infrastructure & development consulting

Leppington Residential Core

Utilities Servicing, Flooding & Stormwater Strategy

August 2023

Infrastructure planning master planning civil engineering project management contract administration

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Client	ALand	**Revision**	A
Author	R. Higgisson	**Reviewed**	A Hilly

1 Introduction

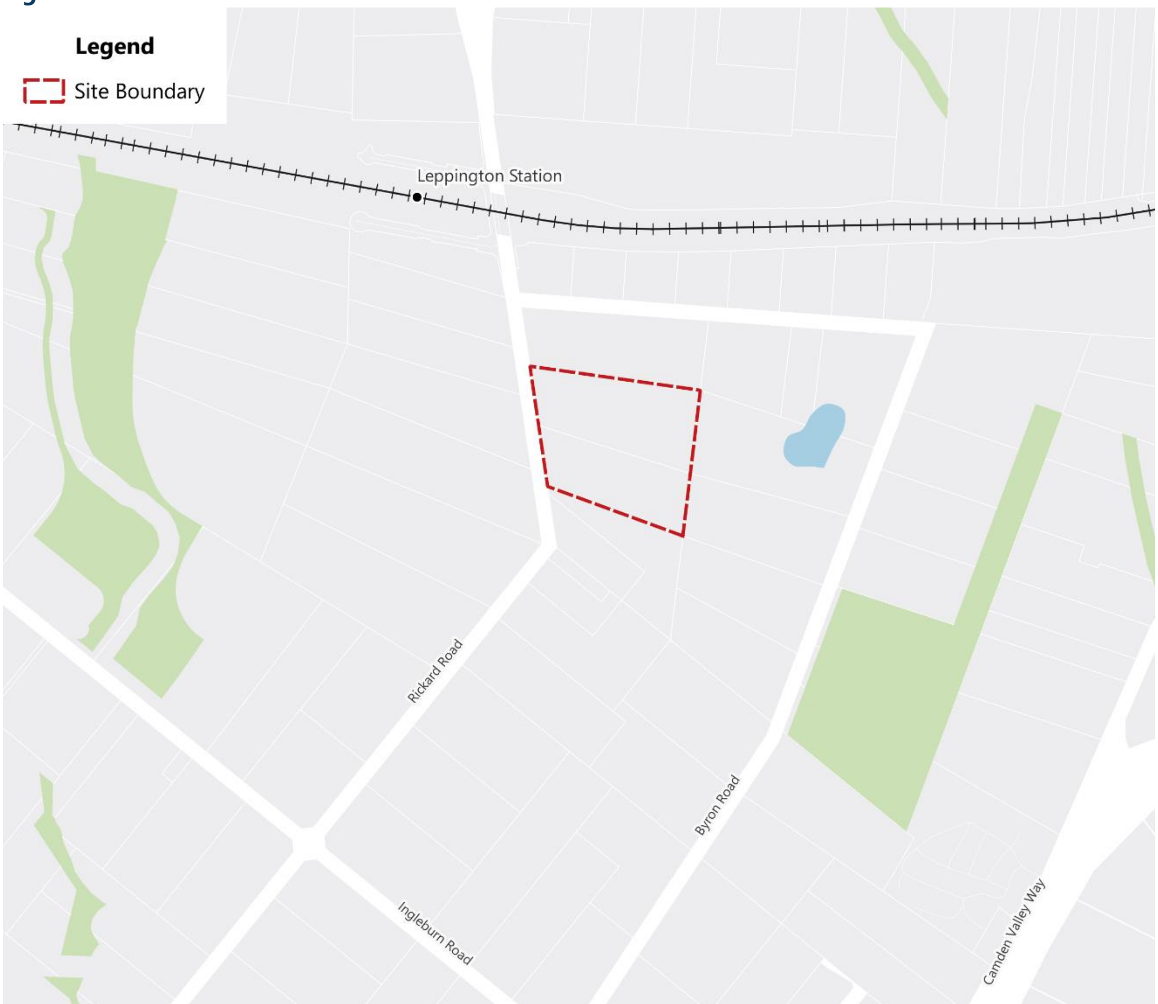
ALand have engaged Infrastructure & Development Consulting Pty Ltd (IDC) to prepare technical inputs to support the Planning Proposal for the Leppington Residential Core site. This report will cover the following:

- Utilities servicing
- Stormwater management
- Flooding

1.1 The Site

The site is approximately 4.31 hectares in size and is bound by Rickard Road to the West and existing rural properties to the north, east and south. The site location is shown in Figure 1 below.

Figure 1 - Site Location



2 Proposed Development

The site will be rezoned to provide a mix of development typologies including high density residential, commercial and open space. A breakdown of the proposed development is provided in Table 1.

Table 1 - Land Use Breakdown

Land Use	Quantity	Unit
Commercial	3,016	m^2 GFA
Apartments	1,305	Dwellings
Public Open Space	6,974	m^2
Private Open Space	3,437	m^2

The proposed development layout is shown in Figure 2.

Figure 2 - Proposed Development Layout

3 Utilities

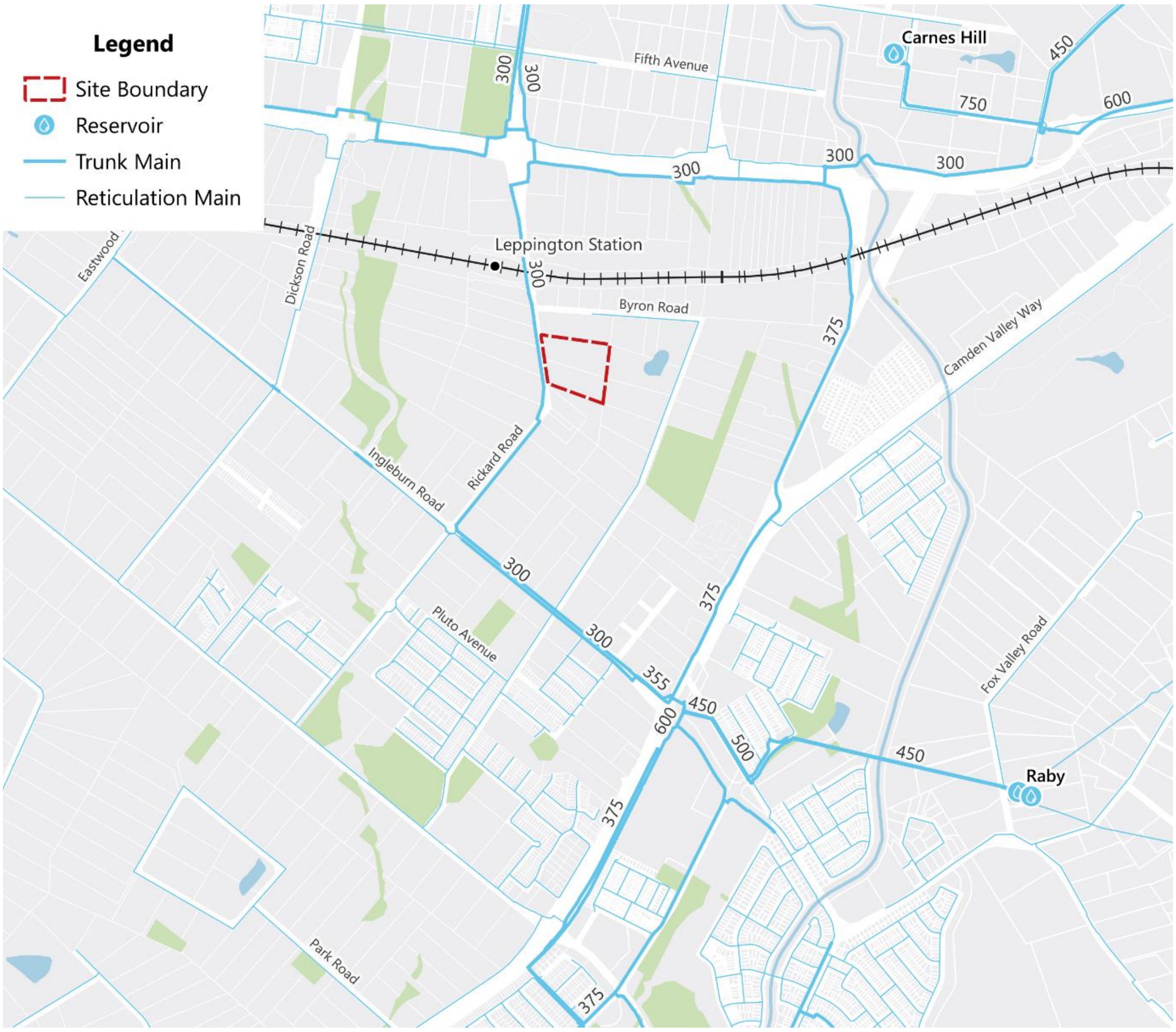
3.1 Water

3.1.1 Existing Infrastructure

Potable water mains extend along the existing roads around the site. Existing uses on the site are supplied potable water via a 300mm watermain in Rickard Road.

The closest reservoirs to the site are the Carnes Hill Reservoir, located 1.6km to the north east, and the Raby Reservoirs, located 2.3km to the south east. The existing potable water infrastructure within the vicinity of the site is shown in Figure 3.

Figure 3 - Existing Water Infrastructure



3.1.2 Sydney Water Growth Servicing Plan

Sydney Water's Growth Servicing Plan (GSP) outlines the servicing strategy to support planned growth in Greater Sydney from 2022-2027. The GSP indicates that there is limited existing trunk capacity within the Leppington Town Centre Precinct. No new planned trunk infrastructure is shown within the Precinct and surrounding area, it is therefore expected that more capacity will become available when new infrastructure to supply the surrounding South West Growth Area (SWGA) and Aerotropolis is constructed.

Sydney Water are currently delivering new reservoirs at Oran Park. Two 24ML reservoirs are being constructed on the western side of The Northern Road, within South Creek West Sub Precinct 5. These reservoirs are expected to be operational in 2024/25 and will supply development within the SWGA as well as southern portions of the Aerotropolis.

In addition, Sydney Water will deliver new reservoirs in Luddenham and will duplicate the existing reservoir at Cecil Park to provide additional potable water supply to development in the Aerotropolis. Delivery timing for this reservoir is unknown at this stage, however it is likely that delivery of this infrastructure will free up trunk capacity within the Austral and Leppington Precincts.

3.1.3 Demand Calculations

A high-level assessment was undertaken using the Water Supply Code of Australia (WSA) to determine the trunk infrastructure requirements to support the proposed development. This involved calculating the peak-hour demand to estimate the likely trunk main size required.

The maximum water demand rates were extracted from the WSA. These rates were used to determine the peak hour demand for each land use type. The results are provided in Table 2.

Table 2 - Proposed Water Demand

Land Use	Max Day Demand Rate (kL/Unit/Day)	Unit	Peak Demand (L/s)
Apartments	0.8	Dwelling	24.2
Commercial	41	Net Ha	0.3
Open Space	7	Ha	0.1
Total			**24.6**

Based on the above assessment a main of approximately 150mm diameter could support the proposed development, however Sydney Water require a minimum 200mm diameter main to be provided for all high-density residential development with buildings of 8 or more storeys.

3.1.4 Proposed Servicing Strategy

A new 200mm diameter main will be extended along all internal roads from the existing 300mm diameter main located on Rickard Road. Any potential upgrades required to the existing main in Rickard Road as a result of this development will be confirmed with Sydney Water during a subsequent stage of the project. The proposed infrastructure required to support the development is shown in Figure 4 below.

Figure 4 - Proposed Water Infrastructure

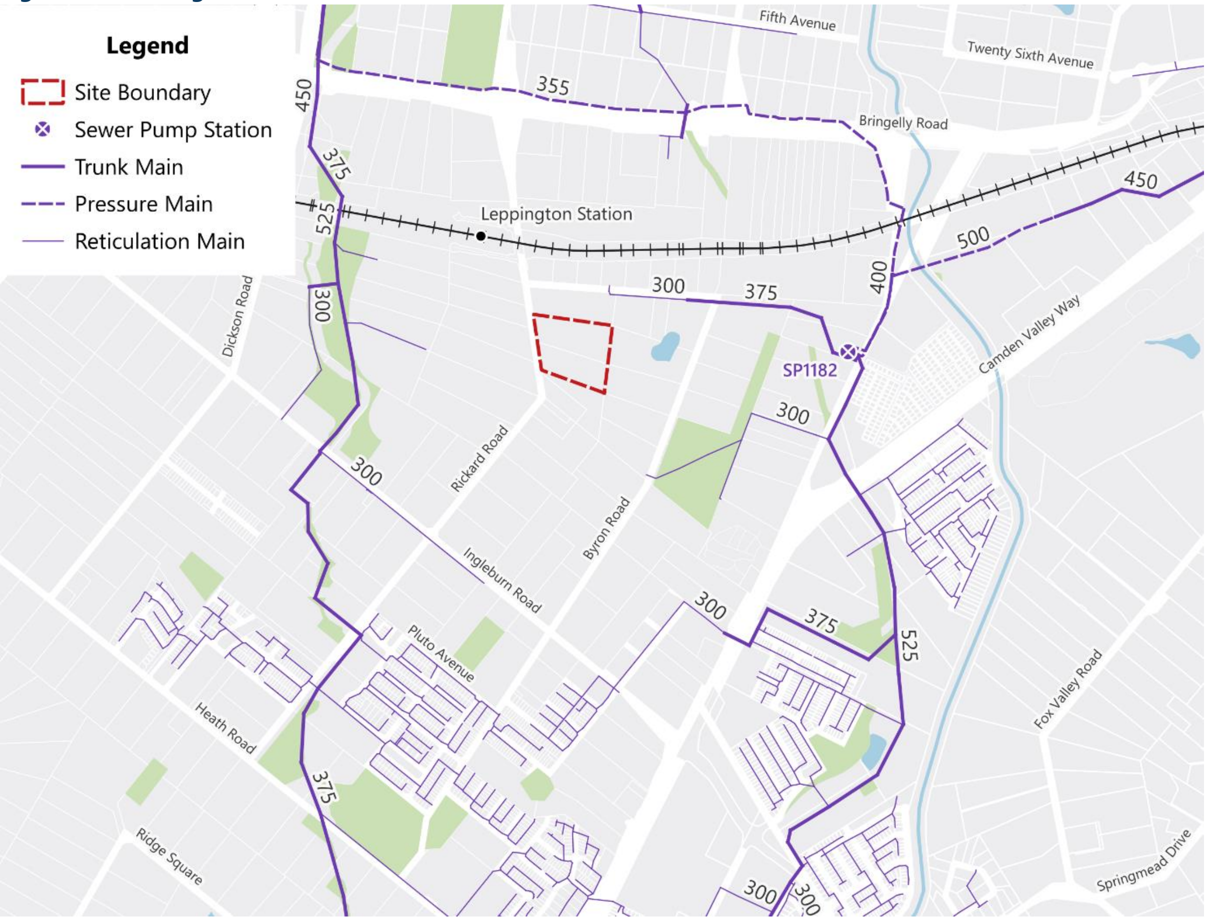
3.2 Sewer

3.2.1 Existing Infrastructure

The site is not currently serviced by the Sydney Water sewer network. Existing rural properties within Leppington utilise on-site septic systems for sewage collection and disposal.

The site drains towards the north-east to an existing 300mm main located approximately 100m to the north of the site. This main drains via gravity to sewer pump station SP1182 in East Leppington which pumps to the Liverpool WWTP. The existing infrastructure within the vicinity of the site is shown in Figure 5.

Figure 5 – Existing Sewer Infrastructure



3.2.1 Sydney Water Growth Servicing Plan

Sydney Water's GSP indicates that there is limited existing trunk capacity within the Leppington Town Centre Precinct. No new planned trunk infrastructure is shown within the Precinct and surrounding area, and these constraints likely relate to the limited capacity available at the Liverpool WWTP to supply additional development. It is expected that these constraints will be resolved with the delivery of the proposed Upper South Creek Advanced Water Recycling Centre (AWRC).

The Upper South Creek AWRC is located to the north of Elizabeth Drive, at the confluence of Badgerys Creek, Wianamatta-South Creek and Kemps Creek. The AWRC is expected to be operational by 2026, in line with the opening of the Western Sydney Airport. Once the AWRC is operational, infrastructure supplying development within Austral and Leppington North which currently drains to the Liverpool WWTP will be switched over to the Upper South Creek AWRC. This will free up capacity at Liverpool WWTP to supply development within the Leppington Town Centre, including the proposed development site.

3.3 Proposed Servicing Strategy

A 225mm diameter gravity main will be required to support the proposed development. This main will be constructed from the site low point at the north-east boundary and connect to the existing 300mm diameter main on the southern side of Byron Road. 225mm mains will also extend throughout the site to provide connections to each development parcel. The proposed infrastructure required to support the development is shown in Figure 6 below.

Figure 6 - Proposed Sewer Infrastructure

3.4 Electricity

3.4.1 Existing Infrastructure

The site is located within the Endeavour Energy (EE) electrical supply zone. The closest zone substations (ZS) to the site are the North Leppington ZS and the South Leppington ZS, located approximately 1km north-west and 3km south of the sites respectively. The North Leppington ZS has a firm capacity of 90MVA, while the South Leppington ZS includes a single transformer and has a firm capacity of 45MVA.

Endeavour Energy's Distribution Annual Planning Report (DAPR) includes utilisation data for all zone substations. The North Leppington ZS is forecast to have 60.3MVA of spare capacity by 2027, while EE estimate the South Leppington ZS will have 15.5MVA spare capacity.

An overhead 11kV high voltage feeder originating from the North Leppington ZS extends down Rickard Road and supplies existing development on the sites and the adjacent properties. It is expected that as development of the sites progresses, existing overhead infrastructure within the site boundary will be decommissioned, and all new infrastructure will be underground. The existing electrical infrastructure within the vicinity of the site is shown in Figure 7 below.

Figure 7 - Existing Electrical Infrastructure

3.4.1 Proposed Servicing Strategy

A high-level assessment was undertaken to determine the electrical servicing requirements for the sites. The electrical demand generated by the proposed development was calculated using electrical demand rates provided by Endeavour Energy. The results of the assessment are tabulated below.

Table 3 – Proposed Electricity Demand

Land Use	Quantity	Unit	Demand Rate (VA/Unit)	Diversified Load (kVA)
High Density Residential	1,305	Dwellings	4,000	4.18
Commercial	3,016	m^2 GFA	70	0.24
				4.42

Based on the assumption that a single 11kV feeder can supply approximately 4-5MVA, the proposed development would likely require one feeder to supply the proposed development.

There may be some capacity in the existing feeders within the vicinity of the site to supply initial stages of development. The availability of spare capacity will be confirmed with Endeavour Energy. After existing capacity is exhausted, new feeders would be constructed from the North Leppington ZS to the site. An indicative alignment for this feeder is shown in Figure 8.

Figure 8 - Proposed Electrical Infrastructure

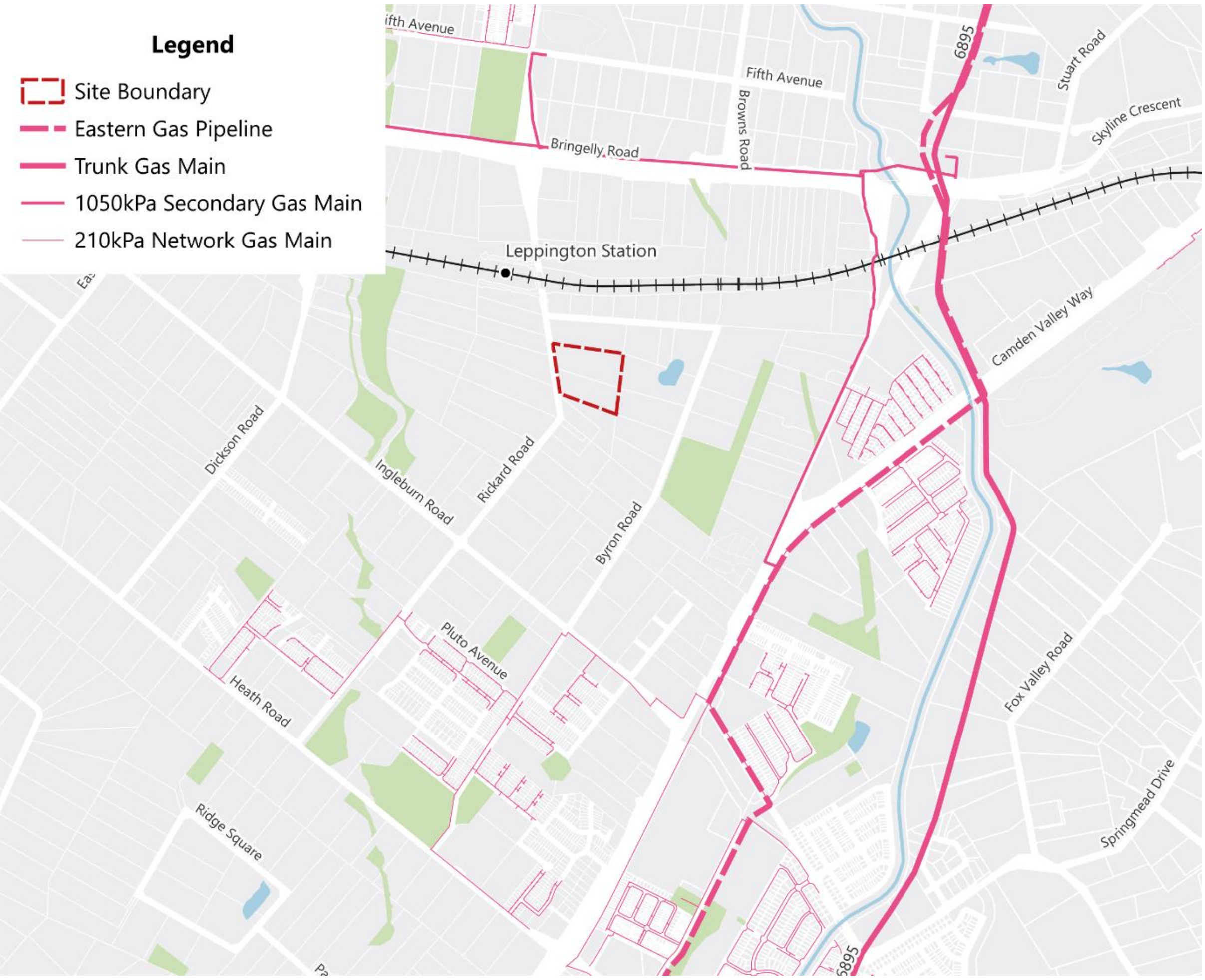
3.5 Gas

3.5.1 Existing Infrastructure

The site is not currently serviced by the Jemena natural gas network. Development sites located south of Ingleburn Road are serviced by reticulation gas infrastructure.

Trunk gas infrastructure located within the vicinity of the site includes the Eastern Gas Pipeline (EGP), located approximately 1km to the east. The EGP extends from gas fields in Gippsland, Victoria to the major gas markets in NSW. The EGP places land use restrictions within a 766m Measurement Length. As the site is located outside the Measurement Length, no restrictions will apply to the proposed development. The existing gas infrastructure located within the vicinity of the site is shown in Figure 9.

Figure 9 – Existing Gas Infrastructure



3.5.2 Proposed Servicing Strategy

Gas is not considered an essential service, however, if desired services could be brought to the site from the Bringelly Road main to the north, or from the Camden Valley Way main to the east.

Generally, little demand for gas can be expected from non-residential development within the site and Jemena will support the demand generated by residential development as required.

3.6 Telecommunications

3.6.1 NBN

NBN Co. are the wholesale provider for new broadband connections. NBN Co. provides services on its local access network on equivalent terms to retail phone and internet providers, to provision for end users.

The site is serviced via fixed line technology, where a physical line connects to each property to provide a connection. Future uses on the site will be able to connect to this fixed line network to receive telecommunications servicing. New infrastructure will be extended along all new roads within the site boundary.

3.6.2 Telstra 5G

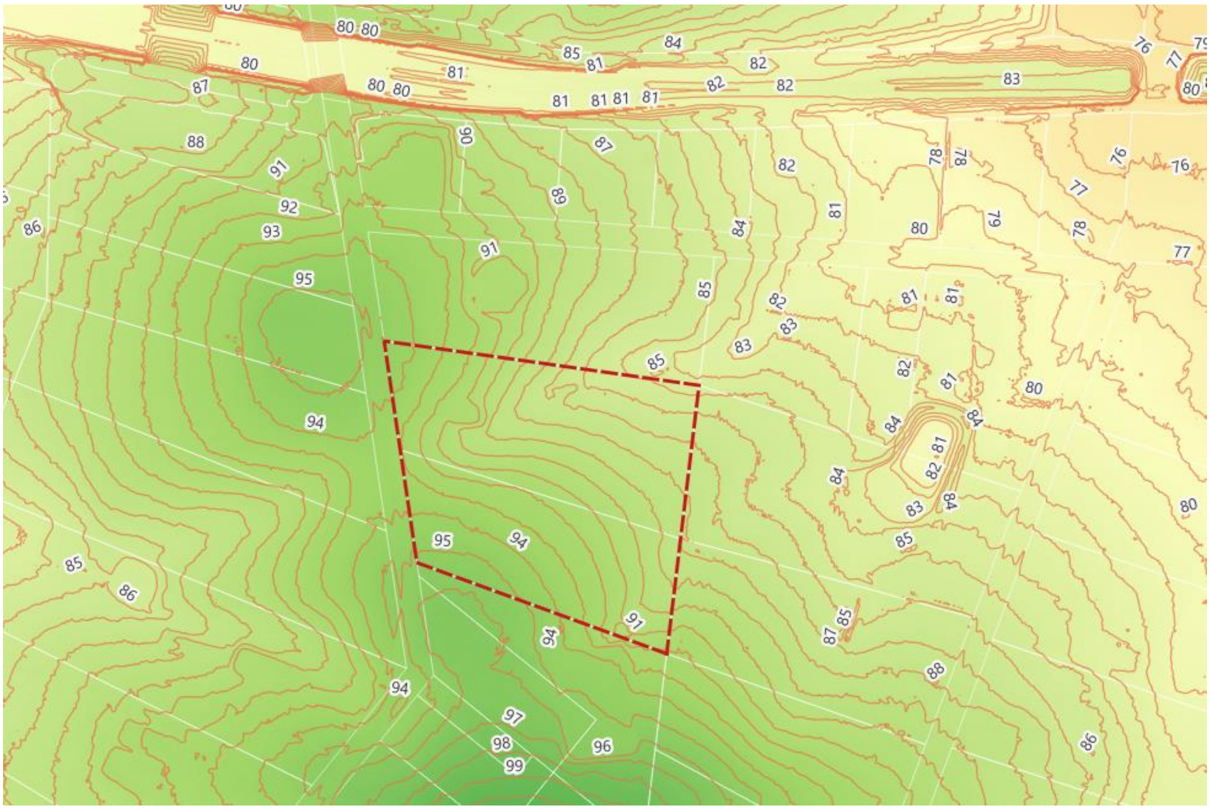
Rollout of Telstra's 5G network has commenced across Western Sydney. The site has blanket existing Telstra 5G network coverage and future land uses will be able to use this network without augmentation or extension of the existing infrastructure.

4 Stormwater Management

4.1 Topography

The site falls from west to east with the highest elevation along the southern boundary in the west of the site at approx. RL.95.5m AHD and low point in the north-eastern corner at RL.84.5m AHD. The site slopes are generally low to moderate, typically ranging from 3-6% with some areas locally up to 10%. In addition, there is a depression (not mapped as a *river* in accordance with the Water Management Act) that runs through Site B where we would expect overland flows to occur in high rainfall events

Figure 10 - Elevation & Contour Map



4.2 Methodology

To fully appreciate the water cycle characteristics of the local catchment, a number of analyses have been undertaken. DRAINS modelling was performed to determine a suitably sized temporary stormwater basin to ensure the development has a no adverse impacts on downstream properties in accordance with Council requirements. MUSIC modelling of pollutant loads was also undertaken to determine a suitably sized streetscape and public domain water sensitive urban design (WSUD) strategy to satisfy water quality improvement objects for the interim development scenario as set out in Council's DCP.

4.3 Input Data

4.3.1 Topography

Topographic information for the site was obtained from 2019 aerial Lidar data.

4.3.2 Rainfall Data

Intensity-Frequency-Duration

IFD data obtained from Council's Engineering Design Guide was utilised for the subject site, with the IFD data for durations longer than the 60-minute interval interpolated based on the IFD polynomial coefficients supplied by Council.

Pluviograph Data

Pluviography data was obtained by using the Camden Council MUSIC Link functionality in MUSIC.

4.4 Design Controls & Guidelines

The stormwater network for the site has been designed to comply with the following guidelines:

- Camden Council's Development Control Plans
- Camden Council – Engineering Design Specification (Feb 2020)
- Australian Rainfall and Runoff and
- Managing Urban Stormwater: Soils and Construction.

4.5 Stormwater Management Strategy

4.5.1 Sediment & Erosion Control

Prior to any works commencing on site, erosion and sediment control measures will be put in place generally in accordance with Managing Urban Stormwater: Soils and Construction 4th Edition, March 2004. These measures will be designed at subsequent DA phases, but may include:

- Installation of a 1.8m high chain wire fence covered with geotextile fabric to the perimeter of the work site area
- Sediment basins situated towards the low points of the site for the collection of stormwater runoff during construction
- The use of appropriate sediment diverting methods to minimise sediment in Council's stormwater drainage network
- Locations for temporary stockpiling
- Provision of a temporary truck wash down facility for vehicles exiting the site during construction

4.5.2 Water Quantity Management

The major/minor approach to stormwater drainage is the recognized drainage concept for urban catchments within the Liverpool Council local government area.

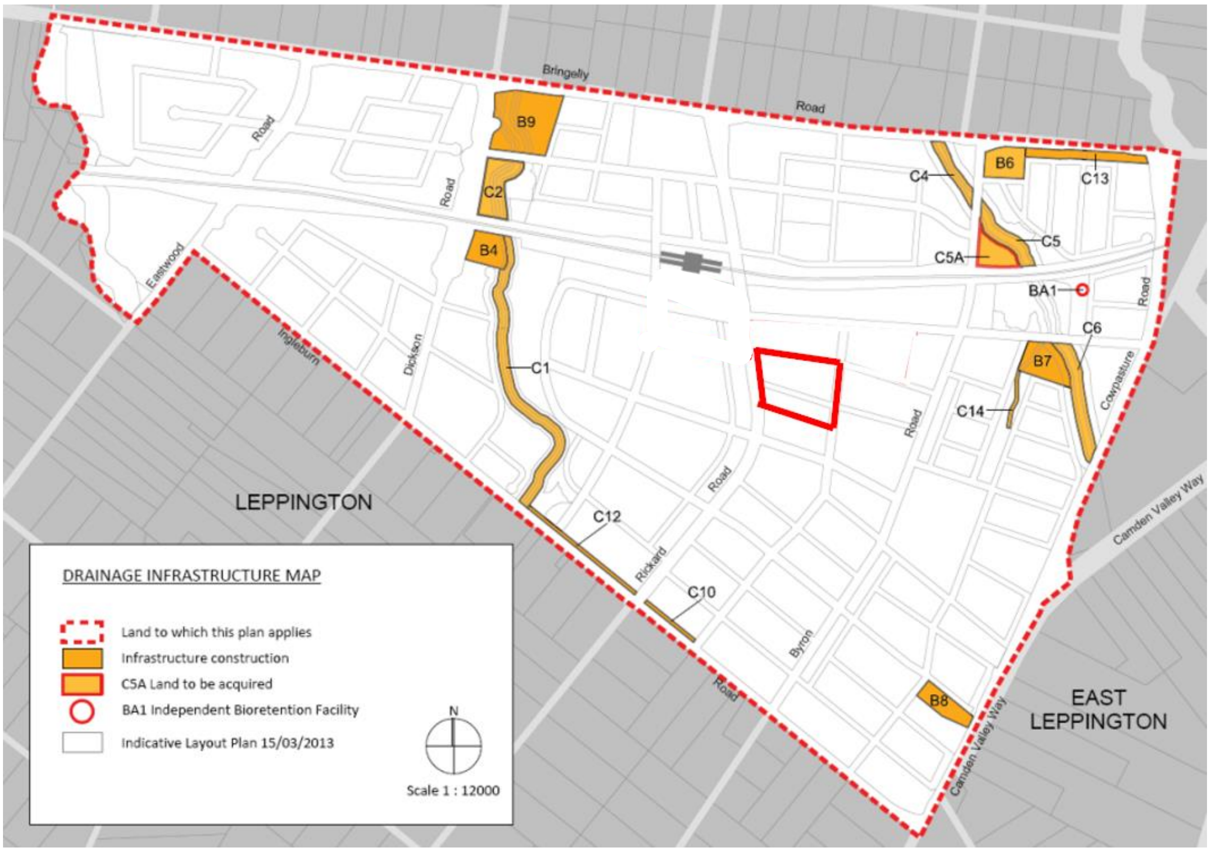
The minor drainage system is comprised of the below ground pit and pipe network within the new local roads and is designed to control nuisance flooding and enable effective stormwater management for the site. Council's Development Controls requires that the minor system be designed for a minimum 5-year ARI.

The major drainage system incorporates overland flow routes through proposed road, hardstand and landscaped areas and is assessed against the 100-year ARI design storm event. The major system also exists to cater for minor system failures. In accordance with council's requirements, the major drainage system is to be designed in a manner that ensures that personal safety is not compromised. As such, all overland flow routes for the site are to be designed so that the maximum velocity-depth product shall not exceed $0.4m^2/s$ in accordance with standard engineering practice.

Detention Strategy

On-site detention (OSD) and Water Sensitive Urban Design (WSUD) is required for the development to manage increased runoff and pollution removal. Figure 11 below shows the regional drainage infrastructure that caters for the site. Because none of the regional infrastructure has been provided yet, we have proposed temporary water management measures until such a time that the regional works are constructed. Figure 11 below shows that the site relies on Channel C14 and Basin B7.

Figure 11 – Section 7.11 Drainage Infrastructure



Due to the fact that no regional drainage infrastructure has been delivered to date, temporary infrastructure will be required to meet the water quantity requirements of no adverse overland flow or flooding impacts to adjacent properties.

4.5.1 Water Quality Management

Due to the fact that no regional drainage infrastructure shown above in Figure 11 has been delivered to date, temporary infrastructure will be required to meet the water quality requirements for pollution removal. However, due to the nature of the proposed WSUD infrastructure being integrated into the streetscape and public domain, we expect that it may remain in perpetuity.

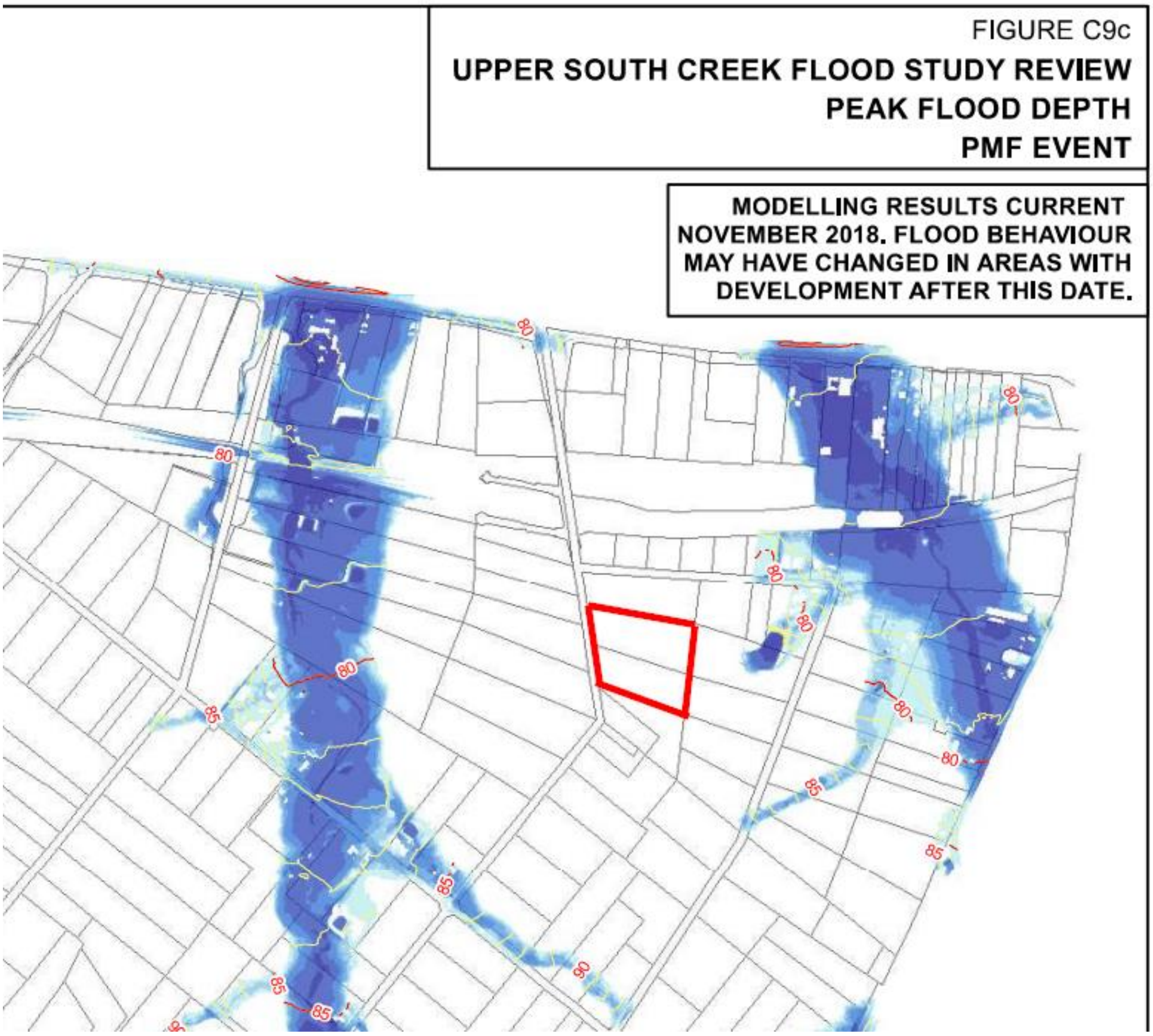
WSUD strategy

The WSUD strategy is to integrate streetscape passive irrigation/bioretention infrastructure into the urban design prior to discharging to the OSD basin. The proposed treatment train and modelling outputs are explained in Section 7.

5 Flooding

The site is situated on a regional crest, with no upstream catchment or natural creek systems flowing through it. Further, the flood extents for the Probable Maximum Flood (PMF) storm event taken from the *Review of Upper South Creek Flood Study in the Context of Ongoing Development October 2022 – Flood Mapping* are shown in Figure 12. This mapping indicates that the site is not flood affected by mainstream flooding the most extreme storm event. Therefore, no additional flood modelling or studies have been undertaken as part of this assessment.

Figure 12 - Flood Extents (PMF)



6 Stormwater Quantity Modelling

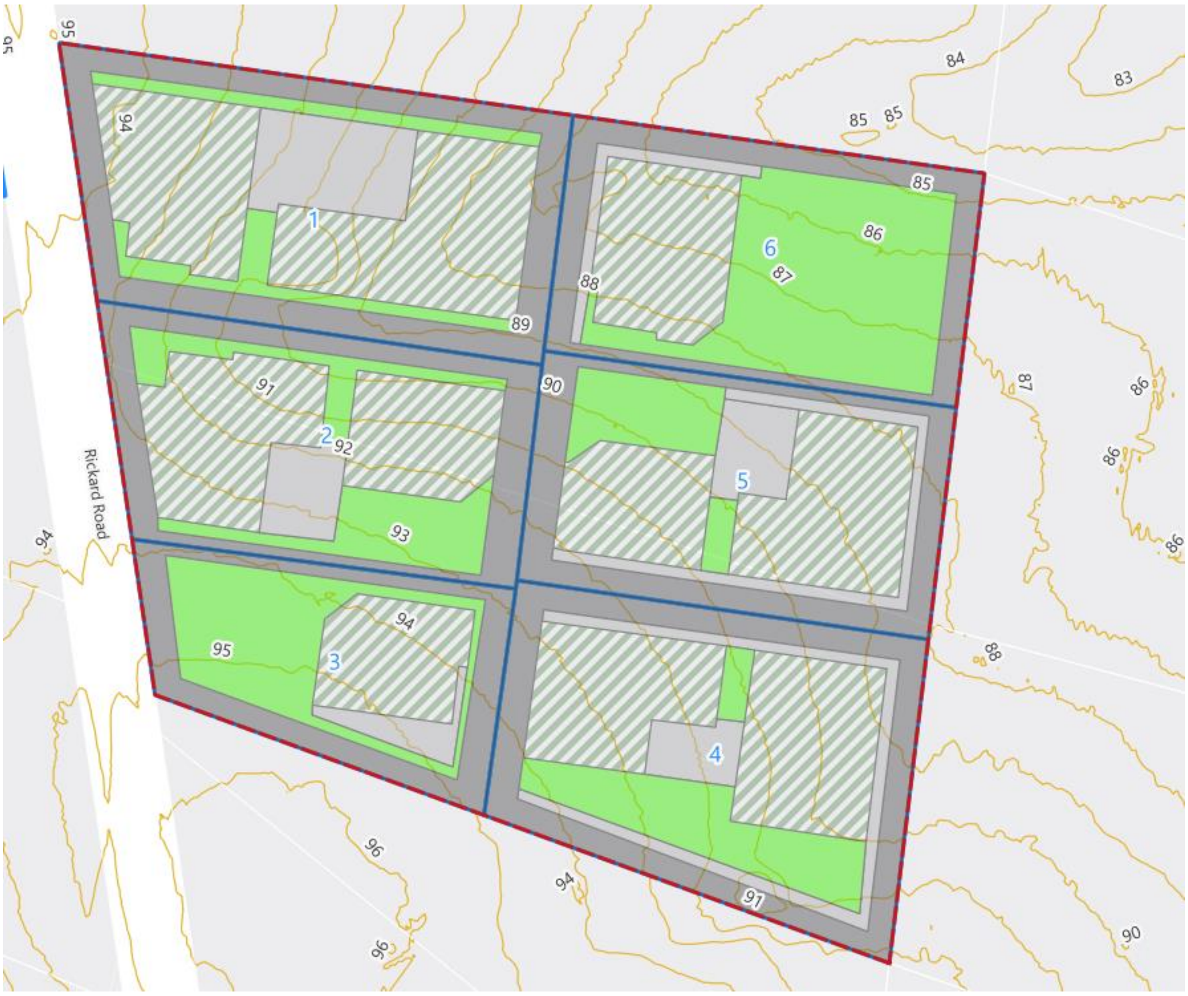
A hydrological model of the catchment was formulated using the DRAINS software package and was analysed to assess the performance of the site stormwater network. The DRAINS program typically performs design and analysis calculations for urban stormwater systems and models the runoff behaviour on both rural and urban catchments.

The user data inputs required by DRAINS include catchment areas, flow path lengths, time of concentration, pervious and impervious areas, IFD rainfall intensities and flow path roughness. Modelling is performed through the development of a network of pipes, pits and nodes to represent both the proposed and existing scenarios on site.

6.1 Catchments and Imperviousness

The site was analysed using GIS software to determine the proposed finishes and catchment delineation for subsequent modelling. This broke the site up in to roads, internal pavements, roof (green roof) and landscape areas.

Figure 13 – Proposed Site Catchments and Imperviousness



The following assumptions of imperviousness for each of the surface finishes were used.

Table 4 - Imperviousness Assumptions

Surface Type	Impervious Area
Hardstand	90%
Landscape	10%
Road	85%
Roof*	20%

**Green Roof*

Using the GIS areas, the following catchment data was obtained for subsequent use in modelling.

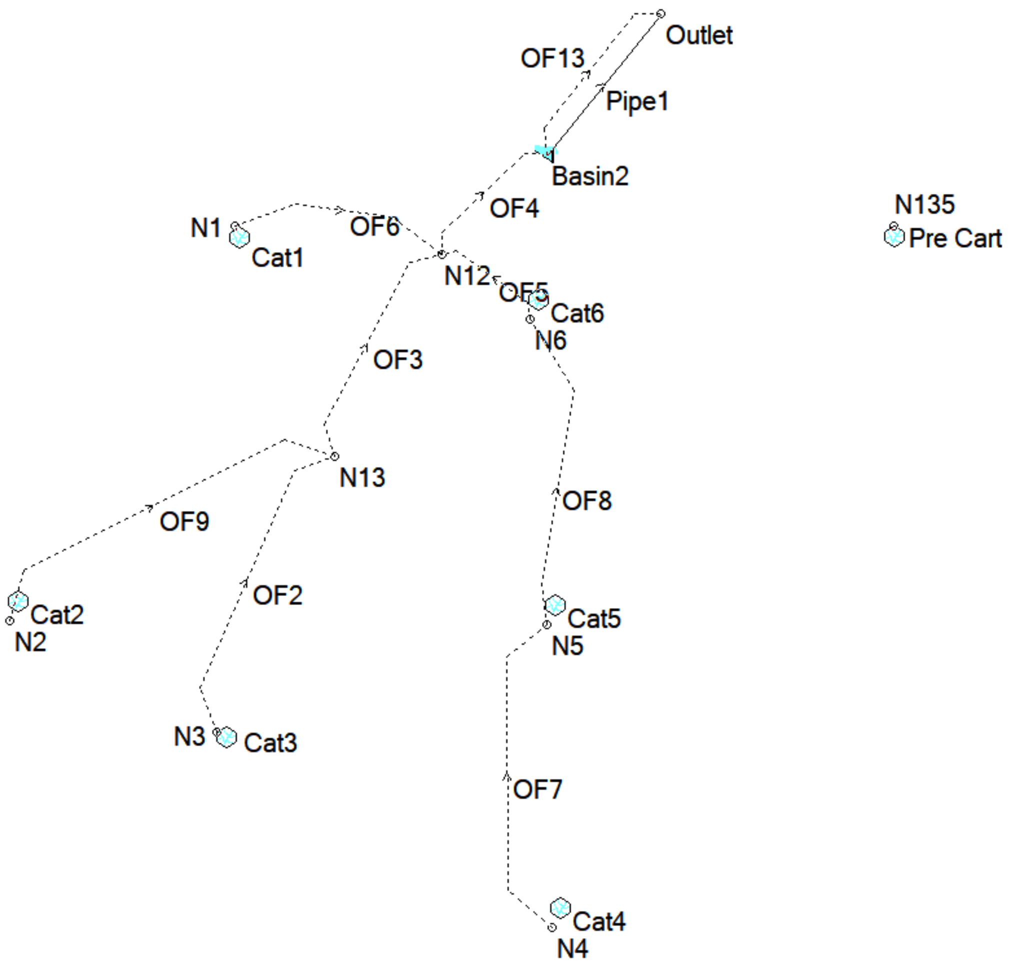
Table 5 - Catchment Information

Catchment	Land Use	Area	Impervious Area	Impervious %
1	Hardstand	1,070	963	47%
	Landscape	1,017	102	
	Road	2,604	2,213	
	Roof	4,058	812	
2	Hardstand	509	458	40%
	Landscape	1,556	156	
	Road	1,848	1,571	
	Roof	2,973	595	
3	Hardstand	312	281	42%
	Landscape	1,804	180	
	Road	1,639	1,393	
	Roof	1,174	235	
4	Hardstand	1,195	1,076	47%
	Landscape	1,568	157	
	Road	2,432	2,067	
	Roof	3,284	657	
5	Hardstand	1,112	1,001	48%
	Landscape	929	93	
	Road	1,927	1,638	
	Roof	2,991	598	
6	Hardstand	300	270	35%
	Landscape	3,372	337	
	Road	1,788	1,520	
	Roof	1,625	325	

6.2 DRAINS Modelling

A concept-level DRAINS model was set up using the above parameters to determine the likely size of on-site detention required to attenuate the post-development flows back to the pre-development levels.

Figure 14 - Proposed OSD DRAINS Model Layout



The iterations undertaken determined that an OSD volume of 1,130m^3 would be required to satisfactorily attenuate the flows. In this instance, there is sufficient space for a shallow, above ground basin to be incorporated into the open space area in the north-eastern corner of the site. At this stage, we have estimated that the basin footprint would be approximately 1,900m^2 (park area is approximately 2,800m^2) with a depth of 0.6m. Alternatively, this storage could readily be accommodated in a light weight, below ground *Atlantis Cell* style tank.

Following the DRAINS analysis of the 1% Annual Exceedance Probability (AEP) event, the following flow rates for the pre and post-development scenarios were calculated.

Table 6 - 1% AEP Pre and Post-Development Flow Rate Comparisons

Storm Duration (mins)	Pre-Development Flow (m^3/s)	Post-Development Flow (m^3/s)	Difference (m^3/s)
5	8.36	6.67	-1.69
10	9.67	7.88	-1.79
15	10.10	8.79	-1.31
20	9.67	8.82	-0.85
25	9.69	9.13	-0.56
30	9.18	8.52	-0.66
45	7.93	7.51	-0.42
60	8.14	7.99	-0.15
90	7.73	7.81	+0.08
120	7.17	7.79	+0.62
180	5.66	5.14	-0.52

The above results show that the pre-development maximum discharge of 10.10m^3/s has not been exceeded in the post-development scenario (max. discharge 9.13m^3/s) and the vast majority of discharges for the respective storm durations have been maintained with two minor exceptions. Based on the above, we consider that Council's requirements have been satisfactorily demonstrated and can be refined on subsequent, more detailed design and modelling phases.

7 Water Quality Modelling

A concept-level MUSIC model was set up using the same parameters to determine a WSUD treatment train that can be fully integrated into the landscape design that provides sufficient.

7.1 Proposed Treatment Train Devices

Gross Pollutant Trap

Prior to secondary treatment in bioretention devices, we have proposed to drain surface water through a GPT. This will remove debris and most sediment prior and minimise future maintenance of the streetscape tree pits.

Due to the fact that phosphorous removal has been included in the GPT calculations, we recommend that an *Ocean Protect* centrifugal type GPT unit be adopted.

The following parameters were used:

Table 7 - GPT Pollutant Removal Rates

Pollutant	Input	Output	Capture %
Gross Pollutants	15.0	0.3	98%
Total Suspended Solids	1,000	300	70%
Total Phosphorous	5.0	3.5	30%
Total Nitrogen	50	50	0%

Street Tree Bioretention Pits

Street tree pits are proposed to be integrated into the streetscape to provide runoff treatment and passive irrigation to the street trees. For the purposes of MUSIC modelling, we have assumed that there will be a tree pit on both sides of the road (2m x 2m) on average every 12m.

Table 8 - Street Tree Pit Areas

Catchment	Full Road Width (m)	Half Road Width (m)	Street Tree Pit Area (m^2)
1	0	397	132
2	0	350	117
3	0	301	100
4	0	378	126
5	0	348	116
6	0	348	116
		TOTAL	**707**

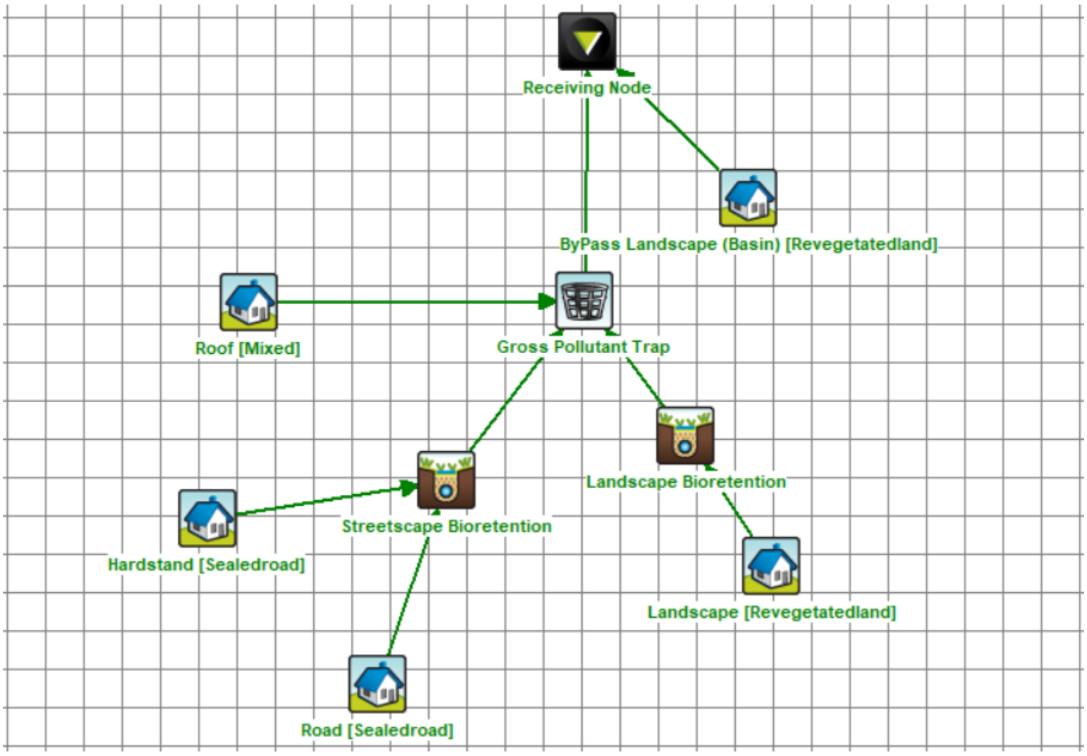
An example of a street tree pit has been shown in Figure 15 below, in this case an *Ocean Protect Filtera* system.

Figure 15 - Example of Street Tree Pit

7.2 MUSIC Model

The MUSIC model was set up with all roads and external hardstand areas draining to the streetscape bioretention areas and the landscape and roof areas by-passing these at-grade facilities discharging to the GPT and OSD basins.

Figure 16 - MUSIC Model Setup



7.3 Results

The MUSIC model was then tested using the MUSIC-Link validation tool and the following results were confirmed and in accordance with Camden Council's minimum requirements.

Table 9 - MUSIC Results

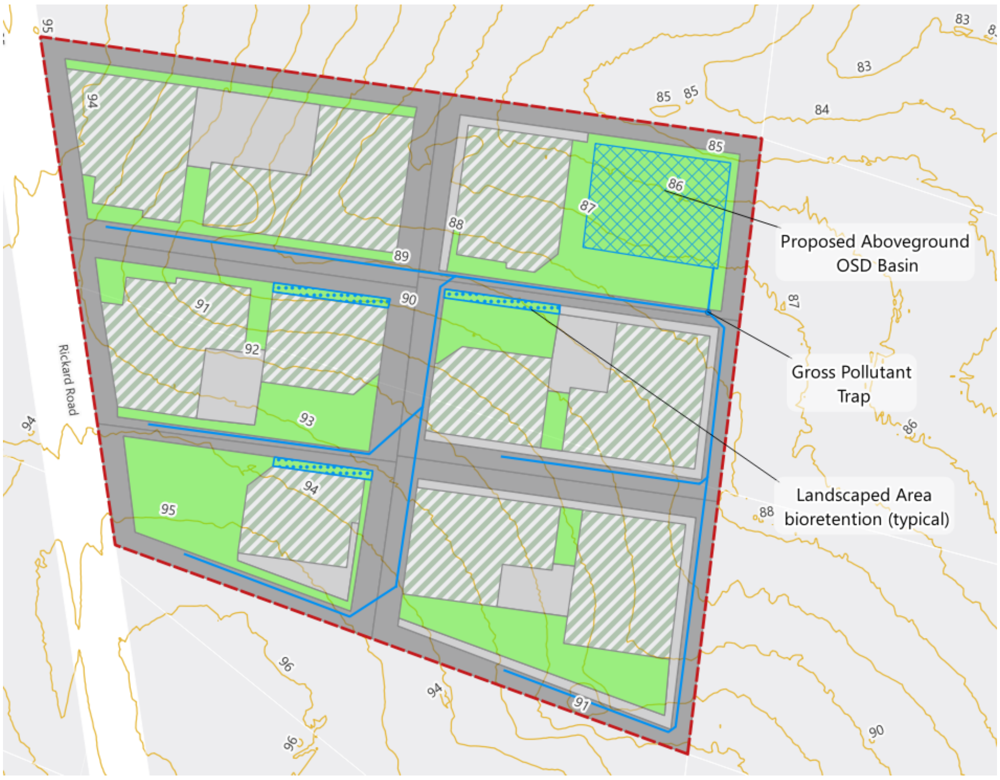
Item	Input	Output	Removal Rate	Required Removal Rate
Flow (ML/yr)	17.2	15.2	11.3%	-
Total Susp. Solids (kg/yr)	4,370	293	93.3%	80%
Total Phosphorus (kg/yr)	7.95	1.83	77.0%	65%
Total Nitrogen (kg/yr)	40.9	21.7	47.0%	45%
Gross Pollutants (kg/yr)	428	8.79	97.9%	95%

These results related to the following required infrastructure:

Table 10 - Required WSUD Infrastructure

Item	Quantity	Comment
Streetscape Bioretention Tree Pits	708m^2	One tree pit on each side of the road at 12m spacing
Gross Pollutant Trap	1	Ocean Protect GPT, or similar
Open Space Bioretention	320m^2	Integrated into the landscape design with a minimum of 0.25m extended detention above

Figure 17 - Proposed Water Management Infrastructure



8 Conclusions

Flooding

Council's flood modelling and mapping show that the site is considerably higher than the PMF flood event and no flood related controls need apply to the development.

Water Quantity

Council's Section 7.11 Plan highlights the future, permanent infrastructure required for water management. Presently, none of this infrastructure has been provided and thus temporary/interim infrastructure must be provided as part of this proposal to protect adjacent and downstream properties.

Our DRAINS modelling has highlighted the required OSD volumes for the 1% AEP flood event and confirmed no increase in discharges from the pre-development to post-development scenarios can be practically achieved at future detailed design phases.

Water Quality

Just like the water quantity situation, this development will need to provide temporary/interim infrastructure to protect downstream waterways from excessive gross pollutants, sediment, phosphorous and nitrogen.

The above MUSIC modelling shows that the proposed urban design layout and implementation of green rooves, along with the street tree pits, gross pollutant trap and central raingarden bioretention ensure that Council's minimum Water Quality requirements have been exceeded.