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CONSULT AUSTRALIA
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STORMWATER MANAGEMENT REPORT

HITCHMAN UNITS

3 LAUDERDALE AVENUE,

FAIRLIGHT NSW 2094

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EXECUTIVE SUMMARY

James Taylor & Associates has prepared a stormwater management report for the proposed development at 3 Lauderdale Avenue, Fairlight NSW 2094. This report has been prepared in accordance with the Northern Beaches Council (NBC) requirements and guidelines. The preparation of the report is to accompany a Development Application submission to NBC.

In discussions with Council, discharge from the site must connect into the existing Council stormwater system located downstream of the site. The site has two (2) options to connect to the Council system:

- Option 1 - Via the public reserve
- Option 2 - Via the existing Council easement on 3A Lauderdale Avenue

Option 1 - Discharge via the public reserve will create significant disturbance during construction to the public walkway and may affect public amenity. After discussions with Council, it was determined that discharge via the public reserve would not be a reasonable solution.

Option 2 - Discharge via the existing Council easement on 3A Lauderdale Avenue would have insignificant affect on that property and does not require the creation of a new easement. The relevant easement is contiguous with the boundary between 3A and 3 Lauderdale Avenue and all proposed works are fully contained within the existing easement extents. Therefore, discharge via the existing easement is the most appropriate solution.

The proposed stormwater system introduces stormwater quality control devices to appropriately manage runoff before it drains into the Sydney Harbour catchment. The NBC Water Management for Development (WMfD) policy and the Sydney Regional Environmental Plan 2005 nominate stormwater quality targets which must be achieved. MUSIC modelling has been undertaken to assess the proposed development against these controls. The treatment train for the proposed development was modelled using a proprietary filtration device, a gross pollutant trap and a rainwater harvesting tank. The results from the modelling meet Council's water quality requirements.

The capacity of the existing Council stormwater system has been assessed to cater for the post development peak flows. The NBC WMfD policy nominates capacity requirements for the public drainage system. DRAINS modelling has been undertaken to analyse the existing pipe for a range of peak storm events. The proposed connection from the site would increase the upstream catchment area by approximately 5%, which is considered an insignificant increase. The results from the model show that the existing system has adequate spare capacity to drain the post development peak flows.

Erosion and sediment control measures have been designed to comply with the WMfD policy. An Erosion and Sedimentation Control Plan has been prepared to meet Councils requirements in regards to pollution protection during construction.

The stormwater management system for the proposed development at 3 Lauderdale Avenue, Fairlight meets Council's requirements and guidelines.

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1. INTRODUCTION

The report has been prepared for the Development Application submission for the proposed demolition of an existing dwelling and construction of new multi dwelling housing. The site is located at Lot 1 DP 527842, 3 Lauderdale Avenue, Fairlight NSW 2094.

The report:

- Describes the water cycle management for the proposed development. This report has been prepared to address the requirements of the NBC. This includes the requirements outlined in the Manly Development Control Plan (DCP) 2013 and the Manly Local Environment Plan (LEP) 2013.
- Describes the assessment methods for determining the quantity of stormwater affected by the development and the quality of the stormwater discharged from the site. This report also describes the strategy for improving the quality of the discharged water in line with the requirements of the pollution reduction targets nominated in the DCP.
- This report and the attached documents may require refinement during detailed design however the basic concept should remain unchanged.

1.1 Reference Documents

The following documents have been referenced in the design of the Stormwater Management for the site:

- Architectural Drawings prepared by Baxter & Jacobson (Job No. 443-01).
- Survey Drawings prepared by Survey Plus.
- Manly LEP 2013.
- Manly DCP 2013.
- NBC Water Management for Development (WMfD) Policy.
- NBC WSUD & MUSIC Modelling Guidelines.
- Sydney Harbour Regional Environmental Plan 2005.
- Landcom Managing Urban Stormwater: Soils and construction - Volume 1.
- NBC AUSPEC 1.

2. SITE DESCRIPTION

2.1 General Site Information

The site is roughly rectangular in shape with an area of approximately 0.0765 hectares (see Figure 1). The site falls from the north east to the south west by approximately 5.5 metres over a distance of approximately 45 metres. Lauderdale Avenue is located to the north of the site.

Figure 1: Lot and Site Boundaries - North up the page
Source: Northern Beaches Council 2025 Online Mapping

The site:

- Adjoins Fairlight Beach and Fairlight walkway, which is contained within the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.
- Adjoins a triangular parcel of land owned by the Department of Land & Water Conservation, which is managed by NBC.
- Adjoins existing residential developments, including multistorey units to the east and semi-detached dwellings to the west.

2.2 Discharge into Existing Council Easement

Due to topography of the site, gravity fed systems will be unable to drain to the Lauderdale Avenue road reserve. Discharge from the site must connect into the existing Council stormwater system located downstream of the site (refer Figure 2). The site has 2 options to connect to the Council system, via the public reserve and via the existing easement on 3A Lauderdale Avenue.

Figure 2: Existing Council Stormwater Infrastructure - North up the page
Source: Northern Beaches Council 2025 Online Mapping

Discharge via the system in the public reserve will create significant disturbance during construction to the public walkway and may affect public amenity. Discharge via the reserve would require a direct connection to connect to pit SPP42412. This would require a new easement through the triangular parcel of land (Lot 1 DP 928512). This lot is owned by the Department of Lands & Water Conservation and is managed by NBC. Creating a new easement and undertaking extensive civil works at this location would significantly impact the future function of the public walkway. After discussions with Council, it was determined that discharge via the public reserve would not be a reasonable solution.

Discharge via the existing easement on 3A Lauderdale Avenue (Lot 2 DP 1187783) would have insignificant affect on that property and does not require the creation of a new easement. The relevant easement is contiguous with the boundary between 3A and 3 Lauderdale Avenue (refer Figure 3).

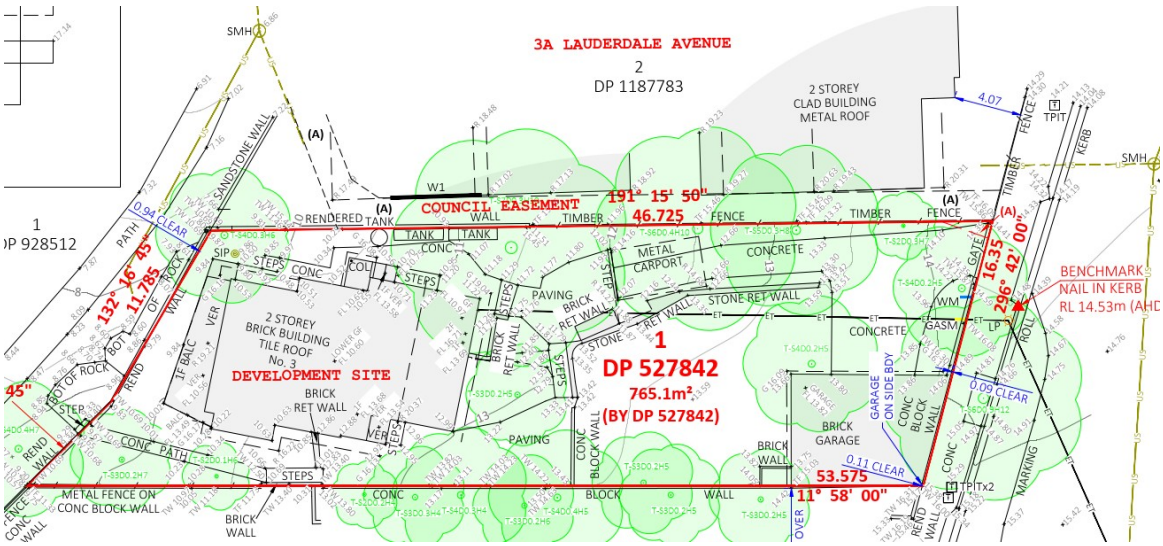


Figure 3: Survey showing Easement Location - Noted as (A)
Source: Survey Plus 2023

Discharge via the existing easement would require a direct connection to pit SPP42413, which is located before the bend in the easement. The capacity of the existing system has been checked for peak storm events to determine if the system can cater for the proposed development site. The proposed connection from the site would increase the upstream catchment area by approximately 5%, which is considered an insignificant increase. The existing system has adequate spare capacity to drain the development site and no upgrades are required. This analysis is discussed further in Section 6 of this report. All the works required for the proposed connection are contained fully within the existing easement, so no extension would be required. Therefore, discharge via the existing easement on 3A Lauderdale Avenue is the most appropriate solution.

Baxter & Jacobson Architects (BJA), the architects for this project, have had discussions and a site meeting with the property owners of 3A Lauderdale Avenue to discuss the proposed connection into the existing easement. The property owners encouraged BJA to submit the proposal to Council for assessment.

3. COUNCIL GUIDELINES

3.1 General Guidelines

The NBC Manly LEP 2013 and Manly DCP 2013 nominate controls for the site generally and specifically relating to stormwater management. The stormwater drainage system for the site has been designed to meet these requirements.

The site is partially located within the low flood risk planning precinct, with 15% of the site being inundated by the PMF flood event (refer Figure 4). The extents of the PMF within the site is due to inundation of the existing Council pits and pipes located within 3A Lauderdale Avenue. Council drainage is designed to cater for all storms up to the 5% AEP storm event so it is expected that these pipes are inundated during the PMF. The minimum FFL for the development will be sufficiently above the PMF level. Therefore, the site is not considered to be flood affected.

Figure 4: Flood Risk Planning Precincts - North up the page
Source: Northern Beaches Council 2025 Online Mapping

3.2 Water Management for Development Policy

The NBC Water Management for Development (WMfD) Policy nominates controls for this site generally and specifically relating to stormwater management.

Section 4.1 outlines the stormwater quality targets that the proposed development must achieve. The proposed drainage system includes stormwater treatment measures which comply with Council's water quality requirements. The stormwater treatment measures are discussed in more detail in Section 5 of this report.

Section 4.3 outlines the requirements for managing erosion, sediment and pollution during the development. The silt & sedimentation plan meets these requirements. Refer to Appendix 2 of this report for the concept stormwater drawings.

Section 6.4 outlines the design requirements for the public drainage system. The Council piped system must be designed to cater for all storm events up to the 5% AEP event. This will be our assessment criteria for determining existing capacity of the system.

Section 9.3.3.4 outlines the OSD requirements for all developments located in Region 3 (previous Manly LGA). The proposed development site is located within Zone 3 in Map 3. No OSD is required for this site. Scour protection is required in accordance with *Section 4.1.2.1.2*.

3.3 Sydney Regional Environmental Plan 2005

The proposed development site is located within the Sydney Harbour Catchment (refer Figure 5). Developments within this catchment must comply with the requirements of the Sydney Regional Environmental Plan 2005. This plan includes specific stormwater quality targets that must be achieved. This is discussed in more detail in Section 5 of this report.

Figure 5: Sydney Harbour Foreshore - North up the page
Source: Northern Beaches Council 2025 Online Mapping

4. CONCEPT STORMWATER DESIGN

4.1 General Strategy

The onsite stormwater management system for the site has been designed to replicate the processes which would occur naturally on the site. The proposed development will incorporate a number of devices and measures aimed at providing adequate and responsible management of stormwater runoff for minor and major storm events. A concept stormwater management plan has been prepared for the proposed development and is included in Appendix 2 of this report. The methods of stormwater capture and disposal are outlined below and have been designed in accordance with AS3500.3 and NBC WMfD policy.

Stormwater that is captured from the ground surfaces and from the subsoil drainage is directed via a network of pits and pipes to stormwater treatment measures before being discharged from the site. Captured stormwater is first directed to a sediment control pit within the driveway which is fitted with a gross pollutant trap. This pit captures sediment and debris before directing treated water to a proprietary filtration device. This low depth filter removes pollutants before directing treated water towards the overflow pit.

Stormwater that is captured from the roof is directed to a belowground rainwater harvesting tank to meet water conservation requirements. Captured rainwater is recycled and reused to reduce water demand for the site. Once the tank reaches capacity, surplus water is directed to the overflow pit.

The overflow pit discharges stormwater into the existing pit within the council easement. The overflow pit has freeboard to the lowest FFL within the site. This is to ensure that in the event of the council pipe blocking, water upwelling flows out of the overflow pit and as overland flow out of the site.

4.2 Site Analysis

The site has been analysed to determine the existing and proposed site conditions for the development. This information will be used for calculations later on in the report to determine stormwater management requirements to comply with the objectives in NBC WMfD policy.

Existing Development Conditions

Area Calculations for Site:

Site Area	= 0.0765 ha
Roof Area	= 0.0205 ha
Paved Area/Impervious Area	= 0.0177 ha
Grassed/Pervious Area	= 0.0383 ha
Total Impervious Area	= 0.0382 ha or 50%

Proposed Development Conditions

Area Calculations:

Site Area	= 0.0765 ha
Roof Area	= 0.0300 ha
Paved Area/Impervious Area	= 0.0280 ha
Grassed/Pervious Area	= 0.0185 ha
Total Impervious Area	= 0.0580 ha or 76%

Increase in Roof Area	= 0.0095 ha
Increase in Paved Area/Impervious Area	= 0.0103 ha
Increase in Total Impervious Area	= 0.0198 ha or 26%

Therefore, the proposed development will increase total impervious area by 26% for the developed site.

Refer to Appendix 2 for the stormwater concept drawings, which includes catchment plans of the existing and proposed development sites.

5. STORMWATER QUALITY CONTROL

5.1 General

The stormwater quality targets are outlined in *Section 4.1* of NBC WMfD policy. The minimum reductions in total pollutant load, compared to untreated runoff from the developed impervious areas of the site must be achieved. These reductions are summarised in the table below (refer Figure 6).

Pollutant	Performance Requirements
Total Phosphorous	65% reduction in the post development mean annual load[1]
Total Nitrogen	45% reduction in the post development mean annual load[1]
Total Suspended Solids	85% reduction in the post development mean annual load[1]
Gross Pollutants	90% reduction in the post development mean annual load[1] (for pollutants greater than 5mm in diameter)
pH	6.5 - 8.5
Hydrology	The post-development peak discharge must not exceed the pre-development peak discharge for flows up to the 50% AEP

Figure 6: Pollutant Reduction Performance Requirements
Source: NBC WMfD Policy 2021

The stormwater quality targets for the Sydney Harbour Catchment are outlined in the NSW Water Quality and River Flow Objectives. The site is contained within the lower estuary according to the Sydney Harbour catchment map (refer Figure 7).

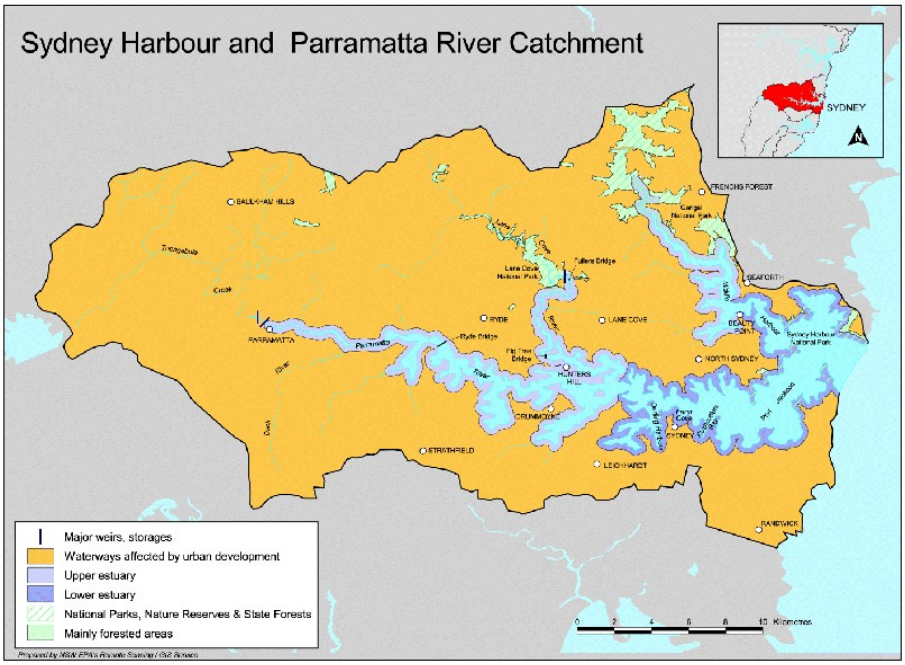


Figure 7: Sydney Harbour Catchment
Source: NSW Water Quality and River Flow Objectives

For developments located within the lower estuary, site discharge must not exceed total pollutant loads. The maximum pollutant loads are summarised in the table below (refer Figure 8).

Pollutant	Maximum Pollutant Load
Total Phosphorous	0.030 mg/L
Total Nitrogen	0.300 mg/L

Figure 8: Lower Estuary Pollutant Loads
Source: NSW Water Quality and River Flow Objectives

The proposed stormwater system as discussed in Section 4 of this report, will introduce stormwater quality devices into the treatment train. The treatment devices include an Ocean Protect OceanGuard, Jellyfish Filter and a rainwater harvesting tank of 20 kL. These devices have been introduced to meet Council's pollutant reduction requirements. These Water Sensitive Urban Design (WSUD) elements remove nutrients and sediments from the stormwater system prior to runoff leaving the site. The Ocean Protect products are SQIDEP verified, refer to Appendix 4 and 5.

For pollution protection during construction, a silt and sedimentation plan is provided to isolate the excavated works that are prone to silt laden runoff. Refer to Appendix 2 of this report for the concept stormwater management plans.

5.2 Modelling

The treatment train for the proposed development was modelled using MUSIC software version 6.4 (Model for Urban Stormwater Conceptualisation) provided by ewater.

The MUSIC modelling parameters were implemented in accordance with NBC WSUD and MUSIC Modelling Guidelines.

The rainfall and evaporation inputs as outlined in Council's guidelines were implemented in the model. The rainfall station used for the rainfall data was 066062 Sydney Observatory with a 6 minute time step. The modelling period of 1/01/1981 to 31/12/1985 was used. The average Sydney potential evapotranspiration (PET) data was used in the model.

The rainfall runoff parameters as outlined in Council's guidelines were implemented in the model. The soil characteristics for the site were '9130gy' as determined from the NSW eSPADE website. The parameters for 'sandy clay loam' were used in the model.

The pollutant generation parameters as outlined in Council's guidelines were implemented in the model.

The treatment node inputs for the Ocean Protect OceanGuard and Jellyfish Filter were provided via the SQIDEP certificates.

5.2.1 Catchment Data

Catchment data for the existing and proposed development site was determined based on information provided in the detailed survey, aerial imagery and in the architectural drawings.

Table 1 shows a summary of the source node parameter which were adopted for the MUSIC model for the proposed development site.

Source Node	Total Area (ha)	Impervious (%)	Pervious (%)
Roof Catchment	0.0300	100%	0%
Ground Catchment	0.0295	75%	25%
Bypass Catchment	0.0170	40%	60%

Table 1: Source Node Parameters

5.3 Results

To demonstrate compliance with Council's stormwater quality targets, MUSIC modelling has been undertaken for the proposed development. Figure 9 shows the layout for the MUSIC model.

The proposed development site consists of 3 source nodes. The roof catchment is treated via the rainwater tank before being discharged from site. The ground catchment is treated via the OceanGuard and Jellyfish Filter before being discharged from site. The bypass catchment flows through a vegetated swale before being discharged from site.

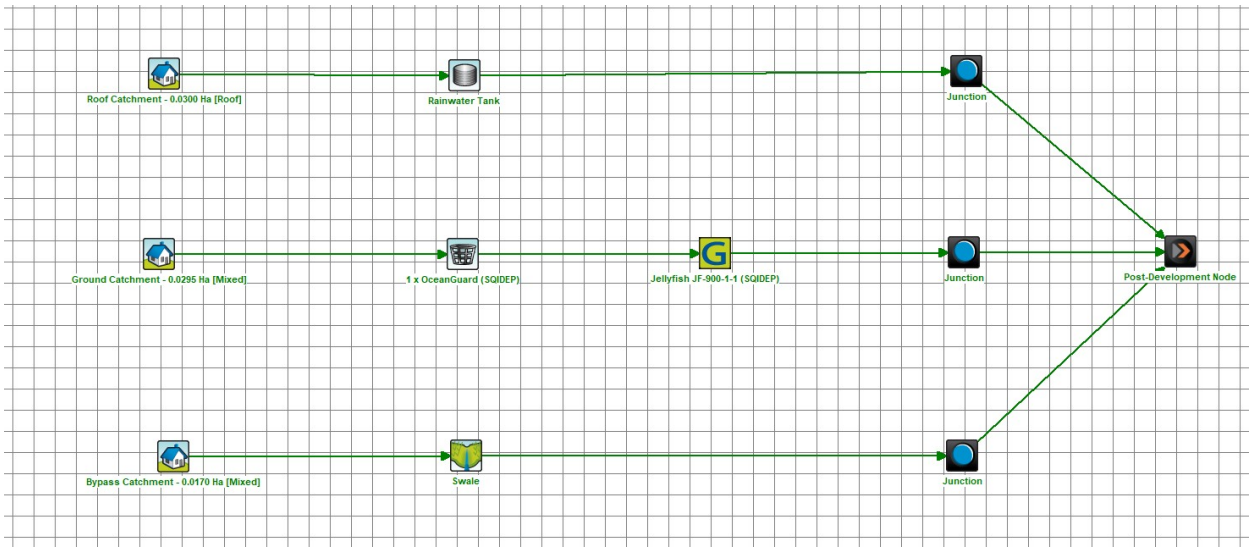
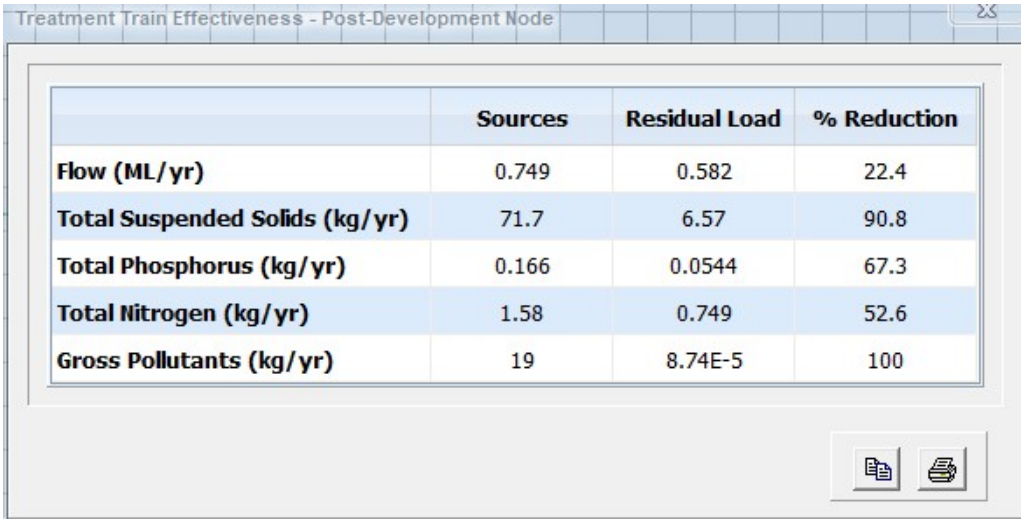


Figure 9: MUSIC Model

Figure 10 shows the treatment train effectiveness for the post development node from the MUSIC model.



	Sources	Residual Load	% Reduction
Flow (ML/yr)	0.749	0.582	22.4
Total Suspended Solids (kg/yr)	71.7	6.57	90.8
Total Phosphorus (kg/yr)	0.166	0.0544	67.3
Total Nitrogen (kg/yr)	1.58	0.749	52.6
Gross Pollutants (kg/yr)	19	8.74E-5	100

Figure 10: Treatment Train Effectiveness for Post Development Node

Table 2 compares the modelled reduction values against the target reduction values for the proposed development site.

Treatment Type	Modelled Reduction (%)	Target Reduction (%)
Total Suspended Solids (kg/yr)	90.8%	85%
Total Phosphorus (kg/yr)	67.3%	65%
Total Nitrogen (kg/yr)	52.6%	45%
Gross Pollutants (kg/yr)	100%	90%

Table 2: Modelled Reductions vs Target Reductions

Where modelled reduction figures exceed target reduction figures, pollutant reduction targets have been met. These results show that the stormwater quality targets in Section 4.1 of the WMfD policy have been met.

Table 3 shows the results for the daily concentrations of phosphorus and nitrogen for the proposed development site.

Treatment Type	Residual Load	Maximum Pollutant Load
Total Phosphorus (mg/L)	0.0242	0.0300
Total Nitrogen (mg/L)	0.2930	0.3000

Table 3: Pollutant Loads

Where modelled load figures are less than maximum load figures, pollutant reduction targets have been met. These results show that the stormwater quality targets for the Sydney Harbour Catchment have been met.

These results confirm that the introduction of 1 Ocean Protect OceanGuard and 1 Jellyfish Filter into the treatment train meets Council's water quality requirements.

6. CAPACITY OF EXISTING COUNCIL INFRASTRUCTURE

6.1 General

To determine if the existing Council infrastructure has sufficient capacity to cater for the proposed development flows, modelling was undertaken. The proposed drainage system will connect directly into the existing Council pit SPP42413. The pipe downstream of this pit, SPI41585, is a 375mm diameter pipe.

Information for the existing Council infrastructure was determined from Council's online mapping system, stormwater works-as-executed (WAE) drawings and the detailed survey.

Section 6.4 outlines the design requirements for the public drainage system. The Council piped system must be designed to cater for all storm events up to the 5% AEP event. The drainage system will be checked against this requirement.

6.2 Modelling

The hydraulic model was created to analyse post-development peak flows for a range of storm events using computer modelling software. The software used for this analysis was DRAINS Version 2025, which uses the runoff routing method.

6.2.1 Catchment Data

Catchment data for the existing and proposed development site was determined based on information provided in the detailed survey, aerial imagery and the architectural drawings.

Refer to Appendix 2 of this report for the concept stormwater management plans, which includes the upstream catchment plan and proposed site conditions.

Table 4 shows the upstream catchment parameters for the council drainage system. The upstream catchment includes a portion of the Lauderdale Avenue road reserve, the Woods Parade road reserve and private property (residential development). The private property is located in Region 3 Zone 1, which requires discharge from sites to be at state of nature conditions. To comply with the WMfD policy, the road area was nominated as 80% impervious and the private property area was nominated as 0% impervious.

Upstream Catchment							
Catchment	**Total Area (ha)**	**Impervious (%)**	**Impervious Area (ha)**	**Time of Concentration (mins)**	**Pervious (%)**	**Pervious Area (ha)**	**Time of Concentration (mins)**
Upstream Catchment	1.4100	20%	0.2850	7.5	80%	1.1250	28

Table 4: Upstream Catchment Parameters

Table 5 shows the pre development parameters for the site.

Pre Development Catchment							
Catchment	**Total Area (ha)**	**Impervious (%)**	**Impervious Area (ha)**	**Time of Concentration (mins)**	**Pervious (%)**	**Pervious Area (ha)**	**Time of Concentration (mins)**
Pre Dev Catchment	0.0765	50%	0.0382	3	50%	0.0383	10

Table 5: Pre Development Catchment Parameters

Table 6 shows the post development catchment parameters for the site. This connection from the site represents a 5.4% increase in catchment area for the Council system to drain. This is considered a minor increase.

Post Development Catchment							
Catchment	**Total Area (ha)**	**Impervious (%)**	**Impervious Area (ha)**	**Time of Concentration (mins)**	**Pervious (%)**	**Pervious Area (ha)**	**Time of Concentration (mins)**
Post Dev Catchment	0.0765	76%	0.0580	3	24%	0.0185	10

Table 6: Post Development Catchment Parameters

6.2.2 Model Parameters and Rainfall Data

The hydrological model used for the analysis was the ARR 2019 Initial loss - Continuing loos (IL-CL) rainfall-runoff model. In accordance with *Section 9.9* of the WMfD policy and current AR&R guidelines, the following parameters were utilised for the DRAINS model:

Impervious Depression Storage	= 1 mm
Supplementary Depression Storage	= 1 mm
Pervious Depression Storage	= 5 mm
Soil Type	= 2.5
AMC	= 3

Rainfall data for the model was sourced via the AR&R Data Hub from the Bureau of Meteorology. The time of concentration for each catchment was determined using the kinematic wave equation.

Refer to Appendix 3 for the DRAINS model data.

6.3 Results

Figure 11 shows the layout for the DRAINS model. The existing Council drainage system drains the upstream catchment. With the connection from the proposed development, the system will also drain the post development catchment. SPI41585 is the first pipe that drains both catchments and has been modelled with an overflow route to check for overland flow. The new overflow pit within the site has also been modelled with an overflow to check the capacity of the proposed connection.

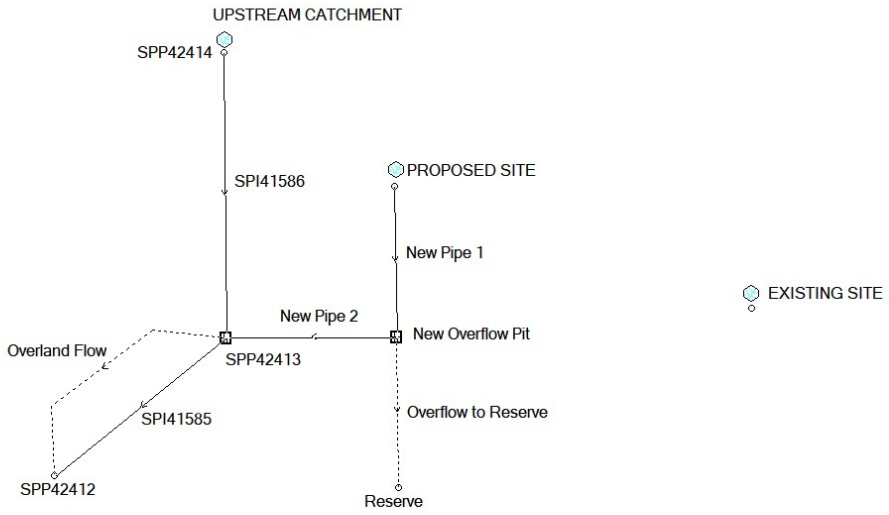


Figure 11: DRAINS Model

Table 7 shows the pipe capacity for SPI41585. The pipe capacity was determined using manning's equation. It should be noted that there are limitations to using manning's equation as it is a theoretical equation which does not account for friction loss for long sections of pipe. This was considered to be acceptable as the pipe is less than 30m in length.

Pipe Name	Pipe Diameter (mm)	Pipe Length (m)	Pipe Grade (%)	Roughness (n)	Max Flow Rate (L/s)
SPI41585	375	15	15% **	0.012	790

Table 7: Pipe Capacity Calculation

** Pipe grade has been interpolated from the stormwater WAE drawings and the detailed survey. The inlet and outlet levels of the pipe were not captured in the survey and will have to be confirmed onsite.

Figure 12 shows the results from the DRAINS model for the 5% AEP storm event. These results show that for this peak storm event, the existing pipe has sufficient capacity to drain the post development catchment, with no overland flow being generated and a flow rate significantly less than the maximum flow rate.

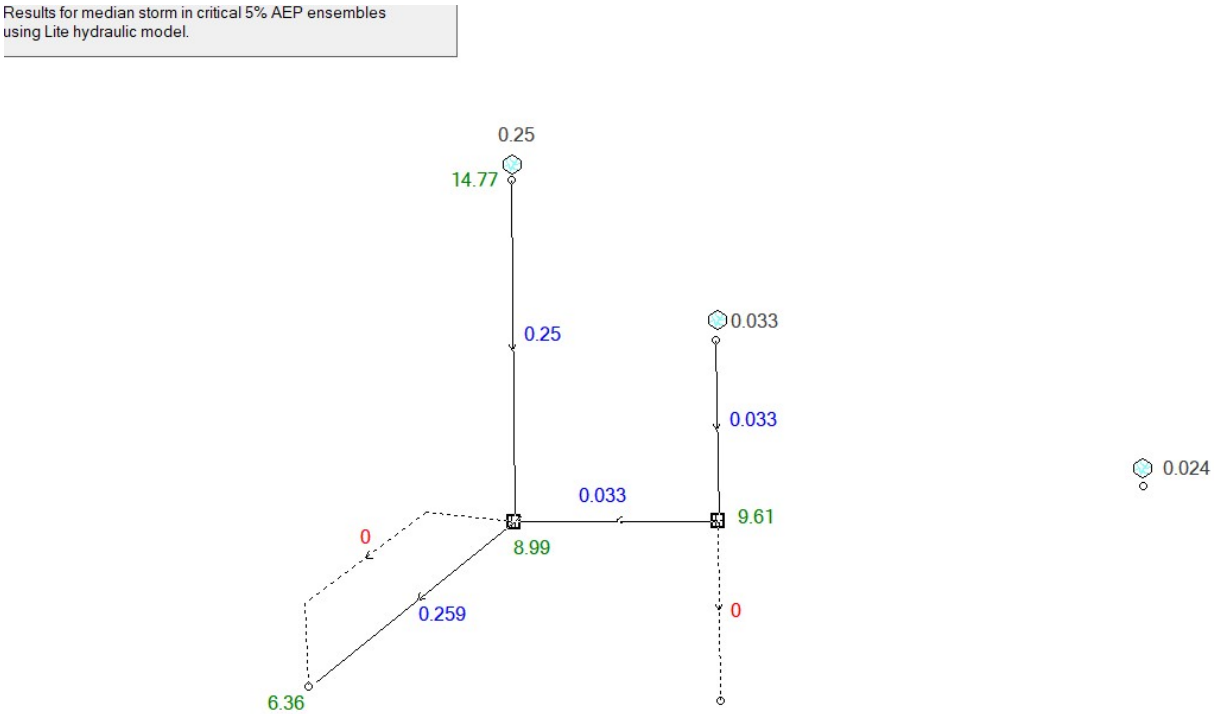


Figure 12: DRAINS Results for 5% AEP

Figure 13 shows the results from the DRAINS model for the 1% AEP storm event. These results show that for this peak storm event, the existing pipe has sufficient capacity to drain the post development catchment, with no overland flow being generated and a flow rate significantly less than the maximum flow rate.

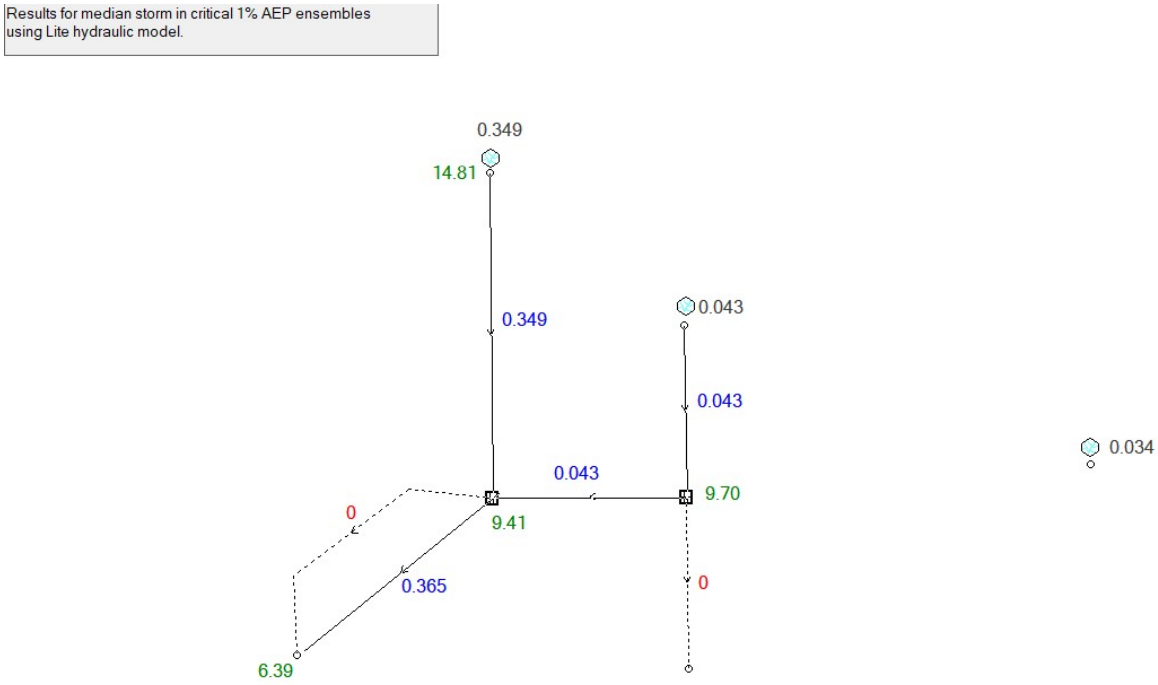


Figure 13: DRAINS Results for 1% AEP

Therefore, the existing Council pipe has sufficient capacity to drain the proposed development site.

7. EROSION AND SEDIMENT CONTROL

7.1 General

Erosion and sediment control measures have been designed to comply with the requirements of *Section 4.1.2.1.2* and *Section 4.3* of the WMfD policy.

All erosion and sediment control measures will be maintained on a periodic basis and after heavy rain events to ensure they remain operational during construction.

Refer to Appendix 2 for the stormwater concept drawings, which includes the silt and sedimentation plan.