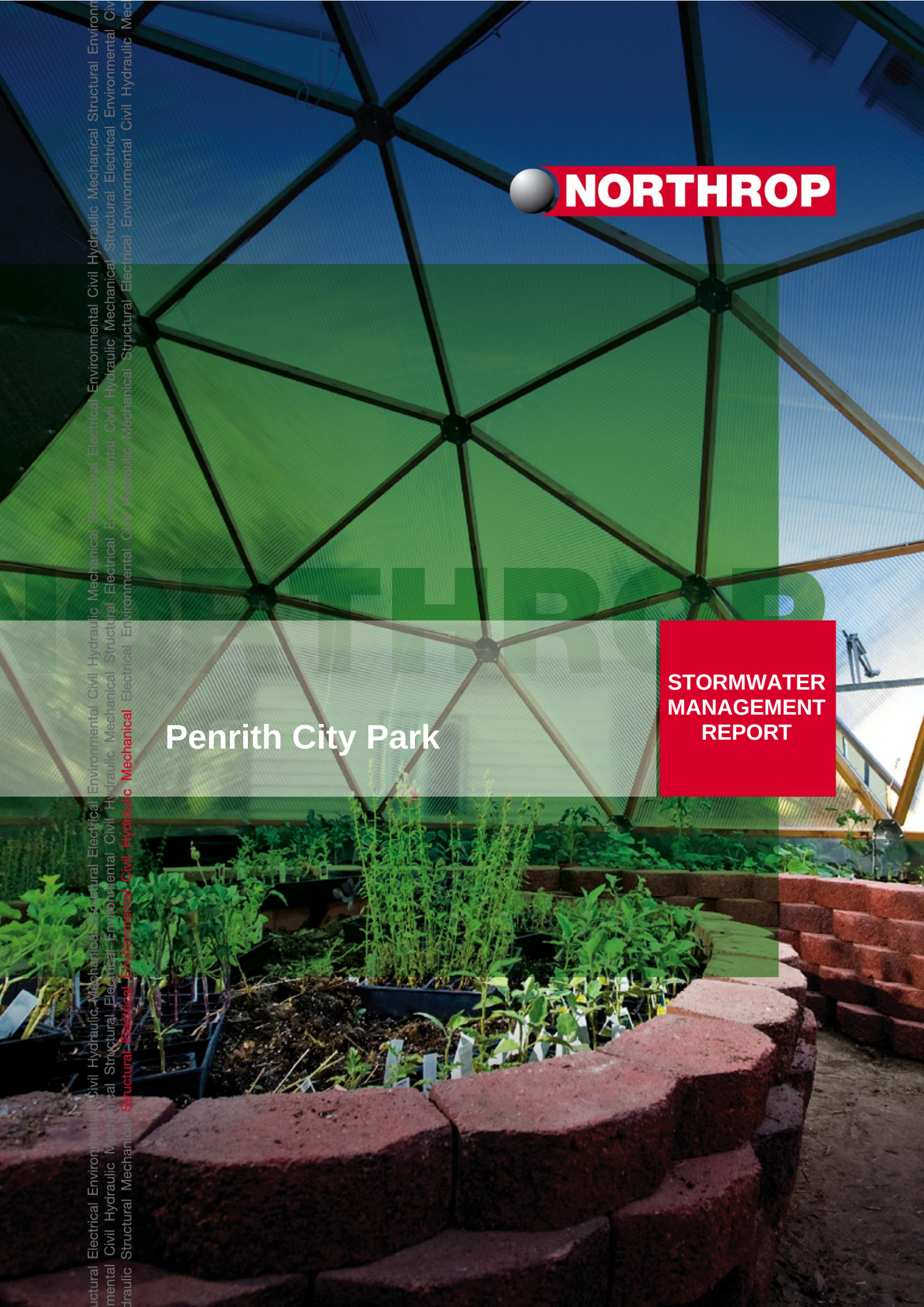
NORTHROP
Penrith City Park
STORMWATER MANAGEMENT REPORT

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Document Control

Prepared for	Development Application
Project Name	Penrith City Park
File Reference	192968
Date	16/08/2021

Document Control

Stormwater Management Strategy Report

Rev	Description	Prepared by	Reviewed by	Issue Date	Client App	Approval Date
A	Issued for DA	EJ	SN	25/05/21		
B	Re-Issued for DA	SN		16/08/21		

Contents

1 Introduction

Northrop Consulting Engineers Pty Ltd have been engaged by JMD Design to undertake the civil design for a proposed park at 114-146 Henry Street, 42-50 Station Street and Allen Place Carpark, in Penrith City Council.

1.1 Site Description

The proposed location for Penrith City Park spans across several lots including Lot 1 DP526304 (537.5m^2), Lot E DP163176 (385.7m^2), Lot 3 DP1200790 (1184m^2), Lot 2 DP 556075 (727.2m^2), Lot 10 DP553665 (954.8m^2), Lot 11 DP553665 (607m^2), Lot 1 DP164798 (252.9m^2) with a total of eight existing buildings, an existing road and a carpark. The area within the existing lot boundaries is 4,649m^2 however the limit of proposed works extends into Allen Place, Gaymark lane and some carpark areas to result in a total park area of approximately 7,500 m^2. The site is bounded by Henry Street to the north, Allen Place to the south, Gaymark Lane to the east and Station Street to the west. The site generally falls from northeast to southwest. Figure 1 provides a diagram of the existing features within the proposed extent of works.

Figure 1: Subject Property. (Source: SIXMAPS 2021)

1.2 Proposed Development

The proposed development is a public park, amenities building and modifications to the two of the adjoining roads (Allen Place and Gaymark Lane). The new development proposes the demolition of eight existing buildings, the eastbound carriageway of Allen Place (where within the site boundary), and a portion of the neighbouring carpark. Figure 2 below shows an overlay of the existing site and proposed development.

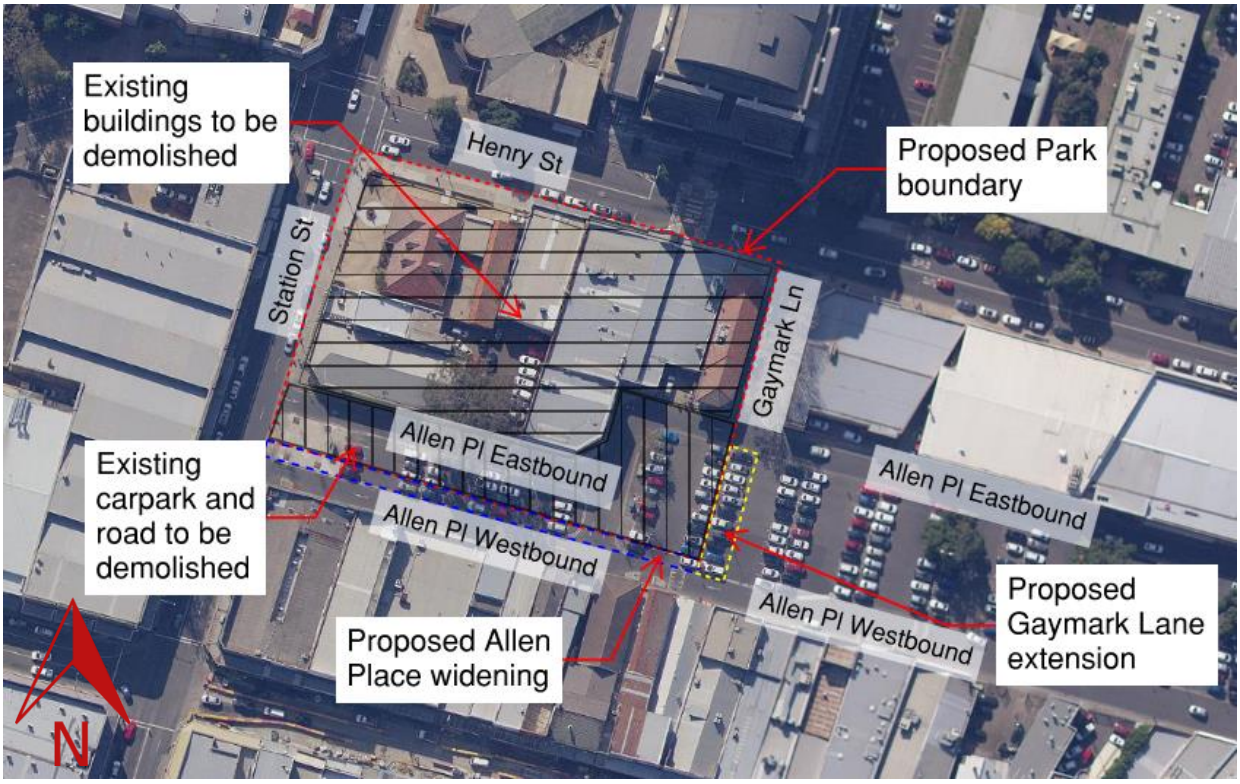


Figure 2: Proposed works over existing aerial (Source: Nearmap)

The existing site is almost completely impervious with the exception of a few small, landscaped areas with trees. According to the landscape plan prepared by JMD Design (Figure 3), the proposed development will result in an additional 3,796m^2 of landscaped area with a total pervious area of 4,190m^2. When compared to the existing 394m^2 of pervious landscape in the existing scenario there is a large increase in pervious area which will enhance infiltration and a decrease peak flows generated by the site. The extensive amount of landscaped area will drastically improve water quality compared to the pre-development scenario and provides an opportunity for stormwater treatment via passively irrigated garden beds.

Figure 3: Landscape plan. (Source: JMD Design)

1.3 Council Requirements

This Stormwater Management Plan has been developed to address all of Council's stormwater management requirements, including:

- Water Quantity
- Water Quality & WSUD
- Water Reuse

WATER QUANTITY

The Stormwater Drainage objectives provided by Penrith City Council within Section 3.6 of the Penrith City Council DCP 2013 are as follows:

a) To prevent damage by stormwater to the built and natural environment;
b) To ensure that new development does not generate stormwater discharges that exceed
c) the capacity of the existing drainage network;
d) To ensure that an adequate and environmentally acceptable method of removing surface water and stormwater is implemented;
e) To minimise nuisance flows of stormwater from one property to adjoining properties;
f) To maximise reasonable on-site detention, to provide opportunities for rainwater re-use;
g) To minimise hardstand and impervious areas on developed land to minimise run off;
h) To provide a stormwater system which can be maintained economically;
i) To provide a stormwater system which utilises open space in a manner compatible with other uses;
j) To control flooding and enable access to allotments, stabilise the land form and control erosion; and
k) To minimise urban runoff pollutants to watercourses.

These objectives are easily met by this development due to the substantial change from impervious to pervious area, decreasing peak flows and the amount of runoff directly connected to Council's network.

WATER QUALITY:

WSUD Objectives

The WSUD objectives provided by Penrith City Council within Section 3.2 of the Penrith City Council DCP 2013 are as follows:

Water Sensitive Urban Design:

a) To protect and enhance natural land and water systems such as creeks and rivers, particularly water quality.
b) To maintain and restore the natural water balance;
c) To make more efficient use of water resources by conserving water, particularly potable (drinking) water;
d) To reduce flood risk in urban areas;
e) To reduce erosion of waterways, slopes and banks;
f) To control stormwater pollution and improve water quality in waterways and groundwater;
g) To integrate stormwater management with water supply and waste water treatment; and
h) To integrate stormwater treatment into the landscape so as to maximise the visual and
i) recreational amenity of urban development.

WSUD Targets

The Water Sensitive Urban Design (WSUD) Factsheet prepared by Penrith City Council outlines the developments that must comply with the water quality requirements provided in Penrith City Council's DCP 2014. The section titled "Which Developments Must Comply?" and Table C3.1 of the

DCP outlines 4 types of developments that are required to follow WSUD guidelines. These development types are as follows:

- "Residential development of 5 or more dwellings including multi dwelling housing, residential housing, residential flat buildings and mixed use development.
- All new commercial, retail, mixed use and industrial development greater than 2,500m^2 total site area and alterations and additions where the increase in the roofed and impervious area is equal to or greater than 250m2 .
- Residential (5 or more lots) or commercial and industrial subdivision
- Any development which results in an increase of the existing impervious area by greater than 250m^2. Development includes but is not limited to additional roads, driveways, vehicle parking areas, manoeuvring areas, loading and storage areas."

The proposed development does not fit into any of the above categories and therefore is not required to strictly adhere to the WSUD requirements. Nonetheless, the intention for this parkland development is to follow best practice and have a positive impact on the environment.

Section C3.2-C-5-B of the DCP outlines the performance criteria and Stormwater quality requirements for all development types identified in Table C3.1 are:

a) Pollution Target Reduction Loads:
    - 90% reduction in the post development mean annual load of total gross pollutants
    - 85% reduction in the post development mean annual load of total suspended solids (TSS)
    - 60% reduction in the post development mean annual load of total phosphorous (TP)
    - 45% reduction in the post development mean annual load of total nitrogen (TN)
    - 90% Free Oils and Grease with no visible discharge.
b) Modelling for the determination of the mean annual loads of land uses must be undertaken in MUSIC and in accordance with the associated WSUD Technical Guidelines.
c) Any changes to the flow rate and flow duration within the receiving watercourses as a result of the development shall be limited as far as practicable. Natural flow paths, discharge point and runoff volumes from the site should also be retained and maintained as far as practicable.
d) Impervious areas directly connected to the stormwater system shall be minimised. Runoff from impervious areas such as roofs, driveways and rainwater tank overflows shall be directed onto grass and other landscaped areas designed to accept such flows.

It should be noted that the modelling of pollutant removal in MUSIC is governed by first order decay algorithms thus the effectiveness of treatment devices decreases for cleaner inputs. Therefore the percentage reduction targets outlined in (a) above are more difficult to achieve for cleaner catchments (such as parks), and are therefore not the most suitable measure of this development's impact on Stormwater quality. As such, it was agreed with Council that this development must achieve better water quality than the pre-development scenario.

WATER REUSE

Re-use Objectives

The Re-use objectives provided by Penrith City Council within Section 3.2 of the Penrith City Council DCP 2013 are as follows:

a) To reduce consumption of potable water for all development types within the City;
b) To use harvested rainwater, treated urban stormwater or treated wastewater for non-potable substitution where appropriate.

Re-use Targets

As outlined previously, the proposed development does not explicitly fit into any of the development categories required to provide WSUD measures (which include rainwater reuse).

Section C3.2-C-5-A of the DCP outlines the performance criteria and water conservation requirements for all development types identified in Table C3.1, the relevant point item for this development being:

(d) Water use within public open space (for uses such as irrigation, pools, water features, etc.) should be supplied from sources other than potable mains water (e.g. treated stormwater or greywater) to meet 80% water use demand.

This development contains a very small amount of roof area (the 100sqm amenities building only) compared to relatively high demands (toilet flushing and irrigation). The maximum percentage of the toilet flushing demand that can be met by harvesting water from the amenities building roof is only around 35%, and with irrigation included the percentage met is a mere 3.5%, both well short of Council's required 80%. Council have advised that the harvesting of water from paved surfaces or the pervious areas of the park, in order to try and meet more of the non-potable demand, is not acceptable without extensive treatment to mitigate risk to public health. Thus the cost of the tank and treatment system for such low reuse volumes would never be paid back by savings in potable water use. As such it was decided by Council to preclude rainwater reuse from this development and invest the money that would be spent on the system into a green roof for the amenities building instead.

1.4 Proposed Stormwater Management Overview

The large amount of pervious area within this site means the management of flows from minor storms will largely occur through infiltration, rather than a traditional pit and pipe network. The site had been graded such that the Amenities building is located at the high point of the site, and the surrounding surface graded away from the building, namely towards the large open lawn area in the centre of the park. The majority of the lawn area falls overland towards a sunken garden bed along the northern boundary of the site. In order to utilise the park as an opportunity to have a broader positive impact of water quality, a castellated kerb is proposed along the western edge of Gaymark lane (eastern boundary of the park) to direct flows from Gaymark lane into landscaped areas to provide passive irrigation as well as a level of water quality treatment.

The amenities building is proposed to have a green roof which will also provide some level of treatment to the stormwater, as well as decreasing the time of concentration for water running off the roof thus having a positive impact on peak flows.

Further details on the proposed stormwater management measures are outlined below.

2 Stormwater Quantity

2.1.1 PITS AND PIPES

Pits and pipes do not feature heavily within the stormwater management scheme for this park as explained above, however there is a pit located in the sunken garden bed to pipe flows that exceed the infiltration capacity of the soil, and the roof drainage is proposed to have a piped connection to

the stormwater network in Allen Place. These have been designed to cater for the 20% AEP design storm.

There is an extensive existing stormwater network running through Gaymark Lane piping flows north toward Henry St. Modifications to the pits along this network are proposed to suit the new road alignments, however the adjustments to catchments is minor and not expected to impact the capacity of this network. The Allen Place westbound carriageway adjacent to the park does not currently have any pits collecting stormwater, with all drainage directed overland to a pit in Station St. The existing eastbound carriageway which will be removed also currently drains overland to Station St. The proposed widening of the westbound carriageway (to enable two way traffic) is proposed to be collected in two kerb inlet pits along the northern side of the road, and directed east to the existing stormwater trunk main that flows north through Gaymark Lane. While this is a redirection of the existing catchment, drainage pits have been added on Council's request to address localised ponding issues in Allen Place.

2.1.2 OVERLAND FLOW

Refer to separate Flood Advice letter (document CR01-B) prepared by Northrop issued 20/05/21, which outlines a detailed 1D overland flow analysis of upstream catchment flow which drains towards the subject site.

2.1.3 CONNECTION TO COUNCIL'S STORMWATER NETWORK

The site drainage connects to Council's existing network in two locations: the sunken garden outlet connecting to the existing kerb inlet pit on henry St (shown as EX01\01 on the Siteworks and Stormwater Management Plan (DAC04.01) included in Appendix A); and the amenities building rood drainage connecting to a proposed kerb inlet pit in Allen Place (shown as pit 01/03).

3 Stormwater Quality and WSUD

Stormwater devices provided as part of the WSUD strategy are:

- Green roof
- Passive irrigation

For the locations of the specific devices refer to Appendix A for the detailed siteworks plans and stormwater device details.

3.1.1 PASSIVE IRRIGATION

Two passively irrigated areas are proposed for the site. Passive irrigation 1 is a sunken garden along the norther boundary of the park, designed to be a landscape feature representing a waterway, with a max 400mm set down. Nearly half of the site is graded to this area. The passive irrigation is designed to have around 50mm of ponding, with a pervious lining to allow infiltration of water to the natural substrata below. The soil is to be a standard landscape sandy loam with more organic material than bioretention filter media, to help moisture retention. While the area is to be planted, the plants are not necessarily water loving bioretention planting, as the garden is not lined and has minimal extended detention. Nonetheless, it has been modelled in MUSIC as the infiltration of water will provide some level of water quality treatment. A detail for the sunken garden can be seen below.

The second passively irrigated area is much the same, however it is only set down by the nominal 50mm ponding amount rather than designed to be a sunken landscape feature. It is bordered by a castellated kerb which allows water from Alen Place and Gaymark Lane to enter the garden and infiltrate. High flows that exceed the infiltration rate will be captured by pit 09/01 located in the sag point along Gaymark Lane.

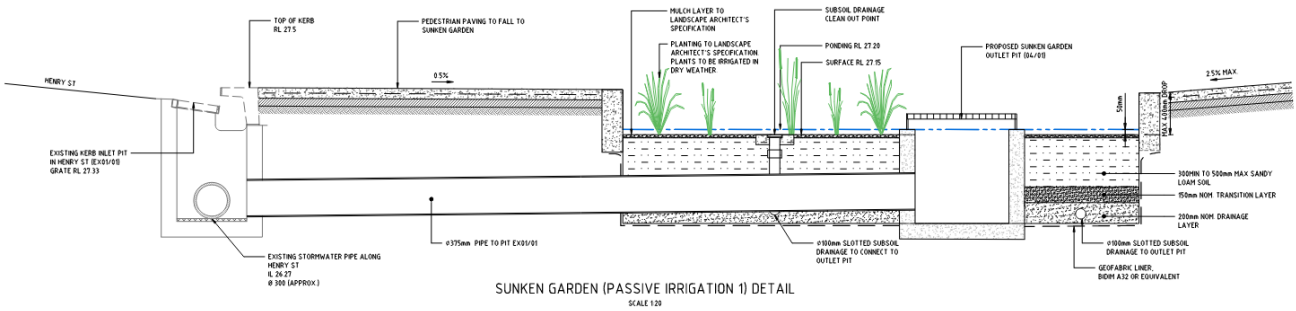


Figure 4: Sunken garden passive irrigation detail

3.1.2 GREEN ROOF

The amenities building is proposed to have a green roof. While this is a landscape feature providing high amenity value and aiding in urban cooling, it also filters water landing on the roof, and attenuates flow by delaying runoff (via storage for water in the soil profile). This has been accounted for in MUSIC by modelling the amenities roof as “impervious” but with a high “rainfall threshold” that was set at the field capacity of the planting media (assumed to be 180mm thick of sandy loam, as per the detail below).

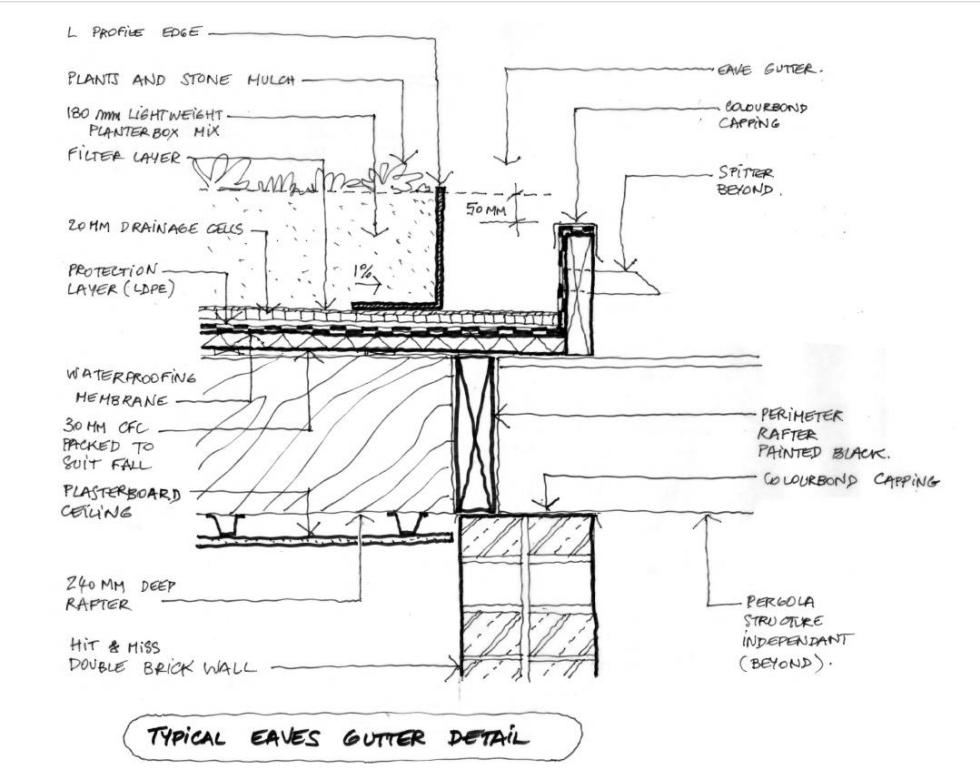


Figure 5: Green Roof detail by Lacoste + Stevenson Architect’s

4 Stormwater Quality Modelling and Results

4.1 MUSIC Modelling Method

The treatment devices described above were modelled in MUSIC as a treatment train. Penrith City Council's MUSIC-Link default nodes were used, to ensure the Event Mean Concentration (EMC) values for different types of catchments were to Council's standard. The MUSIC-link report is included in Appendix B.

4.1.1 RAINFALL DATA

Rainfall data used within the MUSIC modelling used Penrith City Council's MUSIC-Link defaults to ensure values were to Council's Standard.

4.1.2 CATCHMENT DATA

"Mixed" nodes were used for the landscaped and footpath areas and "Roof" nodes were used for the amenities roof. Note only area within the park was modelled in MUSIC. External road catchments shown below were modelled for the purpose of modelling the stormwater network in 12d.

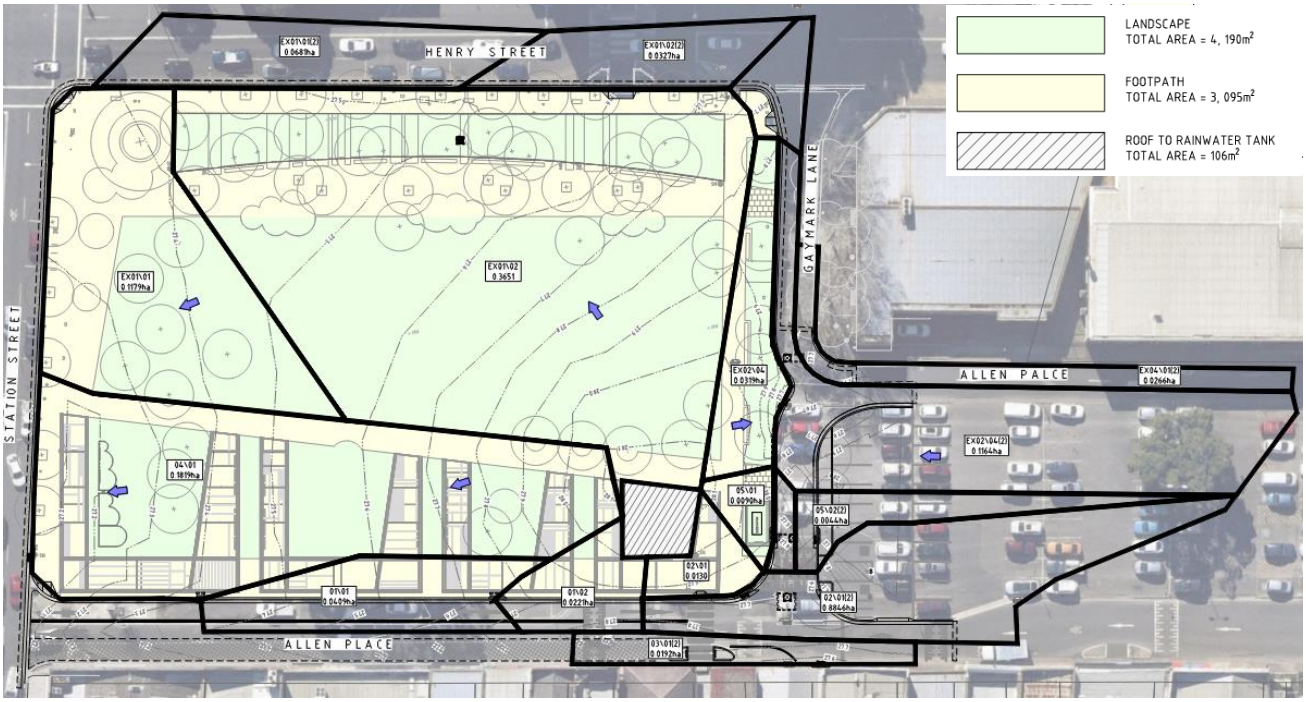


Figure 6: Treatment Train Catchment Plan

The rainfall threshold was adjusted for the green roof catchment by using the field capacity of the soil, i.e. both were modelled as impervious because the drainage system beneath them does not allow for infiltration into the natural ground, however the rainfall threshold (initial losses due to soil holding capacity) were set to be equal to the field capacity, calculated using the method outlined in MacLeod 2008.

4.1.3 TREATMENT NODES

Table 1 summarises the treatment nodes in the MUSIC treatment train, and provides the values modelled for key model parameters, along with a justification for their selection.

The parameters for the treatment nodes representing the proposed landscaping, have been modelled to reflect the likely configuration of the landscaping, based on a collaborative approach taken between Northrop and the landscape architects JMD Design, to integrate stormwater treatment with landscaping. In some cases these values do not fall within the standard range specified by Council in MUSIC-Link. However, the modelling results (refer to Section 3.4) demonstrate that they are effective in pollutant removal compared to the pre-development case.

Table 1: MUSIC Treatment Node Summary

PARAMETER	ADOPTED VALUE	JUSTIFICATION
Sunken garden (passive irrigation 1)		
Surface Area (m^2)	383	The location and size of the garden was coordinated with the Landscape Architect's.
Filtration Area (m^2)	383	As above
Media Depth (m)	0.3	300mm is the minimum recommended for mass planting. The system could have up to 500mm and still have the drainage layer below at a level that allows subsoil drainage to connect to the outlet pit to Henry St.
Extended Detention Depth (m)	0.05	50mm ponding allows for some infiltration to occur through the soil yet still provides 130mm freeboard to the grate on Henry Street to ensure no backwater impacts due to the sunken garden.
Passive Irrigation 2		
Surface Area (m^2)	138	As per coordination with Landscape architect.
Filtration Area (m^2)	138	As per coordination with Landscape architect.
Media Depth (m)	0.3	300mm is the minimum soil depth advised by the landscape architect to suit growing requirements. Ideally this would be increased to 500mm, however the minimum was adopted for modelling purposes.
Extended Detention Depth (m)	0.02	The passive irrigation for this site is not designed to have ponding, but rather it is an area of landscaping that surface flows are directed towards. Therefore, the ponding depth was set to a nominal 20mm.

A screen shot of the MUSIC model can be seen below in Figure 4, and the. Sqz model file has been provided with the submission package to provide any additional information Council may require.

Figure 7: MUSIC model screen shot with landscape plan in the background and pre-development model to the right.

4.2 MUSIC Modelling Results

The MUSIC model results for the pre to post-development comparison are presented in Table 2 below.

Table 2: MUSIC Model Results

Parameter	Pollutant Load Pre	Residual Load Post	% Reduction Pre to Post
TSS (kg/yr)	779	238	69.4
TP (kg/yr)	1.24	0.55	59.4
TN (kg/yr)	9.11	3.7	55.6
GP (kg/yr)	116	33.1	71.5

5 Maintenance

A maintenance schedule is provided in Appendix C outlining the tasks required for the maintenance of the stormwater network, with a brief outline for each device below.

5.1 Raingarden Maintenance

Maintenance of raingardens is paramount in their establishment and for their ability to provide ongoing effective treatment. Maintenance is especially required during the initial establishment period to ensure successful plant uptake, with ongoing maintenance required to avoid weed infestations and ensure the media does not clog up (mulch layer requires periodic replacement). The media also requires eventual replacement, with the current estimates of the media lifetime ranging between 15 to 30 years, depending on hydraulic loading. They also have an operational lag time before functioning to their full treatment capacity, as plants take time to establish. Watering may be necessary until plants establish. Replacement of any dead plants is also required, as dense and even vegetation coverage is essential in the basin's function. A large amount of landscaped

area is proposed as part of the architecture and landscape architecture for this development. This provides substantial opportunity for the filtration of stormwater and uptake of the nutrient pollutant load by vegetation.

5.2 Passive Irrigation

Passively irrigated areas are basically just landscaped areas requiring usual landscape maintenance (ensuring plant health, periodic replacement of mulch, etc), however they include subsoil drainage lines which require frequent flushing / inspecting.

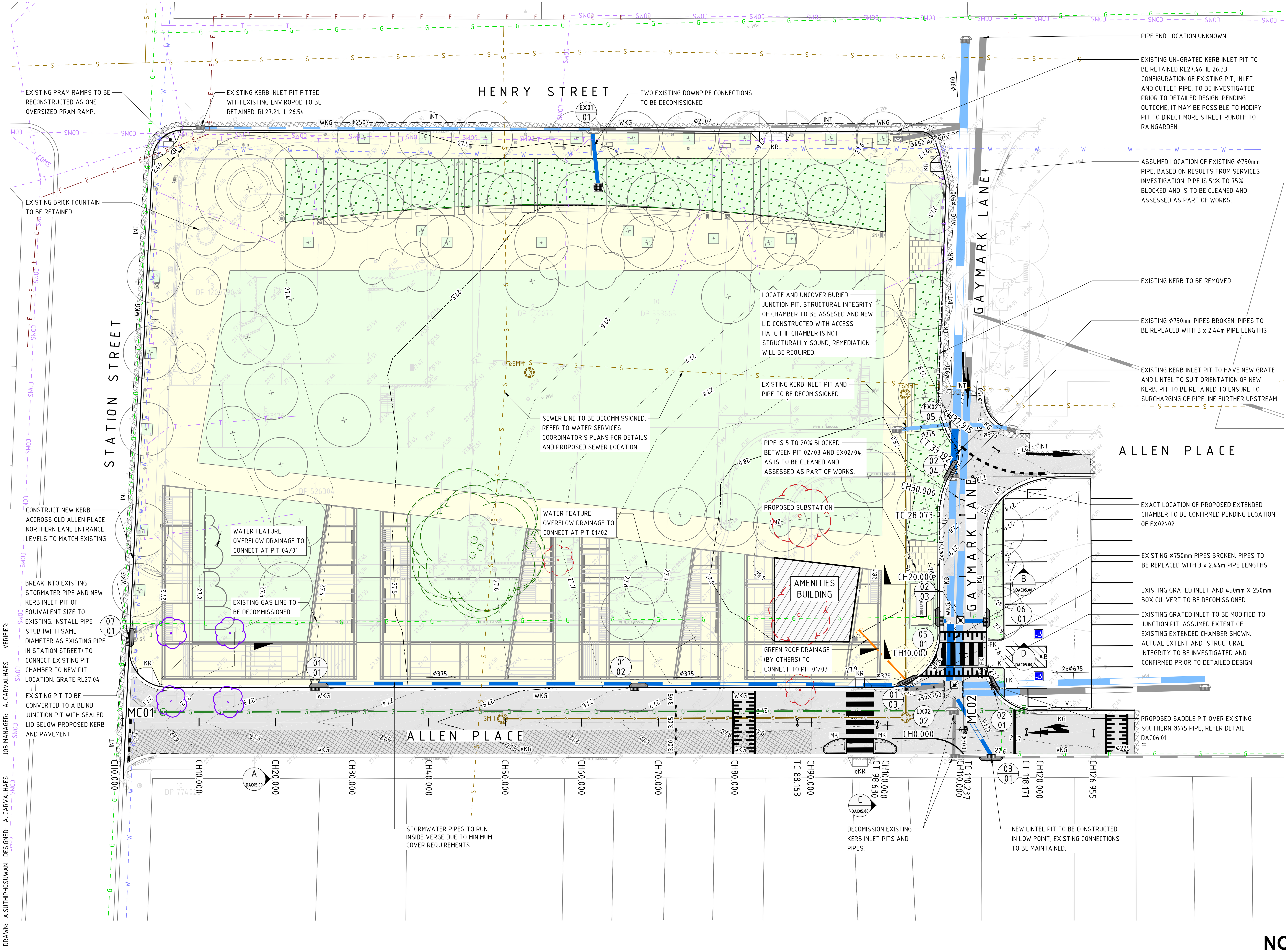
5.3 Grated Drains, Pits and Pipes

As with every stormwater network, pits need cleaning out whenever sludge or litter is building up in the base or in the grates. Grated drains are particularly susceptible to blockage and should be checked frequently. The existing pits along Henry St are fitted with Oceanguard pit filter baskets which should regularly be emptied as part of the park maintenance scheduling.

6 Conclusion

The proposed park will result in an extensive amount of landscaped area providing an opportunity for passive stormwater treatment. The treating of stormwater via the landscaping is a best practice implementation of Water Sensitive Urban Design (WSUD) allowing seamless integration of water quality treatment into the surrounding park landscape.

7 Appendix A – Siteworks and Stormwater Plan



LEGEND

— · · —	EXISTING BOUNDARY LINE
	EXISTING KERB
	PROPOSED KERB
— E —	EXISTING ELECTRICITY
— G —	EXISTING GAS
— COMS —	EXISTING TELECOMUNICATIONS
— T —	EXISTING TELSTRA
— O —	EXISTING OPTUS
— W —	EXISTING WATER
— S —	EXISTING SEWER
× × ×	EXISTING SERVICE TO BE REMOVED
— S — S —	PROPOSED SEWER (CONCEPT)
— G — G —	PROPOSED GAS
	SAWCUT AND PAVEMENT INFILL
eXX	EXISTING KERB 'TYPE AS BELOW'
KG	KERB AND GUTTER
CK	CASTELLATED KERB
KB	BRICK KERB AND GUTTER
FK	FLUSH KERB
MK	MOUNTABLE KERB
WKG	WIDE KERB AND GUTTER
WFK	WIDE FLUSH KERB
KR	KERB RAMP
MTE	MATCH TO EXISTING
• RLXX.XX	PROPOSED SPOT HEIGHT
XX.XX	CONTOURS
XX.XX	EXISTING CONTOURS
	DRAINAGE STRUCTURE WITH EXTENDED CHAMBER (NEW / EXTG)
	EXISTING DRAINAGE STRUCTURE
	NEW DRAINAGE STRUCTURE
MC01	CONTROL LINE
SSD	SUBSOIL DRAINAGE LINE
ø150	PROPOSED STORMWATER PIPE , DIRECTION AND SIZE
	EXISTING STORMWATER PIPE (ASSUMED LOCATION)
ø150	EXISTING STORMWATER PIPE, DIRECTION AND SIZE (WHERE KNOWN)
GTD	GRATED TRENCH DRAIN
• CO	SUBSOIL DRAINAGE CLEAROUT
	ø150mm PVC
1 / A	STORMWATER PIT TAG STRUCTURE No / LINE ID
RWT	RAINWATER TANK
	EXISTING TREE TO BE REMOVED
	EXISTING TREE TO BE RETAINED
	EXISTING TREE TO BE RELOCATED (TBC)
	MILL AND RE-SHEET EXISTING PAVEMENT (DETAIL SUBJECT TO DETAILED DESIGN)
	FLEXIBLE PAVEMENT (BUILD UP SUBJECT TO DETAILED DESIGN)
	FOOTPATH PAVEMENT TYPE '02' - NON-TRAFFICABLE REFER SHEET DAC09.01 FOR DETAIL
	BRICK PAVING TO LANDSCAPE ARCHITECT'S SPECIFICATION
	LANDSCAPING (REFER LANDSCAPE ARCHITECT'S SPECIFICATION)
	PROPOSED PASSIVE IRRIGATION AREA REFER SHEET DAC06.01 FOR DETAIL

GENERAL NOTES:

1. REFER SPECIFICATIONS NOTES FOR STORMWATER AND SITEWORKS GENERAL REQUIREMENTS.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH COUNCIL / RELEVANT AUTHORITY SPECIFICATIONS AND DETAILS.
3. CAD FILES TO BE SUPPLIED IN AUTOCAD FORMAT FOR SETOUT
4. CONTRACTOR TO ALLOW TO ADJUST AND LIAISE WITH RELEVANT SERVICE AUTHORITIES IN RELATION TO EXISTING SERVICE ADJUSTMENT AND MODIFICATIONS.
5. EXISTING STORMWATER ALIGNMENTS AND SIZES ARE DERIVED FROM A COMBINATION OF SURVEY INFORMATION, CCTV INVESTIGATION RESULTS, GIS DATA SUPPLIED BY COUNCIL, AND OTHER COUNCIL DRAINAGE MARKUPS SUPPLIED. ACCURACY IS TO BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRCUTION.
6. ALL EXISTING SERVICES INDICATED ON THE DRAWINGS ORIGINATE FROM SUPPLIED DATA OR DIAL BEFORE YOU DIG SEARCHES, THEREFORE THEIR ACCURACY AND COMPLETENESS IS NOT GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE AND CONFIRM THE LOCATION AND LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE SUPERINTENDENT. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY. NOTE SERVICE AUTHORITY REQUIREMENTS FOR LOCATING OF SERVICES PRIOR TO COMMENCEMENT OF WORKS.
7. CONTRACTOR TO ALLOW TO ADJUST AND LIAISE WITH RELEVANT SERVICE AUTHORITIES IN RELATION TO EXISTING SERVICE ADJUSTMENT AND MODIFICATION.

NOT FOR CONSTRUCTION

DRAWN: A.SUTHIPHOSUWAN DESIGNED: A. CARVALHAES JOB MANAGER: A. CARVALHAES VERIFIER:

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
06	RE-ISSUED FOR DEVELOPMENT APPLICATION	AS		SN	18.01.21
07	ISSUED FOR INFORMATION	AS		SN	23.04.21
08	ISSUED FOR INFORMATION	AS		SN	18.05.21
09	ISSUED FOR INFORMATION	AS		SN	21.05.21
10	ISSUED FOR INFORMATION	VC		SN	10.08.21
11	ISSUED FOR DEVELOPMENT APPLICATION	VC		SN	16.08.21

CLIENT: PENRITH CITY COUNCIL

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ARCHITECT: JMD design

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PROJECT: **PENRITH CITY PARK 114-146 HENRY STREET, 42-50 STATION STREET AND ALLEN PLACE CARPARK**

DRAWING TITLE: **CIVIL ENGINEERING PACKAGE — SITEWORKS AND STORMWATER MANAGEMENT PLAN**

JOB NUMBER: **192968**

DRAWING NUMBER: **DAC04.01** REVISION: **11**

DRAWING SHEET SIZE = A1

8 Appendix B – MUSIC-LINK Results

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PENRITH CITY COUNCIL

music@link

MUSIC-*link* Report

Project Details		Company Details	
Project:	Penrith City Park	**Company:**	Northrop Consulting Engineers
Report Export Date:	16/08/2021	**Contact:**	Steph Noble
Catchment Name:	21.08.16 - DA MUSIC MODEL (PRE TO POST ANALYSIS)	**Address:**	3 Horwood Place Parramatta NSW
Catchment Area:	0.739ha	**Phone:**	0481833655
Impervious Area*:	43.30%	**Email:**	snoble@northrop.com.au
Rainfall Station:	67113 PENRITH		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1999 - 31/12/2008 11:54:00 PM		
Mean Annual Rainfall:	691mm		
Evapotranspiration:	1158mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Penrith		
Scenario:	Penrith Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Post-Development Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	23.7%	Bio Retention Node	2	Urban Source Node	9
TSS	40.1%				
TP	14.7%				
TN	23%				
GP	35.7%				

Comments

Note: it has been agreed with Council that the Park is exampt from the usual treatment train reduction targets and is instead to aim to have an improvement on water quality compared to the pre-development case. As such the reporting parameters will appear to "fail". The amenities building has been modelled as impervious with a rainfall threshold equal to the field capacity of the soil for the proposed green roof profile (180mm). The field capacity is water that the soil will "store" and not lose under gravity, and is therefore the "initial loss" of rainfall, after which runoff will occur.

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Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Passive irrigation 1	PET Scaling Factor	2.1	2.1	2.1
Bio	Passive Irrigation 2	PET Scaling Factor	2.1	2.1	2.1
Post	Post-Development Node	% Load Reduction	None	None	23.7
Pre	Pre-Development Node	% Load Reduction	None	None	0
Urban	Amenities building (106m2)	Area Impervious (ha)	None	None	0.011
Urban	Amenities building (106m2)	Area Pervious (ha)	None	None	0
Urban	Amenities building (106m2)	Total Area (ha)	None	None	0.011
Urban	Impervious to passive irrigation 1 (984m2)	Area Impervious (ha)	None	None	0.098
Urban	Impervious to passive irrigation 1 (984m2)	Area Pervious (ha)	None	None	0
Urban	Impervious to passive irrigation 1 (984m2)	Total Area (ha)	None	None	0.098
Urban	Impervious to Passive Irrigation 2 (130m2)	Area Impervious (ha)	None	None	0.013
Urban	Impervious to Passive Irrigation 2 (130m2)	Area Pervious (ha)	None	None	0
Urban	Impervious to Passive Irrigation 2 (130m2)	Total Area (ha)	None	None	0.013
Urban	Impervious Untreated (1981m2)	Area Impervious (ha)	None	None	0.198
Urban	Impervious Untreated (1981m2)	Area Pervious (ha)	None	None	0
Urban	Impervious Untreated (1981m2)	Total Area (ha)	None	None	0.198
Urban	Pervious to Passive Irrigation 1 (2551m2)	Area Impervious (ha)	None	None	0
Urban	Pervious to Passive Irrigation 1 (2551m2)	Area Pervious (ha)	None	None	0.255
Urban	Pervious to Passive Irrigation 1 (2551m2)	Total Area (ha)	None	None	0.255
Urban	Pervious to Passive Irrigation 2 (180m2)	Area Impervious (ha)	None	None	0
Urban	Pervious to Passive Irrigation 2 (180m2)	Area Pervious (ha)	None	None	0.018
Urban	Pervious to Passive Irrigation 2 (180m2)	Total Area (ha)	None	None	0.018
Urban	Pervious Untreated (1459m2)	Area Impervious (ha)	None	None	0
Urban	Pervious Untreated (1459m2)	Area Pervious (ha)	None	None	0.146
Urban	Pervious Untreated (1459m2)	Total Area (ha)	None	None	0.146
Urban	Pre - Impervious 7000m2	Area Impervious (ha)	None	None	0.7
Urban	Pre - Impervious 7000m2	Area Pervious (ha)	None	None	0
Urban	Pre - Impervious 7000m2	Total Area (ha)	None	None	0.7
Urban	Pre - Pervious 394m2	Area Impervious (ha)	None	None	0
Urban	Pre - Pervious 394m2	Area Pervious (ha)	None	None	0.039
Urban	Pre - Pervious 394m2	Total Area (ha)	None	None	0.039

Only certain parameters are reported when they pass validation

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Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Passive irrigation 1	Exfiltration Rate (mm/hr)	0	0	0.36
Bio	Passive irrigation 1	Extended detention depth (m)	0.1	0.3	0.02
Bio	Passive irrigation 1	Filter depth (m)	0.5	0.8	0.3
Bio	Passive irrigation 1	Hi-flow bypass rate (cum/sec)	None	99	100
Bio	Passive irrigation 1	Orthophosphate Content in Filter (mg/kg)	40	40	80
Bio	Passive irrigation 1	Saturated Hydraulic Conductivity (mm/hr)	100	125	50
Bio	Passive Irrigation 2	Exfiltration Rate (mm/hr)	0	0	0.36
Bio	Passive Irrigation 2	Extended detention depth (m)	0.1	0.3	0.02
Bio	Passive Irrigation 2	Filter depth (m)	0.5	0.8	0.3
Bio	Passive Irrigation 2	Hi-flow bypass rate (cum/sec)	None	99	100
Bio	Passive Irrigation 2	Orthophosphate Content in Filter (mg/kg)	40	40	80
Bio	Passive Irrigation 2	Saturated Hydraulic Conductivity (mm/hr)	100	125	50
Post	Post-Development Node	GP % Load Reduction	90	None	35.7
Post	Post-Development Node	TN % Load Reduction	45	None	23
Post	Post-Development Node	TP % Load Reduction	60	None	14.7
Post	Post-Development Node	TSS % Load Reduction	85	None	40.1
Pre	Pre-Development Node	GP % Load Reduction	90	None	0
Pre	Pre-Development Node	TN % Load Reduction	45	None	0
Pre	Pre-Development Node	TP % Load Reduction	60	None	0
Pre	Pre-Development Node	TSS % Load Reduction	85	None	0
Urban	Amenities building (106m2)	Impervious Area Rainfall Threshold (mm/day)	1.4	1.4	27.26

Only certain parameters are reported when they pass validation

9 Appendix C – Maintenance Schedule

Level 11, 345 George Street, Sydney NSW 2000
T (02) 9241 4188 E sydney@northrop.com.au
ABN 81 094 433 100

Inspection and Maintenance Log:

Inspected by: ……

Date of Inspection: ……

Next Inspection: ……

STORMWATER OPERATIONS AND MAINTENANCE SCHEDULE

Item(s) to be Inspected	Frequency	Performed by	Maintenance Procedure	Maintenance Undertaken	Further Maintenance Required	Inspected By (initial)
General						
Stormwater surface inlet and junction pits	4 Monthly/ After Major Storm	Owner/ Internal Maintenance Staff or Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter and vegetation (e.g. Vacuum/ Eductor truck). Inspect and ensure grate is clear of sediment, debris, litter and vegetation. Ensure flush placement of grate on refitment.			
General inspection of complete stormwater drainage system (that is visible - including roof gutters)	Bi-annually	Owner/ Internal Maintenance Staff or Contractor	Inspect all drainage structure noting any dilapidation, carry out required repairs.			

Item(s) to be Inspected	Frequency	Performed by	Maintenance Procedure	Maintenance Undertaken	Further Maintenance Required	Inspected By (initial)
Eaves/Box Guttering System and Downpipes	6 Monthly/ After Major Storm	Owner/ Internal Maintenance Staff or Contractor	Inspect and remove any build-up of sediment, debris, litter and vegetation within gutter system.			
Green Roof						
Plants	Weekly during establishment then 3 Monthly	Owner/ Internal Maintenance Staff or Contractor	Inspect plants for signs of disease, die-back, pest infection, stunted growth, or senescent plants. Check the plant coverage across the surface. If necessary, treat, prune or remove and replace as necessary, aiming to maintain the original planting densities. Irrigate or water plants during long dry periods. Ensure vegetation is still in place. Remove and replace any plants that are dead or beyond a reasonable level of rehabilitation. Trim vegetation to a height that is suitable for the plant type. Where required fertilise plants with appropriate fertiliser for plant type.			
Underdrain	6 Monthly	Owner/ Internal Maintenance Staff or Contractor	Ensure drainage cells are drainage freely, flush via flushing points if required.			

Item(s) to be Inspected	Frequency	Performed by	Maintenance Procedure	Maintenance Undertaken	Further Maintenance Required	Inspected By (initial)
Passive Irrigation Horticultural						
Establishment	Weekly (if establishing during dry season), high frequency during first 3 months. After, bi-monthly in wetter months and monthly in dry season.	Owner/ Internal Maintenance Staff or Contractor	Inspect after construction, check the vegetation cover development and the drainage properties (check if flow enters freely, covering the entire surface, ponding occurs to the designed depth, high flows bypass, and infiltration rates are acceptable). New seedlings require regular watering and irrigation and protection from high sediment loads and flows. All other plants to be watered and irrigated when necessary. Inspect after first rain. **Establishment inspections must be done up until 2 years.**			
Plant health and cover	3 Monthly, additional checking during long dry spells	Owner/ Internal Maintenance Staff or Contractor	Inspect plants for signs of disease, die-back, pest infection, stunted growth, or senescent plants. Check the plant coverage across the surface. If necessary, treat, prune or remove and replace as necessary, aiming to maintain the original planting densities. Irrigate or water plants during long dry periods. Ensure vegetation is still in place. Remove and replace any plants that are dead or beyond a reasonable level of rehabilitation. Trim vegetation to a height that is suitable for the plant type. Where required fertilise plants with appropriate fertiliser for plant type.			
Weeds	3 Monthly	Owner/ Internal Maintenance Staff or Contractor	Check for weeds; if present, manually remove it, avoid using herbicides.			