WAVERLEY'S PEOPLE, MOVEMENT AND PLACES

A STUDY OF WHERE WE GO AND HOW WE GET THERE

KEY ISSUES REPORT

FOR

WAVERLEY COUNCIL

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Project No: P2336 Version No: 007 Issue date: 30th November 2017

DOCUMENT CONTROL SHEET

Issue History

Report File Name	Prepared by	Reviewed by	Issued by	Date	Issued to
P2336.001 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	08/01/2016	Sara.Stace@waverley.nsw.gov.au
P2336.002 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	01/03/2016	Sara.Stace@waverley.nsw.gov.au
P2336.003 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	03/03/2016	Sara.Stace@waverley.nsw.gov.au
P2336.004 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	14/04/2016	Sara.Stace@waverley.nsw.gov.au
P2336.005 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	20/04/2016	Sara.Stace@waverley.nsw.gov.au
P2336.006 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	25/05/2016	Sara.Stace@waverley.nsw.gov.au
P2336.007 People Movement Places Issues Working Paper	B. James/ M.Zeibots	D. Bitzios	D. Bitzios	30/11/2017	Sara.Stace@waverley.nsw.gov.au

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EXECUTIVE SUMMARY

Background Information

The Waverley LGA has unique and complex transport demands compared to other parts of Sydney. Prior to this study, Waverley Council (Council) had commissioned a number of transport strategies and traffic and parking improvement investigations. Some of the recommendations from those studies have been implemented although many of the recommendations are best described as "aspirational".

Council has lingering concerns regarding the growth in traffic and parking congestion affecting the quality of life of Waverley residents and has initiated this study to generate strategies that can be implemented to improve traffic and transport conditions in Waverley.

This study aims to create specific improvement actions by understanding how people travel, by understanding their movement patterns across the LGA and by understanding the key places they visit.

Foundation strategies and policies that set the scene for this study include:

- the NSW Long Term Masterplan - identifies current and future transport needs across the state and in particular Sydney and has identified key transport corridors whilst setting service levels for Public Transport mode and interchanges. In eastern Sydney the plan classes Bondi Junction as a "major centre" and the link between Bondi Junction and the Sydney CBD as "intermediate" (requires good all day services); and
- the Waverley Together 3 and Waverley Transport Plan - aiming for sustainable community, living, governance and environment. Outlines roads, walking and cycling, public transport and parking as key areas needing improvement to achieve this. The plan has a sustainable transport emphasis with key targets including an average VKT per person decline of 15% and making 40% of total travel distance by public or active transport modes.

This report is the first of two study reports and summarises all of the relevant processes, studies and data. Through stakeholder discussions, data analysis and site observations this report synthesises the key traffic and transport issues facing the Waverley LGA into the future.

A number of current and past planning investigations and action plans have been reviewed for relevance to this study including Bondi Junction Complete Streets, the Waverley Access and Mobility Plan, the Waverley Bike Plan and the Bondi Beach and Pavilion Plan of Management and Masterplan.

International best practice has also been reviewed including public transport travel speed relationships with general road travel speeds and ways of achieving higher active transport modal splits. The recent research consensus is that increasing road space does not necessarily improve travel speeds or congestion and that management of travel, including modal choice, is key. Innovative parking strategies such as SF Park that use parking sensor technology and adaptive demand management have also been reviewed for relevance to parts of Waverley.

Understanding the characteristics of Waverley's population is critically important to identify its future transport challenge as well as to dissect the basis of existing issues. Based on Bureau of Transport Statistics (BTS) NSW data the LGA is forecast to have a population growth of 0.93% p.a. from 2016 to 2036, equating to approximately 10,700 persons. This increase will add more population to a relatively high density area, particularly in central Waverley where a density of 94 people per hectare is one of the highest in Greater Sydney. Other important demographic characteristics and trends include:

- The number of vehicles has stabilised over the past 15 years for most areas in the LGA and sits below the Greater Sydney average;
- High income levels and a low number of persons per household are apparent (compared to other parts of Sydney) alongside a high number of residents in the "young family" age brackets;
- The largest employment growth areas are in the Bondi Junction to Bondi Beach corridor and southern suburbs;
- Journey to Work (JTW) data is key in understanding travel patterns at peak times across the LGA. Of people who were employed in Waverley in 2011 43% of them travel to work from local areas whilst 30% of Waverley residents travel towards the CBD for work;

- Waverley actually has a high usage of public transport and walking/cycling but low private vehicle use compared to areas in Greater Sydney. Whilst car travel distances are shorter on average, car travel times are similar to other parts of Sydney inferring slower traffic speeds and hence higher levels of congestion. Recreational travel is much higher than average coupled with the large number of events and activities in Waverley. This means dispersed origins and destinations across the day generating challenges (and opportunities) for movement and parking.

Parking in Waverley, particularly at Bondi Beach, is very congested. Residents have access to "Beach" and "Residential Parking Scheme" permits that allow them to park unrestricted in some of the busiest areas. In 2014/15 there were 6,484 general permits (includes visitor permits) and 6,279 Beach permits in circulation across Waverley.

The majority of crashes in the LGA involve cars, with some pedestrian/cyclist crashes occurring in high activity areas.

Key Issues - General

Many of Waverley's roads and intersections are at capacity in peak periods. Searching for available on-street parking can be frustrating at times with limited spaces available and long circulation distances. Much of Waverley's older housing stock did not include on-site garaging and relied on on-street parking. As streets have become more congested, and the area more popular, the available street spaces are occupied for much more of the week-day and week-ends.

Whilst traffic congestion is a complex issue to manage, evolving cities generally provide their residents and visitors with increasingly viable modal choice; particularly through improving the competitiveness of public transport and the safety and attractiveness of walking and cycling.

The "trunk" PT network in the Waverley LGA includes Old South Head Road (to/from the north), Oxford Street/Bondi Road (east-west) and Carrington Road (to/from south). None of these corridors, with the exemption of a short section on Old South Head Road, have bus priority measures. Furthermore, bus services currently focus on Bondi Junction and all north-south bus movement across Waverley pass through Bondi Junction. The result of this is that, in general, bus travel times are at least double car travel times for many trips.

Waverley's road network is complicated by its incremental evolution and the topography of the LGA which has resulted in a relatively few major road "spines" converging near Bondi Junction, with limited east-west continuity as well. Being a "long; narrow" shape, Waverley traffic progressively converges at the relatively few east-west connection points to Greater Sydney and this convergence generates congestion. These issues are exacerbated by the lack of north-south connectivity away from the major spines of Carrington Road and Old South Head Road and the reliance on Bondi Road for east-west connectivity between Bondi Junction and Bondi Beach/Tamarama. These issues manifest themselves in an absence of a clear road hierarchy and many one-way local street systems and turn bans have been implemented in an attempt to preserve street-amenity.

Through traffic congestion is exacerbated by localised intersection pinch points, including a number on Syd Einfeld Drive, Old South Head Road, Bondi Road, Bronte Road and Carrington Road. The highest congestion periods can occur during peak shoulder times, mostly likely due to the use of "no stopping" zones at peak times on some of the major through routes in Waverley (such as Bondi Road). On-street parking on major routes also causes traffic friction and influences congestion levels.

The Waverley Bike Plan considers that every street in Waverley will be a "cycling" street. This plan is still in progress and aims to fill in the existing disjointed and incomplete cycle network that creates conflicts with traffic. Challenges for this plan include Waverley's hilly terrain, heavy traffic congestion and limited road space availability. Other challenges for cycling include providing suitable routes for both inexperienced/casual riders and experience/commuter riders.

In comparison to other areas in Greater Sydney, the Waverley LGA has a high percentage of walking trips. The combination of residential density and a strong walking "culture" appear to contribute to this.

There are however locations where the absence of direct pedestrian connections increase walking distances, whilst in Bondi Junction there are obvious connectivity issues and conflicts with vehicles.

Key Issues – Location Specific

Some of the main location-specific issues in Waverley's key centres include:

- Bondi Junction - forced circulation of traffic through centre streets, key pinch point intersections and bus priority and interchange issues, lack of pedestrian/bicycle priority and connectivity, conflicts between pedestrian/cyclists and traffic around the station.
- Bondi Junction to Bondi Beach Corridor - on-street parking, bus stops and sides streets impacting traffic flows, key Bondi Road pinch points at Denham Road and Carrington Road, limited pedestrian crossing points, limited options for bicycle riding and absence of bus priority.
- Bondi Beach - high parking demand creates circulating traffic further congesting streets, north-south traffic permeability is limited, event management in the area is critical and major congestion from large volumes of traffic on Bondi Road as well as large numbers of pedestrians crossing it (particularly during summer and events).
- Northern Centres - limited trunk bus route coverage, difficult to enter/exit Old South Head Road from local streets due to congestion and on-street parking contributes to congestion on Old South Head Road.
- Southern Centres - cluster of Schools and associated parking and traffic issues, convoluted one-way schemes and limited permeability in residential areas creating key pinch points at major road interface as well as an absence of bus priority measures.

Into the future, expected growth areas in Waverley include Charing Cross, Old South Head Road and Bondi Road corridors, Bondi Junction and Bondi Beach. Other isolated major developments, such as the War Memorial Hospital Site, are also identified development opportunities.

1. INTRODUCTION

1.1 THE NEED FOR THIS STUDY

The Waverley Local Government Area (LGA) is unique when considering its complex transport demands, its land use structure, its geography and its topography. Parking congestion and traffic congestion have been raised by Council as key issues that need to be restrained into the future through the implementation of the specific actions recommended by this study.

Waverley Council (Council) has identified the following aspirations for the transport system:

- *For the transport of people and goods into, out of, and throughout the LGA to become more accessible, efficient, effective, safe, connected and sustainable;*
- *To deliver travel and environmental benefits more equitably to meet the needs of all sectors of the Waverley community; and*
- *To meet Council's goals and targets for transport and emissions*.

Council has also identified the following key outcome areas for the study:

- *Enable all Waverley residents and visitors to access places more easily on foot, bicycle and public transport;*
- *Manage vehicular access and traffic flows more efficiently and effectively on the road network, including state roads and traffic lights where RMS has authority;*
- *Establish a clear policy direction for parking supply on private and public land in response to rising demand and anticipated development pressures, particularly in Waverley's key activity centres; and*
- *Improve public transport capacity and accessibility through the LGA by helping to remove constraints within key corridors and interchanges and extending local coverage by state or community transport services.*

Past transport strategies undertaken for Council have aimed at reducing private vehicle usage by targeting reducing trip lengths and lowering the proportion of trips by private vehicle whilst increasing public and active transport usage. Whilst these targets and their associated strategies have been entirely appropriate and consistent with contemporary transport planning approaches, the specific actions needed to achieve these changes have been lacking in terms of detail, their practicality or their ability to actually be implemented.

What the Waverley LGA needs are specific, tangible actions that can be implemented to better manage the effects of excessive traffic and parking demand to the betterment of local residents and businesses.

This study aims to understand the underlying transport needs of people living in, working in or visiting the Waverley LGA, what their motivations for movement are and what specific places they need to travel to and when. By understanding *where people go and how they get there*, and within a framework of improving environmental sustainability and liveability, this study draws on international best practice and adapts it to the context of the Waverley LGA to recommend works and programmes for Council to prioritise.

The Waverley LGA area is shown in Figure 1.1.

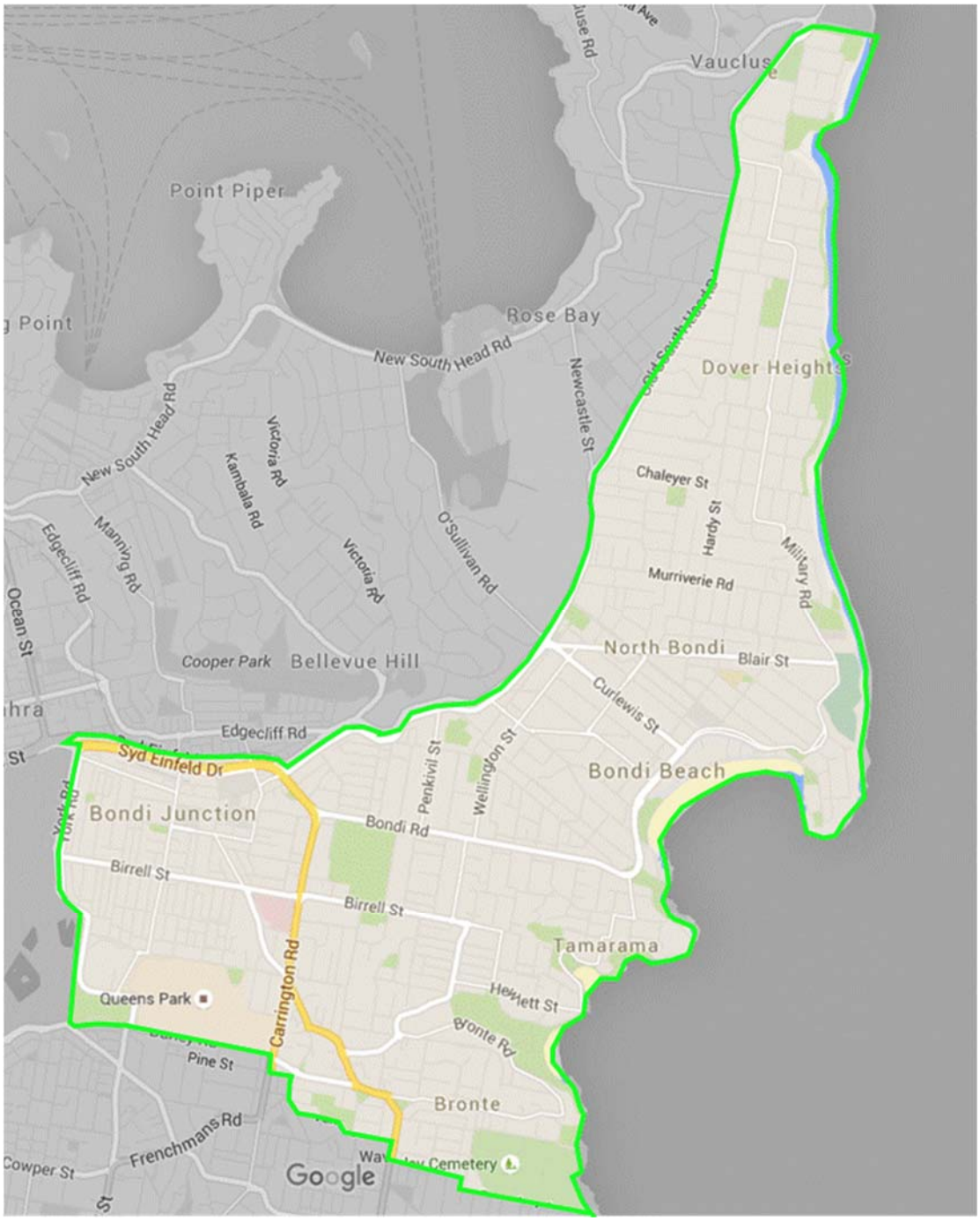


Figure 1.1: Waverley LGA

1.2 Focus Areas and Desired Outcomes

This study considers the entire Waverley LGA and transport interactions with surrounding areas, particularly via road and heavy rail to/from the west (i.e. towards the Sydney CBD). In addition to the assessment of LGA-wide needs and actions, specific "hot spot" areas have also been considered, including:

- Bondi Junction;
- the "Bondi Road corridor" from Bondi Junction to Bondi Beach; and
- local centres clustered in the southern, central and northern parts of the LGA.

Figure 1.2 shows the overall study area and the specific centres under consideration.

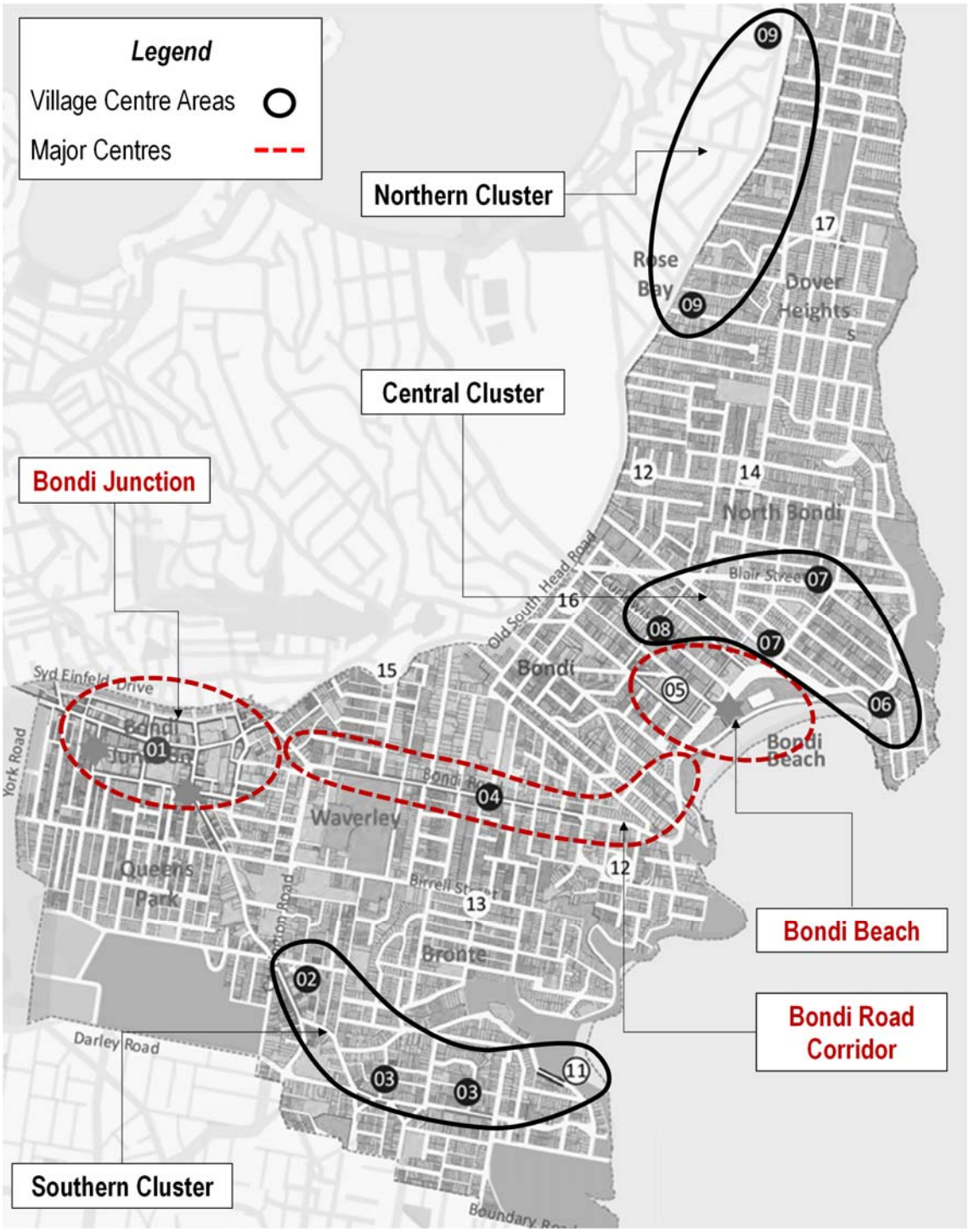


Figure 1.2: Study Area and Focus Areas

1.3 Document Structure

This working paper summarises the overarching strategy documents relevant to movement planning in the Waverley LGA whilst reviewing previous studies that Council has undertaken so as to understand what has been assessed and recommended before. A "best practice" literature review has also been undertaken to identify new and innovative transport demand management measures that might be applicable to the unique issues facing the Waverley LGA.

Key demographic and travel data is reviewed to understand the movement needs of people living and/or working in the LGA, as well as those visiting its businesses and recreational activities. The available networks are then described whilst summarising the likely issues when contrasting what people need/want and what they have been provided with.

These issues and conflicts are described for the entire LGA as well as for specific "hot spots" of traffic and parking congestion.

Finally, this working paper introduces the strategy framework to guide the development of the integrated strategies in subsequent phases of the study whilst listing out specific goals that the strategy will aim to achieve. This is the first of two stand-alone reports. Its companion document is the "Strategies Report" which provides the strategies and detailed actions for implementation.

2. SETTING THE SCENE

2.1 FOUNDATION STRATEGIES AND POLICIES

2.1.1 NSW Long Term Transport Master Plan

The approach to strategic transport planning and service delivery for NSW up to 2021 is described in the *NSW Long Term Transport Master Plan* administered by Transport for NSW.

The release of the master plan coincided with an explicit shift to a greater "customer service" focus in the design and delivery of transport services, which is articulated in the corporate plan for Transport for NSW — *Connections 2012–2017* — and encapsulated in the value statement "we place the customer at the centre of everything we do" (pp. 10 – 11).

The key elements that underpin the master plan are:

- putting customers first — improving customer experience and understanding needs;
- responding to changing customer needs — modernise services, make better use of existing assets and manage impacts on communities and the environment; and
- align transport and land-use plans to meet customer needs — integrate transport with land-use, identify transport corridors, assess current and future needs in terms of capacity, speed and frequencies appropriate to meeting customer needs (TfNSW, 2012, p. 40).

The master plan emphasises the need to:

"Strike the right balance between investing in public transport and roads to support the movement of private vehicles, investing in passenger transport and freight across the city, and supporting walking and cycling for local trips" (TfNSW, 2012, p. 40).

The shift to a greater customer service focus introduced in 2011 has heralded significant improvements to public transport service provision such as increased service numbers in metropolitan Sydney, and also a greater commitment on the part of state government service providers to be more responsive to customer needs through programs like the Customer Satisfaction Index (NSW Minister for Transport, 2013; TfNSW, 2014).

This approach complements the direction identified in the Waverley Transport Plan discussed in Section 2.1.3.

Two key points in the master plan that are significant for Waverley include:

- the approach to setting service levels for public transport modes and interchanges; and
- specific projects foreshadowed for Eastern Sydney.

Guidelines to Public Transport (Operations)

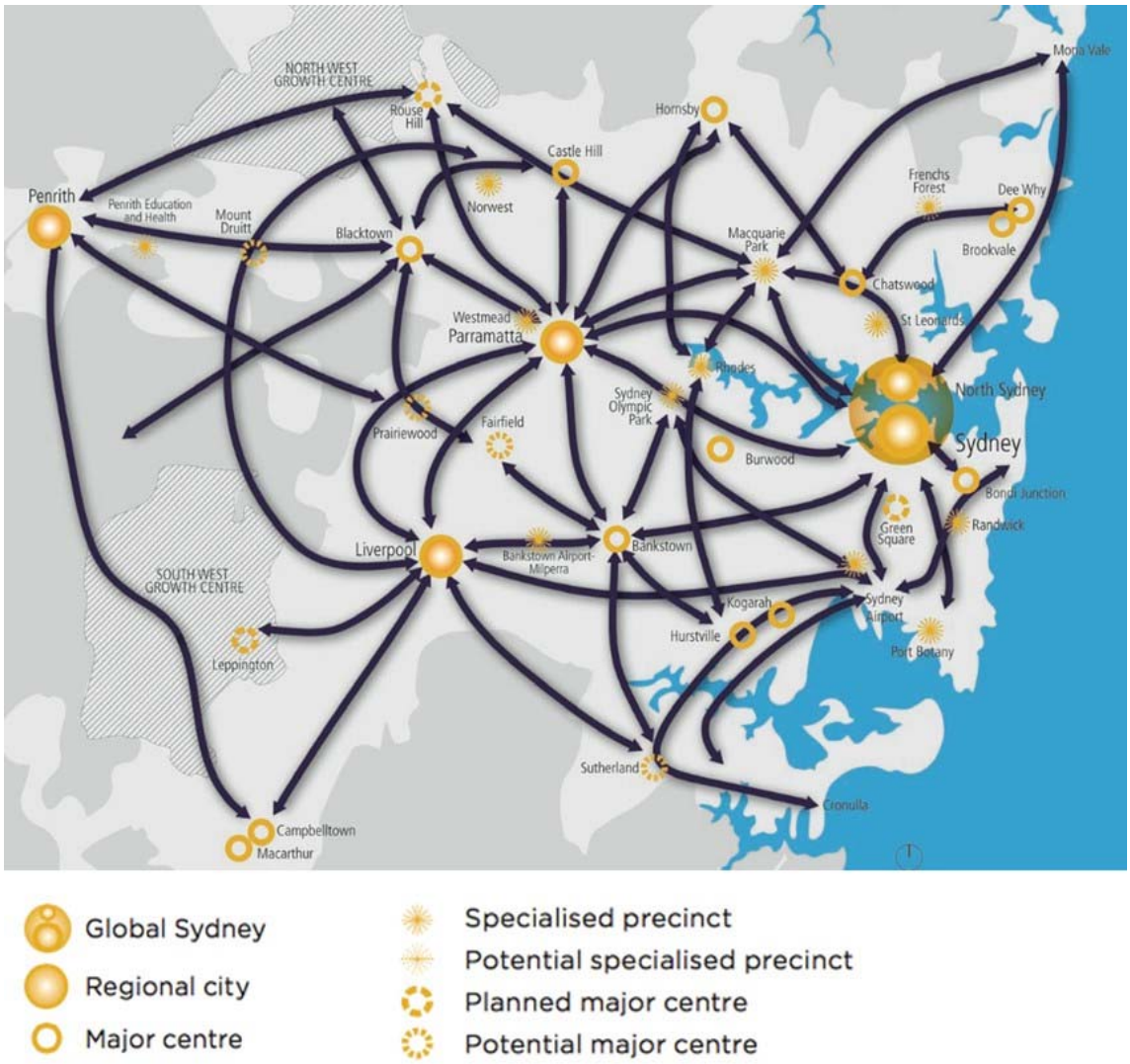
Transport for NSW provides guidance for transport planning in the *Integrated Public Transport Service Planning Guidelines: Sydney Metropolitan Area* (2013). The guidelines support the implementation of the Long Term Transport Master Plan by providing a *"trigger for more detailed consideration of relevant issues"* (TfNSW, 2013, p. 3). In this way, the master plan does not cover local transport issues in detail, but does provide guidance on how local plans can best be developed so they dovetail with the state master plan.

TfNSWs approach for doing this involves four steps:

1. Integrating transport with land use planning — development of strategic activity centres classified according to function, supporting economic development and employment growth;
2. Identifying corridors of demand — forecast travel demand resulting from connections between activity centres;

3. Defining the performance required from the transport network — a transport network hierarchy is used to describe system performance; and
4. Moving towards a connected and integrated system — coordination guidelines for improving interchanging between transport modes (TfNSW, 2013, pp. 8–13).

The key activity centres and corridors within Metropolitan Sydney (steps 1 and 2) identified by Transport for NSW in collaboration with the Department of Planning & Infrastructure are shown in Figure 2.1.



Source: NSW Long Term Transport Master Plan (2012), p. 44

Figure 2.1: Sydney's Activity Centres and Main Demand Corridors

As can be seen, Bondi Junction is classified as a Major Centre within the activity centre hierarchy and sits on two key corridors — an east-west corridor connecting it to the Sydney Central Business District, and a north-south corridor connecting it to the Randwick Education and Health Specialisation and Sydney Airport precincts.

Transport links connecting centres are also classified according to a hierarchy that includes mass transit, intermediate and local transit network links for public transport, and arterial, sub-arterial and local network links for roads. Preferred service capacities, speed and frequency levels for public transport are prescribed in accordance with the function and consequent needs of different centre types. For example, businesses locating in global centres need to access deep labour markets to function and so need networks able to be accessed by populations from across the entire metropolitan area. By contrast, the network connections for local centres only need to provide a high level of accessibility to local populations within the catchment.

The network classifications and corresponding service descriptions used by TfNSW are listed in Figure 2.2.

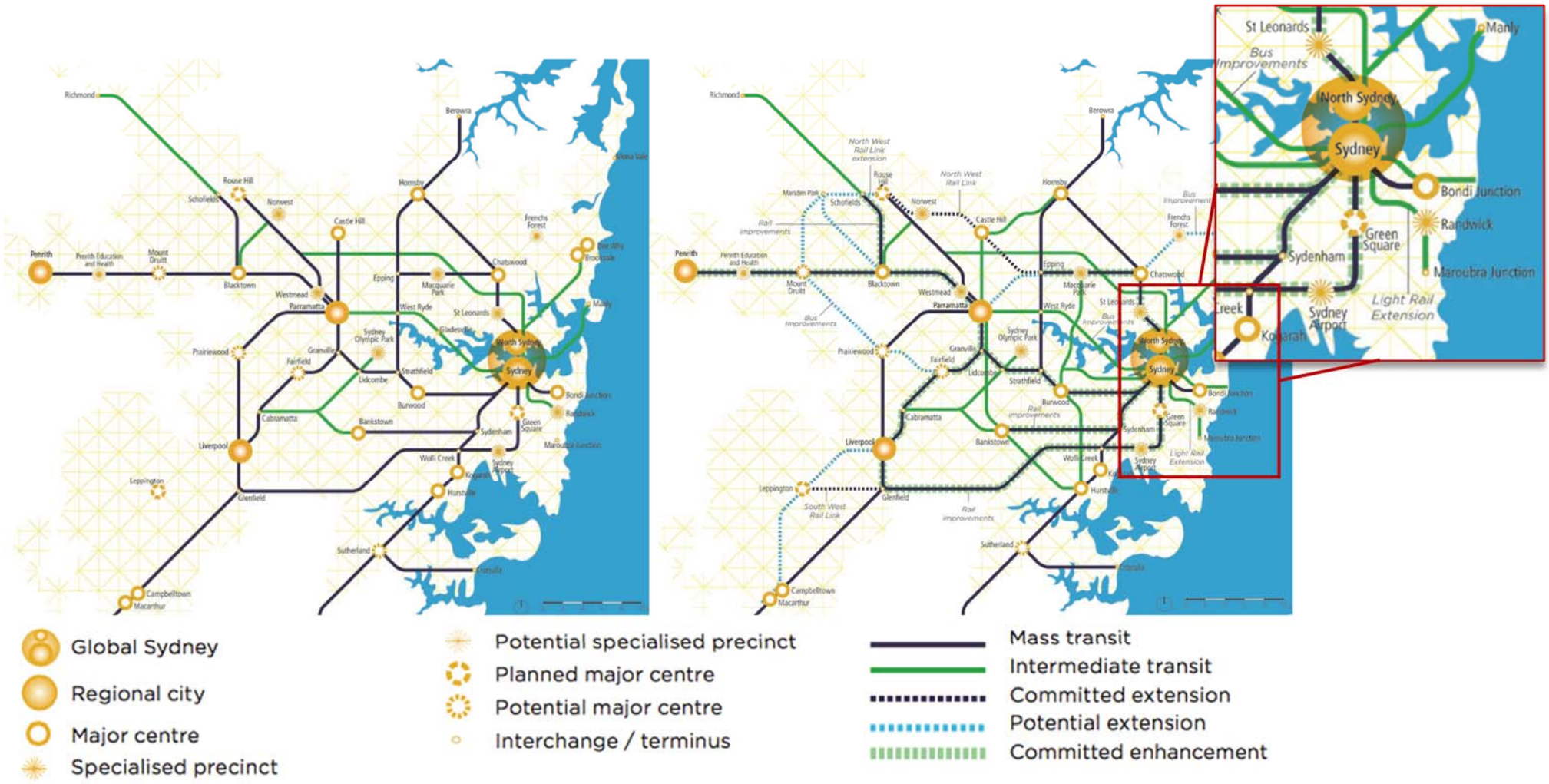
Network	Land use classification	Public Transport	Roads	Road Freight	Interchange
Level 1	Major Centre	Mass Transit Network	Arterial network (includes motorways)	Primary	Regional cities and major centres
Level 2	Town Centre	Intermediate Transit Network	Sub-arterial network	Secondary	Town centres
Level 3	Village	Local Transit	Local Network	Tertiary	Local villages

Service attribute	Mass Transit Network	Intermediate Transit Network	Local Transit Network
Service type	Rapid, express and all-stop services	Express services in peak periods and all-stop all day services	All-stop services only
Frequency	High frequency in peak periods. Good all day frequencies in off-peak periods.	All day frequencies with higher frequency in peak periods	Relatively low frequency due to extensive coverage. Moderate frequencies in peak periods.
Service span	Operates all day	Operates all day	May not operate during some periods
Priority	Operates mostly in separate right of way	Combination of separated right of way and on-street	Predominately on-street
Speed (average. Includes scheduled stops at bus stops, stations, and other stops such as traffic light or signals)	All stop services with speeds. In the range 25 to 60 km/h; express services with speeds up to 70 km/h	All stop services with speed in the range 15 to 25 km/h	All stops services with speeds less than 20 km/h
Network coverage	Confined to relatively small set of direct, high volume corridors	May have coverage over a wider area than Mass Transit Network. Still has a focus on direct connections	Extensive coverage over wide area. Mostly indirect and sometimes circuitous connections.
Capacity	High	Medium	Lower
Stall on/stop spacing	Longer spacing to provide faster travel times. Typically at least 800 metres for bus and longer for rail	Generally long stop spacing (400 metres to 800 metres)	Short stop spacing to improve accessibility
Station access	Long access distances. Important role for park and ride in outer areas.	Shorter access trips. Mostly walking access and some local bus	Predominantly walking access

Source: Integrated Public Transport Service Planning Guidelines: Sydney Metropolitan Area (2013), p. 10 and 12

Figure 2.2: NSW Transport Planning Hierarchies

The significance of public transport links to Bondi Junction and to the Randwick Education and Health Specialisation activity centre is highlighted in the potential upgrades for Sydney's strategic transit network in the master plan. As can be seen in Figure 2.3, the corridor needs are classified as *intermediate*, requiring good all-day service frequency levels, increasing during peak periods with a focus on mostly walking to access stops.



Source: NSW Long Term Transport Master Plan (2012), p. 46 and 91

Figure 2.3: Sydney Strategic Transit Network with Planned and Potential Upgrades

Engagement with Transport for NSW

Since 2011, Transport for NSW has explicitly extended its efforts to collaborate more effectively with stakeholders, including local government, in order to improve its customer service performance (TfNSW 2011, pp. 24–27).

For the delivery of bus and train services, service levels are set by the Transport Services Division within Transport for NSW. The provision of bus services within Waverley is overseen by the *Bus and Ferry Planning* section, which has responsibility for managing contracts with bus operators like Sydney Buses.

Engagement with Transport for NSW on service levels is carried out on an as needed basis.

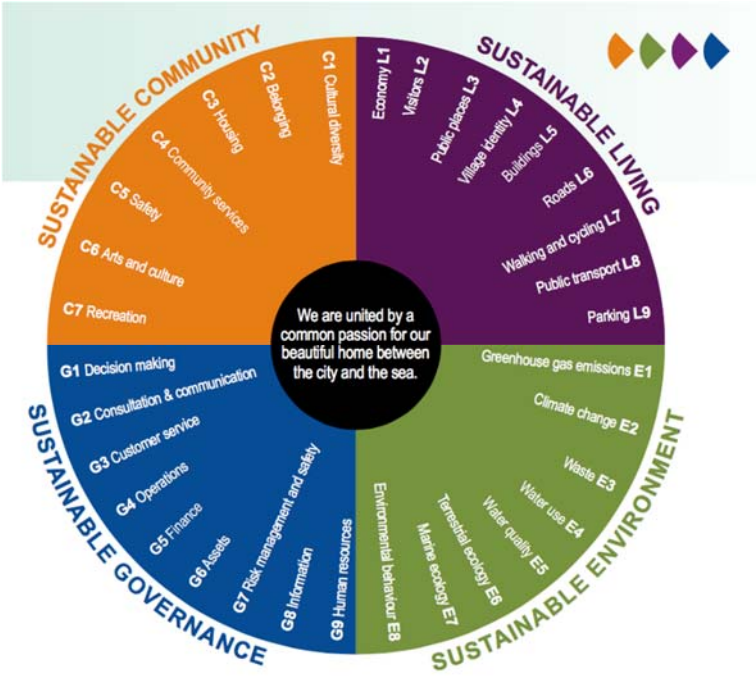
Physical Infrastructure and Specific Projects for Eastern Sydney

The master plan aims to integrate service provision across all transport modes — heavy and light rail, bus, ferry, active (cycling and walking) and private vehicle modes. The plan identifies several new infrastructure projects across the metropolitan region. In Sydney's East the need for potential extensions to the transit network are identified with the addition of an "intermediate transit link" between the Sydney CBD, Bondi Junction and Bondi Beach as shown in Figure 2.3. There are no new major road projects identified. New roads would not be as effective in the medium-long term as improving public transport services given the high urban densities, grid structure and current travel patterns that prevail in the eastern suburbs. These issues are discussed in more detail in Section 3.

2.1.2 Waverley Together 3: Our Community's Strategic Plan (2013–25)

Waverley Together 3 is the strategic plan for the Waverley Local Government Area. The plan deploys a quadruple bottom line approach to address social, economic, environmental and civic leadership factors to identify directions aimed at achieving a sustainable future for Waverley.

The plan summarises directions for these factors under quadrants that include Sustainable Community (social), Sustainable Living (economic), Sustainable Governance (civic leadership) and Sustainable Environment. Each quadrant is supported by goals and initiatives that focus on the factors shown in Figure 2.4.



Source: Waverley Together 3 (2013), p.19

Figure 2.4: Framework for the Strategic Plan

Four strategic transport factors are considered with a set of directions for each under *Sustainable Living* — the economic component of the quadruple bottom line (Waverley Council, 2013, pp.26–27).

L6 Roads — streets are safe and vibrant places which facilitate movement and interaction.

- L6a. Reduce vehicle and pedestrian accidents by improving road and traffic safety measures;
- L6b. Stabilise or reduce private passenger vehicle numbers of trips;
- L6c. Ensure access to major movement hubs is clear and direct; and
- L6d. Create place-based centres which prioritise the pedestrian experience.

This directive is primarily targeted at local streets. Vehicle ownership levels are low in Waverley by comparison with other LGAs within the Sydney Metropolitan area and public transport use is high as discussed in Section 3.

In 2009, however, only 28% of participants in Council's Community Survey were satisfied with local traffic management (Waverley Council, 2013, p. 41).

L7 Walking and cycling — people frequently walk and ride their bikes, particularly for local trips.

- L7a. Create safe and accessible pedestrian and cycle links into, out of and within Waverley.

This directive responds to the high levels of active transport use (walking and cycling) within Waverley as shown in Section 3. In 2009, Council's community survey found that 65% thought Waverley was a safe area for pedestrians while only 27% thought the area safe for people riding bicycles, suggesting more needs to be done to ensure good local network coverage (Waverley Council, 2013, p. 41) and more separated facilities.

The community survey undertaken by Council to ascertain public opinion on system performance relating to both these indicators is undertaken infrequently. While there may have been some movement since 2009, it is assumed the shift would not be greater than a few percentage points in either direction.

L8 Public transport — improved quality, integration and increased frequency of public transport in Waverley.

- L8a. Improve and augment public transport along main routes;
- L8b. Ensure all modes of transport are accessible to all users;
- L8c. Improve access to Bondi Junction interchange; and
- L8d. Implement mass transit between Bondi Junction and Bondi Beach.

This directive would ensure that current public transport users are provided with service better suited to meeting current demand. If speeds can be increased in-line with those envisaged for intermediate level transit services as outlined in the state governments transport master plan, road network speeds might also be increased. Section 3 explains how and why.

Results from the Waverley community survey used to assess performance against this goal found that only 67% of those surveyed felt that public transport was adequate for their needs (Waverley Council, 2013, p. 41). This is in contrast to the 87% customer satisfaction rate for bus and 85% for train services found for the metropolitan population (Transport for NSW, 2014, pp. 16–17). A possible reason for this difference is the high levels of bus bunching, slow travel speeds and over-capacity services during peak periods and special events discussed in Section 3.

L9 Parking — Parking, both on-street and off-street, is equitably accessed and effectively managed.

- L9a. Ensure fair access to parking services through regular review of parking demand, fee structures, enforcement and facilities; and
- L9b. Increase the community's knowledge and awareness of safe parking practices.

This directive recognises that while the Waverley resident community has low levels of car ownership by comparison with many other LGAs across Sydney, parking is a significant issue requiring regular review.

In 2009, it was found that only 19% of residents were satisfied with on-street parking management (Waverley Council, 2013, p. 41). On this basis, on-street parking could be considered one of (if not the most) significant traffic and transport challenges facing the LGA, requiring innovative solutions and possibly difficult choices.

2.1.3 Waverley Transport Plan (2011)

The *Waverley Transport Plan* contains a vision for transport, broad targets, results from community engagement, a framework connecting with Council processes that identifies eight focus areas and a set of short, medium and long-term actions to realise sustainable change in each area.

The emphasis on sustainable transport in the Waverley vision is encapsulated in:

"*With limits to the capacity of the road network this Plan understands that for the people to move around quickly and easily there needs to be efficient public transport and good walking and cycling options.*" (p. 3)

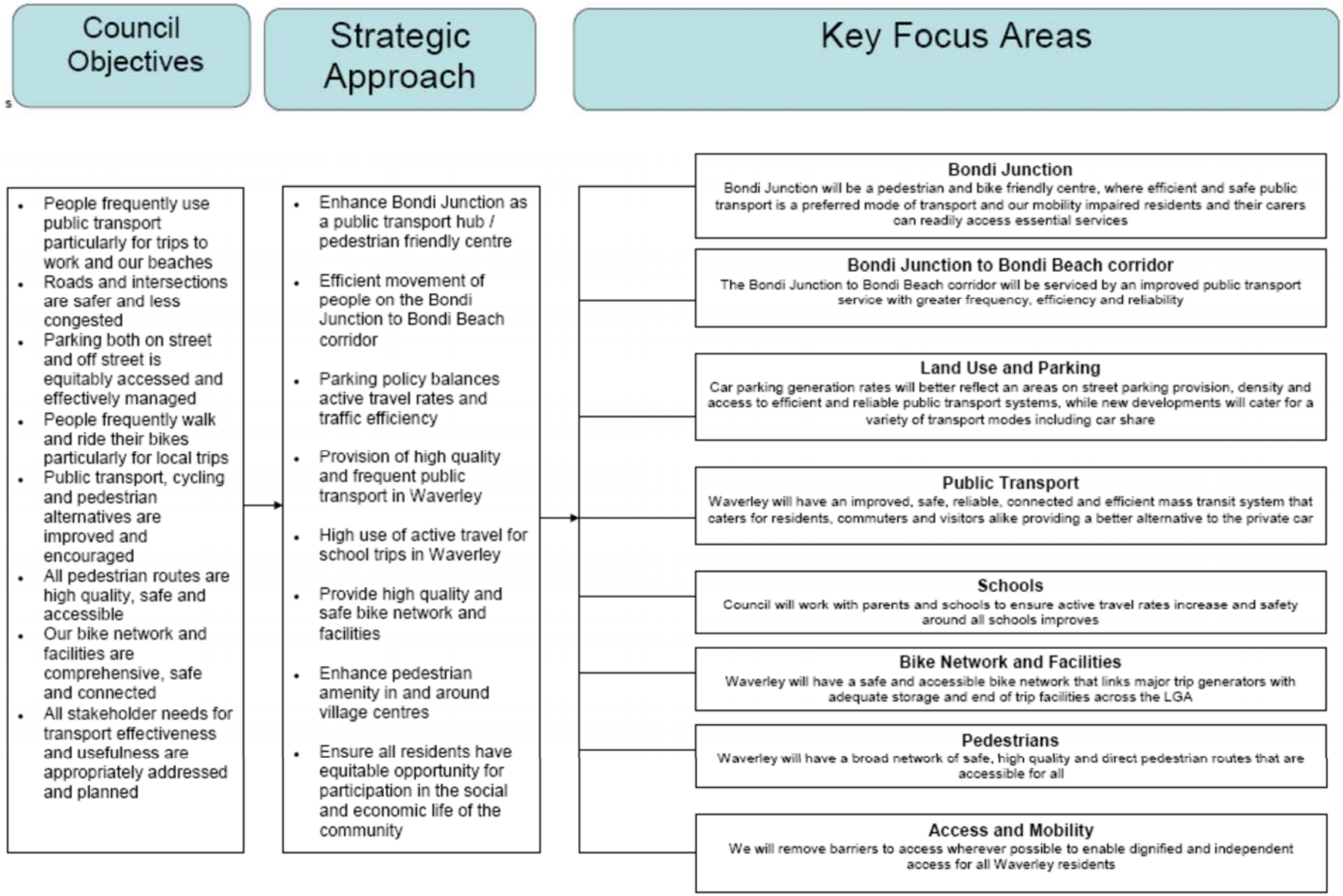
Two key targets identified in the plan for 2020 include:

- average Vehicle Kilometres Travelled (VKT) per Waverley resident by private car needs to decline by 15%; and
- 40% of the total distance travelled by residents is by public transport, walking and cycling.

In 2011 Waverley residents drove 11kms on average per day and 25% of total distance travelled was by public transport, walking and cycling. In fact, Waverley private car travel distances are relatively short already and public and active transport modal shares reasonably high, suggesting a need to shift the planning emphasis to include better management of the limited traffic and parking capacity.

Key Focus Areas

Eight key focus areas were identified as shown in Figure 2.5. After an extensive community consultation process that considered demographic groupings and geographic constraints (Waverley Council 2011, pp. 6–13), short, medium and long-term actions were identified in relation to each of the focus areas (Waverley Council 2011, pp. 17–37). Analysis to support initiatives in the key focus areas is provided in a set of key planning documents discussed in the following section.



Source: Waverley Transport Plan (2011), p.14

Figure 2.5: Waverley Sustainable Transport Plan Framework

The Transport Plan articulated "what" needed to be achieved but provided little specific direction on "how" to achieve its objectives through a program of works or management measures to implement.

2.1.4 Review of Public Transport Fares in Sydney (2015)

The NSW Independent Pricing and Regulatory Tribunal (IPART) is conducting a review of public transport fares in Sydney and released its draft report *More efficient, more integrated Opal fares* in December 2015. This provides insights on recommended changes to the fare structure that may impact on travel costs and therefore the attractiveness of public transport relative to alternative transport modes.

Motivations for using public transport

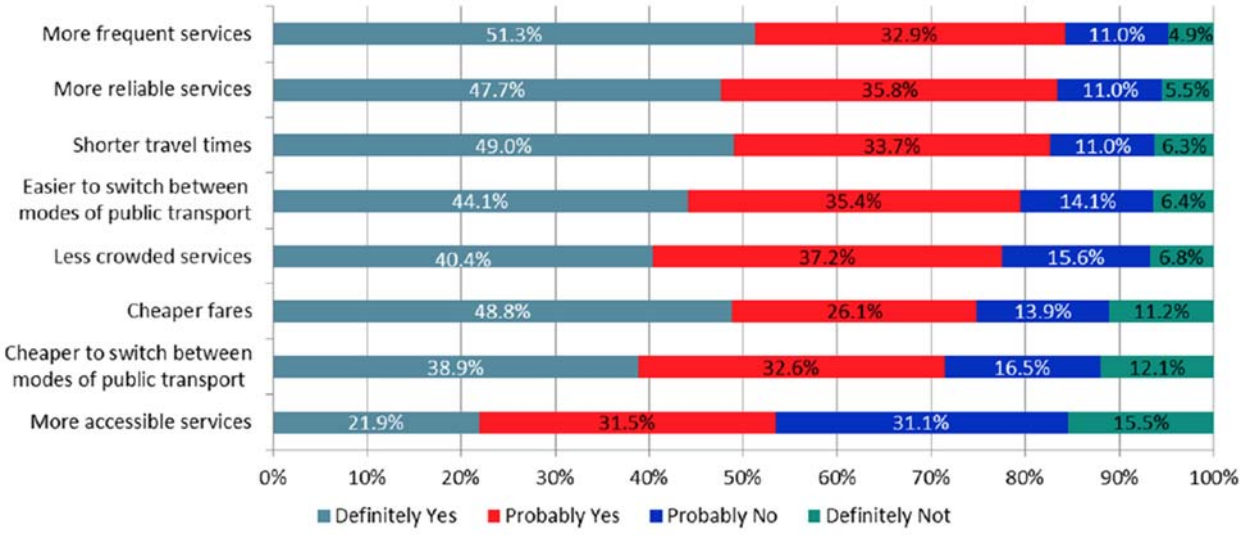
The IPART report was informed by *Sydney Public Transport User Survey 2015* conducted for IPART by Roy Morgan Research, which asked respondents to rate how much each of eight options put to them would lead them to use public transport more often.

The given options were:

- More frequent services;
- Shorter travel times;
- More reliable services;
- Cheaper fares;
- Easier to switch between modes;
- Less crowded services;
- Cheaper to switch between modes; and
- More accessible services.

Half of these options address issues that impact travel time (trip duration): more frequent services, shorter travel times, more reliable services, and easier to switch between modes. They also affect passenger convenience, as does less crowded and more accessible services.

The survey finds that travel time is the overwhelming motivator to use public transport more. Time considerations make up the four top factors for 80-84% of respondents, Figure 2.6, (combining "definitely yes" and "probably yes"). "Cheaper fares" is a strong second most likely reason judged on "definitely yes" at 49%, but only sixth against the combined response, at 75%. "Cheaper to switch between modes" closely follows at 72%.



Source: Sydney Public Transport User Survey 2015 Table I Section 3.8, Roy Morgan Research

Figure 2.6: Factors Likely to Increase Public transport

The survey was limited to current users of public transport and so does not inform about motivations of non-users to change to public transport. All the same, the findings correlate with the literature that travel time is the overwhelming factor in people's decision making.

Integrated and Mode-dependent Fare Structure

Notwithstanding that cost is not the primary motivator, it is a major consideration for three quarters of respondents. The current Sydney fare structure places a penalty on mixed mode travel which may affect the mode choice of those who already use public transport and detract from using it where bus plus train would a more efficient option. In much of the Waverley area, bus is the only public transport option, with transfer to a train or ferry available near the western (Bondi Junction) or northern (Rose Bay) edges of the LGA.

A one way adult fare from Bondi Beach to the Sydney CBD is currently $2.02 more expensive to undertake using multiple modes (train to bus) instead of only bus all the way (Table 2.1). For a daily commuter, this becomes a penalty of almost $16 per week. The penalty is also seen in concession fares. Despite the inefficiency of interchanging between modes, a mixed mode trip can save about 5 minutes over a bus only trip (12 % of the scheduled trip duration).

The significance is the attractiveness of public transport as an efficient and cost effective option against private vehicles, and the relative congestion of the different modes. With more people on trains instead of cars and buses, and in buses instead of cars, the result is a suppression of the growth in road congestion as development occurs.

The IPART recommendation is to progressively reduce the differential cost, with no difference by July 2018. Its draft decision is "We consider that an integrated fare should be charged for all multi-trip journeys whether they involve single or multiple modes." For Waverley this will be significant by removing it as a factor in travel decisions.

Fare Comparison

The below fare comparison example is from Bondi Beach to Town Hall, with an overall distance is approximately 7.5km.

Table 2.1: Fare Comparisons for Mixed Mode Journeys

Fare for Adult 1-way ticket (peak)	Current fare	Proposed fare July 2016	Proposed fare July 2018
Bus for entire journey	$3.50	$3.34	$3.99
Bus and Train	Train $3.38 + Bus 2.10 = $5.48*	$3.36	$3.99
Difference	$2.02	$0.02	nil
** increases to $6.88 if the journey extends a few more bus stops*			
Fare for Adult commuting 5 days a week (return)	**Current fare**	**Proposed fare**	**Proposed fare July 2018**
Bus for entire journey	$28	$33.40	$39.90
Bus and Train	$43.84	$33.60	$39.90
Difference	$15.84	$0.20	nil
Fare for Gold Opal (senior/pensioner*)	**Current fare one way**	**Proposed fare July 2016**	**Proposed fare July 2018**
Bus for entire journey	$1.75	$1.67	$2.00
Bus and Train	$2.50 daily cap	$1.68	$2.00
Difference	$0.75	$0.01	nil
*Under iPART proposal, only Pensioners and NSW War Widow/ers will be eligible			

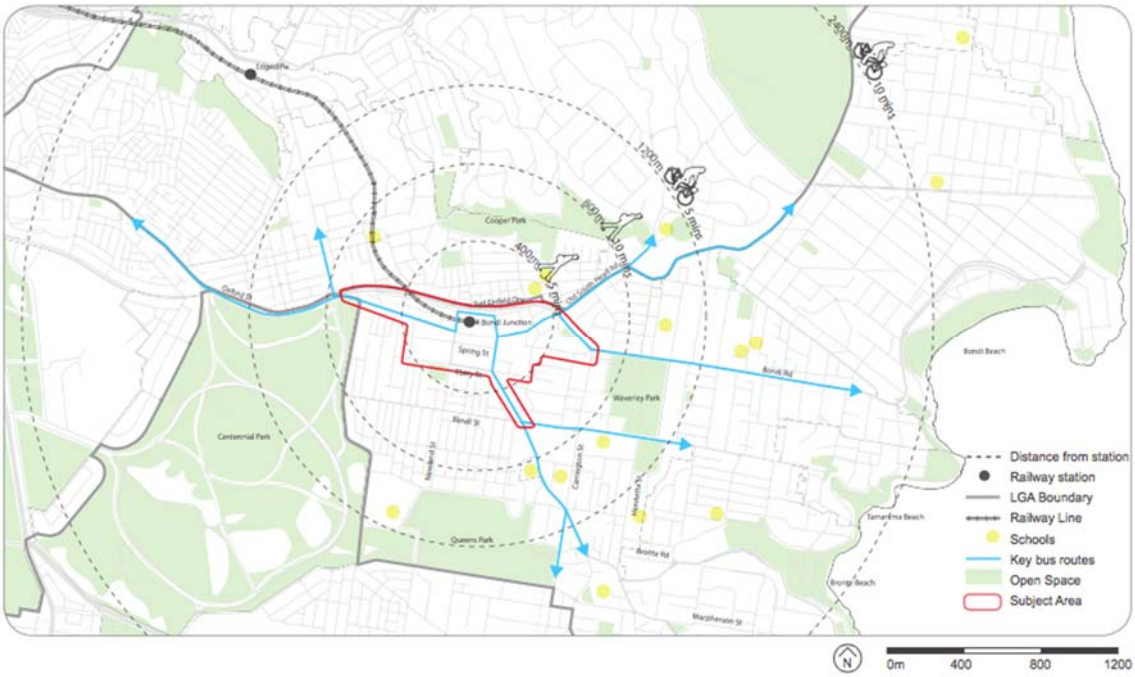
Fare for Concession Opal (half of full fare)	Current fare	Proposed fare July 2016	Proposed fare July 2018
Bus for entire journey	$1.75	$1.67	$2.00
Bus and Train	$2.74 (train $1.69 + bus $1.05 = $2.74)	$1.68	$2.00
Difference	$0.99	$0.01	nil

2.2 PLANNING, INVESTIGATIONS AND ACTION PLANS

This section reviews specific policies and actions that have relevance to the strategic directives on transport. In some cases the policies were created before the directives identified in the strategic plan — *Waverley Together 3.*

2.2.1 Bondi Junction Complete Streets (2013)

The *Bondi Junction Complete Streets Project* addresses many of the issues encompassed in strategic directive L6 Roads — streets are safe and vibrant places which facilitate movement and interaction. The project investigates a wide range of factors affecting the amenity and function of streets located in the study area identified in Figure 2.7. The findings are in alignment with the transport principles outlined in Section 3.2.



Source: Roberts Day. 2013, Bondi Junction complete streets project. Waverley Council, Sydney, p. 6

Figure 2.7: Site Context and Study Area

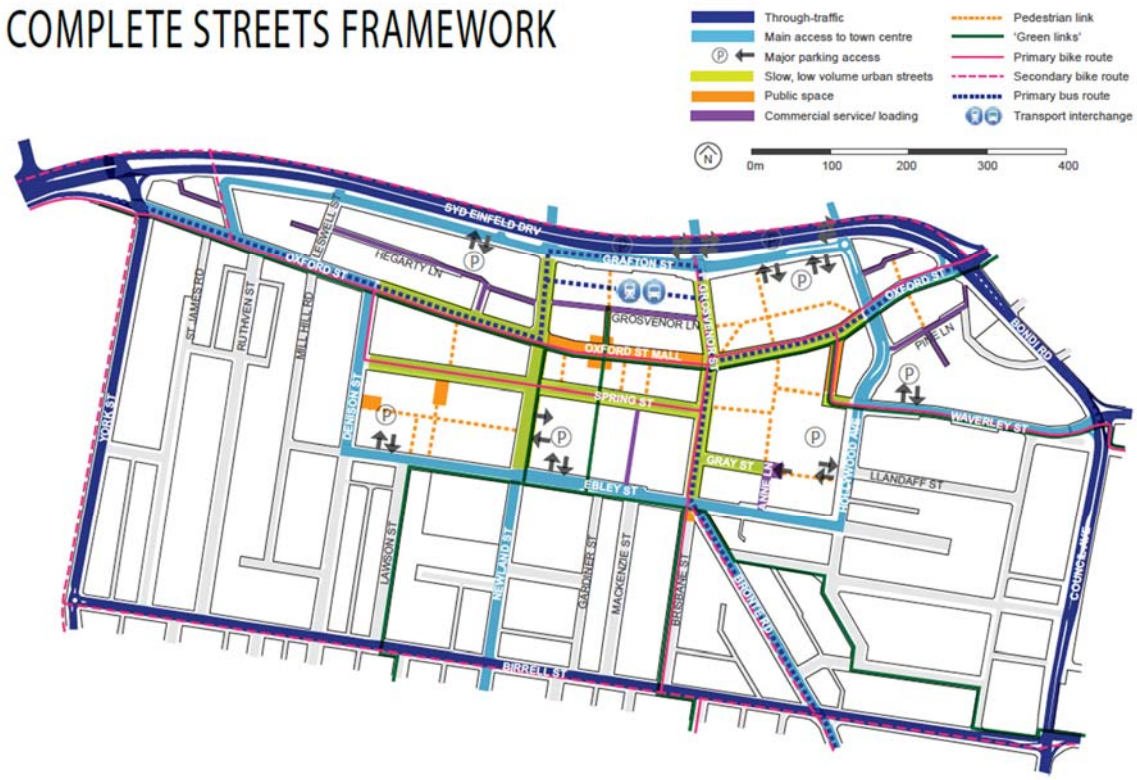
The Complete Streets Framework provides a master plan for the town centre, rather than streets being designed in isolation of one another (see Figure 2.8). It is well founded in best practice urban design principles, taking an approach that integrates and prioritises competing needs in the interests of creating a livable environment for people. It prioritises transport modes for all the streets within the study area and recommends traffic changes and streetscape treatments on a block by block basis to achieve the overall desired outcomes. Council has accepted the findings of this project. Key elements of Complete Streets include:

- objectives of the Complete Streets Framework:
  - reduce the existing pattern of through traffic in the commercial core;
  - through traffic will be encouraged to use thoroughfares on the periphery;

- traffic stopping in Bondi Junction will be encouraged to access the major parking stations without traversing through the town centre;
- the streets in the commercial core will be designed as slow, low-volume streets that support high pedestrian activity;
- street designs need to cater for high pedestrian volumes on the "main streets" (Oxford Street, Bronte Road and Spring Street);
- the primary bicycle routes require as a priority either bike paths (on busier streets) or streets configured for safe on-street cycling (in commercial core);
- the existing bus lanes and key bus routes are maintained unchanged, however changes to bus stops, interchange entries and lane widths are proposed in order to improve pedestrian convenience and safety; and
- key loading areas for Eastgate and Westfield remain unchanged, however Spring Street changes from its existing role and appearance as a loading zone, into a "main street" for people, with loading becoming a secondary function.

▪ other notable points:

- create a main entry to Oxford St mall transport interchange entry;
- net loss (2.4%) of street parking in order to provide more space for street trees, footpaths or cycle paths; and
- a speed limit of 40km/h is proposed for the whole study area.



Source: Roberts Day. 2013, Bondi Junction Complete Streets Project. Waverley Council, Sydney (2013), p. 64

Figure 2.8: Complete Streets Framework

Measures with broader transport consequences within the study area

The key change from the Complete Streets Project is redirection of through traffic and access to the major parking stations away from the commercial core.

York Road, Birrell Street and Council Street

These streets on the periphery of the town centre will carry redirected through traffic. This will impact traffic approaching the Junction making route decisions at intersections with these streets.

Oxford Street, Newland Street, Ebley Street, and Hollywood Avenue or Bronte Road

This current high traffic route would be downgraded, with traffic directed along Denison Street away from the mall, as the main access to the town centre and the major carparks.

Bronte Road

Treatments address its role as a "main street" with traffic calming measures to make it more attractive for pedestrians and cyclists to visit businesses on the strip.

Hollywood Avenue

Changes to traffic reduce turn movements, improve pedestrian access into the mall areas and support access to the medical centre.

Ebley Street

Treatments aim to improve pedestrian and cycle amenity and safety. The project has not considered issues with prevention of right turn exits from Eastgate carpark that generate additional travel distance around the block, and therefore traffic congestion particularly at the Bronte Road intersection.

Localised measures

Oxford Street west end

The intersection of York Road, Oxford Street and Syd Einfeld Drive is recognised as being in need of redesign to improve the gateway to Bondi Junction from the city. At this end Oxford Street is an important vehicle access to carparks, a key bus route, and one of the highest volume bike routes in Sydney. The project recommends a more efficient, legible and safe configuration be found. A bike path is proposed along Oxford Street, and improvements for pedestrians at intersections.

Oxford Street east end

Oxford Street between Syd Einfeld Drive and Hollywood Avenue is recognised as strategically important for arrival into the centre, but it is complex and needing further analysis to solve congestion, and to provide a safe and convenient environment for buses, cyclists and pedestrians. As at the west end, it is also an important vehicle access to carparks, a key bus route, and one of the highest volume bike routes in Sydney. Principles suggested to guide a redesign include wider footpaths, provision for cyclists, and timed traffic management.

Syd Einfeld Drive

Because the streets at both ends of Syd Einfeld Drive are only two lanes compared to its three lanes, it has been identified as having excess capacity that could be converted to pedestrian and cycle lanes, provide an express cycleway for commuter cyclists to the city.

Transport interchange

Recommendations to improve pedestrian entrances to the transport interchange will make it more legible and therefore more convenient, which contributes to making public transport a more attractive alternative.

Project Status as of Early 2016

The majority of the short term recommendations for Complete Streets have commenced. Two capital projects, Brisbane Street Square and the tree planning along Oxford Street west, have been completed. Design Development is underway for the Cycleway and East Bondi Junction Projects, which include a number of streets, summarised below. (Note that these two projects have been significantly delayed due to issues with the Cycleway route).

The "Bondi Junction Streetscape / Cycleway", comprising of streetscape design and a separated cycleway along Spring Street, Denison Street (between Spring Street and Oxford Street) and Oxford Street (west of Denison Street). This has progressed to design development and submission to the Waverley Traffic Committee, pending investigation into alternative routes. Council is currently in the progress of recommencing discussion with stakeholders on the outstanding issues with the project, including options for the Spring Street/Bronte Road intersection.

The "East Bondi Junction" streetscape upgrades along Oxford Street (between Adelaide Street and Bronte Road), Bronte Road (from Oxford Street to Ebley Street) and Grosvenor Street (from Bronte Road to Grafton Street), including formalising cyclists provision along Oxford Street between Adelaide Street and Bronte

Road. This has been placed on hold and TfNSW are reviewing a changed access to the Transport Interchange at Bronte Road/Ebley Street/Brisbane Street.

The full detail of Complete Streets status as of early 2016 is outlined in the Bondi Junction Gap Analysis in Appendix A.

Effect on transport connections into and out of the study area

Oxford Street west end - York Road, Queens Park Road and Darley Road

Improved route legibility should improve traffic flow, especially approaching Bondi Junction from the city. There is a possibility of increasing traffic flows on York Road south of Birrell Street, and along Queens Park Road and Darley Road because of vehicles being encouraged away from the centre and Oxford Street.

Oxford Street east end - Bondi Road and Old South Head Road

The principles identified to guide analysis recognise the need to improve the level of service for traffic as well as improve the bus and cycle connections and improve pedestrian safety, although the Complete Streets offers no detailed solution for the intersection of Oxford Street with Bondi Road and Syd Einfeld Drive. If this is successful, it should improve traffic flow from Bondi Road and Old South Head Road, with consequential benefits for bus travel.

Birrell Street - Carrington Road and Bronte Road

The use of Birrell Street as a through route may adversely impact its intersections with Carrington Road and Bronte Road as drivers on these streets elect to use Birrell Street and the number of turn movements increases. The intersection of Carrington and Bronte Roads is already difficult but traffic volumes are unlikely to change due to this project. On the other hand, drivers bound to and from Bronte and Tamarama and further south may be encouraged away from the Syd Einfeld Drive and Council Street through route and hence reduce traffic levels through the problematic intersection with Old South Head Road. However, this change may result in higher traffic volumes on Bronte Road between Birrell Street and Carrington Road.

Syd Einfeld Drive - cycling

The study suggested taking a lane away from Syd Einfeld Drive should not have adverse impacts on transport because of capacity constraints at the ends, but a fast cycling route alternative for commuters could potentially be an advantage over sharing the roads through the core area with slow cars, buses and pedestrians.

Bus travel

No changes are proposed to bus routes or movements. Overall the changes should advantage buses due to reduced competition with traffic through the centre and at major intersections, and because of clearer priorities with cyclists and pedestrians.

Car parking – alternative transport modes

The recommended fee increases and reduction in the number of kerbside carparks are intended to encourage use of the car park stations. The changes may also contribute to a wider program of encouraging alternative transport modes; against improvements to cycling routes and bus travel times, car travel will become increasingly less competitive.

Changes needed to the transport network beyond the boundaries of the study to support the vision and goals of the project

As the project is implemented, traffic volumes on the approach roads and turn movements at main intersections should be monitored for adverse and unintended consequences.

Road and intersection designs are needed for affected streets beyond the study zone, such as York Rd, Birrell St, Carrington Rd and Bronte Rd, to accommodate or prevent possible increases in traffic.

2.2.2 Waverley Access and Mobility Plan (2011 – 2015)

The *Waverley Access and Mobility Plan* aims to meet Council's legal obligation and social objectives outlined in *Waverley Together 3*. It complements many of the aims of the Complete Streets project by aiming to provide "access to all people, to all places, every day" (Waverley Council 2011, p. 2).

The plan acknowledges that people with a disability can face barriers to access and to participate in community life in the following three forms:

- physical barriers — such as uneven footpaths, inaccessible buildings, streetscapes and facilities due to steps or absence of parking;
- operational barriers — where a person is unable to submit or access information; and
- social attitudes — negative perceptions towards people with a disability (Waverley Council 2011, p. 3).

Council has several operational plans that engage with the Access and Mobility Plan. Four have immediate significance to transport:

- Pedestrian Access and Mobility Plan (PAMP);
- Footpath Program;
- Local Transport Action Plan; and
- Area Traffic Plans.

Specifically, the Bondi Junction PAMP (2009) lists 30 'high priority' projects. Seventeen (17) have been completed and two (2) partly completed. Of the remaining 'high priority' projects, one has been investigated and will not be proceeding; two are outside the jurisdiction of Waverley Council (within the jurisdiction of RMS); four are part of the Spring Street Complete Streets works (SAMP4); and the remaining are deferred until other development occurs. A more detailed outline of these works are provided in the Bondi Junction Gap Analysis within Appendix A.

Council has an *Access Advisory Committee* comprising Councillors, staff and community representatives. The role of the committee is to provide feedback on integrating access needs in Councils' plans and operations as well as provide a central references point for staff and community when responding to requests (Waverley Council 2011, p. 11–12).

Council receives requests from time to time to support specific access projects. Council's ability to do this is dependent on criteria set out in the mobility and access plan including relative benefits to the community as a whole, technical restrictions and operational limitations and costs (Waverley Council 2011, p. 10).

2.2.3 Waverley Bike Plan (2013)

The Waverley Bike Plan addresses directive L7 Walking and cycling — people frequently walk and ride their bikes, particularly for local trips, within the strategic plan for Waverley. Specifically it seeks to:

"significantly increase the number of trips made by bicycle so as to reduce traffic congestion and parking pressure in Waverley while improving the health and amenity of our area" (Waverley Council 2013b, p.4).

The plan defines actions Waverley Council can take to increase cycling for recreation, commuting and short trips, through delivery of infrastructure and programs. It particularly seeks to increase cycling participation by women and inexperienced riders.

The plan recognises the high level of bike usage in Waverley discussed further in Section 4 and increasing cycling rates for the journey-to-work. Difficulties for bicycle riders include steep terrain and lack of separated cycle paths.

The report considers every street in the Waverley LGA a cycling street, but highlights a plan to prioritise routes that are structured to support cycling access to key trip generators. Key destinations and focal points within the LGA include Bondi Beach, North Bondi, Tamarama, Bronte, Waverley Park, Queens Park/Centennial Park and Bondi Junction. Destinations beyond the boundary are Sydney CBD, Paddington, Rose Bay ferry, UNSW and Coogee. Improvements to these routes require collaboration with neighbouring Councils and State government agencies.

The plan identifies six priority bicycle routes, linking workplace and recreational destinations within the LGA and beyond. These are shown in Figure 2.9.

Figure 2.9: Waverley Priority Bicycle Routes Source: Waverley Bike Plan 2013 Figure 4

Route 1: *Bondi Beach to Bondi Junction to CBD Routes* — the highest priority route, being upgraded to separate bicycles from road traffic, and including integration with the State bicycle route.

Route 2: *Bondi Beach to Rose Bay* — a new route that provides access to the Rose Bay ferry wharf and an alternate connection to Bondi Junction from North Bondi Beach. Part of the route is in Woollahra LGA.

Route 3*: Bondi Junction to Bronte Beach* — a largely complete route that links to Clovelly via the Randwick Council bike network.

Route 4: *Bondi Junction to UNSW/Randwick via Queens Park* — an existing route that links local parks to UNSW and Randwick in collaboration with Randwick Council.

Route 5: *Bronte Beach to Centennial Park* — mixed traffic and a hill climb make this route better suited to experienced riders. It connects two trip generators and requires collaboration with Randwick Council and Centennial Parklands to complete.

Route 6: *Coastal Cycleway* — a recreational route suited to more experienced riders, it forms part of a future continuous coastal route from Sydney Harbour to Botany Bay (Waverley Council 2013b, p. 10—11).

Secondary routes provide links to primary routes that connection to trip generators and cross-LGA linkages, as shown in Figure 2.10. Both primary and secondary routes include a diversity of cycle path types, from mixed traffic to special treatments, some of which existed at the time of the report.

Status of Cycle Projects

Council is currently undertaking further studies for Syd Einfeld Drive, with various cycle options being studied by Hill Thalis and Parsons Brinckerhoff for this area. The cycling infrastructure improvements have considered the potential for a westbound on-road cycle lane between the Oxford Street and Bondi Road intersections on Syd Einfeld Drive. Council has noted that Roads and Maritime Services (RMS) NSW have not been supportive of any reduction in capacity on Syd Einfeld Drive for the cycleway but remain open to prospects of cycle infrastructure at its two major intersections.

Many Priority Route treatments in the Waverley Bike Plan have been completed or are currently being designed. Major exceptions include:

- Route 2 Bondi Beach to Rose Bay which has been initially completed as mixed traffic but proposed for a Feasibility Study for a separated bidirectional cycleway. This was not originally intended to be done until after the Spring St separated Cycleway was completed; and
- Route 6 Coastal Cycleway which is an on-road recreational cycleway is not eligible for state government Active Transport funding and which would be ideally undertaken in conjunction with Woollahra and Randwick Councils.

Major treatment reviews in close proximity to Bondi Junction have been placed on hold until the Bondi Junction Cycleway design has been approved by Council. Refer to the Gap Analysis in Appendix A for more information.

Source: Waverley Bike Plan 2013 Figure 3

Figure 2.10: Waverley Bicycle Network Map

The plan incorporates strategies for:

- wayfinding and signage to support the bicycle network, including directional and behavioural signage (Waverley Council 2013b, p. 12–14);
- bicycle parking and end-of-trip facilities for new developments are identified as responsibilities of Waverley Council through the development process;

- on-street bike racks at key destinations (Waverley Council 2013b, p. 15–16);
- establishment of a bicycle parking compound at the Bondi Junction interchange to cater for short trips;
- a range of activities run or supported by Waverley Council to encourage and promote cycling; and
- information and awareness materials, campaigns and participatory learning events (Waverley Council 2013b, p. 17).

2.2.4 Waverley Light Rail Report (2013)

Council commissioned an analysis of light rail options for the corridor between Bondi Junction and Bondi Beach.

The report analysed several factors that make light rail an attractive option for the corridor including:

- carrying capacity relative to other transport modes — light rail vehicles can carry up to 300 people per set while buses can carry from 60 to 100 depending on the vehicle type;
- efficient use of limited road space — a light rail vehicle uses around 50% less road space to carry 300 people than would buses; and
- road traffic congestion — road traffic using the Bondi Road corridor is currently operating at capacity with volumes highest at the western end where more lanes are available (AECOM. 2013, p. 13, 14 & 21–22).

Development of a light rail service is in keeping with the "intermediate transit" status of the corridor identified by Transport for NSW in the NSW Long Term Transport Master Plan discussed in Section 2.1.1.

Three alignment options were assessed and these are shown in Figure 2.11.

Source: AECOM. 2013, Waverley Light Rail. Waverley Council, p.27

Figure 2.11: Three Route Options for Light Rail from Bondi Junction to Bondi Beach

The key features of each option include:

Option 1: Bondi Junction to Bondi Beach via Old south Head Road, Birriga Road & Curlewis Street, 4.2km route length, 8mins 23 secs estimated travel time at 30km/h with the estimated daily patronage for 2011 as 6,300 passengers per day (AECOM. 2013, p. 30).

Option 2: Bondi Junction to Bondi Beach via Bondi Road, 3.9km route length, 7mins 47 secs estimated travel speeds at 30km/h, parking lanes would be taken out along Bondi Road with the estimated daily patronage for 2011 as 14,800 passengers per day (AECOM. 2013, p. 31).

Option 3: Bondi Junction to Bondi Beach via Council Street, Birrell Street & Watson Street, 4.7km route length, 9mins 24secs estimated travel speeds at 30km/h with the estimated daily patronage for 2011 as 14,800 passengers per day (AECOM. 2013, p. 32).

Option 2 was identified as the preferred option given its shortest route length, travel time and high patronage potential.

Current bus services on this corridor support the patronage levels estimated for Options 2 and 3 today. The potential increase in capacity possible with light rail would likely induce patronage growth in this high demand corridor.

The analysis also examined light rail options from Bondi Junction connecting with the Sydney CBD. Two route options were examined — Oxford Street or Moore Park Road. Of these two, given the arterial road traffic function of Moore Park Road and the potential for revitalising Oxford Street, Oxford Street was identified as the preferred option (AECOM. 2013, p. 34).

Light rail options are also being investigated by a current feasibility study being undertaken by Parsons Brinckerhoff.

2.2.5 Car Share Policy (2012)

This policy addresses two strategic directives articulated in in Waverley Together 3, including L9 Parking — Parking, both on-street and off-street, is equitably accessed and affectively managed and L6b — Stabilise or reduce private passenger vehicle numbers of trips.

Council's current car share policy requires all available car-share vehicles to be allocated a dedicated parking bay or pod with the following conditions:

- all car-share pods be in dedicated parking bays, ideally located adjacent to public, council or government land but may be located next to business premises or residential properties;
- dedicated car-share pods will not be located at the front of residential properties, in metered or commercial locations;
- operators are responsible for the installation and management of signage in accordance with Council's specification; and
- if a car-share pod is not used within a four-week period, Council may revoke approval for the pod.

Council charges operators an application fee to secure additional pods. Upon application, residents within a 50m radius of the proposed pod and local precinct committees are contacted for input.

In relation to parking fees and permits, car-share vehicles:

- all vehicles allocated a dedicated car-share pod within a Resident Parking Scheme Area (RPSA) are issued with a Car Share Parking Permit (CSPP) subject to an annual fee;
- a CSPP exempts vehicle from time limits shown on parking control signs signposted 'Permit Holders Excepted' where a pod is occupied by an unauthorised vehicle; and
- a CSPP is valid for 12 months and must be renewed by the operator.

A range of fees apply to car-share pods including:

- an application fee for securing a dedicated pod ($200);
- an annual fee for occupying the pod and issuing the CSPP in areas where Resident Parking Permit Schemes (RPPS) apply ($173); and
- for pods in non RPPS areas a reduced annual fee of $50 applies.

In relation to car-share vehicles, the policy states:

- vehicles should have a 4-star or greater green rating; and
- electric vehicles are not charged the annual operators fee for non RPPS areas and a reduced annual fee is charged for pods in RPPS areas.

Current Car Share Policy for the Waverley DCP

In order to provide the framework for more efficient and effective Car Sharing across the LGA the following Care Share policy is currently included in the DCP:

"*Car sharing enables individuals to reduce or eliminate the need for ownership of a private vehicle. This in turn reduces the space required for car parking and promotes the use of sustainable forms of transport such as walking, cycling and public transport. There is extensive use of car share vehicles in Waverley.*

Objectives

(a) To provide off-street parking opportunities for car share groups, in balance with competing parking demands.

(b) To support alternative methods of transport and reduce the demand on private car ownership.

Controls

(a) That the maximum amount of car parking spaces for a development is inclusive of the minimum number of parking spaces allocated for car sharing.

(b) A minimum of 1 car share space is to be provided for every 90 residential units.

(c) A minimum of 1 car share space be provided for every 50 commercial car parking spaces.

(d) Car share parking spaces must be publicly accessible at all times, adequately lit and sign posted and located off the street.

(e) 1 car share space can be provided in lieu of 3 car parking spaces.

(f) Car share spaces must comply with the design principles and standards in the DCP and Australian Standards.

(g) Car share spaces must be in optimum positions within the parking area to allow ease of access to car share vehicles by residents and the public.

(h) Car share spaces must be always under the ownership of a building's Owners' Corporation as common property.

(i) Car share spaces must be used and have authorised use by car share vehicles only.

(j) If a car share space is not taken up by a genuine car share provider, they cannot be permanently or temporarily designated for alternative purposes."

It is understood that these measures have not been effectively implemented across the LGA, creating a need for reinvestigation of Car Share strategies within a broader kerbside allocation strategy.

2.2.6 Bondi Park, Beach and Pavilion Plan of Management and Master Plan (2013)

The vehicle parking and movement study investigation of parking options (2013) also addresses directive L9 Parking by investigating options for improving parking layout and access to Bondi Beach, the park and pavilion and pedestrian access and safety.

The precinct has a total capacity of just over 700 car-parking bays (GTA Consultants, 2013, p. 11), with parking demand characteristics showing:

- Sundays followed by Saturdays are the days of highest demand;
- January is the month of highest demand, followed by November; and
- average parking duration is 1 to 2 hours with few visitors staying more than 3 hours (GTA Consultants, 2013, p. 12).

The study considered four options aimed at improving pedestrian access and safety as well as improving parking management within the Bondi Park precinct:

- *Option 1*: refine parking and movement in current configuration, removing traffic access at pavilion front;
- *Option 2*: partially underground Park Drive with green roof, with staged options;
- *Option 3*: fully underground car parking at Bondi Park; and
- *Option 4*: develop more compact car parking structure and loading facilities at pavilion rear while removing parking on Queen Elizabeth Drive.

The report identifies a variation of Option 4 as the preferred option, including development of an underground parking facility behind the Bondi Pavilion and vehicle access improvements to Queen Elizabeth Drive. Progression towards this option is envisaged as two stages — short and long term options as shown in Figure 2.12.

Short-term option

Long-term option

Source: GTA Consultants. 2013. Bondi Park, Beach and Pavilion Plan of Management and Master Plan: vehicle parking and movement study investigation of parking options. Waverley Council, Sydney, pp. 39 and 40.

Figure 2.12: Conceptual Layout for Short-term and Long-term Options

The report also canvasses issues relating to Waverley's Resident Parking Permit Scheme (RPPS), noting that "beach permit holders" make up an estimated 80% of parking transactions on Queen Elizabeth Drive and Park Drive North with unlimited time restrictions, thereby preventing a higher turnover of parking spaces. This creates higher traffic movements as more drivers cruise down Queen Elizabeth Drive looking for a parking space. The report highlights the opportunity cost associated with revenue loss arising from unmet parking demand from other users (non-permit holders).

Current Project Status

Major traffic actions involving changes to Queen Elizabeth Drive are on hold pending the implementation of a Traffic and Transport Study. The objective of the Traffic and Transport Study is to provide Council with an accurate understanding of the impacts of the proposed traffic actions. This study has not been implemented as it requires further refinement to ensure it meets objectives while remaining within the budget allocated. There is opportunity to combine this study with any data collection required for the proposed Campbell Parade upgrades.

The temporary traffic measures installed on QED will require upgrade, replacement or removal within twelve months to ensure they do not deteriorate and become hazards. Site observations indicate these measures have reduced conflict between users.

For more details regarding the status of transport-related actions for the Bondi Park Plan of Management refer to Gap Analysis in Appendix A.

2.2.7 Residential Parking Scheme Reviews

A series of reviews of Waverley Council's Residential Parking Schemes have been undertaken, including in 2009, 2012/13 and 2015. All of these reviews have attempted to address directive *L9 Parking – Parking, both on-street and off-street, is equitably access and effectively managed*.

The broad aim of these reviews has been to address problems with the shortfall between the *supply* of on-street parking and *demand* by local residents across the Waverley LGA, but in particular the Bondi Junction and Bondi Beach precincts.

The 2009 review identified the following principles:

- Wherever demand for public parking exceeds supply, demand management solutions should be considered before resorting to solutions that rely on increasing the supply of parking spaces;
- It is appropriate to use price to manage demand – with higher prices in higher demand areas/times/seasons and lower prices in lower demand areas/times/seasons;
- Parking should be paid for by users rather than being funded through rates. That is, it should be a user pays system, not subsidised by ratepayers, especially ratepayers who don't drive;
- Residents should be favoured to some extent, at least to the extent that the system should be designed to maximise their chances of getting a parking space near their home, especially if they don't and/ can't have off-street parking of their own;
- It is appropriate to use time restrictions to maximise supply of spaces and turnover;
- Where supply side solutions are a cost effective method of injecting capacity into parking systems, they should be adopted (Waverley Council, 2014); and
- While these high level principles set the direction for parking policy they didn't create significant change on the ground.

In the later review carried out in 2012/13 a particular focus was given to oversold, or almost oversold, individual resident parking areas where more permits were provided than there are spaces available. The review considered some 93 different points and issues ranging from Councils' decision-making processes, resident parking scheme area boundaries, permits, surveys and enforcement.

The most significant actions and recommendations arising from the review include:

- widening of resident parking areas to reduce the number of oversold areas;
- allowing households within the boundaries of a resident parking area to apply for a permit, regardless of whether there are restrictions in front of or near their property;
- daily visitors' permit to be available in all resident parking areas (depending upon capacity);
- discontinue the Bronte Visitors Permit, to be replaced with permit above;
- introducing new temporary permits and a carer's permit; and
- improvements to internal processes, conducting surveys and collection of information (Waverley Council, 2013).

In response to this initiative, the boundaries of several resident parking scheme areas (RPS) have been widened so that the Waverley LGA includes 11 rather than 23 RPS'. The Bondi Beach precinct contains the most oversold RPS at 110% followed by Bondi Junction.

For example, residents living on streets without RPS can experience difficulties in accessing parking as visitors to an area may fill these spaces. The ability to access permits has been extended to residents in such situations enabling them to access regulated parking spaces at destinations within easy walking distance of their homes which they may not have been able to access previously.

While these changes and adjustments are ongoing, there is still an overarching problem with demand for car parking being higher than the capacity to supply it.

2.2.8 Parking Price Review (2015)

Building on changes carried out in previous years, a review of prices for the variety of parking permits offered by Council was carried out in 2015.

In general, prices for properties with no off-street parking remained low at $40 per year (up from $34) while properties with one and two spaces incurred higher prices at $129 (up from $125) and $196 (up from $190) respectively. Concession rates apply for properties with no off-street parking, while electric vehicles, motorcycles and scooters are charged at lower rates due to their lower environmental footprints.

The difference in prices aims to encourage households with access to off-street parking to reduce their number of household vehicles and thereby reduce pressure on oversold resident parking areas.

The price of beach parking permits also remained relatively low for Waverley residents at $119 per year, while the same permit for non-residents is charged at $1,532 per year.

Further changes being rolled out in 2015/16 include changes to parking meter prices throughout Bondi Junction, Bondi Beach and Bronte Beach. These include trials to switch off parking meters in Bronte Cutting car park during winter and free winter parking in Queen Elizabeth Drive after 7pm, as well as the issuing of books providing 10 'daily visitor passes' for residents in parking restricted areas.

2.2.9 Bondi Junction Traffic and Transport Study (2007) and Review (2010)

The Bondi Junction Traffic and Transport Study (2007, Maunsell Aecom) provided 24 recommendations for Bondi Junction. Among others these recommendations included upgrades to traffic signals, provision of footpaths, safety improvements. Currently fourteen of these recommendations have been completed by Council. Of the ten actions not completed, five have been investigated with a decision not to proceed further (e.g. was not required, or did not have support of RMS/ Sydney Buses).

The five actions recommended in the Study, which have not been completed, currently warrant further action. These include; a number of changes to Grosvenor Street (currently being investigated in partnership with RMS), Rowe Street/ Rowe Lane projects and suggested changes to bus movements and operations across Bondi Junction.

The Bondi Junction Traffic and Transport Review (2010, Aecom) followed the release of the Bondi Junction LEP. The recommendations of this review were incorporated into the Bondi Junction DCP.

Refer to the Gap Analysis provided in Appendix A for more detail.

2.3 CURRENT TRAVEL PLAN POLICY FOR THE WAVERLEY DCP

To assist in providing a guidance framework for Waverley to be more economical and further encourage sustainable travel across the LGA the following Travel to Work policy is implemented as part of the DCP:

"A travel plan is a package of actions designed to encourage safe, healthy and sustainable travel options. By reducing car travel, Travel Plans can improve health and wellbeing, free up car parking space, and make a positive contribution to the community and the environment.

Objective

(a) To remove barriers to active travel for all users of developments.

(b) To maximise the number of people who walk, cycle or take public transport to and from the development.

Controls

(a) A Green Travel Plan or Workplace Travel Plan is mandatory for all new developments:

(i) With over 2,500m² for office / commercial/ retail land uses;

(ii) Including 15 units or more;

(iii) Where 50 or more employees are proposed; or

(iv) As deemed necessary by Council.

(b) A travel plan must include:

(i) Targets – this typically includes the reduction of a single occupant car trips to the site for the journey to work and the reduction of business travel.

(ii) Travel data – an initial estimate of the number of trips to the site by mode is required.

(iii) Measures – a list of specific tools or actions to support and achieve the targets.

For further information on how to prepare a Green Travel Plan or Workplace Travel Plan go to: www.pcal.nsw.gov.au and www.travelsmart.gov.au"

3. BEST PRACTICE RESEARCH

3.1 OVERVIEW

This section describes four generic relationships within transport and land-use systems. A description of how these relationships work provides an explanation for the options identified later in this study. These relationships, when applied, create more sustainable transport outcomes that underpin world's best practice in integrated transport strategies, highlighting the important role that public transport services play.

Waverley Council does not have direct control over the level of service provided through mass transit services like buses and trains. Council does however have significant control over parking and so special attention has been focussed on innovative approaches to parking management strategies aimed at alleviating road traffic congestion.

3.2 INTEGRATED TRANSPORT PRINCIPLES

At the outset, it needs to be acknowledged that Waverley is an established and high-density urban area. High residential densities generally mean traffic densities are also high and, if the emphasis is on private car travel, it is inevitable that the area will experience high levels of road traffic congestion.

There are changes to the network that can be made to dampen these impacts into the future, however their success is dependent on treatments to public and active transport networks and not to the road network in isolation.

Three principles identified in the literature and relevant to transport operations in Waverley are:

- public transport network speeds are determined by road network speeds;
- public transport service level improvements and patronage increases create increases in active transport (walking and cycling) use; and
- increasing road and parking space in isolation does not relieve traffic congestion levels.

The relationship between road and public transport network speeds

Public transport speeds are not only significant for public transport users, they are also significant for general road users. This is because of a relationship known as the Mogridge Principle that was identified by a UK physicist and transport modeller who worked for the Greater London Council during the 1980s and 90s known as Martin Mogridge (Mogridge 1997).

The reasoning behind the Mogridge Principle is as follows:

- public transport operates to a fixed speed — a timetable;
- road networks operate to variable speeds determined by the number of cars on the road;
- most people will take whichever transport option is quickest;
- if public transport is quicker because of an improvement, people will catch a train or bus for example, and in most cases the number of people using the service won't change its speed;
- if driving is quicker, people will use their car. The more people who drive the slower the road network speed becomes because road speeds are determined by the number of cars that join the network. Road networks are highly susceptible to changes in their operating speeds by comparison with public transport speeds; and
- when people shift between modes in pursuit of the quickest option they usually keep doing this until there is no significant advantage anymore in shifting from one to the other. In this way, the networks reach an equilibrium.

This principle is supported by microeconomic theory and its effects can be seen in local road and public transport data as well as comparative international data for cities.

When comparing different sectors of Sydney for example, those sectors with faster public transport speeds also have higher road speeds than those with slower public transport services.

Similarly, when the average speeds of public transport networks from cities around the world are compared with one another, the general trend is for those cities with faster public transport networks to also have higher road network speeds.

In the case of Waverley, public transport speeds on the significant Bondi Road corridor are effected by road traffic speeds because bus services share the road with cars and there are few opportunities for buses to be given priority. Perhaps more significantly, demand for public transport services within this corridor is high and the boarding times are long due to the high demand. This further slows bus services down and encourages people to drive. This is because, in general, driving is faster than using public transport even though roads are heavily congested.

If public transport speeds can be increased, it is likely that shifts will occur from car use to public transport use and so improve service levels for motorists as well as public transport users.

The relationship between public transport and active transport use

There is also a significant relationship between public transport and active transport. When public transport use is high across a population, then the active transport mode-split in that population is generally higher as well. This can be seen in the Millennium Cities Database produced by the International Association of Public Transport Users (UITP) based in Brussels to which Sydney Trains and Transport for NSW are both members.

The relationship can also be seen in cities that have undergone sudden and significant improvements in public transport service levels. For example, when the City of Zurich in Switzerland introduced its integrated ticketing system in 1995, it enabled people to move seamlessly between different public transport modes without paying a penalty, or additional fare for interchanging. At the same time a unitary information and integrated timetable were introduced to make wayfinding significantly easier and waiting times for interchanging between services was also reduced. In the wake of these changes, there was also a significant increase in the number of trips made by walking and riding bicycles.

The reason for this relationship seems to be that in urban precincts where public transport services are of a high standard, walking and riding a bicycle are often easier ways to connect with mass transit than is driving. Cities with higher urban densities are able to afford higher levels of service on their public transport systems making it more attractive to users, however the higher densities also mean that traffic densities are generally higher which can detract from car use by slowing vehicles down.

Increasing road and parking space in isolation does not relieve traffic congestion levels

One of the more counter-intuitive relationships in urban transport systems is the link between the supply of road space and the amount of driving that populations will undertake.

When looking at a heavily congested stretch of road or intersection, it seems logical that the best way to reduce delays would be to increase the amount of road space. In practice however, existing road users and sometimes public transport users respond to the quicker travel times by changing their behaviour. In many cases this involves drivers making additional or longer distance trips than they previously would have made or people switching from public transport services to driving in order to gain a travel time advantage provided by the additional road capacity. These travel behaviour responses are referred to as induced traffic growth and can be most easily seen when a significant increase in road capacity is made to a network such as the opening of a new urban motorway.

There are several different forms of travel behaviour change that occur on urban road and public transport networks when significant changes are made to prevailing service levels. These include:

- Traffic reassignment: where drivers find a new or improved road more attractive than an old route and so switch from one to the other. Significantly, this behavioural response is not classified as induced demand;
- Mode-shifting: where people find travel by car on a new or improved road faster than using alternate public transport services and so shift modes, a response that is classified as induced traffic growth;
- Trip rescheduling: where congestion during peak periods is reduced so that some people who scheduled trips outside the peaks change their departure time, thereby increasing peak traffic volumes;

- Change in vehicle occupancy rates: where people travelling as a passenger in another's motor vehicle choose to drive their own car;
- Trip redistribution: where destinations that had previously taken too long a time to access fall within quicker travel times, inducing travel to more distant destinations;
- Induced or generated trips: where faster network speeds result in people choosing to undertake trips they had not travelled previously or to use a longer length of the "faster" network; and
- Development traffic: where a district that was inconvenient to access because journeys times were too long becomes more attractive as a place to settle once network capacity has been augmented (SACTRA, 1994, pp. 20–22, 51 and 53).

When a significant change to service levels occurs on any transport network, especially at the centre of systems where congestion levels and demand is high, many if not all, of these travel behaviour changes occur in response. Some can work to de-optimise a network making its performance less efficient. This is why any changes to road network capacity must be considered in parallel with prevailing public transport service levels as discussed in the previous section.

Put simply, most people will not consistently join long or extended road traffic queues where significant delays occur. Or in other words, congestion stops traffic volumes from growing indefinitely. Once traffic volume throughput begins to deteriorate regularly, people respond by choosing other routes, other modes or not travelling at all. Other macro changes can also occur such as travelling to alternative destinations or even moving to new trip origins. This does not account for irregular disruptions to traffic however, such as accidents where queues leading to considerable delays can occur.

The research consensus is clear; unless there are compelling economic reasons to do so, providing additional trunk road capacity for local traffic movements works against "shaping" land use into a more sustainable form where trips lengths are shorter and trip intensity is concentrated around centres of public transport accessibility.

3.3 Innovative Parking and Traffic Management Measures

A significant challenge in relation to the management of scarce parking resources is the impacts it has on wider network operations and levels of driver frustration, including:

- when parking is in short supply, drivers can circle blocks looking for parking spaces, taking up valuable road space and adding to road traffic congestion and impacting on public transport travel times;
- if spaces are taken up by drivers who don't have a trip purpose in the immediate vicinity of shops adjacent to the on-street parking, shops can lose revenue and valuable customers; and/or
- when changes are made to parking prices, Council may be perceived as revenue raising against the interests of residents, drivers, local shopkeepers and businesses alike.

One approach that has enabled communities and businesses to overcome the problems listed above is the introduction of performance-based parking pricing schemes.

This approach to the management of parking was pioneered in the US, while some of the technology used to implement the approach is currently operating here in Australia and Sydney with high levels of success.

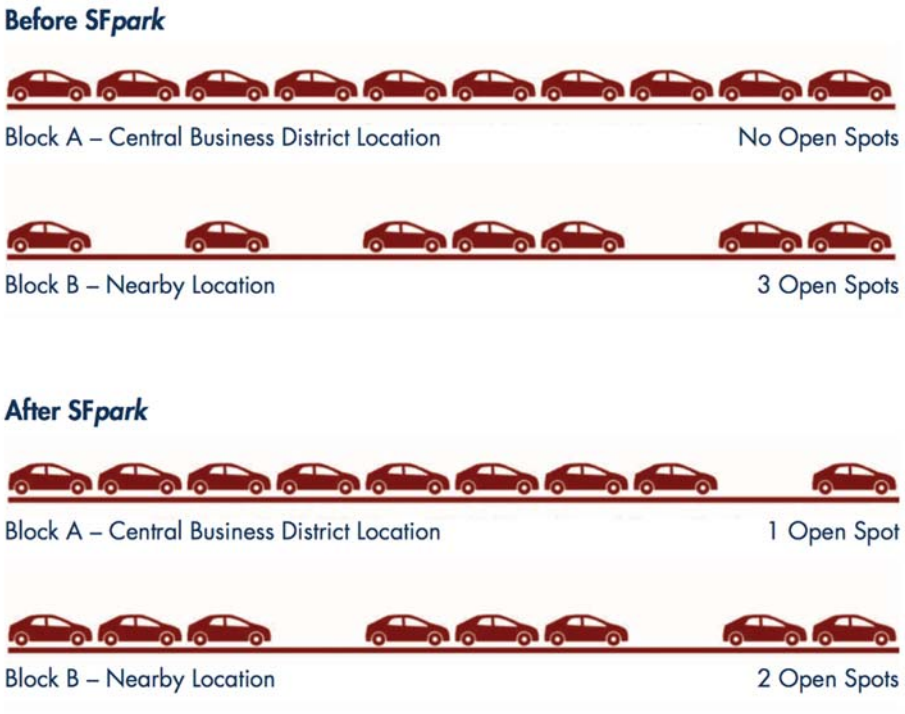
What is performance parking pricing?

Performance parking pricing enables variation in the price charged for on-street parking spaces across a series of city blocks, so that in areas where demand is high, parking prices for on-street parking are maintained at a higher prices than at blocks where demand is less. This encourages some motorists to shift their position when looking for a parking spot, bringing network benefits to all system users.

One city that leads the world in this practice is San Francisco.

In 2012, the city introduced seven pilot zones where sensors that can report the occupancy of every on-street car parking space were installed. Data collected from the sensors is used to adjust the price of parking for three time periods — before mid-day, from midday to 3:00pm and after 3:00pm — in accordance with the level of demand for parking.

The aim of the price that is set is to ensure that at least one space is left available on any given block so that drivers looking for parking spaces do not have to circle blocks looking for a parking spot and thereby increase traffic congestion. The principle is demonstrated in Figure 3.1.



Source: Pierce, G. and Shoup, D. 2013, 'SFPark: parking pricing by demand' in ACCESS, No. 43, Fall, p. 22

Figure 3.1: Performance Prices Balance Occupancy Across City Blocks

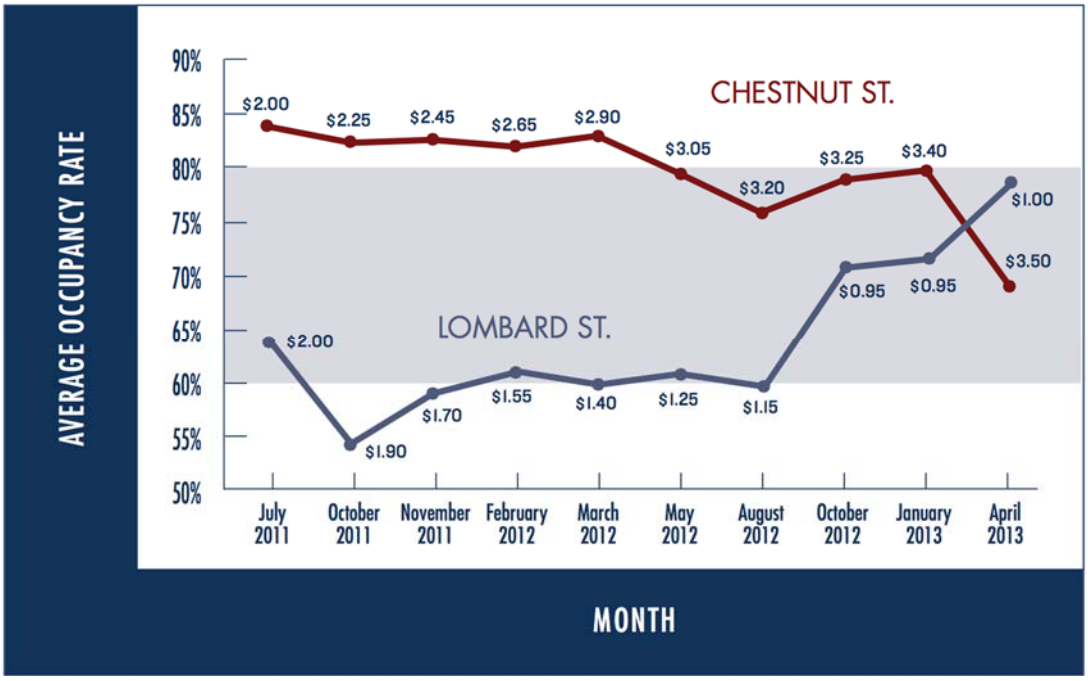
Before the introduction of performance parking pricing, parking on some street blocks was fully occupied while on others there were more vacancies as shown on the two streets at the top of Figure 3.1.

After the introduction of performance parking pricing, vacancies were "balanced" between different blocks by changing the pricing. In high demand blocks, prices were increased making them less attractive. In low demand blocks, prices were decreased making them more attractive and so inducing behaviour change on the part of some drivers.

This principle - changing the price to a level that encourages some drivers to shift to areas where there are more parking spaces, while also setting general prices at a level that discourages motorists from trying to park in areas where there are more drivers than parking spaces — has been successful in San Francisco. A large part of this success is attributed to the constant monitoring and review of parking prices, block by block over time by the city's planners.

Figure 3.2 shows the changes to prices for two streets - Chestnut and Lombard - in San Francisco over time. As shown, the prices for Chestnut Street were progressively increased while prices for Lombard were reduced. This adjustment to prices over time encouraged some people to shift from parking in Chestnut Street to Lombard Street and this can be seen in the change of average occupancy rates, bringing both streets into the target occupancy range shown in the grey shaded area.

The goal of the SF Park program is to optimise parking, not maximise revenue. While the scheme generates more revenue than is needed to operate it, revenues raised above operating costs are redirected into local improvement programs that benefit the local community.



Source: Pierce, G. and Shoup, D. 2013, "SFPark: parking pricing by demand" in ACCESS, No. 43, Fall, pp. 24.

Figure 3.2: SF Park Pricing Adjustments Example

One of the advantages of a scheme of this kind is that it was able to depoliticise the parking debate. By using a transparent data base, pricing rules bypass politics because community demand dictates prices. In this way, key decision-makers are able to avoid the claim that prices have been increased to raise revenue. This is also because the aim of the variable pricing scheme is to optimise parking availability and not revenue collection.

New parking sensor technology

The emergence of new sensor technology and the ability to link it to publicly available real-time information on parking makes the transparency real enabling most people to access information at any time.

This approach to managing parking is used by several cities in the US including Seattle, San Diego and Los Angeles in addition to San Francisco.

This approach to parking is made possible by new sensor technology that is able to monitor the time periods over which individual parking spaces are occupied or vacant. San Francisco uses sensor technology while Seattle uses manual surveys.

With recent innovations in sensor technology, the cost is low and is currently in use at a wide range of sites throughout Australian states and cities, including Victoria, Queensland, SA and WA and in commercial car parks across the country. They are also being used for monitoring on-street parking by five NSW councils including Penrith, Wyong and Port Macquarie. In many cases, the sensors are used for surveillance of potential car park infringements and not variable pricing management.

North Sydney Council appears to be leading the way with this technology. A further benefit is that data coming off the sensors can be linked to apps developed to help motorists find vacant spaces and so further reduce the amount of circling around blocks looking for a parking space. North Sydney reports:

"Council will also be able to link the sensor data to parking guidance signage, helping motorists to find parking within village centres or car parks. This will reduce the circling that currently occurs in some shopping areas and in our ground-level car parks, which in turn will reduce congestion and driver frustration" (North Sydney Council, 2015)

Waverley Council has installed parking sensors in conjunction with dynamic signage at several sites within the Bondi Beach precinct, including Queen Elizabeth Drive, Park Drive (north and south) and Campbell Parade (662 in total). Sensors are also in place at sites at Bronte cutting (141 spaces) and Victoria Street in Bondi Junction (28 spaces) and Tamarama Park (4 spaces). The sensors are intended to detect whether or not a vehicle is occupying a parking bay and then uses this information to convey to motorists whether or not parking spaces are available in order to facilitate easier parking. This is currently communicated through an on-site dynamic information display that lists the number of vacant parking bays.

This system was provided by APARC but has experienced technical difficulties with discrepancies between the number of vacancies reported on signs and those actually available. The technical difficulties are currently under investigation.

Council will be calling for tenders for a new parking guidance system. This system will also use sensors to report on parking availability at parking stations in the Bondi Junction precinct at Eastgate, Hollywood and the Library (an estimates 1190 spaces in total). The preferred system will report on availability outside the station and provide further guidance on parking locations to motorists once in the parking station. This system is likely to be in place by mid-year.

Council is currently investigating possible use of parking sensor data in a smartphone app that would enable residents and motorists to access information on parking availability before entering the precinct. Such information has the potential to influence driver behaviour by deterring people from driving to the precinct to park if they know parking availability is poor thereby potentially reducing local road traffic congestion. For such communications to be effective, the information has to be reliable and so technical difficulties with the sensors need to be resolved before this can proceed.

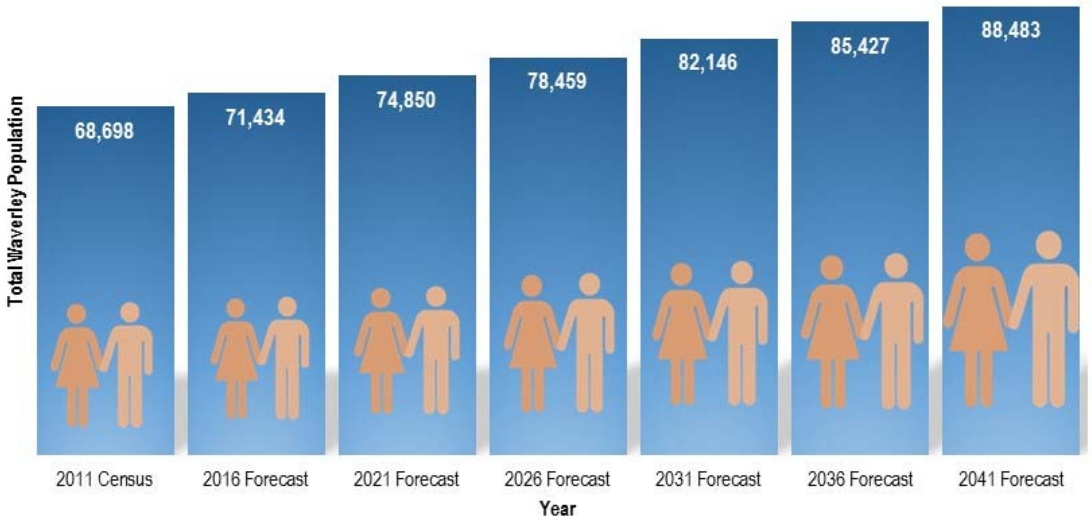
Such technologies can also be linked to on-line payment schemes for parking, making it easier for motorists to navigate and manage themselves through parking facilities. This can also potentially reduce management costs for Council.

4. WHERE ARE PEOPLE GOING AND HOW DO THEY GET THERE?

4.1 RELEVANT RESIDENT CHARACTERISTICS

4.1.1 LGA Population

In the 2011 census, the Waverley LGA recorded 68,698 residents and this has been forecast by the Bureau of Transport Statistics (BTS) of NSW to increase to 82,146 by 2031 (see Figure 4.1) equating to an annual compounding growth rate of 0.9% per annum.



Source: Bureau of Transport Statistics NSW

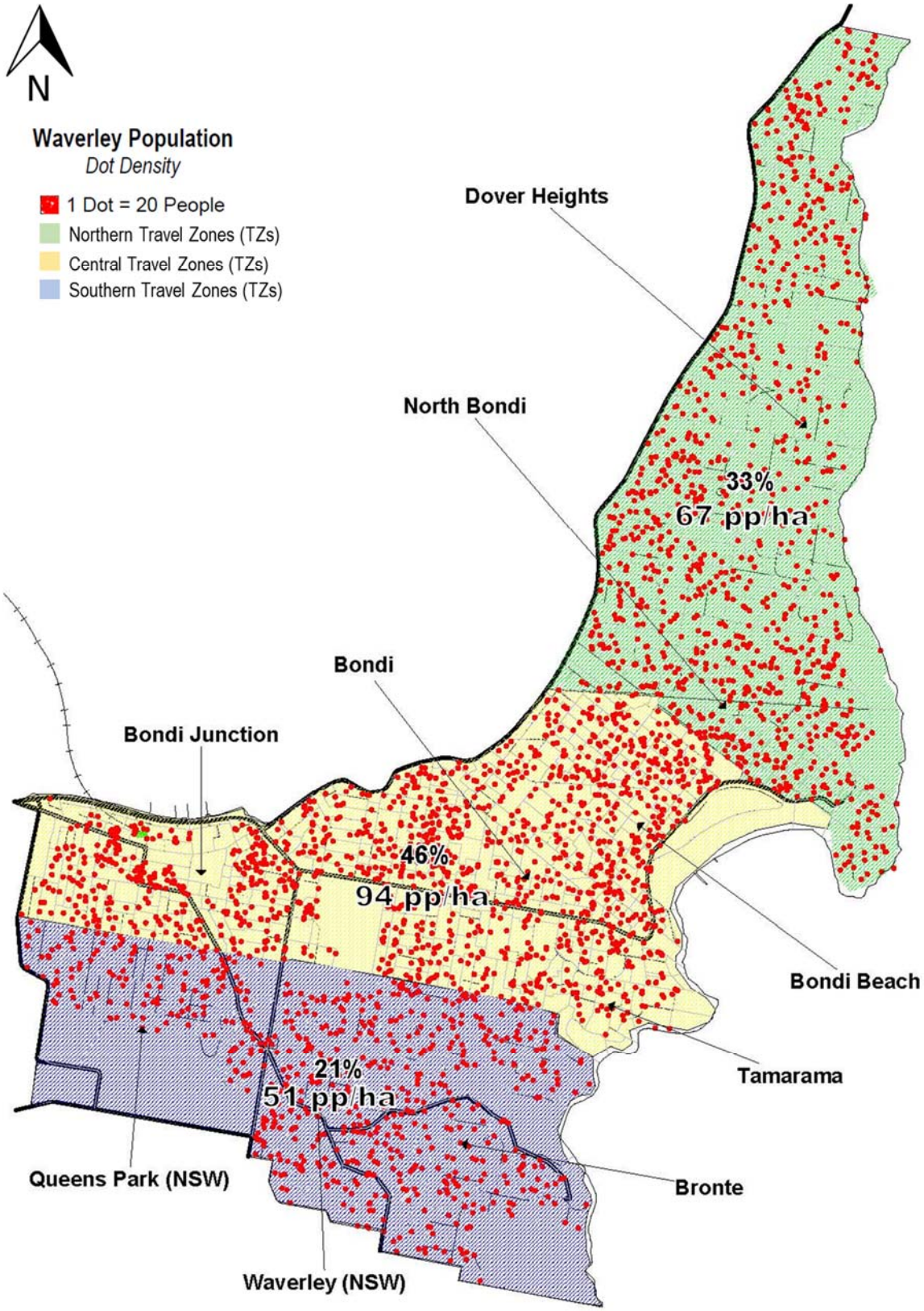
Note: The 2016 ABS census shows a population of 66,821 for the LGA . The BTS data has not been updated to reflect this and may use a different area boundary.

Figure 4.1: Waverley LGA Population and Population Growth

Whilst this annual population growth rate is less than many other parts of Metropolitan Sydney, it is occurring in an area where many segments of the transport system are already at capacity for much of the day and much of the week.

4.1.2 Population Density

Figure 4.2 shows the population density in 2016 across the LGA divided into three key collections of suburbs. The average population density across Greater Sydney was 3.8 persons per hectare in 2013 with many "central" Sydney areas having a density greater the 30 persons per hectare. In comparison Waverley is considered to have one on the highest population densities in Greater Sydney, particularly in the Bondi Junction to Bondi Beach corridor where the density is approximately 94 persons per hectare.

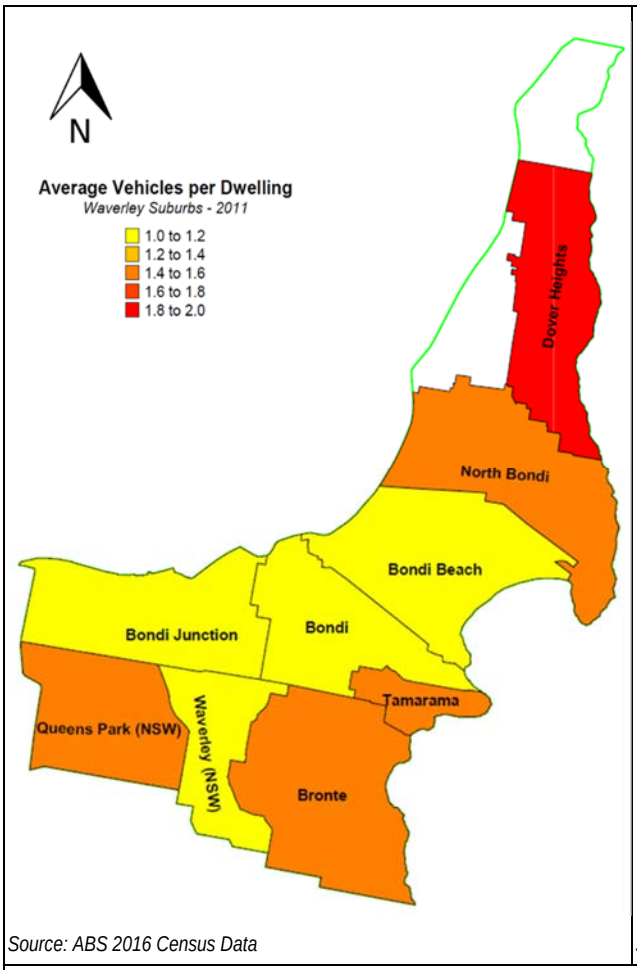


Source: ABS 2016 Census Data

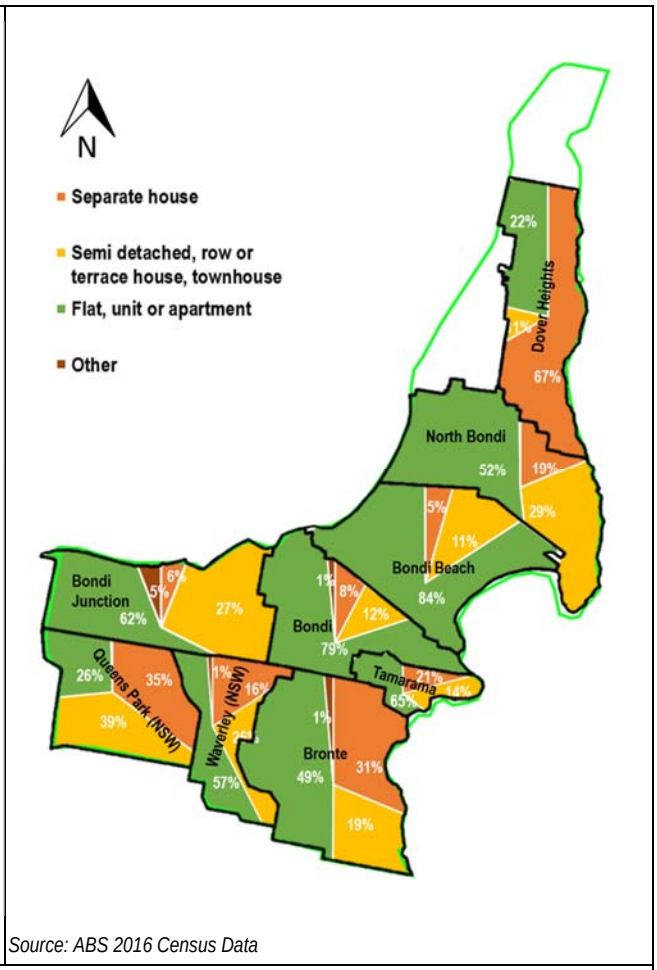
Figure 4.2: Waverley LGA Population Density in 2016

4.1.3 Car Ownership Levels and Trends and Household Structure

Figure 4.3 shows the 2016 distribution of car ownership rates across the LGA with Dover Heights and Bronte having car ownership rates that match or exceed the Greater Sydney Average of 1.7 car per household with the higher residential density areas of Bondi Junction, Bondi and Bondi Beach understandably having smaller household sizes and lower car ownership per household.



Source: ABS 2016 Census Data



Source: ABS 2016 Census Data

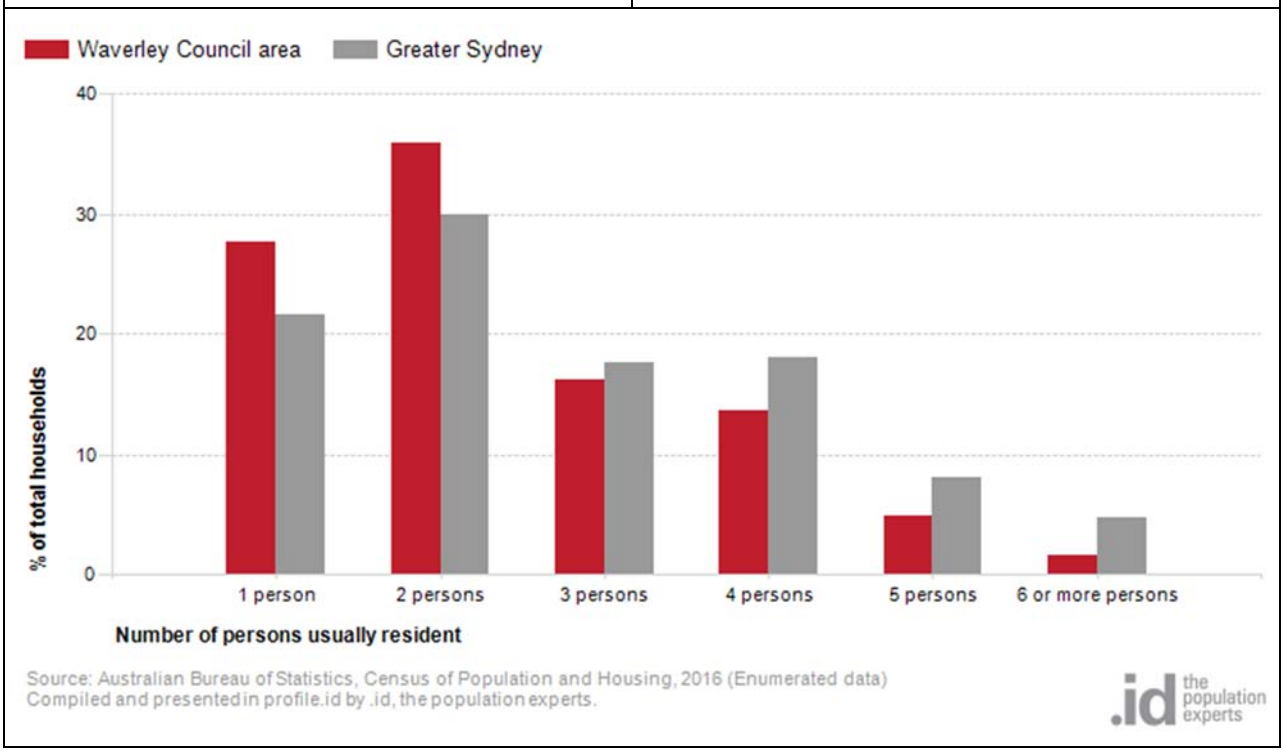
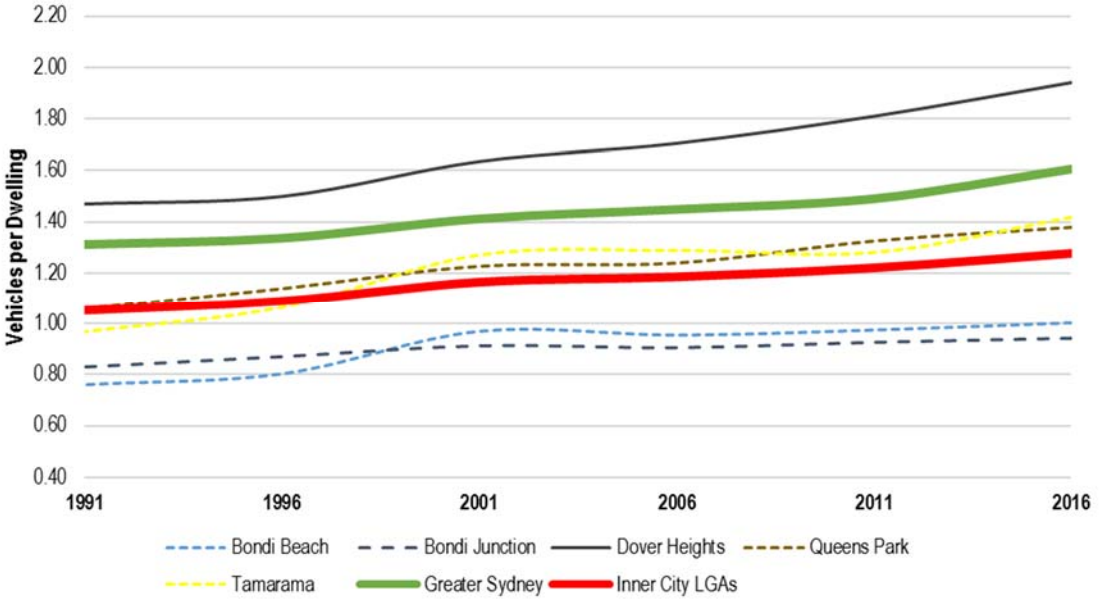


Figure 4.3: Waverley LGA Car Ownership and Household Structure in 2016

Figure 4.4 shows how the average car ownership has changed over time in the Waverley LGA.



Source: ABS 2016 Census Data.

Note 1: The Waverley suburbs graphed were chosen to best show trends across the LGA and provide clear representation of the LGA's northern, central and southern suburbs.

Note 2: In calculation of the Vehicles per Dwelling rate households labelled as having"3 or more vehicles" were assumed to have a total of 3 vehicles and those with "4 or more vehicle" assumed to have a total of 4 vehicles (2016 data only).

Figure 4.4: Waverley LGA Average Car Ownership Trends by Suburb

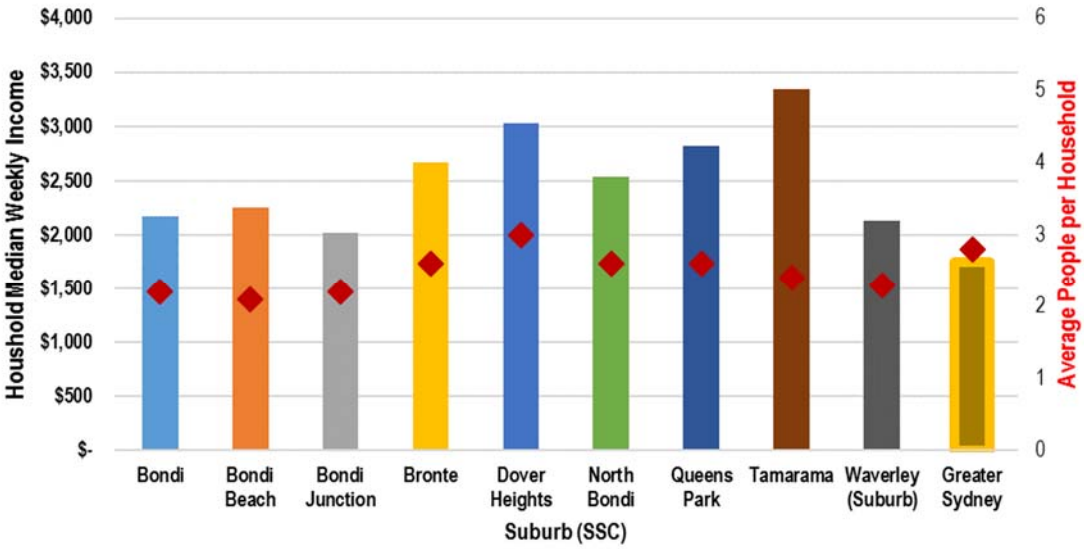
Average vehicle ownership per household trend lines for various suburbs within the Waverley LGA and for Greater Sydney from 1996 to 2016 are shown above in Figure 4.4. With the exception of Dover Heights and Queens Park each of the localities in Waverley show vehicle ownership has levelling off since 2001. Dover Heights in particular appears to be increasing at a rate above that of Greater Sydney. This is against a broader trend of increasing car ownership across Greater Sydney, from 1.3 cars per household in 1991 to 1.7 cars per household in 2016. Bondi Junction and Bondi Beach have averaged around 0.8 and 0.9 cars per household respectively for the past decade; while Tamarama has increase slightly to 1.4 cars per household. This is most likely due to population density/household structure factors, for example, Bondi Junction suburbs close proximity to a major rail station (Bondi Junction Station), and the dwelling types mix staying relatively similar over this period.

The number of vehicles per household has increased in all areas however, compared to Greater Sydney, only Dover Heights presents a greater ratio of vehicles per household, both it and Queens Park have trended with faster increases in the average vehicles per household than other suburbs in Waverley and the Greater Sydney average. However, the overall the rate of growth in car ownership in Waverley has been less than the Greater Sydney average.

4.1.4 Income Levels and Household Size

The household income levels and the average number of people per household for each Waverley suburb is shown below in Figure 4.5 and includes the Greater Sydney average for comparison. A relationship of higher average income corresponding with higher average people per household, is apparent in most Waverley suburbs. It is noted however that the suburbs of Tamarama and Queens Park have lower people per household with much higher average weekly income levels when compared to other Waverley suburbs.

Across the entire Waverley LGA all suburbs have a higher than average weekly income compared to Greater Sydney and all suburbs (excluding Dover Heights) have less than the average number of people per household. This indicates that Waverley is a high income area of Sydney with high amounts of high density living and/or mostly single/couple living.

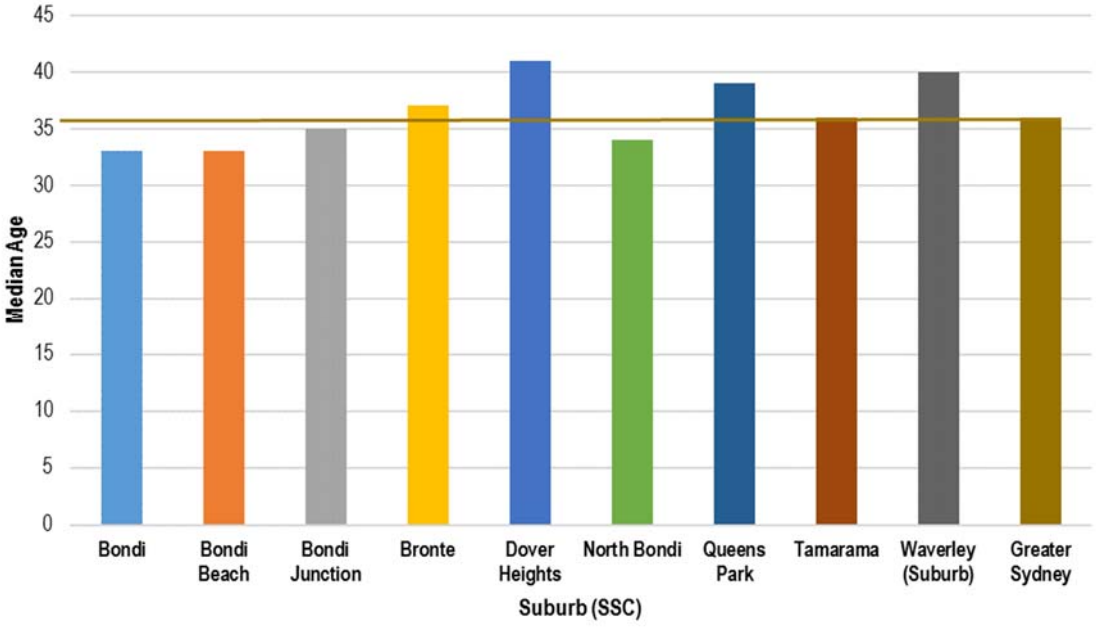


Source: ABS 2016 Census Data

Figure 4.5: Waverley LGA Income v Persons per Household by Suburb

4.1.5 Age Considerations

Figure 4.6 shows the median age of the population residing in each suburb. The median age in Waverley varies widely by suburb. Bondi Junction, Bondi and Bondi Beach have the youngest average ages whereas less "dense" suburbs like Dover Heights, Queens Park and Waverley (Suburb) have older average populations.

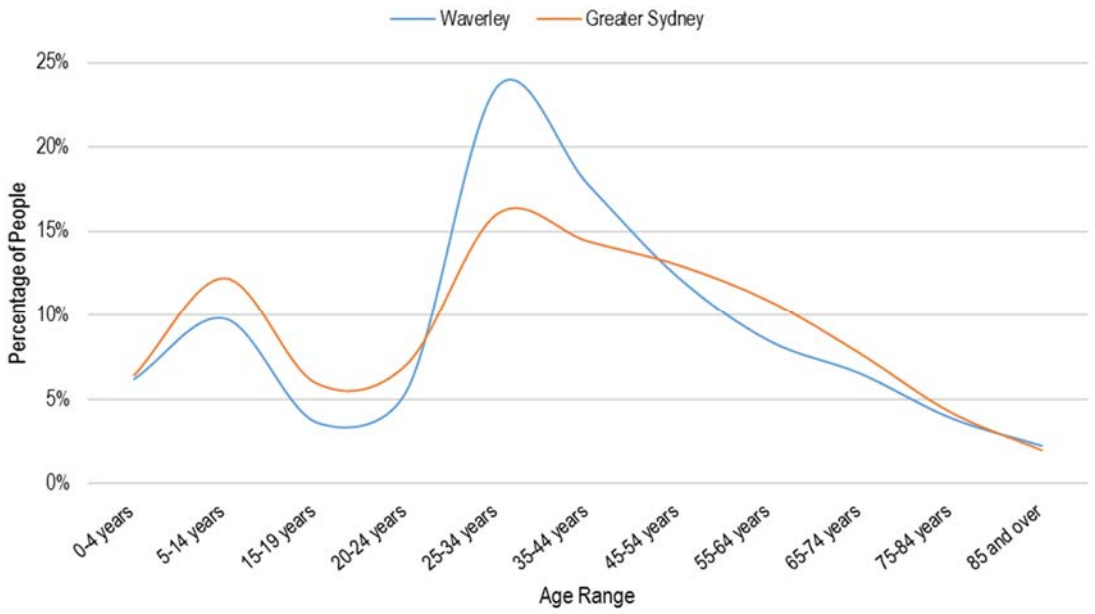


Source: ABS 2016 Census Data

Figure 4.6: Waverley Median Age by Suburb

Figure 4.7 shows the age distribution profile of the Waverley LGA compared to Greater Sydney. It is interesting to note Waverley's disproportionate number of residents in the 25 – 34 and 34 – 44 year age brackets which suggest a few key emerging issues, namely:

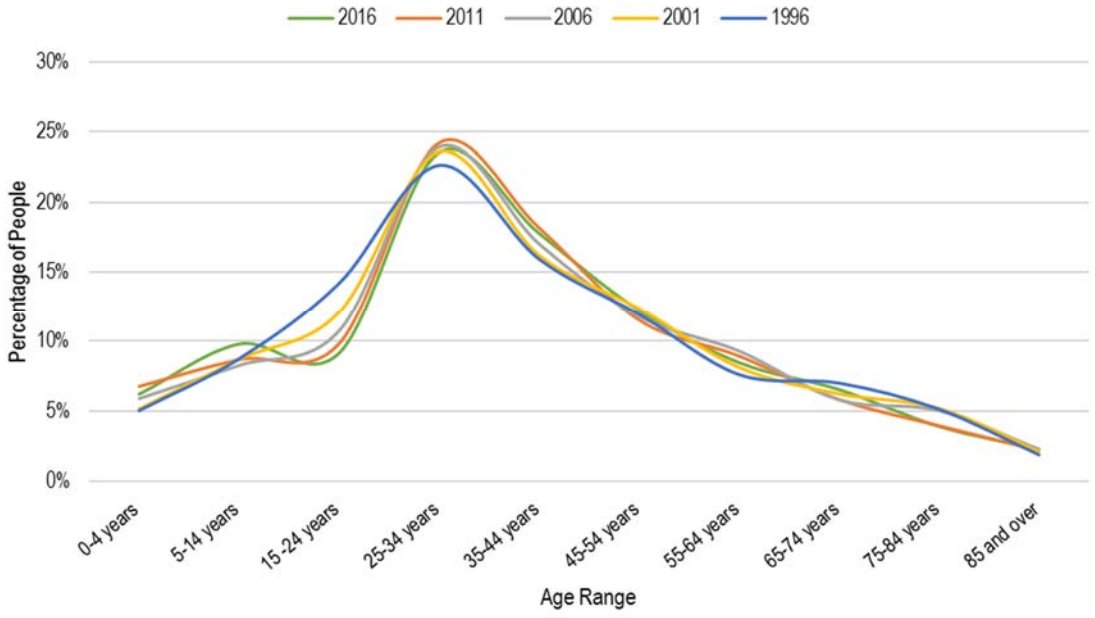
- a "pulse" of growing families coming through that may age in-situ, generating higher car ownerships;
- a growing demand for household sizes; and
- a shift in School travel demand from Primary to Secondary Schools.



Source: ABS 2016 Census Data

Figure 4.7: Waverley LGA vs Greater Sydney Population Age Profile

Figure 4.8 shows the Age Profile trends over the last 20 years from 1996 to 2016. The profiles indicate that Waverley consistently remains an area with a relatively high population of people between the ages of 25-34 years (i.e. young families and double income no kids groups). The fact that the age profile has not moved substantially over the past 20 years suggests a transient resident population with, a possible scenario of couples moving in, staying with young families then moving out as the children reach secondary/tertiary education.



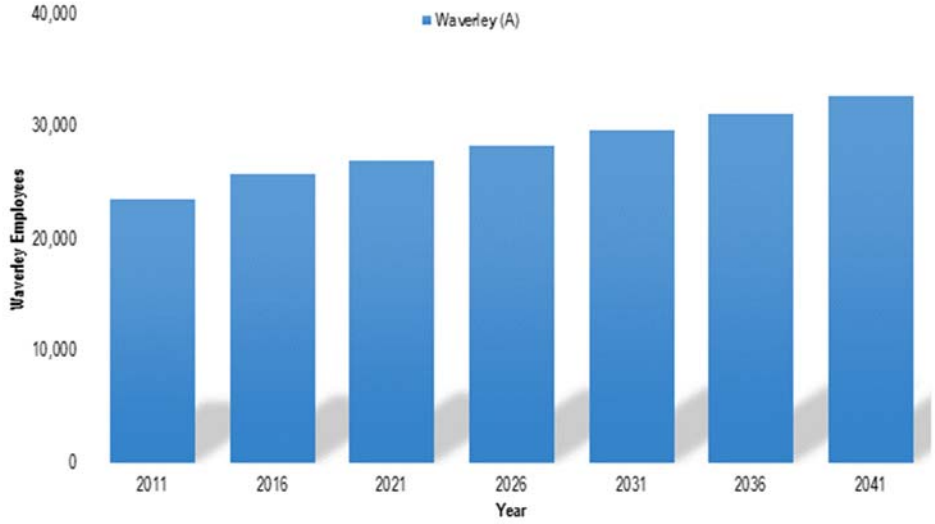
Source: ABS 2016 Census Data

Figure 4.8: Waverley Statistical Area (SLA) Age Profile Trends

4.2 RELEVANT EMPLOYEE CHARACTERISTICS

4.2.1 Total Employment

As shown in Figure 4.9, total employment is forecast to increase from about 23,000 jobs in the LGA in 2011 to approximately 29,000 jobs in 2031.

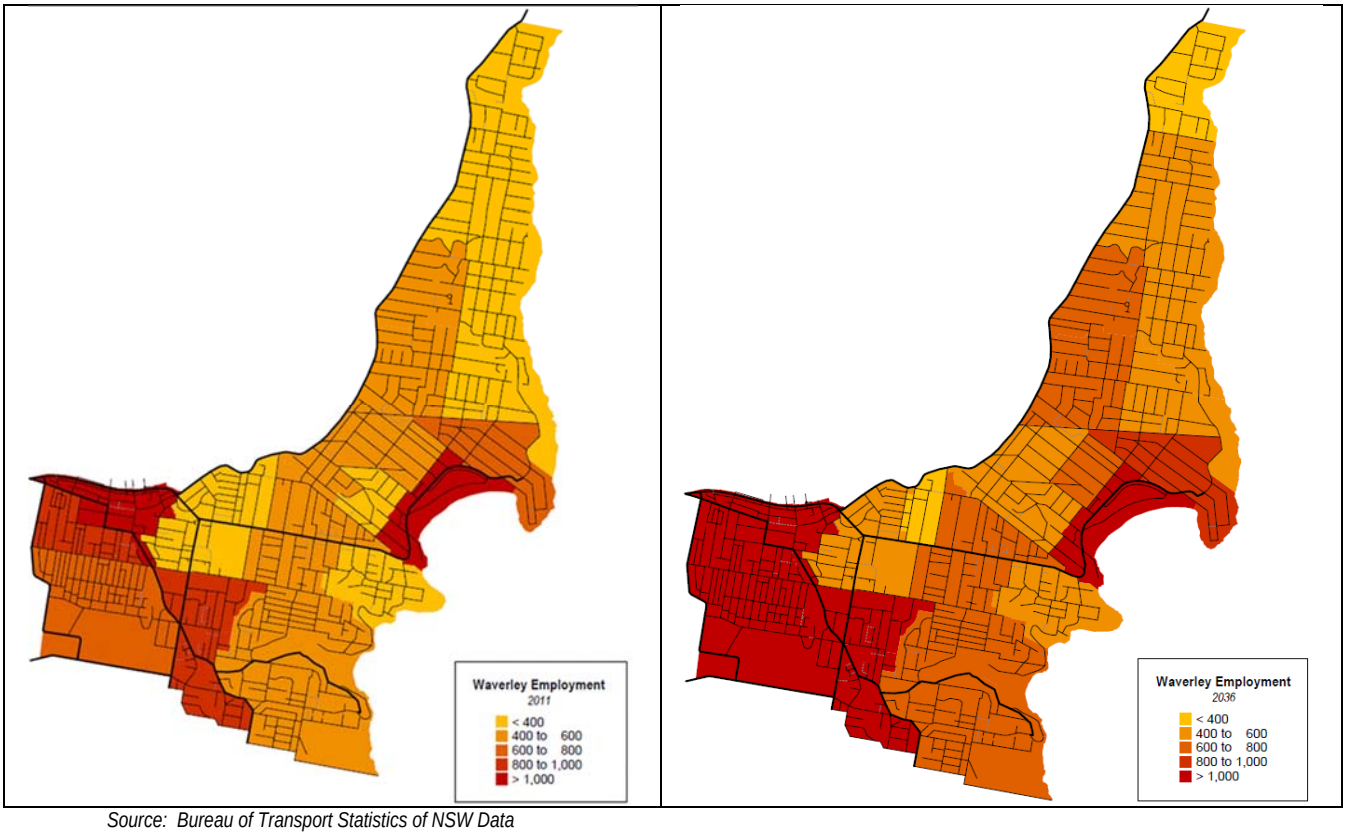


Source: Bureau of Transport Statistics of NSW Data

Figure 4.9: Waverley LGA Jobs and Jobs Forecast

4.2.2 Employment Growth Areas

Figure 4.10 highlights 2011 employment density along with projections made by the BTS of NSW for 2036 employment density. It is interesting to note that the figure shows the greatest change in intensification of employment to the south of Bondi Junction and in the Queens Park area which is mostly the area south of Bondi Junction rather than closer to Queens Park itself.

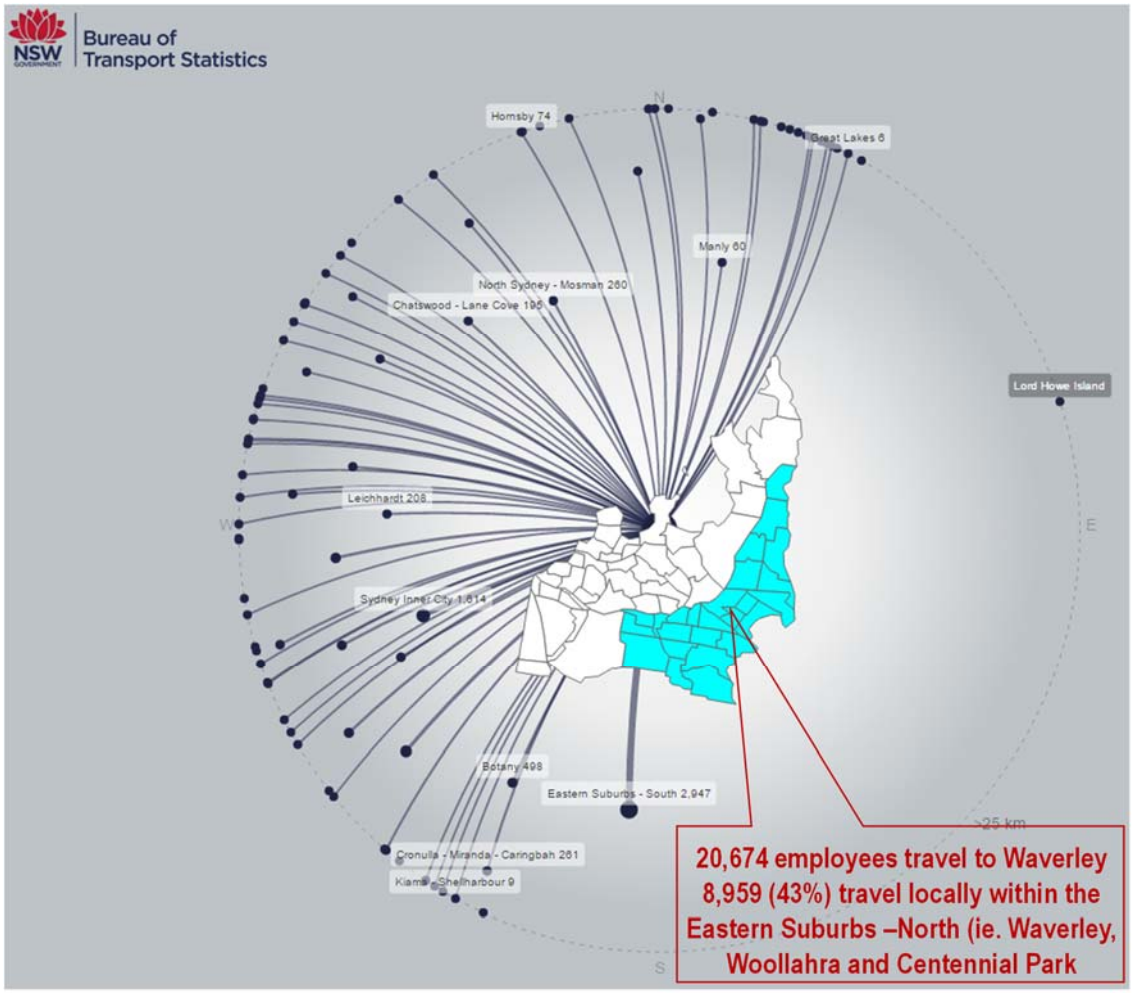


Source: Bureau of Transport Statistics of NSW Data

Figure 4.10: Waverley LGA Employment Density and Expected Growth

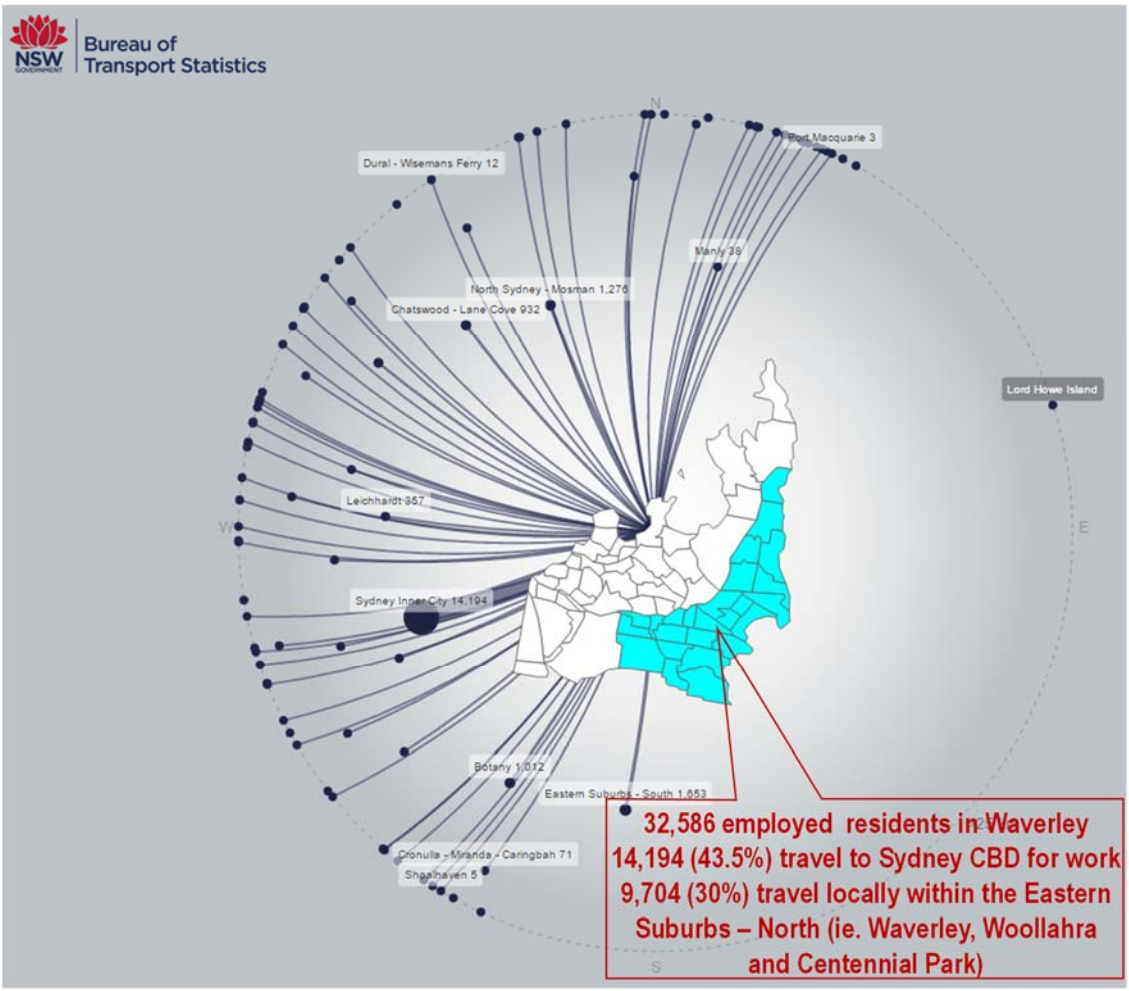
4.3 JOURNEY TO WORK DATA

Figure 4.11 shows journeys to work for people are employed in the Waverley LGA. Of the total employees travelling to Waverley approximately 43% live within the Eastern Suburbs – North Region (i.e. Waverley, Woollahra and Centennial Park). Figure 4.12 shows that of the total employed Waverley residents, 43.5% travel the Sydney CBD for work, and 30% travel to work "locally" in the Eastern Suburbs – North Region.



Source: Bureau of Transport Statistics of NSW (based on 2011 data)

Figure 4.11: Journey to Work Travelling to Waverley - Origin Distribution

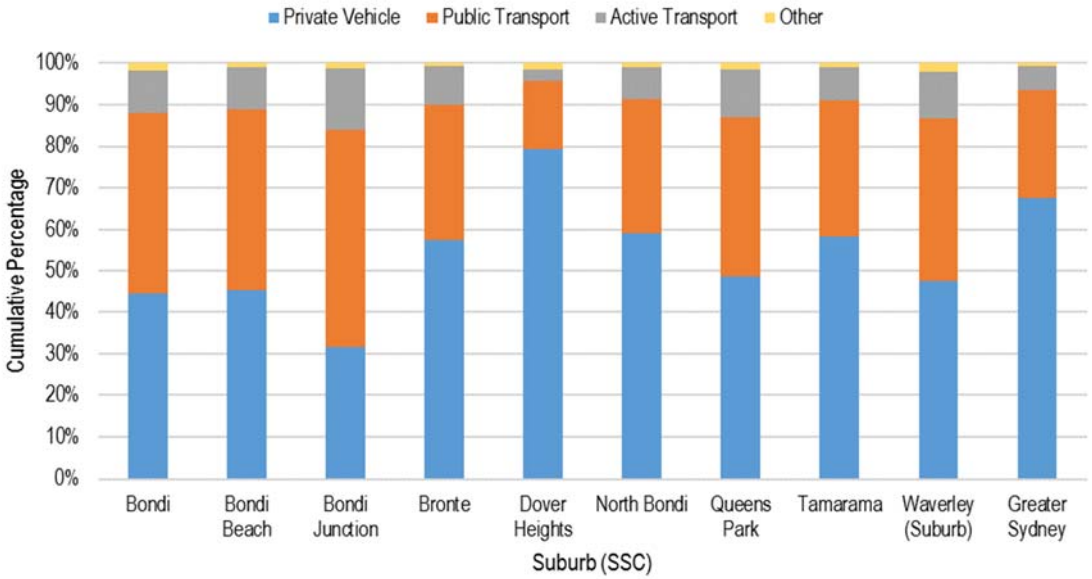


Source: Bureau of Transport Statistics of NSW (based on 2011 data)

Figure 4.12: Journey to Work by Waverley Residents - Destination Distribution

4.4 TRAVEL PATTERN DATA

Figure 4.13 shows resident journey to work modal splits by suburb across the Waverley LGA in comparison with the Greater Sydney average. As expected the data aligns closely with the number of vehicles per household for each suburb with suburbs such as Bondi Beach and Bondi Junction having low private vehicle usage and suburb like Dover Heights and North Bondi having higher private vehicle use. It is noted however that all Waverley suburbs except Dover Heights has greater public transport usage and smaller private vehicle usage than the Greater Sydney average. Dover Heights also has the least densification of dwellings and highest number of people per dwelling indicating a family based area. Potential exists here to encourage active transport trips to school and investigating how to encourage more public transport use for journey to work trips such as better connections with Bondi Junction.



Source: ABS 2016 Census Data

Figure 4.13: Journey to Work Modal Share by Suburb

Key Waverley travel indicator data from BTS NSW is shown in Table 4.1 and compared to Greater Sydney averages.

Table 4.1: Key Transport Indicators 2012/2013

Indicator		Waverley	Greater Sydney
Trips per person - weekday		4.9	3.7
Trips per person - weekend		4.3	3.4
Purpose of travel (trips %)	Commute	13%	16%
	Work related business	8%	8%
	Education/childcare	6%	8%
	Shopping	16%	16%
	Personal business	6%	6%
	Social/recreation	31%	25%
	Serve passenger	15%	18%
	Other	4%	4%
Mode of travel (trips %)	Vehicle driver	34%	47%
	Vehicle passenger	16%	20%
	Train	4%	6%
	Bus	8%	6%
	Walk only	32%	20%
	Other modes	6%	3%
Mode of travel (distance %)	Vehicle driver	53%	57%
	Vehicle passenger	19%	20%
	Train	6%	11%
	Bus	8%	5%
	Walk only	6%	3%
	Walk linked	3%	2%
	Other modes	5%	3%
VKT per person (excludes walking)		11.0	17.2
Average Trip duration - all purposes including walking (mins)		19.0	21.9

Source: BTS NSW based on 2012/2013 Travel Data

The above data shows that Waverley resident's trips per person are very high in comparison to trips per person for the Greater Sydney area for both weekday and weekend trips. Factors contributing to this higher trip rate may be the cosmopolitan environment and feel of the Waverley LGA encouraging shorter, more localised trips before/after work times, higher incomes with more disposable income, high frequency of various recreational activities and events and more internal interaction across the Waverley LGA. It also aligns with the higher percentage of overall active transport usage for trips in the LGA.

The highest percentage of trips are for recreational purposes which remains consistent with the Greater Sydney averages, although Waverley's proportion of recreational trips is 6% higher than the Greater Sydney average. This may indicate that Waverley residents have a more active lifestyle than average across Greater Sydney and it also aligns with the high number of events, tourist activities and young people in the LGA. The "commute" and "serve passenger" trips within Waverley are below average for the Greater Sydney area by 3% in both instances.

It seems that Waverley residents use private transport for longer commuting distance trips. This can be seen, for example, in that while only 34% of total trips are made by private vehicle, drivers account for 53% of trips on a distance-travelled basis. From this it can be inferred that private transport is used more heavily by residents for commute trips outside of Waverley and that there is a relatively large proportion of walk trips within the Waverley area (32%).

The average Vehicle-Kilometres Travelled (VKT) per person of 11.0 is well below the Greater Sydney average of 17.2. However, the average trip duration of 19.0 minutes is close to the 21.9 minute average for Greater Sydney and suggests that average travel speeds are much slower in Waverley than the Greater Sydney average. This highlights two things; greater than average traffic congestion issues in the Waverley LGA and a much higher proportion of walk trips.

4.5 Bondi Junction Train Station

The Bondi Junction Station is the only rail link into the Waverley LGA. As such all people travelling by train to/from Waverley (including Bondi Beach) must pass through this station. Table 4.2 summarises the average station movements for 2014.

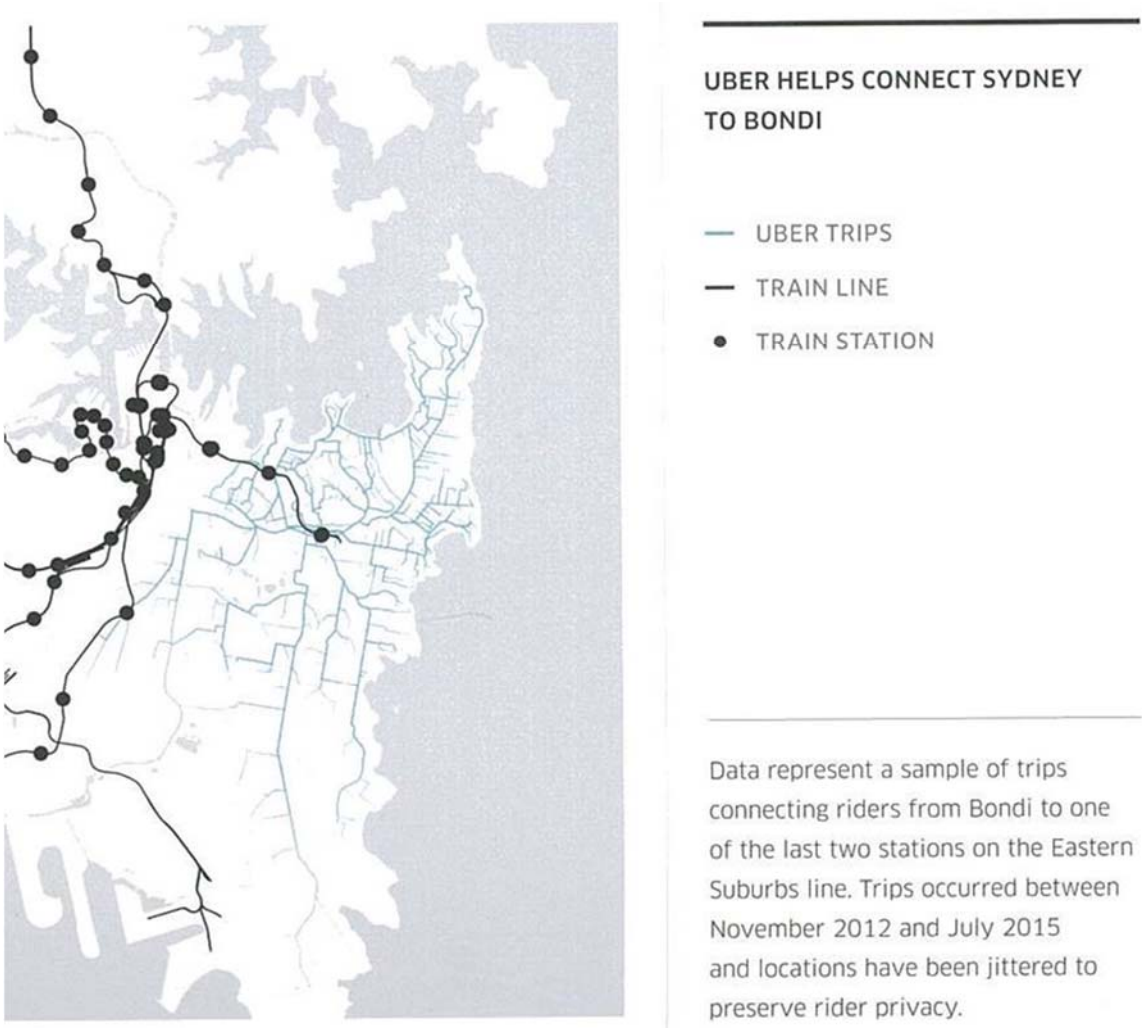
Table 4.2: Bondi Junction Station Typical Movements 2014

Time Period	People IN	People OUT	Total
Average 24 hour period	21,880	21,880	43,760
Average AM peak 3 hrs	10,150	4,350	14,500
Average PM peak 3 hrs	5,240	8,330	13,570

Approximately 64% of train usage is during the AM and PM peak periods indicating that Bondi Junction train station is heavily used for commuting (to and from Waverley) and possibly for tertiary education trips. As Bondi Junction is the only station available it is expected that most trips that occur via train in Waverley would occur as part of a multi-modal trip involving travel by car, bus or walking and cycling to the station.

4.6 "Uber" Usage

A recently released report from ride sharing platform Uber (Sydney: A Mobility Case Study, 2015), claims that "two out of three trips on the Uber platform in Sydney begins or ends in one of the city's public transit deserts." The report includes a map showing trips between the Waverley region and the heavy rail stations (refer Figure 4.14). The report also suggests that "These trips peak in volume during the morning and evening rush hour and represent commuters from the far eastern suburbs who use Uber to connect into the rail network…There is also, however, a large number of tourists using Uber to connect onward to the world-famous Bondi Beach".



Source: Uber Sydney: A Mobility Case Study, 2015, p. 29

Figure 4.14: Uber Connections to/from Bondi Junction and Edgecliff Stations

The final train station on the line farthest to the right in Figure 4.14 is Bondi Junction. The blue lines radiating out from the last 2 stations represent a sample of trips taken on the Uber platform to and from the surrounding residential neighbourhoods between November 2012 and July 2015.

4.7 PARKING DATA

4.7.1 Parking Spaces

The majority of visible and easily accessible parking within Waverley is on-street, particularly in the Bondi Beach area and while Bondi Junction provides a higher number of off-street parking areas parking on local sides streets is still an issue. Table 4.3 summarises some key on-street parking data information for the Waverley LGA's allocated residential parking zones.

Table 4.3: Waverley Parking Spaces

On-Street Parking in Residential Parking Zones	Total Spaces as of 2015
Permit Allowable Spaces in restricted parking zones	6,458
Non-restricted spaces	12,638
Restricted spaces that are not permit accepted	1,723
Total Spaces	20,819

Source: Waverley Council Parking Data

4.7.2 Residential Parking Permits

Waverley's Residential Parking Permit Scheme (RPPS) allows residents and some visitors to purchase permits that allow them to park unrestricted in restricted parking zones. This scheme has been set up to ensure that residents have parking available nearby to where they live. The permits are distributed/renewed yearly and the number of permits sold in both the 2013/14 and 2014/15 years are shown below in Table 4.4.

Table 4.4: General Parking Permits

Permit type	Total 2013 / 14	Total 2014 / 15
First permits	4,180	4,386
Second permits	781	1,374
Third permits	65	194
Carer permits	2	
Short term visitor	215	542
Annual visitor (1 registration)	211	341
Annual visitor (2/3 registration)	9	11
Total Residential	*5,028*	*5,954*
Total Visitor	*435*	*894*

As can be seen from the data above the greatest increase in permits has been in the "second permits" and "short term visitor" permits. This may indicate a greater number of households owning more than one vehicle and possibly a better understanding of the potential impacts of the scheme. The number of visitor permits more than doubled from 2013/14 to 2014/15. The high number of parking permits available can cause conflict and further circulating traffic congestion on local streets as both residents and visitors search for available on-street parking. This is particularly relevant during summer and event periods.

4.7.3 Beach Parking Permits

Waverley's parking scheme also provides Beach-specific parking permits that can be used in parking areas directly adjacent to the beach. The purpose of these permits is to allow locals and regular beach goers access to the beach for longer than the restricted time period. The number of permits sold to residents, non-residents and surf life savers are shown below in Table 4.5.

Table 4.5: Beach Parking Permits

Permit type	Total 2013 / 14	Total 2014 / 15
Beach parking (resident)	7,973	6,090
Beach parking (non-resident)	11	33
Surf life Saving	67	156
TOTAL Beach Permits	*8,051*	*6,279*

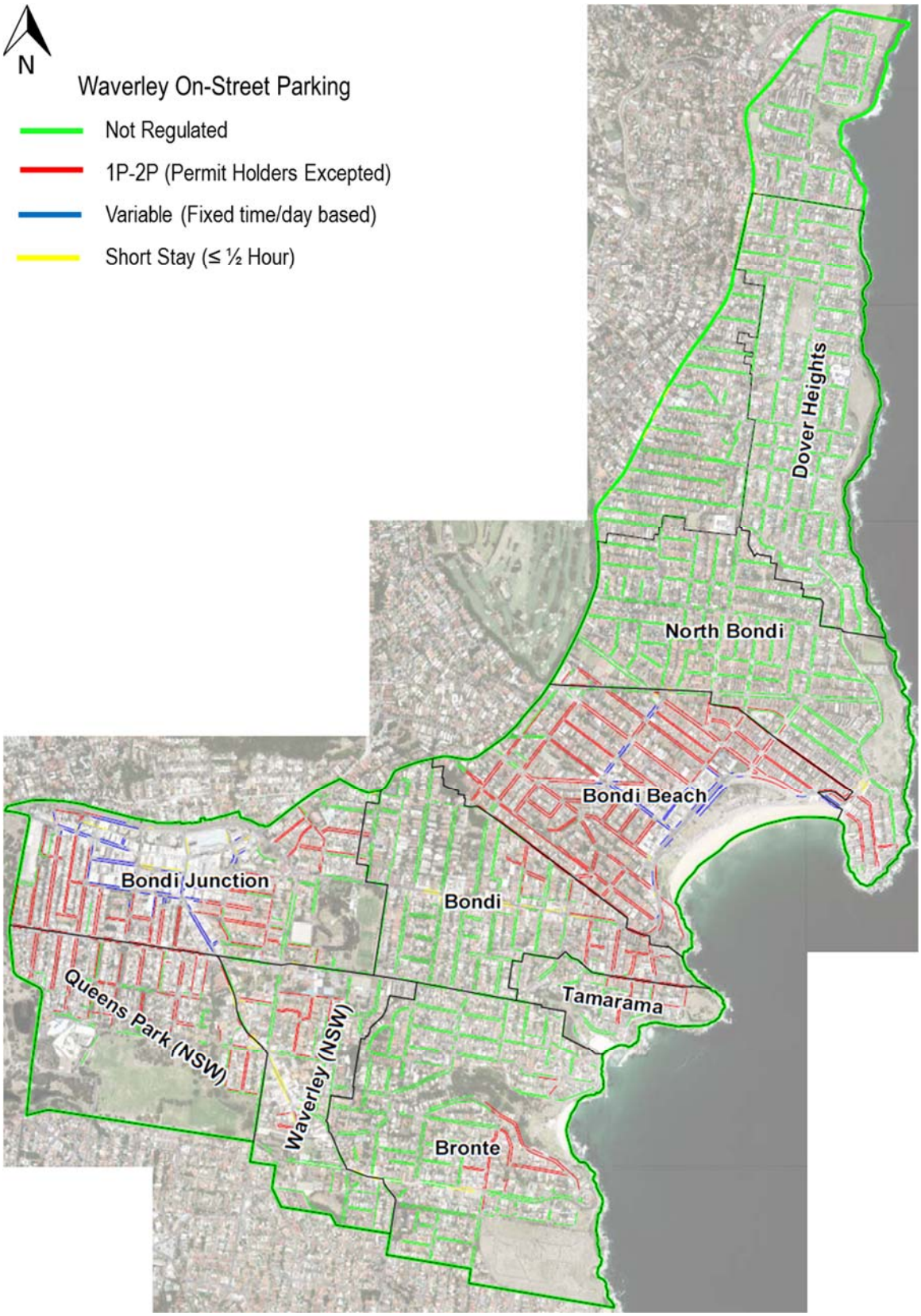
The results show a significant decrease in beach permits purchased by residents which may indicate that many residents find alternative modes of transport easier than finding a park in the very congested beachside parking areas. Surf life savers have a noticeable increase in the number of permits purchased and it is noted that the Bondi Surf Club has a gated area at the back of the club for parking.

The very low number of non-resident permits sold highlights the low value-for money proposition that these permits provide for non-residents who have to pay more than residents.

The provision of both Residential and Beach permits may present issues with residents parking vehicles in "prime" locations for very long periods during the peak visiting times and result in households leaving secondary vehicles that may not be used for daily travel in spaces, effectively reducing the available parking capacity of Bondi.

4.7.4 Regulated Parking

Figure 4.15 shows the on-street parking limits provided throughout the LGA. This figure shows that, for most of the LGA, on-street is unrestricted although areas around Bondi Junction – Queens Park, Bondi Beach, Tamarama and Bronte all have time-limited parking.

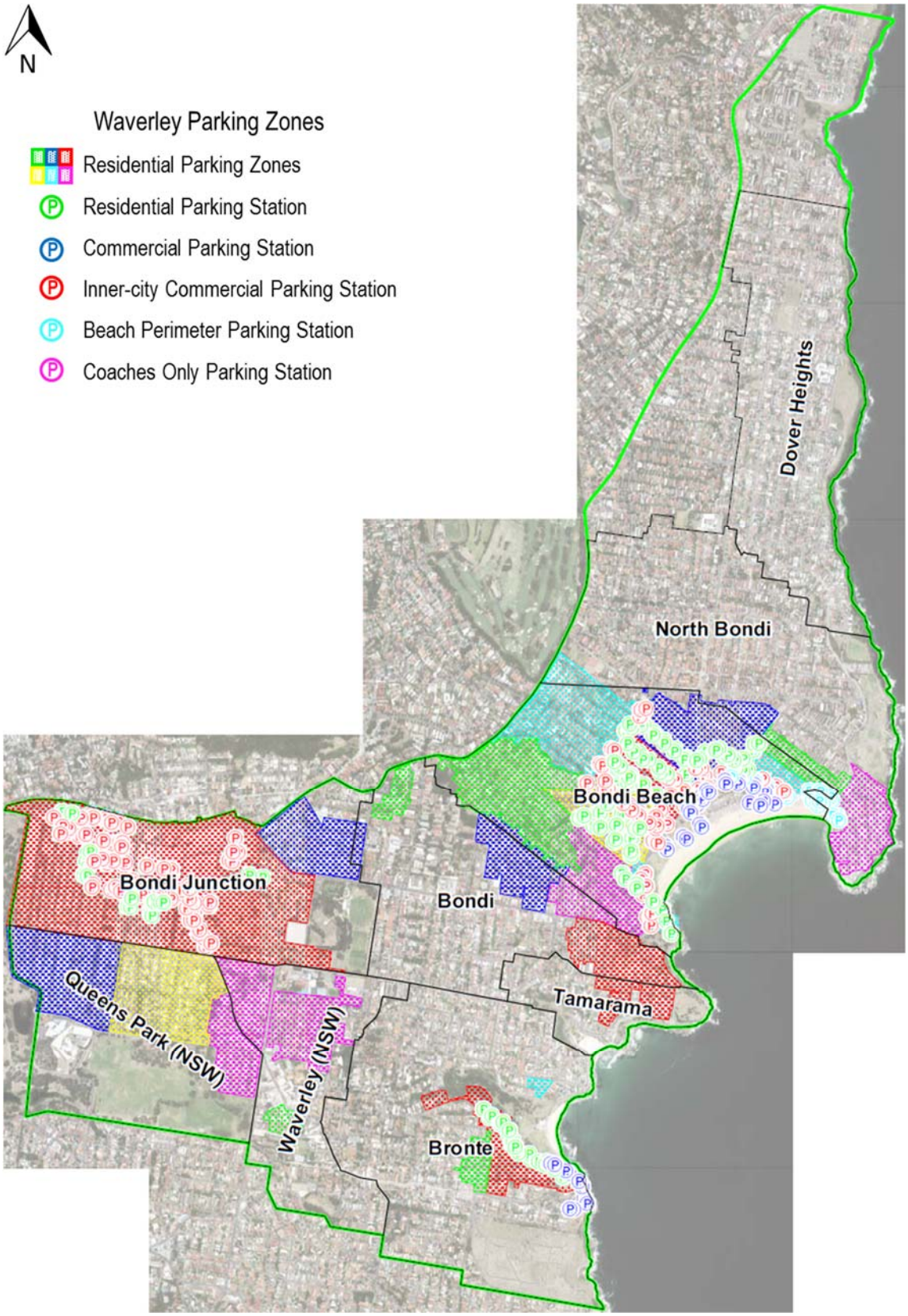


Source: Waverley Council Data

Figure 4.15: Regulated Parking Controls

4.7.5 Permit Parking

Figure 4.16 shows the residential parking permit areas which essentially align with the regulated parking areas across the LGA. This suggests that a lot of the available on-street space in key centres is over utilised by residents, leaving less space for visitors (recreational, shopping, business, etc.) on-street and potentially leading to congested traffic conditions with excessive traffic circulation.



Source: Waverley Council Data

Figure 4.16: Parking Permit Areas

4.8 CRASH DATA

A snapshot of traffic crash data for 2014 is provided in Figure 4.17. This figure shows, as expected, the highest concentration of crashes on the busiest roads with the few pedestrian crashes occurring in Bondi Junction and near Bondi Beach.

Source: Waverley Council Data

Figure 4.17: Waverley LGA Crash Data 2014

4.9 EVENTS AND VISITORS

4.9.1 Tourist Movements

Waverley LGA attracts some of the largest numbers of tourists in Australia, to visit its famous Bondi Beach, experience the Bondi lifestyle and visit attractions and events.

Historical eastern suburbs tourism profiles (*Source: SGS Economics and Planning - Eastern Suburbs Economic Profile Report*) show that more residents are heading elsewhere for holidays while international tourist numbers remain relatively steady. It is noted in report that of all international tourists expected to be drawn to the area, the Chinese markets is forecast to be the largest by 2016.

The report also says that while Bondi Beach is considered one of the largest international attractions in Australia, the number of motels/hotels in Sydney's eastern suburbs has been declining. Factors contributing to this may include the increase in accessibility of holiday homes/flats/units through apps like "Airbnb" and "couch surfing", or the trend of "day-trip" only visits to Bondi Beach with accommodations in the city. Waverley holds and offers a large number of major and minor events that draw large crowds to the LGA increasing traffic congestion and impacts during these times.

4.9.2 Events

Table 4.6 outlines a number of typical events that occur in Waverley throughout the year. A major event has been defined as occurring occasionally/yearly that draws large numbers of visitors to the Waverley LGA. A minor event is defined as more localised and common events that tend to be focused on smaller numbers of visitors and locals.

Table 4.6: Waverley LGA Typical Major and Minor Events

Event Name	Location	Time of Year/Frequency
Major Events – Yearly/Occasional and Draw Large Crowds		
Open Air Cinema	Bondi Beach	January – March (Yearly)
Vans Bowl-a-Rama (Festival of Skateboarding)	Bondi Beach	February (Yearly)
Sydney Writers Festival	Bondi Beach	May (Yearly)
Bondi Beach Ice Rink	Bondi Beach	June-July (Yearly)
City 2 Surf	Vaucluse, Old South Head Road and Bondi Beach	August (Yearly)
Festival of the Wind (Kite Festival)	Bondi Beach	September (Yearly)
Bondi Beachfest (Music Festival)	Bondi Beach	October (Yearly)
Sculpture by the Sea	Bondi Beach	October - November (Yearly)
Bondi Feast (food, arts and music festival)	Bondi Beach	November (Yearly)
Carols by the Sea	Bondi Pavilion (Bondi Beach)	December (Yearly)
New Year's Eve	Dudley Page Reserve (Dover Heights)	December 31st (Yearly)
Minor Events – Monthly/Regular and Draw Mostly Local Crowds		
Walking Tours	Bondi Beach, Coastline Walks (i.e. Dover Heights, Tamarama)	Offered by council every 2-3 months
Young Children Activities (story-time, games, activities, etc. at Library and Community Centres)	Most suburbs encourage some form of this	Monthly
Local Surf Lifesaving Competitions, Events and Functions	Bondi Beach	Monthly and sometimes weekly

Event Name	Location	Time of Year/Frequency
Local Film Festivals	Mostly in Bondi Beach	6 monthly
Bondi Farmer and Regular Markets	Bondi	Monthly
Book and Speaker events	Various Locations	2-3 every 6 months
Workshops (Tech, Eco, etc.)	Various Locations	Monthly

4.9.3 Issues During Peak Holiday Periods and Events

As shown in Table 4.6 above a large number of major and minor events occur throughout the year, most of which occur at Bondi Beach. To access these events the most direct travel route is the Bondi Junction – Bondi Beach corridor. As such this corridor must be able to cater for large influxes of visitors regularly whilst still allowing for local movements particularly during the summer months when large numbers of beach goers visit daily.

Other issues that may occur during peak holiday periods and events include:

- large increase in pedestrian numbers particularly in Bondi Beach, Hall Street and Bondi Junction areas;
- further congestion of Bondi Road and Old South Head Road as the main access routes to Bondi Beach; and
- restricting local street accessibility and reducing the number of on-street spaces that may be usually utilised by residents returning from work.

4.9.4 Parking Survey - Visitors

Parking surveys were undertaken by UTS in key Waverley locations to gain a better understanding of how people travel to Waverley and how they do so. The full dataset has been analysed in a *Waverley Survey Report* completed in conjunction with this report, however, the following points summarise visitor-specific parking and movement highlights based on this data:

- most visitors to the key areas surveyed travelled relatively locally indicating a highly mobile population that is highly active within the local area. This was extenuated in that almost 90% of travellers surveyed visited key centres regularly;
- regular visits indicates a high awareness of transport mode options and parking options;
- approximately 70% of parkers aimed for “proximity” and “convenience” when choosing a place to park. This indicates a large number of “time value aware” visitors and is evidenced by 50% of all drivers surveyed saying they did so as it was “quicker”;
- public transport tends to be used where it is faster than car (i.e. to the CBD);
- walking is a large transport mode in comparison to other LGAs in Greater Sydney. It is utilised often where it is viable, also note that Waverley walk trips are longer than average Greater Sydney trips;
- short trips beyond a walkable range tend to be made by car (shops, schools beach etc.) and parking is “expected” to be available for these local trips; and
- the high number of events means that they tend to be understood as “business as usual” and residents are very aware of their regularity.

5. TRANSPORT NETWORKS AND ISSUES

5.1 PUBLIC TRANSPORT NETWORK

5.1.1 Overview

As discussed in Section 4, a large proportion of trips undertaken by people in Waverley are made using public transport. Given the level of urban density in Waverley, public transport plays a critical role in ensuring adequate movement and access not just for public transport users but also for private vehicles by reducing overall demand for road space and parking.

In this section, a general description of the public transport network hierarchy is provided, with a particular emphasis on bus services given that most of the network in the local area is provided for by buses.

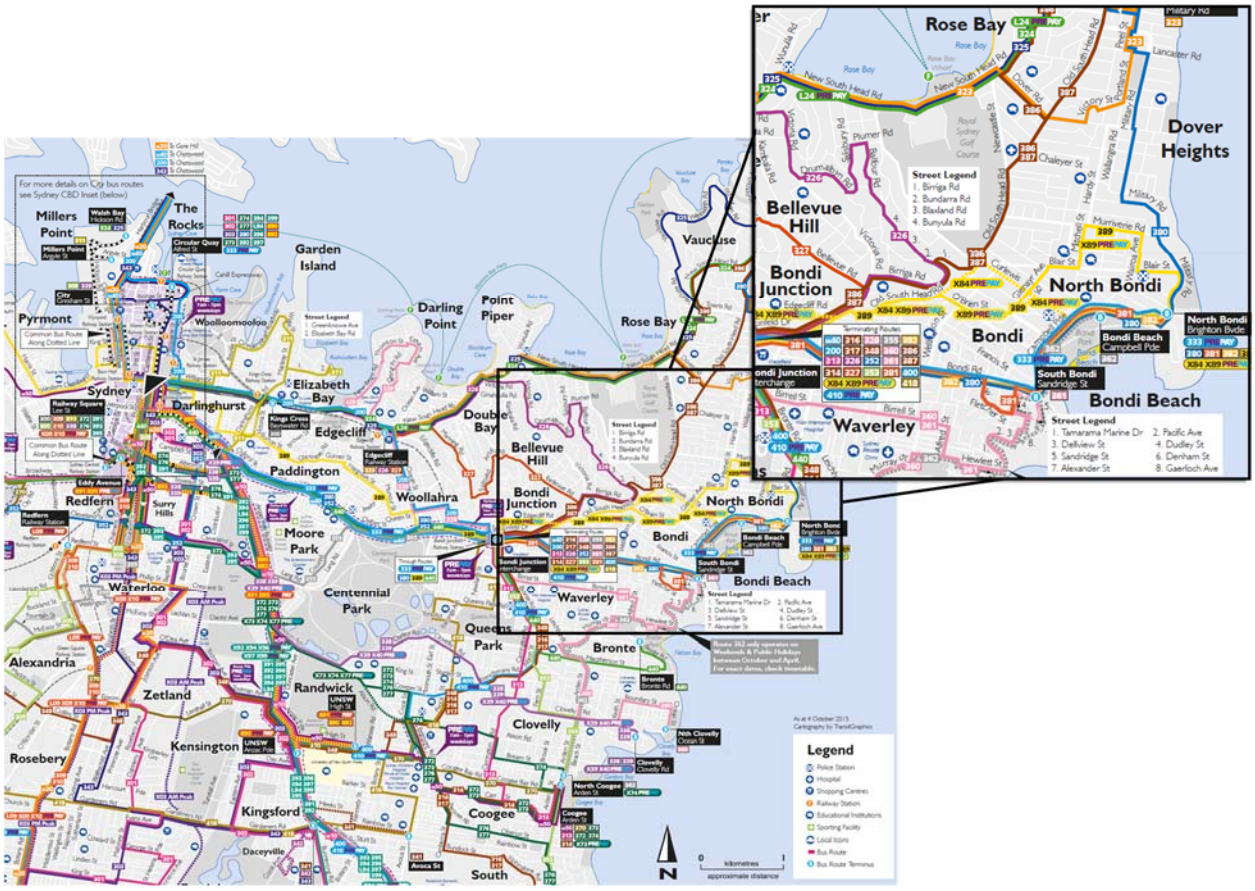
Several issues arise given the high demand for public transport and limited capacity.

5.1.2 Network Description

The public transport network hierarchy in Waverley LGA is dominated by the provision for east-west movements through a series of radial trunk routes, most of which are focussed or terminate in the Sydney CBD. Concentrations of bus routes from the CBD travel along three key trunks:

- New South Head Road;
- Oxford Street and Bondi Road; and
- Anzac Parade.

At the eastern end of these bus services, routes disperse to extend network coverage to a wider area of residential suburbs as shown in Figure 5.1.



Source: State Transit. 2015, Eastern Suburbs Region Bus Services. Transport for NSW, Sydney.

Figure 5.1: Eastern Suburbs Region Bus Services

Within this network hierarchy, there are few opportunities for extended travel along north-south corridors through Waverley to local destinations in Woollahra, Randwick and Botany LGAs. Similarly, there are few direct cross-city services to destinations to the south-west of the Sydney CBD (to Marrickville LGA for example).

While this network hierarchy works to provide good public transport access and to strengthen the role of key centres like the Sydney CBD and Bondi Junction, it provides relatively poor connections to diverse destinations throughout the region. This lack of north-south transit service provision with the Waverley LGA essentially requires all public transport trips to be made via Bondi Junction if moving between southern and northern parts of the LGA.

5.1.3 Key Issues

There are two key issues relating to the level of service provided by the bus network in the Waverley LGA:

- high and unmet demand for bus services in Waverley; and
- tensions between road space provision and priority for various modes of travel.

The demand for bus services is high in the eastern suburbs, especially the east-west corridor between Bondi Junction and Bondi Beach. Demand appears to have out-paced supply which has led to several operational problems, including:

- "bunching" - several buses with the same service route banking up directly behind each other - created by general traffic congestion and slow boarding times due to the high demand for services and policy on single point of entry at the front of vehicles;
- available bus capacities often cannot cater to demand, leading to passengers often unable to board their service of choice, and left at bus stops to wait for later services;
- at peak periods and during special events, bus services are often delayed well beyond their scheduled arrival times at key destination points; and
- reduced travel times and improved reliability would likely create conditions for mode-shifting and induced demand for public transport services, leading to the further need to increase service capacities.

This last point is significant because it has implications for both public transport and private transport due to the relationship between the two networks described in Section 3.2.

A second key issue is the seemingly limited scope for increasing public transport service capacities. In most cases, public transport services compete with private motor vehicles for limited road space including:

- few opportunities for bus priority signalling at key intersections;
- high demand corridor services compete with private vehicles for road space;
- limited options for North-South bus routes that do not pass through Bondi Junction;
- tension exists between the need to provide bus priority and on-street parking in some key corridors; and
- potential tensions also exist between the need to provide bus priority and opportunities for higher speed bus travel, while maintaining street amenity along key streets like Bondi Road that also act as key movement corridors.

5.2 ROAD NETWORK

5.2.1 Network Description

The major arterial routes through the Waverley LGA include:

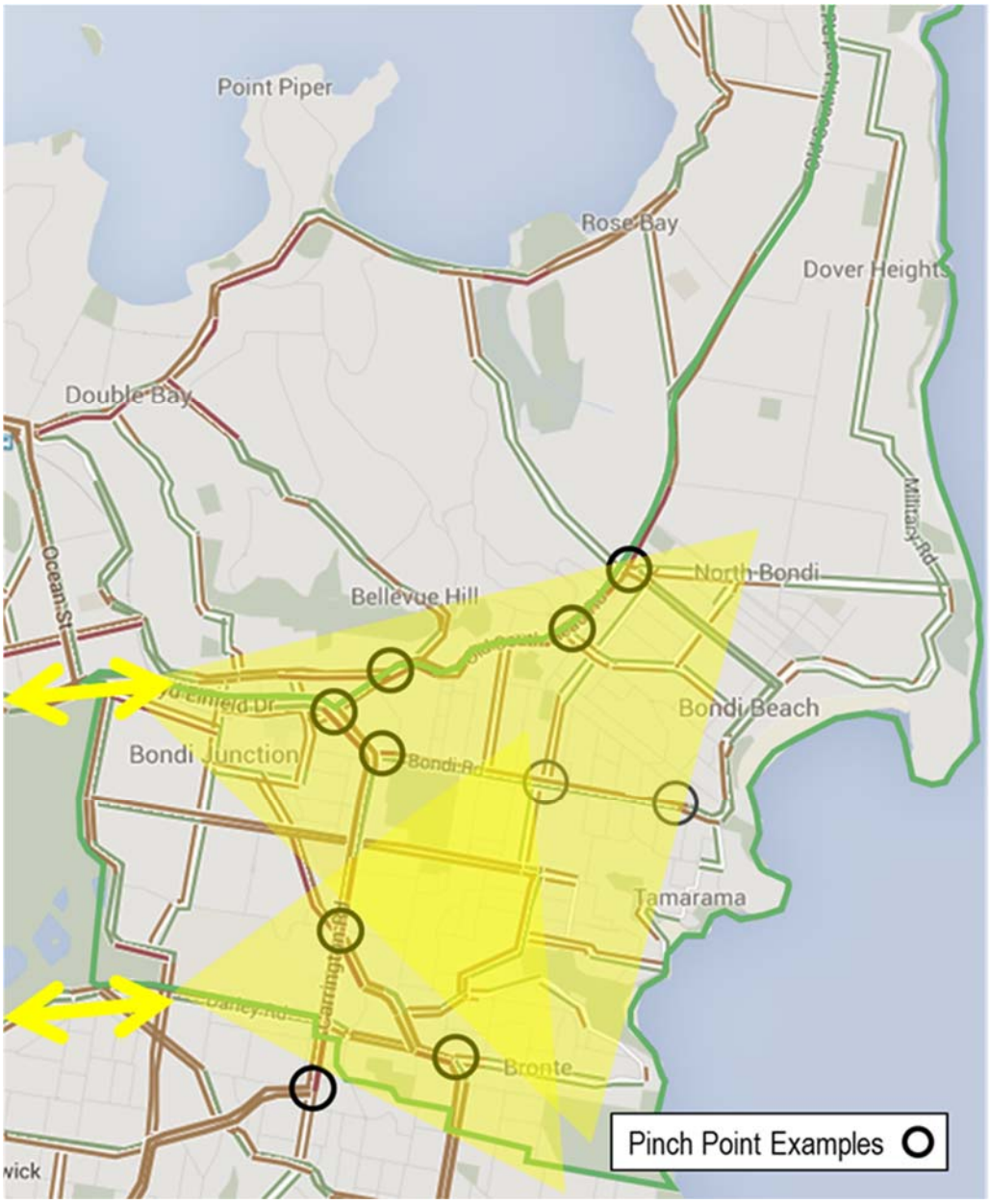
- Syd Einfeld Drive;
- Bondi Road;
- Old South Head Road;
- Campbell Parade;
- Bronte Road; and
- Carrington Street.

5.2.2 Connectivity Issues

Most of the arterial roads in the LGA converge on Bondi Junction with limited alternative major road connectivity north-south. This convergence of traffic routes near Bondi Junction results in key movement conflicts between north-south and east-west through movements in an area that has a large volume of local trips in its own right.

The absence of major north-south connections across Bondi Road in particular is a consequence of the evolution of the road system as well as topographical constraints. Another issue with this lack of north-south connectivity is that north-south traffic must travel east-west on part of Bondi Road before heading north-south again, further congesting this key corridor. The evolution of the road network over time seems to have introduced long "collector" level roads tangential to sub-arterial roads with limited/no supporting source road structure parallel to the sub-arterial roads. It also appears that incremental measures to reduce "rat running" in residential streets has led to convoluted one-way systems in some areas, aggregating traffic turning movements to key intersections at major road interfaces. A consequence of this is circulating for parking, vehicles are channelled on to the same roads with long circulation lengths and blocks with little or no local street permeability. This increases the amount of traffic on these routes increasing congestion, particularly during events with large parking demands. These limitations also have impacts on resident's accessibility to the local road network by reducing opportunities for residents to "spread" through the network to avoid heavily congested areas during peak time or events. These issues are particularly evident either side of Bondi Road, at Bondi Junction, in Tamarama and in Bronte.

Figure 5.2 shows the limited number of east-west connections from Waverley LGA to areas further west essentially due to Centennial Park. The consolidation of traffic movements onto two key routes generates a range of congestion issues, particularly between north-south and east-west movements at key locations.

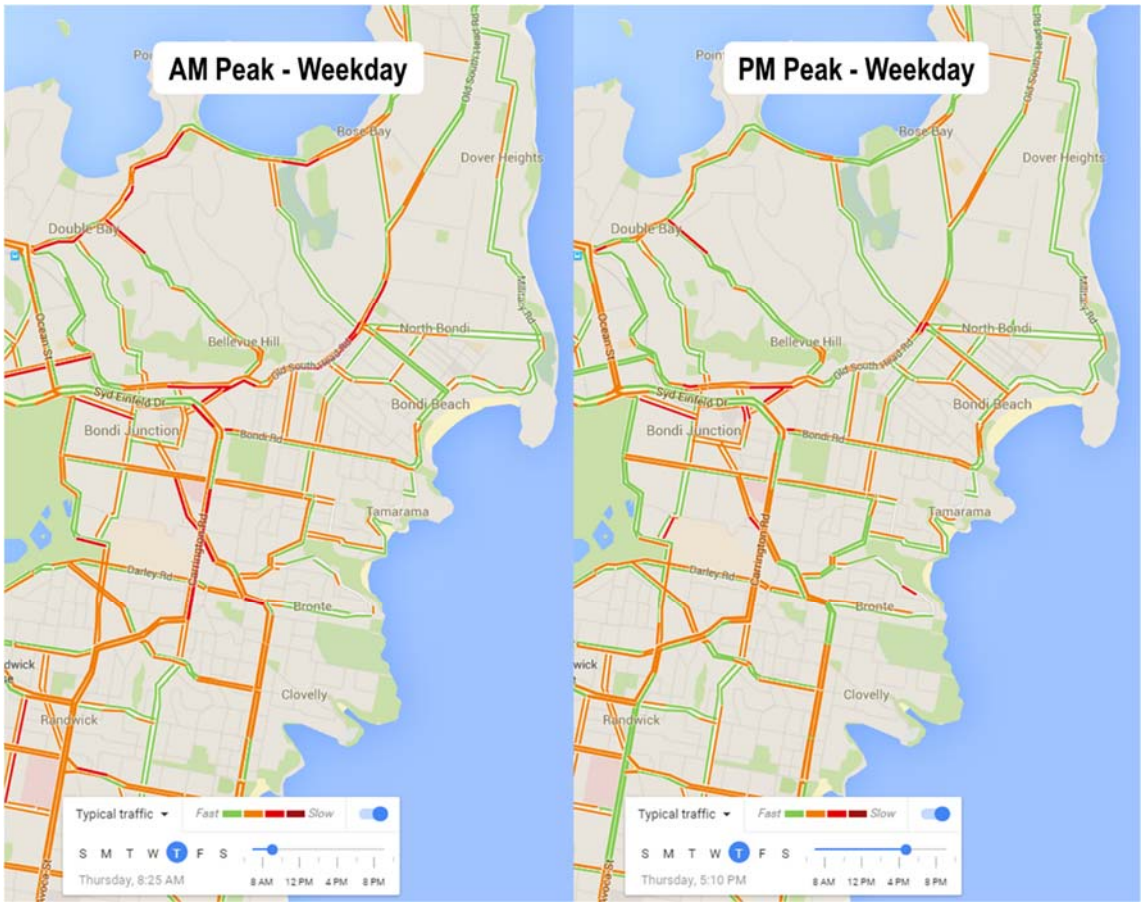


Source: Google Maps

Figure 5.2: Congestion Focal Points

5.2.3 Traffic Congestion Issues

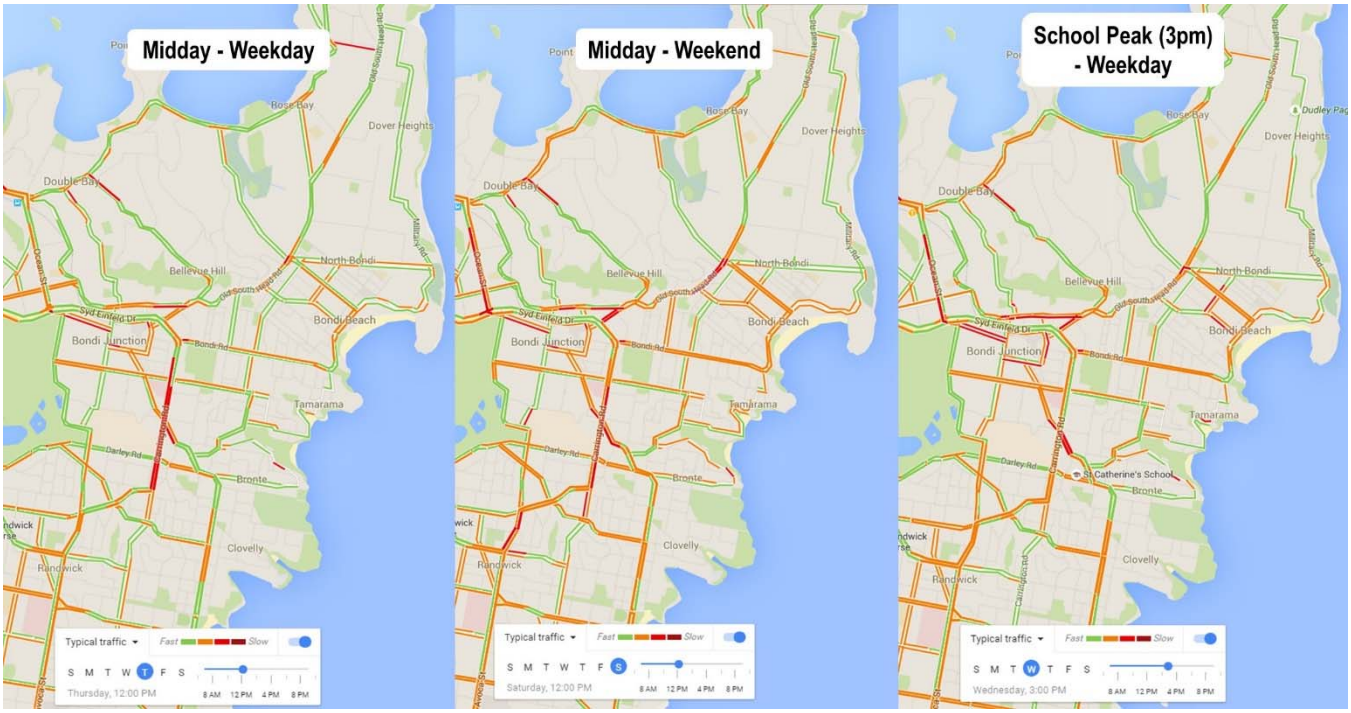
Figure 5.3 shows the typical weekday traffic within Waverley and its immediate surrounds during the AM and PM Peak periods.



Source: Google Traffic

Figure 5.3: Typical Weekday Peak Period Traffic

Peak period traffic clearly indicates a number of high congestion locations including along Old South Head Road, Carrington Road and Bondi Road. For comparison Figure 5.4 shows the typical midday weekend traffic within Waverley and its immediate surrounds.



Source: Google Maps

Figure 5.4: Typical Weekday and Weekend Midday Period Traffic

It is interesting to note that traffic appears to be typically more congested in the middle of the day on both weekdays and weekends than in the typical commuter peak periods. This trend may be attributed to the timing restrictions and availability of the provided clearways on key inbound routes, such as Bondi Road and Old South Head Road as well as the lower levels of public transport usage and more local trip making (less commuting) on the weekends.

5.2.4 Other Road Network Issues

Most of the road corridors within the Waverley LGA are generally two lane roads with on street parking and high levels of turning "friction". This limits through movements efficiency for longer distance trips. Also, in key activity centres of Bondi Junction and Bondi Beach, most of the parking is embedded within the core of these centres requiring traffic to travel deep into the centre where the congestion is greatest. Also, in these centres on-street parking is limited and circulation is arduous generating more traffic on more lengths of streets in these areas.

5.3 TRUNK CYCLING NETWORK

5.3.1 Network Description

At around 6%, Waverley has a relatively high proportion of trips undertaken by bicycle when compared to the average for the rest of the Sydney Metropolitan Area, which stands at around 3%.

5.3.2 Network Description

The bicycle network envisaged in the Waverley Bike Plan (Section 2.2.3), provides connections between clearly identified trip generators. Its six priority routes target commuting and recreational trips and destinations. The secondary network identifies feeder routes and cross-route linkages.

In many cases key links are facilitated by a mix of different path types. For example, a link might comprise sections of on-street mixed traffic with shared path or dedicated cycleway infrastructure. People unfamiliar with the area may not be able to identify these routes as suitable for riding bicycles. In general, network connectivity and a person's sense of it, is critical, especially in areas where road traffic is heavy and the road environment potentially unfriendly. If one key section in a trunk route is not present, this can significantly undermine the viability of whole network link, especially for young teens and parents riding with very young children who may not be confident about joining mainstream road traffic. An example of a trunk link that has been completed and where legibility is high is the contraflow network link on Henrietta Street that connects to the shared path through Waverley Park. In other areas, network legibility could be improved with dedicated cycle ways for people riding bicycles.

In addition to the state of bicycle network links, the provision of bicycle parking facilities, especially at key centres and public transport interchanges, plays a critical role in facilitating higher levels of bicycle riding.

5.3.3 Key Issues

There are several issues relating to improving conditions for people riding bicycles in the Waverley LGA, including:

- steep terrain — especially in streets connecting the rest of the LGA to beach sites
- network connectivity and the need to enhance some key links
- limited bicycle parking across LGA, particularly in key centres
- heavy road traffic congestion on some key network sections where people riding bicycles need to share the road with regular traffic, presenting challenges to safety
- accurate information for people wishing to ride bicycles on the state of cycle ways in the Waverley LGA - the RMS cycle finder site for example, does not include all completed network segments
- coordination of cycle ways and end-of-trip facilities with public transport interchanges and stops and areas of high usage

5.4 WALKING

5.4.1 Levels of Walking

As discussed in Section 4, Waverley LGA has a larger proportion of walk trips than most LGAs in the Sydney Metropolitan Area. This can be attributed to the higher proportion of destination points within practical walking distance that occur as a result of the higher urban densities in many parts of the LGA.

From a whole-of-system transport perspective, higher walking rates are a positive outcome that can reduce pressure on local roads and parking infrastructures. From an amenity perspective, greater walkability can also enhance local safety by increasing natural surveillance and provide health benefits to communities through greater active living.

5.4.2 Network description

Several studies carried out by Waverley Council recommend changes to infrastructures that would improve conditions for pedestrians, however these are mostly confined to precincts or spot treatments and do not consider walking viability in terms of total trips from end to end. At present, there is no comprehensive inventory of footpath and walking infrastructure for the entire Waverley LGA. The key features for consideration when assessing network performance include:

- footpath condition — network connectivity and pavement condition;
- road crossings — prioritised pedestrian crossings and signal phases for pedestrians at signalised intersections;
- kerb ramps and access — pram and wheelchair access when negotiating kerbs and aids for people with vision impairment especially in key centres; and
- way-finding — signage and information layouts to assist pedestrian navigation.

In cities throughout the world, higher rates of walking occur alongside higher rates of public transport use. In many cases, poor walkability can be a barrier to public transport use and so network connectivity and access to key nodes is a necessary compliment to shifting trips towards more sustainable outcomes.

5.4.3 Key issues

From a strategic transport perspective, the key issues relating to walking in Waverley are:

- Improving network connectivity and permeability in and around key centres;
- Improving footpath quality and usability in relation to mobility impaired users or prams as well as lack of shade, narrow paths, etc.
- Ensuring pedestrians are given more opportunities to cross roads safely in areas where pedestrian traffic flows are high; and
- Improving walking connections to public transport stops and interchanges.

Although walking is predominantly seen as a 'local' transport consideration, a broader walking strategy is required to address systemic issues and provide strategic connections and improvements.

6. LOCATION SPECIFIC CONSIDERATIONS

6.1 KEY ISSUE LOCATIONS

Focusing on issues in key community centres is the most efficient way of improving traffic and transport in the LGA. Figure 6.1 below outlines an index of the 5 key areas analysed for specific considerations in the following sections. These areas have been defined based on the information outlined above.

Source: Google Earth – NSW Globe

Figure 6.1: Waverley Key Centres for Transport Consideration

6.2 BONDI JUNCTION

Bondi Junction is one of three key centre zones in the Waverley LGA and is the main conduit for traffic flows to and from the Sydney CBD. Figure 6.2 shows the Bondi Junction network and shows a number of current traffic and transport issues in the area determined through a review of the data, stakeholder consultation and detailed site investigations.

Bondi Junction has a number of KEY issues and impacts resulting from high concentration of movements across all modes of transport. The key issues shown are expanded upon below:

Circulating and through-traffic Issues

- vehicles heading north from Randwick (Darley Road and Avoca Street) travel along York Road and divert into Newland Street. As a result, Newland Street carries significant traffic volumes;
- westbound traffic on Edgecliff Road use Vernon Street, Grafton Street and Nelson Street to access Oxford Street to travel west;
- significant queuing of vehicles and delays for buses westbound in Birrell Street east of Council Street in the morning peak;
- limited traffic accessibility options for traffic moving to/from the centres;
- available routes cause through traffic to be drawn to close to centre; and
- major congestion issues on Oxford Road, Bronte Road, Bondi Road and Old South Head Road. Note that Syd Einfeld Drive seems to be underutilised and "out of balance" with its capacity constraints at either end.

Car Park Issues

- vehicles exiting Eastgate Shopping Centre onto Ebley Street are required to travel east. To turn around and head west towards the CBD they either use Mackenzie Street (U-turn) to or circulate around via Spring Street. Vehicles forced to circulate through central streets increases traffic congestion;
- vehicles exiting Eastgate Shopping Centre onto Spring Street create additional traffic in high pedestrian priority area;
- vehicles exiting Westfield Shopping Centre into Waverley St conflict with the high volume of pedestrians accessing the Waverley St pedestrian mall and medical centres; and
- vehicles entering and exiting Westfield Shopping Centre into Hollywood Avenue create a high volume of traffic along Hollywood Avenue and Waverley Street.

Pedestrian Issues

- Oxford Street Mall is a fully pedestrianised zone with a high volume of foot traffic. These pedestrians mainly originate from or walk:
  - to the bus and train interchange, either through Tiffany Plaza or along Grosvenor Street
  - to the bus stops located along Grafton Street, Oxford Street (west and east), and Bronte Road
  - through the surrounding arcades and shops (mostly Bronka Arcade) to Spring Street and Eastgate Shopping Centre
  - to access Westfield Shopping Centre by crossing Bronte Road (at multiple points).
- Oxford Street Mall sets up a daily market in order to activate the space, however this causes pedestrian and cyclist conflicts in the narrowed thoroughfare;
- Pedestrians access Bondi Junction from every direction and on every road, including Old South Head Road, Waverley Street, Bronte Road, Brisbane Street, Newland Street, Denison Street, Centennial Park, and from Woollahra (either under Syd Einfeld Drive or over the pedestrian bridge at Nelson Street); and
- Pedestrians utilise the open streets, the enclosed shopping malls and the bus/train interchange to walk between destinations.

It should be noted that approximately 5,000 pedestrians a day cross at the Bondi Road/Old South Head Road/Oxford Street intersection to the east of the Bondi Junction centre. On a weekday pedestrians account for up to 38% of all AM peak hour traffic (7.30am-8.45am) and for 30% of all traffic in PM (5.15pm-6.30pm), a significantly large number.

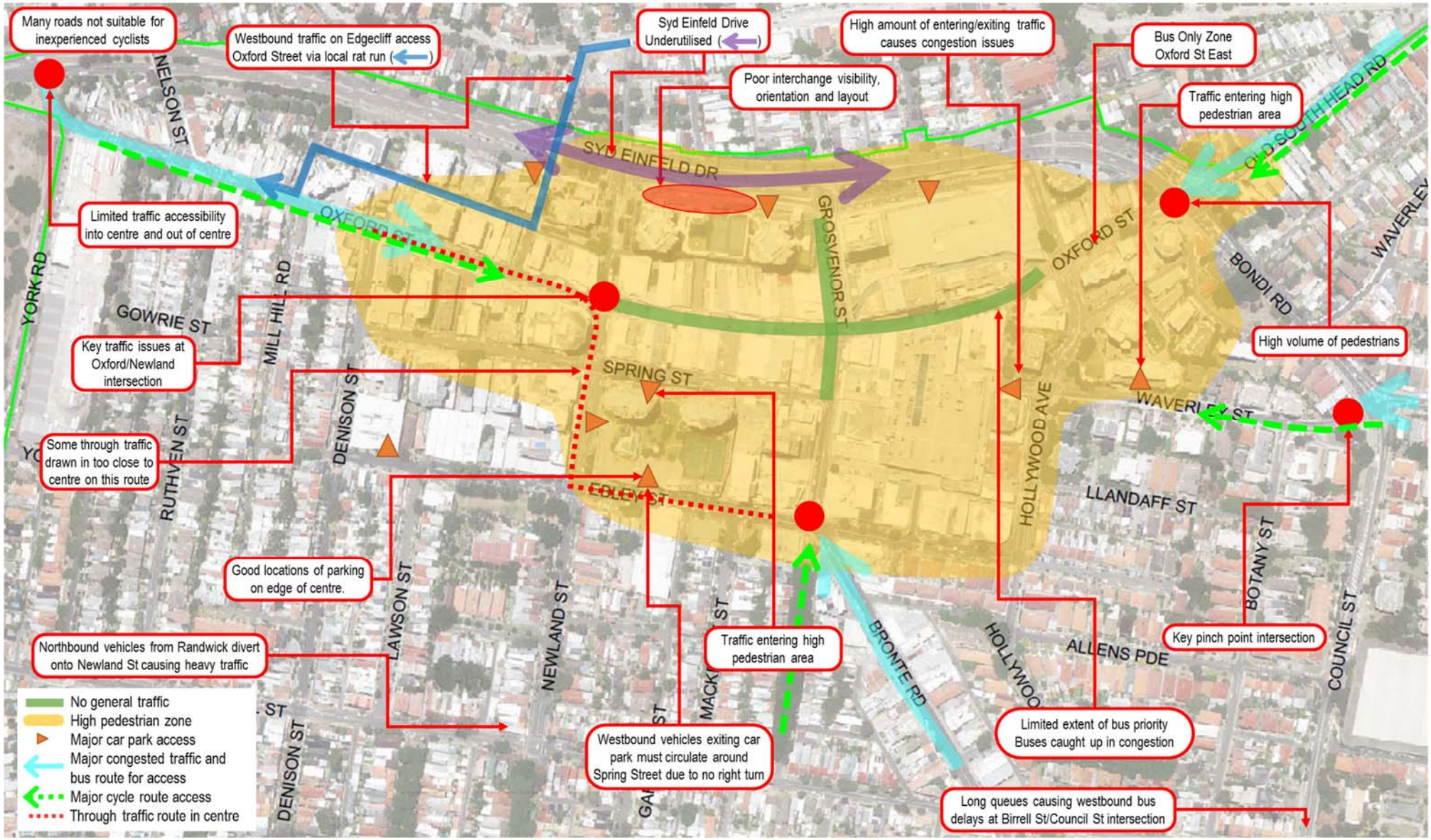


Figure 6.2: Bondi Junction Centre Zone Issues and Considerations

Bus Issues

- there are four bus trunk routes into and out of Bondi Junction: from the CBD along Oxford St West, Old South Head Road, Bondi Road, and Bronte Road;
- Oxford Street East is a bus-only zone;
- all buses circulate through the Bondi Junction bus and train interchange (or on Grafton St adjacent to the interchange). Buses have difficulty negotiating the hilly terrain whilst making tight turns into the interchange. There is also a high level of pedestrian activity in all streets surrounding the interchange;
- limited bus priority extents cause buses to be caught in traffic congestion and limits accessibility, such as on Oxford Street;

Cycle Issues

- there are four key bicycle routes into and out of Bondi Junction: from the CBD/ Centennial Park along Oxford St West, Old South Head Road along the shared footpath, Bondi Road via Waverley Street, and Brisbane Street to Queens Park shared footpath;
- bicycles are allowed to ride through the Oxford Street Pedestrian Mall, although it can be difficult during periods of high pedestrian volumes; and
- many of the busier roads around Bondi Junction are not suitable for inexperienced bicycle riders.

Future Growth Implications

- Bondi Junction is identified by the NSW state government as a strategic centre, and will continue to share a part of Sydney's growth in transport, employment and residential development;
- previous traffic and transport reviews have been undertaken by Council in 2004, 2007 and 2011 for Bondi Junction. The 2004 and 2007 reviews formed the basis of the gazetted Bondi Junction Centre Local Environment Plan 2010 (WLEP (BJC) 2010). The 2011 review undertook to, identify the expected traffic growth and implications of increased floor area as identified in the LEP, provide a benchmark review and analysis of car parking generation rates at other similar town centres, identify opportunities to reduce the dependence on cars and encourage other forms of transport including public transport, walking and cycling in Bondi Junction and across the LGA;
- in 2015 Council undertook a Bondi Junction Floor Space Study in order to better understand the current and future floor space demands and provide a baseline data set for evidenced based planning. The survey identified 112 hectares of total floor space comprising of, 46% employment floor space (51.7 hectares), 29% residential (33.0 hectares), and 15% short term accommodation (16.6 hectares). The employment floor space within Bondi Junction provided for nearly 14,000 jobs and comprised of retail trade (28% of employment floor space), health care (15%), professional and other services (25%). The Bondi Junction Floor Space Study also identified that an additional 21.3 hectares of floor space will be required within Bondi Junction by 2036.

6.3 BONDI JUNCTION TO BONDI BEACH CORRIDOR

The Bondi Junction to Bondi Beach corridor (Bondi corridor) is the second of the three key centre zones in the Waverley LGA. It exists as the major connecting route within the LGA between the Bondi Junction and Bondi Beach key node points. Figure 6.3 shows the Bondi Corridor and summarises a number of current issues in the area.

Figure 6.3: Bondi Corridor Zone Issues

The Bondi Corridor has a number of core issues and impacts resulting from high traffic concentration through its central route on Bondi Road and its existence as the key connection between Waverley's two largest activity hubs. The key issues shown are expanded upon below:

- key traffic pinch points exist at either end of the corridor at the Bondi Road/Council Street (Carrington Road) and Bondi Road/Denham Street intersections. This causes major traffic congestion for adjacent roadways and Bondi Road itself;
- due to high traffic levels there are limited opportunities for pedestrians to cross Bondi Road;
- most buses to Bondi Beach travel along Bondi Road and are also caught in daily congestion;
- on-street parking, bus stops and side street affect the flow of traffic along Bondi Road; and
- "no stopping zones" are in place on Bondi Road's kerbside lanes between the hours 7am – 9am for westbound traffic and 4pm – 6.30pm for eastbound traffic. This is in line with typical weekday peak periods and improves traffic flows however when "clearways" are not in place during off-peak times congestion increases greatly. Having highest congestion levels during off-peak and weekend periods has significant traffic impacts on local and tourist traffic.

6.4 BONDI BEACH

Bondi Beach is one of the most well-known tourist areas in Australia, and it is a key activity centre for residents. Figure 6.4 shows the Bondi Beach road network and highlights a number of current issues in the area.

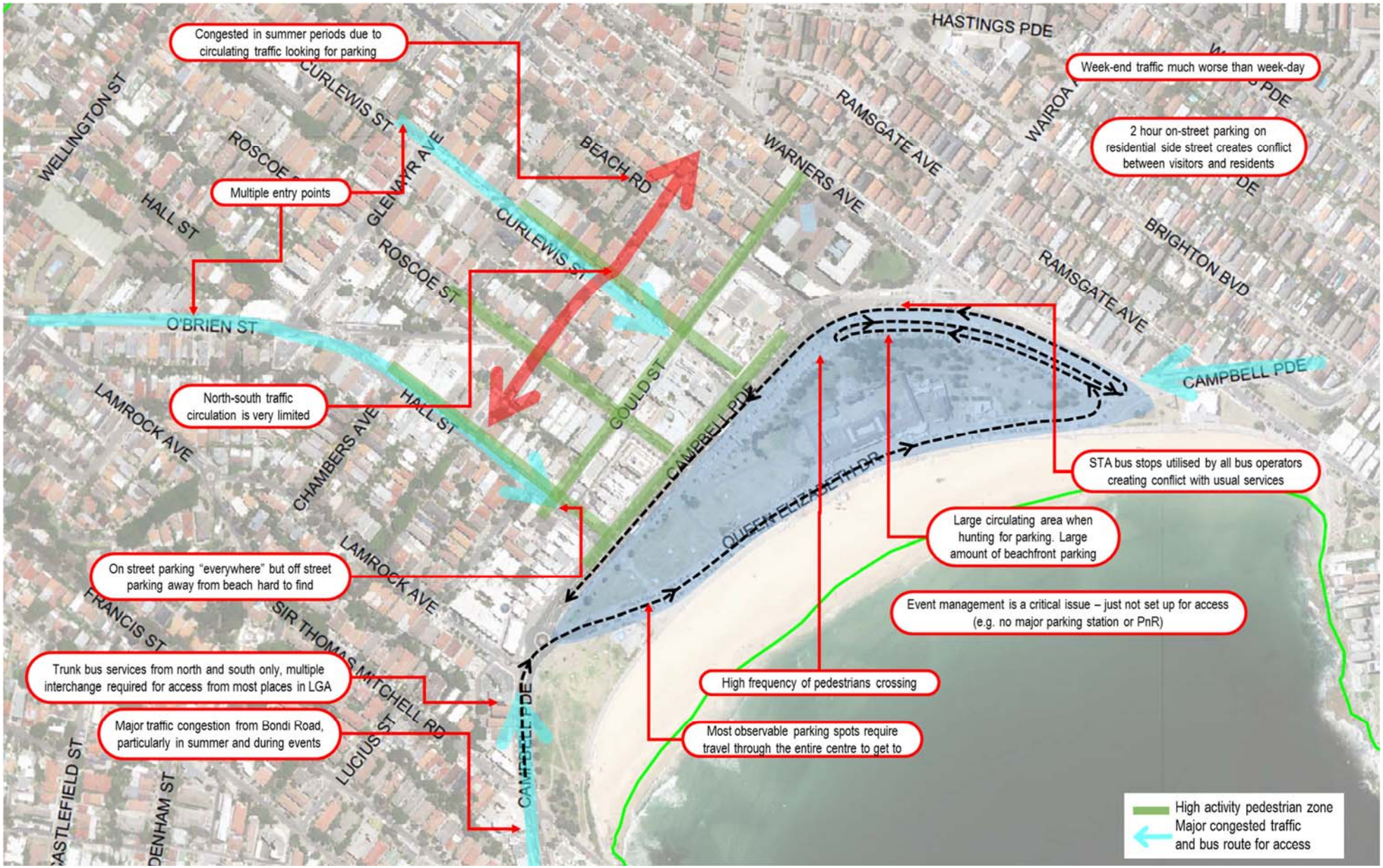


Figure 6.4: Bondi Beach Centre Zone Issues

Bondi Beach has a number of core issues and impacts resulting from high traffic concentration across all modes of transport. The key issues shown are expanded upon below:

Private Vehicle Traffic and Parking Issues

- there is a very high amount of on-street parking promoting parking of this type, whilst off-street parking facilities are limited and are not conveniently located for "distance to attractions" or "accessibility;
- Bondi Beach hosts a large number of events throughout the year therefore event management is a critical issue that impacts the way people travel to Bondi Beach;
- while there are multiple entry points to Bondi Road the north-south connections between these streets is minimal limiting opportunities for traffic dispersal and funnelling all traffic looking for parking down the same main routes with large circulation blocks;
- the most observable parking locations require travel through the entire centre to get to. Further, when drivers are searching for parking they are forced to follow large circulating routes adding to traffic levels on most streets;
- weekend traffic levels are much higher than peak weekday period levels;
- most side streets during summer are congested with circulating visitor traffic searching for parking;
- high number of car parking spaces provided at the beachfront leads to circulating visitor traffic searching for parking;
- Bondi Road is heavily congested in summer peak periods and events; and
- 2-hour parking zones on residential side streets allow beach-goers and shoppers to use street parking, resulting in difficulty for residents to park in their own street.

Public Transport, Cycling and Pedestrian Issues

- trunk bus services only exist from the north and south causing multiple interchanges to be required in order to reach Bondi Beach from most locations within the LGA;
- high incidence of pedestrians crossing mid-block across Bondi Road, despite fences to try and stop them;
- the steep hill up from the beachfront discourages cycling and walking journeys; and
- private bus operators using STA bus stops results in traffic congestion when STA buses are unable to utilise the bus stops, which may cause issue during large events.

6.5 LOCAL PRECINCTS

Waverley consists of a number of village centres throughout the LGA. For the purposes of the assessment of issues these centres have been analysed in "clusters".

6.5.1 Village Centres – Northern Cluster

Figure 6.5 shows a layout of the area surrounding the Northern Cluster of suburbs and outlines a number of current issues in the area. The Northern Cluster is located in the Dover Heights/Rose Bay area and includes the "Rose Bay South" village centre.

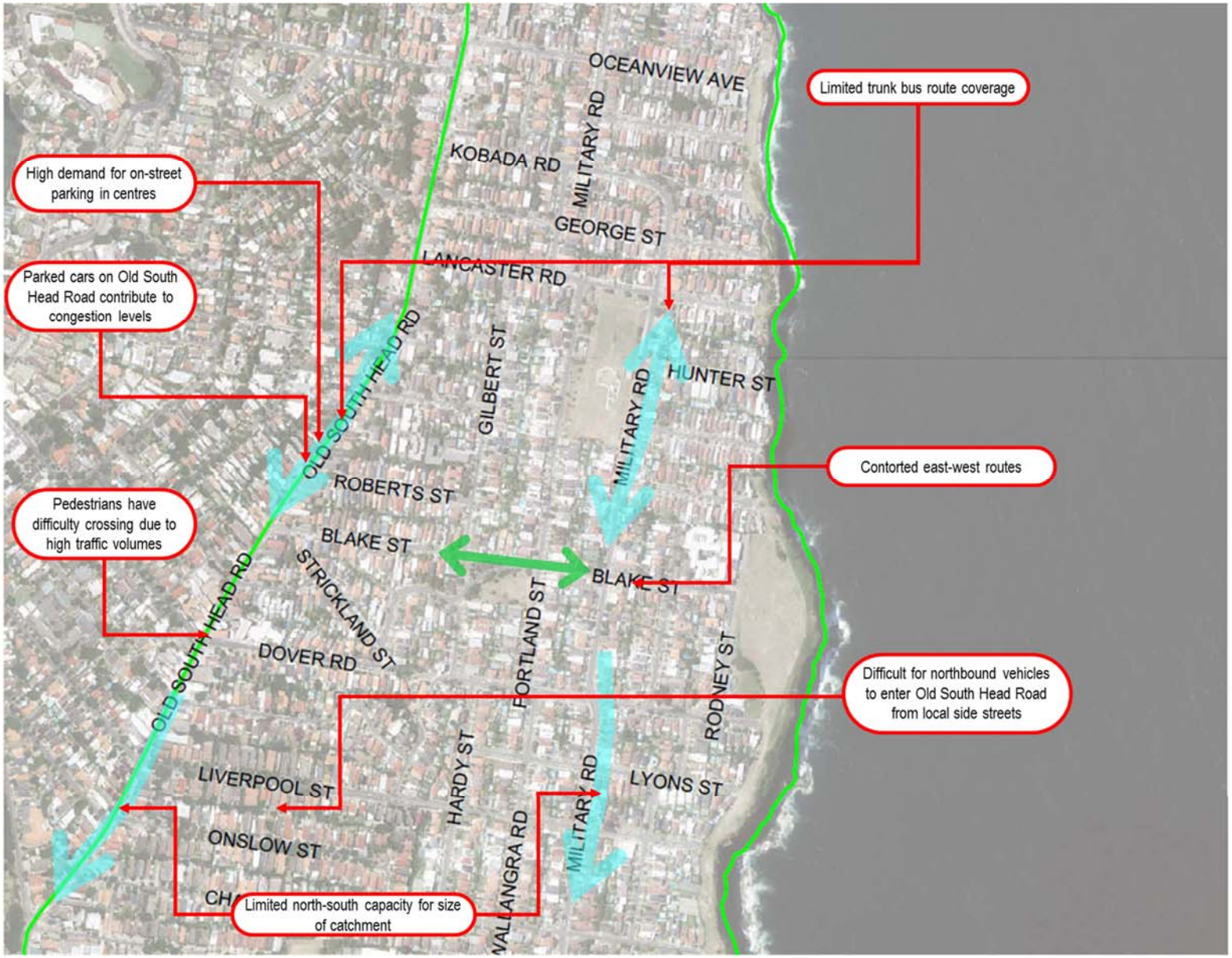


Figure 6.5: Northern Cluster Issues

The key issues shown are expanded upon below:

- there are very few trunk bus routes in the northern parts of Waverley LGA and those that do exist suffer from contorted routes and car-related congestion;
- the Dover Heights/Rose Bay South is actually a reasonably large catchment extending in an elongated north-south direction. Its geometry and geography mean a heavy reliance on north-south travel and only a small number of routes are available for access to Bondi Beach and Bondi Junction. It is inevitable that these few routes suffer from congestion in peak periods;
- on-street parking, whilst important for the vitality of the Rose Bay Village, does act as a source of traffic friction and congestion on South Head Road;
- further south, South Head Road becomes increasingly congested as other local catchments' traffic enter, culminating in long delays from Curlewis Street south to Bondi Junction; and
- changes are being made by RMS to Old South Head Road between O'Brien Street and Penkivil Street, which will restrict on-street parking to allow better traffic flows.

6.5.2 Village Centres – Southern Cluster

Figure 6.6 overleaf shows a layout of the area surrounding the Southern Cluster of suburbs in Waverley and outlines a number of current issues in the area. This cluster consists of two main centres located at Charing Cross and along Macpherson Street.

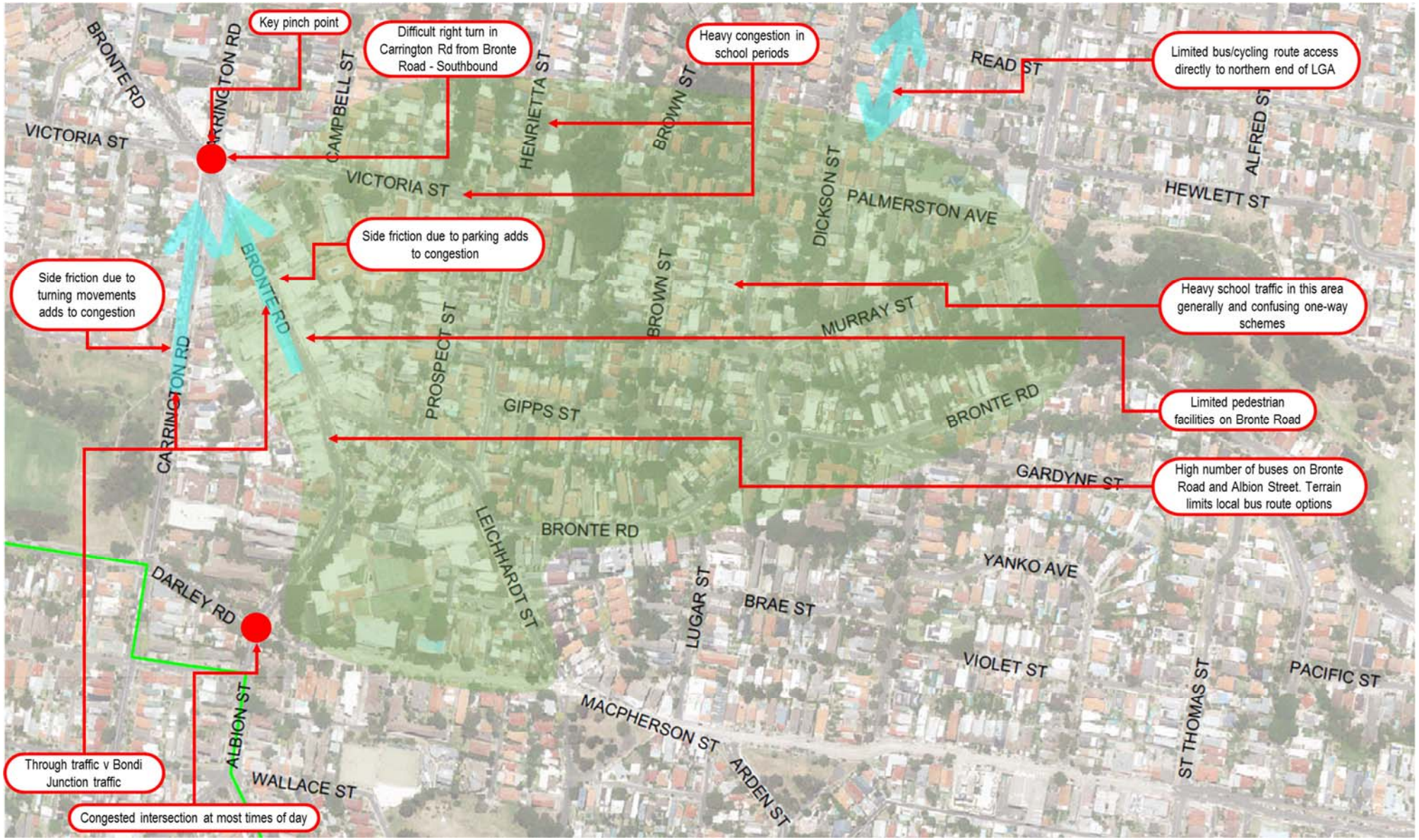


Figure 6.6: Village Centres – Southern Cluster Issues

The Southern Cluster localised traffic issues mostly involve through traffic impacting localised movements. The key issues shown are expanded upon below:

Traffic Issues

- through traffic on Bronte Road and on Carrington Road conflicts with Bondi Junction traffic to the north causing congestion on both roads;
- the area consists of heavy localised school traffic due to high concentration of schools in this area;
- side friction due to parking on main through routes adds to traffic congestion;
- traffic travelling south from Bondi Junction along Bronte Road has difficulty turning right onto Carrington Road, resulting in a high level of through traffic at Charing Cross village;
- limited pedestrian crossing facilities along Bronte Road, including outside schools and in the Charing Cross Village precinct;
- one-way street systems in Bronte and Tamarama "funnel" traffic to relatively few key intersections for right turn access onto Carrington Road, generating high traffic "pinch points";
- congestion at intersection of Bronte Road and Albion Street during both peak and off-peak times; and
- Henrietta Street north of Victoria Street, and Victoria Street east of Carrington Road are congested at school drop off and pick up times. High volume of through traffic.

Public Transport Issues

- most bus services in Bronte travel to Bondi Junction where interchanging in required to access other local LGA areas (i.e. Dover Heights) meaning car is much faster for these trips;
- a large number of bus routes pass through Charing Cross in Bronte slowing buses and concentrating coverage to this localised area; and
- a high volume of buses travel north-south along Bronte Road and Albion Street. There are limited local bus options outside of these trunk routes (in part due to very hilly terrain).

Localised school traffic is expected to increase with the proposed expansion of St. Catherine's School. The school extensions will sit adjacent to Macpherson Street and Albion Street with one new access point indicated for each of these streets. The school is expected to cater for a new maximum of 1,200 students by the year 2029.

6.6 LAND USE TRANSPORT STRATEGY

The Council's LEP outlines Land Zoning Maps that are used as guidelines for development types and centre areas across Waverley. A review the LEP Land Zoning Maps can identify two main land use types that define community centres, these include:

- School or church; and
- Commercial centre / mixed use / neighbourhood centre.

The locations of centre zone areas, based on the LEP mapping, give an overall picture of the key development zones and internal LGA connections. Figure 6.7 below summarises the current apparent land use transport strategy in the LEP.

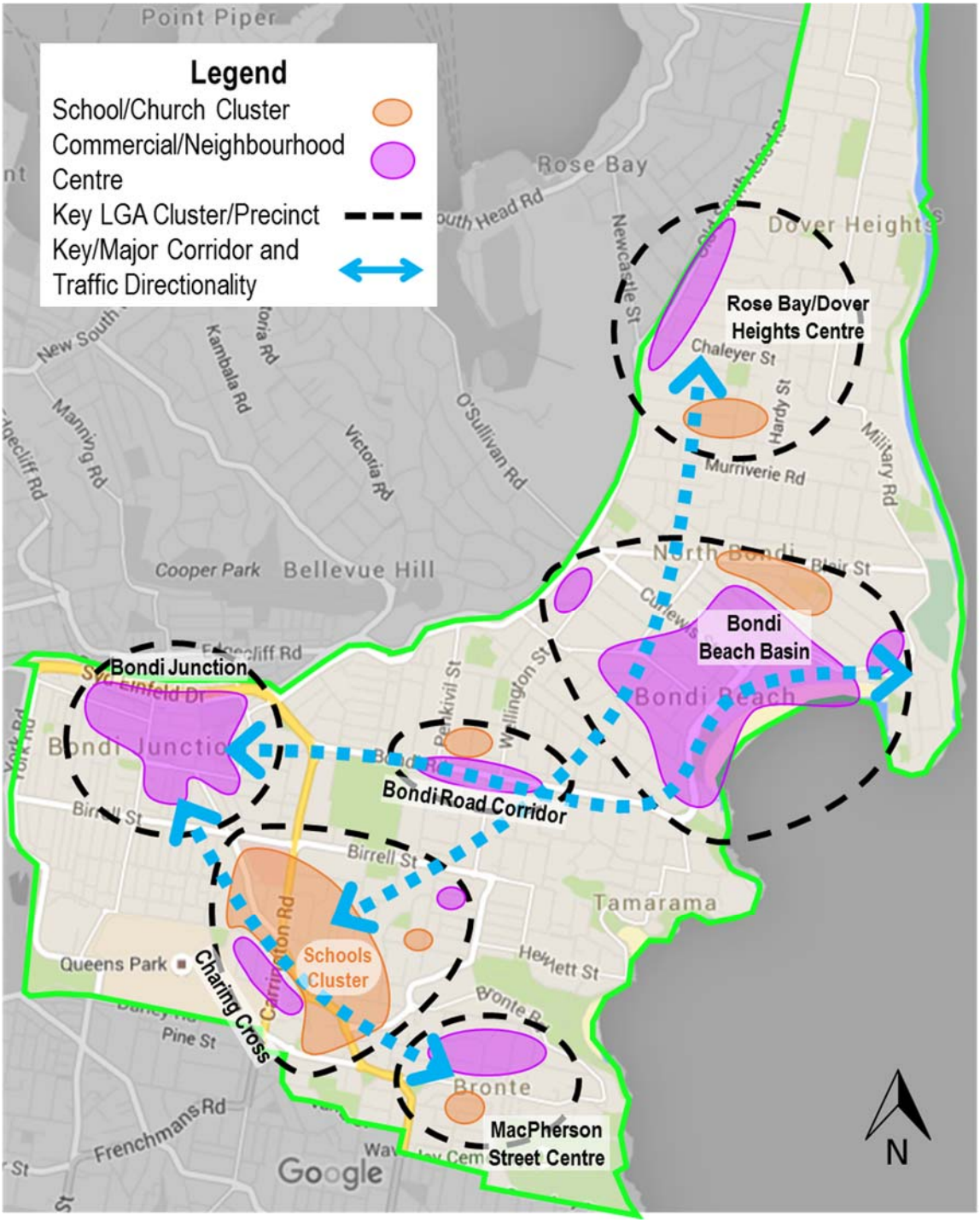


Figure 6.7: Waverley Land Use, Key Precincts and Major Links

As shown above, the identified key centre zones in Waverley are:

- the Bondi Junction centre as the commercial heart of Waverley;
- the Bondi Beach Basin as a major tourist centre;
- the large Schools Cluster in the Charing Cross zone;
- the Rose Bay/Dover Heights town centre;
- the Bondi Road corridor as the major through connection in Waverley between 2 key centres (Bondi Junction and Bondi Beach); and
- MacPherson St, Bronte.

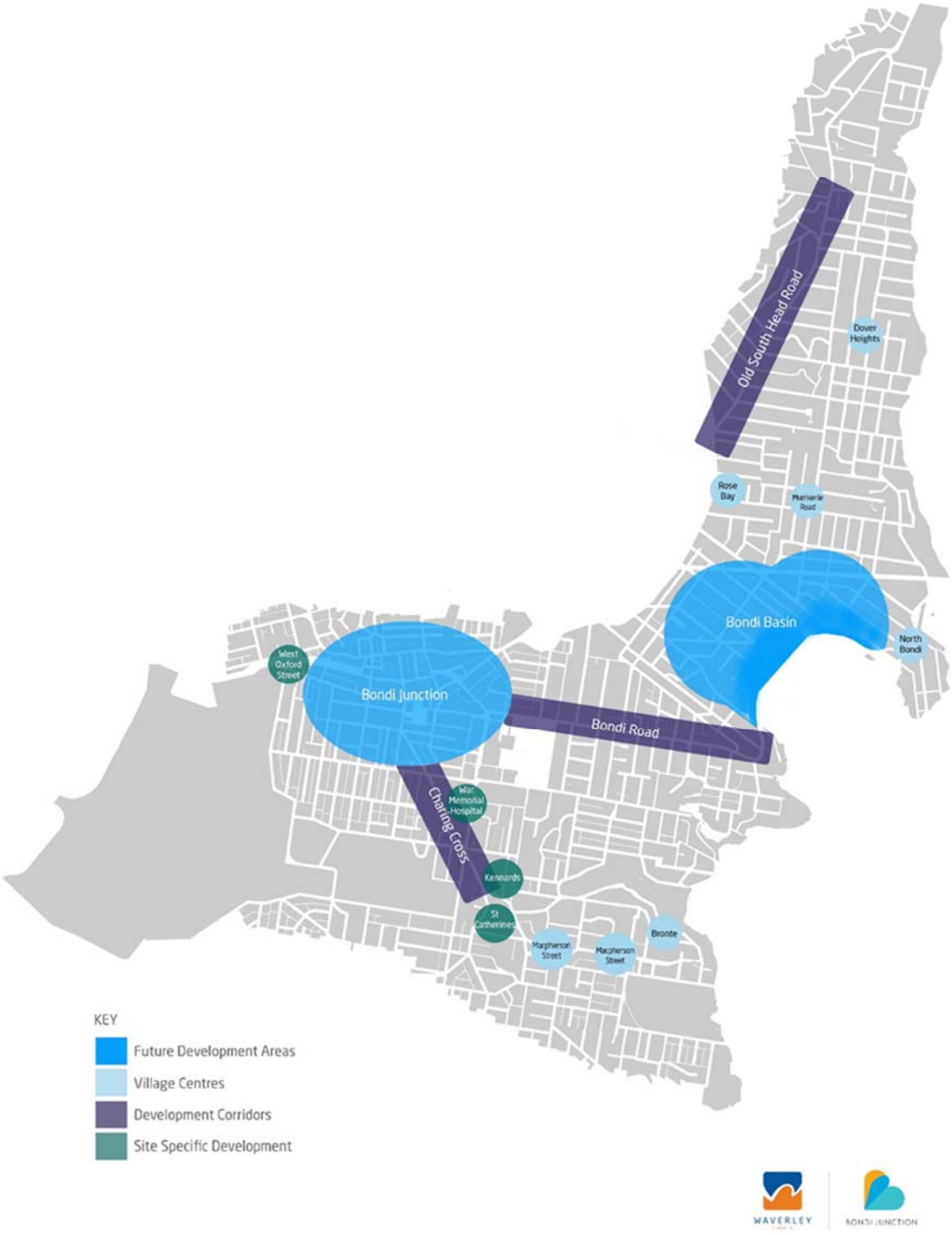
These precincts are centres for schools, jobs and shopping, and create demand for transport within and beyond the local government area. Providing high quality connections between these precincts is of strategic importance.

There are three corridors which can be identified to link these precincts:

- an east-west link from Bondi Junction along the Bondi Road corridor, to south Bondi and then to North Bondi. This is currently the key bus route (333, 380) with large numbers of passengers travelling daily;
- there is a north-south arc from Rose Bay through the Bondi Beach basin and Bondi Road to Charing Cross. Currently there is very little provision to connect these precincts by public transport (bus), cycling or walking. Providing better connections along this north-south spine makes strategic sense; and
- there is a major corridor from Bondi Junction along Bronte Road through to Charing Cross and MacPherson St. There is a large cluster of schools along this route, as well as mixed use/ commercial developments. This spine has a large number of bus routes (including Routes 400, 410 and 440) and is relatively flat. It is an ideal route for pedestrians and bicycles, although the road environment is not prioritised towards these modes.

6.7 EMERGING GROWTH AREAS

Councils DCP, LEP and various planning documents indicate areas most likely to be developed or redeveloped in the near future to activate commercial and residential opportunities across the LGA. The various zones outlined in Figure 6.8 below have been noted by Council as "potential redevelopment areas".



Source: Waverley Council

Figure 6.8: Potential Renewal and Growth Areas in Waverley

Key expected growth/redevelopment centres in Waverley LGA include:

- Bondi Junction Commercial Centre - noted as a Sub-Regional Centre for Sydney and it will continue remain a key residential and commercial development focus in Waverley, whilst expanding southwards;
- Bondi Basin including the Hall Street Town Centre and Campbell Parade - Bondi Beach (Bondi Basin) particularly, is an area of Inter-War Residential Flat Buildings (RFBs) generally 2 – 3 stories in height. As such, it is an area which is likely to be redeveloped in the near future as building stock continues to deteriorate and refurbishment and/or redevelopment become more economically viable. It is understood that growth opportunities will be considered as part of a future *Waverley Housing Strategy* which Council advise should commence this year;
- Bondi Road and Bondi Village - is a key link between Bondi Junction and Bondi Beach. As a key corridor, there is potential along this street for redevelopment due to its access to public transport and relatively high traffic volumes and accessibility;
- Small Village Commercial Centres - the small centres around Charing Cross and Rose Bay (North and South) are located on key bus routes providing opportunity for redevelopment. These commercial centres also have a hierarchy outlined in the Waverley DCP and the potential for more mixed local centre development (i.e. shop top housing); and
- Small Neighbourhood Centres - various small centres with local amenities are expected to provide opportunities for localised redevelopment as surrounding residential densities grow and demand for local amenities increases. Small neighbourhood centres outlined in the DCP include Bronte Beach, Bronte (Macpherson Street), Murray Street, North Bondi, Murriverie Road and Blake Street.

These centres and corridors, along with those noted in Figure 6.8, will be key for future growth and development across the Waverley LGA.

7. CONCLUSIONS

Traffic and parking congestion continue to be raised by the Waverley community as key issues affecting the quality of life in their LGA. There have been many previous transport strategies that have attempted to address these issues although many of them have produced aspirational recommendations with little potential for implementation. What is needed now are clear integrated planning principles to respond to the issues identified that can be reflected in specific actions that can actually be implemented by Council or for which Council can clearly articulate their need to the State Government.

It is clear from the review of historic data and future projections for Waverley that congestion is an issue that will not simply "go away". Restraining congestion growth as development growth occurs is a valuable objective whilst providing more realistic choice for residents and visitors for alternative transport modes to the private car. In fact, the research acknowledges this is the most effective way of restraining congestion growth in a sustainable way.

The Waverley LGA is unique in the Sydney context. With a highly "active" population (32% more trips per person than the Greater Sydney average) and with more young families, more income and reasonably dense housing, the area's mobility needs are very high. Shorter trip lengths and more public and active transport than the Greater Sydney average, as well as lower car ownership per household than Grater Sydney means enormous opportunities for further increasing public and active transport mode share if those modes can be made more efficient in comparison to private vehicles.

Notwithstanding the above there is still a clear need to better value and better manage the available trafficable and parking space on road within the LGA.

Overall, this Issues Report shows the fundamental land use, travel demand and resident characteristics in Waverley provide opportunities to improve the efficiency of movement across the LGA. The issues presented in this report provide the basis for developing clear actions to improve how people travel with more movement choice (how, where, when) and to improve their connectivity to key places they visit.

REFERENCE LIST

ABS, 2011, *ABS Community Profile Census Data*. Australian Bureau Statistics, Federal Government, Canberra.

AECOM. 2013, *Waverley Light Rail*. Waverley Council, Sydney.

Armstrong, B. 2004, *Personal communication*. Roads & Traffic Authority of New South Wales, Sydney.

BTS NSW, 2012, *BTS Census and Journey to Work Data*. Bureau of Transport Statistics, NSW.

Google, 2015, *Google maps online*, Google Australia.

Google Earth, 2012, *NSW globe data/information*. NSW Government, Sydney.

GTA Consultants. 2013. *Bondi Park, Beach and Pavilion Plan of Management and Master Plan: vehicle parking and movement study investigation of parking options*. Waverley Council, Sydney.

IPART, 2015, *More efficient, more integrated Opal fares*. Independent Pricing and Regulatory Tribunal of NSW

Mogridge, M.J.H. 1997, "The self-defeating nature of urban road capacity policy: a review of theories, disputes and available evidence", in *Transportation Policy*, Vol. 4, No. 1, pp. 5–23.

NSW Minister for Transport. 2013, *Media release: Sydney trains to deliver better customer service*. NSW Ministry for Transport, Sydney, Monday 1 July.

Pierce, G. and Shoup, D. 2013, "SFPark: parking pricing by demand" in *ACCESS*, No. 43, Fall, pp. 20–28.

Profile.id, 2011, ABS Census data compilation and profiling comparison website. www.profile.id.com.au, id.

Roy Morgan, 2015, *Sydney Transport User Survey 2015*. Roy Morgan Research.

RTA. 1995, *Traffic volume data for Sydney Region 1993*. Roads & Traffic Authority of New South Wales, Sydney.

SACTRA, 1994, *Trunk roads and the generation of traffic*. HMSO, London.

SGS, 2013, *Eastern Suburbs Economic Profile: Final Report*. SGS Economics and Planning.

STPP. 1998, *An analysis of the relationship between highway expansion and congestion in metropolitan areas: lessons from the 15-year Texas Transportation Institute Study*. Surface Transportation Policy Project, Washington, DC.

Transport for NSW, 2011*, Connections 2012–2017 corporate plan*. NSW Government, Sydney.

Transport for NSW, 2012, *NSW Long Term Transport Master Plan*. NSW Government, Sydney.

Transport for NSW, 2013, *Integrated Public Transport Service Planning Guidelines: Sydney Metropolitan Area*. NSW Government, Sydney.

Transport for NSW. 2014, *Customer satisfaction index.* NSW Government, Sydney.

Waverley Council, 2012, *Car share policy*. Waverley Council, Sydney.

Waverley Council, 2012, *Access and mobility policy and action plan 2011–2015*. Waverley Council, Sydney.

Waverley Council. 2012b, *Waverley Bike Plan 2013*. Waverley Council, Sydney.

Waverley Council, 2012, *Waverley Council Website Calendar.* Waverley Council, Sydney.

Waverley Council, 2013a, *Waverley Together 3*. Waverley Council, Sydney.

Waverley Council, 2013b, *Outcomes of Review of Waverley's Resident Parking Scheme (A12/0276).* Waverley Council, Sydney.

Waverley Council, 2014a, *Waverley Development Control Plan and Local Environment Policy.* Waverley Council, Sydney.

Waverley Council, 2014b, *Waverley Council officer working group parking pricing review, terms of reference. August,* Waverley Council, Sydney.

Waverley Council, 2015, *Mapinfo crash, parking and mapping data across the Waverley LGA.* Waverley Council, Sydney.

APPENDIX A

Bondi Junction Traffic and Transport Studies GAP Analysis