Rent A Space Brookvale

Stormwater Drainage Concept Design

Harding Architects Pty Ltd

20 March 2020
Ref: 20192073R001RevA

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Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
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Contents

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Client: Harding Architects Pty Ltd
Ref: 20192073R001RevA

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1 Introduction

1.1 Background

Rent A Space (RAS) are proposing to construct a new multi-storey storage facility at 4 Cross Street, Brookvale. The proposed development will include the construction of a three-storey self-storage building, on-site parking, a one-way driveway through the site and two driveway crossovers.

Tonkin has been engaged by Harding Architects Pty Ltd, on behalf of RAS, to develop a preliminary design for stormwater drainage within the site to support the Development Application (DA) to Northern Beaches Council (Council).

1.2 This report

This report forms the basis for the stormwater drainage design. It outlines the design requirements for site drainage and discharge, details the design procedure and presents the proposed stormwater drainage plan for the management of site runoff.

This report shall be read in conjunction with the preliminary drawings. A copy of the drawings has been provided in Appendix A.

1.3 Design inputs

The stormwater design draws on a number of inputs which are summarised in Table 1.1.

Table 1.1 List of design inputs

Data	Source	Reference	Date	Note
Architectural Plans	Harding Architects	*1915 Prelim Set*	October 2019	Sheets 100-103, 200-203 & 300-301
Detail Survey	LandPartners	*SY074811.000.1*	Survey: 06/11/2019 Drawing: 13/11/2019	
Dial Before You Dig	Dial Before You Dig	*Job No. 19178485*	10/03/2020	Data received from: AusGrid, Council, Jemena, NBN, Optus, Sydney Water and Telstra

1.4 Relevant standards and guidelines

The preliminary stormwater drainage design has been carried out in accordance with the relevant local, state and national design guidelines and Australian Standards. These include, but are not limited to:

- Australian Rainfall and Runoff (ARR) guidelines
- AS 3500.3 – Plumbing and drainage – Stormwater drainage
- AS 3725 – Design for installation of buried concrete pipes
- PL 850 WATER – Water Management Policy
- On-site Stormwater Detention Technical Specification
- NSW MUSIC Modelling Guidelines.

1.5 Council requirements

The stormwater drainage system must comply with a number of Council requirements and policies including, but not limited to:

- site flood information must be assessed to determine whether additional stormwater management measures are required to protect the development from external floodwaters in all events up to and including 1% annual exceedance probability (AEP) storm events.
- on-site detention (OSD) requirements must be established so as to ensure that the site includes measures to minimise its impact on downstream flooding where possible.
- site drainage systems must be designed to the major/minor system design principles in the Australian Rainfall and Runoff guidelines, allowing for overflows of the piped system and flows in excess of the capacity of the piped system to be discharged in a controlled manner.
- Water Sensitive Urban Design (WSUD) principles are to be implemented into the development through the design of stormwater drainage, on-site detention and landscaping in order to improve the quality of site discharge so that natural drainage systems downstream of the development are protected.

2 Site description and conditions

2.1 General

The proposed development is located at 4 Cross Street, Brookvale, and occupies approximately 2,600 m^2 of land. The site can be accessed from the north, via a 40 m long laneway leading out of a cul-de-sac in Cross Street, or from the south as the property fronts Cross Street.

Detailed survey indicates that the main portion of the site generally falls in a south-easterly direction at an approximate grade of 0.8% (LandPartners, 2019). The laneway does however lead into the site at a steeper grade of approximately 2.7%.

2.2 Existing conditions

Before its demolition, the site comprised a two-storey self-storage building that extended across the full width of the allotment with on-site parking at the rear of the allotment. It was almost completely impervious, with only a small portion (approximately 30 m^2) of pervious surface within a garden bed at the front of the allotment.

Details of Council's existing drainage infrastructure in the vicinity of site works are shown in Figure 2.1.

Figure 2.1 Council-owned stormwater drainage infrastructure (Northern Beaches Council, 2020a)

There is an existing 525 mm diameter pipe within Cross Street that runs along the southern boundary of the allotment, eventually discharging to Brookvale Creek. There is an existing kerb inlet pit (KIP) located at the south-eastern corner of the site (i.e. the lowest point of the site). This pit is connected to the 525 mm diameter pipe and acts as a connection point for the development site.

There is also an existing 825 mm diameter pipe within the adjacent property that runs along the eastern boundary of the allotment. This pipe connects into the same drainage system that the 525 mm diameter pipe is connected to.

Site construction works within close proximity to the 825 mm diameter pipe must consider the associated risks and comply with the requirements of building adjacent to Council drainage systems. This will include maintaining minimum clearance to the pipe and will require locating the pipe prior to commencing construction works.

2.3 Proposed development works

The proposed site works will maintain the current level of imperviousness – approximately 98% of the total site area. Therefore, the proposed development is not likely to increase site discharge. The existing rear of allotment car parks will be redeveloped into part of the new building, which will improve the quality of runoff coming from the area.

As exposed surfaces across the proposed development will almost entirely comprise roof areas, runoff from the entire site will be collected and conveyed via the underground drainage network. The site's underground drainage network can then be connected into the existing KIP within Cross Street.

3 Flood management

Design of stormwater drainage systems must give consideration to the management of flows from external catchments in addition to the management of flows generated within the site, so as to ensure that the development is protected in all events up to and including 1% AEP storm events.

Flood information provided by Council has identified the site as flood-affected in a 1% AEP storm event (Northern Beaches Council, 2020b). A Flood Management Report is therefore required as part of the Development Application to assess the flood risk and any impact the proposed development may have on existing flood levels, storage and flow paths.

Details on the management of flood flows moving through the site and how the preliminary stormwater drainage design complies with Council requirements and design standards for developing on flood prone land are discussed in the Flood Management Report (Tonkin, 2020).

4 On-site detention storage

On-site detention (OSD) is a common requirement for industrial and commercial developments to control the rate of discharge and help minimise flooding in downstream drainage systems. OSD is not however required where the development site is located within the 1% AEP floodplain (Warringah Council, n.d.).

Flood information provided by Council indicates that the development site is located within the 1% AEP floodplain (Northern Beaches Council, 2020b). On this basis – in accordance with the On-Site Stormwater Detention Technical Specification (Warringah Council, n.d.) – and based on discussions with Council, the site does not require OSD storage.

5 Internal drainage system

5.1 Design standard

External flows and runoff generated by the site will be managed via an underground drainage system comprising pits and pipes. The internal drainage system will collect and convey flows towards Council's existing drainage network in Cross Street.

The underground drainage system shall have sufficient capacity to convey 5% AEP flows, at a minimum. Overland flow paths shall convey flows exceeding the capacity of the underground drainage system in all events up to and including a 1% AEP design event.

5.2 Hydrologic and hydraulic modelling

DRAINS modelling was used to design the internal drainage system. The modelling approach is consistent with Council's guidelines and the latest (2016) Australian Rainfall and Runoff guidelines.

5.2.1 Rainfall data

Consistent with the Australian Rainfall and Runoff guidelines, the model was run for an ensemble of storm events (i.e. varied temporal patterns and storm durations) and the median peak flows generated by the catchments were adopted. The latest rainfall intensities and temporal patterns within the region were obtained from the Bureau of Meteorology (BoM) and Australian Rainfall and Runoff Data Hub, respectively.

5.2.2 Hydrological loss parameters

Council guidelines specify a set of parameter values that must be adopted for hydrological modelling (Warringah Council, n.d.). The adopted loss parameters are summarised in Table 5.1.

Table 5.1 Hydrological loss parameters

Parameter	
Impervious area depression storage	1 mm
Pervious area depression storage	5 mm
Soil type for antecedent conditions and infiltration rates	2.5

5.2.3 Assumptions

External flows

As mentioned in the Flood Management Report, it has been estimated – based on flood levels provided in the Flood Information Report (Northern Beaches Council, 2020b) – that flood flows overtopping the driveway and entering the site via the laneway could potentially be in the order of 80 L/s in a 1% AEP storm event (Tonkin, 2020). These calculations can be found in the Flood management Report (Tonkin, 2020).

These external flood flows, in addition to runoff generated by the driveway itself, have been accounted for in the design of the internal drainage system.

It has been assumed that there are no external flows overtopping the driveway crossover and entering the site in smaller events (e.g. in the 5% AEP storm event).

Downstream conditions

It is proposed that the site drainage system connects into the existing KIP in Cross Street. In the absence of hydraulic grade levels at this pit, it has been assumed that water levels at the pit will be at

water table (10.19 mAHD) in the 5% AEP storm event and at top of kerb (10.35 mAHD) in the 1% AEP storm event. These levels were obtained from the most recent site survey (LandPartners, 2019).

5.2.4 Results

The DRAINS modelling results are provided in Appendix B.

The modelling results indicate that the proposed drainage system is capable of conveying the 5% AEP flows generated by the site, such that a minimum freeboard of 150 mm can be achieved at all pits.

The underground drainage system also has sufficient capacity to convey 1% AEP flows such that there is no surcharging at any of the pits, with the exception of the downstream most grated inlet pit at the south-western corner of the site. This pit, and the pit at the south-eastern corner of the site, allow for surcharging where the roof drainage system connects into the underground drainage system.

As these pits are located near the downstream boundary of the site, surcharged flows can safely make their way to Cross Street without risking inundation of the building or creating a safety hazard.

The two grated inlet pits and strip drain within the laneway are capable of capturing the external flood flows in addition to runoff generated by the driveway in a 1% AEP storm event. This prevents floodwaters from entering the building via the roller doors and moving through the internal driveway within the building.

As a failsafe, the internal driveway has been designed to have gradual fall towards Cross Street in case these pits were to completely block up. There are also a number of additional inlet pits along the internal driveway to collect any flows that bypass the upstream pits.

6 Water Sensitive Urban Design

6.1 Pollutant reduction targets

Council requires that all developments implement the principles of Water Sensitive Urban Design (WSUD) in order to meet the water quality improvement targets presented in Table 6.1.

Table 6.1 Pollutant reduction targets

Pollutant	Performance target reduction loads
Gross pollutants	90% reduction in the mean annual load of gross pollutants
Total suspended solids (TSS)	85% reduction in the mean annual load of TSS
Total phosphorus (TP)	65% reduction in the mean annual load of TP
Total nitrogen (TN)	45% reduction in the mean annual load of TN

6.2 Water quality modelling

In order to assess and determine the required measures to achieve the above pollutant reduction targets, water quality modelling of the proposed development was undertaken using the eWater Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The modelling approach complies with the NSW MUSIC Modelling Guidelines (BMT WBM, 2015).

6.2.1 Meteorological data

Rainfall

Daily rainfall data recorded at the Castle Cove weather station (Station No. 066080) was obtained from the Bureau of Meteorology (BoM) as this station is relatively close to the development site (approximately 6 km) and has a long record of continuously recorded rainfall data from 1959 to present.

Water quality modelling requires a five-year period representative of typical climate in the region to be modelled. It is important that rainfall patterns over the selected five-year period are representative of long-term averages. Rainfall records from 2010 to 2014 were selected for modelling as the annual average rainfall across this period (1369 mm) is comparative to the long-term average, over a 61-year period (1311 mm).

The average annual distribution of rainfall across the five-year period is also comparative to the long-term averages. Figure 6.1 compares average annual rainfall distributions for the five- and 61-year periods.

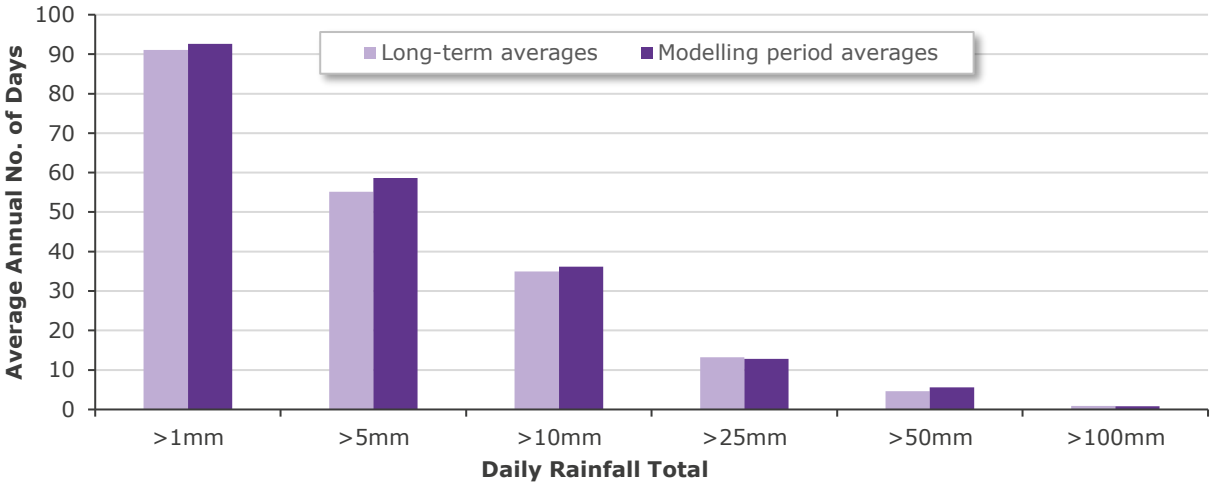

Figure 6.1 Daily rainfall total comparison

Evapotranspiration

The monthly averages for aerial Potential Evapotranspiration (PET) were obtained from BoM's gridded database. The total average annual evapotranspiration within the region is 1239 mm.

6.2.2 Parameters

The rainfall-runoff and pollutant generation parameters were selected based on values provided in the NSW MUSIC Modelling Guidelines (BMT WBM, 2015). The adopted parameters are summarised in Table 6.2 and Table 6.3.

Table 6.2 Adopted rainfall-runoff parameters

Parameter	Value
Impervious Area Properties	
Rainfall threshold (mm/day)	1.00
Pervious Area Properties	
Soil Storage Capacity (mm)	108
Initial Storage (% of capacity)	25%
Field Capacity (mm)	73
Infiltration Capacity Coefficient – a	250
Infiltration Capacity Exponent – b	1.3
Groundwater Properties	
Initial Depth (mm)	10
Daily Recharge Rate (%)	60%
Daily Baseflow Rate (%)	45%
Daily Deep Seepage Rate (%)	0%

Rainfall-runoff parameters for Sandy Clay Loam were adopted as a number of soil profiles at locations near the site generally have a Sandy Loam/Sandy Clay Loam composition (Office of Environment and Heritage, 2020).

Table 6.3 Adopted pollutant generation parameters

Area		TSS (log^{10} mg/L)		TP (log^{10} mg/L)		TN (log^{10} mg/L)	
Roof	Baseflow	n/a	n/a	n/a	n/a	n/a	n/a
	Stormflow	1.30	0.32	-0.89	0.25	0.30	0.19
Driveway	Baseflow	1.20	0.17	-0.85	0.19	0.11	0.12
	Stormflow	2.43	0.32	-0.30	0.25	0.34	0.19
Front yard	Baseflow	1.20	0.17	-0.85	0.19	0.11	0.12
	Stormflow	2.15	0.32	-0.60	0.25	0.30	0.19

6.2.3 Modelling results

The MUSIC modelling results are provided in Appendix C.

Modelling results indicated that the following water quality improvement measures are required in order to achieve to required level of treatment:

- 3 Cartridge StormFilter System by OceanProtect (or approved equivalent) to remove pollutants from stormwater runoff. The pit containing the three 690 mm high StormFilters will need to be located at the downstream (southern) end of the site so it can treat runoff coming from the majority of the site, including the driveway and roof area.
- Grass buffer at the front of the site to treat the areas that cannot be directed to the StormFilters. The grass buffer will slow down runoff and allow for infiltration/evaporation to occur.

Table 6.4 shows the treatment effectiveness of the above measures and demonstrates how the pollutant reduction targets can be met.

Table 6.4 Mean annual pollutant loads

	Source	Residual load	Reduction
Flow (ML/yr)	3.36	3.36	0
Total Suspended Solids (kg/yr)	163	22	86%
Total Phosphorus (kg/yr)	0.7	0.13	81%
Total Nitrogen (kg/yr)	7.3	3.4	53%
Gross Pollutants (kg/yr)	82	2	98%

7 Summary

This design report has been prepared to support the Development Application for the proposed new self-storage facility at 4 Cross Street, Brookvale. The preliminary stormwater drainage design has been carried out in accordance with the relevant local, state and national design guidelines and Australian Standards.

The key stormwater design elements include:

- an underground drainage system with sufficient capacity to convey the 5% AEP flows
- overland flow paths capable of safely conveying flows that exceed the capacity of the underground drainage system in all events up to and including a 1% AEP storm event
- water quality improvement measures that meet the principles of Water Sensitive Urban Design (WSUD) and provide the level of treatment required by Northern Beaches Council. The adopted measures include:
  - grassed buffer at the front of the development; and
  - a filtration system within the downstream most pit.

On-site detention (OSD) is not required as part of this development has it has been identified that the proposed development is located within the 1% AEP floodplain.

8 References

BMT WBM (2015). *NSW MUSIC Modelling Guidelines.* Prepared for Greater Sydney Local Land Services. Rev 0.

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LandPartners (2019). *Detail Survey of Lot 2 in DP543012 – 4 Cross Street, Brookvale.* Ref no. SY074811.000.1. Rev 1.

Northern Beaches Council (2020a). *Northern Beaches Mapping.* Accessed 13/03/2020. https://services.northernbeaches.nsw.gov.au/icongis/index.html

Northern Beaches Council (2020b). *Flood Information Request – Comprehensive.* Property: 4 Cross Street, Brookvale. Issue Date: 14/02/2020. Flood Study Reference: Manly Lagoon Flood Study 2013, BMT WBM.

Office of Environment and Heritage (2020). *eSPADE v2.0.* Accessed: 13/03/2020. https://www.environment.nsw.gov.au/eSpade2WebApp#

Tonkin (2020). *Rent A Space Brookvale – Flood Management Report.* Ref no. 20192073R002RevA.

Warringah Council (n.d.). *On-site Stormwater Detention Technical Specification.*

Appendix A – Preliminary design drawings

LEGEND

- CADASTRAL BOUNDARY
- EXISTING STORMWATER PIPE
- PROPOSED STORMWATER PIPE
- PROPOSED RIDGE
- PROPOSED GRATED INLET PIT (GIP)
- EL:11.85 SURFACE ELEVATION

CROSS STREET

EXISTING DN525 RCP

600 x 600 GIP CONNECTION POINT FOR WESTERN ROOF DRAINAGE

EL:10.98
EL:10.87
DN 375 RCP
EL:10.99
EL:11.05
EL:10.99
EL:10.77
DN 375 RCP
EL:11.12
EL:11.27
EL:11.27
-5.0%
-1.3%
-1.3%
-1.3%
-1.3%
-2.5%
-2.2%
-2.0%
-2.5%

DISABLED RAMP 5% GRADE

CONCRETE PLANTER BOX / RETAINING WALL

3 STEP STAIR

CONNECT TO EXISTING KERB INLET PIT

EL:10.56
EL:11.39
EL:10.38

DN 1460 PIT WITH OCEAN PROTECT 3 CARTRIDGE STORMFILTER SYSTEM OR APPROVED EQUIVALENT.

600 x 600 GIP CONNECTION POINT FOR EASTERN ROOD DRAINAGE

DN 375 RCP

600 x 600 GIP COVER LEVEL 10.16

EL:11.27

600 x 600 GIP COVER LEVEL 11.19

EL:11.30

EL:11.25
DN375 RCP

EL:11.30

600 x 600 GIP COVER LEVEL 11.26

EL:11.35

EL:11.30

KERB ONLY

KERB ONLY

-2.9%
-1.7%
-0.9%
-3.1%
-1.1%
-4.3%
-4.9%
-2.0%
-1.1%
-1.8%
-3.3%
-1.4%
-1.3%

WC FFL 11.30

EL:11.40
EL:11.40
EL:11.40

EL:11.25
EL:11.25
EL:11.40

KERB ONLY

BUILDING
FFL 11.40

EXISTING DN825 RCP (LOCATION INDICATIVE ONLY)

KERB AND GUTTER 2.6% LONG. GRADE

EL:11.87

600 x 900 GIP

CONNECT STRIP DRAIN DIRECTLY TO DN375 RCP

EL:11.50

EL:11.30

-3.6%
-3.6%
-2.4%

EL:11.93

KERB ONLY

300 WIDE STRIP DRAIN

EL:11.39

DN 375 RCP

600 x 600 JUNCTION PIT

EL:11.35

RECONSTRUCT EXISTING DRIVEWAY CROSSOVER TO MATCH

EL:12.37
EL:12.40

-5.0%

RECONSTRUCT EXISTING FOOTPATH AND REGRADE VERGE TO MATCH

-3.6%

THIS DRAWING IS TO BE VIEWED IN COLOUR AS SOME FEATURES / SYMBOLS ARE DIFFERENTIATED BY COLOUR. DRAWING NOT TO BE RELIED ON IF PRINTED IN GREYSCALE.

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SHEET SIZE A1

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DATUM: ALL LEVELS TO A.H.D.
SCALE:
SURVEYED:
SURVEY DATE:
APPROVED / PROJECT LEADER

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RENT A SPACE

STORAGE UNITS AT 4 CROSS ST BROOKVALE
-
STORMWATER MANAGEMENT PLAN

FILENAME: 20192073_SMP.DWG
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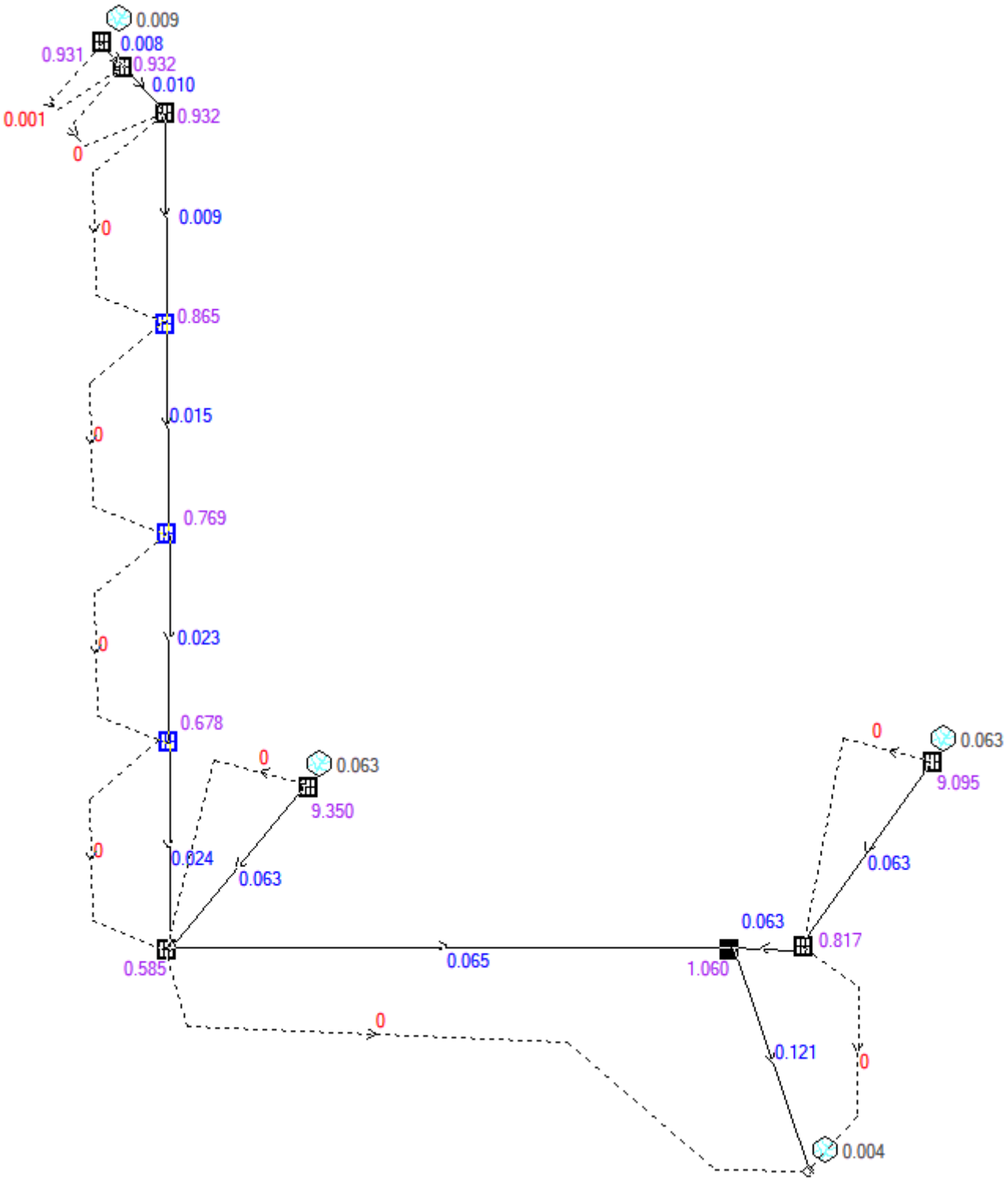
Appendix B – DRAINS modelling results



Legend

0.00 Freeboard at pit
0.00 Peak overflow
0.00 Peak pipe flow

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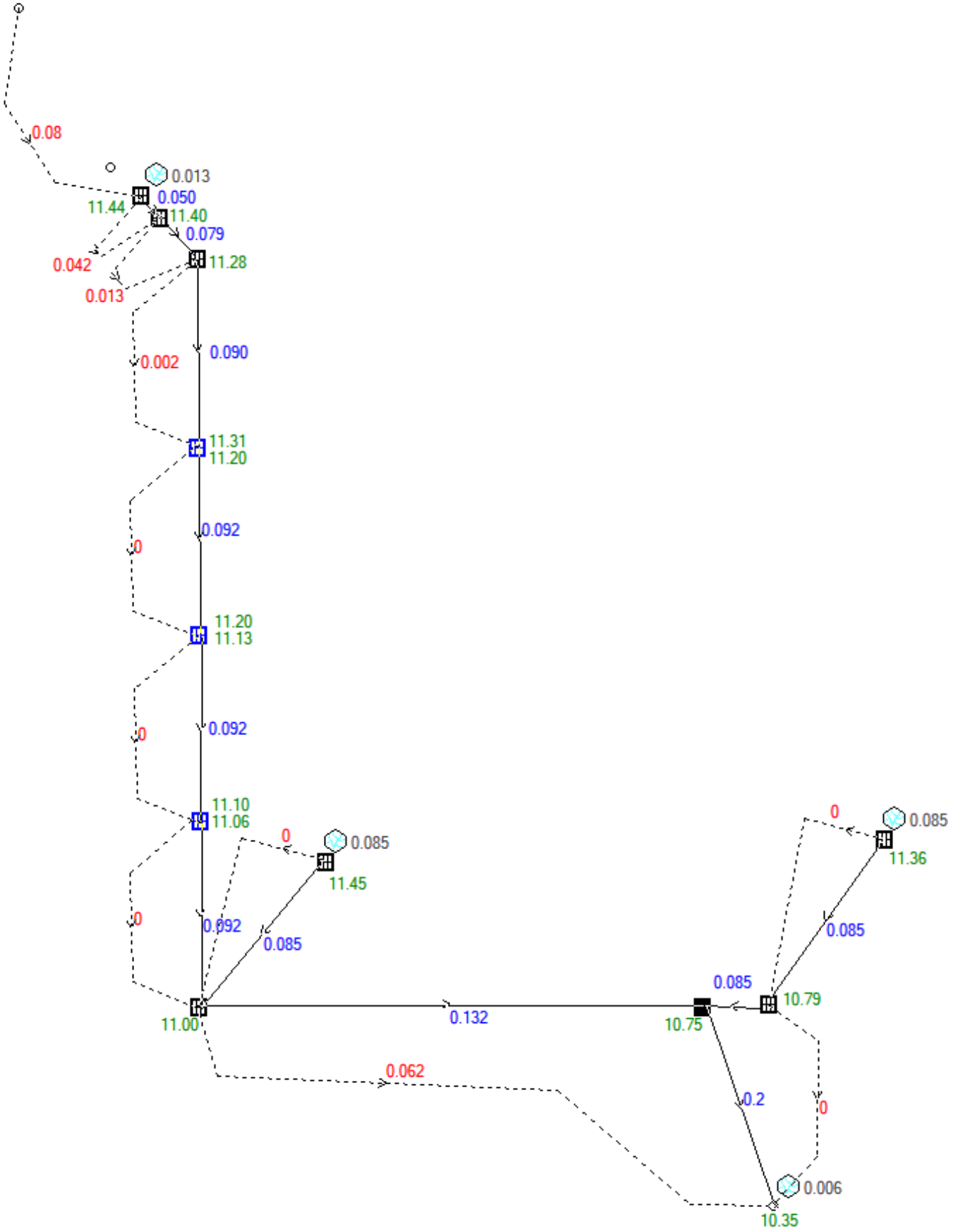
RENT A SPACE BROOKVALE
DRAINS results
5% AEP storm events



Legend

0.00 Peak water level at pit
0.00 Peak overflow
0.00 Peak pipe flow

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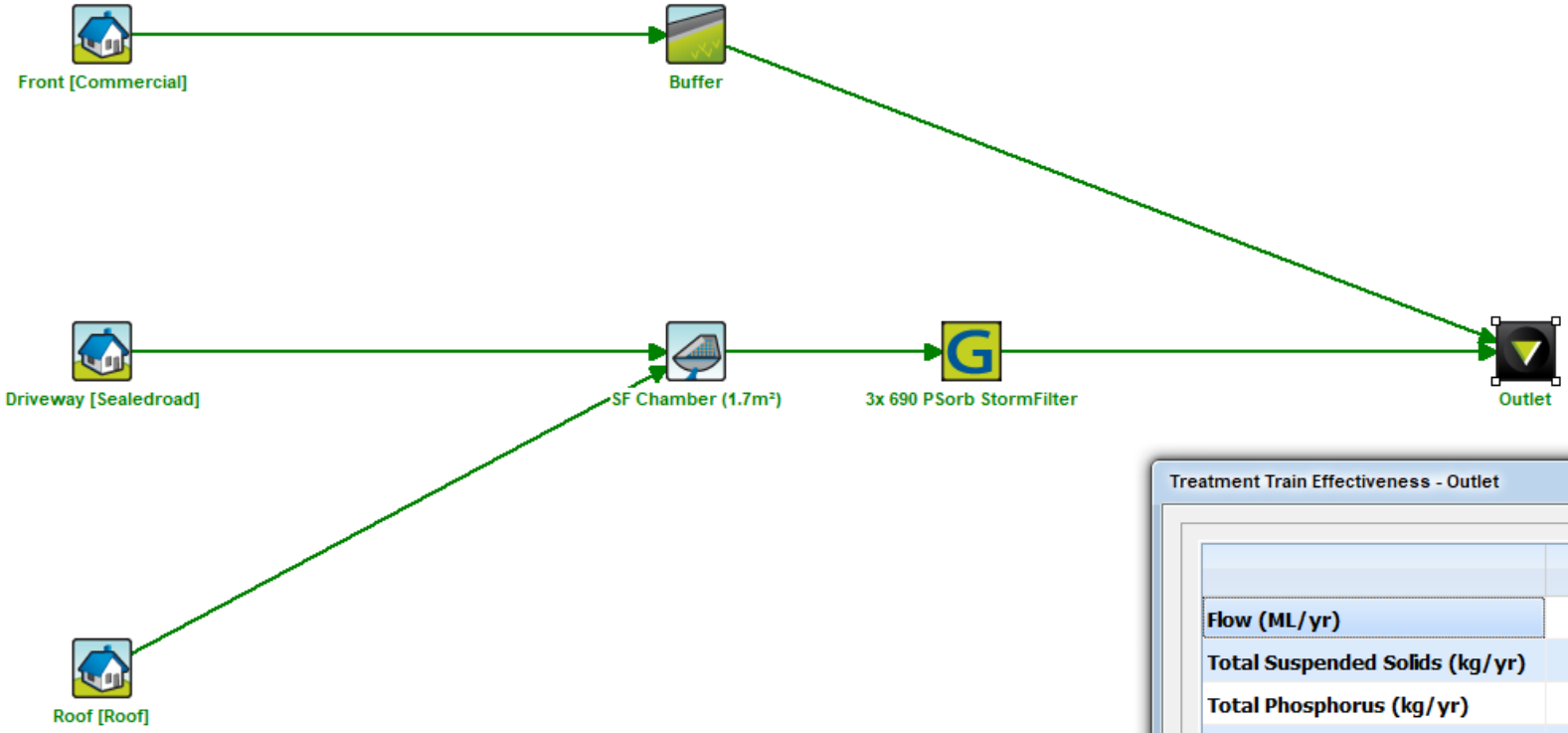
RENT A SPACE BROOKVALE
DRAINS results
1% AEP storm events

Appendix C – MUSIC modelling results



Treatment Train Effectiveness - Outlet

	Sources	Residual Load	% Reduction
Flow (ML/yr)	3.36	3.36	0
Total Suspended Solids (kg/yr)	163	21.9	86.5
Total Phosphorus (kg/yr)	0.7	0.131	81.3
Total Nitrogen (kg/yr)	7.3	3.4	53.4
Gross Pollutants (kg/yr)	82.4	1.97	97.6