,0.37

Appendix D – MUSIC Model Results

Sw,0.11
Sh,0.05
Emax (m/day),0.008
Ew (m/day),0.001
IN - Mean Annual Flow (ML/yr),38.0
IN - TSS Mean Annual Load (kg/yr),1.90E3
IN - TP Mean Annual Load (kg/yr),11.1
IN - TN Mean Annual Load (kg/yr),77.8
IN - Gross Pollutant Mean Annual Load (kg/yr),211
OUT - Mean Annual Flow (ML/yr),37.3
OUT - TSS Mean Annual Load (kg/yr),633
OUT - TP Mean Annual Load (kg/yr),4.91
OUT - TN Mean Annual Load (kg/yr),45.7
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
Flow In (ML/yr),38.0091
ET Loss (ML/yr),0.722874
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),20.2046
Weir Out (ML/yr),17.0705
Transfer Function Out (ML/yr),0
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,1.93097
TSS Flow In (kg/yr),1901.41
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),47.0794
TSS Weir Out (kg/yr),586.09
TSS Transfer Function Out (kg/yr),0
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,66.7
TP Flow In (kg/yr),11.1049
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),1.18406
TP Weir Out (kg/yr),3.72435
TP Transfer Function Out (kg/yr),0
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,55.7995
TN Flow In (kg/yr),77.8046
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0

TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),12.171
TN Weir Out (kg/yr),33.56
TN Transfer Function Out (kg/yr),0
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,41.2233
GP Flow In (kg/yr),210.745
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),0
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100
PET Scaling Factor,2.1

Generic treatment nodes
Location,Humeceptor Interim Blacktown Node 2013-07-19
ID,8
Node Type,GPTNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),100
Flow Transfer Function
Input (cum/sec),0
Output (cum/sec),0
Input (cum/sec),10
Output (cum/sec),10
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Gross Pollutant Transfer Function
Enabled,True
Input (kg/ML),0
Output (kg/ML),0
Input (kg/ML),20

Appendix D – MUSIC Model Results

Output (kg/ML),5
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Total Nitrogen Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),1
Output (mg/L),1
Input (mg/L),10
Output (mg/L),8.5
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Phosphorus Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),0.1
Output (mg/L),0.1
Input (mg/L),5
Output (mg/L),3.5
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),

Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Suspended Solids Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),15
Output (mg/L),15
Input (mg/L),1000
Output (mg/L),200
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
TSS Flow based Efficiency Enabled,Off
TSS Flow based Efficiency,
TP Flow based Efficiency Enabled,Off
TP Flow based Efficiency,
TN Flow based Efficiency Enabled,Off
TN Flow based Efficiency,
GP Flow based Efficiency Enabled,Off
GP Flow based Efficiency,
IN - Mean Annual Flow (ML/yr),38.0
IN - TSS Mean Annual Load (kg/yr),7.67E3
IN - TP Mean Annual Load (kg/yr),14.3
IN - TN Mean Annual Load (kg/yr),85.8
IN - Gross Pollutant Mean Annual Load (kg/yr),843
OUT - Mean Annual Flow (ML/yr),38.0
OUT - TSS Mean Annual Load (kg/yr),1.90E3
OUT - TP Mean Annual Load (kg/yr),11.1
OUT - TN Mean Annual Load (kg/yr),77.8
OUT - Gross Pollutant Mean Annual Load (kg/yr),211
Flow In (ML/yr),38.0091
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0

Appendix D – MUSIC Model Results

Transfer Function Out (ML/yr),38.0091
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,0
TSS Flow In (kg/yr),7667.95
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),0
TSS Weir Out (kg/yr),0
TSS Transfer Function Out (kg/yr),1901.41
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,75.2031
TP Flow In (kg/yr),14.3334
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),11.1049
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,22.5247
TN Flow In (kg/yr),85.7708
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),77.8046
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,9.28775
GP Flow In (kg/yr),842.982
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),210.745
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100

Appendix D – MUSIC Model Results

Other nodes
Location,Receiving Node,Junction
ID,1,3
Node Type,ReceivingNode,JunctionNode
IN - Mean Annual Flow (ML/yr),37.3,38.0
IN - TSS Mean Annual Load (kg/yr),633,7.67E3
IN - TP Mean Annual Load (kg/yr),4.91,14.3
IN - TN Mean Annual Load (kg/yr),45.7,85.8
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,843
OUT - Mean Annual Flow (ML/yr),37.3,38.0
OUT - TSS Mean Annual Load (kg/yr),633,7.67E3
OUT - TP Mean Annual Load (kg/yr),4.91,14.3
OUT - TN Mean Annual Load (kg/yr),45.7,85.8
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,843
% Load Reduction,1.93,-1.08E-12
TSS % Load Reduction,91.7,107E-15
TN % Load Reduction,46.7,199E-15
TP % Load Reduction,65.8,112E-15
GP % Load Reduction,100,-378E-15

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,2,5,4,6,7,3,8
Target node ID,3,1,3,3,3,8,5
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , ,
Muskingum theta, , , , , , ,
IN - Mean Annual Flow (ML/yr),12.2,37.3,16.3,3.52,6.00,38.0,38.0
IN - TSS Mean Annual Load (kg/yr),4.51E3,633,421,649,2.08E3,7.67E3,1.90E3
IN - TP Mean Annual Load (kg/yr),7.26,4.91,2.47,1.05,3.56,14.3,11.1
IN - TN Mean Annual Load (kg/yr),29.4,45.7,34.9,7.43,14.1,85.8,77.8
IN - Gross Pollutant Mean Annual Load (kg/yr),291,0.00,409,0.00,143,843,211
OUT - Mean Annual Flow (ML/yr),12.2,37.3,16.3,3.52,6.00,38.0,38.0
OUT - TSS Mean Annual Load (kg/yr),4.51E3,633,421,649,2.08E3,7.67E3,1.90E3
OUT - TP Mean Annual Load (kg/yr),7.26,4.91,2.47,1.05,3.56,14.3,11.1
OUT - TN Mean Annual Load (kg/yr),29.4,45.7,34.9,7.43,14.1,85.8,77.8
OUT - Gross Pollutant Mean Annual Load (kg/yr),291,0.00,409,0.00,143,843,211

Catchment Details
Catchment Name,32489-1-MUISC-BIO
Timestep,6 Minutes
Start Date,1/01/1959
End Date,31/12/1959 11:54:00 PM
Rainfall Station, 66062 SYDNEY
ET Station,Monthly User Defined
Mean Annual Rainfall (mm), 1490
Mean Annual ET (mm), 1260

CATCHMENT 'B' MUSIC RESULTS

Source nodes
Location,Carpark,Roof Area 1,Ground Area Impervious,Roads
ID,2,3,4,5
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Sealedroad,Roof,Mixed,Sealedroad

Appendix D – MUSIC Model Results

Total Area (ha),0.428,0.424,0.773,0.421
Area Impervious (ha),0.428,0.424,0,0.421
Area Pervious (ha),0,0,0.773,0
Field Capacity (mm),51,51,51,51
Pervious Area Infiltration Capacity coefficient - a,135,135,135,135
Pervious Area Infiltration Capacity exponent - b,4,4,4,4
Impervious Area Rainfall Threshold (mm/day),1.5,0.3,1,1.5
Pervious Area Soil Storage Capacity (mm),54,54,54,54
Pervious Area Soil Initial Storage (% of Capacity),10,10,10,10
Groundwater Initial Depth (mm),50,50,50,50
Groundwater Daily Recharge Rate (%),10,10,10,10
Groundwater Daily Baseflow Rate (%),10,10,10,10
Groundwater Daily Deep Seepage Rate (%),0,0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),2.43,1.3,2.15,2.43
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.32,0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.3,-0.89,-0.6,-0.3
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25,0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.34,0.3,0.3,0.34
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19,0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),1.2,1.1,1.2,1.2
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.17,0.17,0.17,0.17
Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-0.85,-0.82,-0.85,-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19,0,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0.11,0.32,0.11,0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12,0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0,0
Flow based constituent generation - enabled,Off,Off,Off,Off
Flow based constituent generation - flow file, , , ,
Flow based constituent generation - base flow column, , , ,
Flow based constituent generation - pervious flow column, , , ,
Flow based constituent generation - impervious flow column, , , ,
Flow based constituent generation - unit, , , ,
OUT - Mean Annual Flow (ML/yr),5.53,6.11,4.50,5.44
OUT - TSS Mean Annual Load (kg/yr),1.96E3,161,831,1.88E3
OUT - TP Mean Annual Load (kg/yr),3.29,0.944,1.28,3.16
OUT - TN Mean Annual Load (kg/yr),13.2,13.3,9.50,12.9
OUT - Gross Pollutant Mean Annual Load (kg/yr),132,153,0.00,130
Rain In (ML/yr),6.37546,6.31588,11.5146,6.27119
ET Loss (ML/yr),0.844444,0.209214,7.01887,0.830632
Deep Seepage Loss (ML/yr),0,0,0,0
Baseflow Out (ML/yr),0,0,0,0
Imp. Stormflow Out (ML/yr),5.53102,6.10666,0,5.44056
Perv. Stormflow Out (ML/yr),0,0,4.49571,0

Appendix D – MUSIC Model Results

Total Stormflow Out (ML/yr),5.53102,6.10666,4.49571,5.44056
Total Outflow (ML/yr),5.53102,6.10666,4.49571,5.44056
Change in Soil Storage (ML/yr),0,0,-1.4E-5,0
TSS Baseflow Out (kg/yr),0,0,0,0
TSS Total Stormflow Out (kg/yr),1956.33,160.831,831.153,1876.57
TSS Total Outflow (kg/yr),1956.33,160.831,831.153,1876.57
TP Baseflow Out (kg/yr),0,0,0,0
TP Total Stormflow Out (kg/yr),3.29121,0.943843,1.28086,3.16347
TP Total Outflow (kg/yr),3.29121,0.943843,1.28086,3.16347
TN Baseflow Out (kg/yr),0,0,0,0
TN Total Stormflow Out (kg/yr),13.1604,13.283,9.49513,12.9245
TN Total Outflow (kg/yr),13.1604,13.283,9.49513,12.9245
GP Total Outflow (kg/yr),132.021,153.206,0,129.862

No Imported Data Source nodes

No USTM treatment nodes

Generic treatment nodes
Location,Enviropod 200,Enviropod 200,Enviropod 200 ,Humeceptor,Stormwater360 Jellyfish-JF2250-4-1
ID,6,7,8,9,10
Node Type,GPTNode,GPTNode,GPTNode,GPTNode,GenericNode
Lo-flow bypass rate (cum/sec),0,0,0,0,0
Hi-flow bypass rate (cum/sec),0.04,0.04,0.04,100,0.0225
Flow Transfer Function
Input (cum/sec),0,0,0,0,0
Output (cum/sec),0,0,0,0,0
Input (cum/sec),10,10,10,10,10
Output (cum/sec),10,10,10,10,10
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Input (cum/sec), , , , ,
Output (cum/sec), , , , ,
Gross Pollutant Transfer Function
Enabled,True,True,True,True,True
Input (kg/ML),0,0,0,0,0
Output (kg/ML),0,0,0,0,0
Input (kg/ML),14.780776740251,14.780776740251,14.780776740251,20,100
Output (kg/ML),0,0,0,5,1
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,

Appendix D – MUSIC Model Results

Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Input (kg/ML), , , , ,
Output (kg/ML), , , , ,
Total Nitrogen Transfer Function
Enabled,True,True,True,True,True
Input (mg/L),0,0,0,0,0
Output (mg/L),0,0,0,0,0
Input (mg/L),10,10,10,1,7
Output (mg/L),7.9,7.9,7.9,1,3.2
Input (mg/L), , , ,10,
Output (mg/L), , , ,8.5,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Total Phosphorus Transfer Function
Enabled,True,True,True,True,True
Input (mg/L),0,0,0,0,0
Output (mg/L),0,0,0,0,0
Input (mg/L),10,10,10,0.1,0.4
Output (mg/L),7,7,7,0.1,0.14
Input (mg/L), , , ,5,
Output (mg/L), , , ,3.5,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,

Appendix D – MUSIC Model Results

Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Total Suspended Solids Transfer Function
Enabled,True,True,True,True,True
Input (mg/L),0,0,0,0,0
Output (mg/L),0,0,0,0,0
Input (mg/L),100,100,100,15,200
Output (mg/L),46,46,46,15,22
Input (mg/L), , , ,1000,
Output (mg/L), , , ,200,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
Input (mg/L), , , , ,
Output (mg/L), , , , ,
TSS Flow based Efficiency Enabled,Off,Off,Off,Off,Off
TSS Flow based Efficiency, , , , ,
TP Flow based Efficiency Enabled,Off,Off,Off,Off,Off
TP Flow based Efficiency, , , , ,
TN Flow based Efficiency Enabled,Off,Off,Off,Off,Off
TN Flow based Efficiency, , , , ,
GP Flow based Efficiency Enabled,Off,Off,Off,Off,Off
GP Flow based Efficiency, , , , ,
IN - Mean Annual Flow (ML/yr),4.50,5.44,5.53,21.6,21.6
IN - TSS Mean Annual Load (kg/yr),831,1.88E3,1.96E3,2.51E3,734
IN - TP Mean Annual Load (kg/yr),1.28,3.16,3.29,6.53,5.19
IN - TN Mean Annual Load (kg/yr),9.50,12.9,13.2,42.0,38.6
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,130,132,157,39.2
OUT - Mean Annual Flow (ML/yr),4.50,5.44,5.53,21.6,21.6
OUT - TSS Mean Annual Load (kg/yr),470,921,958,734,379
OUT - TP Mean Annual Load (kg/yr),0.964,2.26,2.36,5.19,3.26
OUT - TN Mean Annual Load (kg/yr),7.86,10.3,10.5,38.6,26.6
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,1.69,1.79,39.2,7.40
Flow In (ML/yr),4.49578,5.44056,5.53105,21.5739,21.5739
ET Loss (ML/yr),0,0,0,0,0
Infiltration Loss (ML/yr),0,0,0,0,0
Low Flow Bypass Out (ML/yr),0,0,0,0,0
High Flow Bypass Out (ML/yr),0.858125,0.302625,0.316994,0,9.29967
Orifice / Filter Out (ML/yr),0,0,0,0,0
Weir Out (ML/yr),0,0,0,0,0
Transfer Function Out (ML/yr),3.63765,5.13793,5.21406,21.5739,12.2742
Reuse Supplied (ML/yr),0,0,0,0,0
Reuse Requested (ML/yr),0,0,0,0,0
% Reuse Demand Met,0,0,0,0,0

Appendix D – MUSIC Model Results

% Load Reduction,-4.93896E-15,3.67609E-5,5.42392E-5,0,0.000185409
TSS Flow In (kg/yr),831.165,1876.58,1956.33,2509.96,733.644
TSS ET Loss (kg/yr),0,0,0,0,0
TSS Infiltration Loss (kg/yr),0,0,0,0,0
TSS Low Flow Bypass Out (kg/yr),0,0,0,0,0
TSS High Flow Bypass Out (kg/yr),161.816,107.885,107.438,0,334.911
TSS Orifice / Filter Out (kg/yr),0,0,0,0,0
TSS Weir Out (kg/yr),0,0,0,0,0
TSS Transfer Function Out (kg/yr),307.9,813.596,850.49,733.644,43.8607
TSS Reuse Supplied (kg/yr),0,0,0,0,0
TSS Reuse Requested (kg/yr),0,0,0,0,0
TSS % Reuse Demand Met,0,0,0,0,0
TSS % Load Reduction,43.487,50.8956,51.0344,70.7707,48.3712
TP Flow In (kg/yr),1.28088,3.16347,3.29121,6.52947,5.18899
TP ET Loss (kg/yr),0,0,0,0,0
TP Infiltration Loss (kg/yr),0,0,0,0,0
TP Low Flow Bypass Out (kg/yr),0,0,0,0,0
TP High Flow Bypass Out (kg/yr),0.224732,0.159106,0.185274,0,2.21444
TP Orifice / Filter Out (kg/yr),0,0,0,0,0
TP Weir Out (kg/yr),0,0,0,0,0
TP Transfer Function Out (kg/yr),0.739306,2.10305,2.17415,5.18899,1.0411
TP Reuse Supplied (kg/yr),0,0,0,0,0
TP Reuse Requested (kg/yr),0,0,0,0,0
TP % Reuse Demand Met,0,0,0,0,0
TP % Load Reduction,24.7364,28.4913,28.3113,20.5297,37.2608
TN Flow In (kg/yr),9.49526,12.9245,13.1604,42.0351,38.6149
TN ET Loss (kg/yr),0,0,0,0,0
TN Infiltration Loss (kg/yr),0,0,0,0,0
TN Low Flow Bypass Out (kg/yr),0,0,0,0,0
TN High Flow Bypass Out (kg/yr),1.68945,0.655102,0.721116,0,16.435
TN Orifice / Filter Out (kg/yr),0,0,0,0,0
TN Weir Out (kg/yr),0,0,0,0,0
TN Transfer Function Out (kg/yr),6.16659,9.69284,9.82702,38.6149,10.1394
TN Reuse Supplied (kg/yr),0,0,0,0,0
TN Reuse Requested (kg/yr),0,0,0,0,0
TN % Reuse Demand Met,0,0,0,0,0
TN % Load Reduction,17.2636,19.9354,19.8494,8.13673,31.181
GP Flow In (kg/yr),0,129.862,132.021,156.688,39.172
GP ET Loss (kg/yr),0,0,0,0,0
GP Infiltration Loss (kg/yr),0,0,0,0,0
GP Low Flow Bypass Out (kg/yr),0,0,0,0,0
GP High Flow Bypass Out (kg/yr),0,1.68732,1.79401,0,7.11171
GP Orifice / Filter Out (kg/yr),0,0,0,0,0
GP Weir Out (kg/yr),0,0,0,0,0
GP Transfer Function Out (kg/yr),0,0,0,39.172,0.291417
GP Reuse Supplied (kg/yr),0,0,0,0,0
GP Reuse Requested (kg/yr),0,0,0,0,0
GP % Reuse Demand Met,0,0,0,0,0
GP % Load Reduction,100,98.7007,98.6411,100,81.8449

Other nodes
Location,Receiving Node
ID,1
Node Type,ReceivingNode

Appendix D – MUSIC Model Results

IN - Mean Annual Flow (ML/yr),21.6
IN - TSS Mean Annual Load (kg/yr),379
IN - TP Mean Annual Load (kg/yr),3.26
IN - TN Mean Annual Load (kg/yr),26.6
IN - Gross Pollutant Mean Annual Load (kg/yr),7.40
OUT - Mean Annual Flow (ML/yr),21.6
OUT - TSS Mean Annual Load (kg/yr),379
OUT - TP Mean Annual Load (kg/yr),3.26
OUT - TN Mean Annual Load (kg/yr),26.6
OUT - Gross Pollutant Mean Annual Load (kg/yr),7.40
% Load Reduction,35.8E-9
TSS % Load Reduction,92.1
TN % Load Reduction,45.6
TP % Load Reduction,62.5
GP % Load Reduction,98.2

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,2,5,4,8,3,7,6,9,10
Target node ID,8,7,6,9,9,9,9,10,1
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , , , ,
Muskingum theta, , , , , , , , ,
IN - Mean Annual Flow (ML/yr),5.53,5.44,4.50,5.53,6.11,5.44,4.50,21.6,21.6
IN - TSS Mean Annual Load (kg/yr),1.96E3,1.88E3,831,958,161,921,470,734,379
IN - TP Mean Annual Load (kg/yr),3.29,3.16,1.28,2.36,0.944,2.26,0.964,5.19,3.26
IN - TN Mean Annual Load (kg/yr),13.2,12.9,9.50,10.5,13.3,10.3,7.86,38.6,26.6
IN - Gross Pollutant Mean Annual Load (kg/yr),132,130,0.00,1.79,153,1.69,0.00,39.2,7.40
OUT - Mean Annual Flow (ML/yr),5.53,5.44,4.50,5.53,6.11,5.44,4.50,21.6,21.6
OUT - TSS Mean Annual Load (kg/yr),1.96E3,1.88E3,831,958,161,921,470,734,379
OUT - TP Mean Annual Load (kg/yr),3.29,3.16,1.28,2.36,0.944,2.26,0.964,5.19,3.26
OUT - TN Mean Annual Load (kg/yr),13.2,12.9,9.50,10.5,13.3,10.3,7.86,38.6,26.6
OUT - Gross Pollutant Mean Annual Load (kg/yr),132,130,0.00,1.79,153,1.69,0.00,39.2,7.40

Catchment Details
Catchment Name,32489-1-MUISC-JF
Timestep,6 Minutes
Start Date,1/01/1959
End Date,31/12/1959 11:54:00 PM
Rainfall Station, 66062 SYDNEY
ET Station,Monthly User Defined
Mean Annual Rainfall (mm), 1490
Mean Annual ET (mm), 1260