
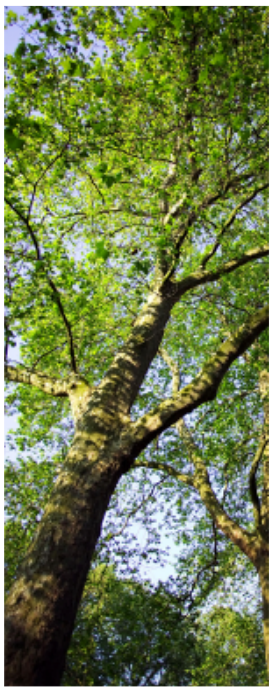


Nepean Green

Civil Engineering, Infrastructure and Stormwater Report

July 2012

Parkview Penrith Pty. Ltd.

Mott MacDonald

Nepean Green
164 Station Street, Penrith

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Content

1. Introduction

Parkview Penrith Pty Ltd is preparing a Concept Plan and Project Application for the proposed redevelopment of 164 Station Street, Penrith. The land is situated within the Penrith City Council Local Government Area and covers an area of approximately 7.85 hectares.

The proposed Concept Plan development works are to be completed over six (6) stages and consist of the construction of a new multi-storey mixed residential/commercial development to be known as 'Nepean Green'. The first stage of the works, a bulky goods, hardware, building supplies and garden centre is proposed in the Project Application.

Mott MacDonald has been appointed by Parkview Penrith to undertake a review of the existing service infrastructure to outline the constraints associated with the proposed development of the site. The purpose of this report is to review the infrastructure requirements and identify the opportunities, constraints, risks and other issues associated with the proposed development works. The views expressed herein are to provide a broad strategy for servicing the proposed development and comment on the possible infrastructure opportunities and constraints associated with the development of the site.

Following a review of the available documentation, Mott MacDonald has prepared this Civil Engineering and Infrastructure Report for the site which addresses the following items:

- Undertake a comprehensive services search (DBYD) and liaise with the relevant service providers (Sydney Water, Telstra, Endeavour Energy, and Jemena);
- Identify the existing infrastructure, risks and other issues associated with servicing the proposed development. The primary development constraints and issues that are relevant to the project include:
  - Protection or augmentation of existing trunk services in the vicinity of the site during the construction of new infrastructure and temporary connections;
  - Demolition of existing services on site without affecting neighbouring properties;
  - Identifying suitable access to adequate infrastructure to serve the proposed development; and
- Assess the stormwater issues related to the subject site, including:
  - Concept Water Quantity analysis;
  - Concept Water Quality analysis;
  - Preliminary stormwater drainage layout; and
  - Identify any potential impacts of flooding within the development areas.

It is expected that the following stakeholders will be involved in any future development of the site:

- Parkview Penrith Pty Ltd
- Penrith City Council;
- Department of Planning and Infrastructure (DoPI);
- Department of State and Regional Development;
- Department of Environment and Climate Change;
- NSW Transport - Roads & Maritime Services; and
- Relevant service authorities (Sydney Water, Telstra, Endeavour Energy, and Jemena).

1.1 Documentation

The following documentation has been resourced:

- A Comprehensive Services Search (DBYD);
- Detail site survey 15666-3 by Dunlop Thorpe & Co. Pty. Ltd.;
- Concept Architectural Plans by Turner and Associates
- Project Application Architectural Plans by Leffler Simes Architects;
- Concept Landscape Plans by Site Image;
- A Sydney Water Hydra search;
- Sydney Water Feasibility Application; and
- Written correspondence from relevant authorities and service providers (refer to Appendices).

1.2 Drawings

The following plans have been prepared by Mott MacDonald for the proposed development in conjunction with this report (refer Appendices):

Drawing No.	Title
MMD-310574-C-SK-00-XX-0001	Services Plan
MMD-310574-C-SK-00-XX-0101	Concept Catchment Plan
MMD-310574-C-SK-00-XX-0102	Concept Stormwater Management Plan
MMD-310574-C-SK-00-XX-0103	Concept Stormwater Quality Treatment Plan
MMD-310574-C-SK-00-XX-0104	Preliminary Road Grading Sketch

2. Site Description and Proposed Works

2.1 The Site

The subject site is Lot 12 DP234581 located at 164 Station Street, Penrith. It is situated approximately 1.2km south west of the Penrith CBD and is bounded by:

- Station Street / Penrith Stadium to the west;
- Jamison Road to the south;
- Woodriff Street to the east; and
- An existing commercial development (Centro Nepean) to the north.

Figure 2.1 – Site Area

The surrounding area has a diverse mix of residential, commercial and industrial properties. On the opposite side of Station Street lies Penrith Stadium, while the areas to the south and east are primarily residential. Further north of the site is the Penrith Town Centre with mainly commercial and industrial uses.

2.2 Topography

The existing site of approximately 7.85 ha is occupied by light industrial buildings to the north with a vacant paddock / open space area to the south. The site is highest towards the south east where it has a frontage to Jamison Road / Woodriff Street (Approx RL 28.51) and grades north-west towards Station Street (Approx RL 27.71). There is an existing grass-lined drainage swale centrally located within the development site which drains north-south to an outlet at Jamison Road.

2.3 Proposed Works

The proposed site works consists of the demolition of the existing buildings and structures on site and the construction of a new home improvement centre and multi storey mixed-use development. The development will form two (2) proposals:

2.3.1 Stage 1 - Site A

Stage 1 (referred to as Site A) consists of a 13,603m^2 commercial home improvement centre and 380 on grade car spaces to be constructed on the vacant lot which forms the southern portion of the development area.

2.3.2 Future Stages 2-6 – Site B

Stages 2-6 (referred to as Site B) is to include a mix of residential (approximately 570 units), neighbourhood retail / commercial (approximately 995m^2 GFA), tavern (1,800m^2 GFA) and open space uses on the northern portion of the site. The proposed buildings are to rise between four (4) and eight (8) storeys with provision for both on grade and basement car parking capacity.

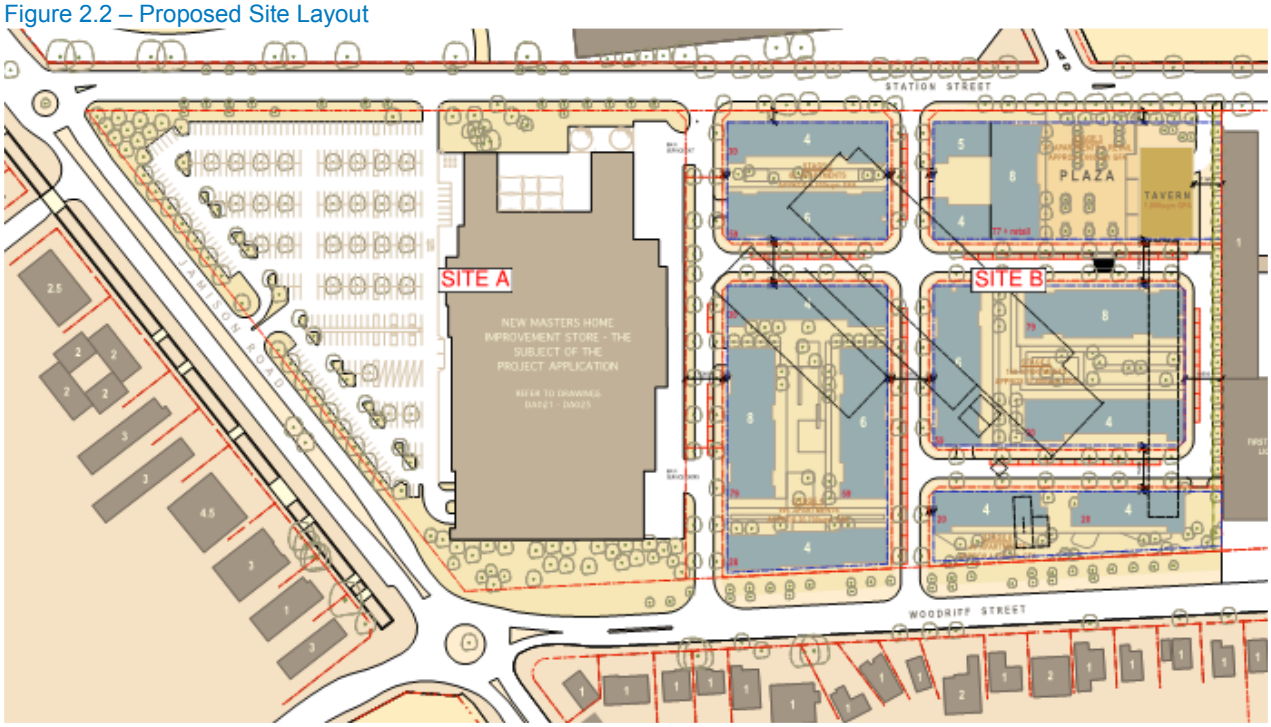
The following is a breakdown of the proposed building scope:

- Residential;
  - Stage 2 = 89 apartments
  - Stage 3 = 77 apartments
  - Stage 4 = 196 apartments
  - Stage 5 = 168 apartments
  - Stage 6 = 40 apartments

  Total = 570
- Retail / Commercial;
  - Commercial space is to consist of small specialty retail (995m^2 GFA) and a two storey tavern (900m^2 GFA each level) as part of Stage 3.

  Total GFA = 2,795m^2

Figure 2.2 – Proposed Site Layout



Source: Site Context Plan by Turner and Associates

A number of trunk utility services exist around the perimeter of the site including water, sewer, electricity, telecommunication, and gas mains. These are discussed in more detail throughout the following report.

3. Services

3.1 Potable Water

3.1.1 Existing

The main water service in the vicinity of the site is a 600mm DICL trunk main which runs within an easement along the northern boundary of the development area. This water main is significant as it supplies water to the surrounding suburbs. As such, service disruptions should be avoided during future construction works and connection of proposed services.

Other potable water services located in the vicinity of the site include:

- a 150mm DICL water main located beneath the eastern verge of Station Street;
- a 100mm DICL main along the southern side of Jamison Road; and
- a 100mm DICL main which runs parallel to the site along the eastern verge of Woodriff Street.

3.1.2 Proposed

3.1.2.1 Site A

The most likely connection point for the proposed development will be to connect to the existing 150mm DICL water main in Station Street provided there is sufficient capacity. We do not expect demolition of any mains external of the site will be required.

3.1.2.2 Site B

The existing potable water supply within the development area will be extended and upgraded where necessary. It is intended to retain as much of the major external mains network as possible, with all new pipe work to connect into the existing system. Similarly, the existing 600mm DICL trunk main running through the site along the northern boundary is to be avoided by any new building layout.

The most likely connection point for the proposed development will be to connect to the existing 150mm DICL water main in Station Street provided there is sufficient capacity. We do not expect demolition of any mains external of the site will be required.

A feasibility application has been lodged with Sydney Water to confirm our desktop assessment and identify any further requirements for the site. We are currently awaiting feedback from Sydney Water which will be included in Appendix A when received.

3.2 Sewer

3.2.1 Existing

The main sewer line in the vicinity of the site is a 525mm VC main which drains in a similar alignment to the 600mm DICL water main along the northern boundary of the development area. This line drains to a sewer pump station (SP0896) in the adjacent land to the west before being conveyed north via a 600mm DICL rising main. This sewer line is significant as it appears to be the carrier sewer line for the surrounding suburbs.

Other sewer services in the local area include:

- a 225mm VC main which bisects the site through the proposed development layout;
- a 225mm VC line which drains into the 525mm VC main from the existing commercial development to the north; and
- two (2) 500mm DICL rising mains which run in parallel through the adjoining development to the west of Station Street.

3.2.2 Proposed

3.2.2.1 Site A

It is anticipated that Sydney Water will require an extension (and possibly an upgrade) of the existing sewer services neighbouring the site to service the proposed Masters development. Based on a preliminary assessment of the site, the most likelt connection point would be to coneect to the existing 225mm VC main to the north (pending capacity check).

Subject to confirmation of existing sewer levels, it is possible that the site waste water system may need to be pumped to the waste water outlet which will need to be considered as part of the design development phase.

3.2.2.2 Site B

Site sewer flows are likely to discharge to the existing 225mm VC main (subject to capacity check) which currently bisects the site through the development area. This service will need to be locally realigned on site to suit the proposed building footprint. Design of the proposed main adjustment will need to be undertaken by a qualified water servicing

coordinator for approval by Sydney Water. As such, ongoing discussions with Sydney Water will be required through the design development phase.

A feasibility application has been lodged with Sydney Water to confirm our desktop assessment and identify any further requirements for the site. We are currently awaiting feedback from Sydney Water which will be included in Appendix A when received.

3.3 Electrical

3.3.1 Existing

The existing electrical supply network in the vicinity of the site consists of a combination of above ground and below ground reticulation. Overhead powerlines follow the alignment of the neighbouring road network, supplying the existing residential properties and commercial and industrial developments surrounding the site.

DBYD information indicates that under-ground conduits are also present beneath the surrounding road network, including:

- Station Street at the intersection with the nearby Ransley Road; and
- Woodriff Street to the north-east of the development area.

3.3.2 Proposed

3.3.2.1 Site A

Preliminary assessment by Endeavour Energy has indicated that the existing feeders within the surrounding area do not have capacity to supply the required load for the proposed development (refer to Appendix B for details). As such, the development is to be supplied by installing a new 11KV feeder from Penrith Zone Substation to the site (approximately 1.7km). It should be noted that this will likely require crossing the Western Railway Line. However, Endeavour has also indicated that, depending on the final development plan, there is potential to supply Stage 1 works via a new feeder from Kingswood Zone Substation (approximately 2.1km to the south-east). It is also likely that an 750kva kiosk substation in a suitable location with relevant easements will be required on site.

A Level 3 Accredited Service Provider will be required to determine a suitable method of supply for the new development in accordance with Endeavour Energys requirements.

3.3.2.2 Site B

Preliminary assessment by Endeavour Energy has indicated that the existing feeders within the surrounding area do not have capacity to supply the required load for the proposed development (refer to Appendix B for details). As such, the development is to be supplied by installing a new 11KV feeder from Penrith Zone Substation to the site (approximately 1.7km).

A Level 3 Accredited Service Provider will be required to determine a suitable method of supply for the new development in accordance with Endeavour Energys requirements.

3.4 Telecommunications

3.4.1 Existing

3.4.1.1 Telstra

The existing Telstra network consists of a below-ground reticulated service (including fibre optic cables) which follows the alignment of the surrounding road network.

3.4.1.2 Optus

Optus services have also been identified in the vicinity of the proposed development area, with conduits running beneath the western and southern verges of Station Street and Jamison Road respectively.

3.4.2 Proposed

3.4.2.1 Site A

Connection to the service is likely to be provided at either Station Street / Jamison Road for distribution to the site.

3.4.2.2 Site B

Connection to the service is likely to be provided at Station Street for distribution to the site.

It has been identified that existing fibre optic cables are present in the surrounding road network. As such, care should be taken by the contractor when undertaking verge works in these areas.

The relevant service providers have been contacted and an intent to develop lodged for project feasibility. These have been included in Appendix C of this report.

3.5 Gas

3.5.1 Existing

The existing gas supply network in the local area consists of a 150mm secondary main (1050 kPa) which enters Station Street from the northern approach of the nearby Ransley Street.

3.5.2 Proposed

3.5.2.1 Site A

Currently there are no plans for gas as part of this proposal

3.5.2.2 Site B

The gas supplier, Jemena, has been contacted about the proposed works and a feasibility application lodged with the service provider (refer Appendix D). A preliminary review has indicated the following:

- Jemena have indicated there is natural gas infrastructure located within the public footpaths adjacent to the proposed development site. As such, any construction that takes place should include the use of Dial Before You Dig to provide location of services;
- the most likely connection point will be to connect to the existing 150mm secondary main within Station Street;
- any relocation of existing assets in public thoroughfares to accommodate the proposal will be at a third party cost; and
- a formal offer of supply is to be lodged with the service provider during the detail design phase once service loads are known.

4. Roads and Transport

4.1 Existing System

The proposed Nepean Green development area fronts Station Street and Woodriff Street. These roads are two-way sealed roads and traverse the site along the western and eastern boundaries.

Jamison Road also extends along the southern boundary of the subject site. This road is a two-way sealed road and can be classified as a major collector road.

4.2 Proposed Works

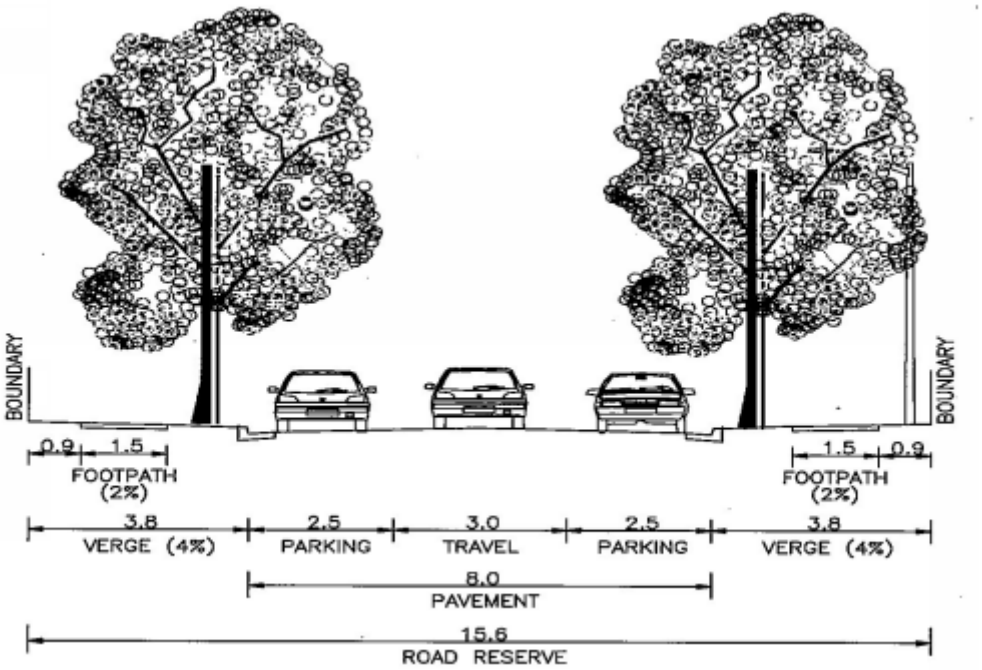
4.2.1 Site A

Based on the latest architectural plans by Leffler Simes Architects, a new access is proposed off Station Street which will serve as one of the primary access points to the car park areas within the site. Recent discussions with Parkview Penrith have indicated that there is potential to upgrade Station Street as part of the proposed development works. This upgrade is to consist of an additional slip lane to accommodate right turn traffic at the new Station street access. It is likely that these works will require the loss of existing on-street parking on one or both sides of Station Street in the vicinity of the site access.

4.2.2 Site B

A new local road network will be provided as part of the proposed Nepean Green development works. These roads are to be two-way sealed roads and will serve as the primary access points to the commercial and residential areas within the site, as well as providing a new transport link between Station Street and Woodriff Street in accordance with councils *Penrith City Centre DCP 2007*.

Figure 4.1 – Typical Local Road Cross Section



Source: Penrith City Council *DCP 2010 C10: Transport, Access and Parking*

4.2.3 Parking Provision

Refer to the separate *Traffic and Accessibility Impact Study for Proposed Nepean Green Development, 164 Station Street, Penrith* prepared by Colston Budd Hunt & Kafes Pty. Ltd. for details of the proposed parking provision for the development.

5. Infrastructure Management Issues

The items listed below have been identified as potentially having an impact on the Nepean Green project.

5.1 Sediment and Erosion Control

Prior to any earthworks commencing on the site, erosion and sediment control measures are to be put in place generally in accordance with Penrith City Council's requirements and Managing Urban Stormwater: Soils and Construction 4th Edition, March 2004. These measures may include:

- Installation of a 1.8m high chain wire fence covered with geo-textile filter fabric, to the perimeter of the work site area, where required;
- The use of sediment diverting methods to minimise sediment in Council's stormwater drainage using sandbagging at kerb inlet pits and geo-fabric filter fabric around drop inlet pits;
- The provision of a sediment basin will be required where disturbed areas are greater than 2,500m^2. The sediment basin will be required to be designed in accordance with Urban Stormwater Quality Management Plan (1999) for which stormwater runoff shall be channelled and treated during construction; and
- The provision of a temporary truck wash-down facility to service vehicles exiting the site during the construction stage.

5.2 Flooding

Informal discussions with Penrith City Council have indicated that, due to the relatively flat nature of the existing site, the development area is affected by localised flooding in large storm events. Preliminary studies by council indicate that the existing site is partially inundated during the 1% AEP storm event, with flood depths typically ranging between 0.15m – 0.4m.

Council has indicated that there is currently no flood planning level available for the site. It is understood that a flood study has been commissioned by Council and is currently being finalised with results expected by September 2012.

In lieu of more detailed data from Council, Mott MacDonald has undertaken a desktop review of the existing site flooding conditions. Preliminary assessment indicates that site overland flows are conveyed north-south via a grass swale to a trapped low point on the southern portion of the development area. The local topography of this area forms a natural depression which acts to trap and attenuate overland flows in relatively minor storm events. Based on detail survey data and visual site inspections, it appears that the resultant level of inundation is

consistent with the flood depths provided by Council. As such, it would appear that flooding issues on site are dictated by on site drainage issues.

Preliminary assessment of the proposed re-development indicates that the subject site can typically be improved from the existing scenario, with flooding issues to be managed by on-site measures. This is discussed in more detail in Section 6.3 of the report.

At this stage, further discussions will be required with Council to confirm site flooding constraints pending publication of results for the Council commissioned flood study.

5.3 Earthworks

5.3.1 Site A

Based on the existing levels on site it is expected that filling will be required to construct the proposed commercial Building on a level pad.

A preliminary desktop assessment of earthworks volumes has been undertaken to determine indicative quantities of fill material required to be imported to site. Findings indicate that approximately 30,000m^3 of fill material will be required to construct the building pad level to the proposed floor level.

5.3.2 Site B

It is anticipated that cut to fill for bulk earthworks will be required for the site.

5.4 Retaining Walls

We would expect that the majority of the site could be graded to alleviate level differences within the proposed development site. Desktop assessment of the site indicates that retaining walls would likely be required along the northern boundary of the development site adjacent to the existing Nepean Centro, as well as along the boundary between the proposed Site A and Site B works. Confirmation of retaining wall heights and extents will need to be further investigated as the design progresses.

5.5 Pavement Design

Based on previous experience with similar projects we would expect pavement designs to be based on a CBR value of 5% subject to further investigation by the geotechnical engineer.

For the car park pavement we would expect the car parking pavement to consist of the following profile subject to confirmation by the project geotechnical engineer.

General Pavement – Car park
30mm Layer of Asphaltic Concrete
200mm thick layer of DGB20 Sub-base compacted to 95% MMDD
Sub-grade compacted to CBR 5%

For asphaltic vehicular pavement likely to be trafficked by service vehicles we would recommend a heavy duty vehicular pavement profile be adopted as follows;

Heavy Duty Pavement – New Street Network
30mm Layer of Asphaltic Concrete
200mm thick layer of DGB20 base course compacted to 98% MMDD
200mm thick layer of DGS40 compacted to 95% MMDD
Sub-grade compacted to CBR 5%

For service road / loading dock pavements likely to be trafficked by heavy articulated vehicles we would recommend the following concrete pavement profile;

Concrete Pavement – Service Road & Loading Dock
170mm thick concrete (F'c = 32MPa) with SL82 mesh (50mm top cover)
100mm thick layer of DGB20 compacted to 98% MMDD
Sub-grade compacted to CBR 5%

For pedestrian footpaths the following pavement profile may be adopted.

Concrete Footpath
125mm thick concrete (F'c 32MPa) with SL82 mesh (50mm top cover)

Concrete Footpath
100mm thick layer of DGB20 compacted to 98% MMDD
Sub-grade compacted to CBR 5%

It is noted that the pavement designs noted above are preliminary only and would need to be confirmed by the project geotechnical engineer.

6. Stormwater Management

The stormwater drainage for the proposed development is to be designed to comply with the following guidelines:

- Penrith City Councils *Development Control Plan DCP* (2010);
- Penrith City Councils *Guidelines for Engineering Works for Subdivisions and Developments* (1997);
- Australian Rainfall and Runoff (2001); and
- Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition, March 2004.

The proposed stormwater management strategies for the site are to consist of the following:

6.1 Water Quality

Penrith City Councils *Development Control Plan (DCP)* 2010 requires improved water quality of the stormwater flow from the developed site prior to discharge into the authorities' drainage network.

Council also requires the removal of target pollutants from the site during the construction phase as vehicles that may enter or exit could generate various pollutants such as oil and grease. These target pollutants can be identified into five major groups of stormwater pollutants:

- Gross pollutants;
- Coarse, medium and fine sediments;
- Nutrients;
- Heavy metals; and
- Oil and grease.

6.1.1 Water Quality Objective

In accordance with Table C3.2: Pollution Retention Criteria of Penrith City Council's Development Control Plan, we note that the following targets have been set in relation to stormwater quantity:

- Reduction in annual average suspended solids (SS) export load of 50%;
- Reduction in annual average total phosphorus (TP) export load of 45%
- Reduction in annual average total nitrogen (TN) export load of 45%; and
- Reduction in annual average gross pollutant (GP) export load of 70%

In addition to satisfying the requirements and standards of Council, the promotion of sustainable water practices must comply with the

protection or enhancement of natural water quality as stated in Penrith City Council's Local Environment Plan.

To demonstrate compliance with these objectives, treatment removal loads were analysed from pre to post development scenarios using MUSIC (Model for Urban Stormwater Improvement Conceptualisation) software. Model development and results are discussed in section 6.1.3.Proposed Treatments

6.1.2 Proposed Treatments

The removal and treatment of target pollutants can be achieved through the use of integrated water sensitive urban design principles. Proposed treatment devices which are to be included as part of the Nepean Green development works include:

6.1.2.1 Gross Pollutant Traps (GPT)

"Gross Pollutant Trap" is a term applied to either in-situ, or proprietary units that remove litter, vegetative matter and sediment. Although the numerous units fall under the one umbrella of gross pollutant traps, the actual mechanics of the different units vary, as do the achievable pollutant removal rates. GPTs come in a range of sizes, with the larger units able to effectively treat large catchment areas and high flow rates. They are usually sized based on their maximum treatable flow being equal to, or greater than the 3-month Annual Recurrence Interval (ARI) storm event (typically 50% of the 1-year ARI storm event) of the upstream catchment.

In developing the MUSIC model for the site, a Humegard / Humeceptor arrangement positioned in series is proposed at the outflow from each sub-catchment area. The proposed GPTs have been positioned to maximise flow and enable easy access for maintenance. The Humegard is to provide primary treatment and target larger gross pollutants and sediments. Treated water will then pass through the proposed Humeceptor (secondary treatment) further downstream, which targets oils and grease, nutrients and fine sediments.

6.1.2.2 Rainwater Tanks

Rainwater tanks are sealed tanks designed to retain rainwater collected from roofs for subsequent re-use on site. Roof water from each of the proposed buildings has been modelled to discharge directly to rainwater harvesting tanks. Water demand rates for the Nepean Green development have been defined based on assumed re-use rates in

order to attain the most efficient water usage on site. A preliminary analysis based on estimated water demand indicates that rainwater tanks totalling around 360kL will be satisfactory.

Table 6.1 – Site A MUSIC Rainwater Tank Inputs

Development Stage	Irrigation Area (m2)	Irrigation Requirement (mm/m2/week)	Weekly Demand (kL)	Daily Demand (kL)	Tank Volume* (kL)
1	1565	25	39.13	5.59	100

*Based on minimum 3 weeks storage

Table 6.2 – Site B MUSIC Rainwater Tank Inputs

Development Stage	Number of Units	Assumed Number of Occupants per Unit	Weekly Demand* (kL)	Daily Demand (kL)	Tank Volume# (kL)
2	89	3	13.44	1.92	40
3	78	3	11.76	1.68	35
4	198	3	29.89	4.27	90
5	168	3	25.34	3.62	75
6	40	3	6.02	0.86	20

*Based on 3.6L/flush twice daily

#Based on minimum 3 weeks storage

The excess water from the harvesting tanks will discharge into the stormwater network and through the GPTs prior to exiting the site. Due to the uncertain nature of the rainwater supply, the tanks will be connected to mains water for “top-ups” in dry weather conditions.

6.1.3 Water Quality Modelling – MUSIC Model, Parameters and Methodology

A water quality modeling tool, MUSIC was utilised to simulate urban stormwater systems operating at a range of temporal and spatial scales. MUSIC models the total amounts of gross pollutants and nutrients produced within various types of catchments. It allows the user to simulate the removal rates expected when implementing removal filters to reduce the increased gross pollutant and nutrient levels created by the proposed development.

The following methodology and parameters were incorporated in the MUSIC modeling:

- The MUSIC model was created to assess the effectiveness of water quality treatment nodes which are to be constructed as part of the proposed Nepean Green development.

- The MUSIC models default pluviograph data for Sydney Observatory 6 minute interval (10 years historical data) was utilised within the model. This time range seemed acceptable since those years had both wet and dry periods and were close to the site.
- A MUSIC model was setup to represent the post developed site. The development area was consolidated into five (5) sub-catchment areas based on the proposed drainage system and lot layout (refer to Appendix F for the catchment plan). From architectural plans the site was then categorised into the following areas;
  - Roof;
  - Road;
  - Other;
  - Carpark / Service Road; and
  - Landscaped areas.

Table 6.3 – Site A Post-Developed Catchments

Sub-Catchment	Post-Developed Region	Area (Ha)
M1	Roof	0.88
	Roof Bypass	0.48
	Carpark/Service Road	1.55
	Landscaping	0.57
Total		**3.48**

Note: Fraction impervious areas for these catchments were estimated based on the current Project Application documentation

Table 6.4 – Site B Post-Developed Catchments

Sub-Catchment	Post-Developed Region	Area (Ha)
M2	Roof	0.24
	Road	0.23
	Other	0.16
M3	Roof	0.24
	Road	0.46
	Other	0.46
M4	Roof	0.45
	Road	0.15
	Other	0.43
M5	Roof	0.50
	Road	0.40
	Other	0.64
Total		**4.36**

Note: Catchments were modelled as high-density residential with effective impervious fraction of 80%

Refer to Appendix H for the MUSIC model.

- Pollutant concentration parameters used within the model were based on the recommended model defaults for different land use categories as specified in the MUSIC modeling Guidelines for NSW
- A treatment train was designed to incorporate a series of treatment nodes including Rainwater Tanks, Humegard, and Humeceptor. The effectiveness of the proposed treatments is summarised in section 6.1.4.
- Stormwater that discharges directly from the roofed areas is generally 'clean' water and has been modeled to discharge directly to a rainwater tank for re-use on site.

6.1.4 Results

The following results were achieved within the model:

Table 6.5 – MUSIC Results

Pollutant	Post-Development with no WSUD measures (kg/yr)	Post-Development with WSUD measures (kg/yr)	Removal Rate (%)	Target Removal Rate (%)
Total Suspended Solids	46,200	4,790	90	50
Phosphorus	33.6	18.4	45	45
Nitrogen	217	114	48	45
Gross Pollutants	2,330	223	90	70

Results of the MUSIC modelling indicate that the treatment train as listed above appears to satisfy Council's statutory requirements in target removal rates.

6.2 Water Quantity

6.2.1 Existing System

Detailed site survey by Dunlop Thorpe & Co. indentifies an open channel (approximately 6.3m wide x 2.1m high) and culvert system which traverses the site along the southern boundary of Jamison Road. Preliminary discussions with Penrith Council and visual site inspections indicate that piped stormwater flows from Jamison Road are conveyed to the channel via an existing 1050mm dia pipe, while an additional 750mm dia pipe allows flows to enter from the northern approach of Station Street.

There is an existing grass-lined drainage swale centrally located within the development site which drains north-south and conveys surface flows from the proposed Masters site to an outlet at Jamison Road. From here, flows are directed to the pit and pipe network within Jamison Road before discharging into the open channel to the south via the existing 1050mm dia pipe.

6.2.2 Proposed System

6.2.2.1 Major/Minor Drainage System

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

The minor drainage system is comprised of the below ground pit and pipe network and is designed to control nuisance flooding and enable effective stormwater management for the site. Council's Stormwater Management Guidelines requires that the minor system be designed for a minimum 5 year ARI for all new developments (refer C3.6: Stormwater Management and Drainage from Councils DCP 2010 for details).

The major drainage system incorporates overland flow routes through proposed road, car parking 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. Subsequently, all overland flow routes for the site are to be designed so that the maximum velocity x depth product shall not exceed 0.4m^2/s as outlined in the NSW Floodplain Development Manual (2005).

Figures SK-00-XX-101 to 103 in Appendix F present a concept stormwater management plan for the proposed Nepean Green Project. However, it should be noted that the stormwater management strategies shown are indicative only, with detailed hydraulic calculations to be undertaken during the design development phase to size the proposed site pit and pipe network to adequately convey the minor (5yr ARI) storm event with safe overland flows for the 100yr ARI storm event.

6.2.2.2 Connection to Council System

- Site A – the most likely connection point for minor system (5yr ARI) flows will be to connect to the existing pit and pipe network in Jamison Street along the southern boundary of the development area. From here, flows are to be conveyed to the open channel system downstream via the existing 1050mm dia stormwater pipe.

- Site B – it is anticipated that the majority of the catchement (approximately 2.57Ha) is to drain to the existing authorities stormwater network in Jamison Road via a new drainage easement along the eastern boundary of the development area. The remaining areas (approximately 1.79Ha) are proposed to discharge to the existing pit and pipe network in Station Street. From here piped flows will be conveyed to the downstream open channel and culvert system via the existing trunk stormwater drainage network (750mm dia pipe).

6.2.2.3 On-Site Stormwater Detention (OSD)

Informal discussions with Penrith City Council have indicated that on-site detention is not required for the subject area, however, post development flows are not to adversely impact on existing drainage systems.

A desktop review of Councils existing pit and pipe networks indicates the following:

- Site A – preliminary assessment indicates that the proposed discharge point (existing 1050mm dia stormwater pipe) has sufficient capacity to accept post-development flows. As such, OSD is not required;
- Site B – desktop assessment of Councils drainage network in Station Street / Woodriff Street indicates that the existing stormwater systems have insufficient capacity to receive increased surface flows as a result of the proposed development. As such, it is anticipated that OSD will be required for Stage 2-6 works to restrict

overland flows exiting the site to existing levels for storm events up to and including the 100yr ARI.

An assessment of the existing site conditions indicates that surface flows in excess of the minor system capacity (assumed to be 20yr ARI for commercial / industrial development) will be conveyed overland to Station Street, with a portion also being directed to Woodriff Street. This flow split was estimated at approximately 50% ($0.2m^3/s$ and $0.2m^3/s$ for the 100yr ARI).

Preliminary analysis undertaken for the post-developed site using the DRAINS software package indicates approximately $700m^3$ of storage would likely be required to satisfy pre-post requirements.

Table 6.6 – Proposed OSD Provision

Development Stage	OSD Volume
Stage 2	$100m^3$
Stage 3	$150m^3$
Stage 4	$200m^3$
Stage 5	$150m^3$
Stage 6	$100m^3$
Total	**$700m^3$**

It should be noted that these volumes are preliminary only and will need to be confirmed in subsequent Development Applications. The most likely locations for the OSD tanks would be within the basement carparking areas beneath each stage. These locations would maximise flows and allow easy access for maintenance.

6.3 Flooding

As detailed earlier in Section 5.2 of this report, discussions with Penrith City Council have indicated that, due to the relatively flat nature of the existing site, the development area is affected by localised flooding in large storm events. Following our visual assessment of the site we concur with this, with localised flooding being caused by a lack of continuous overland flow paths through the site.

Preliminary assessment of the proposed development indicates that the subject site will be improved from the existing scenario, with flooding issues to be managed by on-site measures. Overland flowpaths with sufficient fall (minimum 1%) are to be provided along the proposed new local street network / Site A carpark to convey stormwater flows in excess of the minor (pit and pipe network) capacity to the adjoining

street network. Similarly, verge works will better define overland flows in the new street network / carpark and help keep surface flows away from the proposed buildings.

7. Conclusions and Recommendations

All relevant services issues will be further investigated at the detailed design stage in order to take advantage of the opportunities for cost savings and reduced exposure to risk which may be expected to arise from consideration of the following:

- Finalise the detailed survey of the developable area to identify above ground and below ground structures, services and utilities requiring modification, removal or replacement;
- Preparation of Earthworks Management plans to coincide with the construction stages as part of the design development. This would minimise the double handling of excavated material or exporting surplus and importing deficit material from independent stages thereby providing cost savings;
- Investigation of the capacity of existing Authority services on the site and the extent of augmentation, and retention that is possible;
- Further discussion with service providers to determine any requirements for the area;
- Further investigation of the type, size and location of the site stormwater quantity and quality strategies needed to satisfy council's statutory requirements; and
- Further investigation of the site flooding requirements pending results of the Council commissioned flood study.