46-66 O'Connell St, Caddens - Preliminary Engineering Design Report – Concept Plan DA

Job Number: 78090

CWG Development Pty Ltd

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Revision History

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[01]	[14.12.16]	[Paul D'Orazio]	[Craig Hood]	[Graeme Fleming]
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[03]	[20.01.17]	[Paul D'Orazio]	[Craig Hood]	[Graeme Fleming]

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1. SITE CONSTRAINTS

1.1. Steep Site Grades

The existing topography of the site is generally steep. The steepest parts of the site fall towards the south western corner. North-south roads are not ideal in the south western portion of the site, where retaining walls will be required to allow for flat building envelopes. Existing level constraints with respect to grade and road design will be discussed in further detail in the section below.

There is a ridge line running through the middle of the site from east to west, allowing for a scenic vista vantage point looking towards the Blue Mountains. To maintain these views for the proposed development, minimising the amount of cut earthworks is the developer's preference.

Figure 1 Detail Survey (Lockley Surveyors)

1.2. Existing Cumberland Plan Woodland (CPW) Community

An existing community of Cumberland Plain Woodland (CPW) has been identified on the southern portion of the site as indicated on the below Figure 2 overlaid against the Concept Plan layout proposal (18th November 2016).

In accordance with report A16004F provided by the engaged ecologist Travers Ecology, it is targeted to retain 84.3% of the CPW trees within this community. Figure 3 below is a sketch provided by Travers Ecology reviewing their initial Flora and Fauna results showing the proposed area to be reserved for the retention of the CPW Community. It is noted that initially it was proposed to provide above ground On Site Detention (OSD) within the remainder of the open space north of the CPW community. However, to add support to the Vegetation Management Plan Prepared by Travers Ecology, the approach is to retain this open space for passive and non-passive purposes.

Figure 2 Existing Cumberland Plan Woodland (CPW)

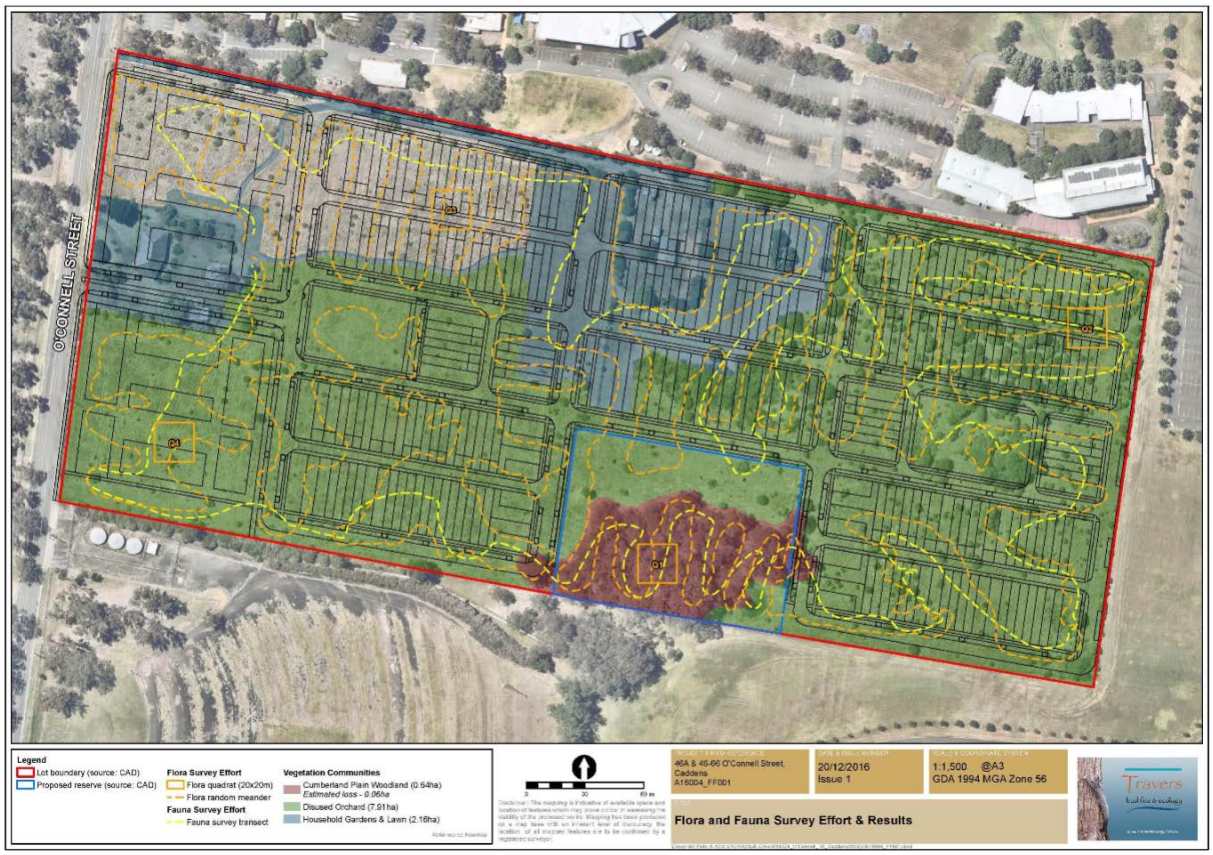

Figure 3 Flora & Fauna Survey Efforts & Results Plan (Travers Ecology)

Figure 4 Proposed Concept Plan (22th December 2016 – Hills Thalis)

1.3. External Site Constraints

1.3.1. Western Sydney University (WSU)

Western Sydney University (WSU) borders the development site along the southern and eastern boundaries. Discussions between Chiwayland and WSU are ongoing in relation to the southern boundary and the proposed road running east to west along the common boundary. The Caddens Development Control Plan 2014 indicates that the road is wholly within WSU's land. As such, the proposed Concept Plan layout (refer to Figure 4 above) incorporates roads within the development parallel to the southern boundary with the potential for future road connections taken into consideration.

WSU have proposed certain design road levels that made road grades exceed 10% and therefore potential tie-in purposes unfeasible. The Concept Plan has been designed to facilitate future development and has been created as an open-edge estate that encourages future connections, including the south-western portion of the site.

Furthermore, stormwater drainage discharge will be required through WSU's land at the low point on the southern boundary. The stormwater drainage discharge and OSD strategy will be discussed in further detail in the section below.

In addition, the strategic importance of retaining the CPW community for the benefit of future residents, further constrained the feasibility of a proposing road along the southern boundary.

1.3.2. O'Connell Street

O'Connell Street is an existing road that runs adjacent to the site's western boundary. Currently there is a steep fill batter along the eastern frontage that requires regrading to tie-in with the existing footpath level in order to allow for the proposed entry road. Existing services inclusive of stormwater drainage infrastructure, sewer, water, gas, electrical and communications will be reviewed in further detail. (Refer services infrastructure report 78090.01.RE01-Services of 8th December 2016 by SMEC).

In accordance with the Caddens DCP 2014, O'Connell Street is proposed to be re-aligned at the south western corner of the development site, with the proposed alignment along the southern boundary from east to west. A Transport Impact Assessment undertaken by The Transport Planning Partnership (TTPP), however concluded the future east-west alignment of O'Connell St would result in a poor urban design outcome due to drawing traffic away from the main travel desire line. Furthermore, the proposed alignment would result in additional traffic friction and disruption due to additional conflict points from the new alignment. TTPP has made the recommendation that O'Connell Street should remain as present a direct north-south alignment due to an east-west alignment being unfeasible from a traffic perspective.

1.3.3. Nepean College (TAFE)

The Nepean College borders the northern boundary of the development site.

In the north eastern corner of the site, large level differences are apparent with an existing retaining wall retaining the development site. A low point is proposed to drain the north eastern portion of the development site through TAFE's land. The stormwater drainage discharge and OSD strategy will be discussed in further detail in the section below. Further investigation into the interface with the TAFE will be required at the detailed design phase.

1.3.4. Survey

A detail survey model was provided by LTS Lockley in January 2017 in dwg (AutoCAD) format. The survey included survey control including co-ordinates and levels relative to Map Grid of Australia (MGA) and Australian Height Datum (AHD) respectively.

Topographical features in the survey have been defined using string label coding. Underground utilities search was also undertaken in November 2016 based on Dial Before You Dig (DBYD).

2. ROAD & LOT DESIGN

2.1. Guidelines

- Published RMS supplements to Austroads Guides;
- Austroads Guides;
- Australian Standards; and
- Penrith City Council Engineering Design Specifications.

2.2. Design Software

- Road Design: 12D Model (.12da) – Version 11.0C1k;
- Drainage: Drains (.drn) – Version 2016.14 – 1 Dec 2016;
- CAD Drawings: AutoCAD (.dwg) – Version 2016; and
- Turning Paths: Auto track (.dwg) – Version 2016.

2.3. Road Design Parameters

A number of road layout options have been discussed throughout the Concept Plan process. We have undergone a detailed analysis to determine the vertical and horizontal design, initial proposed cut/fill figures, typical road cross sections and road long section outputs for discussion.

Through this process SMEC has reviewed Penrith City Council's Engineering Design Guide (November 2013) and have identified potential issues with the road layouts proposed to date:

2.3.1. Design Vehicle

Figure 5 below is an excerpt from the Penrith City Council Design Specification regarding the geometric standards adopted in the Concept Plan road network. All roads within the proposed development are assumed at 50km/h.

The design of urban roads is to provide smooth, safe trafficable horizontal and vertical alignments, adequate sight distance with consideration being given to the road classification requirements, pedestrian access to each allotment, provision for utilities and stormwater drainage. The design speed to be used for a particular road shall be the legal road speed limit for that road.

For design speeds up to 60 km/hour, the use of transition curves is not considered necessary.

The minimum radius of horizontal curves should be:-

Minimum Deflection Angle	Minimum Radius (m)
75°	20
60°	33
40°	65
30°	75
20°	100

Where the deflection angle is 90° and travel speed is not an issue, the size of the horizontal curve is to be related to the turning requirements of vehicles such as single unit trucks (removalist vans and garbage trucks).

Figure 5 2.2.13 Geometric Standards (PCC Design Guidelines for Engineering Works – 20th November 2013)

Turning movements have also been reviewed in relation to the proposed Concept Plan layout with a 12.5m design vehicle used throughout each intersection. These movements have been taken into consideration in developing the proposed layout and will ultimately determine the minimum allowable kerb radii. Turning movements will be provided as part of the Concept Plan submission by TTPP and Traffix.

2.3.2. Horizontal alignment

Figure 6 below is an excerpt from the Penrith City Council Design Specification regarding intersections. Approximately 70m is required between intersections in relation to the proximity of another intersection. It is noted that there are several locations within the proposed Concept Plan that do not comply with this specification. The incorporation of one-way streets and traffic calming devices will be used and developed in further detail at the design detail phase.

"T" junctions shall be adopted in preference to four way intersections. Where staggered "T" junctions are to be provided, the junctioning roads shall be spaced a minimum distance of 2 x stopping distance for the travel speed along the through-road (1.5 second reaction time).

Figure 6 2.2.26 Intersections (PCC Design Guidelines for Engineering Works – 20th November 2013)

2.3.3. Vertical alignment

Figure 7 below is an excerpt from the Penrith City Council Design Specification regarding the vertical alignment geometry. Due to the nature of the existing topography, the Concept Plan layout road network and concept road design has taken this into consideration.

> The maximum permissible grade on all roads is 16% for a maximum distance of 150 metres on a straight alignment, with a minimum grade of 0.5%.
>
> A maximum grade of 10% (1 to 10) shall be used adjacent to street intersections, locations of poor visibility, horizontal curves of radius 15 metres or less and, at cul-de-sacs. Turning circles in cul-de-sacs on steep grades shall have grades less than 5%.

Figure 7 2.2.14 Vertical Alignment (PCC Design Guidelines for Engineering Works – 20th November 2013)

2.3.4. Typical Cross Sections

This section demonstrates the typical cross sections adopted for the proposed Concept Plan road network. It is noted that the development site has two separate Development Control Plans (Penrith and Caddens) with their own road widths, carriageway width, and class of road. Hill Thalis have provided the below typical cross sections for the site.

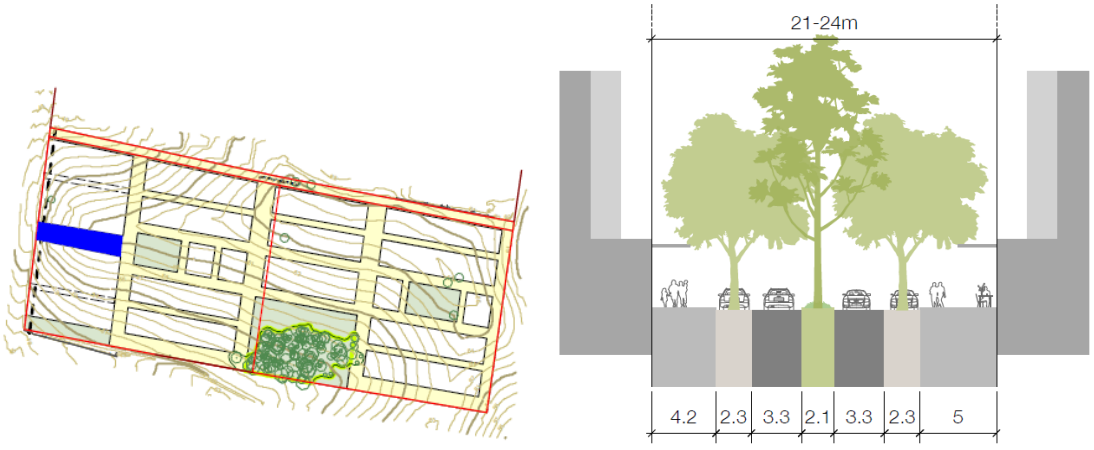

Figure 8 21-24m Wide Road (Hills Thalis)

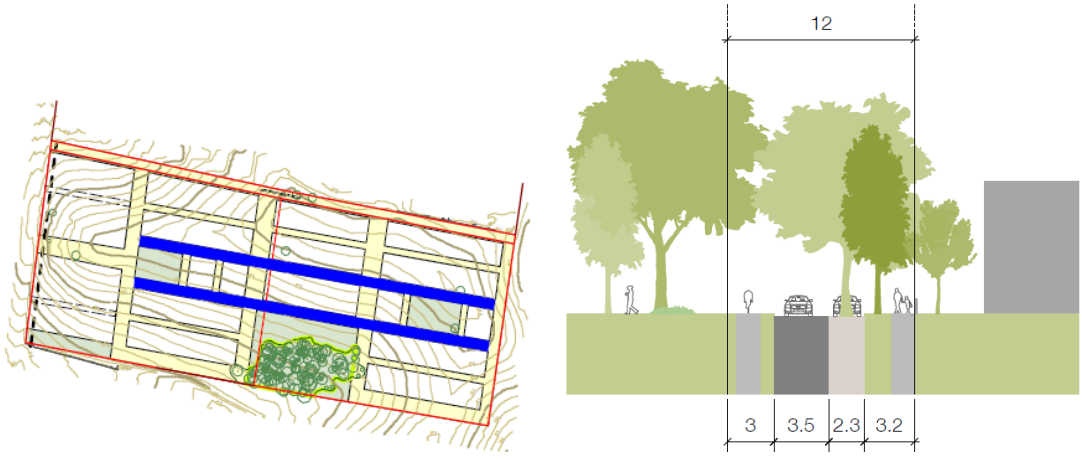

Figure 9 12m Wide Road – One-way (Hills Thalis)

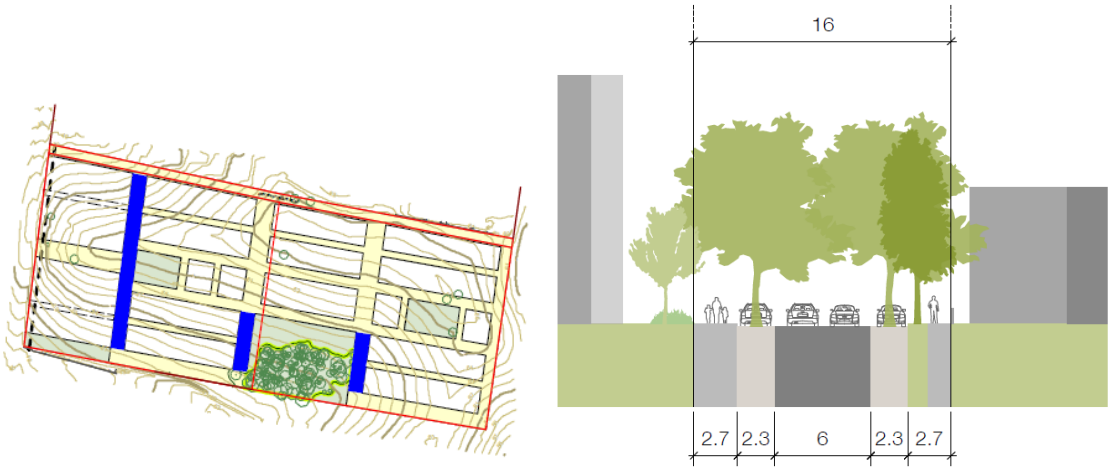

Figure 10 16m Wide Road (Hills Thalis)

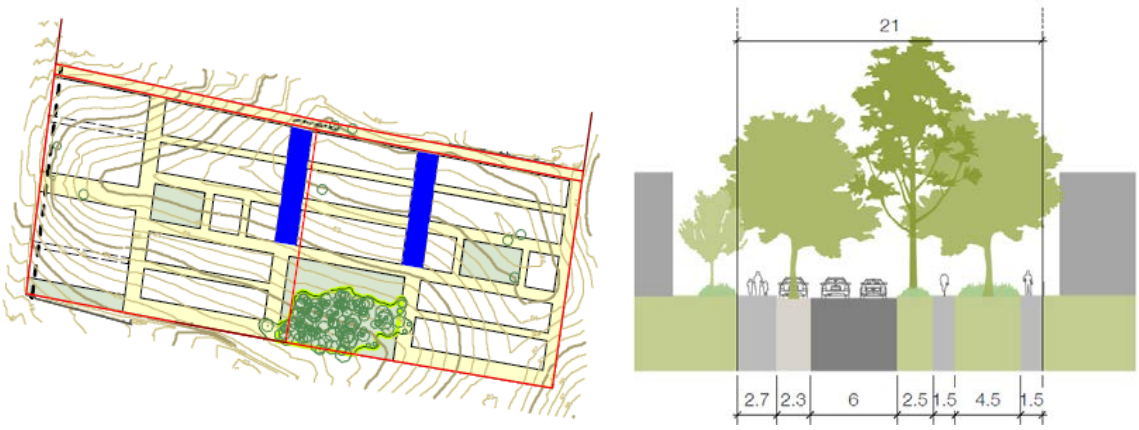

Figure 11 21m Wide Road – Widened Verge (Hills Thalis)

Figure 12 16m Wide Road – Edge Corridor (Hills Thalis)

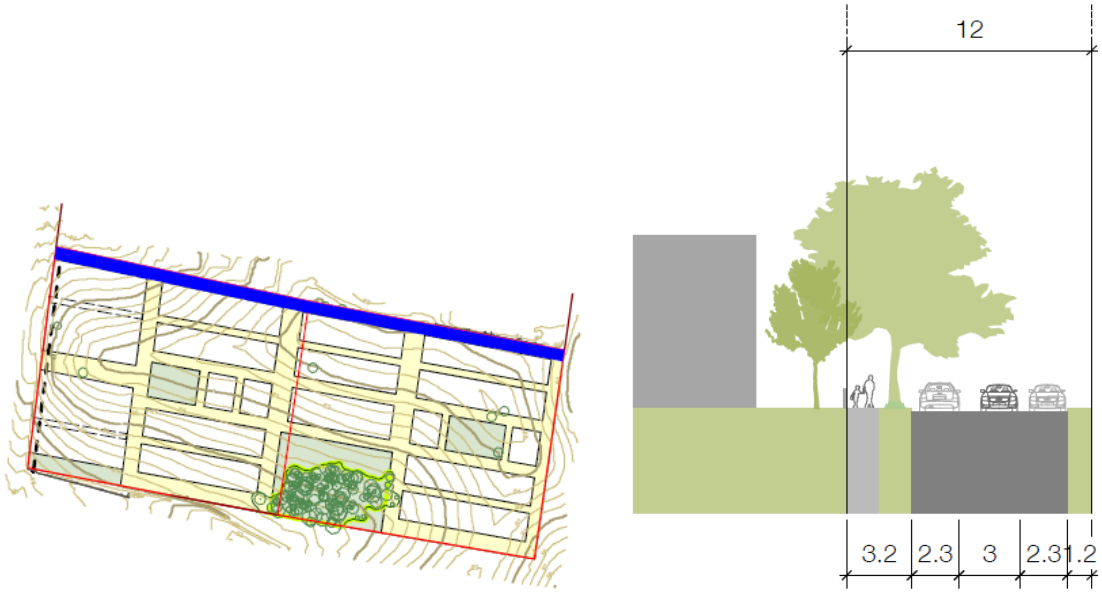

Figure 13 12m Wide Road – Existing Laneway Upgrade (Hills Thalis)

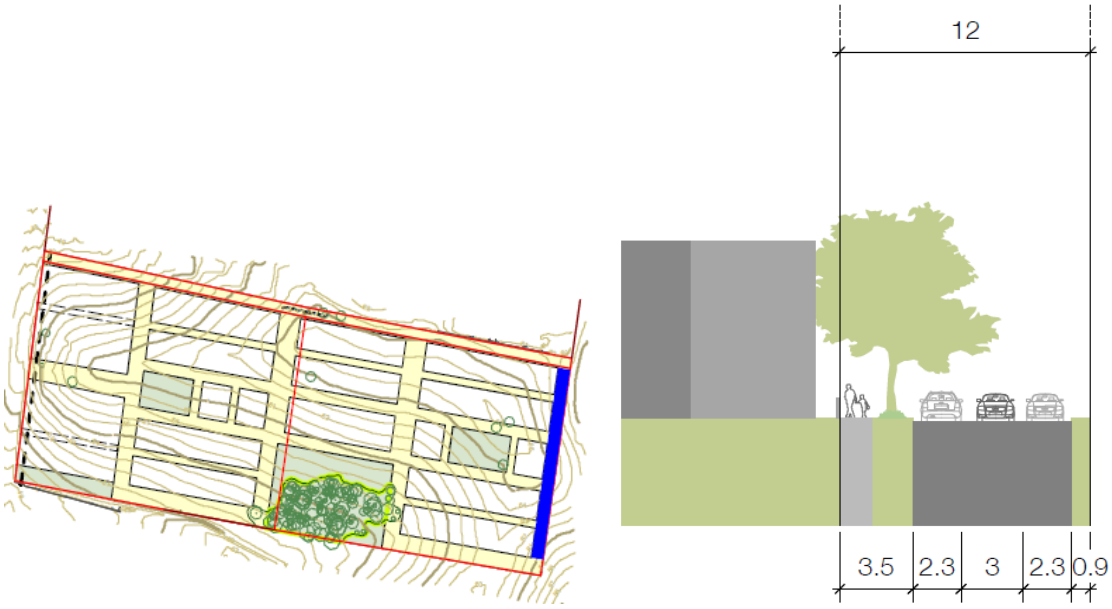

Figure 14 12m Wide Road (Hills Thalis)

2.3.5. Laneways

Both DCP's covering the development site do not have an allowance for a laneway however there is the intention of providing laneways in accordance with the proposed Concept Plan. Currently the proposed laneway is to be one-way with a total road reserve width of 7.5m wide consisting of a 1.7m verge, 4m roadway with a one-way cross-fall and a 1.8m verge. Alternatively, it has been discussed with Penrith City Council that laneways won't be dedicated to Council. It is proposed that a right of carriageway easement can be created over the lot to accommodate this use of the land under a Community Title Scheme.

2.3.6. Lot Orientation

With respect to the steep grades across portions of the site, lot orientation and the subsequent road layout is critical in minimising the visual impacts of retaining wall locations and cost. The proposed Concept Plan layout (Refer to Figure 4) has taken this into consideration.

2.3.7. Bus Route

Due to the proposed Concept Plan's road hierarchy, it is no recommended for a bus route to travel within the proposed development site. The north-south roads in the Concept Plan however has been designed to accommodate potential bus routes through the site and facilitate broader Precinct improvements for public transport accessibility.

3. DRAINAGE DESIGN

3.1. Rainfall Data

The design IFD data for the site was derived from the Australian Bureau of Meteorology. The rainfall station used was determined from the approximate area of the site.

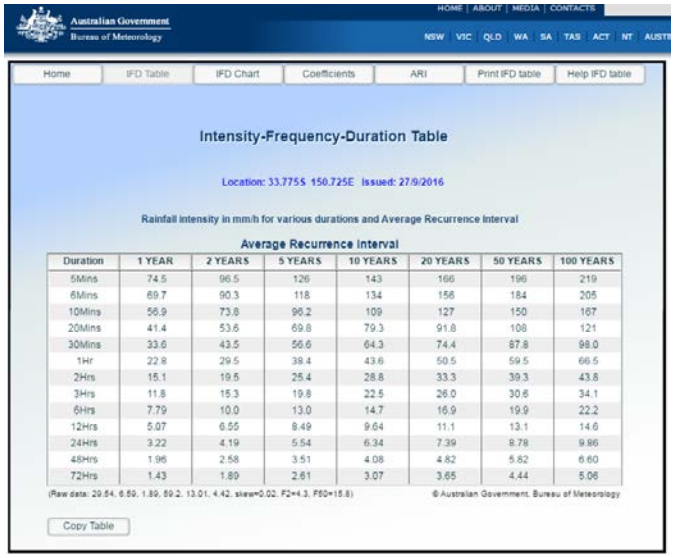

Table 1: Rainfall Intensities (mm/hr) (Bureau of Meteorology)

3.2. Catchment Data

There are no existing upstream catchments draining into the development site. The total catchment area under consideration therefore is the total developable area of the site (Excluding the proposed open space and CPW Community area). The total site area has been split into four existing sub-catchments in order to more accurately model existing flows leaving the site's boundary and replicate existing times of concentration. Figure 15 below indicates the existing catchments for the development site.

Existing catchment conditions have been assessed through the use of site survey, site photos and computer drainage modelling. Existing catchments have been modelled using DRAINS software as sub-catchment nodes (Refer to Figure 16).

Catchment ID	Total Area (ha)
South Western (SW 1)	7.044
North Western (NW 1)	2.373
North Eastern (NE 1)	1.542
South Eastern (SE 1)	0.432

Table 2: Existing Catchment Information

Figure 15 Existing Catchment Plan

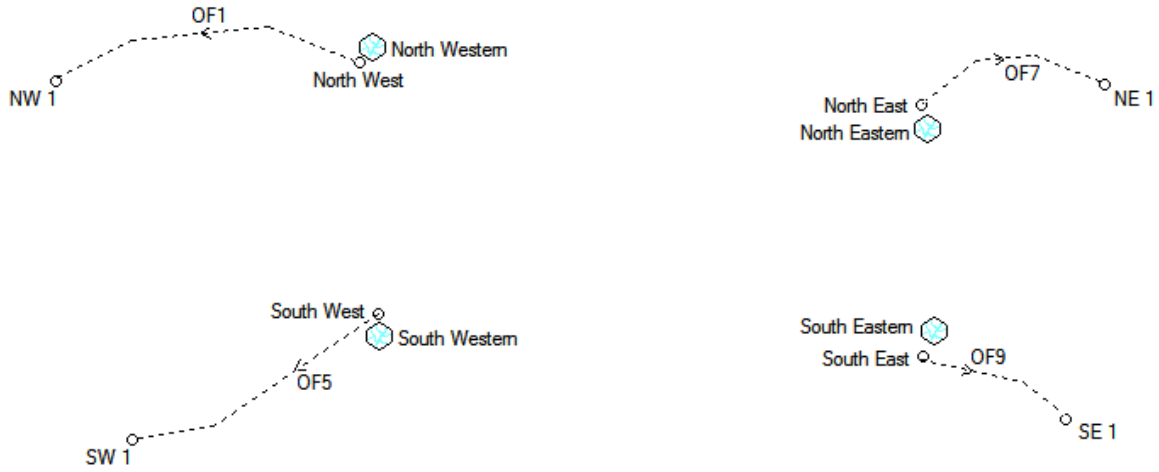

Figure 16 Existing DRAINS Model

3.3. Existing Drainage Networks

The nature of existing drainage networks draining the local area has been picked up from field survey. The majority of the surrounding area is drained via existing dry creek beds, unformed swales adjacent to rural roadways and road culverts as cross drainage.

3.4. Stormwater Quantity Design

3.4.1. Design Objectives

The key objectives for stormwater quantity consist of the below:

- To ensure that the proposed development does not generate stormwater discharges that exceed the capacity of the existing drainage discharge through the use of above ground detention and below ground storage detention to reduce peak flows;
- To provide a stormwater system which can be maintained economically – to ensure maximum yield potential for the proposed development, utilising underground storage where possible in public open space for adequate maintenance access and within private property; and
- To prevent stormwater damage to the built and natural environment, all drainage infrastructure proposed will be designed to carry overland flow safely within the allocated road reserves during rare flood events without disruption to the existing watercourses.

3.4.2. Stormwater Management Strategy

The proposed drainage system will be a major/minor system. The pit and pipe network will be designed to safely convey the 20% AEP storm event whilst still complying with Penrith City Council's standards ensuring no pit upwelling or freeboard issues in a minor storm event. The major system flows are to be catered for within proposed road reserves and are to be designed for a 1% AEP storm event. All major overland flow routes will be assessed on levels of flow depth and velocity depth product in accordance with Penrith City Council's standards to ensure safety and amenity for future residents.

3.4.3. Proposed Conditions

To calculate design flowrates, computer based models of the proposed catchments were constructed using DRAINS. Design storms were applied to these models to give estimates of the AEP discharges for all storm events ranging from 20% to 1% AEP.

The proposed drainage network and its associated developed catchments were created using 12d software. A proposed model of the site was created replicating the proposed roads, housing lots, design basins and drainage network. A screenshot of our proposed DRAINS model indicating the proposed design stormwater drainage network is shown below in Figure 17.

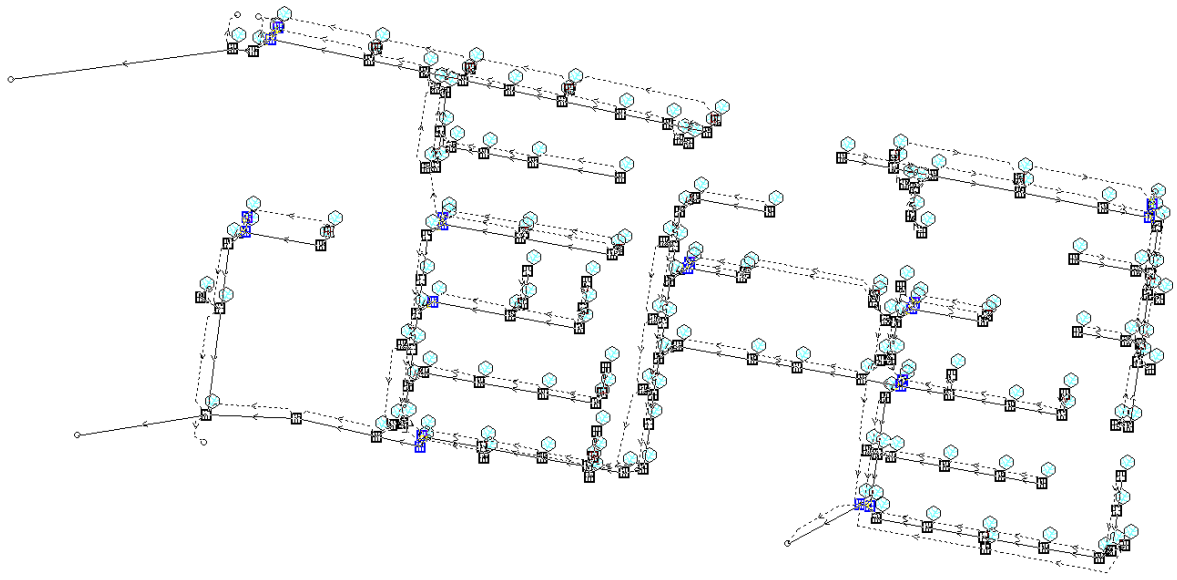

Figure 17: Proposed Drains Model Layout

3.4.4. On Site Detention (OSD) Strategy

A review of the external catchment has determined that minimal external flow enters the development site and that all post developed flow generated from the proposed subdivision works will be required to be detained. Preliminary stormwater calculations indicate that approximately 5,400m^3 will be required to be detained on site (1% AEP Storm Event), broken up into 4 sub catchments as shown in Figure 18 below.

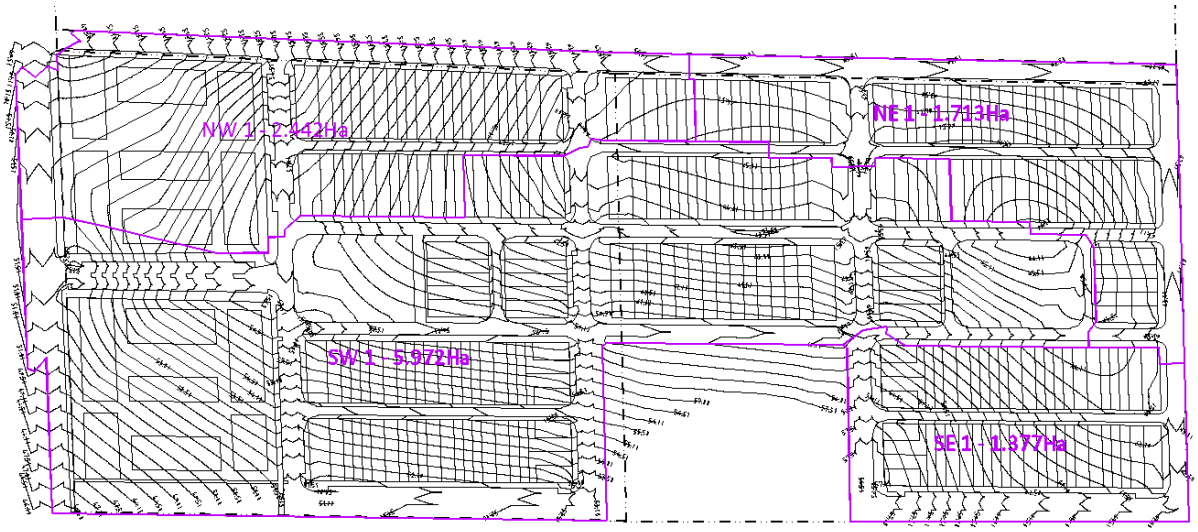

Figure 18: Post Catchment Plan

The initial concept results for the approximate storage required at each outlet is as follows:

South Western Catchment (SW 1):

- Pre Catchment Area = 7.044Ha;
- Post Catchment Area = 5.972Ha;
- Pre Catchment Discharge = 1.070m^3/s;
- Post Catchment Discharge = 2.467m^3/s;
- Detention Required = 2,000m^3.

North Western Catchment (NW 1):

- Pre Catchment Area = 2.373Ha;
- Post Catchment Area = 2.452Ha;
- Pre Catchment Discharge = 0.514m^3/s;
- Post Catchment Discharge = 1.145m^3/s;
- Detention Required = 770m^3.

North Eastern Catchment (NE 1):

- Pre Catchment Area = 1.542Ha;
- Post Catchment Area = 1.713Ha;
- Pre Catchment Discharge = 0.275m^3/s;

- Post Catchment Discharge = 0.798m^3/s;
- Detention Required = 990m^3.

South Eastern Catchment (SE 1):

- Pre Catchment Area = 0.432Ha;
- Post Catchment Area = 1.377Ha;
- Pre Catchment Discharge = 0.155m^3/s;
- Post Catchment Discharge = 0.680m^3/s;
- Detention Required = 640m^3.

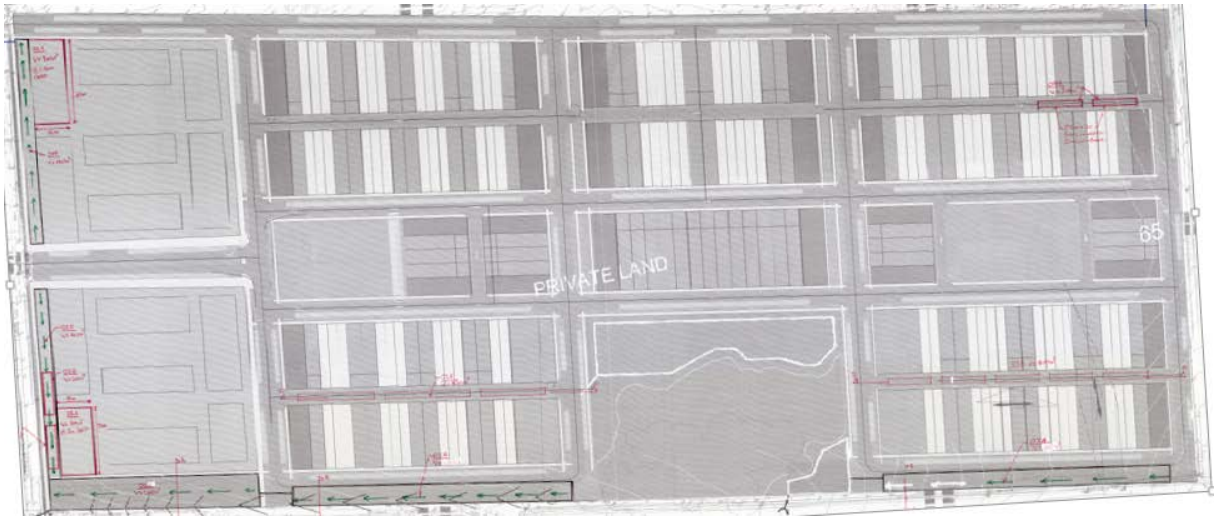

Figure 19: On Site Detention Concept Quantity & Quality Strategy Layout

To optimise the Nett Developable Area (NDA) within the high density zoning in the north western and south western portion of the development site, it is recommended that an underground tank storage system for OSD is further investigated should Penrith City Council allow underground tank storage. It is also recommended that Penrith City Council review the utilisation of a combination of underground tanks (box culverts), individual dwelling OSD tanks storage systems and above ground basins/swales to provide adequate storage for each sub-catchment. Preliminary estimations indicate that a combination of these systems will provide the necessary detention requirements but is subject to detailed design.

Water quality measures will also be incorporated into the OSD basin/swale designs using Penrith City Council's guidelines. It is also our recommendation that alternative water quality treatment devices such as underground treatment systems (Gross Pollutant Traps and other fine pollutant removal devices) be raised with Council. Water quality treatment is discussed in further detail in the next section of this report.

3.5. Stormwater Quality Design

3.5.1. Design Objectives

The key objectives for stormwater quality consist of the below:

- To minimise urban runoff pollutants to the existing watercourses, the proposed treatment measures will ensure that site runoff is treated to remove excessive levels of sediment and chemical pollution in order to prevent algal blooms and deoxygenation from occurring in local waterways; and
- To maximise reasonable on site detention and to provide opportunities for rainwater re-use by capturing runoff, storing and re-using on site as non-potable re-use applications wherever possible in order to reduce demand on town water supply systems.

3.5.2. Water Quality Management Strategies

In order to meet the required objectives of stormwater quality for the development, bio-retention filtration areas, gross pollutant traps and household rainwater tanks will be required as part of a site treatment train system. These treatment measure will ensure that the appropriate environmental runoff and rainwater re-use targets for the site are met in accordance with Council's guidelines.

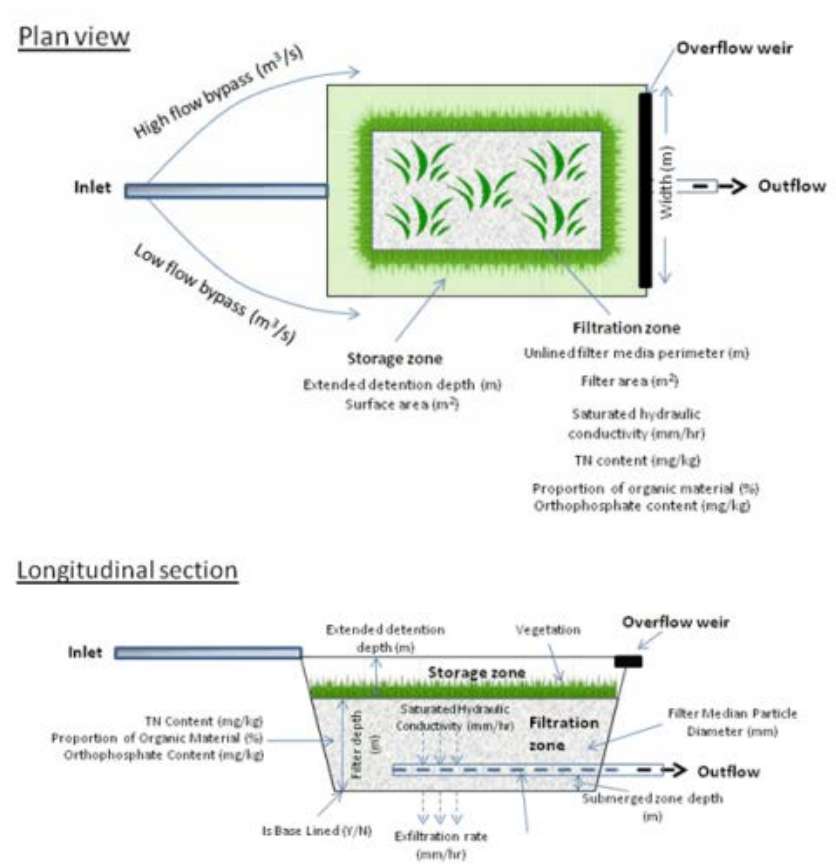

Figure 20: Example of a Typical Bio-Retention System

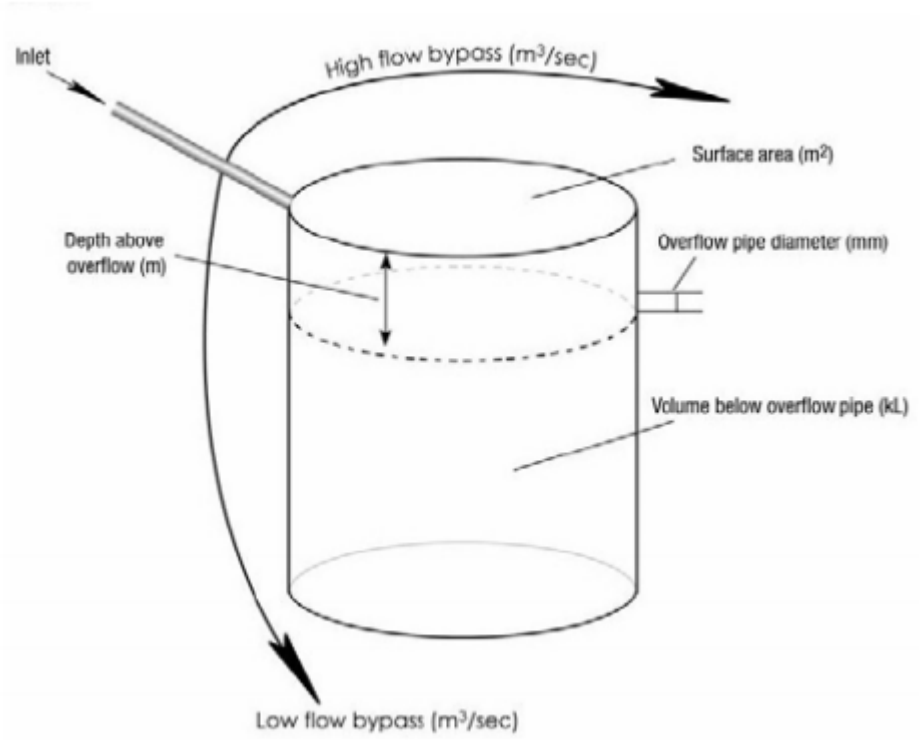

Figure 21: Example of a Typical Rainwater Tank

3.5.3. Pollutant Sources

Various sources of pollution runoff exist on the site including proposed roof space, roadway and hardstand areas. Litter, silt/sediment, automobile exhaust and oils can contaminate these sources. These sources can then become mobile once rainfall occurs and conveyance carries these pollutants as runoff to site boundaries.

3.5.4. Pollutant Types

The following are the targeted pollutants that the proposed water quality treatment devices will help decrease below Penrith City Council's pollutant removal targets:

- Total Suspended Solids (TSS) – Common pollutant types within stormwater runoff are excessive levels of suspended solids. These can consist of particles of sand, cement, gravel, silt or clay from eroded soils on the site. These pollutants can cause siltation and blockage to occur to downstream existing creek ways as well as cause sunlight to be blocked out to local waterways. This can create changed hydraulic conditions in existing creeks and cause water to become deoxygenated killing off aquatic species of fish and plants;

- Total Phosphorus & Nitrogen (TP/TN) – Common pollutant types within stormwater runoff are excessive levels of phosphorous and nitrogen. These chemicals can result from localised fertiliser use and subsequent erosion of garden areas. IF excessive chemical contaminants reach local waterways algal blooms such the formation of blue-green algae can occur. This can be deadly to existing creek ways as algal blooms choke oxygen levels in the creek, killing off a diversity of existing aquatic species; and

- Gross Pollutants (GP) – Gross pollutants consist of litter/rubbish which can result from household waste becoming loose or dislodged from waste disposal or from public littering. Packaging and litter can block proposed stormwater drainage networks affecting the hydraulic performance of such systems and even cause localised flooding in extreme examples. Rubbish can also be eaten and digested by aquatic species causing poisoning/asphyxiation and subsequent death.

3.5.5. Water Sensitive Urban Design (WSUD)

Similar to the water quantity, the same 4 sub-catchments require water quality treatment devices installed to ensure adequate removal of the above mentioned pollutants types. A MUSIC model will be setup in accordance with Penrith City Council's Water Sensitive Urban Design (WSUD) Policy (December 2013) and WSUD Technical Guidelines (Version 2 – July 2014) to model the proposed water quality treatment devices required to meet Council's pollutant removal targets.

Water quality treatment devices proposed to be installed through this development include the following for each sub-catchment:

- Gross Pollutant Traps (GPT) – will be modelled and installed at each outlet prior to discharging into the existing watercourse. Detailed modelling and sizing of each GPT will be determined at the detailed design phase;
- Bio-Retention Filter – will be modelled and installed where possible to undertake the fine pollutant removals (Phosphorus and Nitrogen). Open space areas within each sub-catchment have been allowed for to ensure the required pollutant removal can be achieved. Indicative bio-retention basin locations have been allocated along the western frontage of the proposed development site (adjacent to O'Connell Street), along the southern edge of the proposed development site adjacent to the proposed apartment site and along the corridor road edges, along the widened footpath verges on the north-south running roads (Refer to Figure 11 – 21m Wide Road – Widened Verge) and within the allocated open space parks as required; and
- Proprietary in-ground products – with the amount of underground storage proposed throughout the development site, we would suggest to Penrith City Council take into consideration the use of a system such as the Jellyfish product or similar. These products treat both Gross Pollutants and Fine Pollutants. A maintenance manual and a life cycle costing would be required and provided upon request should this option be a viable treatment option.
- Any water quality treatment will take into consideration the proposed landscaping Concept Plan.

4. CONCLUSION

4.1. Findings & Recommendations

This report covers the preliminary concept design principles for the proposed subdivision of Lots 46-66 and 46A O'Connell Street, Caddens. This document is to accompany the Concept Plan development Application for CWG Development Pty Ltd.

SMEC have discussed the existing site conditions including the existing constraints of the site and have discussed the appropriate measures that have been taken into consideration in preparing the preliminary road and drainage design.

The proposed road network optimises the use of the land with respect to the identified site constraints such as the retention of the CPW community and maintaining the views by minimising the earthworks and hence maintaining the natural grades where possible. Further detail will be required to assess the turning movements and the impacts splay corners to lots, minimum kerb return radii and road and verge widths.

It has been established from the site modelling that in order to effectively manage and control the site flows to levels of permissible site discharge, a total detention of approximately 4,400m^3 is required on the site through the use of above-ground and underground storage devices. Further to this detention, water quality has been reviewed with the proposed Concept Plan layout allowing for sufficient areas to concentrate water treatment devices prior to discharging off site.

It is noted that this is a preliminary design report only issued for the purposes of providing sufficient information for Penrith City Council to make a determination on the proposed Concept Plan DA submission and that further detailed design is required for all road, lot, water quantity and water quality.