Penrith Retirement Living

Stormwater drainage design report

Fresh Hope Care

28 April 2020
Ref: 20181340R002A

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Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
A	For DA	MZ	OO		28 April 2020

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Ref: 20181340R002A

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1 Introduction

Fresh Hope Care is proposing to construct a retirement living facility at 154-162 Stafford Street, Penrith, New South Wales. The proposed development comprises three two-storey buildings with a basement car park. The buildings will accommodate 33 residential apartments and a central courtyard between building A and C.

Tonkin has been engaged to provide a preliminary design and documentation of stormwater drainage within the site to support the Development Application (DA) to the Penrith City Council (Council).

1.1 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.

1.2 Design inputs

The most recent architectural plans from Smith & Tzannes, Sheet A-100-103, A-200, A-202 (Revision 27/04/2020), and most recent survey of the site (Project Surveyors, 20 November 2018) were used to provide input into the preliminary design of the stormwater drainage system.

1.3 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 guidelines (2016)
- AS 3500.3 – Plumbing and Drainage – Stormwater Drainage
- Penrith Development Control Plan (2014)
- Penrith City Council – Stormwater Drainage Specification for Building Developments (2018)
- Penrith City Council – Water Sensitive Urban Design (WSUD) Policy (2013)
- Penrith City Council – WSUD Technical Guidelines (2015)

1.4 Council requirements

There are a number of Council requirements that guided the design of the preliminary stormwater drainage design. The most notable of these requirements include:

- site flood information must be assessed to determine whether additional stormwater management measures are required to protect the development from external floodwaters in a 1% AEP event.
- on-site detention (OSD) is required to limit site discharge so as not to adversely impact downstream drainage systems or adjacent properties.
- site drainage systems must be designed to the major/minor system design principles outlined in 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

The site of the proposed development currently comprises two single-dwelling allotments and a larger allotment that houses the Churches of Christ. It is proposed that all development across the site is demolished and the existing allotments amalgamated to form a single allotment, approximately 4,880 m^2 in size, in preparation for construction of the proposed retirement living facility.

In its pre-development state, the site comprises dwellings, buildings, carparks, driveways and other paved surfaces. The impervious area across the entire site when in its current state of development is approximately 67% of the total site area.

The proposed development will only increase the impervious area by 1% – a total impervious area of 68% – which is unlikely to significantly increase the amount of runoff generated by the site.

Review of available survey shows that the site generally falls in a north-easterly direction at an approximate grade of 4%, towards Stafford Street (Project Surveyors, 2018). Runoff from the site currently discharges directly to Stafford Street via kerb outlets and as overland flow.

The piped system within the site will also discharge to Stafford Street. Flows will then be directed in an easterly direction towards Council's underground drainage network. The nearest pit or pipe within Council's drainage network is approximately 40 m east of the site. Council's drainage system then directs flow in a north-westerly direction, eventually discharging to the Nepean River – a tributary to the Hawkesbury River.

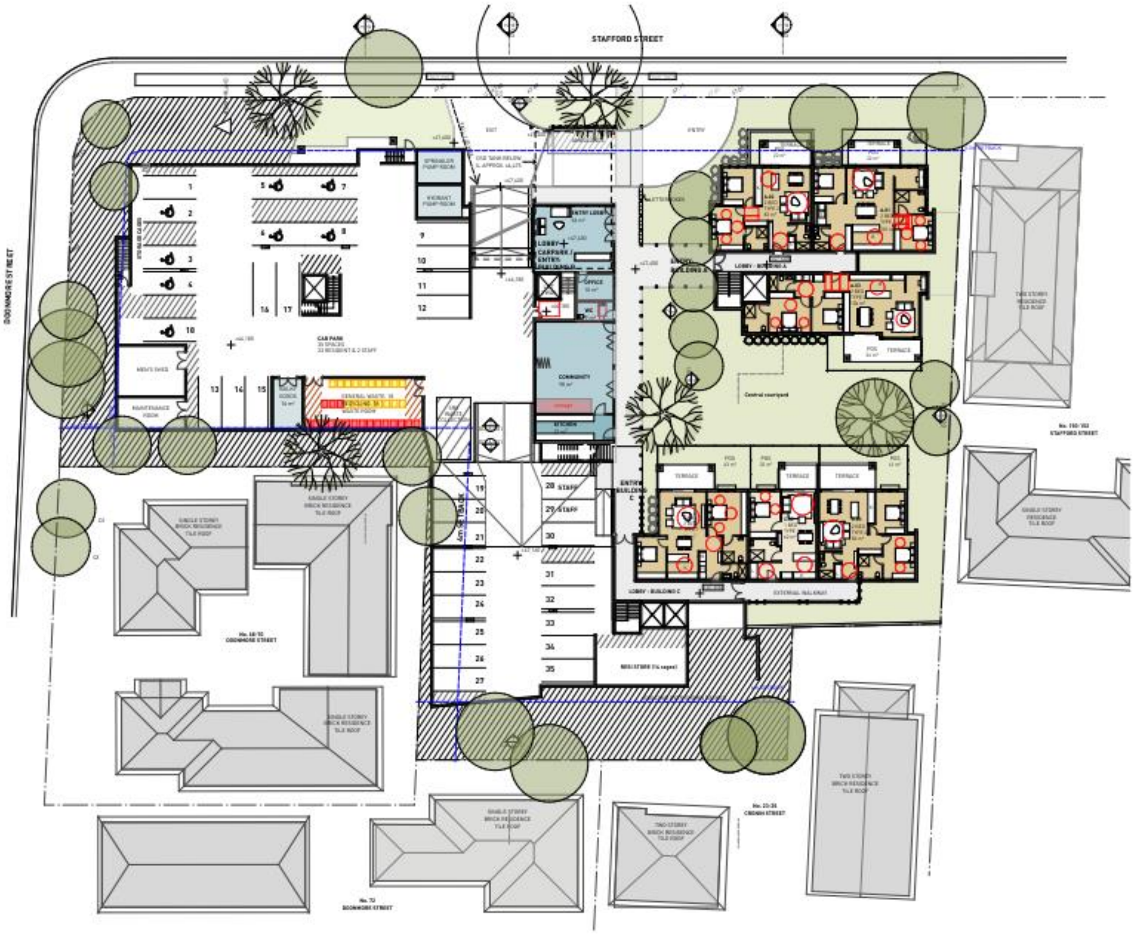


Figure 2-1 Proposed ground floor layout plan

3 Flood assessment

The design of stormwater systems must give consideration to the management of flows from external catchments in addition to the management of flows generated within the site. The following flood studies were used to determine whether the site is subject to flooding from external catchments:

- the overland flow flood overview study for Penrith (Cardno, 2006)
- an overland flow flood study within Penrith CBD (Cardno, 2015)
- Nepean River flood study (Advisian, 2018).

Review of these flood studies has indicated that the site is not subject to flooding in all events up to and including a 1% annual exceedance probability (AEP) event. As the site is not subject to flooding, the stormwater drainage design for the site does not need to include measures to manage flows from external catchments – it only needs to provide measures to manage runoff generated within the site.

4 On-site detention

On-site detention (OSD) is required for the proposed residential flat building so as to ensure that the proposed development does not adversely impact flooding at downstream locations in all storm events up to 1% AEP events. During the stormwater design development, Council confirmed that the OSD should be designed to limit peak post-development peak flows to pre-development flow rates.

Design of the OSD system has been undertaken using DRAINS model to perform calculations in accordance with Council's stormwater drainage policy (Penrith City Council, 2018). The design is such that there will be no increase in the peak flow rates from the site as a result of the development under all durations and for all events up to and including the 1% AEP event.

Based on the results of the DRAINS model, the pre-development peak flows are estimated to be:

- 20% AEP flow =124L/s
- 10% AEP flow =164L/s
- 5% AEP flow =196L/s
- 1% AEP flow =261L/s.

In addition to limiting post-development flows to pre-development flows, the design of the OSD has also taken into account Council's requirement that the maximum discharge to the kerb at any single point shall be 25L/s for 10% AEP storm events.

Due to the topography of the site, it is not possible to drain 100% of the site to the OSD. The documented stormwater design has 95% of the site draining to the OSD, with 5% bypassing. The modelling indicates that a 14m (L) x 11m (W) X 1.05m (D) underground OSD tank with a 98mm diameter orifice meets Council's requirements. Based on the aforementioned characteristics, the post-development peak flow rates from the site (including the OSD bypass flows) are as follows:

- 20% AEP flow =18L/s
- 10% AEP flow =21L/s
- 5% AEP flow =31L/s
- 1% AEP flow =115L/s

It can be seen that the proposed stormwater configuration and OSD reduces the peak flows below pre-development flow rates. The 10% AEP flow rate discharged from the site is 21L/s, which meets Council's requirement.

The top water level of the OSD tank at 1% AEP flow is 47.05 which provides a 350mm freeboard to habitable floors and driveway crest (at 47.4 mAHD).

5 Site drainage system

The stormwater drainage system within the site has been designed to provide both major and major systems, as detailed in Australian Rainfall and Runoff. The major and minor systems are required to provide the following drainage standards, at a minimum:

- the minor system will consist of a pit and pipe network that has the capacity to collect and convey the 10% AEP flows
- the major system will consist of overland flow paths that have the capacity to safely convey the 1% AEP flows that exceed the capacity of the minor system around the proposed buildings in such a manner that does not encroach on adjacent properties.

DRAINS modelling has been used for the hydraulic analysis and preliminary design of the major/minor stormwater drainage system. The modelling approach is consistent with Council's guidelines and the latest (2016) Australian Rainfall and Runoff guidelines.

The development will also require a pumped system to pump out any water that collects within the basement.

5.1 Flow estimation

The DRAINS model was used to estimate the peak flows generated by sub-catchments within the site. As various design elements, including roof drainage and landscaping, are yet to be confirmed, the sub-catchment boundaries have been approximated. The catchment plan is shown on sheet number DA410 of Appendix A.

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 flow was adopted. The latest (2016) rainfall data was obtained from the Bureau of Meteorology (BoM).

The calculated peak flow rates were based on an ILSAX type hydrological model. The adopted model parameters are summarised in Table 5-1. Details of the DRAINS model including model layout, input data and results are provided in Appendix B.

Table 5-1 ILSAX hydrological model parameters

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

5.2 Hydraulic analysis

The hydraulic modelling undertaken in DRAINS assumed the following Manning's roughness (n) values:

- 0.011 for all uPVC pipes
- 0.013 for all concrete pipes
- 0.015 for all paved surfaces
- 0.030 for all landscaped surfaces.

The pressure head change coefficients (k_u) at all pits were calculated using guidelines from the Queensland Urban Drainage Manual (QUDM, 2013).

5.2.1 Design criteria

In accordance with the relevant standards and guidelines, the site drainage system was designed to achieve the following:

- the minor system caters for 10% AEP storm events.
- the major system caters for 1% AEP events, such that:
  - there is sufficient freeboard between overland flow and building floor levels so as to protect buildings from inundation
  - site runoff is not directed into adjacent properties
  - the product of flow depth and velocity within overland flow paths does not exceed 0.4.

5.3 Basement pump

A pumped system is required within the basement to evacuate flows that cannot be drained via a gravity line. Only a portion of the driveway (50 m^2) will contribute to flows directed into the basement.

In accordance with Council requirements, the pumped system must include:

- a pump-out pit which has been sized to store the total runoff entering the basement in a 1% AEP, 2-hour duration storm event.
- pump(s) with capacity to pump the peak flow rate entering the basement in a 1% AEP, 5-minute duration storm event.

On this basis, a 5 m^3 pump-out pit is required to store flows that enter the basement and two pumps, each with capacity to pump at a rate of 6 L/s on an alternative basis, are required to evacuate these flows. The pumps will direct flows into the OSD tank via a rising main.

6 Water Sensitive Urban Design

Council requires that all developments implement the principles of Water Sensitive Urban Design (WSUD) in order to meet the water quality improvement targets provided in Table 6-1. Improving the quality of water leaving the site is aimed at protecting or enhancing natural drainage systems downstream, including natural watercourses such as Nepean River.

Table 6-1 Water quality improvement 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)	60% reduction in the mean annual load of TP
Total nitrogen (TN)	45% reduction in the mean annual load of TN

6.1 Water quality modelling

The water quality of runoff from the site was modelled using the eWater Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The meteorological data, parameters for source nodes (catchments) and water quality improvement measures were selected using the Penrith City Council MUSIC-link.

The site will consist of the following water quality improvement measures in order to meet the aforementioned performance objectives:

- gross pollutant traps;
- rainwater tank and re-use;
- OSD with a filtration system.
- Grass buffer

6.1.1 Gross pollutant traps

It is proposed that three gross pollutant traps (GPTs) are installed on Grated Inlet Pits (as shown on Drawing 402). The GPTs are proposed in the drainage network upstream of the OSD to remove gross pollutants, total suspended and attached pollutants.

The GPTs will remove gross pollutants before discharge to Council's drainage network. It is recommended that Ocean Protect OceanGuards or an approved equivalent are used. The treatment efficiency data required for input into the MUSIC model was provided by the manufacturer.

6.1.2 Rainwater tank and re-use

A proposed 15-kL rainwater tank (RWT) is currently implemented into the stormwater drainage system for collecting and retaining runoff from the roof of the existing buildings for on-site re-use. The RWT has been modelled to service the common landscape.

6.1.3 OSD tank with filtration system

While the proposed GPTs are an effective measure for removing gross pollutants, they are not very effective at removing suspended and dissolved pollutants, including total suspended solids, phosphorus and nitrogen. It is therefore proposed that a filtration system within the OSD tank is used to absorb and retain these pollutants.

In order to meet the water quality improvement objectives, the proposed filtration system will comprise 6x 460 PSorb StormFilters in total by Ocean Protect, or an approved equivalent. It is proposed that the 3x 460 StormFilters are located within a chamber at each upstream of the OSD tank. Pipes entering the tank will be directed to the StormFilter chamber so as to ensure that all water entering the tank is filtered through the system.

The treatment efficiency data and model parameters for the StormFilters and their chamber within the OSD tank were provided by the manufacturer.

6.1.4 Grass buffer

To minimise the amount of direct runoff from impervious areas, runoff from paved/impervious areas will be directed through a grassed buffer where possible. The purpose of the buffer strip is to slow down runoff, allowing the grass to trap sediment and enhance the removal of nutrients.

It is assumed that all grass buffer strips will be mowed and maintained regularly; therefore, a grass thickness of 50 mm was adopted. As flow is likely to sheet across the buffer strip relatively quickly, it was not reasonable to assume that any exfiltration would occur.

6.2 Modelled results

Modelling of the above water quality improvement measures has confirmed that the pollutant loads leaving the site meet the targets outlined in Table 6-1. The modelled results, shown in Table 6-, demonstrate the level of treatment that is provided by the proposed water quality improvement measures outlined in the above sections. More details of the model and modelled results are provided in Appendix C.

Table 6-2 Mean annual pollutant loads leaving the site

	Source	Residual load	Reduction
Flow (ML/yr)	2.05	1.72	16.3%
Total Suspended Solids (kg/yr)	153	22.9	85%
Total Phosphorus (kg/yr)	0.405	0.145	64.1%
Total Nitrogen (kg/yr)	4.47	2.23	50.2%
Gross Pollutants (kg/yr)	61	1.74	97.2%

7 Conclusion

This stormwater design report has been developed to support the development application for the proposed retirement living facility at 154-162 Stafford Street, Penrith, New South Wales. 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 design elements include:

- on-site detention storage that has been designed to meet the permissible site discharge rates set by Penrith City Council.
- a major/minor stormwater drainage system that was designed in accordance with Australian Rainfall and Runoff guidelines, and consisting of:
  - a pit and pipe system of sufficient capacity to collect and convey runoff in 10% AEP events.
  - overland flow paths for ensuring that the 1% AEP flows that exceed the capacity of the pit and pipe system are safely conveyed towards the discharge point.
- water quality improvement measures that meet the principles of Water Sensitive Urban Design (WSUD) and provide the level of treatment that is required by the Penrith City Council. The adopted measures include:
  - gross pollutant traps;
  - rainwater tank
  - a filtration system
  - grass buffer.

8 References

Advisian (2018). *Nepean River Flood Study – Final Report.* Volume 1: Main Report. Reference no. 301077-14401.

Cardno (2006). *Penrith Overland Flow Flood "Overview Stufy" – Flood Analysis for Central Urban (Zone 1), Northern Rural (Zone 2), Southern Rural (Zone 3).* Prepared for Penrith City Council. Reference no. J2453/R2251.

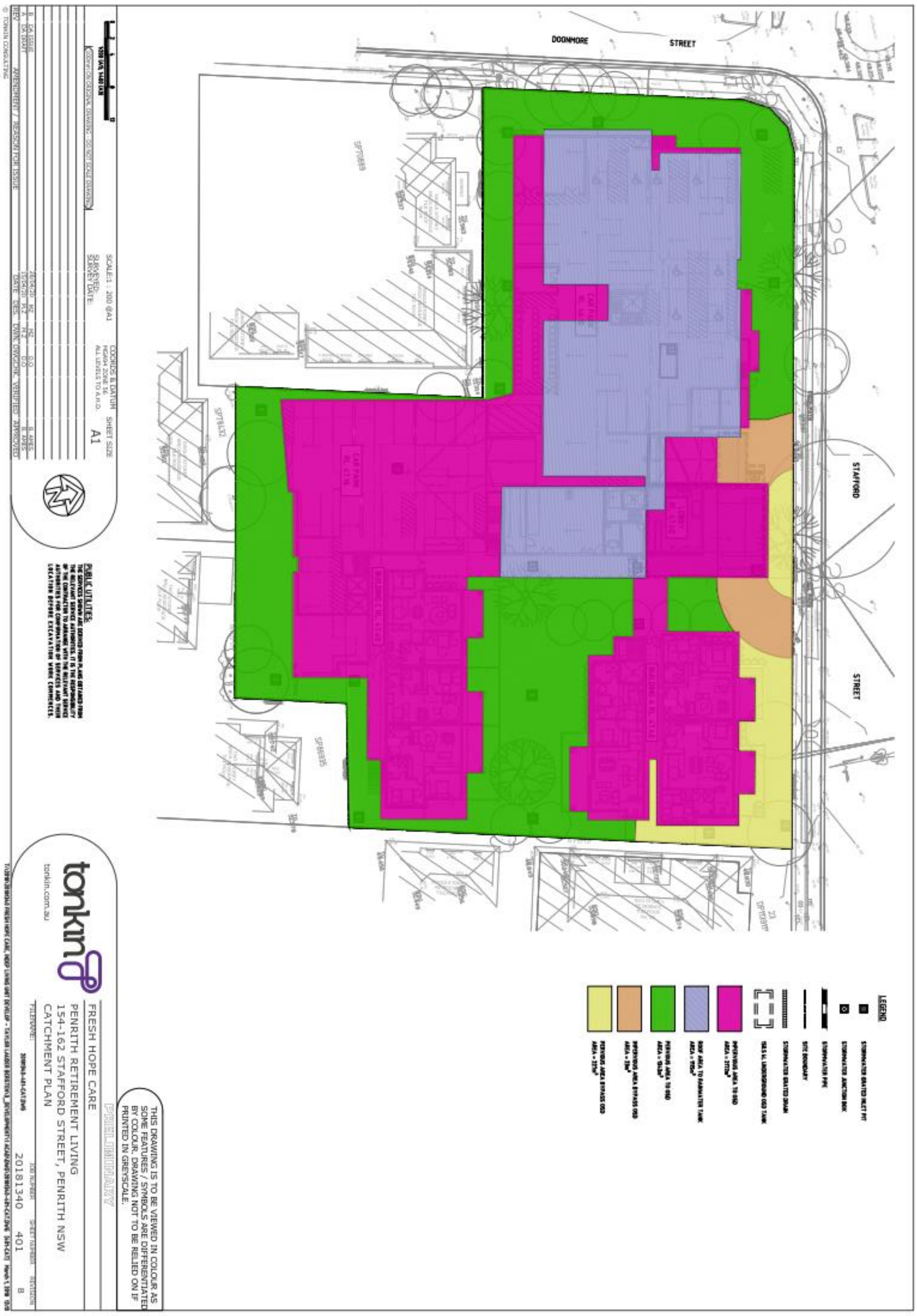
Cardno (2015). *Penrith CBD Detailed Overland Flow Flood Study – Final Report.* Prepared for Penrith City Council. Reference no. W4735.

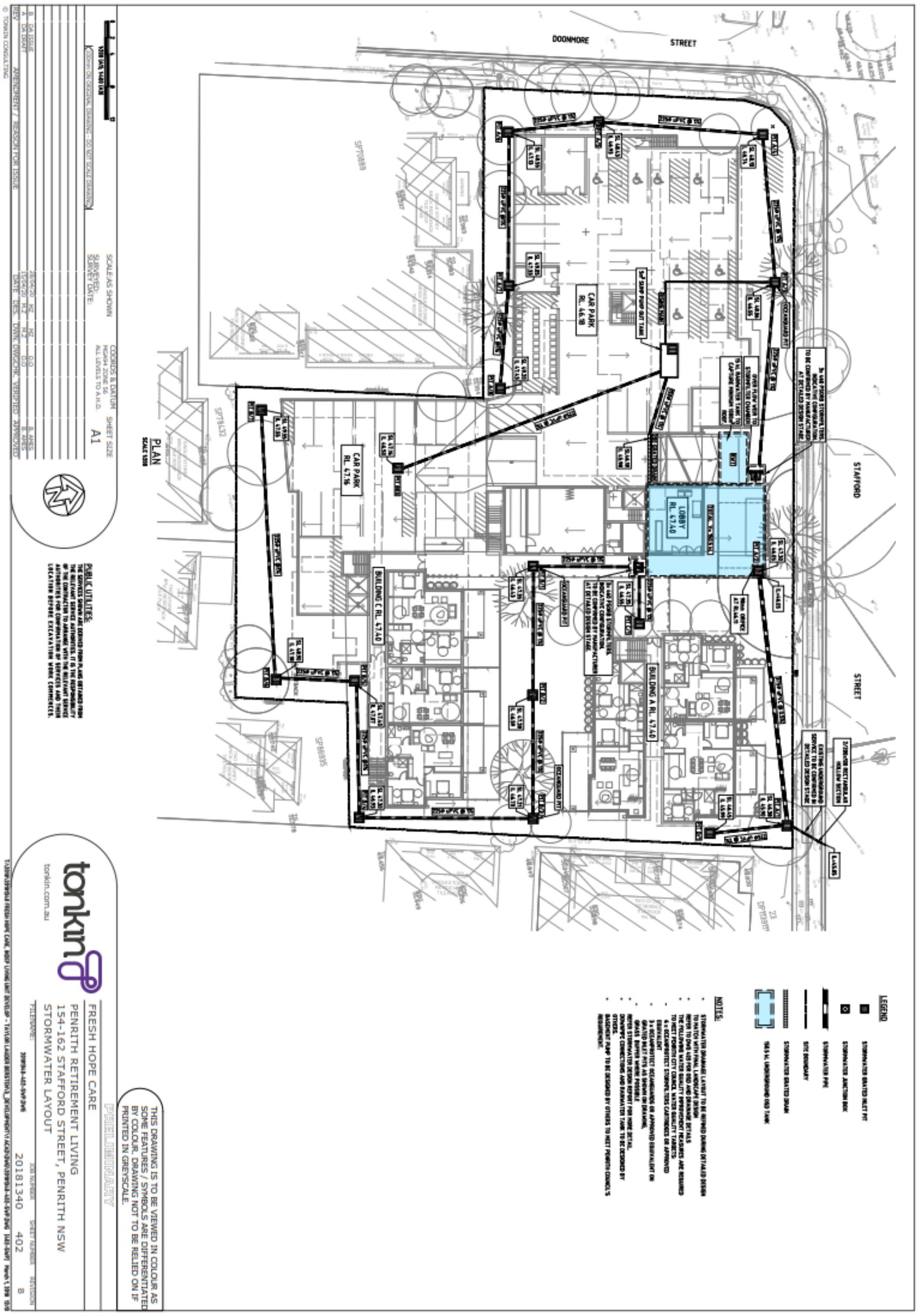
Fulton Trotter (2019). *Penrith Retirement Living – State Environent Planning Policy (Housing for Seniors or People with a Disability) 2004 – Development Application.* Project no. 7082PE01. Dated 05/04/2019.

Penrith City Council (2018). *Stormwater Drainage Specification for Building Developments.*

Project Surveyors (2018). *154-162 Stafford Street, Penrith – General detail and site levels.* Job ref. B04360. Date of survey: 05/09/2018.

Appendix A – Preliminary design drawings




DOONMORE STREET
STAFFORD STREET
CAR PARK RL 46.18
CAR PARK RL 47.16
LOBBY RL 47.40
BUILDING A RL 47.40
BUILDING C RL 47.40
PLAN
LEGEND
NOTES:
PUBLIC UTILITIES:
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.
PRELIMINARY
FRESH HOPE CARE
PENRITH RETIREMENT LIVING
154-162 STAFFORD STREET, PENRITH NSW
STORMWATER LAYOUT
20181340
402
B
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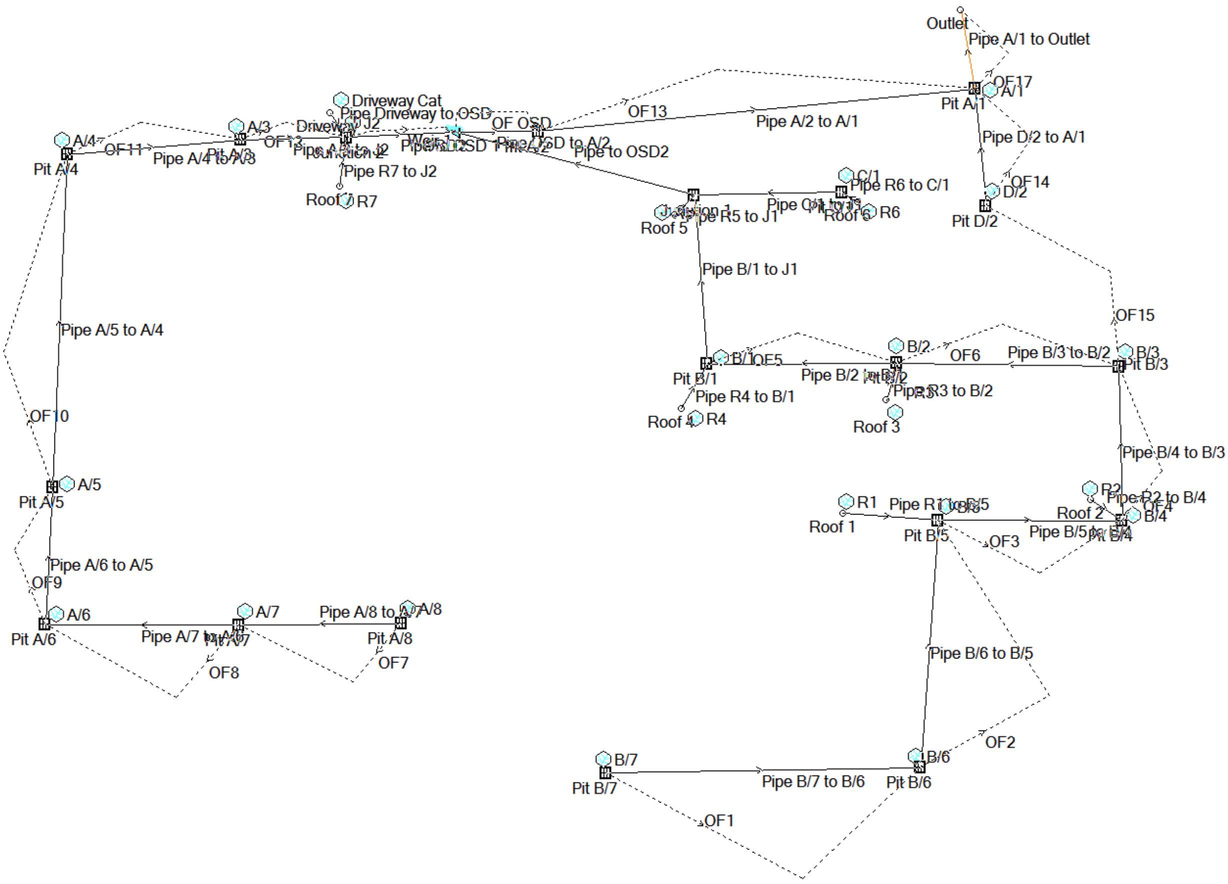
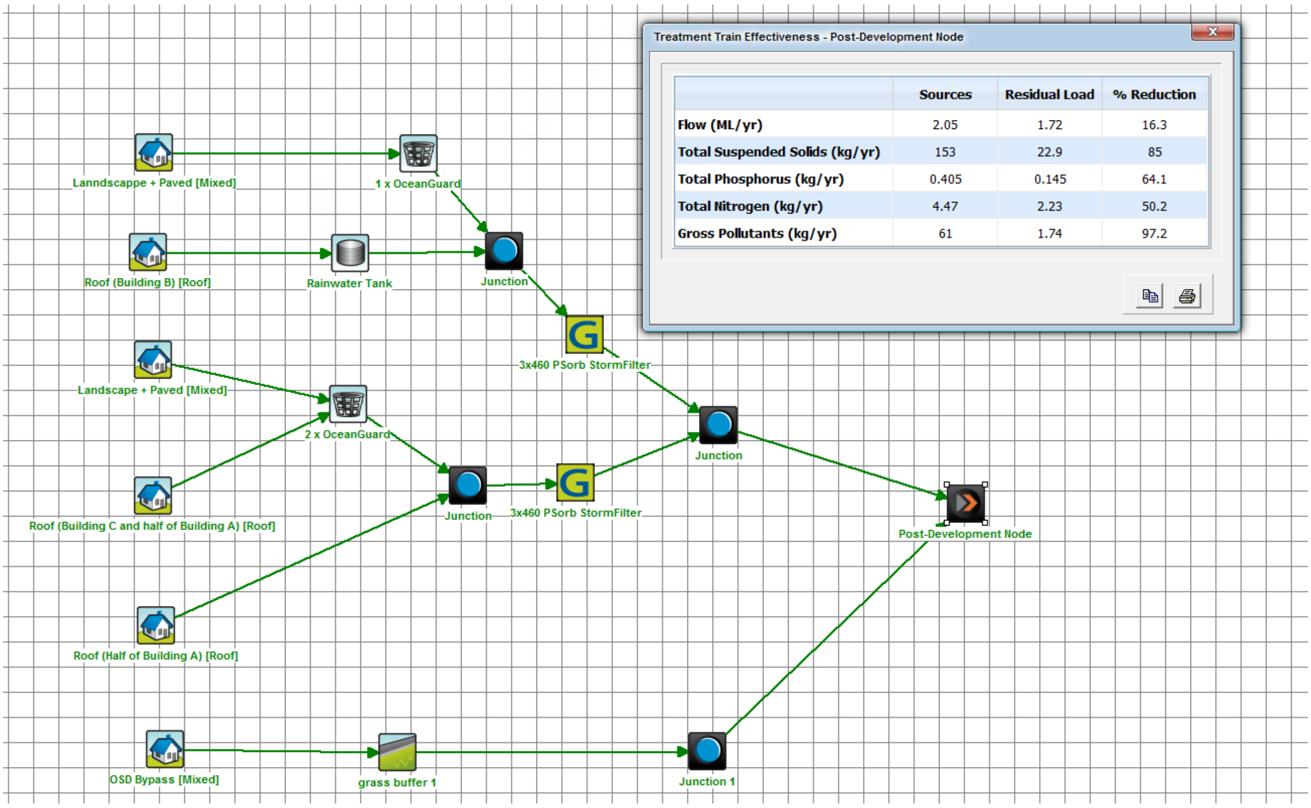
SCALE AS SHOWN
A1

Appendix B – DRAINS model



Appendix C – MUSIC results



	Sources	Residual Load	% Reduction
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Total Nitrogen (kg/yr)	4.47	2.23	50.2
Gross Pollutants (kg/yr)	61	1.74	97.2