AECOM

Department of Planning & Infrastructure
(on behalf of Hixson Pty Ltd)
24-Oct-2013

Catherine Field (part) Precinct

Post Exhibition Transport and Access Review (Addendum)

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Client: Department of Planning & Infrastructure (on behalf of Hixson Pty Ltd)

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Prepared by

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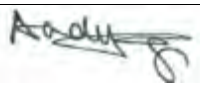
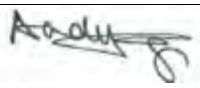
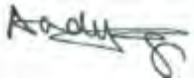
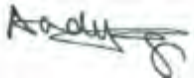
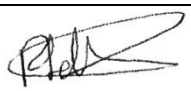
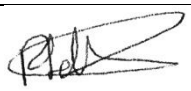
A	14-Feb-2012	Draft Report	Andy Yung Principal Transport Planner	
B	25-May-2012	Final Report	Andy Yung Principal Transport Planner	
C	1 July 2013	Post Exhibition Review (Addendum) Draft	Andy Yung Principal Transport Planner	
D	02 September 2013	Post Exhibition Review (Addendum) Draft Edition #2	Andy Yung Principal Transport Planner	
E	18 October 2013	Post Exhibition Review (Addendum) **Final**	Roger Jeffries Principal Transport Planner	
F	24 October 2013	Post Exhibition Review (Addendum) **Final#2**	Roger Jeffries Principal Transport Planner	

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Purpose of Report

This Transport and Access Strategy Review (Addendum) has been prepared for the Department of Planning and Infrastructure (on behalf of Hixson Pty Ltd) following the public exhibition of the Catherine Field (part) Precinct Transport and Access Strategy dated 25 May 2012.

This review is based on the exhibited Transport and Access Strategy with updates and amendments included to address relevant submissions. This review also assesses the precinct's internal transport network in greater detail based on the final Indicative Layout Plan (ILP) and revised traffic forecasts.

The responses for each of the traffic / transport comments raised are also provided in **Appendix A**.

Executive Summary

Context

This addendum report follows the exhibited Transport and Access Strategy and incorporates amendments resulting from traffic modelling updates, additional intersection assessments and relevant submissions.

The purpose of this report is to set out the transport and access components to support the finalisation of an Indicative Layout Plan (ILP) for Catherine Field (part) Precinct in the South West Growth Centre (SWGC). This document forms part of a suite of documents forming the overall Catherine Field (part) Precinct Plan. It covers a range of transport modes and considers improvements to public transport and walking and cycling networks to ensure planned sustainable accessibility and transport opportunities for these communities in future. An assessment of road network opportunities has been undertaken from both a strategic point of view and a local perspective to ensure appropriate highway connections and capacity to meet future forecast traffic volumes.

Road network

The strategic road network analysis has assisted in determining appropriate future highway corridor classifications and methods of control for intersections across the proposed road network for Catherine Field (part) Precinct. The designated road network hierarchy focuses vehicular access on the most appropriate routes to arterial roads via higher order corridors. Vehicles are distributed through the precinct via the hierarchical network of Sub-Arterial, Transit Boulevard and Collector Roads then via local streets to individual land parcels. The road hierarchy for Catherine Field (part) Precinct is proposed with reference to the Oran Park DCP, Austral & Leppington North DCP, RMS SWGC Road Network Strategy and the expected traffic flows on the road network.

The key strategic highway route serving the precinct is Camden Valley Way. At ultimate development it will have three lanes in each direction and provide a strategic traffic function for the South West Growth Centre for both private vehicles and public transport. The RMS SWGC Road Network Strategy shows Oran Park Drive as a designated Transit Boulevard linking Oran Park to Camden Valley Way and providing a route to Campbelltown Station through Gregory Hills Drive. Oran Park Drive will have two lanes in each direction and will have a strategic public transport function, providing a high frequency bus corridor with bus priority and dedicated travel lanes at intersections.

The key route linking the precinct to the proposed Leppington major centre is Rickard Road (a proposed future connection), designated as a four-lane Transit Boulevard. This will form a strategic bus connection linking the precinct to Leppington major centre and Leppington Station.

The collector and local road network provides two accesses to Oran Park Town Centre via South Circuit and Peter Brock Drive. All collector roads and local roads within the precinct require only one traffic lane in each direction, with localised widening at intersections and parking lanes if required.

Intersections

All the intersections across the precinct have been designed to accommodate future year traffic demands associated with the full development of the precinct as well as wider regional development at 2036. The intersections within the precinct will all operate at an acceptable level of service during the morning peak hour and evening peak hour, with appropriate forms of control.

In line with RMS guidance those intersections which are proposed to be signalised have been assessed to perform at Level of Service D or better, at full development in 2036, and therefore will provide adequate capacity and operational efficiency.

Signalisation is proposed for the following intersections:

- Oran Park Drive | Rickard Road | Forest Grove Drive* (4 arm); and
- Oran Park Drive | Dan Cleary Drive (4 arm).

Public Transport Framework

The precinct will benefit from good public transport accessibility through a comprehensive proposed bus network and bus servicing strategy linking key centres, Leppington Rail Station, Campbelltown Rail Station, schools, employment opportunities and residential areas.

The proposed bus strategy for this precinct is consistent with the SWGC Road Network Strategy and will broadly follow the South West Growth Sector Bus Servicing Strategy. The proposed long term bus network for the precinct will comprise a mixture of regional routes and district routes to maximise speed and efficiency of high frequency peak hour services as well as a number of local bus routes to ensure maximum coverage throughout the precincts, facilitating public transport access and travel choice.

The combination of Regional and District routes and the potential for local routes on the collector road network provides an efficient and flexible bus network to serve the future Catherine Field (part) precinct. The exhibited bus service strategy for the precinct was agreed in the meeting between AECOM, TfNSW, RMS, DP&I and Camden Council on 22 March 2012. Following exhibition, further input was received from TfNSW regarding the position of service routes. This report has since been amended to show a revised service strategy.

Key bus operating corridors with services providing fast, efficient regional connections will operate along the east-west route (Oran Park Drive) and on the north-south route (Rickard Road extension), with links to notable regional destinations such as Leppington major centre, Oran Park Town Centre, Liverpool, and Campbelltown.

Roads serving bus routes should have two lanes in each direction or one lane in each direction with a parking lane that could accommodate a bus stop. Lanes that accommodate buses need to be a minimum of 3.5 metres wide. Oran Park Drive and Rickard Road extension are both identified as critical links in the bus network for bus priority measures.

A draft Rickard Road Study has been undertaken by Arup. This report seeks to establish the preferred alignment of Rickard Road based on a four-lane road with a design speed of 70km/h. Preliminary results of the Arup report have been taken into consideration as part of this report and the Indicative Layout Plan.

Indented bus stops are not recommended and where bus stops are located in proximity to education or activity centres, safe pedestrian crossing facilities should be proposed.

Pedestrian and Bicycle Networks

There are good opportunities for walking and cycling within the study area, but the limited existing provision of walking and cycling facilities within the precinct will not be appropriate to future demands.

Providing viable alternatives to the private car for journeys with destinations both within and outside the precinct is essential to encourage the use of more sustainable modes of travel among residents. In particular it will be important to connect internal roads within the precinct with direct pedestrian and cycle connections to allow access to the future centres, schools, retail, employment, public transport nodes and other trip attractors in the area.

A comprehensive bicycle network is proposed for the precinct which will link the centres, schools and various residential neighbourhoods with key strategic routes and onward destinations. The proposed bicycle network will include a mixture of dedicated bicycle facilities which will take the form of:

- Off-Road (Shared Path)
- Off-Road (Cycle Lane)
- Off-Road (Shared Path – Green Corridor).

All proposed roads throughout the precinct will have dedicated pedestrian footpaths to create a comprehensive network following proposed road alignments. In order to ensure connectivity of the pedestrian network the provision of regular pedestrian crossing opportunities should be provided by dedicated pedestrian crossing facilities throughout the precinct.

The proposed road grid network and block sizes will also work to facilitate pedestrian permeability and be conducive to encouraging walking trips. Regular cross streets with pedestrian footpaths, a grid network and physical crossing points of South Creek will encourage pedestrian activity, and achieve a high level of permeability.

In addition, Green Travel Plans for schools could encourage parents and children to walk, cycle or catch public transport for journeys to school. Reducing the number of local car trips to schools is likely to result in better health, better social interaction at the community level, air quality improvements and road safety benefits. This is also important in establishing behaviours which continue later in life and an important part of the development of healthy, active communities in the precinct.

1.0 Introduction

1.1 Background

This report serves as an addendum to the exhibited study, refined to take into consideration submissions and additional stakeholder consultation undertaken post exhibition.

The Metropolitan Plan for Sydney 2036 (December, 2010) reaffirmed the pressures being faced by the metropolitan area in terms of residential growth and associated demands for the economy and employment, housing, transport, environment and resources, parks and public places.

In response, the North West and South West Growth Centres were identified as the location for new communities to accommodate up to 500,000 people over the next 30 years. The South West Growth Centre comprises 18 precincts, is approximately 17,000 hectares and has capacity for around 110,000 new dwellings for 300,000 people.

A considerable amount of urban development has occurred or is underway in the area surrounding the precinct including Oran Park Town, Gregory Hills, Sekisui lands (The Hermitage) and Harrington Park. Austral and Leppington North (ALN) precincts have also recently been rezoned. These precincts are expected to accommodate a population of 50,000 comprising 20,000 residential dwellings and a major centre in Leppington serviced by the South West Rail Link (SWRL) to be opened in 2016.

The key challenge for the planning and development of these precincts has been to successfully integrate the precincts with surrounding residential areas, major centres and transport hubs. To achieve this, a balanced approach was needed that considers the natural constraints, such as the riparian corridor, and built environment constraints such as the future widening of Camden Valley Way and heritage buildings located on the site (Oran Park House). These influenced the proposed configuration of the internal road network as well as pedestrian and cyclist circulation.

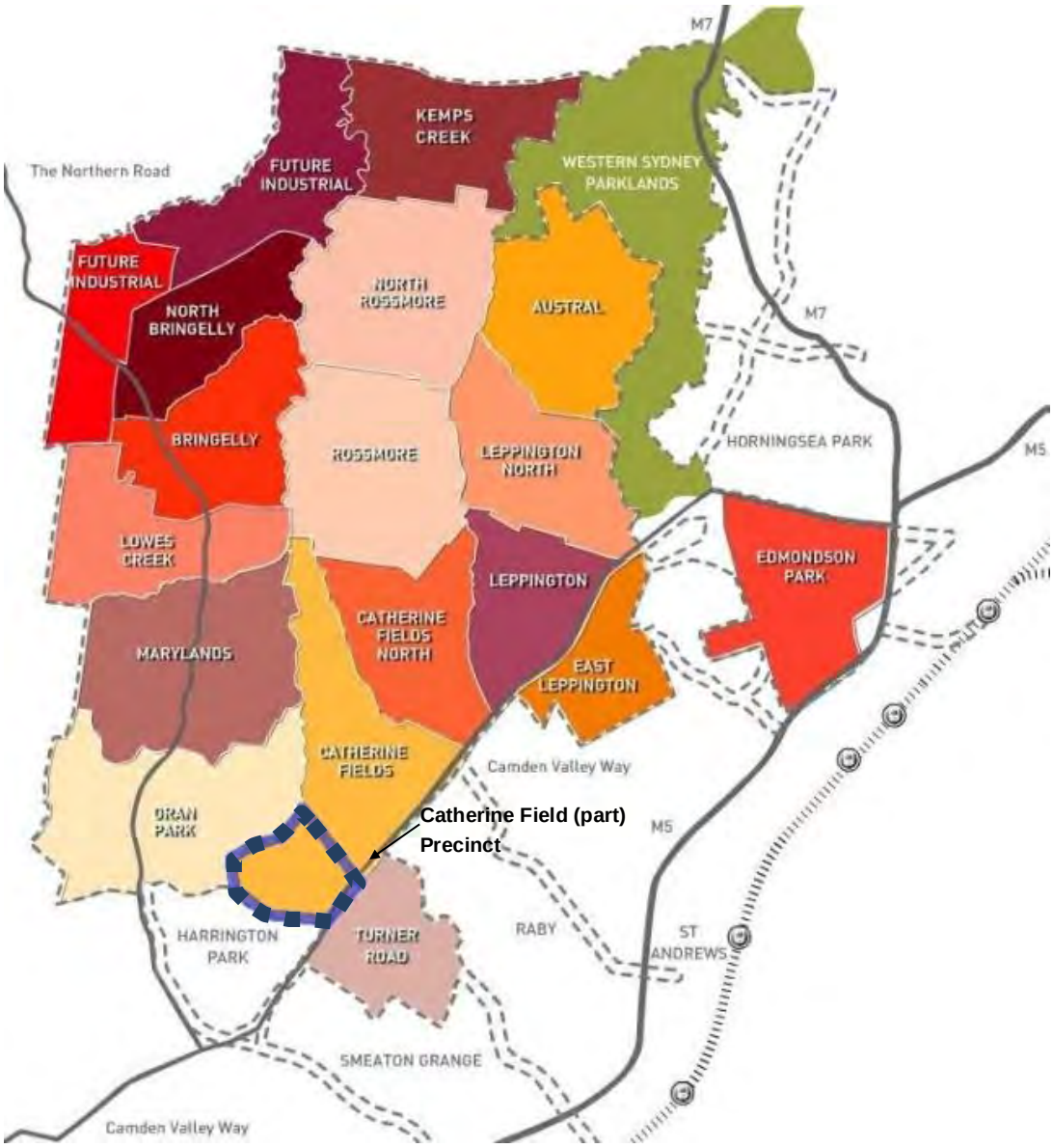
There is currently limited public transport provision to the area although a network plan has been developed by Transport for NSW (TfNSW), which will guide future service provision. Similarly, there is a limited pedestrian and cycle network; however these are increasing with surrounding infrastructure upgrades.

AECOM has been appointed by the Department of Planning & Infrastructure (on behalf of Hixson Pty Ltd) to assess the transport and access components for the Catherine Field (part) Precinct (herein referred to as “the precinct”). The purpose of this study is to provide a transparent and robust assessment of the Indicative Layout Plan by all modes of transport including walking, cycling, public transport and passenger vehicles that takes into account relevant submissions and amendments following exhibition of the original study. This document comprises part of a suite of documents forming the Precinct Plan.

The precinct is located approximately 52km south west of Sydney and is bounded by Camden Valley Way, Oran Park Drive, Oran Park Precinct, and the southern boundary of the residential fronting Springfield Road. The precinct comprises approximately 320 hectares of rural lands and will accommodate approximately 3,000 dwellings.

The precinct together with regional context of the South West Growth Centre is shown **Figure 1**.

Figure 1: Regional Context of the South West Growth Centre and The Catherine Field (part) Precinct



Source: NSW Planning & Infrastructure

This Report identifies suitable facilities for people to walk, cycle, access public transport or use private cars. This process enables people to make the most appropriate choice of transport mode for their journey, and ensures that the built environment supports travel choice; including walking for short trips to local shops, cycling to community centres or catching a bus to work. Communities are designed to increase travel choice, accessibility and reduce dependency on private cars and hence reduce the associated emissions generated by high levels of private car use.

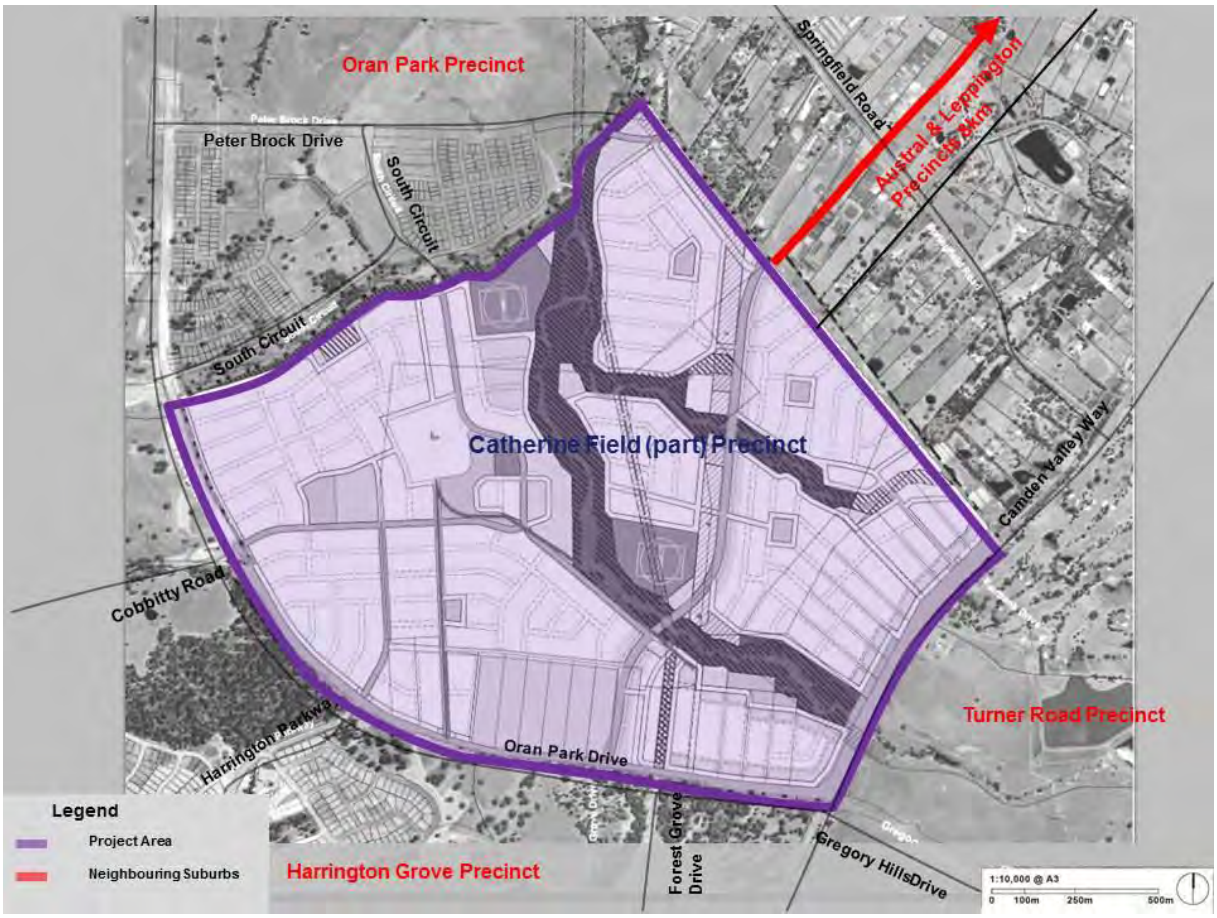
This report follows public exhibition as well as consultation with NSW government agencies and local council. This has helped to confirm the walking, cycling, public transport and road networks and improve transport outcomes for the precinct that are reflected in the ILP.

1.2 Study area

The precinct is located within the local government area of Camden and is located at the southern boundary of the South West Growth Centre. It is bordered by Oran Park Precinct to the west and by Turner Road Precinct to the east. The precinct is also bounded by Camden Valley Way to the east and Oran Park Drive to the south.

Figure 2 sets out the extent of the study area for the project, covering the precinct area in relation to neighbouring precincts.

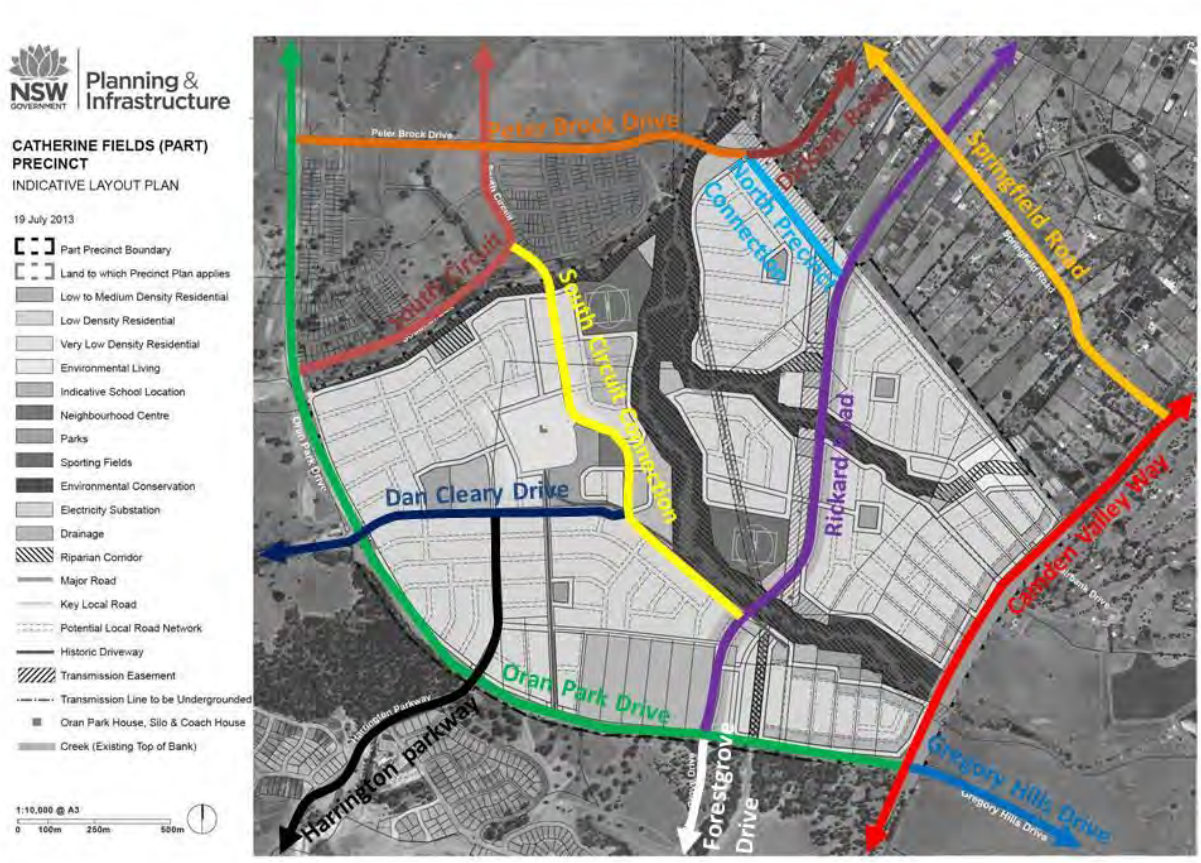
Figure 2: Study Area: Catherine Field (part) Precinct



Source: AECOM, 2012

Figure 3 provides a reference for road names used within this report. Note that North Precinct Connection links to Peter Brock Drive at the point in which it Peter Brock Drive becomes Dickson Road.

Figure 3: Road References: Catherine Field (part) Precinct



Source: AECOM, 2013

2.0 Indicative Layout Plan

2.1 Introduction

Precinct plans are a proven approach to the delivery of greenfield residential developments. The intention being to achieve high quality outcomes, including easy access to jobs and major town centres, streets and suburbs planned so that people can walk to shops, and frequent bus services that link to the rail network for longer journeys.

An Indicative Layout Plan (ILP) was developed through an iterative process over a period of time, involving multiple stakeholders across a range of technical disciplines providing inputs and guidance as to the precinct development opportunities and constraints. Following public exhibition and consultation with landowners and NSW Government Agencies the ILP has been amended. These amendments reflect a balanced approach that considered relevant submissions and stakeholder preferences. The transport network within the precinct plan broadly follows the RMS South West Growth Centre Road Network Strategy and a revised South West Bus Servicing Strategy (TfNSW), with maximised opportunities for land use and transport integration.

2.2 Land use and built form

The NSW Government has clearly identified its vision for the Growth Centres as an opportunity to deliver new homes in a way that minimises environmental impacts and improves travel choice. To achieve this outcome it is necessary to plan for a range of land uses that provide a balanced mix of housing, employment and activity centres. It is recognised that land use, built form and transport are intrinsically linked in planning terms, with good urban design helping to achieve good transport outcomes and vice versa.

A range of housing choices provides for different needs and different incomes, such as houses on their own block of land along with smaller medium density homes and terraces that might be more suitable to older people and young singles or couples.

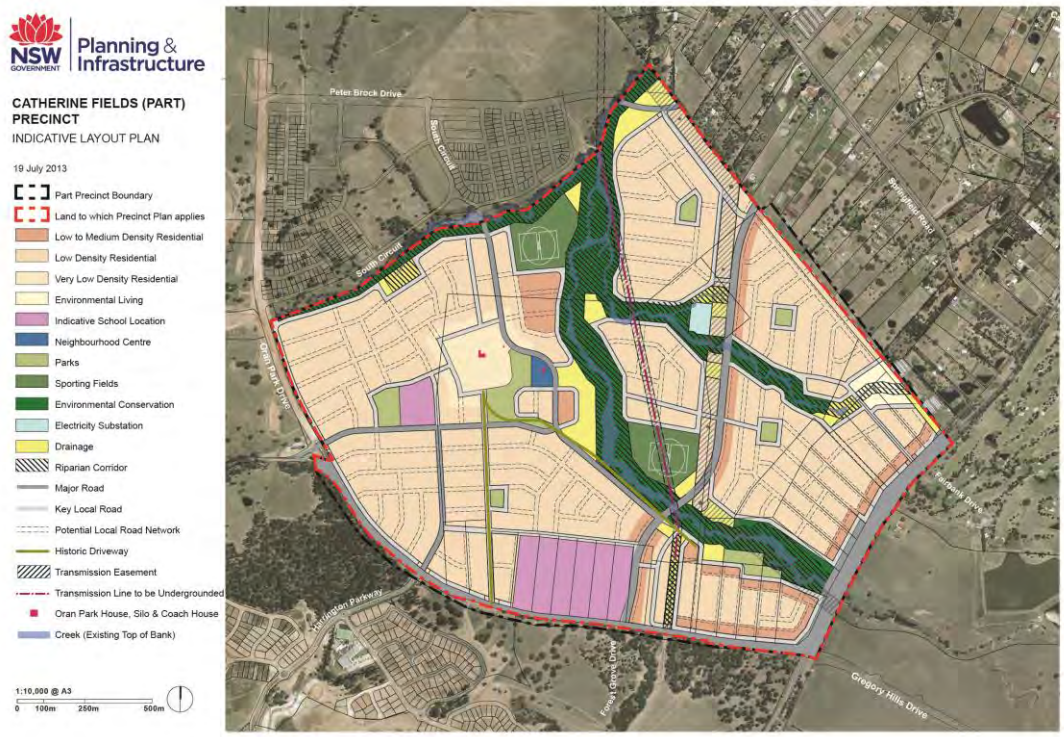
Residents from the precinct will need easy access to existing and proposed major town centres such as Leppington, Oran Park and Campbelltown/Macarthur with a full range of shops, services and recreational facilities. Efficient bus connections and transport hubs at these major centres (bus interchange at Oran Park, rail stations at Leppington and Campbelltown) are required to maximise public transport connectivity to other parts of Sydney.

The precinct will also provide a neighbourhood centre, sporting fields, and education facilities which maximise accessibility to local shops and services for daily needs.

2.3 Indicative Layout Plan

An Indicative Layout Plan (ILP) is provided in **Figure 4**. The land use details of the precinct are discussed below:

Figure 4: Indicative Layout Plan for Catherine Field (part) Precinct



Source: AECOM, 2013

2.3.1 Residential land uses

Proposed residential land development within the precinct will be largely low density and comprise of approximately 3,229 dwellings. Population density will determine the level of transport demand generated by the residences in various parts of the precinct. Estimates of population density suggest an average of 3.2 persons per dwelling or approximately 10,300 residents for the precinct. This includes:

- Approximately 181.5ha of residential land proposed as low density providing 84% of homes within the precinct at a density of 15 dwellings per hectare
- 10.4ha low / medium density residential providing 6.4% of homes within the precinct at a density of 20 dwellings per hectare
- Medium density residential occupying 6.9ha (5.4% of homes) at 25 dwellings per hectare
- 5.2ha of large lot residential (500m2) providing 2.2% of homes at a density of 13.6 dwellings per hectare
- 4.9ha of large lot residential (700m2) providing 1.5% of homes at a density of 9.7 dwellings per hectare
- Environmental Living occupying 1.9ha (0.2% of homes) at 3.5 dwellings per hectare.

2.3.2 Historical sites

Two buildings of historical significance are to be retained within the precinct. The main building is Oran Park House, while the second is a smaller associated building nearby. These are located centrally within the precinct, immediately adjacent to the proposed neighbourhood centre.

2.3.3 Local and neighbourhood centres

A neighbourhood centre is proposed within the precinct. This will be located centrally within the precinct and adjacent to a neighbourhood park and the Oran Park House historical site. It will include a small number of retail premises, and incorporate the smaller historic building associated with Oran Park House.

2.3.4 Educational land uses

The St Benedict's (secondary) and St Justin's (primary) schools will be located on the corner of Oran Park Drive and Forest Grove Drive at the southern boundary of the precinct. The schools front Oran Park Drive and are proposed to be accessed via a local road at the rear of the site. A bus drop off area will be provided along this road. The school locations also mean they are also close to the neighbourhood precinct of Harrington Park. In addition, a 2.0ha education site (likely to be primary) is proposed to the west of the Oran Park House Historical site on the northern side of Dan Cleary Drive.

It is important to provide high quality walking and cycling routes to schools and along proposed public transport routes. Both proposed sites are accessible to potential bus routes.

2.3.5 Community uses and open space

Under the ILP there is opportunity to provide several open space areas. A number of parks and sports fields are proposed within the precinct. These will be accessible by public transport as well as walking and cycling routes.

A riparian corridor follows South Creek, traversing through the precinct, restricting internal connections and external connections to Oran Park. An access road across this corridor is provided at a central location within the precinct, as well as at the north of the precinct (via Peter Brock Drive) and via Oran Park Drive. The riparian corridor does however provide an opportunity for recreational walking and cycling routes, encouraging activity and providing health benefits to the community. Provision of walking and cycling routes within the riparian corridor may require resolution of access to the rear of private properties.

2.4 Preliminary transport assessment of ILP

Through the ILP development process, transport design advice and transport infrastructure assessment has been undertaken in collaboration with key stakeholders, including:

- The NSW Department of Planning and Infrastructure (DP&I), *formerly the Department of Planning (DoP)*
- The NSW Roads & Maritime Services (RMS), *formerly Roads and Traffic Authority (RTA)*
- Transport for NSW (TfNSW), *formerly the Department of Transport (DoT) and Transport NSW (TNSW)*
- Camden Council.

A transport assessment was undertaken for the initial road layout plans through an opportunities and constraints analysis and subsequent exhibited as part of the transport and access strategy. The following transport elements were considered for the preliminary layout:

- Road network connections
- Public transport opportunities
- Walking and cycling opportunities.

Comments were also provided on the location of different land uses, such as neighbourhood centres, as this can impact upon the accessibility and mode choice within the precinct. Mixed use and proximity to local centres are a key factor in promoting sustainable transport modes such as walking and cycling and helps to meet the key objective of the Growth Centres Development Code.

Preliminary discussions on the connectivity of the precinct to Oran Park, Leppington and Campbelltown/Macarthur major centres identified the need to delay finalising the alignment of local and regional bus routes.

3.0 Road Network

3.1 Introduction

This section establishes principles for the design of road networks and then describes how the Precinct Plan has been tested against these guidelines.

3.2 Principles and guidelines

Guidelines for road network design can be allocated into three main categories:

- Road classification (road hierarchy) – how will traffic move through the precincts? And, how is the road designed to accommodate its intended function?
- Road capacity – are adequate lanes provided to accommodate traffic without significant congestion?
- Intersection performance – are delays at intersections acceptable?

3.2.1 Road classification

Roads fall into a hierarchy of functional classes. The standards relating to each road are dependent upon this classification. Descriptions of each classification are shown in the tables below. **Table 1** shows the Austroads classifications and a description of the functionality of each road type.

Table 1 : Urban Road Functional Classification (Austroads)

Type of Road	Function
Controlled access highways (motorways or freeways)	Motorways and freeways have an exclusive function to carry traffic within cities and to ensure the continuity of the national or regional primary road system. As they are designed to accommodate through traffic, they do not offer pedestrian or frontage access.
Urban arterial roads	Urban arterial roads have a predominant function to carry out but also serve other functions. They form the primary road network and link main districts of the urban area. Arterial roads that perform a secondary function are sometimes referred to as sub-arterial roads.
Urban collector/distributor roads	These are local streets that have a greater role than others in connecting contained urban areas (e.g. residential areas, activity areas) to the arterial road system. Generally, consideration of environment and local life predominate and improved amenity is encouraged over the use of vehicles on these roads.
Urban local roads	These are roads intended exclusively for access with no through traffic function.

Source: Austroads Guide to Road Design Part 2: Design Considerations 2006

NSW Roads and Maritime Services (formerly NSW Roads & Traffic Authority) and the Department of Planning and Infrastructure (formerly Growth Centres Commission) have also developed guidelines for classification of roads**. Table 2** summarises the RMS functional classification system.

Table 2: Functional Classification of Roads (NSW Roads and Maritime Services)

Road Type	Traffic Volume (AADT)	Through Traffic	Inter-Connections	Speed Limit (km/h)
Arterial/Freeway	No limit	Yes	Sub-arterial	70-110
Sub-Arterial	<20,000	Some	Arterial/Collector	60-80
Collector	<5,000	Little	Sub-arterial/Local	40-60
Local	<2,000	No	Collector	40

Source: Updated Guidelines for Functional Classification of Roads in Urban Areas, RMS, 1993

The Growth Centres Development Code classifications, shown in **Table 3** are broadly consistent with the RMS classifications, except with higher traffic volume (AADT) limits for all road types, reflecting the amount of traffic that have been carried on elements of the Sydney road network.

Table 3: Functional Classification of Roads (DP&I)

Road Type	AADT	Functions and Connections	Speed Limit
Arterial/Freeway	35,000+	Connects large urban areas	Over 80km/h
Transit Boulevard	30,000 – 35,000	Located close to centres Pedestrian friendly environment Allow for long term upgrades & dedicated busways	60 to 80km/h
Sub-Arterial	10,000 – 35,000	Arterial roads to town centres Carries major bus routes	Up to 70km/h
Collector	3,000 – 10,000	Connects neighbourhoods Can accommodate public transport	Up to 60km/h
Local	1,000 – 3,000	Priority to pedestrians and cyclists Designed to slow residential traffic	Up to 50km/h

Source: Growth Centres Development Code, October 2006

3.2.2 Road capacity

Level of Service (LoS) is an index of the operational efficiency of a roadway or intersection. The analysis is essential in planning and design of the transport network and can influence the number of lanes provided or the arrangement of a traffic control system under study.

LoS can be measured mid-block or at intersections. As a midblock measure, LoS is a qualitative measure describing the operational conditions on a road and their perception by a driver. At intersections, LoS is considered in terms of average delay experienced by drivers. Intersection LoS is discussed at **Section 3.2.3**.

The capacity of urban lanes with interrupted flow is provided in **Table 4** for each LoS. These capacities may increase when priority is given to the major traffic flow at intersections or if there is flaring at intersections to accommodate more traffic. The spacing of intersections will differ with the hierarchy and function of the road.

Table 4: Mid-block Level of Service and Capacity

LoS	Description	Hourly flow (vehicles)	
		1 Lane	2 Lanes
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	200	900
B	In the zone of stable flow and drivers still have the reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with LOS A.	380	1,400
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	600	1,800
D	Close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	900	2,200
E	Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.	1,400	2,800

Source: Guide to Traffic Generating Developments, RMS, 2002.

It is generally acceptable to provide road capacity at Level of Service D in the peak hour since over-provision of road capacity is not conducive to promoting alternative transport modes to the car.

3.2.3 Intersection performance

The capacity of an urban road network is controlled by the capacity of the intersections within that network. Average delay is commonly used to assess the actual performance of intersections, with Level of Service used as an index. A summary of the Level of Service index is shown in **Table 5**.

Table 5: Level of Service Criteria for Intersections

Level of Service	Average Delay / Vehicle (sec/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

Source: Guide to Traffic Generating Developments, RMS 2002

Level of Service D is generally accepted by the RMS as a design constraint. The other important intersection measurement is Degree of Saturation (DoS), or the ratio of flow to capacity. It is generally accepted that intersections should have a degree of saturation of less than 0.9.

At signalised intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled and roundabout intersections, the LoS is based on the average delay (seconds per vehicle) for the worst movement.

3.3 Existing road network connections

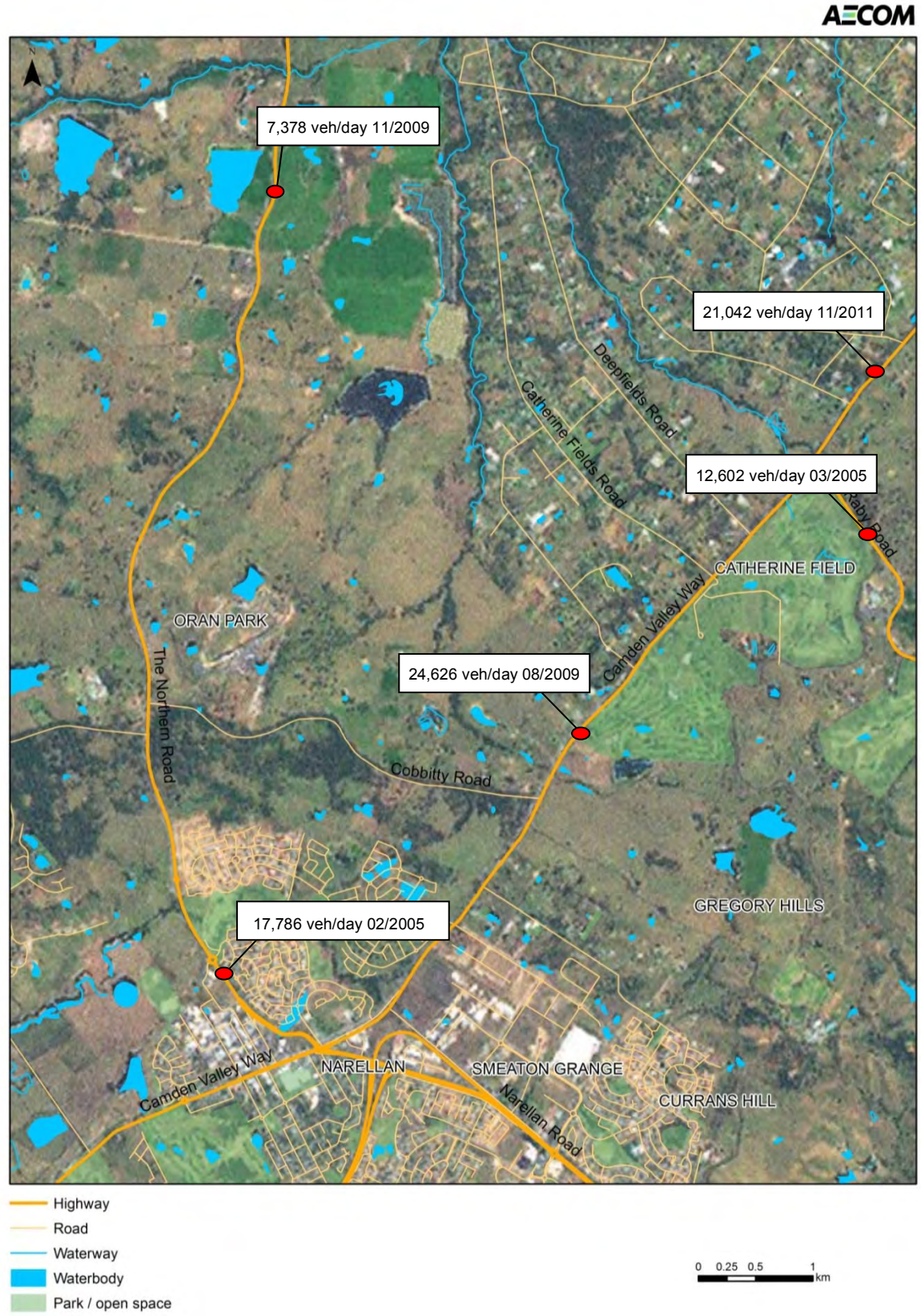
Camden Valley Way, Gregory Hills Drive / Oran Park Drive, Dan Cleary Drive (formerly Cobbitty Road) and Harrington Parkway provide main access points to and from the study area. These routes connect to the wider road network including the M5 Motorway, Narellan Road and The Northern Road.

Annual average daily traffic collected by the RMS (2005-2011) on the major road network surrounding the precinct is shown in **Figure 5**. One of the major constraints to the road network is the capacity of Camden Valley Way which operates with only one travel lane in each direction between Oran Park Drive and Cowpasture Road. Note that an upgrade of this section of Camden Valley Way (to two lanes in each direction) is scheduled to be completed at the end of 2015.

Existing access to the precinct is available from Camden Valley Way and Oran Park Drive. The access to Oran Park House is also provided at Oran Park Drive to the east of Harrington Parkway. The existing intersection control for these accesses is outlined below:

- Existing intersection control on Camden Valley Way in the vicinity of the precinct consists of a signalised intersection at Oran Park Drive / Gregory Hills Drive and a T-intersection with Springfield Road. The signalised intersection with Oran Park Drive / Gregory Hills Drive has recently been upgraded as part of the Road Network Strategy for the South West Growth Centre, while the intersection with Springfield Road is also proposed to become signalised as part of the long-term strategy for Camden Valley Way.
- Existing intersection control on Oran Park Drive adjacent to the precinct includes priority T-intersections with Forest Grove Drive, Harrington Parkway and Dan Cleary Drive. It is proposed that two sets of traffic signals will be provided at the intersection with Forest Grove Drive and the proposed Rickard Road extension and also at the Harrington Parkway and Dan Cleary Drive intersections. The existing access road to Oran Park House is proposed to be left in / left out only.

Figure 5: Estimated Average Daily Traffic in the vicinity of Catherine Field (part) Precinct



Source: RMS, 2012

Some of the main challenges with regard to the road network will be:

- Providing vehicular and public transport access to Leppington major centre and Leppington Rail Station via Rickard Road.
- Maximising accessibility to the road network including Oran Park Drive and Camden Valley Way.
- Providing sufficient road network access to Oran Park Town Centre as the closest employment and retail centre to the precinct.
- Providing a sufficient road network across the South Creek corridor to ensure that communities are connected internally within the precinct.
- Providing a local road network that provides access to services and open space within the precinct.

Planned major road network upgrades include:

- Camden Valley Way between Oran Park Drive and Cowpasture Road (two lanes in each direction with ultimate upgrade and potential to expand to three lanes as required) as outlined in the South West Road Structure Plan and Camden Valley Way Access Strategy.
- Bringelly Road.
- The Northern Road.

Future highway network and intersection performance will significantly change as the precinct and surrounding SWGC develops. Additional highway and intersection capacity will be required, both through upgrades to existing infrastructure and new or extended links to accommodate growth. The cumulative traffic impacts of the development of adjacent SWGC precincts and adjacent release areas will need to be taken into account in the assessment of future highway performance.

Oran Park Drive is a four lane road providing access to Oran Park from Camden Valley Way. Gregory Hills Drive is an extension of Oran Park Drive to the east of Camden Valley Way which will eventually provide a direct connection to Campbelltown Station. Harrington Parkway currently provides a connection to Harrington Parkway with a secondary connection to the suburb provided at Forest Grove Drive.

The RMS is committed to having a road connection (Rickard Road) from Leppington Station through the precinct, linking with Forest Grove Drive. It is envisaged that Rickard Road near Leppington will be extended south towards the precinct, providing a road connection between the precinct and Leppington major centre / Leppington Station, supplementary to Camden Valley Way. Rickard Road will be connected to Springfield Road and Oran Park Drive which will provide additional accessibility to the upgraded Camden Valley Way in the future. This report considers the preliminary outcomes of an assessment of the route of Rickard Road being undertaken by the Department of Planning & Infrastructure.

3.4 Road network analysis (Traffic modelling)

In order to identify the road network & access requirements of the precinct, a traffic model has been developed to forecast future year traffic volumes (2036) in the vicinity of the precinct. The model takes into account assignment of locally generated vehicle trips on the precinct road network and provides a framework for network and travel demand scenario testing.

The intent of the model is to identify likely volumes on the road network within the precinct such that the form of the Precinct Plan can be confirmed as being appropriate. Information extracted from the model for this purpose includes link flows to confirm the number of lanes required and whether road hierarchy assumptions and network density are appropriate. Forecast traffic volumes are also used to identify access requirements to and from the surrounding local network.

Following public exhibition, the traffic model was updated to include revised BTS employment and population data (released in August 2012) resulting in a general increase in traffic volumes across the SWGC. These updated traffic flows are reflected in the recommendations of this Review Report. Other modelling assumptions were also updated to reflect the latest regional road network information such as the likely alignment of Rickard Road and the likely future connectivity of Dickson Road to Peter Brock Drive.

Note: a feasibility assessment of the Dickson Road / Peter Brock Drive connection was undertaken by AECOM in May 2013 and is included as ***Appendix C****.*

3.4.1 Development of the strategic traffic model

AECOM has developed a traffic forecast model for the Catherine Field (part) Precinct using CUBE software. The CUBE model has been prepared to represent long term scenarios, based on future forecasts associated with the full development of the precinct and development of surrounding regional areas.

The Catherine Field Model was developed by expanding on the AECOM Oran Park Precinct Model, which has been approved for use by the RMS for the precinct planning of the adjacent Oran Park Precinct. This model includes all the major arterial roads surrounding the precinct and connections to roads external to the South West Growth Centre.

Morning peak hour and evening peak hour models have been developed for the year 2036. The modelling assumptions are based upon the RMS Guide to Traffic Generating Development (version 2.2, 2002) and the BTS Household Travel Survey.

Traffic forecast on the network is governed by the following:

- Land use
- Road Hierarchy (Capacity)
- Type of intersection control
- Posted Speed
- Access provisions.

The external trips in the Catherine Field Model are based on the Sydney Strategic Traffic Model (SSTM). SSTM is a CUBE based model for Sydney's greater metropolitan area built and owned by AECOM Australia Pty Ltd. The area surrounding Oran Park and Catherine Field precincts have been considered to estimate the external to external trips in the Catherine Field Model.

The external zone totals in the Catherine Field Model have been compared with screenline totals of SSTM using GEH value. It is observed that all origins/destinations totals in the model have the required GEH value of less than 5.0. The table below represents the screenline totals and the corresponding GEH value.

Table 6: Screenline totals for Catherine Field Model and comparison with the SSTM

Time Period	Screen-line	Origin from External Zones				Destinations to External Zones			
		SSTM	CFM	Difference	GEH	SSTM	CFM	Difference	GEH
AM Peak	SL#1	3,374	3,328	-46	0.8	6,194	6,539	345	4.3
	SL#2	4,536	4,584	48	0.7	2,896	3,138	242	4.4
PM Peak	SL#1	4,536	4,584	48	0.7	2,896	3,138	242	4.4
	SL#2	7,039	7,215	176	2.1	3,572	3,854	282	4.6

Source: AECOM, 2013

Note: SSTM refers to model outputs produced by AECOM's CUBE model and CFM refers to modelling outputs by the Catherine Field Model (AECOM). GEH is a formula used to compare two sets of traffic volumes, the formula is:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

- *Where M is the hourly traffic volume from the traffic model (or new count) and C is the real world hourly traffic count (or the old count).*

The Catherine Field Model was used to forecast traffic volumes within the precinct based on the existing Oran Park Traffic Model *(Oran Park Transport Assessment by AECOM*) and proposed land use changes in the SWGC as set out in **Section 3.2.2** and proposed road network changes in **Section 3.4.4**. Further detail in relation to modelling assumptions, trip distribution and road classification are provided in the following sections.

3.4.2 Model scenarios and assumptions

Morning and evening peak hour models have been developed to test road network infrastructure within and adjacent to the precinct. The morning peak hour is assumed to be the average hour between 7.00am and 9.00am, while the evening peak hour is an average hour between 4.00pm to 6.00pm.

Model assumptions are based on the most up-to-date land use forecasts and proposed future year road network changes. These assumptions are consistent with the latest BTS land use forecasts indicating that the SWGC will be approximately 79% developed at 2036 and that the region in proximity to Catherine Field (part) Precinct will be 89% developed. The model also assumes the Catherine Field (part) Precinct will be fully developed by 2036. It is therefore considered that the 2036 Catherine Field Model traffic forecasts are robust and represent long-term traffic conditions of the road network in the vicinity of the precinct.

3.4.3 Regional land use assumptions

The land use in the SWGC and Western Sydney is expected to change dramatically in the next 30 years according to the latest Metropolitan Plan. This will have significant impacts on the future demand for travel in the SWGC.

The Metropolitan Plan for Sydney 2036 (NSW Government, 2010) identified a need to plan for 770,000 new homes in Sydney between 2006 and 2036.

The Sydney metropolitan region is divided into 10 Subregions for strategic planning purposes. The South West Subregion covers Liverpool, Campbelltown, Camden and Wollondilly local government areas (LGAs) and includes the SWGC.

DP&I forecasts for the SWGC include growth of approximately 300,000 people in 110,000 new dwellings, spread over approximately 17,000 hectares of land in 18 precincts. Over 50% of the future residential dwelling supply estimated in the South West Subregion will be provided in the SWGC. Other growth areas are scattered throughout Camden, Campbelltown, Liverpool and Wollondilly LGAs.

The intention for the South West Subregion is to at least maintain, or, increase, the level of self-containment to reduce the number of additional trips outside the subregion. Therefore, the delivery of proposed employment targets in major centres near the SWGC and within the subregion will assist in achieving this policy objective.

Through both new development and the intensification of existing activities a rapidly growing population will be serviced, and a range of regionally important activities accommodated such as manufacturing, logistics, warehousing, high technology industry and business parks.

The proposed residential and employment growth in the South West Subregion and the SWGC will put pressure on the existing road and transport infrastructure / network that are fast approaching capacity, especially during the peak hours. Extra road network capacity and new public transport services will be needed to move people within and out of the sub-region efficiently.

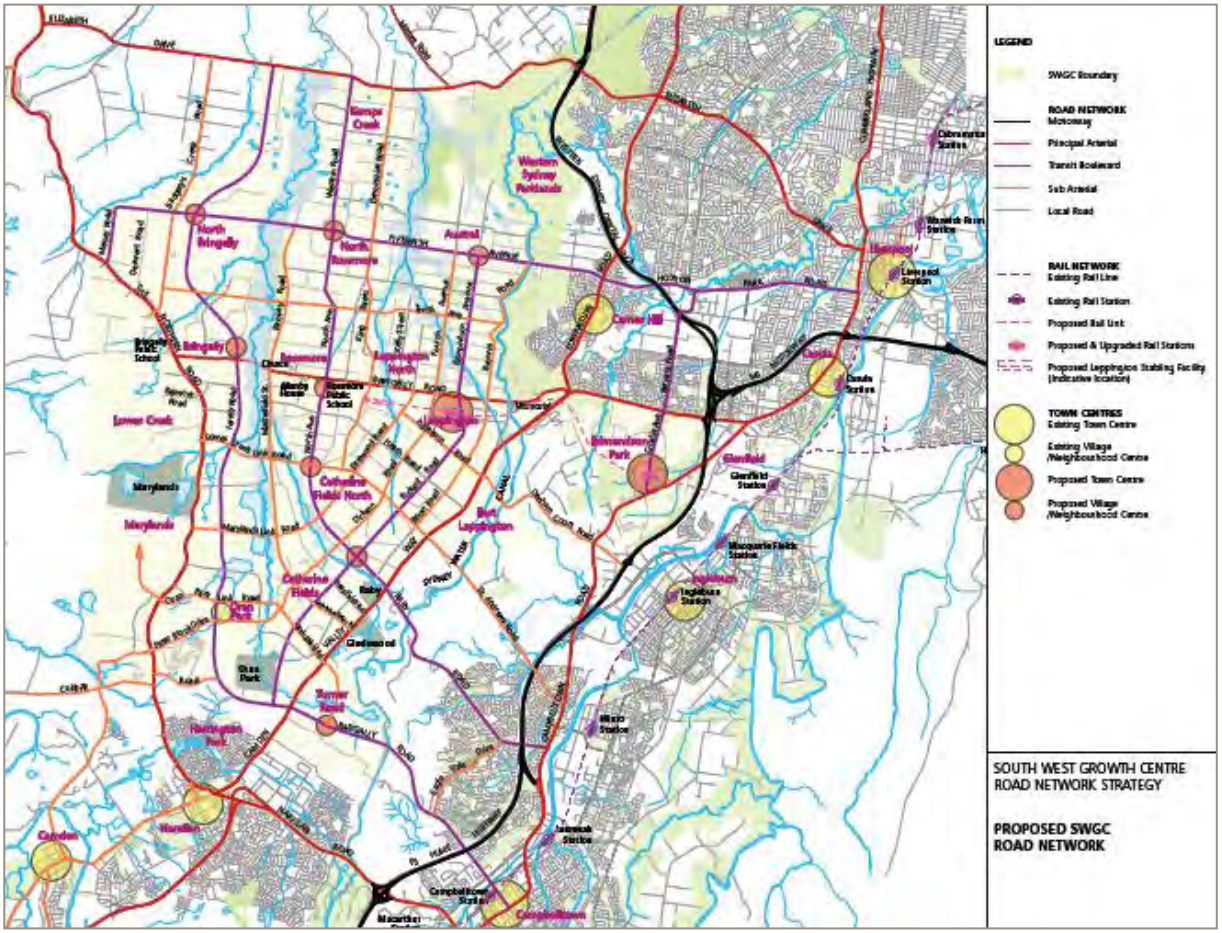
3.4.4 Road network assumptions

The RMS has prepared a draft Road Network Strategy for the SWGC in order to enable greater certainty in planning, design and construction of the future regional road network in the SWGC and to cater for the future expected increase in population and employment growth in the region. The draft Road Network Strategy is shown in **Figure 6**.

The objective of the strategy is to establish a strategic level of integrated land use and road planning for the area. The focus is to ensure that the wider (proposed) SWGC road network coordinates with the existing State Road Network (in particular Camden Valley Way and The Northern Road) in a way that maintains the efficient performance of the arterial roads whilst promoting the development of communities with a legible, high quality built environment and public domain. This will facilitate and enhance the growth of active, vibrant and safe centres which are convenient to access across multiple transport modes.

The potential road upgrades in the SWGC and other major potential road upgrades in Sydney will be reflected in the strategic model based on information published by the RMS and other motoring bodies. The strategic model has been altered at each of the modelling years to accommodate assumed network upgrades and changes agreed with RMS planning.

Figure 6: SWGC Road Network Strategy



Source: RMS, 2011

Road network assumptions in the strategic model developed were in accordance with major road upgrades and the South West Growth Centre Road Network Strategy provided by the RMS. In proximity to the study area, major road upgrades included within the 2036 model were:

- Widening of Camden Valley Way to 3 lanes in each direction
- Gregory Hills Drive extension to Campbelltown Station
- Widening of Oran Park Drive to a 2-lane Transit Boulevard in each direction
- Widening of Rickard Road to 2 lanes in each direction from Leppington to Oran Park Drive to accommodate safe and efficient strategic bus movements[1]
- Widening of Springfield Road to 2 lanes in each direction
- A signalised intersection at Camden Valley Way / Gregory Hills Drive / Oran Park Drive
- A signalised intersection at Camden Valley Way / Springfield Road
- A left turn in/left turn out intersection connecting the north-east of the precinct to Camden Valley Way located approximately 800m north of the Camden Valley Way / Gregory Hills Drive / Oran Park Drive intersection opposite Fairbank Drive (to provide local access to Camden Valley Way for residents located in the north east of the precinct).

[1] This has been agreed with RMS, TfNSW and Council in the meeting dated 22 March 2012.

3.4.5 Local land use assumptions & trip generation

Population mix and density is an important consideration in the transport assessment as it can affect the peak hour trip generation of the precinct and hence the infrastructure requirements. Trip productions within the model have been calculated on the basis of the number of residential households in the precincts. The estimated dwelling density is as follows:

- Low density dwelling (including large lots) at 3.2 persons/dwelling
- Medium density dwelling at 2.5 persons/dwelling.

The proposed distribution of dwellings in the precinct is 84%, 12% and 4% for low density, medium density and large lot density dwellings respectively. This provides for a forecast population of approximately 10,300 within the precinct.

Critical to the assessment of the impact of the precinct on the surrounding road network is the number of trips generated by the development and the distribution of those trips onto the local and wider strategic road network.

The following trip generation factors prescribed in the Guide to Traffic Generating Developments (RMS, 2002) have been applied to estimate the traffic generated by the residential dwellings in the precinct:

- Low density dwelling (including large lots) at 0.85 car trips per dwelling
- Medium density dwelling at 0.6 car trips per dwelling.

3.4.6 Trip distribution patterns

Estimates of trip distribution for full development (nominally at 2036) were based on outputs from the strategic model. The model will consider trip generation and distribution of surrounding precincts to ensure their impact on the precinct can be assessed accurately.

Trips generated by dwellings have been distributed using Household Travel Survey data (Summary Report – September 2011 Release). The distribution is classified as follows:

- HBW (Home Based Work trips) – 37%
- HBS (Home Based School trips) – 20%
- HBO (Home Based Other trips) – 43% - being personal business, recreation, shopping etc.

The modelling assumes that some of the trips will be to and from the Oran Park Precinct. The following trip containment percentages have been assumed for the trips generated by the Catherine Field (part) Precinct:

- 25% of employment trips go to the Oran Park Precinct (75% go to wider destinations)
- Trip containment for education trips assumed to be 75% (25% go to wider destinations)
- 60% of other trips go to the Oran Park Precinct and Catherine Field (part) Precinct (40% go to wider destinations)

The wider network trips with origins and destinations outside of Oran Park Precinct are modelled as per the outputs from the Sydney Strategic Traffic Model (SSTM). The SSTM is a CUBE based model for Sydney's greater metropolitan area built and owned by AECOM. It derives its inputs from population and employment projections from Transport for NSW Bureau of Transport Statistics (BTS). The projections currently used in the SSTM are from August 2012 (the latest available release). The model outputs are for future year 2036.

Trip distribution analysis has taken into account available links and connections, posted speed, and road hierarchy. In addition, a number of assumptions have been made relating to the proposed road layout (as follows):

- The number of vehicles travelling on Rickard Road and Camden Valley Way has been assessed immediately upon arriving / departing the precinct (south of Springfield Road).
- Eastbound trips will be made using both Gregory Hills Drive and Fairbank Drive.

- Southbound trips will be made using Camden Valley Way, Forest Grove Drive and Harrington Parkway. The percentage split for southbound trips is based on strategic forecasts produced by the RMS, but refined based on understanding of the local road network and land use south of Oran Park Drive.
- Vehicles heading west on Dan Cleary Drive will connect with The Northern Road and travel south from that intersection as it is left in, left out only. Vehicles can continue west along Dan Cleary Drive at the next right turn opportunity; therefore vehicles using Dan Cleary Drive have been classified as westbound.
- Trips on South Circuit, Oran Park Drive (west), and Peter Brock Drive will be moving between the precinct and Oran Park Town Centre.
- Following discussions with RMS and Council it is now assumed that Dickson Road will connect to the north in 2036. This link has been added to the strategic model and connects with the precinct via an intersection at the north of the precinct (Dickson Road / Peter Brock Drive / Northern Connector).

3.4.7 Road classification (Hierarchy)

The road classifications for the precinct are determined based on the forecast peak hour traffic flows and proposed function in line with the Oran Park DCP and also the South West Growth Centre Road Network Strategy. The proposed road hierarchy is illustrated in **Figure 7** overleaf.

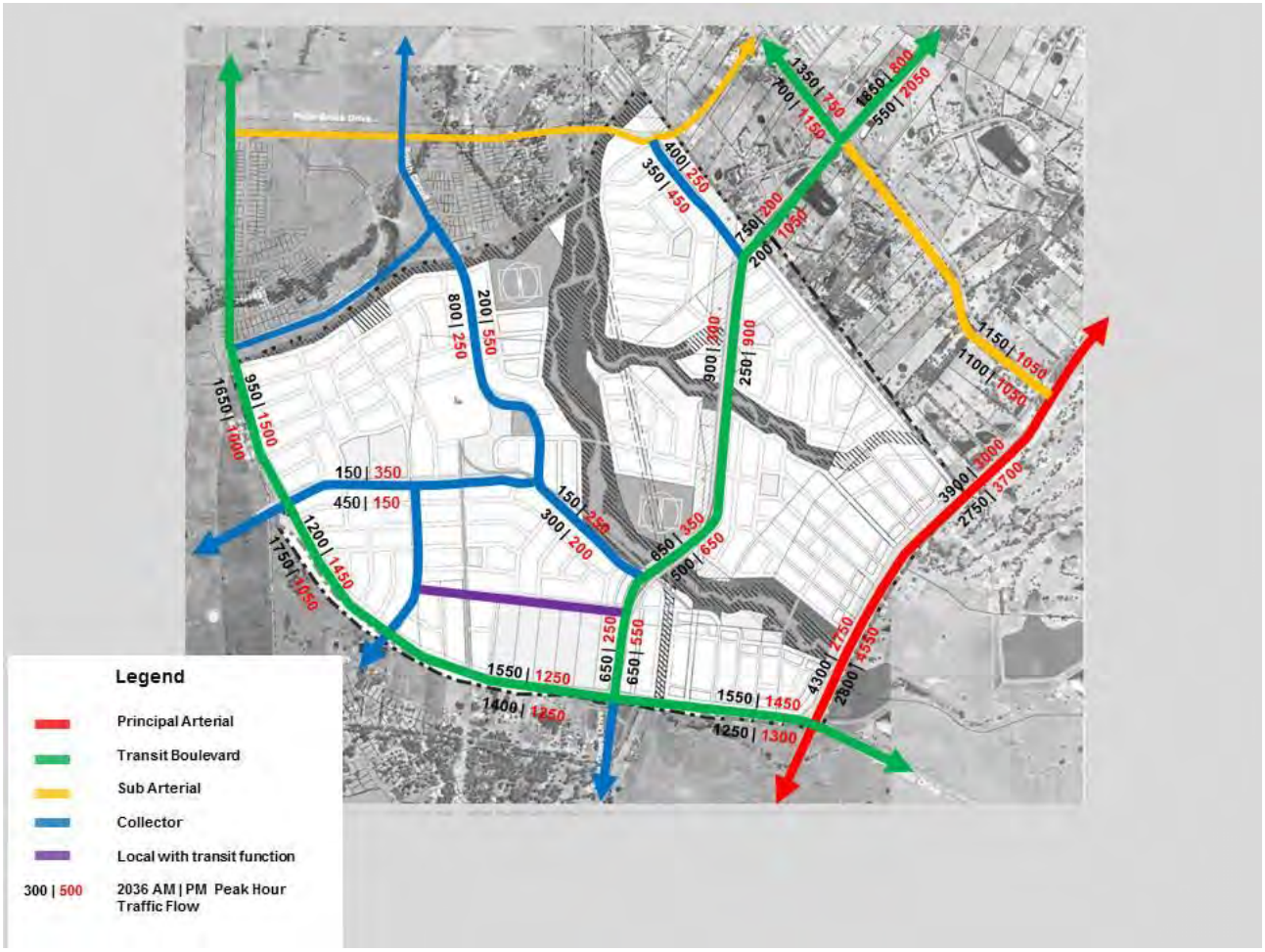
The outputs of the modelled forecast traffic flows for the preferred ILP road network are provided in **Appendix A** for both the 2036 morning and evening peak hours. The future forecast volumes and the implications of these volumes for the upgrade of road network are in line with the SWGC network classification system.

DP&I, RMS and Austroads have identified various categories of road, ranging from **Principal Arterial Roads**, such as Camden Valley Way, **Sub-Arterial Roads** such as Peter Brock Drive, **Transit Boulevards**, such as Oran Park Drive (a road corridor with a transit function), as well as **Collector Roads** such as Dan Cleary Drive (within the precinct) and **Local Streets**.

The road classifications for the precinct are determined based on the modelled forecast 2036 peak hour flows for the proposed road network and the proposed function and required capacity of the road, determined by the road network classification system for the south west growth sector, as described above.

Under the proposed road hierarchy, the model results show that the majority of the proposed roads within the precinct are likely to operate with acceptable mid-block levels of service (better than or equal to LoS D), see **Figure 7**. However, the traffic model highlights that Camden Valley Way may require more detailed consideration if it increases to 3 lanes in each direction.

Figure 7: Catherine Field (part) Precinct Proposed Road Hierarchy and Mid-Block Flows



Source: AECOM, 2013

Roads within the precinct are able to operate at LoS D or better for 2036 with one lane in each direction, including the Rickard Road extension. However, a sensitivity test undertaken for 2046 showed that Rickard Road would require two lanes in each direction based on current traffic growth forecasts. In addition, it is considered more appropriate for Rickard Road to be four lanes wide in order to accommodate safe and efficient strategic bus movements. It has therefore recommended that Rickard Road be four lanes through the precinct, with one bus lane and one traffic lane in each direction.

3.4.8 Precinct access

The number of access points to the precinct has been considered based upon a number of factors, including existing road infrastructure and intersection connectivity to adjacent precincts, potential bus route access and circulation as well as proposed schools and neighbourhood centre location.

The final ILP proposes three key access points along Oran Park Drive. All three accesses are extensions of existing roads from Harrington Park including:

- Dan Cleary Drive – this access provides direct connection to the centre of the precinct including Oran Park House and the neighbourhood centre from areas to the west of the precinct. Connecting Dan Cleary Drive to Oran Park Drive will act to improve the accessibility for all modes to the Catherine Field (part) Precinct, will enhance the connectivity of the neighbourhood centre and improve access to proposed schools.
- Harrington Parkway – this access provides direct connection to the centre of the precinct including Oran Park House and the neighbourhood centre from Harrington Park.

- Forest Grove Drive / Rickard Road extension – this access provides direct connection to the precinct including the school site at the corner of Oran Park Drive / Rickard Road extension. It will also provide an alternative connection to Leppington Town Centre and Station.

One other left-in left-out access is proposed to be provided along Oran Park Drive to provide local access to the heritage driveway to Oran Park House.

A minor left-in left-out access is proposed along Camden Valley Way within the precinct boundary, opposite Fairbank Avenue. This access will provide local access to the residential subdivision on the eastern frontage of the precinct. The location and control of this access conforms to RMS's Camden Valley Way access strategy.

Two connections are proposed across South Creek to maximise connections between the precinct and Oran Park Town Centre. These are proposed to connect via South Circuit and Peter Brock Drive / Northern Precinct Connector.

Rickard Road extension will be the main access to the precinct from the north including Leppington Town Centre (and station) and other precincts to be developed in the future such as the remainder of the Catherine Field Precinct. Dickson Road will also connect to the north in 2036, with both routes offering bus services toward Leppington.

Given the location of the precinct within the SWGC, the proposed access points will maximise the accessibility to the precinct with the surrounding areas for all modes of travel. It should be noted that the three left-in left-out accesses will have little impact upon traffic on Oran Park Drive and Camden Valley Way, as they will feed local roads with low levels of traffic by increasing accessibility to the residential precincts.

3.5 Intersection analysis

Analysis has been undertaken of the major intersections providing access into the precinct from the regional road network as well as key intersections within the precinct. These have been assessed with the aid of SIDRA Intersection software for the full development year 2036 during the AM and PM peak hour periods.

Traffic signals are required to manage heavy conflicting movements at some key intersections, and provide increased priority to buses. Signalised intersections also provide increased safety for pedestrians and cyclists on key desire lines between local centres and surrounding residential areas.

Bus priority facilities (bus lanes or bus jumps) may be required at signalised intersections on bus routes. In future, as delays increase for general vehicles, these facilities will enable buses to maintain journey times and improve the attractiveness of public transport.

Note that all intersection layouts and recommendations provided in this section have been assessed at a strategic level and are subject to detailed design.

3.5.1 2036 intersection summary

A summary of intersection performance for the 2036 full development road network is shown **Table 7**.

Table 7 2036 Intersection Performance

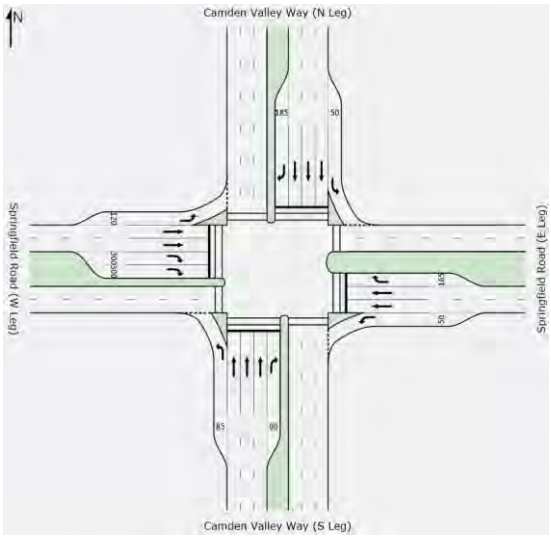
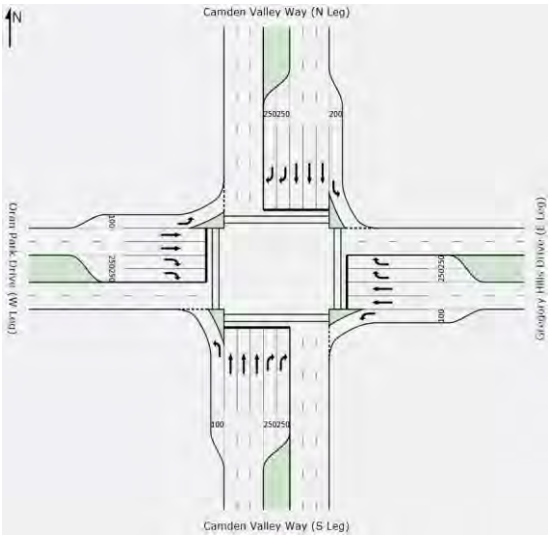
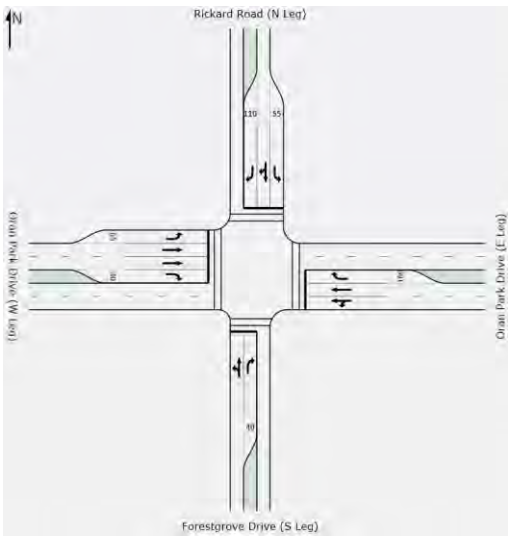
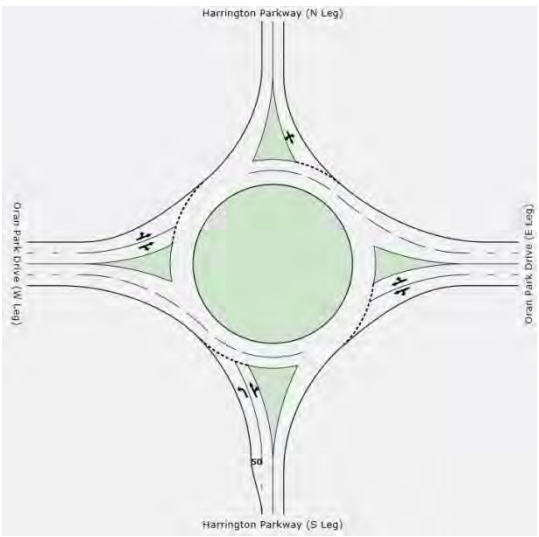
Intersection	Type	Peak	Vehicles Per Hour	LoS	Average Delay (s)	95th Queue (m)	Degree of Saturation
Camden Valley Way | Springfield Road	Signals	AM	8,217	F	137.7	1299 (S Leg)	1.087
		PM	8,219	F	149.7	1260 (N Leg)	1.086
Camden Valley Way | Oran Park Drive / Gregory Hills Drive	Signals	AM	9,388	F	178.6	1306 (S Leg)	1.124
		PM	9,840	F	242.1	1686 (N Leg)	1.203
Oran Park Drive | Rickard Road | Forest Grove Drive	Signals	AM	3,584	D	42.8	281 (W Leg)	0.867
		PM	3,158	C	33.7	206 (W Leg)	0.830
Oran Park Drive | Harrington Parkway	Roundabout	AM	3,423	B	23.2	41 (E Leg)	0.692
		PM	2,911	A	12.7	34 (W Leg)	0.538
Oran Park Drive | Dan Cleary Drive	Signals	AM	3,520	D	55.2	391 (S Leg)	0.881
		PM	3,100	C	29.3	189 (N Leg)	0.732
Dickson Road | Peter Brock Drive | North Precinct Connection	Priority	AM	1,753	A	6.0	17 (W Leg)	0.456
		PM	2,035	A	7.3	34 (W Leg)	0.642
Rickard Road |North Precinct Connection	Seagull	AM	1,288	B	21.3	22 (W Leg)	0.553
		PM	1,592	D	45.6	48 (W Leg)	0.803
Rickard Road | South Circuit Connection	Seagull	AM	1,386	C	28.6	19 (W Leg)	0.536
		PM	1,160	A	12.3	10 (W Leg)	0.312
South Circuit Connection | Dan Cleary Drive	Priority	AM	726	A	9.9	5 (W Leg)	0.258
		PM	665	A	9.6	7 (N Leg)	0.191
Dan Cleary Drive | Harrington Parkway	Priority	AM	418	A	8.8	3 (W Leg)	0.137
		PM	237	A	7.8	3 (W Leg)	0.068

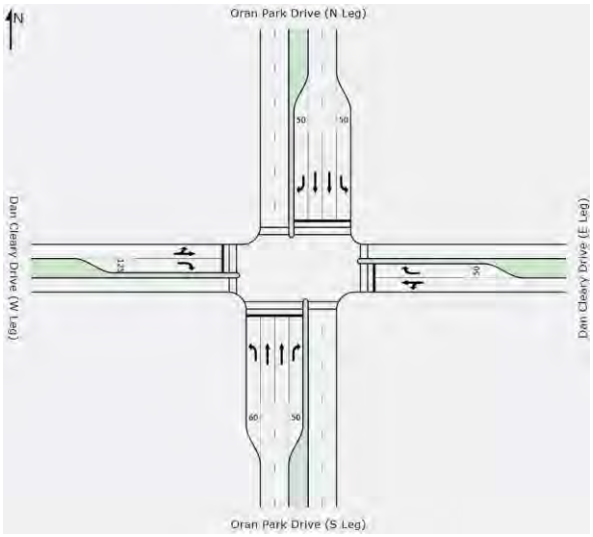
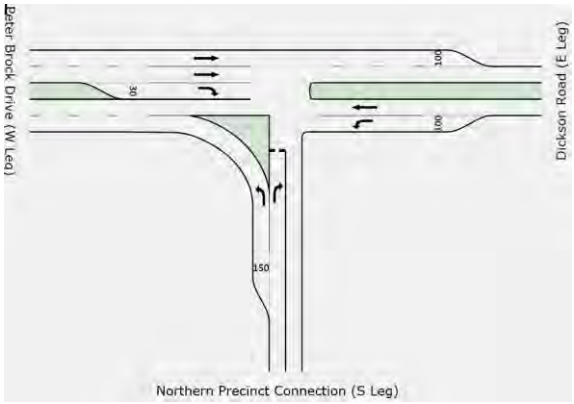
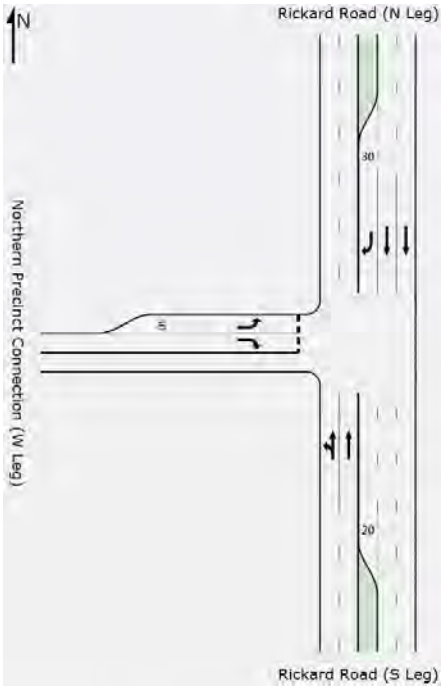
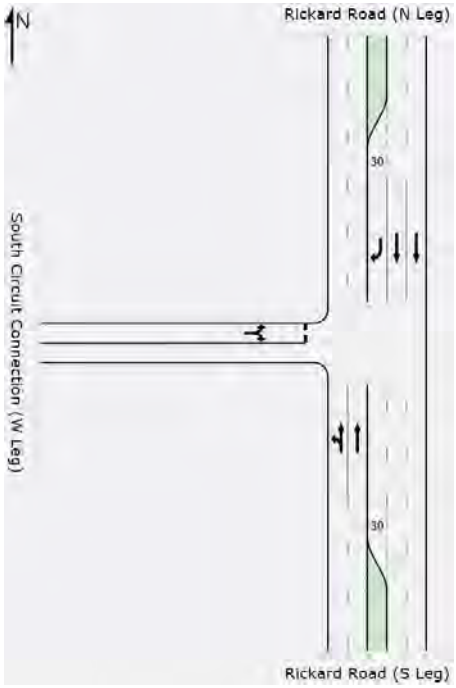
Source: AECOM, 2013

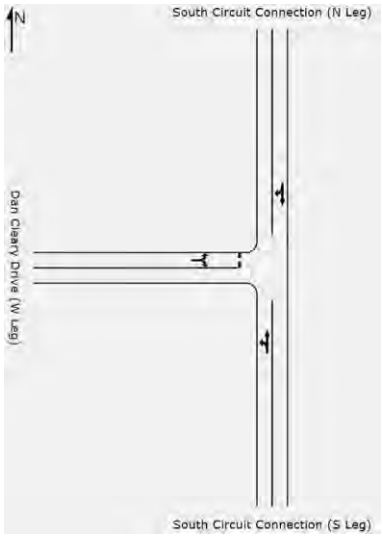
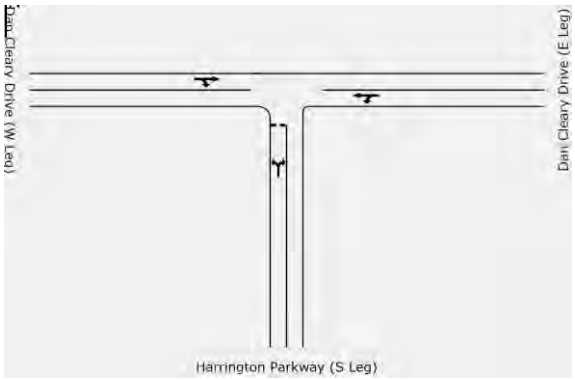
Note: rows highlighted in green show the critical approach of the intersection (the LoS, Average Delay and Queue length of the worst approach) for priority, seagull and roundabout intersections.

Refer to **Figure 8** for the intersection layouts listed above.

Figure 8 2036 intersection layouts

Camden Valley Way | Springfield Road	Camden Valley Way | Oran Park Drive / Gregory Hills Drive
	
Oran Park Drive | Rickard Road | Forest Grove Drive	**Oran Park Drive | Harrington Parkway**
	

Oran Park Drive | Dan Cleary Drive	Dickson Road | Peter Brock Drive | North Precinct Connection
	
Rickard Road |North Precinct Connection	**Rickard Road | South Circuit Connection**
	

South Circuit Connection | Dan Cleary Drive	Dan Cleary Drive | Harrington Parkway
	

Source: AECOM, 2013

3.6 Findings and recommendations

3.6.1 Road network

The strategic network analysis has assisted in determining the size of the road network and classification of key corridors to establish the recommended road network hierarchy. The road network hierarchy channels vehicular access to arterial roads via higher order corridors.

Capacity should be provided for Camden Valley Way to become three lanes wide in each direction to accommodate 2036 levels of regional traffic.

Two traffic lanes in each direction are recommended on Oran Park Drive and Rickard Road to facilitate safe and efficient bus movements and meet the requirements of transit boulevards. Forecast traffic flows along these routes also indicate that two lanes will be required in each direction in order to accommodate future traffic demand (in 2036 for Oran Park Drive and in 2046 for Rickard Road). All other collector roads and local roads within the precinct require only one traffic lane in each direction, with localised widening at intersections and parking lanes if required.

3.6.2 Intersections

The analysis indicates that all intersections within the precinct will operate at an acceptable level of service (better or equal to LoS D) during the 2036 morning peak hour and evening peak hour based on the intersection treatments shown in **Figure 8**.

Outside the precinct, the Camden Valley Way | Oran Park Drive | Gregory Hills Drive and Camden Valley Way | Springfield Road intersections are shown to operate at LoS F in 2036 and have excessive queue lengths. This is due to the high volumes of traffic forecast for Camden Valley Way as a result of wider regional development. Given the large size of these intersections, it is not considered appropriate to recommend additional treatments or upgrades to accommodate 2036 traffic forecasts - particularly as Camden Valley Way is strongly influenced by modifications to the wider regional road network. Further study of the Camden Valley Way corridor is likely to be required prior to 2036 in order to determine the potential need for upgrade.

The intersections of Oran Park Drive | Rickard Road | Forest Grove Drive and Oran Park Drive | Dan Cleary Drive are recommended to be 4-arm signalised intersections as both are forecast to have traffic volumes exceeding the minimum requirement for RMS signal warrants. In addition, both intersections would benefit from signals from a safety perspective. The Oran Park Drive | Rickard Road | Forest Grove Drive intersection is located immediately adjacent to St Benedict's secondary school and is therefore expected to have a high number of pedestrians during peak school periods. A signalised intersection would be more appropriate to cater for this need (in comparison to a roundabout). Connecting Dan Cleary Drive to Oran Park Drive will act to improve the accessibility for all modes to the Catherine Field (part) Precinct, will enhance the connectivity of the neighbourhood centre and

improve access to proposed schools. The Oran Park Drive | Dan Cleary Drive intersection is located atop a ridge that reduces sight lines, therefore signals are considered to offer the safest option for reducing accidents at this location.

Signalisation is proposed for the following intersections:

- Oran Park Drive | Rickard Road | Forest Grove Drive; and
- Oran Park Drive | Dan Cleary Drive.

A roundabout is recommended at the intersection of Oran Park Drive | Harrington Parkway. Analysis shows that this intersection will not operate successfully as a priority or seagull intersection in 2036, while forecast traffic volumes are not sufficient to meet RMS signal warrants.

Seagull intersections are a form of priority intersection that provide turning bays for traffic on the major arm (see layouts for the intersections below shown in **Figure 8**). Seagull intersections can be used in instances where a standard priority intersection is insufficient from a traffic or safety perspective and where the provision of a roundabout might be considered inappropriate. The North Precinct Connection | Rickard Road and South Circuit Connection | Rickard Road intersections both require turning traffic to cross Rickard Road which has two lanes in each direction. Standard priority intersections will not be sufficient to cater for these movements in 2036. Analysis has shown that the intersections of Rickard Road | North Precinct Connection and Rickard Road | South Circuit Connection have sufficient capacity to cater for the 2036 traffic demands as seagull intersections.

Seagull intersections are proposed for the following locations:

- North Precinct Connection | Rickard Road
- South Circuit Connection | Rickard Road

The following intersections were assessed to perform adequately as 3-arm priority intersections in 2036:

- Harrington Parkway | Dan Cleary Drive
- South Circuit Connection | Dan Cleary Drive

The intersection of Dickson Road | Peter Brock Drive | North Precinct Connection does not perform adequately as a standard priority intersection or a seagull intersection. In addition, the footprint of a roundabout is likely to be unacceptable in this location due to physical constraints (South Creek and the adjacent transmission line easement) and the traffic volumes do not meet RMS signal warrants. The solution presented in **Figure 8** shows an upgraded priority intersection whereby the left westbound lane of Dickson Road forms a dedicated left turn lane for vehicles entering and exiting the North Precinct Connection. This ensures that vehicles turning right from Peter Brock Drive into the North Precinct Connection are only required to turn across a single lane of through traffic. This layout has been tested to operate at LoS A in 2036 and has the added benefit of a relatively straightforward conversion to signals should they be required beyond 2036.

A 3-arm priority intersection with dedicated left turn lanes on the major arm is proposed for:

- Dickson Road | Peter Brock Drive | North Precinct Connection

3.6.3 Heavy goods vehicles

The proposed residential land uses within the precinct are not expected to generate a significant amount of heavy goods vehicles, nevertheless a heavy vehicle weight limit may be required to redirect heavy vehicles from residential areas. Delivery vehicles to retail premises within Oran Park Town Centre are expected to use Springfield Road and Oran Park Drive. Rickard Road, Dickson Road and Camden Valley Way facilitate northbound demand from the precinct to Leppington and inner Sydney suburbs.

4.0 Public Transport Framework

4.1 Urban design principles

Efficient public transport networks are influenced by four primary factors (TCRP Report 116, TRB, 2006):

- Density – the number of people within a given area. Density directly affects patronage potential. The more people in a service catchment, the more opportunity there is for a successful service.
- Diversity – the mix of land uses present. A mix of origins and destinations within a service area presents the opportunity for public transport services to collect passengers at different points in the network and at different times of the day.
- Design – the quality of the urban form. The urban form can be considered through the availability of footpaths to enable passengers to easily walk to bus stops and the connectivity of the street network (grid coverage, cul-de-sacs and/or curvilinear road forms). Footpaths should be provided on all roads to enable pedestrians to access public transport services.
- Driving Deterrents – reasons why people would choose public transport over driving. The major factors in travel choice are travel time and cost of parking. Networks should be designed to provide public transport priority wherever required and possible.

Other factors that influence the use of public transport systems include:

- Building orientation, pedestrian access and provision of free parking.
- Location of bus stops and availability of crossing points.
- Quality of the urban infrastructure, including bus stop facilities (shelters, seating, timetables, etc.).
- Streetscapes that discourage walking or limit access to facilities (rear fences, noise walls, etc.).

These factors have been considered in defining the following public transport options for The Catherine Field (part) Precinct.

4.2 Existing conditions

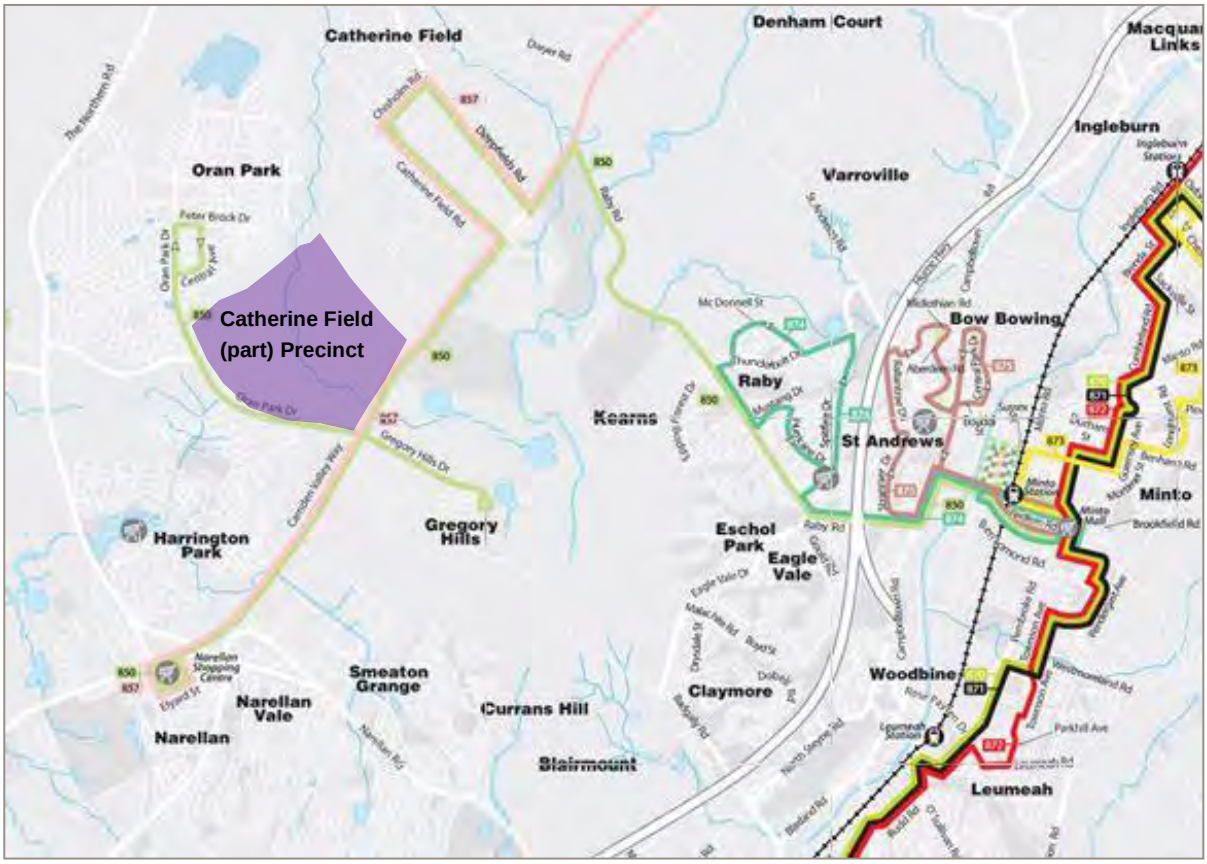
There is limited public transport serving the precinct at present, with no direct rail service and 2 bus services connecting to Liverpool and Minto respectively (see **Figure 9** below). This reflects the limited demand for services generated by the current land uses.

- Route 850 operates from Oran Park Narellan to Minto and Narellan via Oran Park Drive and Camden Valley Way, with services on the hour throughout the day and every half hour during peak periods.
- Route 857 operates from Narellan to Liverpool via Camden Valley Way with 5 scheduled services.

These bus services are timed to arrive at Minto and Liverpool stations in order to connect with onward rail services to the City.

The government has acknowledged the need for improved public transport services to cater for growth in the SWGC including the completion of the South West Rail Link and a future bus network strategy. This will be further discussed in **Section 4.4**.

Figure 9: Existing Local Bus Services

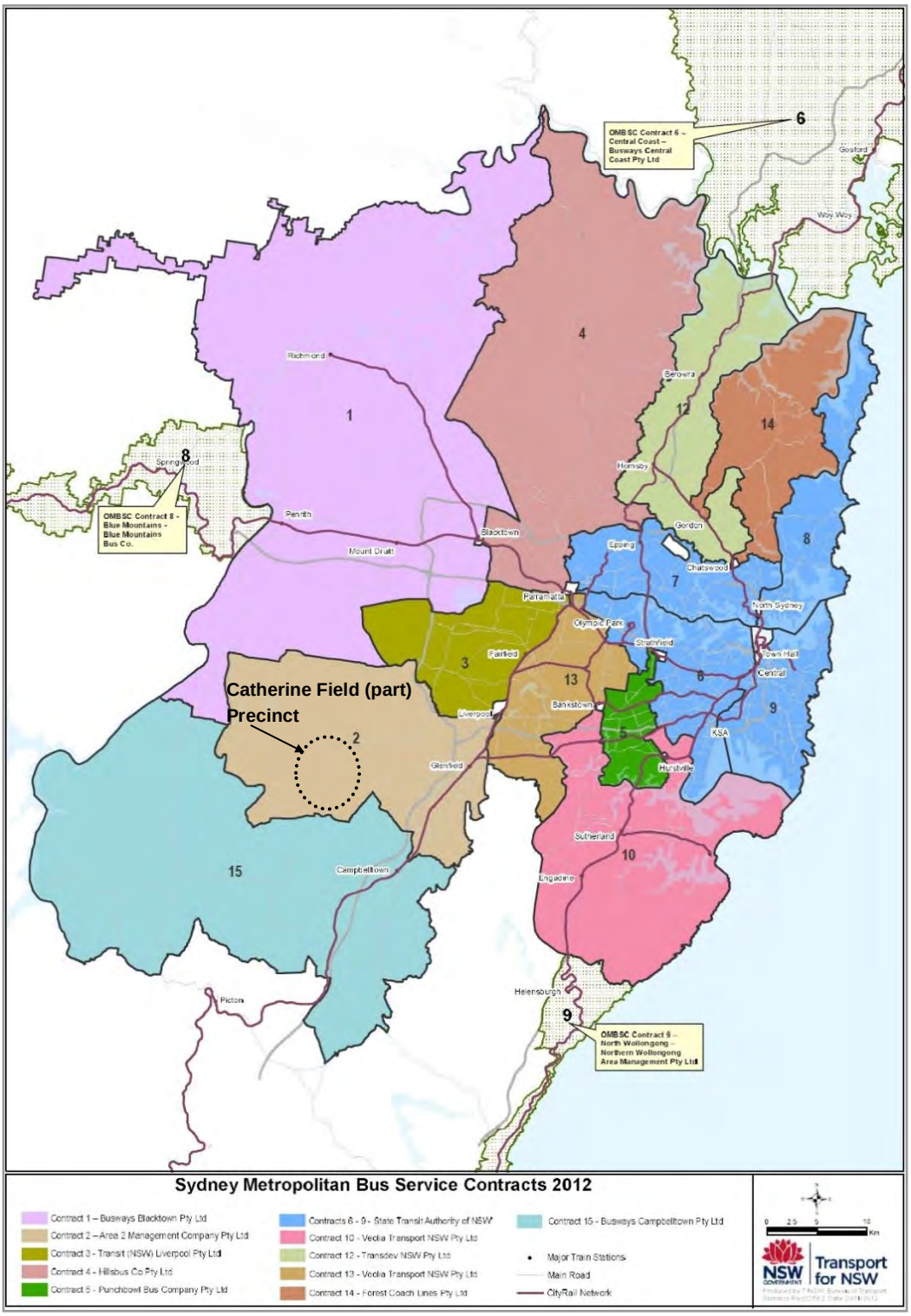


Source: Busabout Bus Services 2013 http://www.busabout.com.au/networkmap.html

4.3 NSW Bus Service Planning Guidelines

In NSW, bus network planning is directed by the NSW Service Planning Guidelines (Transport for NSW, 2005-2012). These contract areas may be revised in the future, however at this stage the existing framework identifies 15 contract regions within the Sydney metropolitan area, with bus services undertaken on a contract basis by operators on behalf of TfNSW. The precinct is currently located in contract region two as shown in **Figure 10**.

Figure 10: Metropolitan Sydney Contract Regions, 2012



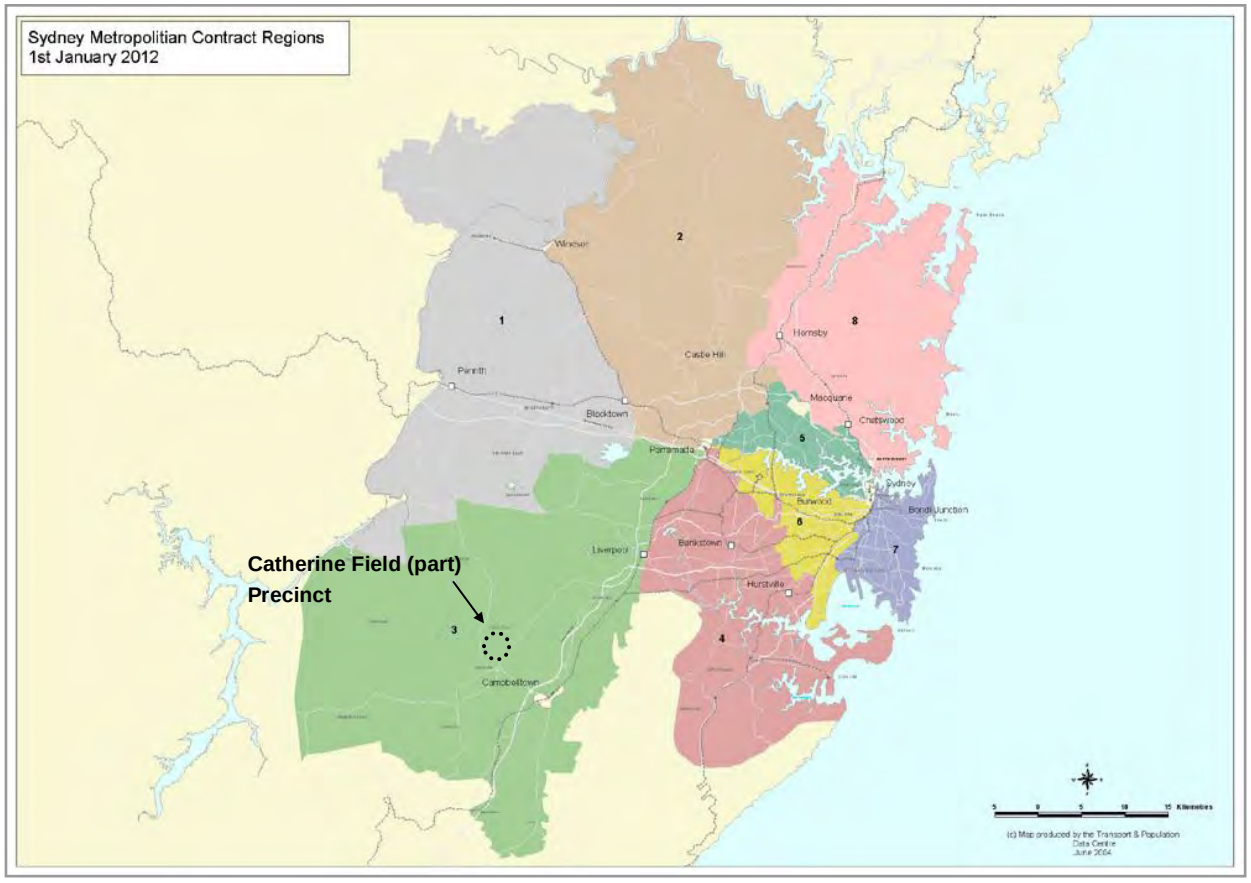
Source: Transport for NSW, 2013

The NSW Government, in consultation with the bus operator, has developed an Integrated Network Plan for the contract region *"to establish Strategic Transport Corridors and a hierarchy of bus route types that:*

- *Link to regional centre(s)*
- *Pass through patronage generators such as district centres, TAFE colleges, hospitals and universities*
- *Connect with other transport modes (trains, ferries and other buses)*
- *Are multifunctional (serving journeys to work, education, shopping and recreation)*
- *Are direct and frequent*
- *Meet the network planning principles.*

Going forward, the existing 15 regional contracts may be consolidated into eight. The precinct will then become part of the newly formed contract region three (as shown in **Figure 11)**.

Figure 11: Metropolitan Sydney Contract Regions



Source: NSW Service Planning Guidelines, Transport for NSW, 2012

4.4 Future public transport service provision

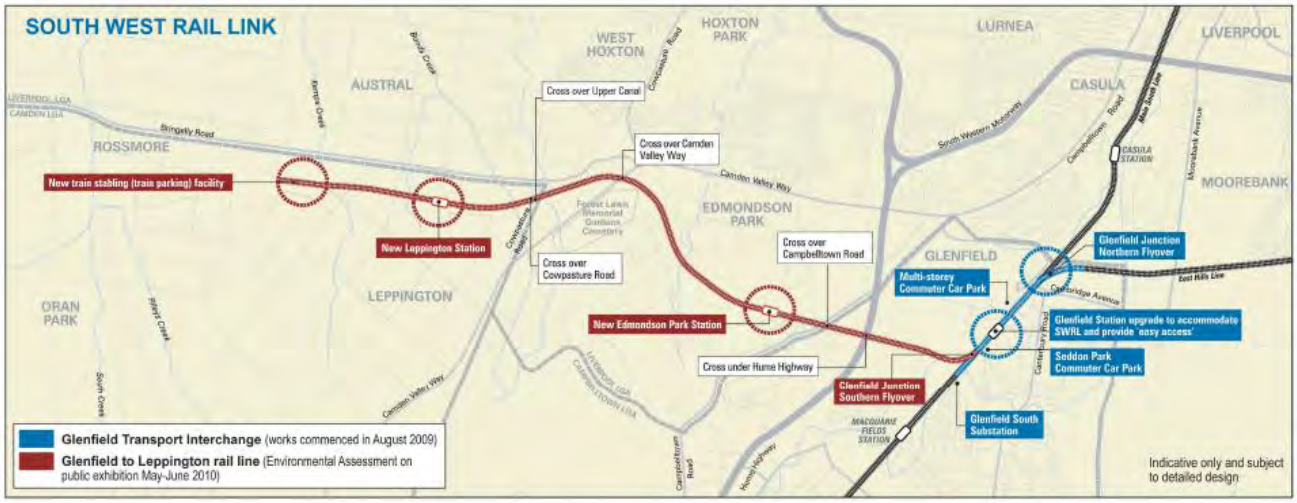
4.4.1 Overview

The planning of future public transport services will need to provide connections within the precinct and to surrounding precincts including Oran Park, Turner Road, Leppington and Campbelltown/Macarthur. In particular, the planning of public transport for the precinct needs to integrate regular bus services with the new rail station at Leppington and the bus hub at Oran Park, as this will help to provide access to regional opportunities for employment, retail, and recreational trips. The staged rollout of bus services also needs to be considered so that service provision is in line with the staged development of the precincts and that early provision of bus services is facilitated to maximise potential uptake of public transport from the outset. Bus connection(s) to Leppington Station and/or Campbelltown Station in the early phase of development of this precinct will be critical in establishing a 'non-car culture' to assist in achieving State mode shift targets.

4.4.2 South West Rail Link

In 2009, the NSW Government announced the construction of a new 11 kilometre rail line – South West Rail Link (SWRL) from Glenfield to Leppington in South West Sydney. The project includes two new stations at Edmondson Park and Leppington. The delivery of the two new stations includes bus interchanges, pedestrian and cyclist facilities as well as kiss and ride zones and commuter car parking. Construction of the SWRL commenced in 2011 and is due for completion in 2016. A map of the SWRL project is shown in **Figure 12.**

Figure 12: Proposed South West Rail Link



Source: Transport Construction Authority, July 2010

The SWRL will offer a heavy rail transport option for the future residents of the SWGC by providing frequent train services to Glenfield and the rest of the CityRail network. The SWRL will provide two new stations at Leppington and Edmondson Park, which provide a major opportunity for transit-oriented and sustainable development servicing the new communities and the broader SWGC.

RailCorp proposes an initial four services per hour throughout the day with up to 12 trains per hour in peak periods (subject to change as a result of detailed design and/or the ability to meet future standards). Furthermore, the frequency of service is likely to be increased over time as demand increases and service provision is influenced by patronage demand as well operating requirements of the network. Options for a potential future extension of the project beyond Rossmore have been investigated by the NSW Government, but there is no commitment to an extension at this stage.

Rickard Road, a designated Transit Boulevard according to the RMS SWGC Road Network Strategy, will be the main access route for residents of the precinct to Leppington Station. Bus services along this route will need to align with train departure/arrival times at Leppington Station. Dickson Road will also provide bus services between the Oran Park bus hub and Leppington.

As part of the construction of SWRL and Leppington Station, a total of 800 commuter car parking spaces and bus stops will be provided on both sides of the station on the day of opening of services. The main vehicular access to the station interchange will be provided via Rickard Road.

The SWRL would significantly enhance opportunities for public transport travel to and from the precinct, as such the planning of the precinct should maximise the opportunity presented by this new infrastructure to minimise the need for car travel.

Measures to improve accessibility to Leppington Station include:

- Provision of frequent bus routes between the precinct and the station via Oran Park.
- Design of appropriate cycling routes and crossing facilities along Rickard Road as well as in the vicinity of the station.
- Provision of good interchange facilities at the station, catering for all modes of transport.

4.4.3 Improved accessibility to Campbelltown Station

Future residents of the precinct also have the opportunity for improved access to Campbelltown Station via the proposed Gregory Hills Drive extension. Campbelltown Station has regular express rail services to the major centres within Sydney and has improved interchange facilities on the western side of the station to provide an alternative access to commuters from the SWGC.

4.4.4 Future bus provision

Forward planning of a comprehensive network of future bus routes is a priority to provide equitable access to local and regional opportunities for employment, retail and recreational trips. It is important that future services provide sufficient connections within the precinct but also to/ from surrounding precincts and to/ from major destinations such as employment, retail centres, and health, education and leisure facilities.

To serve the major centre and SWRL station at Leppington, Rickard Road, as the primary north-south route to Leppington major centre has been designated as a Transit Boulevard to provide public transport priority opportunities to the town centre. Given Rickard Road's significance as a bus corridor, a planned extension of the road towards the southern side of the SWGC will assist with efficient bus movements to cater for regular bus services and shorter travel times at the ultimate development stage. In the interim (prior to the completion of the Rickard Road extension) public transport connectivity to Leppington will be fulfilled by Camden Valley Way with its public transport priority measures implemented once widening has been completed.

In addition to Rickard Road, Dickson Road will also provide bus connections between Oran Park and Leppington in 2036, while Oran Park Drive and Gregory Hills Drive have also been designated as Transit Boulevards in the RMS SWGC Road Network Strategy. The Transit Boulevards will provide public transport priority opportunities between the new suburbs and Oran Park as well as Campbelltown. This also gives residents of the precinct access to wider Sydney via the Campbelltown railway station.

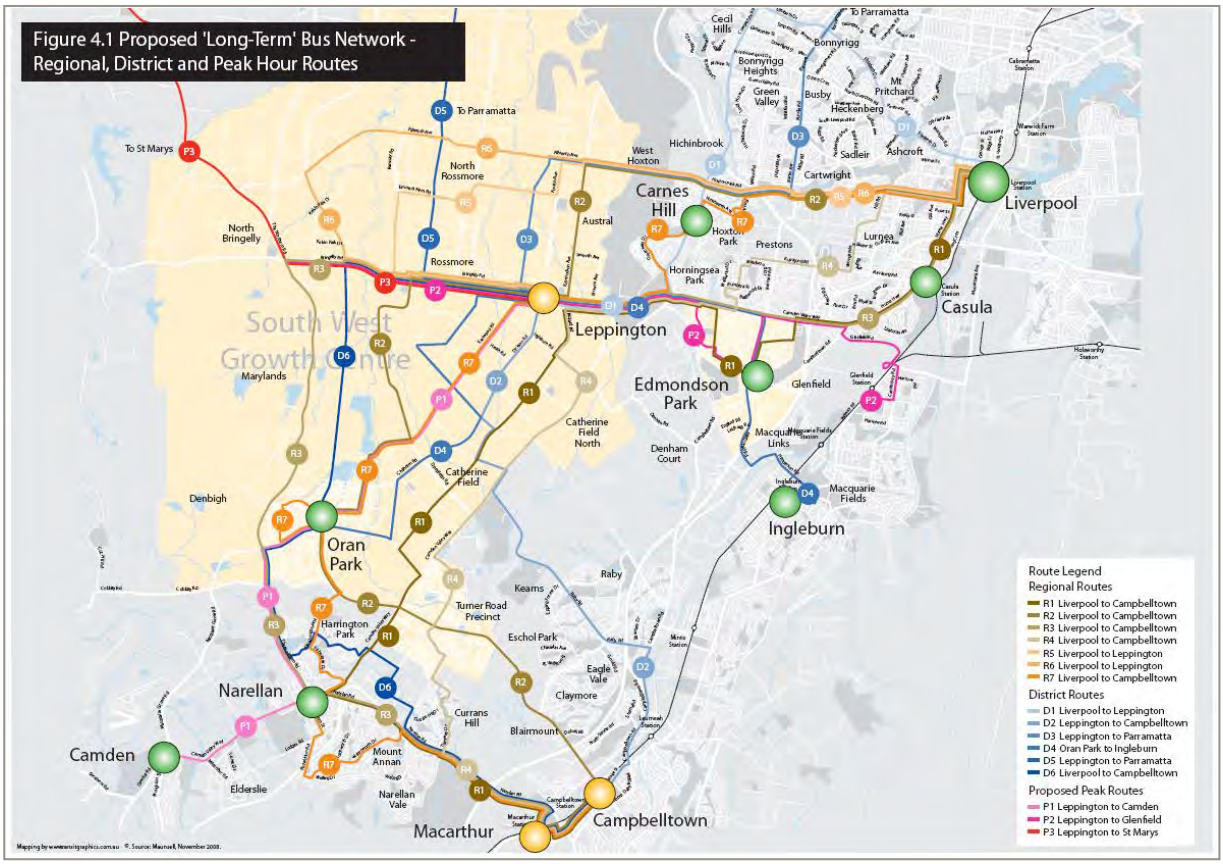
The South West Bus Servicing Strategy was produced in 2009 by AECOM for TfNSW. The strategy proposed regional services along Camden Valley Way and Oran Park Drive around the precinct. The existing route (850) was proposed to continue as a district service that could potentially be re-routed to travel via Leppington between Oran Park and Ingleburn Station. These proposed routes would provide a significant enhancement to existing bus services, in line with the proposed development of the precinct to serve future residential and employed populations.

The South West Bus Servicing Strategy 'long-term' bus network proposal consisted of seven regional, six district and three peak hour only bus routes to provide a network that would link the proposed major centres (Liverpool, Campbelltown, Parramatta, Oran Park and Leppington) and support accessibility to each of the SWGC precincts. The TfNSW South West Sector 'long-term' bus network plan is shown in **Figure 13.**

The South West Bus Servicing Strategy proposed likely peak hour headways of 30 minutes for District Bus Routes and 15 minutes for Regional and Peak Bus Routes. With potentially three regional routes (R1, R2 & R7) and one district route (D4) travelling to Leppington Station, it is expected that bus services could operate at a five minute frequency between the precinct and Leppington Station. A regional service (R2) could also provide direct bus services to Campbelltown Station via Gregory Hills Drive.

It should be noted that the bus network shown below in **Figure 13** does not include the SWRL. However, the basic principle of bus links between Leppington major centre and Oran Park are clearly identified.

Figure 13: Long term South West Sector Bus Servicing Strategy



Source: AECOM, 2009

Table 8 sets out a summary of the service planning from the NSW bus planning guidelines, restated in the South West Sector Bus Servicing Strategy. This sets the criteria and benchmarks which were adopted in the development and planning of the bus route network to cover the entire south west sector, including those routes which serve the precinct.

Table 8: Service Planning Guidelines Summary

Bus Planning Characteristics	Benchmark/Criteria
Network (Area) Coverage	- 90% of households to be within 400 metres of a rail line and/or a Regional or District bus route during commuter peaks, inter peak and weekend day time. - 90% of households to be within 800m of a rail line and/or a Regional or District bus route at other times.
Network Legibility	- Peak and off-peak services should use the same route wherever possible.
Route Design	- Regional Routes to be between 10 and 25 kilometres in length. - Routes to be between 30 and 60 minutes in duration. - Maximum diversion from the fastest or shortest route (between termini) to be no more than 20%.

Bus Planning Characteristics	Benchmark/Criteria
Accessible Buses	- Low floor, wheelchair accessible buses to be allocated to Strategic Transport Corridor routes. - Accessible buses to be evenly timetabled on the corridors and advertised as “accessible” trips in the public timetable.
Dedicated School Services	- Dedicated school services should be kept to a minimum in order to maximise the frequency and availability of normal route services. - Average 5 boardings per revenue kilometre. - Students to be delivered to their school within half an hour of school commencement time and picked up within half an hour of school finishing.
Section Points	- The range of section point lengths to be between 1.3 km and 1.9 km. - The average length of section points within each route to be 1.6 km.
Patronage	- Average 1.5 to 2.5 boardings per revenue kilometre (based on an average operating speed of 24 kph). - Peak period patronage to be in the range of 50% (25% at other times) seated capacity and 85% of the legal bus capacity (averaged by the number of trips operated during any 20 minute period) at maximum load point. - Passengers not to stand for more than 30” of a timetabled service.

Source: NSW Service Planning Guidelines, NSW Ministry of Transport, 2006

4.4.5 Proposed bus network

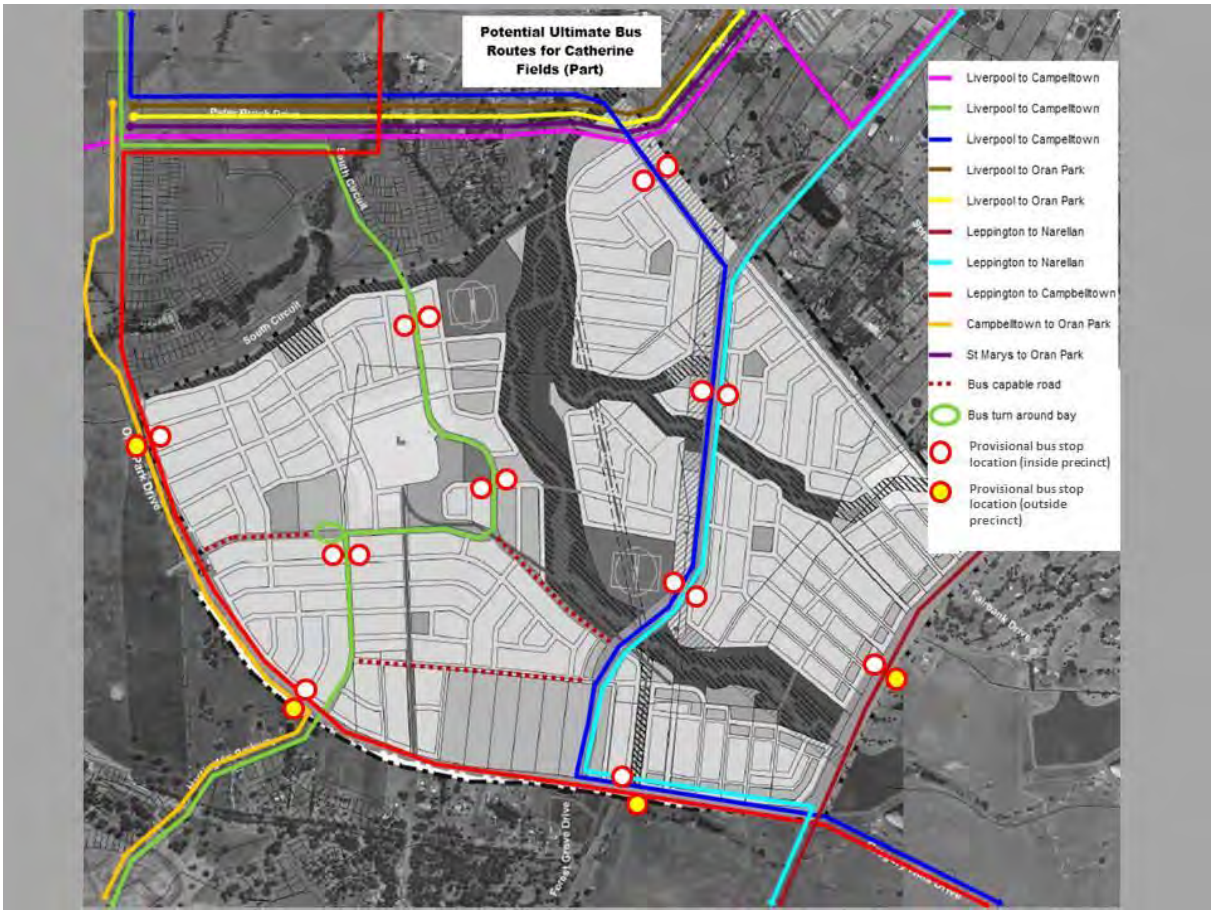
The proposed long term bus network for the precinct will comprise a mixture of regional routes and district routes to maximise speed and efficiency of high frequency peak hour services as well as a number of local bus routes to ensure maximum coverage throughout the precincts, facilitating public transport access and travel choice.

Regional and District bus routes will predominantly be located on arterial roads and transit boulevards, while additional local bus routes / services can be operated along collector roads. The combination of Regional and District routes and the potential for local routes on the collector road network provides for an efficient and flexible bus network to serve the future Catherine Field (part) precinct.

The exhibited bus strategy for the precinct has been revised by TfNSW following exhibition. The proposed routes are shown in **Figure 14**. This shows that bus routes will be oriented toward Oran Park (to reflect a proposed bus hub located in the Oran Park Town Centre), however there will also be a direct connection between the Precinct and Leppington Town Centre/Station along the full length of Rickard Road.

Within the precinct itself, two services will operate along Rickard Road, while one will operate through the west of the precinct via South Circuit, Dan Cleary Drive and Harrington Parkway. This service also proposes a bus turnaround facility within or adjacent to the proposed school (on the corner of Harrington Parkway and Dan Cleary Drive) enabling school buses to operate more efficiently. This is shown as a loop in **Figure 14**.

Figure 14: Bus Strategy for Catherine Field (part) Precinct



Source: TfNSW / AECOM, 2013

The coverage achieved by the proposed routes covers all centres, schools, all medium density housing and at least 90% of low density residential, providing feasible public transport options for all land uses. Even those fringe residential areas, the majority of which are low density in nature, are no more than 600m from a proposed bus service. Therefore, the proposed bus strategy will achieve efficient penetration of the precinct by public transport and ensure accessibility, without comprising service efficiency.

Proposed bus stop locations have been identified to ensure that bus services can be accessed in less than 10 minutes walk for all residents of the precinct.

Table 9 below sets out the key criteria and benchmarks for network, service and route performance set out in the planning guidelines.

Table 9: Bus Network Evaluation

Bus Planning Characteristics	Benchmark/Criteria	Met*
Network (Area) Coverage	90% of households to be within 400 metres of a rail line and/or a Regional or District bus route during commuter peaks, inter peak and weekend day time. 90% of households to be within 800m of a rail line and/or a Regional or District bus route at other times.	Yes
Network Legibility	Peak and off-peak services use the same routes.	Yes
Route Design	Regional Routes to be between 10 and 25 kilometres. Routes to be between 30 and 60 minutes in duration. Maximum diversion from the fastest or shortest route (between termini) to be no more than 20%.	Yes
Section Points	The range of section point lengths to be between 1.3km and 1.9km. The average length of section points within each route to be 1.6 km.	Yes

It is important to establish public transport early in the development stage in order to foster more sustainable behaviour amongst residents. Any proposed short term bus network for the precinct will rely on the completion of proposed infrastructure upgrades for the connection into different major centres and transport hubs such as Rickard Road extension and Gregory Hills Drive extension.

Prior to the completion of the South West Rail Link:

- Existing routes (850 & 857) to connect to Liverpool or Minto Station with potential local diversion of these services to improve bus coverage (no reliance on additional road infrastructure).
- Potential bus service to Campbelltown Station with the completion of Gregory Hills Drive.

With the commission of the South West Rail Link at Leppington Station:

- Re-route of Minto/Liverpool bus service via Leppington.
- Continue bus service to Campbelltown.
- Additional direct services to Leppington Station.
- Additional service to Oran Park bus hub.

The number and frequency of the short term services listed above will depend on the timing of roll out and location of residential dwellings in Oran Park Precinct and the Catherine Field (part) Precinct.

4.5 Public transport framework analysis

4.5.1 Rail network

The precinct will be accessible to the new South West Rail Link via Leppington Railway Station when it is expected to be operational in 2016. Furthermore, the precinct is also 8km from Campbelltown Rail Station which provides services on the Cumberland Line, Airport & East Hills Line and South Line to the wider Sydney area. The precinct will connect to these stations using proposed frequent bus services along the Transit Boulevards on Oran Park Drive and Rickard Road, identified as part of the RMS SWGC Road Network Strategy.

4.5.2 Bus network

The precinct will be well served by buses, with three bus routes travelling through the precinct, and eight further bus routes in adjacent roads. The combination of the Regional and District routes and the potential for local routes on the collector road network provides an efficient and flexible bus network to serve the future Catherine Field (part) precinct.

These bus routes will provide access to both local and regional centres such as the Oran Park Town Centre, Leppington major centre, Liverpool, Narellan and Campbelltown. In addition, the bus network will provide links to the wider transportation network via Leppington Station and Campbelltown Station.

4.5.3 School buses

It is expected that local bus services will be established to provide connection between the schools and major transport nodes as well as the developed residential areas within the precincts. Separate dedicated school bus services could be introduced or extended as appropriate to serve the primary schools located within the precincts, where demand exceeds maximum passenger loadings. However, in general students would be encouraged to travel on scheduled public transport routes. All proposed schools are located on roads that are capable of accommodating bus routes. TfNSW has also indicated their preference for a bus turnaround facility within the school site on Dan Cleary Drive to increase the efficiency for buses operating along this route.

4.5.4 Bus stops

Bus stop locations would be defined during detailed planning as land uses become more refined. However, at this stage any routes identified as bus corridors need to have space within the road reserve to accommodate bus stops or shelters. Bus stops in the proximity of traffic signals on arterial roads would be located on the departure side of signalised intersections.

Stops should be provided approximately every 400m to maintain vehicle speeds while providing sufficient access for passengers. This requires routes to have either two lanes in each direction (for example Rickard Road extension) or one lane in each direction for other collector roads with a parking lane that could accommodate a bus stop. Lane widths on bus routes are at a minimum of 3.5m.

Whilst indented bus stops are a possible solution where a cross-section has one lane in each direction, they do not allow flexibility in bus stop location as land uses and patronage demands change. Therefore, indented bays should be avoided. Adequate seating and shelter is also recommended at bus stops within the precinct and on Oran Park Drive and Camden Valley Way.

4.6 Findings and recommendations

The precinct will receive adequate public transport accessibility through transit corridors that allow access to local rail services at Leppington and Campbelltown. In addition, bus routes should link key centres, transport hubs, schools, employment opportunities and residential areas.

The proposed bus strategy for this precinct is consistent with the SWGC Road Network Strategy and broadly follows the South West Growth Sector Bus Servicing Strategy. The proposed long term bus network for the precinct will comprise a mixture of regional routes and district routes to maximise speed and efficiency of high frequency peak hour services as well as a number of local bus routes to ensure maximum coverage throughout the precincts, facilitating public transport access and travel choice.

The combination of the Regional and District routes and the potential for local routes on the collector road network provides an efficient and flexible bus network to serve the future Catherine Field (part) precinct. This bus strategy was recently updated by TfNSW following exhibition of the draft ILP. These updates form the basis of the bus network strategy shown in **Figure 14**.

Key bus operating corridors with services providing fast, efficient regional connections will operate along the east-west route (Oran Park Drive) and on the north-south route (Rickard Road extension), with links between notable regional destinations such as Leppington major centre, Oran Park Town Centre, Liverpool, and Campbelltown.

Roads serving bus routes should have two lanes in each direction or one lane in each direction with a parking lane that could accommodate a bus stop. Lane widths need to be a minimum of 3.5 metres. Oran Park Drive and Rickard Road extension are both identified as critical links (with 2 lanes in each direction) in the bus network for bus priority measures. Further details on the proposed cross-sections are provided in **Section 6.0**.

5.0 Walking and Cycling Networks

5.1 Introduction

Walking and cycling has a major role to play in the future transport system and land use planning initiatives for Metropolitan Sydney. The NSW State Plan aims to increase the share of short trips by bike in Greater Sydney for all travel purposes to 5 per cent by 2016. Walking is also a smart travel choice and a viable option for a significant number of smaller trips.

Mixed use development and proximity to local centres are a key factor in promoting sustainable transport modes such as walking and cycling, together with high quality walking and cycling routes with streetscapes that encourage these modes.

The objective of this section is to present opportunities to provide high quality walking and cycling networks within the Catherine Field (part) Precinct, and integrating these into adjacent areas (Oran Park, Turner Road and Harrington Park) and regional cycle routes.

5.2 Existing conditions

Within the precinct there is currently limited provision of dedicated walking and cycling infrastructure and a lack of consolidated network planning, which has been in keeping with its existing land uses but will not be appropriate to cater for future demands.

5.3 Opportunities and constraints

Overall the precinct is undulating with gentle slopes. As the terrain is not particularly steep there are good opportunities for walking and cycling within the study area.

Providing viable alternatives to the private car for journeys with destinations both within and outside the precinct is essential to encourage the sustainable development of the precinct. In particular, it will be important to connect internal roads within the precinct with direct pedestrian and cycle connections to allow access to the future centres, schools, retail, employment, public transport nodes and other trip attractors in the area.

The future widening of Camden Valley Way could create a barrier to east-west pedestrian and cycle movements. Therefore this corridor needs to be planned in such way to minimise the impedance to east-west pedestrian and cycle connectivity i.e. by minimising corridor width and incorporating sufficient pedestrian and cycle priority wherever possible. The upgrade of Camden Valley Way will, however, provide associated upgrades to pedestrian and bicycle facilities in a north-south direction. This includes a cycle way on path along the western side of Camden Valley Way.

A further cycle path is planned to operate in an east-west direction along the northern side of Oran Park Drive. This will connect Camden Valley Way to Oran Park Town Centre and provide residents of the precinct with viable cycle access to adjacent town centres.

The riparian corridor at South Creek could provide an additional barrier to north-south movements within the precinct. The Rickard Road extension can provide pedestrian and cycle connections across the riparian corridor, however additional pedestrian and cycle links may be needed to improve pedestrian and cycle access across the creek at different locations.

There are good opportunities to provide for recreational walking and cycling by enhancing links to the various parks and sports fields located within the precinct. There is also potential to develop recreational pedestrian and cycle pathways within the riparian corridor.

5.4 Principles and guidelines

Three documents guide the provision of pedestrian and cyclist networks in this area. The Growth Centres Development Code (Growth Centres Commission, 2006) includes guidelines for all aspects of urban design from street layout to open space and water use. The other key documents guiding the design of cycle networks are the NSW Bicycle Guidelines (NSW Roads and Traffic Authority, 2003) and Camden Council Walking & Cycling Strategies (2006). A review of these documents follows.

5.4.1 Growth Centres Development Code

Salient objectives of the Growth Centres Development Code that relate to pedestrian and cycle planning are to improve:

- Facilities at a local level (i.e. walking/cycling distance from residences).
- Access to public transport.
- Encourage reduction of the reliance of private vehicles.
- Walking and cycling connections, especially between residential areas, shops and schools.
- Buildings and landscapes to define thoroughfares as civic places.
- Developments to accommodate pedestrians while also adequately accommodating vehicles.

The objectives can be achieved by adhering to the elements of the code that follow. The elements highlighted in bold can be achieved at this stage of planning. The remaining elements will be carried forward for consideration during later planning stages (through DCP's).

It is important to ensure that these 'later' elements are not precluded by design decisions at this stage including:

- Pedestrian and cycle routes will be direct, continuous and well lit.
- Cycle routes will be linked to those outside the site.
- Grid like street network pattern to facilitate walking and cycling.
- Limit use of culs-de-sac (they should be used only where other more permeable options are not available).
- Clearly delineated routes for pedestrian, bicycles and vehicles.
- Public open space should be a design feature, with recreational uses along drainage lines.
- "Recreational trails" will connect public open space using on or off road routes.
- Smaller lots and higher densities should be provided close to centres and public transport.
- Pedestrian movement should not be inhibited by parking areas in town centres.
- Lots will front open space and major streets to provide casual surveillance.
- High level of pedestrian amenity, with active streets and links between parks and plazas.
- Streets and lanes will be shared spaces accommodating all users.

5.4.2 NSW Bicycle Guidelines

The NSW Bicycle Guidelines (NSW Roads and Traffic Authority, 2003) assist in the design of bicycle facilities and the principles of network design are also relevant when designing pedestrian networks. The document provides a step by step process that the design should move through and details factors that should be considered. It is a best practice guide and professional judgement should be used when applying the guidelines.

The NSW Bicycle Guidelines identify five key principles to adopt when designing a cycle network. These are:

- **Coherence**: The cycle network should link popular destinations in a continuous form, with consistent quality across the network. The correct path, especially at intersections, should be clear. There should be adequate density of routes to offer a choice to cyclists.
- **Directness**: Long detours should be avoided, but minor detours to avoid the steepest section of a hill are advisable so that the cyclist can maintain a constant speed throughout the journey. Barriers, such as a crossing at critical points can disrupt the momentum of the ride.
- **Safety**: Intersections should be designed with bicycles in mind and should include a path for cyclists. Roadway crossings should be safe and easy to negotiate.

- **Attractiveness**: Bicycle infrastructure should fit with the surrounding environment. Routes should be clearly signed, line marked and well lit to offer a sense of security.
- **Comfort**: A smooth surface ensures a safe and comfortable ride. Space should be allocated to cyclists within the road reserve (in either a cycle lane or separated path) on all roads unless speed and traffic volumes are very low.

Other principles to be considered that are not included in the guidelines are:

- **Capacity**: There must be adequate space for waiting pedestrians, particularly at bus stops.
- **Integration**: Walking and cycling should be integrated with other modes (particularly bus and train services) through the provision of obvious, safe and convenient pedestrian/cycle access paths to interchange areas, as well as secure cycle storage facilities.
- **Storage facilities**: Appropriate storage facilities should be provided at all key destinations (including train stations, major bus stops and large developments). Storage facilities should provide for both long and short term storage of cycles and related equipment. Design should be such that storage is not only secure and provides weather protection, but also conveys a sense of high priority for the treatment of cycles and cyclists.

Commuter cyclists would prefer to use direct routes and are not as deterred by gradients and travel within the vehicle carriageway as recreational cyclists. Recreational cyclists are more likely to prefer a longer but flatter route and travel time is less of a consideration than a pleasant ride.

5.4.3 Camden Council walking and cycling strategies

The core objective of the Camden Council Walking and Cycling Strategies (2006) is to encourage greater use of walking and cycling as a means of transport and recreation. This is because of the low cost, low impact, wide suitability and health benefits associated with walking and cycling. Camden Council's pedestrian and bicycle strategy is to integrate these modes with Land Use, Road Network, Parking and Public Transport Strategies to assist access to existing and potential bus and rail networks.

These strategic objectives will ideally be achieved through provision and management of walking and cycling facilities and opportunities in a way that:

- Understands the key walking and cycling needs in the region.
- Recognises the role walking and cycling plays in the reduction of car-based trips in the Campbelltown and Camden region, and how the provision of improved facilities and opportunities can help promote mode change in the future.
- Understands the need for the separation of pedestrians and cyclists from motor vehicle traffic.
- Identifies mechanisms for the community to have regular input into the provision of walking and cycling facilities.
- Recognises that all trips involve walking at either the beginning or end of the journey, resulting in the need for connections between parking and public transport areas and destinations.
- Incorporates walking and cycling issues into the Land Use, Road Network, Parking and Public Transport Strategies.
- Recognises that walking and cycling paths can form key routes between destinations.
- Understands that walking and cycling trips perform a variety of functions, not only travel from an origin to a destination, but such trips are also undertaken for recreation and/or health benefits, which can be influenced by the amenity of the route.

5.5 Proposed bicycle and pedestrian networks

5.5.1 Bicycle network

A comprehensive bicycle network is proposed for the precinct which will link the neighbourhood centre, schools, and residential neighbourhoods with key strategic routes and onward destinations. The proposed bicycle network will include a mixture of dedicated bicycle facilities which will take the form of:

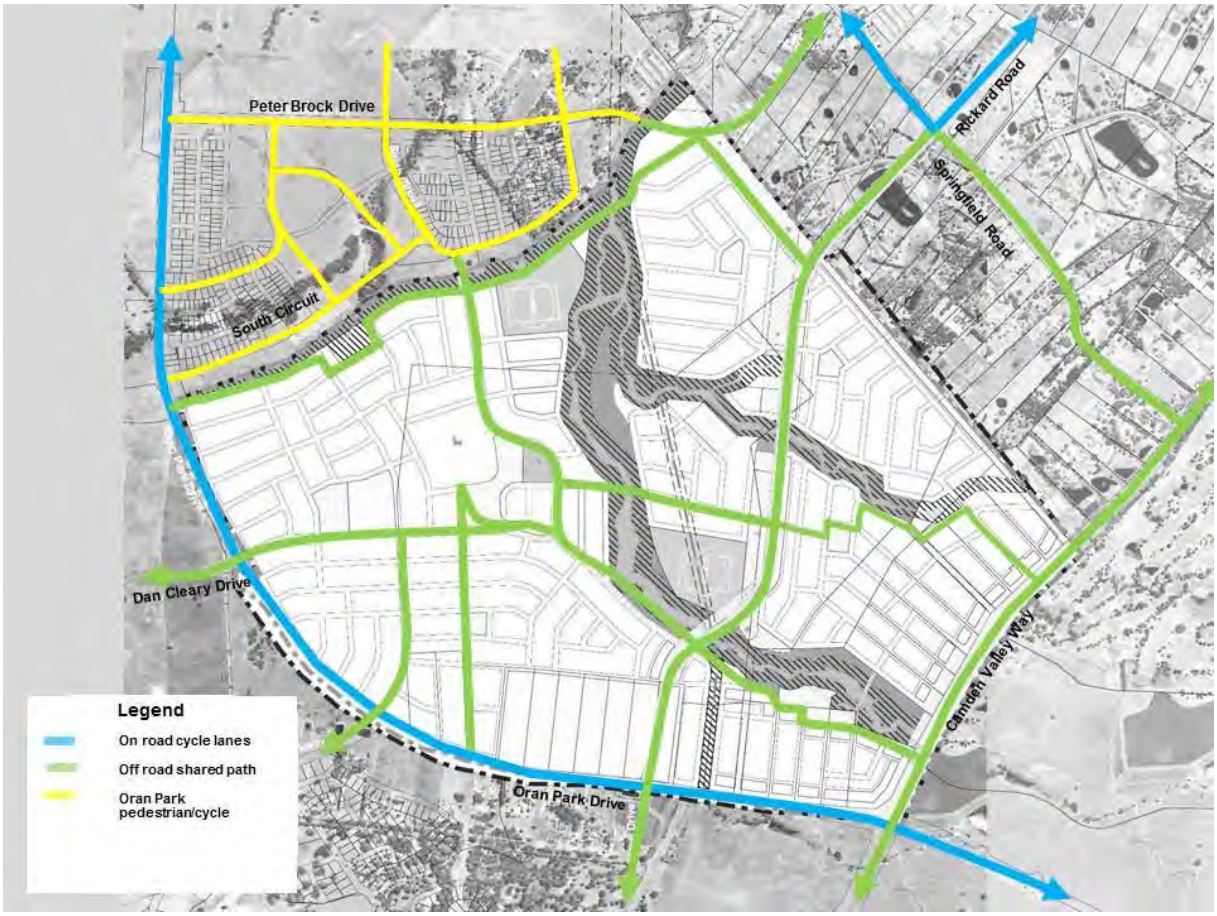
- Off-Road (Shared Path)
- On-Road (Cycle Lane)
- Off-Road (Shared Path – Green Corridor).

Camden Valley Way, designated as principal arterial road, will have shared path bicycle facilities in addition to a 2m wide shoulder on both carriageways that could potentially be used by on-road cyclists. Off-road cycle lanes are proposed along Transit Boulevards providing a network of high order bicycle facilities for fast, efficient connections for both local travel within the precinct; travel to Oran Park Town Centre and Leppington Town Centre and to regional destinations such as Camden and Campbelltown.

All sub-arterial roads and collector roads connecting key origins and destinations within the precinct and onto other external destinations will have dedicated shared path bicycle facilities. The proposed cycling connections are designed to create a continuous network of facilities removing obstacles and barriers to cycling, both physical and perceived. Physical crossing points of the creek have been included in the bicycle network plan to ensure route connectivity and network permeability.

There are also further opportunities to create additional recreational cycle routes beyond those shown, along the riparian corridors. However these would require access behind property boundaries, which are likely to be privately owned, and are in a zone liable to flooding. These can be considered in future if opportunities arise for further development and consolidation to create additional bicycle paths. The proposed future cycle network is shown in **Figure 15**.

Figure 15: Proposed Cycle Network



Source: AECOM 2013

5.5.2 Pedestrian network

All proposed roads throughout the precinct will have dedicated pedestrian footpaths to create a comprehensive network following proposed road alignments.

The proposed road grid network and block sizes will also work to facilitate pedestrian permeability and be conducive to encouraging walking trips. As the network has been designed around a linear grid structure the regular cross streets with pedestrian footpaths, and block sizes will encourage pedestrian activity, and achieve a high level of permeability.

There is also opportunity to provide recreational paths along the riparian corridor along South Creek. These are proposed on both sides of the corridor in the Camden Growth Centres DCP and Section 94 Plan.

5.5.3 Network analysis

The proposed networks for the precinct are assessed against the planning guidelines and the results are shown in **Table 10**.

Table 10: Assessment of the ILP against planning principles

	Catherine Field (part) Precinct
Development Code Principle	
Recreational uses along drainage lines	Opportunity exists
"Recreational trails" will connect to public open space using on or off road routes	√
Pedestrian movement should not be inhibited by parking areas in town centres	√
Net lot density of >15 lots per hectare	√ *
Smaller lots/higher densities close to centres/public transport	√
Lots will front open space and major streets to provide casual surveillance	√
Link cycle routes to those outside the site	√
Limit use of cul-de-sacs. Cul-de-sacs should be used only where other options are not available.	√
High level of pedestrian amenity, with active streets and links between parks	√
Streets and lanes will be shared spaces	√
Grid like street network pattern where possible to facilitate walking and cycling routes	√
Clearly delineated routes for pedestrians / bicycles / vehicles	√
Direct, continuous and well lit pedestrian/cycle routes	√
Other Design Principles	
Coherence	√
Directness	√
Safety	√
Attractiveness	√
Comfort	√
Capacity	√
Integration	√
Storage	√

Source: AECOM, 2012

*Excluding larger lot housing around Oran Park House.

Key points to consider during the next stages of planning include:

- Allow 'space' for cycle paths through intersections.
- Allow 'space' for pedestrian waiting areas at bus stops/ interchanges.
- Allow space for cycle route to follow behind bus stop.
- Retain pathways in linear green spaces.

5.6 Findings and recommendations

Providing viable alternatives to the private car for journeys within and outside the precinct is essential for the achievement of sustainable outcomes. In keeping with its existing land uses, there is currently limited provision of dedicated walking and cycling infrastructure within the precinct. The area does however provide good opportunities for future pedestrian and cycling routes to, from and within the study area considering its gently undulating terrain and riparian corridor. It will be important to connect internal roads within the precinct with direct pedestrian and cycle connections to allow access to the future centres, schools, retail, employment, public transport nodes and other trip attractors in the area.

Natural and built constraints within the precinct include:

- South Creek which divides the site.
- Camden Valley Way (located along the eastern border of the study area) restricts opportunities for cycle and pedestrian connectivity to the east.

Existing proposals, including shared paths and pedestrian overbridges, would significantly improve pedestrian and cycling connectivity to the surrounding network. The proposed cycle routes on Camden Valley Way, Oran Park Drive and Rickard Road will improve the connectivity to the regional cycle network, providing links to Leppington major centre, Oran Park Town Centre and towards Campbelltown. It is important for proposed pedestrian and cycle facilities within the precinct to integrate with these planned facilities.

Within the precinct, cycle routes are proposed along all collector roads, providing connectivity within the precinct and to other main attractors including neighbourhood centres, proposed schools (including St Justin's and St Benedict's), parks and sports fields. The proposed street network is conducive to encouraging pedestrian and cycle trips.

There is also opportunity to provide recreational paths along the riparian corridor. Providing a recreational trail together with linkages to parks and sports fields would encourage cycling and provide facilities for recreational cyclists.

In order to ensure connectivity of the pedestrian network the provision of regular pedestrian crossing opportunities will be provided through the provision of dedicated pedestrian crossing facilities throughout the precinct and linear pedestrian walkways along both sides of South Creek.

Green Travel Plans for schools could encourage parents and children to walk, cycle or catch public transport for journeys to school. Reducing the number of local car trips to schools is likely to result in better health, better social interaction at the community level, air quality improvements and road safety benefits. This is also important in establishing behaviours which continue later in life and an important part of the development of healthy, active communities in the precinct.

6.0 Cross-sections

6.1 Introduction

Cross-sections for roads within the Catherine Field (part) Precinct have been revised following exhibition based on the Camden Growth Centres DCP. Relevant submissions and advice from TfNSW has also been considered. In addition, as Oran Park is the neighbouring precinct (to the west of the study area), with important road links to Catherine Field (part) Precinct such as Oran Park Drive, South Circuit, and Peter Brock Drive, cross-sections should be kept consistent across both precincts where possible.

The following sections set out (for each of the functional classification road types) the proposed cross-section width and composition of vehicle travel lanes (including bus lanes), parking, landscaping and verge, footpath and cycle facilities.

Given the nature of Catherine Field (part) precinct as a residential precinct, the entire road network within the precinct comprises of two-lane collector roads and local roads, with the exception of Rickard Road extension which will be reserved as a 4-lane corridor that would accommodate safe and efficient vehicular and bus movements (as agreed in the meeting with the relevant transport agencies dated 22 March 2012). The cross-section of Rickard Road, other collector roads and local roads will be highlighted in the following sections.

6.2 Rickard Road extension

Transit Boulevards are similar to Sub-arterial roads in that they generally have two vehicle travel lanes in each direction and connect the collector road network and the regional arterial road network.

The recommended cross-section of Rickard Road within the precinct has taken into account the Camden Growth Centres DCP (cross-section for transit Boulevards and sub-arterial roads), consultation with TfNSW and discussions with other stakeholders. The final recommendations adopt some elements of the cross-sections outlined in the Camden Council DCP. The proposed cross-section for Rickard Road is subject to detailed design however is anticipated to include varying cross-section widths. This includes:

- **A Road Reserve of 23m (excluding at intersections with the North Precinct Connection and South Circuit).** The road reserve includes 14m for traffic and 9m for pedestrian/cycle paths and landscaping. This road reserve will not be appropriate in proximity to the above intersections (distance subject to detailed design)**.**
- **A Road Reserve of 27.2m at intersections with the North Precinct Connection and South Circuit. This includes a median of 4.2m** (as per the standard for a Sub-arterial road in the Camden Growth Centres DCP). The additional median width is sufficient to cater for the seagull intersection turning bays recommended as part of this study (note that this width is below the 5m standard median for a Transit Boulevard identified in the Camden Growth Centres DCP). There is potential for this wider road reserve to be used in other locations along Rickard Road within the precinct should the future accommodation of right turn bays at local road intersections be desired. Note that the required length of this road reserve is subject to detailed design requirements.
- **Each 2-lane carriageway along Rickard Road should be 7m wide.** This is above the recommendation for a Transit Boulevard (6.5m) and below that of a Sub-arterial road (7.75m) in the Camden Growth Centres DCP. This will enable express buses to overtake slower local buses along the corridor, allowing for more efficient bus movements.
- **The left lane of each 2-lane corridor operates as a transit lane.** This is possible as regular traffic is capable of operating on a single lane up to and including 2036. Buses would stop in this lane to allow passengers to alight at designated bus stops;
- **No on street parking provision.** On-street parking would reduce the functionality of Rickard Road as a Transit Boulevard and require the provision of a wider road reserve. Parking for local residents would instead be provided via rear laneways;
- **No direct property access.** This will reduce vehicle conflicts and improve the efficiency of both bus operations and the off-road cycleway. Property access will instead be provided via rear laneways;
- **Off-Road separated cycle lanes.** These are required in order to ensure that fast and efficient cycling is possible along the corridor in the absence of an on-road cycleway. An on-road cycle lane would be likely to

conflict with buses (as advised by TfNSW), and there is a good opportunity for off-road cycle lanes due to restricted direct property access for vehicles. Cycle lanes would have limited interruptions and cyclists could maintain speeds similar to those used on-road whilst avoiding buses.

- Width gained on the corridor due to the removal of the on-road cycle lane allows space for the off-road cycle lanes to be separated from the pedestrian path within the recommended road reserve. Note that the Camden Growth Centres DCP cross-sections show on road cycle lanes on Transit Boulevards and off-road shared paths for Sub-arterial roads. The recommendation outlined above is not consistent with either of these cross-sections; however it is considered the most appropriate option based on consultation with relevant stakeholders;
- Off-road cycle paths provide increased safety by separating vehicles and cyclists on these higher order roads with increased traffic volumes and vehicle speeds and appeal to a variety of cyclists. On Transit Boulevards, separate off-road cycle lanes also help to reduce potential conflict with buses.

Note that of the 4.5m designated on the outside of the carriageway it is anticipated that 1.5m would be used for footpath (incorporating property clearance and property boundary utilities as required), 1.5m for a dedicated cycle lane (one way) and 1.5m for planting and kerb. It is assumed that the dedicated cycle lane will be separated from the footway using pavement markings (subject to detailed design).

Table 11: Rickard Road Cross-section (indicative)

Street type	Cycle/ Ped Paths	Planting/ Landscape	Travel Lanes	Median	Travel Lanes	Planting/ Landscape	Cycle/Ped Paths	Total Width
Rickard Road extension (outside the vicinity of Collector Road intersections)	**4.5m**		**7.0m**		**7.0m**	**4.5m**		**23m**
Rickard Road extension (in the vicinity of Collector Road intersections)	**4.5m**		**7.0m**	**4.2m**	**7.0m**	**4.5m**		**27.2m**
Transit Boulevard Camden GC DCP	5.7m		6.5m	5m	6.5m	5.7m		29.4m
Sub-arterial Road Camden GC DCP	4.7m		7.75m	4.2m	7.75m	4.7m		29.1m

Source: AECOM based on Camden Council Growth Centres DCP, stakeholder consultation and TfNSW bus operating requirements

6.3 Collector roads

Collector roads have a balance of traffic and urban functions, linking local streets to the strategic road network. These roads should be designed to accommodate public transport routes. Amenity and safety on collector roads should be maintained by restricting vehicle speeds through traffic-calming measures and intersection design. Internal roads that link local roads have been classified as collector roads within the precinct. Intermittent parking with landscaping is provided on both sides of the street. All the collector roads are designed to facilitate safe and efficient bus movements.

Collector Roads within the precinct will retain a 20m road reserve consistent with the Camden Growth Centres DCP. It is anticipated that will be some variation in the carriageway width within the road reserve in order to accommodate safe bus movements at bus stops**. Figure 16** represents the regular cross-section, while the cross-section at bus stops is subject to detailed design and likely to include:

- A wider carriageway to ensure buses can overtake other stopped buses;
- Removal of planting;
- Bus shelters incorporated into shared paths.

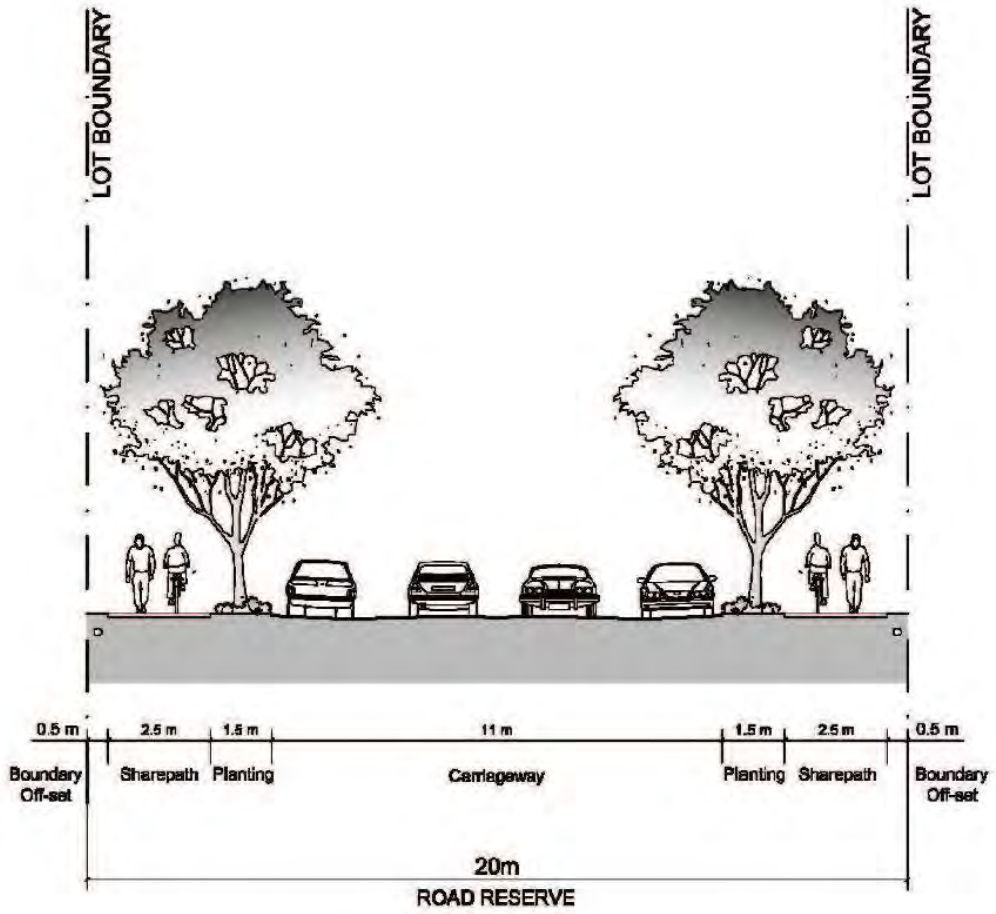
The cross-section for collector roads within the precinct is shown in **Table 12** and **Figure 16** respectively.

Table 12: Collector Road Cross-section

Street type	Planting	Shared path	Parking/ Landscape	Travel Lanes	Travel Lanes	Parking/ Landscape	Planting	Shared Path	Total Width
Collector Road (Camden GC DCP)	4.5m			5.5m	5.5m	4.5m			20.0m
Collector Road at Bus Stops	3.3m			6.7m	6.7m	3.3m			20.0m

Source: AECOM, 2013

Figure 16: Collector Road cross-section



Source: Camden Council South West Growth Centres DCP

6.4 Local roads

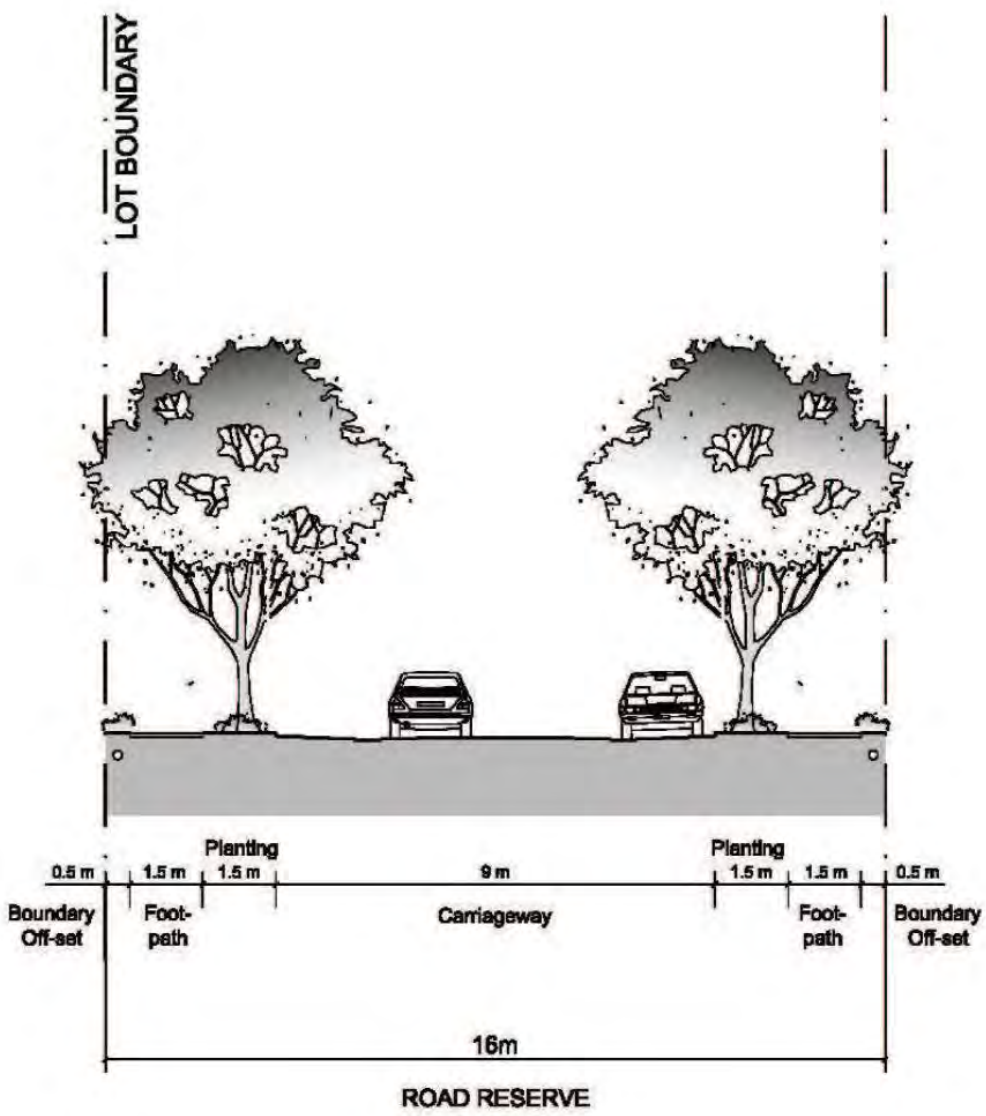
Local roads provide an urban function and are intended to carry low volumes of traffic and be amenable for cycling without needing dedicated bicycle facilities, whilst providing a comprehensive network to aid and encourage walking. They also provide local residential access and one lane of on-street parking and therefore have a high level of amenity.

Table 13: Local Street Cross-section

Street type	Footpath	Planting	Parking	Vehicle Lane	Vehicle Lane	Planting	Footpath	Total Width
Typical local roads	3.5m		9.0m			3.5m		16.0m

Source: Camden Council Growth Centres DCP

Figure 17: **Local Street Typical Cross-section**



Source: Camden Council Growth Centres DCP

Within the precinct one local road is proposed to have the capacity to accommodate buses – the proposed road to the rear of St Benedict's School, which connects between Rickard Road and Harrington Drive and provides bus access to two schools. This road would maintain a standard local road reserve throughout its length, however along the school boundary the carriageway would be widened to accommodate buses. The school-adjacent cross-section is subject to detailed design and is likely to include:

- Restrictions to remove on-street parking during school peak periods;
- A widened carriageway;
- Removal of planting (adjacent to the school only) to accommodate a wider pedestrian footpath.

Table 14: Local Street Cross-section adjacent to St Benedicts School

Street type	Footpath	Bus Loading	Vehicle Lane	Vehicle Lane	Planting	Footpath	Total Width
Local road bus capable	2.5m	10.0m			3.5m		16.0m

Source: Camden Council Growth Centres DCP

7.0 Conclusions

7.1 Road network

The strategic road network analysis has assisted in determining appropriate future road hierarchy and methods of control for intersections across the proposed road network for the Catherine Field (part) Precinct. The designated road network hierarchy focuses vehicular access on the most appropriate routes onto arterial roads via higher order corridors. Vehicles are distributed through the precinct via the network of collector roads then via local streets to individual land parcels.

The key strategic route serving the precinct is Camden Valley Way, a principal arterial road providing services in a north-south direction. Oran Park Drive and Rickard Road extension link to Oran Park Town Centre and Leppington major centre by providing a high frequency bus corridor with bus priority and dedicated travel lanes at intersections. Peter Brock Drive and Dickson Road will also have a strategic public transport function. At full development of the South West Growth Centre, Camden Valley Way will require widening to three lanes in each direction in order to accommodate regional and local traffic (2036), and ensure minimal delay to buses on the Principal Arterial.

Two traffic lanes in each direction are recommended on Oran Park Drive and Rickard Road extension to facilitate safe and efficient bus movements and to accommodate future traffic growth. All other collector roads and local roads within the precinct require only one traffic lane in each direction, with localised widening at intersections, bus stops and parking lanes as required.

All the intersections within the precinct have been designed so they will accommodate future year traffic volumes associated with the proposed full development of the Catherine Field (part) Precinct (2036) as well as wider regional development. The intersections within the precinct will operate at an acceptable level of service during the morning peak hour and evening peak hour, with appropriate forms of control.

Excessive queue lengths are identified at the intersection of Camden Valley Way / Oran Park Drive / Gregory Hills and at Camden Valley Way / Springfield Road. In 2036 these intersections are operating at Level of Service F. This is generally due to the high volumes of traffic forecast for Camden Valley Way.

Within the precinct, signalisation is proposed for the intersections of Oran Park Drive | Rickard Road | Forest Grove Drive and Oran Park Drive | Dan Cleary Drive. These intersections are both four-arm with traffic volumes in 2036 forecast to exceed the minimum RMS signal warrant requirements. Connecting Dan Cleary Drive to Oran Park Drive will act to improve the accessibility for all modes to the Catherine Field (part) Precinct, will enhance the connectivity of the neighbourhood centre and improve access to proposed schools.

A heavy vehicle weight limit may be required within the precinct to limit the amount of through traffic and heavy vehicles traversing the residential area.

7.2 Public transport network

The precinct will benefit from public transport accessibility through a bus network and servicing strategy linking key centres, transport nodes, schools, employment opportunities and residential areas.

The proposed bus strategy for this precinct is consistent with the SWGC Road Network Strategy and will broadly follow the South West Growth Sector Bus Servicing Strategy. The proposed long term bus network for the precinct will comprise a mixture of regional routes and district routes to maximise speed and efficiency of high frequency peak hour services as well as a number of local bus routes to ensure maximum coverage throughout the precincts, facilitating public transport access and travel choice.

The combination of the Regional and District routes and the potential for local routes on the collector road network provides an efficient and flexible bus network to serve the future Catherine Field (part) precinct. The long term bus strategy has been updated by TfNSW in order to accommodate the road layout of the precinct and provide greater acknowledgement of the Oran Park bus hub and Rickard Road transit corridor.

Key bus operating corridors with services providing fast, efficient regional connections will operate along the east-west route (Oran Park Drive) and on the north-south route (Rickard Road extension), with links between notable regional destinations such as Leppington major centre, Oran Park Town Centre, Liverpool, and Campbelltown.

Roads serving bus routes should have two lanes in each direction or one lane in each direction with a parking lane that could accommodate a bus stop. Lane widths need to be a minimum of 3.5 metres. Oran Park Drive and

Rickard Road extension are both identified as critical links (with 2 lanes in each direction) in the bus network for bus priority measures.

7.3 Walking and cycling

A comprehensive bicycle network is proposed for the precinct which will link the centres, schools, transport nodes and various residential neighbourhoods with key strategic routes and onward destinations. The proposed bicycle network will include a mixture of dedicated bicycle facilities which will take the form of:

- Off-Road (Shared Path)
- Off-Road (Cycle Lane)
- Off-Road (linear shared pathways along South Creek)

Camden Valley Way, designated as principal arterial road, will have shared path bicycle facilities in addition to a 2m wide shoulder on both carriageways that could potentially be used by on-road cyclists. Off-road cycle lanes are proposed along Rickard Road providing for fast, efficient connections both within the precinct; travel to Oran Park Town Centre and Leppington Town Centre and to regional destinations such as Camden and Campbelltown.

All collector roads connecting key origins and destinations within the precinct and onto other external destinations will have dedicated shared path bicycle facilities. The proposed cycling connections are designed to create a continuous network of facilities removing obstacles and barriers to cycling, both physical and perceived. Physical crossing points of the creek have been included in the bicycle network plan to ensure route connectivity and network permeability.

It is also proposed to provide recreational paths along the South Creek riparian corridor. This would act to improve linkages to parks and sports fields across the precinct.

All proposed roads throughout the precinct will have dedicated pedestrian footpaths to create a comprehensive network following proposed road alignments. In order to ensure connectivity of the pedestrian network the provision of regular pedestrian crossing opportunities will be provided through the provision of dedicated pedestrian crossing facilities throughout the precinct.

The proposed road grid network and block sizes will also work to facilitate pedestrian permeability and be conducive to encouraging walking trips. As the network has been designed around a linear grid structure the regular cross streets with pedestrian footpaths, and block sizes will encourage pedestrian activity, and achieve a high level of permeability.

In addition, Green Travel Plans for schools could encourage parents and children to walk, cycle or catch public transport for journeys to school. Reducing the number of local car trips to schools is likely to result in better health, social interaction at the community level, air quality improvements and road safety benefits. This is also important in establishing behaviours which continue later in life and an important part of the development of healthy, active communities in the precinct.

Appendix A

Submissions Review

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Memorandum

To	Lee Mulvey	Page	1
CC	Nathan Herborn		
Subject	Catherine Field (part) Precinct Preliminary Submission Review		
From	Dan Riley		
File/Ref No.	60286713	Date	27-Feb-2013

The following review identifies relevant submissions relating to traffic and transport. A preliminary response is provided to address/consider the implications of the issues raised. All comments are subject to the revised ILP and Rickard Road Corridor Study. The key issues are summarises as follows:

- Landowners generally prefer a reduced proportion of road space and lower housing densities;
- Landowners adjacent to CVW prefer B4 mixed Use;
- Local Road access to the Catholic Schools is requested at the rear of the site (Schools, TfNSW);
- Hixson prefers Rickard Road to abut the transmission line easement and include direct property access;
- Hixson prefer medium density to be more flexible in its location;
- Hixson's suggested ILP removes all but one road crossing of Oran Park House Drive;
- The Cobbitty Road link is contentious. Hixson is seeking its removal due to high traffic, GCD2 prefers the access relocated to the north, while Camden Council request that the route is retained with a roundabout at the intersection with Oran Park Drive;
- Hixson request reductions in cross section width, GCD2 prefer That cross sections are consistent with Oran Park while Council prefer cross sections to reflect growth centres DCP;
- The width of Rickard Road is contentious. TfNSW prefer 4 lanes with SWGC Cross sections and no car parking along the route. Hixson prefer two different cross sections north and south of the creek, while Council suggest that the Rickard Road cross section should be subject to the Rickard Road study;
- TfNSW, RMS and Council prefer Peter Brock Drive turning north to reflect RMS Road Network Strategy;
- Signals only supported by TfNSW at Harrington Road / OPD if warrants are met;
- TfNSW request that the intersection of OPD and CVW is reviewed for potential traffic mitigation measures;
- TfNSW requests confirmation over Rickard Road corridor classification (SP2?);
- The updated bus network strategy should be taken into account;

Relevant Submissions	Relevant Items (Transport)	Comments
Endeavour Energy	"Where necessary, the substation easement location and size shall be altered and increased as shown to ensure that the retaining wall (or vehicle impact protection device, such as bollards) is wholly within the one property boundary and the easement includes the retaining wall (or vehicle impact protection device). If this condition cannot be met, an	To be addressed during detailed design.

Relevant Submissions	Relevant Items (Transport)	Comments
	alternative may be considered on application".	
Landowner	"There are too many roads proposed for our land. Thereby reducing the number of lots available for housing. This in turn will affect us financially when we decide to sell our property."	A balanced outcome will be sought whereby the local road network provides suitable property access and appropriate connections to key locations. Note that the current layout is designed to provide access to medium density housing.
Camden Valley Way Landowners Submission	This submission presents a case for non-residential land use in the properties fronting Camden Valley Way: "Amend the Indicative Layout Plan to present mixed use employment activities in the subject properties; and amend the draft Zoning map to zone the properties 'B4 Mixed Use' (and correspondingly amend the associated height, FSR, lot size, density and other maps to suit)".	Camden Valley Way is unable to provide direct access to the area fronting Camden Valley Way other than a proposed Left in Left out. Therefore access to this property area must be provided via the internal road network through other residential areas. Should such a land use change take place, the layout and nature of the internal road network would need to be adjusted in order to accommodate a change in land use (to mixed use), including the provision of further collector roads enabling HGV access to the area.
YMCA	Recommends a local/youth community facility to include four outdoor courts "co-located with the planned neighbourhood centre to create an integrated community recreation and community service hub".	The co-location of the youth/community centre and outdoor courts in a community hub is supported from a transport planning perspective. This location would provide good bus and active travel links to the rest of the precinct via the collector road network.
	The submission states that the community facility should be: • "Integrated into the planned footpath and cycle networks for Catherine Fields". • "Accessible by public transport. Provision for parking through open-planned parking spaces to allow for weekend community markets and other community events". • "Completely accessible for people with a disability to ensure that the facility is truly for the whole community".	The Addendum Transport and Access Strategy will continue to ensure that all public facilities are well serviced by public transport, walking and cycling networks.
Catholic Education Office	• "2.3.4 of the Transport and Access Strategy document – Access to St Benedict's (secondary) and St Justin's (primary) schools will be via Oran Park Drive, but schools will no longer be expected to have access from Rickard Road". • "Through ongoing consultation and negotiation with RMS and Camden Council the signalised intersection into the schools	The Addendum Transport and Access Strategy will reflect the changes to school access agreed following exhibition (and outlined in the submission of the Catholic Education Office). This includes a main access via the rear of the site. No direct access will be provided to Rickard Road.

Relevant Submissions	Relevant Items (Transport)	Comments
	site from Oran Park Drive will no longer be required". • "The Catholic Education Office strongly supports the development of the road to the immediate north of the school site which will assist in traffic movement in, out and around the schools". • "The development of Rickard Road to the east of the schools site has been supported by the Catholic Education Office with the draft precinct plan correctly displaying education land set aside for the establishment of the intersection and road". • "The two schools are extremely supportive of the expected provision of "high quality walking and cycling routes to the schools".	
South Western Sydney Local Health District	"Consideration should be given to the timely upgrade of transport systems, required for the population growth in Catherine Field as well as surrounding precincts".	A short-term bus strategy will provide public transport access at an early stage of development. This will encourage residents to utilise public transport from an early stage.
	"It is noted that there are plans to upgrade Camden Valley Way and Oran Park Drive and Develop Rickard Road. The timely upgrade of these roads is required to link the precinct to Leppington Town Centre and to cope with increased traffic flow from surrounding developments".	Transit boulevards will require construction at an early stage in order to connect the precinct to public transport hubs such as Leppington and Campbelltown.
Hixson part 1 Submission	The Hixson Submission provides a number of recommendations for inclusion in the revised ILP and Addendum Transport and Access Strategy. These are outlined below.	Relevant recommendations provided in the submission by Hixson will be assessed for their feasibility as part of AECOM's review of the precinct plan. Where appropriate, these recommendations will be incorporated into the Addendum Transport and Access Strategy. This includes an assessment of a realigned internal road network (including Rickard Road) in consultation with the master-planner.
	The realignment of Rickard Road so that the road abuts the existing transmission line easement.	In principle, there is potential to re-align Rickard Road adjacent to the transmission line easement, however this will be dependent on the results of the independent study into the alignment of Rickard Road.
	Provision for property access along Rickard Road.	The possibility for direct property access from Rickard Road is dependent on the road width which is subject to the revised modelling undertaken as part of the

Relevant Submissions	Relevant Items (Transport)	Comments
		Addendum Transport and Access Strategy. Note that regardless of the road width, direct property access along Rickard Road is not favoured as this conflicts with its role as a "collector with a transit function".
	An altered local road layout (incl. Oran Park House) to include reduced crossings of the Oran Park House Driveway, reduced overall road coverage and single lane roundabouts on Rickard Road.	The road network within and adjacent to the precinct will be re-assessed for traffic impacts based on the recently released BTS traffic data. Recommended intersection treatments will be included in the Addendum Transport and Access Strategy. While AECOM understands the desire to maximise land profitability by reducing the space allocated to roads, this should not adversely impact upon local accessibility. This will be considered as part of the precinct plan review.
	AECOM signals at western end of the school are no longer valid. Access to the school has changed so that the main access will be located on the north side of the site.	Post-exhibition changes agreed for school accesses will be incorporated into the Addendum Transport and Access Strategy.
	Recommendations for several amendments to the DCP, including increasing density in areas that have a variety of transport options, (not just public transport) and precinct specific road designs.	Best practice is for medium density housing to be located in locations with 'high levels of public transport', as opposed to locations with access to 'a variety of transport options'.
	A new cycle / pedestrian network that alters and removes some links.	The suggested Cycle and Pedestrian network has removed some active travel routes from Collector Roads. Cycle and pedestrian routes should be retained where possible, and on all collector roads.
	The removal of the Collector Road connection to Cobbitty Road.	Addendum Transport and Access Study to consider the location of precinct access points, including Cobbitty Road.
	Direct property access from collector roads.	This is acceptable as Collector Roads will have only one traffic lane in each direction.
	Sports fields to be relocated to Rickard road.	Sports fields would ideally be located in areas served by public transport and/or co-located with the neighbourhood centre to achieve ideal transport outcomes.

Relevant Submissions	Relevant Items (Transport)	Comments
	An off-road shared path on Oran Park Drive (rather than on-road cycle lane).	Cycle and pedestrian infrastructure along Oran Park Drive to be confirmed in Transport and Access Strategy.
	Reductions in cross section widths: • Reducing road space of Collector Roads from 20m down to 18.5m resulting in one lane of on-street parking and one shared path. • Reducing Local Road widths from 16m down to 14.4m losing a lane of parking and one footpath. • A revised cross section for Rickard Road with the inclusion of a 4m median south of South Creek. For aesthetic reasons and consistency with Forest Grove Drive. Identifying that road cross-section diagrams provided in the Transport & Access Strategy may be out of date and have not considered the latest infrastructure requirements.	Recommendations for changes to precinct road cross-sections will be considered in consultation with the Project Working Group. Any changes will be incorporated into the Addendum Transport & Access Strategy.
	Identifying that the Transport & Access Strategy does not consider utility service allocations.	Detail of Utility Service Allocations will be confirmed at the detailed design stage.
Hixson part 2a (Christopher Hallam)	Concerned with ambiguity in the number of lanes required on Collector Roads.	Collector Roads are proposed to include one traffic lane in each direction, with one parking lane on each side. These parking lanes will discontinue where bus stops are required.
	Deems direct property access is appropriate for Rickard Road, based on traffic flows and cross-sections in the Transport and Access Strategy.	The possibility for direct property access from Rickard Road is dependent on the road width which is subject to the revised modelling undertaken as part of the Addendum Transport and Access Strategy. Note that regardless of the road width, direct property access along Rickard Road is not favoured as this conflicts with its role as a "collector with a transit function".
	A reason is identified for Hixson's preference to remove the connection from Dan Cleary Drive to Cobbitty Road; "Detailed subdivision planning by Hixson Pty Ltd of the area immediately south of Oran Park has identified an area where a concentration of traffic will have the potential to exceed environmental capacity guidelines". It goes on to state that; "the immediate effect of the deletion of Dan Cleary Drive is that traffic flows on the link down to Oran Park Drive / Harrington Parkway would increase" and suggests the re-modelling of this intersection to	Traffic operations and intersection requirements in the vicinity of Dan Cleary Drive, Cobbitty Road, Oran Park Drive and Harrington Parkway will be reviewed as part of the Addendum Transport & Access Strategy.

Relevant Submissions	Relevant Items (Transport)	Comments
	check if it warrants signals.	
	Raises concern of rat run to OPD through precinct immediately west of CVW.	The updated ILP will be reviewed to identify any potential rat runs.
GCD2 part 1 submission	"The proposed regional road hierarchy, as reflected in the draft ILP does not provide for the planned endorsed Transit Boulevard Connection between Oran Park Town Centre and Leppington Regional Centre".	The Transit Boulevard between Leppington and Oran Park Town Centre is proposed to utilise Springfield Road and Rickard Road north of Springfield Road.
	"The AECOM report does not recommend that the Rickard Road extension be provided as a Transit Boulevard. This road is identified only as a local bus route, with the Transit Boulevard extending to the Oran Park Town Centre".	The AECOM report identifies Rickard Road as a "Collector Road with Transit function". This will be re-assessed and confirmed as part of the Addendum Transport and Access Strategy.
	A new Road hierarchy is suggested whereby the Rickard Road Transit Boulevard curves toward Oran Park Town Centre, while Rickard Road is a sub-arterial south of Springfield Road.	A curved Transit Boulevard is unlikely to occur due to land ownership issues. The connection of the Transit Boulevard to Oran Park Town Centre will be reviewed within the Addendum Transport and Access Strategy.
	Proposed zone change to low density residential on all land owned by GDC2.	A mixture of low and medium density housing is likely to occur within the precinct. The location of these zones will be determined by the Masterplanner as part of the revised ILP.
	An ILP Review indicates a Collector Road linking with Oran Park Drive at a new intersection north of Cobbitty Road.	Traffic operations and intersection requirements in the vicinity of Dan Cleary Drive, Cobbitty Road, Oran Park Drive and Harrington Parkway will be reviewed as part of the Addendum Transport & Access Strategy.
	Road layout based more on contours to reduce costs.	The internal road layout will be reviewed by the Masterplanner as part of the revised ILP.
	Proposes to locate the school on GDC2 land adjacent to the collector road linking the Precinct to Oran Park.	The position of the school is subject to detailed design.
	"We request that the road cross sections be amended to adopt the existing adopted road cross sections endorsed by Camden Council in the Oran Park and Turner Road DCPs".	The road cross sections included within the Transport and Access Strategy are consistent with those agreed for the Oran Park Precinct.
State Emergency Service	"Evacuation must not require people to drive or walk through floodwater".	For consideration by the Masterplanner.
Camden	Camden Council's submission identifies a number of	Any additional public space to be located

Relevant Submissions	Relevant Items (Transport)	Comments
Council	transport related issues including a "Drastic undersupply of public space".	adjacent to a collector road, preferably co-located with the neighbourhood centre.
	"As a general comment, Council notes that although adjoining Oran Park and Turner Road, it is appropriate for Catherine Fields (Part) Precinct to be subject to the Growth Centres DCP as it reflects the latest Council requirements and specifications that may not be present in the Oran Park and Turner Road DCPs".	Discussion with Camden Council will be undertaken to confirm road cross-sections.
	"Council supports the extension of Dan Cleary Drive (Cobbitty Road) into the precinct. It is noted that there are two options for this intersection outlined in the report by AECOM. Council requests that this intersection be restricted to a roundabout in design and that this is incorporated into the Development Control Plan Schedule for Catherine Fields Part Precinct".	Traffic operations and intersection requirements in the vicinity of Dan Cleary Drive, Cobbitty Road, Oran Park Drive and Harrington Parkway will be reviewed as part of the Addendum Transport & Access Strategy. The design of intersections will be confirmed following assessment of the updated traffic flows.
	"Rickard Road as proposed is suitable, but is subject to the outcomes of the Rickard Road Route Strategy. Council looks forward to working with the Department further on this matter".	
	"As requested throughout the planning process, Council is supportive of Peter Brock Drive entering into the precinct to ensure its funding and construction as well as providing connectivity between the precinct and Oran Park Town Centre. However, Council urges the Department to reconsider the layout of the ILP as it relates to Peter Brock Drive to ensure it turns north sooner to be consistent with the SWGC Road Network Strategy, rather than connect with Rickard Road extension. The current layout will lead to a major and fundamental change to the Road Network Strategy and the modelling the RMS has carried out to formulate this strategy. Whilst Council understands the Department's position of not endorsing the Strategy, Council is supportive of the Strategy and requests that it be followed in the planning for Catherine Fields Part Precinct".	The feasibility of connecting Peter Brock to Dickson Road will be assessed as part of the Addendum Transport and Access Strategy.
	"Council supports the connection to South Circuit in Oran Park over Kolombo Creek. Council requests that the proposed connecting road be given priority over South Circuit at their intersection and that this be reflected in any traffic study update carried out as part of post exhibition works."	The intersection of South Circuit and the precinct access road (collector) to Oran Park will be updated in the modelled network to reflect the priority of the precinct access road.
TfNSW & RMS	"Further Consultation is sought regarding the proposed alignment of Peter Brock Drive which differs significantly from the RMS South West Growth	To be addressed in Addendum Traffic Report

Relevant Submissions	Relevant Items (Transport)	Comments
	Centre Road Framework".	
	"TfNSW continues to support a four lane configuration for Rickard Road allowing for dedicated bus priority and higher average speeds".	
	"It is noted that the location of Peter Brock Drive extension is not consistent with its alignment in the South West Growth Centre Road Network Strategy which swings sharply to the north connecting with Springfield Road west extension. TfNSW and RMS request a meeting to confirm their understanding of the engineering impediments to providing Peter Brock Drive along its original alignment as shown in the *South West Growth Centre Road Framework*. It is also important this issue is resolved from a bus servicing perspective. If the Peter Brock Drive connection to Rickard Road as currently proposed is ultimately constructed then greater bus operating costs will be incurred by Government as some of the potential bus services in Figure 1 would need to deviate off route to resume their normal routes, incurring additional travel distance and travel time".	Subject to preliminary corridor assessment.
	"RMS grants "in principle" approval to an additional left in/left out access off Camden Valley Way subject to the intersection being designed to RMS requirements. Details of the intersection should be submitted to RMS for review and approval. Ensuring adequate provision is made for bus services is also a critical component of this approval and TfNSW can provide comment when required".	
	"The forecasted traffic volume on Rickard Extension as shown in the figure 6, page 19 of the report appears lower than the forecasted traffic volume from EMME models, particular in PM peak hour. The Catherine Fields Draft Precinct Plan submissions report should discuss the difference between the EMME models forecast and the Cube models forecast for the precinct".	Subject to revised modelling
	"On road safety grounds, all vehicular and pedestrian accesses to St Benedict's and St Justin's schools should be via local roads".	Does this include collector roads?
	"An electronic copy of SIDRA models should be submitted to RMS for determination of the geometric layout of the intersections. The intersection of Catherine field Road/Oran Park Drive/Forrest Grove Drive in particular should be supplied with the updated Cube modelling results. It should be noted that the intersection of Catherine field Road/Oran Park Drive/Forrest grove Drive will become the main access point to the precinct until the connections to	

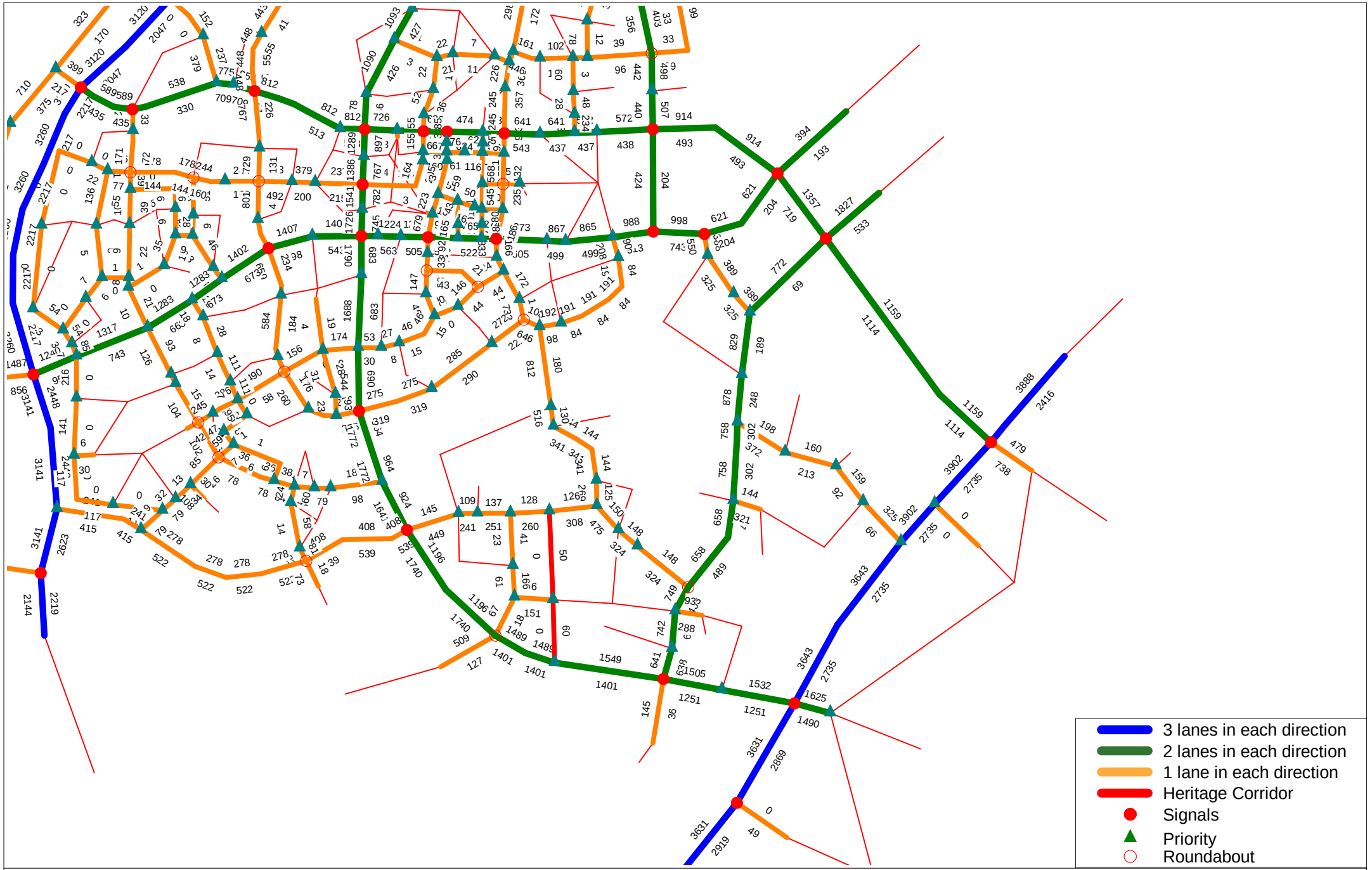
Relevant Submissions	Relevant Items (Transport)	Comments
	Peter Brock Drive and Springfield Road are available".	
	"No RMS approval has been granted to the traffic signals at Catherine field/Oran Park Drive/Harrington Parkway intersection and Oran Park Drive/Cobbitty Road intersection. RMS will only grant approval to the provision of traffic signals if the warrants as specified in the Traffic Signal Design Guide, Section 2 – Warrants, are met".	Traffic levels to be confirmed.
	"The intersection of Peter Brock Drive/Rickard Road extension should be modelled to identify the appropriate traffic control device and the geometric layout of this intersection".	
	"It is noted that the report (page 23) states that the excessive queue lengths are identified at the intersection of Camden Valley Way/Oran Park Drive/Gregory Hills Drive for right tuning vehicles approaching from the east (AM & PM peak) and west (AM Peak). Investigation should be undertaken to identify whether any mitigation measure are required at this intersection as a result of the precinct development".	Subject to revised traffic assessment.
	"TfNSW/RMS have noted the proposed classified road (SP2) zone on the Catherine Fields (Part) Precinct – South West Growth Centre Land Zoning Map where Rickard Road extension is proposed to connect to Oran Park Drive. TfNSW understands the Catherine Fields developer is now assuming responsibility for this section of Rickard Road and purchased the majority of the land in January 2013. It is also understood that arrangements are nearly finalised for the developer to construct a road on the remainder of the corridor. The net effect will be that the final land acquisition mapping presented to the Minister of Planning and Infrastructure will not show a SP2 classified road corridor. TfNSW supports this approach and would appreciate immediate advice if this understanding is not correct".	
	"TfNSW supports the delivery of the intersection of Rickard Road and Oran Park Drive by the precinct proponent prior to the first urban lot as proposed under the terms of the draft Voluntary Planning Agreement".	
	"Road noise attenuation should be provided in accordance with the draft Camden Growth Centre Precinct Development Control Plan. Physical noise barriers (ie. Noise walls or solid fencing) are not supported along Camden Valley Way".	

Relevant Submissions	Relevant Items (Transport)	Comments
	"The upgrading of Oran Park Drive and the signalised intersection of Catherine field Road/Oran Park Drive/Forrest Grove Drive should be programmed for provision in the first stage of development".	
	"TfNSW and RMS continue to prefer the transit boulevard/sub-arterial road cross sections as specified in the South West Growth Centre strategy".	Noted.
	"TfNSW continues to support the reservation of a fourth lane corridor for Rickard Road extension that will accommodate safe and efficient strategic bus movements. The Rickard Road cross section Figure 15 (Reproduced as Figure 3 below) should be amended to delete reference to parking in the 3.5 metre bus lane as this is a significant impediment to bus network efficiency. If DP&I and Camden Council are determined that parking should be allowed in the kerb side lane of Rickard Road (lane 2) then the width of the inner lane should be widened from 3.25 metres to 3.5 metres to better accommodate bus passing".	Noted.
	"The Long term bus network for the south west is currently being reviewed in line with the updating of the South West Bus Servicing Strategy. Figure 6 shows the potential bus network for the precinct connecting it to Camden, Campbelltown, Leppington, Liverpool and Narellan. Further bus coverage may be provided by local bus routes and operated along the collector road network. Figure 31 (reproduced below as figure 5) in the Catherine Fields Precinct Planning Report would need to be updated to reflect the proposed bus network in Figure 1. DP&I must ensure that the roads indicated in red dotted line are also designed to be capable of accommodating bus movements".	Will be reviewed as part of Addendum Traffic Study.
	"TfNSW notes the proposed 1ha centre in the southern section of the precinct is not located near any of the AECOM proposed bus routes but are proposed by TfNSW as per the Figure 6 diagram. This highlights TfNSW earlier comments regarding the need for collector roads to be able to accommodate two passing buses on two 3.5 metre lanes and parallel parking that meets AS 2890.5 – On Street Parking Facilities".	Noted.
	"DP&I must ensure that the Development Control Plan for the precinct requires that should a school be constructed at the proposed northern indicative school location, bus turn around bays would need to be constructed on the collector road that the school site fronts to allow buses operating on the potential bus route to divert via the school at school start/finish	Subject to finalised school location.

Relevant Submissions	Relevant Items (Transport)	Comments
	times and resume the normal route with the shortest diversion as possible. This is identified in Figure 1".	
	"DP&I must ensure that the Development Control Plan for the precinct requires that if a school is constructed at the proposed northern indicative school location, bus turn around bays would need to be constructed on the collector road that the school site fronts to allow buses operating on the potential bus route to divert via the school at school start/finish times and resume the normal route with the shortest diversion as possible. This is identified in Figure 1".	
	"TfNSW supports the traffic and transport report finding (page iii) that indented bus stops are not recommended".	
	"TfNSW supports the mix of predominantly low to medium density housing along Rickard Road as shown in Schedule 3 of the proposed Development Control Plan. This will support the proposed high frequency, high speed and priority bus service between Liverpool, Leppington, Oran Park and Campbelltown. The relevant graphic is reproduced at Figure 8 below".	
	"The Active Transport network (figure 6) appears appropriate".	
	"The cycling facilities should be provided in general in accordance with Australian Standard AS1742.9, Austroads, RMS supplements for Austroads, and NSW Bicycle Guidelines. Pedestrian refuges are to be designed in accordance with Australian Standard 1742, RMS Technical direction, RMS supplements for Austroads".	

Appendix B

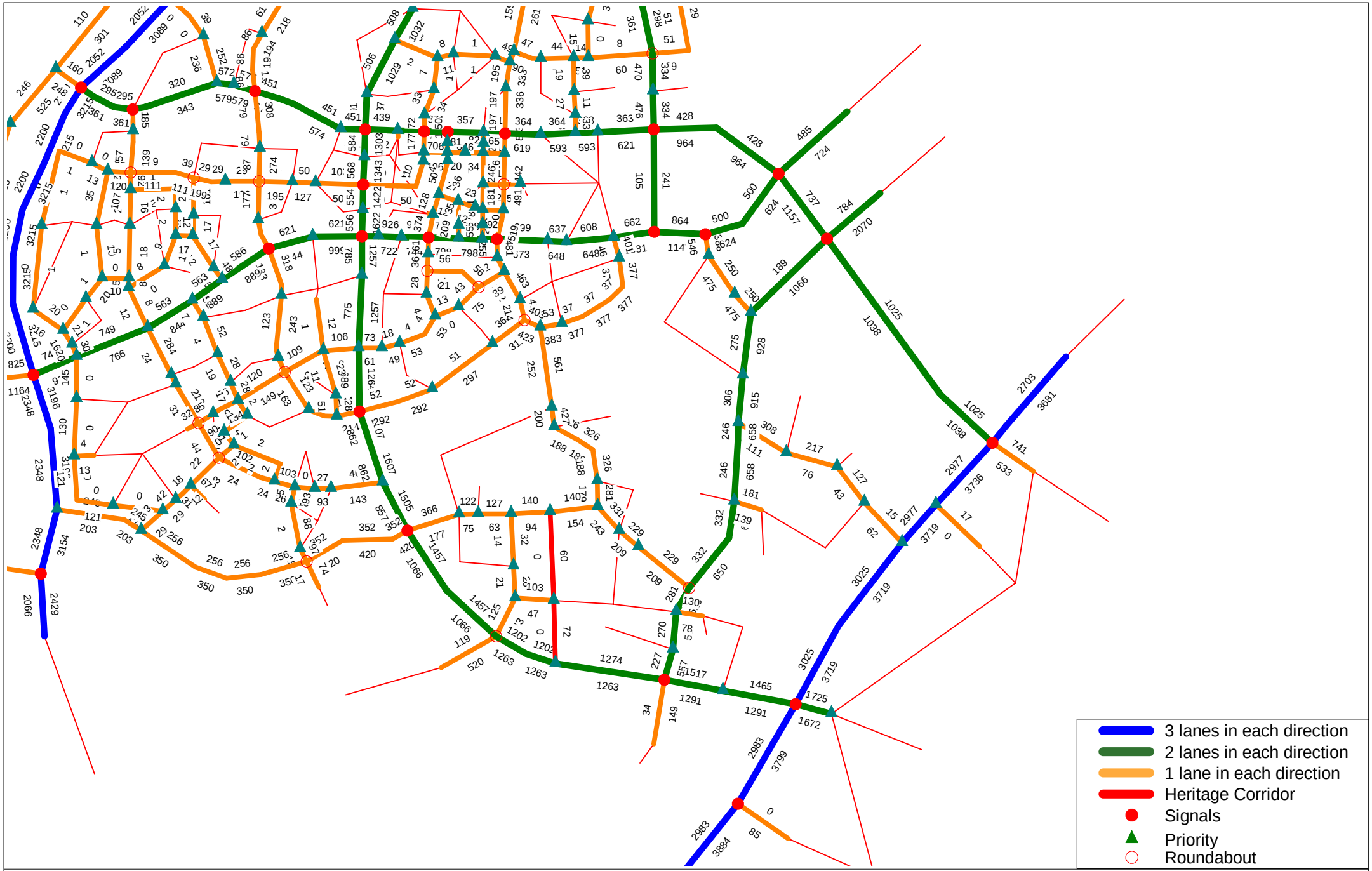
Forecast Traffic Volumes



Catherine Field Precinct Model

Scenario: 0595 - 2036 Full Development - am peak Hour

cube



Catherine Field Precinct Model

Scenario: 0596 - 2036 Full Development - pm peak Hour

cube

Appendix C

Peter Brock Drive Extension – Strategic Concept Design Report

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9th May 2013

Lee Mulvey - Department of Planning and Infrastructure

c/o Hixson Pty Ltd
PO Box 42
Narellan NSW 2567

Dear Lee

Catherine Fields Precinct Plan - Peter Brock Drive Extension
Strategic Concept Design - Summary

We are pleased to provide a summary of the preparation of Strategic Concept Design for Peter Brock Drive (PBD) Extension as part of the Catherine Fields Precinct Planning process. This is with reference to our proposal letter dated 12th March 2013 and the subsequent purchase orders from Hixson dated 13th March 2013.

This strategic concept design has been prepared to identify potential alignments, review their interface with exisitng physical constraints and to identify future design development and regulatory requirements.

1. PETER BROCK DRIVE LOCATION AND DESCRIPTION

PBD is located within the Catherine Fields Precinct of the South West Growth Centre (refer to Figure 1).

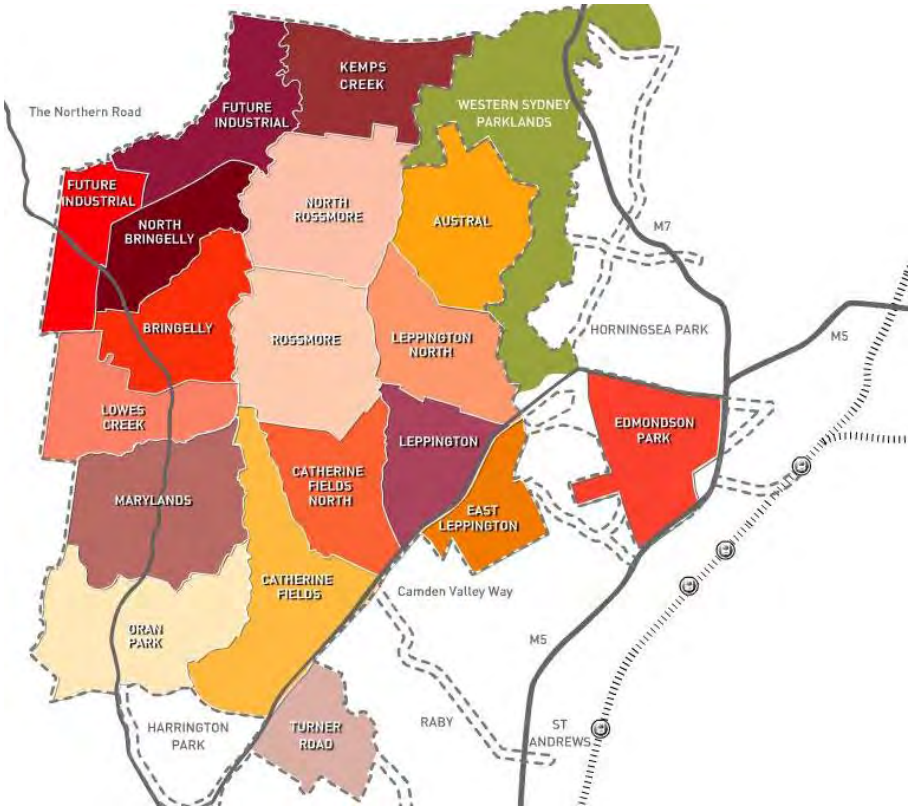

Figure 1 – Layout of Precincts within the South West Growth Centre

The existing PBD is an east west alignment linking existing and proposed developments within Oran Park. The existing PBD road is a four lane (two each way) sub-arterial road with a wide median which accommodates turning filter lanes to side roads. The posted speed is 60km/h.

PBD extension is proposed to link the existing PBD of Oran Park to a proposed new sub-arterial road north of Springfield Road.

2. CONSTRAINTS

The alignment of the PBD extension is constrained by several existing features, as described in the following sections.

a. Existing Waterways

The route of the PBD extension alignment will cross over South Creek. It is anticipated the proposed new road level should be designed to avoid flooding during the 1 in 100 year flood event. Further consultation with the State Emergency Service will be required during later design stages to confirm flood evacuation routes within this area.

South Creek is classified a 4th Order Stream (the highest level under the Strahler system) and will require an 40m riparian corridor on both sides of the main channel width.

In addition, where the road levels are on fill, a flood study should be completed to ensure that any works do not adversely impact the existing watercourse flood levels because of either reduced flood conveyance capacity or reduced flood storage.

b. Topography and Existing Land Use

The topography of the area to be occupied by the PBD extension is relatively flat with levels varying between 82.730m and 80.000m AHD. This is based on contour information provided by the Land & Property Management Authority.

The area to be occupied by the PBD extension is currently characterised as 'Primary Production Small Lots and Sydney Region Growth Centres' according to the 'Camden Local Environment Plan 2010'.

c. Infrastructure

There are two sets of aerial electrical transmission lines in the area of the proposed PBD extension, one at 330kV and one at 132kV. The 330kV lines are the Transgrid Wallerawang-Sydney South transmission line which traverses the proposed area for the PBD extension in a northwest-southeast alignment. The 132kV lines are Endeavour Energy transmission lines which traverses the proposed area for the PBD extension in a north-south alignment.

Refer to the attached 'Landpartners' survey drawing for details of the transmission lines. The road is understood to be required to pass between tower 289 and 290 of the 330kV transmission lines.

The design should be completed to ensure the vertical and horizontal clearance requirements of Transgrid, Endeavour Energy and Australia Design Standards are adhered to.

d. Stakeholder Requirements

Formal engagement with all regulatory stakeholders has not been undertaken as part of this study however the various requirements were established as part of consultation with Department of Planning and Infrastructure, Transgrid and Endeavour Energy.

3. DESIGN CRITERIA

Road layout requirements including the cross section have been adopted based on information from the Camden Council 2011 DCP.

Geometric design criteria adopted for the strategic concept design are presented in the attached design criteria spreadsheet. This has been developed through review of relevant design standards listed as follows:-

- Camden Council 2011 Development Control Plan
- Austroads, 2009, Guide to Road Design
- RTA, 2000, Road Design Guide
- AS/NZS 7000:2010 – Overhead Line Design – Detailed Procedures

4. STRATEGIC CONCEPT DESIGN OF PBD EXTENSION

a. Description

The proposed alignment for the PBD extension presented in the Strategic Concept Design drawings has been developed using the design parameters discussed in the following sections and the enclosed design criteria table.

The design speed has been set as 70 km/h to accommodate a posted speed limit of 60km/h (as for the existing PBD).

A connection road from the proposed South West Growth Centre Catherine Fields Precinct indicative layout plan (ILP) is required and is included within this strategic concept design. The connection road design speed has been set at 60km/h to accommodate a posted speed limit of 50km/h.

b. Horizontal Alignment

The proposed horizontal alignments of PBD extension and the Catherine Fields Precinct road connection are presented in drawings 60286713-DRG-CI0010 to 60286713-DRG-CI0013.

Key Aspects of the proposed horizontal alignments are as follows:-

- From the existing PBD the road will curve to the south and pass underneath the 132kV transmission lines before crossing over South Creek. The road will then begin to curve to the east and pass beneath the 330kV transmission lines as it curves to the north east to create a junction with Springfield Road.
- Curve radii have been designed to be greater than 300m to avoid the requirement for superelevation. This removes the requirement to flip the road crossfall on the proposed bridge over South Creek as a result of opposite turning curves at either end.
- The road has been designed to maintain minimum horizontal clearances of 30m to transmission lines supports in accordance with the requirements of Transgrid. The 30m clearance to the transmission lines supports has also been implemented for the Endeavour Energy lines.
- The horizontal alignment has been designed to reduce the impact to the riparian zone of South Creek by seeking to cross at an angle as close to 90° as practicable.
- The Catherine Fields Precinct road connection will form a T-junction with the PBD extension on the south side of the PBD extension between South Creek and the easement zone of the 330kV transmission lines. Transgrid do not allow signalised junctions within transmission line easement zones.

c. Vertical Alignment

The proposed vertical alignments of PBD extension and the Catherine Fields Precinct road connection are presented in drawings 60286713-DRG-CI0010 to 60286713-DRG-CI0013.

Key Aspects of the proposed vertical alignment are as follows:-

- From the existing PBD the road will generally follow the existing topographic levels as it approaches and passes beneath the 132kV transmission lines before rising up to cross over South Creek. After crossing South Creek the road will drop back down to follow the existing topographical levels whilst maintaining a minimum longitudinal fall of 1%.
- As the road passes beneath the 132kV transmission lines a minimum vertical clearance of 7.5m from wire at maximum operating temperature to road surface has been provided in accordance with AS/NZS 7000 and Endeavour Energy requirements. This is based on the existing vertical clearance information received from Endeavour Energy by email.
- The 100 year flood event level for the area of the bridge crossing is approximately 78.8m as reported by 'Brown Consulting' authors of the Catherine Fields (part) Precinct 'Water Cycle Management and Flood' report. The level of the road when crossing South Creek is between 80.350m AHD and 80.750m AHD ensuring clearance of the 100 year flood event plus 500mm freeboard level of 79.3m to reduce risk of future flooding of the road.
- As the road passes beneath the 330kV transmission lines a minimum vertical clearance of 12m from wire at maximum operating temperature to road surface has been maintained in accordance with the requirements of Transgrid. This is based on the Transgrid sketch enclosed as received by email. This is only achievable in close proximity to the transmission lines tower supports due to the sag of the wire, refer to Transgrid sketch.
- The vertical clearance constraints of the transmission lines on either side of South Creek prevent the possibility of bridging over the entire riparian zone of south creek. This is a departure of the Office Water requirement of no development within the riparian zone for a forth order stream and therefore direct consultation with the Office of Water should be completed at a later stage of design for approval.

The impact on flood levels from filling within the vicinity of the South Creek floodplain needs to be reviewed in detail as part of future investigations to ensure the works will not have any adverse impact on the flood behaviour.

d. Cross Section

The existing PBD is classified as a sub-arterial road and is currently a four lane road with filter lane median. Therefore it is proposed the road continue with the same cross-section in accordance with the requirements of the Camden Council 2011 DCP. See Table 1 for details of the cross section.

Table 1: Sub-Arterial Road Cross Section

Sub Arterial Road	Verge	Cycle Path	Parking Lane	Travel Lanes	Median	Travel Lanes	Parking Lane	Cycle Path	Verge	Total Width
Oran Park DCP	5.4m (3.0m shared path)	-	-	6.7m	4.2m	6.7m	-	-	3.9m (1.5m Shared path)	26.9m

The Catherine Fields Precinct connection road is required to accommodate buses and is therefore assumed toll be a four lane road with no median. The road is classified as a collector road and will be in accordance with the requirements of the Camden Council Growth Centres DCP. See Table 2 for details of the cross section.

Table 2: Collector Road Cross Section

Collector Road	Boundary Off-set	Sharepath	Planting	Carriageway	Planting	Sharepath	Boundary Off-set	Total Width
Growth Centres DCP	0.5m	2.5m	1.5m	14m (3.5m x4)	1.5m	2.5m	0.5m	23m

5. FURTHER WORK

The strategic level concept designs of PBD extension and Catherine Fields Precinct connection road as presented in drawings 60286713-DRG-CI-0010 to 60286713-DRG-CI-0013 have been prepared to inform the Catherine Fields Precinct planning process and to facilitate further discussion about the final design of the road.

There are a number of issues which have been identified during preparation of these strategic concept designs which need to be investigated in further detail as part of future design work:

- *Road Safety Audit* – A stage 1 and 2 Road Safety Audit should be undertaken as part of concept design development.
- *Flooding Impacts* – Bridge proposals will need to be reviewed through detailed hydraulic modelling to determine size and investigate potential impacts on the upstream and downstream flood levels.
- *Road Cross Section* – The final road cross section will need to be agreed with the relevant stakeholders to allow the final footprint of the corridor (and property impacts) to be identified.
- *Property Impacts* – Related to the above point, property impacts and required land acquisitions are to be investigated.
- *Detailed Intersection Design* – The current strategic level concept design does not include detailed modelling of intersections.
- *Stakeholder/Approval Authority Liaison* – As noted, this study has not involved formal liaison with stakeholders or approval authorities other than consultation with DP&I, Endeavour Energy and Transgrid. Prior to commencement of future design stages, formal consultation should be undertaken with relevant stakeholders and approval authorities.

Should you wish to discuss any of the points presented in this letter, please do not hesitate to contact the undersigned.

AECOM

Yours sincerely

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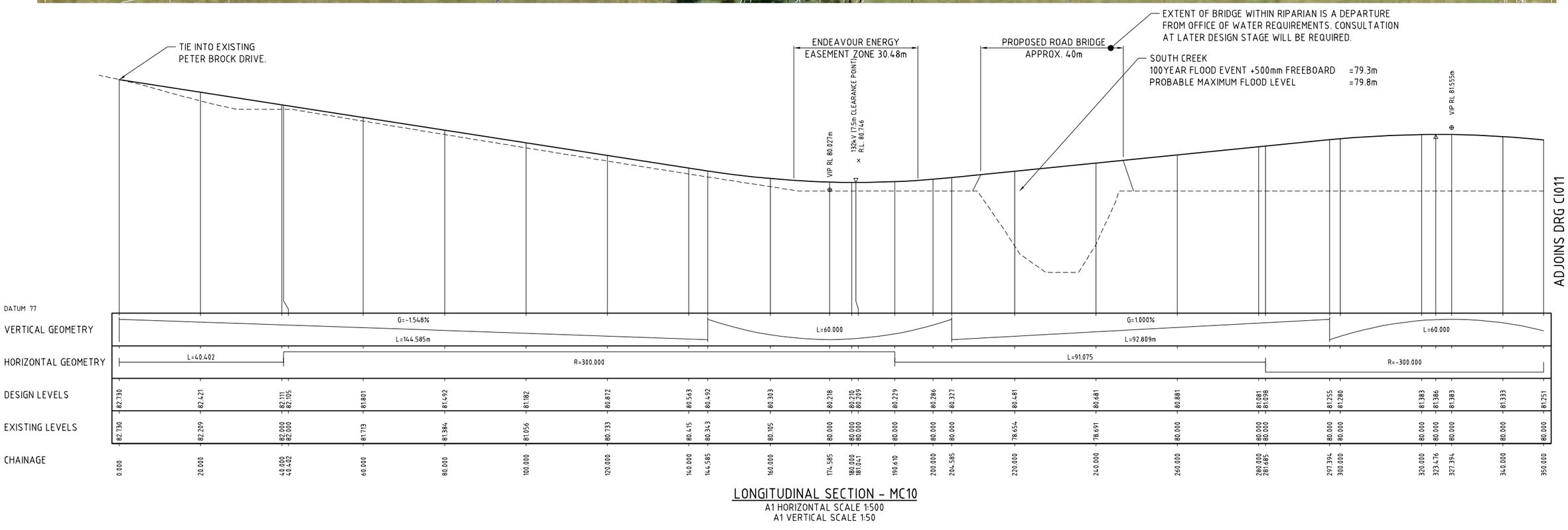
encl: Strategic Concept Design Drawings 60286713-DRG-CI0010 to 60286713-DRG-CI0013
Design Criteria
Transmission Line Sketch (source Transgrid)
LandPartners Transmission Line As-built survey

cc:
Andy Yung (AECOM)
Dan Riley (AECOM)

Cad ref: P:\60286713_CFPP_Review\5. CADD\5.3 Working\Drg\60286713-DRG-CI-0010.dwg Last modified: 09 May 13 - 14:27



LONGITUDINAL SECTION - MC10

A1 HORIZONTAL SCALE 1:500
A1 VERTICAL SCALE 1:50

REVISIONS					
No.	BY	DATE	DESCRIPTION	APPD
01	TR	06.05.2013	FOR INFORMATION	RW

Scales:

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001-2000

DESIGNED	BK	CHECKED	RW
DRAWN	TR	CHECKED	
APPROVED	RM	DATE	26.04.2013

THIS DRAWING IS CONFIDENTIAL AND SHALL ONLY BE USED FOR THE PURPOSES OF THIS PROJECT.

Contractor :

Client :

Designer :

AECOM Australia Pty Ltd
A.B.N. 20 093 846 925

Project: CATHERINE FIELDS PRECINCT PLAN

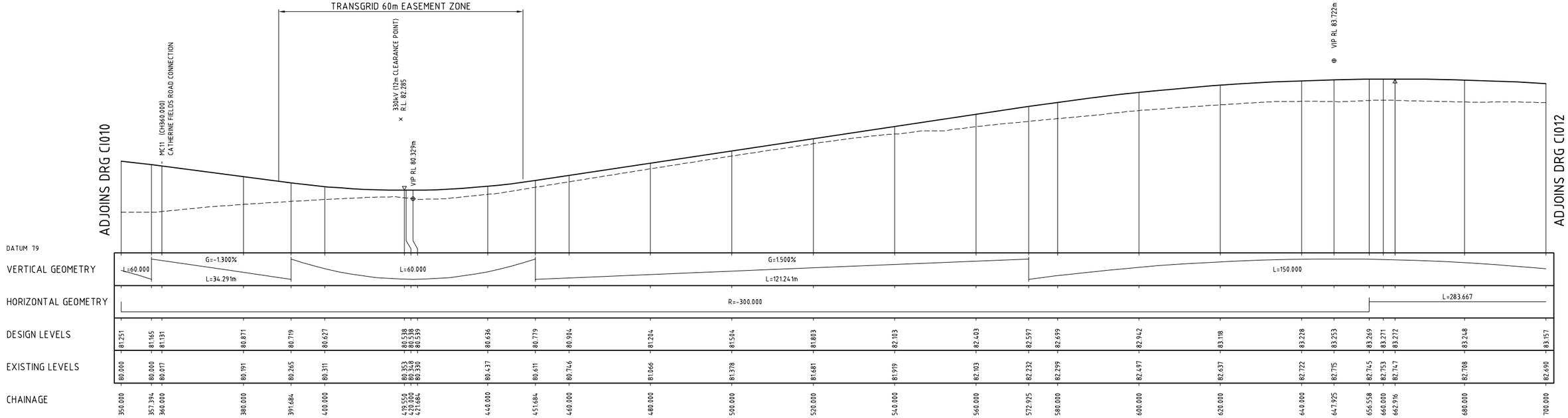
Title: PROPOSED STRATEGIC CONCEPT DESIGN FOR PETER BROCK DRIVE EXTENSION ROAD PLAN AND LONG ITUDINAL SECTION

SHT 1

Status: CONCEPT DESIGN

Drg No.: 60286713-DRG-CI-0010

Rev.: 01



LONGITUDINAL SECTION - MC10

A1 HORIZONTAL SCALE 1:500
A1 VERTICAL SCALE 1:50

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
01	TR	06.05.2013	FOR INFORMATION	RW

Scales:

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DESIGNED	BK	CHECKED	RW
DRAWN	TR	CHECKED	
APPROVED	RM	DATE	26.04.2013

Contractor :

Client :

Designer :

AECOM

AECOM Australia Pty Ltd
A.B.N. 20 093 846 925

Project: CATHERINE FIELDS PRECINCT PLAN

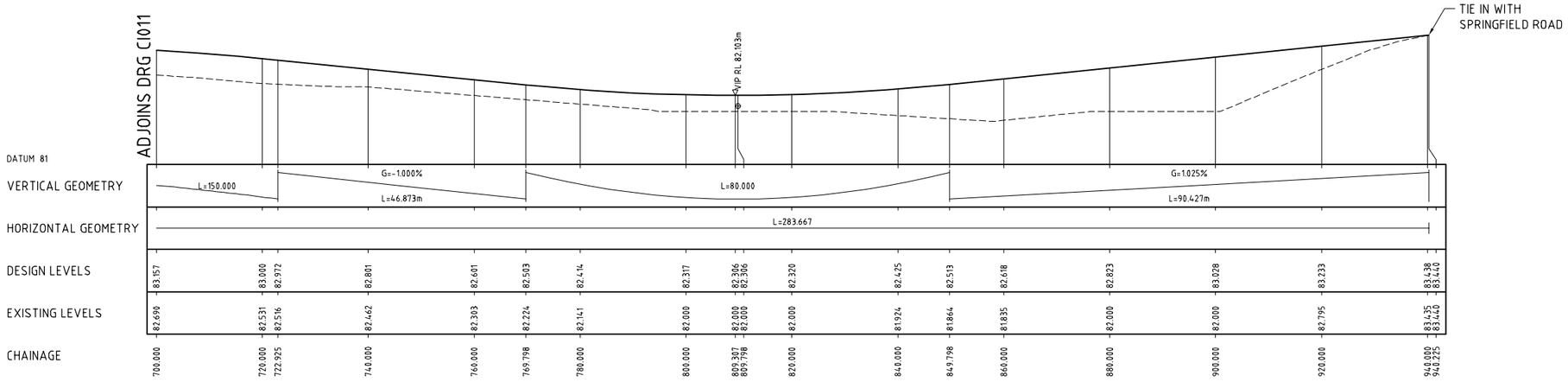
Title: PROPOSED STRATEGIC CONCEPT DESIGN FOR PETER BROCK DRIVE EXTENSION ROAD PLAN AND LONG ITUDINAL SECTION

SHT 2

Status: CONCEPT DESIGN

Drg No.: 60286713-DRG-CI-0011

Rev.: 01



LONGITUDINAL SECTION - MC10

A1 HORIZONTAL SCALE 1:500
A1 VERTICAL SCALE 1:50

REVISIONS

No.	BY	DATE	DESCRIPTION	APPD
01	TR	06.05.2013	FOR INFORMATION	RW

Scales:

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED	BK	CHECKED	RW
DRAWN	TR	CHECKED	
APPROVED	RM	DATE	26.04.2013

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Contractor :

Client :

Designer :

AECOM

AECOM Australia Pty Ltd
A.B.N. 20 093 846 925

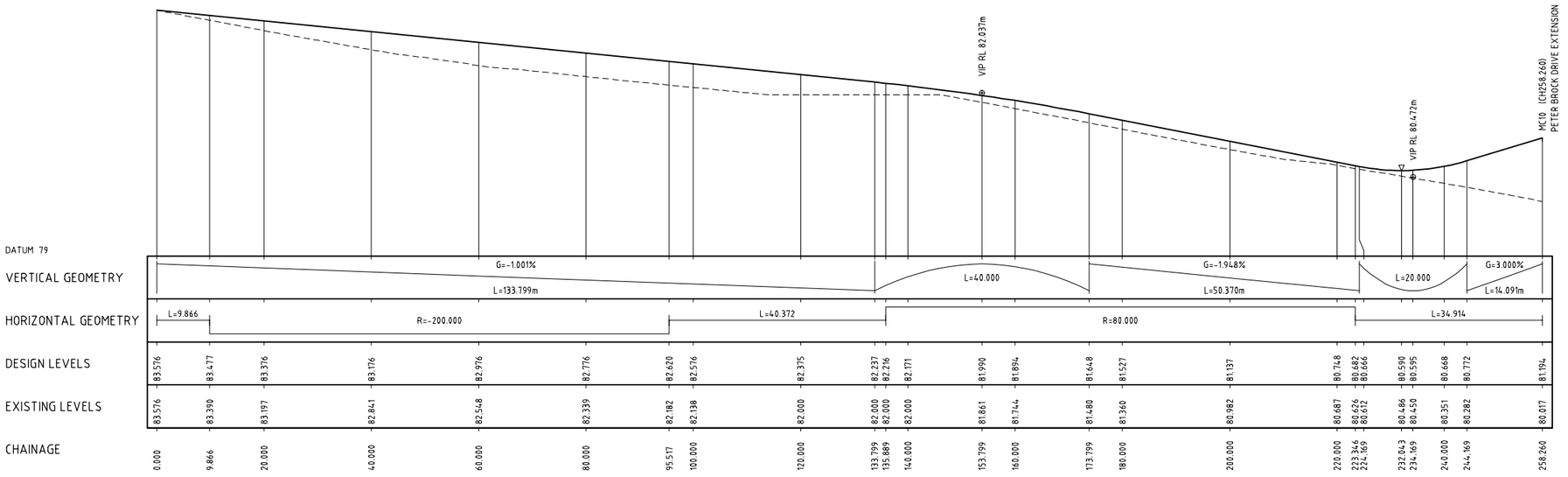
Project: CATHERINE FIELDS PRECINCT PLAN

Title: PROPOSED STRATEGIC CONCEPT DESIGN FOR PETER BROCK DRIVE EXTENSION ROAD PLAN AND LONG ITUDINAL SECTION SHT 3

Status: CONCEPT DESIGN

Drg No.: 60286713-DRG-CI-0012

Rev.: 01



LONGITUDINAL SECTION - MC11

A1 HORIZONTAL SCALE 1:500
A1 VERTICAL SCALE 1:50

REVISIONS					
No.	BY	DATE	DESCRIPTION	APPD
01	TR	06.05.2013	FOR INFORMATION	RW

Scales:

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED	BK	CHECKED	RW
DRAWN	TR	CHECKED	
APPROVED	RM	DATE	26.04.2013

Contractor :

Client :

Designer :

AECOM

AECOM Australia Pty Ltd
A.B.N. 20 093 846 925

Project: CATHERINE FIELDS PRECINCT PLAN

Title: PROPOSED STRATEGIC CONCEPT DESIGN FOR PETER BROCK DRIVE EXTENSION ROAD PLAN AND LONG ITUDINAL SECTION

SHT 4

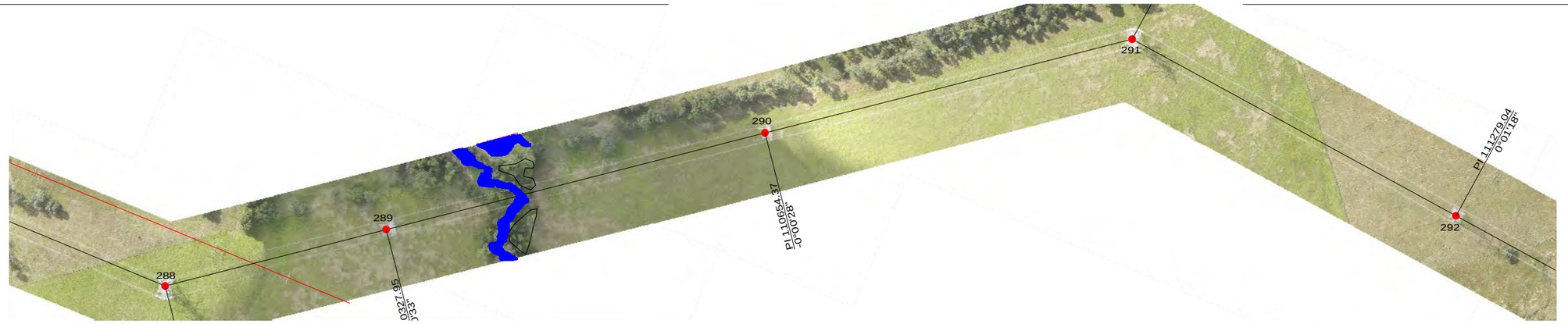
Status: CONCEPT DESIGN

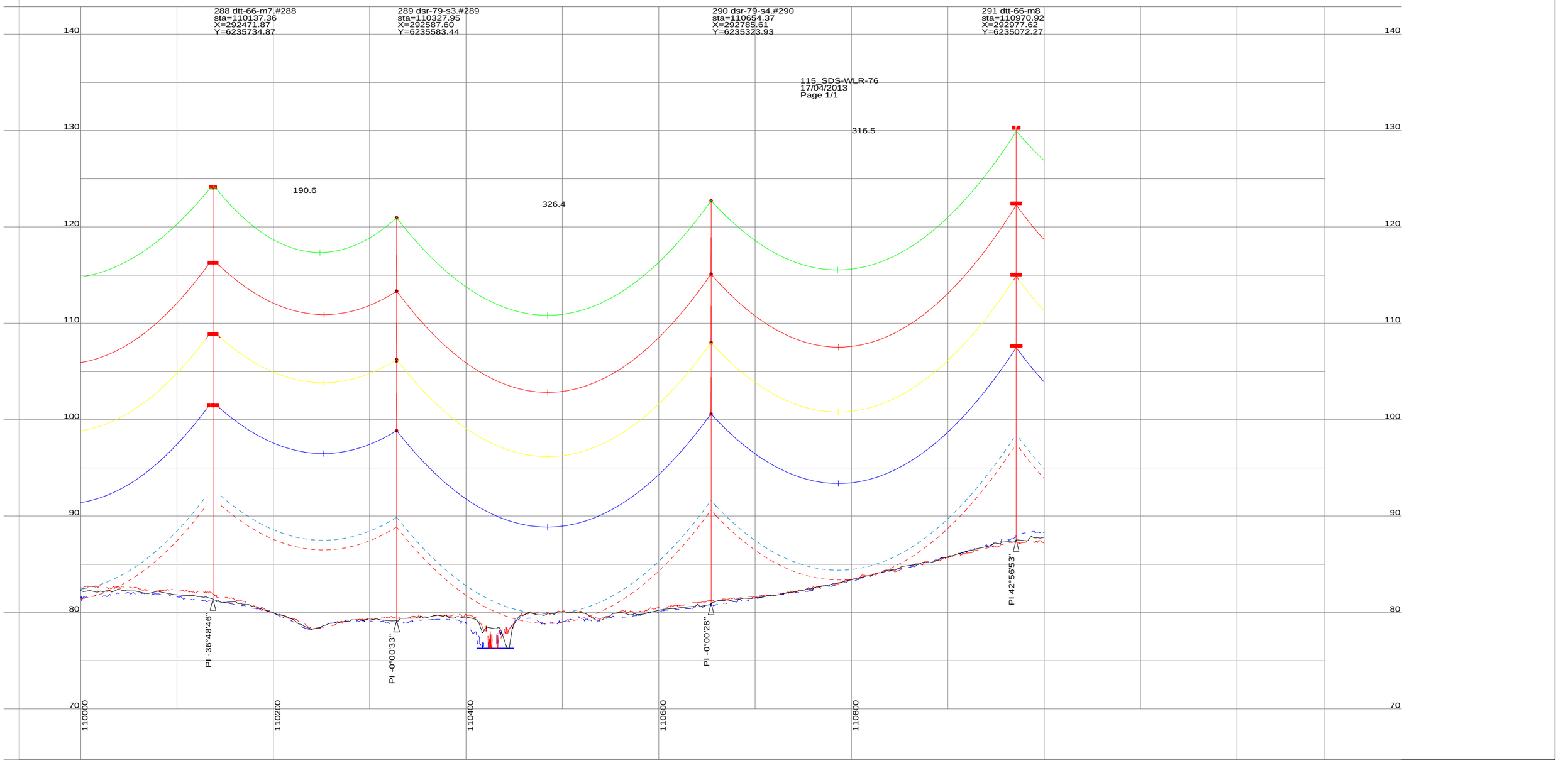
Drg No.: 60286713-DRG-CI-0013

Rev.: 01

Parameter	Design Criteria / Design Assumption	Resource	Comments
CROSS-SECTION			
Operating speed	60km/hr	Direction from client	
Design speed	70km/hr	Direction from client	
Full alignment surface width	As per standard for Sub-Arterial or Collector Road	Camden DCP	
Lane width	As per standard for Sub-Arterial or Collector Road	Camden DCP	
Lane Cross-fall	3%	Austroads Guide to Road Design 2009, Part 3 Table 4.2	
Footpath width	As per standard for Sub-Arterial or Collector Road	Camden DCP	
Footpath cross-fall	1% desirable, 2.5% maximum.	Austroads Guide to Road Design 2009, Part 3 Table 4.29	
Cycleway width	As per standard for Sub-Arterial or Collector Road	Camden DCP	
Cycleway cross-fall	1% desirable, 2.5% maximum.	Assumed	
Median width	As per standard for Sub-Arterial or Collector Road	Camden DCP	
Median cross-fall	3% minimum, 1V:6H maximum.	Austroads Guide to Road Design 2009, Part 3 Table 4.15	
Buses	Yes	Assumed	
Trucks	Yes	Assumed	
Design Vehicle	19.0m	Assumed	
VERTICAL ALIGNMENT			
Maximum grade	5 % desirable, 7% absolute maximum.	Austroads Guide to Road Design 2009, Part 3 Section 8.5.3	Assume "flat".
Desirable length of maximum grade	450m if use 5%, 300m if use > 6%.	Austroads Guide to Road Design 2009, Part 3 Table 8.4	
Minimum grade	1% desirable, 0.3% absolute minimum.	Austroads Guide to Road Design 2009, Part 3 Table 8.5	Roads with kerb and channel.
Flood level/water table	100 yr (78.8m) + 0.5m freeboard to underside of structure	Brown Consultings's 'Catherine Fields (part) Precinct - Water Cycle mangement and Flooding' May 2012	
Hortizontal distance between separated bridge structures	N/A		
Minimum length of crest vertical curve	50 - 60m	Austroads Guide to Road Design 2009, Part 3 Table 8.6	
Minimum K value for crest vertical curves	19.1	Austroads Guide to Road Design 2009, Part 3 Table 8.7	
Desirable minimum K value for sag curves	13 (with streetlighting), 21 (without streetlighting)	Austroads Guide to Road Design 2009, Part 3 Figure 8.7	
Maximum grade change without a vertical curve	0.7%	Austroads Guide to Road Design 2009, Part 3 Table 8.10	
Reaction time (Rt)	2.0s	Austroads Guide to Road Design 2009, Part 3 Table 5.2	
Sight stopping distance	92m car and 105m truck	Austroads Guide to Road Design 2009, Part 3 Table 5.4 & 5.5	Plus correction for grades
Vertical clearance to power lines	12m (for 330kV), 7.5m (for 132kV)	Transgrid and Endeavour Energy	Reference AS/NZS 7000
HORIZONTAL ALIGNMENT			
Spirals	N/A	Austroads Guide to Road Design 2009, Part 3 Table 7.2	Not required - low speed urban area
Side friction values	Des car 0.19, Abs max car 0.31, Des truck 0.14, Abs max truck 0.23.	Austroads Guide to Road Design 2009, Part 3 Table 7.4	
Minimum radius	Des min 161m, Abs min 107m.	Austroads Guide to Road Design 2009, Part 3 Table 7.5	Urban roads - 5% superelevation.
Max deflection angle not requiring horizontal curve	0.5 (4 lane), 1 (2 lane)	Austroads Guide to Road Design 2009, Part 3 Table 7.6	
Min length horizontal curve	140m	Austroads Guide to Road Design 2009, Part 3 Table 7.6	
Maximum superelevation	5%	Austroads Guide to Road Design 2009, Part 3 Table 7.7	
Superelevation development length (Le)	47m	Austroads Guide to Road Design 2009, Part 3 Table 7.9	-3% to +3% for 2 lanes
Min length of straight between curves	55m	Austroads Guide to Road Design 2009, Part 3 Section 7	
Minimum radii with adverse crossfall	300m	Austroads Guide to Road Design 2009, Part 3 Table 7.10	for 3% adverse crossfall
Curve widening per lane for design vehicle	0.59m	Austroads Guide to Road Design 2009, Part 3 Table 7.11	for 19m truck
Horizontal clearance from power supports	30m	Transgrid and Endeavour Energy	to back of roadside footpath
INTERSECTIONS			
Alignment of approaches	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 2	
Minimum downgrade approaching intersection	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 2	
Minimum upgrade approaching intersection	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 2	
Minimum approach sight distance (ASD)	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 3	
Minimum crest curve size (K) for ASD	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 3	
Minimum safe intersection sight distance (SISD)	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 3	
Minimum crest curve size (K) for SISD	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 3	
Minimum gap sight distance (MGSD)	Not included as part of study	Austroads Guide to Road Design 2009, Part 4A Section 3	
DESIGN LIFE			
Pavement/widening	Not included as part of study	Austroads Guide to Road Design 2009, Part 3 Section 4	
Bridges	Not included as part of study	Austroads Guide to Road Design 2009, Part 3 Section 4	
Tunnels	N/A		

PLS-CADD Drawing





Transgrid Wallerawang-Sydney South transmission line sketch 20130418
Source: Transgrid by email

M.G.A. NORTH (ZONE 56)

NOTE:
HINGE = FIXED HINGE FOR CONDUCTOR
WIRE = CONNECTING WIRE TO BOTTOM OF CONDUCTOR

TOWER 289
N.S. =RL 78.87
WIRE =RL 99.06
HINGE =RL 102.36

TOWER 290
N.S. =RL 80.75
WIRE =RL 100.85
HINGE =RL 104.09

TOWER 291
N.S. =RL 87.32
WIRE =RL 106.85
HINGE =RL 107.46

H TYPE POLE
N.S. =RL 78.22
WIRE =RL 86.36
HINGE =RL 86.48

H TYPE POLE
N.S. =RL 79.29
WIRE =RL 91.86
HINGE =RL 93.44

H TYPE POLE
N.S. =RL 79.75
WIRE =RL 90.72
HINGE =RL 92.29

H TYPE POLE
N.S. =RL 81.13
WIRE =RL 93.89
HINGE =RL 94.96

H TYPE POLE
N.S. =RL 81.75
WIRE =RL 95.63
HINGE =RL 97.21

TOWER 292
N.S. =RL 88.30
WIRE =RL 108.42
HINGE =RL 111.75

LOT 239
DP 705154

291
DP 708154

D P 3 1 9 9 6

TRANSGRID
WALLERAWANG–SYDNEY SOUTH
330Kv Transmission Line

TOWER 293
N.S. =RL 87.43
WIRE =RL 107.59
HINGE =RL 110.93

TOWER 294
N.S. =RL 91.24
WIRE =RL 109.18
HINGE =RL 112.51

292
DP 708154

D P 3 1 9 9 6

TOWER 295
N.S. =RL 87.70
WIRE =RL 107.65
HINGE =RL 108.15

28
D P 2 1 3 3 3 0

D P 3 1 9 9 6

H TYPE POLE
N.S. =RL 83.41
WIRE =RL 95.86
HINGE =RL 97.45

H TYPE POLE
N.S. =RL 83.28
WIRE =RL 94.30
HINGE =RL 95.88

H TYPE POLE
N.S. =RL 85.53
WIRE =RL 99.97
HINGE =RL 99.58

LOT 999
DP 1164435

ENDEAVOUR ENERGY
132Kv Transmission Line

H TYPE POLE
N.S. =RL 86.16
WIRE =RL 97.26
HINGE =RL 98.85

H TYPE POLE
N.S. =RL 86.86
WIRE =RL 99.23
HINGE =RL 100.81

H TYPE POLE
N.S. =RL 87.74
WIRE =RL 99.22
HINGE =RL 99.74

LOT 27
DP 213330

D P 3 1 9 9 6

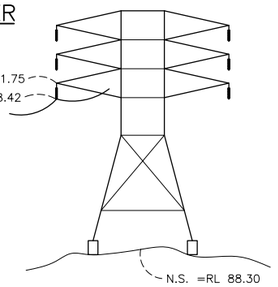
D P 3 1 9 9 6

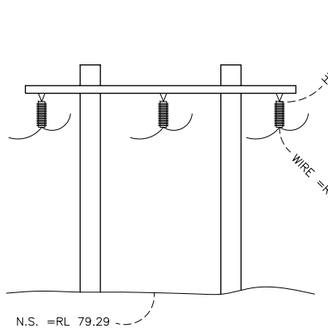
ORAN PARK
DEVELOPMENT

CAMDEN VALLEY WAY

ORAN PARK DRIVE

TRANSGRID TOWER
NOT TO SCALE





ENDEAVOUR H TYPE POLE
NOT TO SCALE

100 0 100 200 300 400 METRES

SCALE 1 : 4000

NOTES

* BOUNDARY DIMENSIONS AND AREAS HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE AT LPI. NSW AND ARE SUBJECT TO FINAL SURVEY.
* CONTOURS IF SHOWN ARE AN INDICATION OF THE TOPOGRAPHY AND SHOULD ONLY BE USED FOR PLANNING PURPOSES. IF DETAILED DESIGN IS TO BE UNDERTAKEN, SPOT LEVELS SHOULD BE USED.
* DO NOT SCALE OFF THIS PLAN – RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES IS DIAGRAMMATIC AND IF CRITICAL SHOULD BE CONFIRMED BY A BOUNDARY SURVEY.
* NO SERVICES SEARCH HAS BEEN UNDERTAKEN. SERVICES SHOWN ARE BASED ON SURFACE INDICATORS EVIDENT AT THE DATE OF SURVEY DURING FIELD SURVEY & CHARTED AS A GUIDE TO THE POSITION & NATURE OF THE SERVICE.
* THE POSITIONS OF ANY UNDERGROUND SERVICES, INCLUDING FIBRE OPTIC CABLE, HAVE NOT BEEN DETERMINED.
* NO "DIAL BEFORE YOU DIG" SEARCH HAS BEEN UNDERTAKEN. CONTACT "DIAL BEFORE YOU DIG" ON Ph: 1100 PRIOR TO COMMENCING WORK ON SITE.

NOTE:
THESE PLANS SHOULD BE READ IN CONJUNCTION WITH DIGITAL DATA ISSUED TO CLIENT. THE DIGITAL DATA CONTAINS NUMEROUS LAYERS OF INFORMATION WHICH ARE NOT SHOWN ON THESE PLANS FOR THE SAKE OF CLARITY.

LJMc

CLIENT
VALAD PROPERTY GROUP

PROJECT
DETAIL SURVEY
OF
TRANSMISSION LINE SURVEY
ORAN PARK DRIVE
& CAMDEN VALLEY WAY
SOUTH CATHERINE FIELDS

NOTES
The title boundaries shown hereon were not marked at the time of survey and have been determined by plan dimensions only and not by field survey.
Services shown hereon have been located where possible by field survey. If not able to be so located, services have been plotted from the records of relevant authorities where available and have been noted accordingly on the plan. Where such records do not exist or are inadequate a notation has been made hereon.
Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

PPP/CF	LPL	DD/MM/YY	COMMENT

Symbols shown are indicative only. The symbol size and orientation does not necessarily represent the real size or orientation of the feature.

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e sydney@landpartners.com.au
w www.landpartners.com.au
ISO 9001:2008 FS 535063

HEIGHT DATUM: AHD	LOCAL AUTHORITY: CAMDEN COUNCIL
HEIGHT ORIGIN: SSM 20148 RL 94.809	SCALE: 1:4000 (A1)
MERIDIAN: 56	CONTOUR INTERVAL: N/A
CO-ORD SYSTEM: MGA	SURVEYOR: MC — DATE OF SURVEY: 07/12/11
CCAD FILE: 73032	DRAWN: LJMc — DATE: 10/12/11
AUTOCAD FILE: 73032 Detail	CHECKED: MC — DATE: 12/12/11
ARCHIVE FILE: 73032	APPROVED: GKO — DATE: 12/12/11

PLAN NUMBER
73032.006

SHEET 1 OF