NEW PARRAMATTA RD

Parramatta Road PRECINX Sustainability Report

September 2015

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UrbanGrowth NSW

Prepared by Kinesis
Level 6, 155 Clarence Street
Sydney, 2000 NSW
P.O. Box Q164
Queen Victoria Building
NSW 1230
admin@kinesis.org

Document Version
Final

Authors
Bruce Taper, Director
David Holden, Associate Director
Tom Watson, Sustainability Analyst

Note: This report is provided subject to some important assumptions and qualifications:

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy, water and greenhouse consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

Parramatta Road Urban Transformation
PRECINX Strategy Report

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1. Introduction

1.1. OVERVIEW

Over the next 20 years, Sydney's population will grow by 1.6 million people. Sydney will need to provide more diverse and affordable housing, a broader range of job opportunities aligned with our changing economic structure and easier and more sustainable ways for people and goods to move around the city to support this growth. As the city grows, we must look to the renewal of our existing urban areas to provide a more sustainable way of meeting increasing demand for housing, transport and services.

The Parramatta Road Corridor (the Corridor) is identified in A Plan for Growing Sydney as an urban renewal corridor that will be the focus for increased housing, economic activity and social infrastructure. The Corridor is proposed to be transformed through the implementation of the Draft New Parramatta Road Urban Transformation Strategy over the next 30 years. In 2050, the Corridor will have an estimated resident population of 70,000, approximately 40,000 new dwellings and 30,000 new jobs.

Realising the Corridor's full potential is important to the future productivity and liveability of metropolitan Sydney. Urban transformation within the Corridor presents a unique opportunity to optimise sustainability performance and implement new strategies that could achieve best practice outcomes.

Under the right commercial and technical conditions, precincts along the Corridor could potentially incorporate building and infrastructure optimisation strategies to improve resource efficiency, reduce peak demand impacts and lower capital and recurrent costs for infrastructure providers, developers and householders above and beyond a business as usual scenario.

The exact technologies and strategies to achieve these gains will need to be considered at the next phase of planning. However, a range of potential optimised sustainability strategies have been identified that could be considered by planning authorities when undertaking future strategic and statutory planning processes.

The construction of WestConnex will allow for significant improvements to local amenity by reducing through-traffic on surface roads, and allowing for enhanced north-south local connectivity. The Government will investigate the feasibility of light rail along Parramatta Road for the length of the corridor.

The corridor will be a focus for increased housing, economic activity and social infrastructure, especially around centres with good public transport access and amenity. An Urban Renewal Strategy is being prepared to guide development in selected precincts in the Parramatta Road Corridor and to bring new life to local communities. Burwood, Sydney Olympic Park and Rhodes will continue to be a particular focus for employment.

A Plan for Growing Sydney

1.2. THE STUDY AREA

Due to the nature of the required inputs and key deliverables of the draft Strategy, the Corridor and its components are referred to in different ways, for various components and stages of work.

The **Study Area** covers the 10 LGAs which the Corridor spans and includes the geographical area between Parramatta CBD and Sydney CBD and the Parramatta River in the north to the Western Rail Line in the south.

The **Parramatta Road Corridor** is the continuous length of Parramatta Road, and includes land with direct frontage to Parramatta Road, as well as the eight Precincts.

Change and growth along the Corridor is focused in eight **Precincts** which have been chosen for their ability to support growth, and their access to public transport, services, and jobs. The Precincts have been informed by a range of factors including natural features or barriers, built form or land use change, and subdivision patterns. In some cases, the Precincts straddle LGA boundaries.

Frame Areas are portions of the Corridor located between the identified Precincts with direct frontage to Parramatta Road, and typically capture the first strip of lots or land to the first street/laneway running parallel to the north or south of Parramatta Road. The Frame Areas form important links that may experience some change, but at a lower intensity than that anticipated in the Precincts. The NPUTP should not be seen as the redevelopment of precincts alone, but rather the combined renewal of Precincts and Frame Areas that will collectively deliver a transformational effect along the Corridor.

Figure 1 identifies the extent of the Study Area, Corridor, Precincts, and Frame Areas. Figure 1 also illustrates the extent of the Transport Study Area used by Transport NSW for the purposes of the Draft

Transport Plan (which is a wider catchment than the Study Area used for the draft Strategy). Table 1 identifies the LGAs that the Precincts are located within.

Precinct	Corresponding LGAs
Granville	Parramatta City Council Holroyd Council
Auburn	Auburn City Council
Homebush	Strathfield Municipal Council City of Canada Bay Council
Burwood	Burwood Council City of Canada Bay Council
Kings Bay	Burwood Council City of Canada Bay Council Ashfield Council
Leichhardt	Leichhardt Municipal Council Marrickville Council
Taverners Hill	Leichhardt Municipal Council Marrickville Council Ashfield Council
Camperdown	City of Sydney Leichhardt Municipal Council

Table 1: Parramatta Road Corridor precincts by Local Government Area

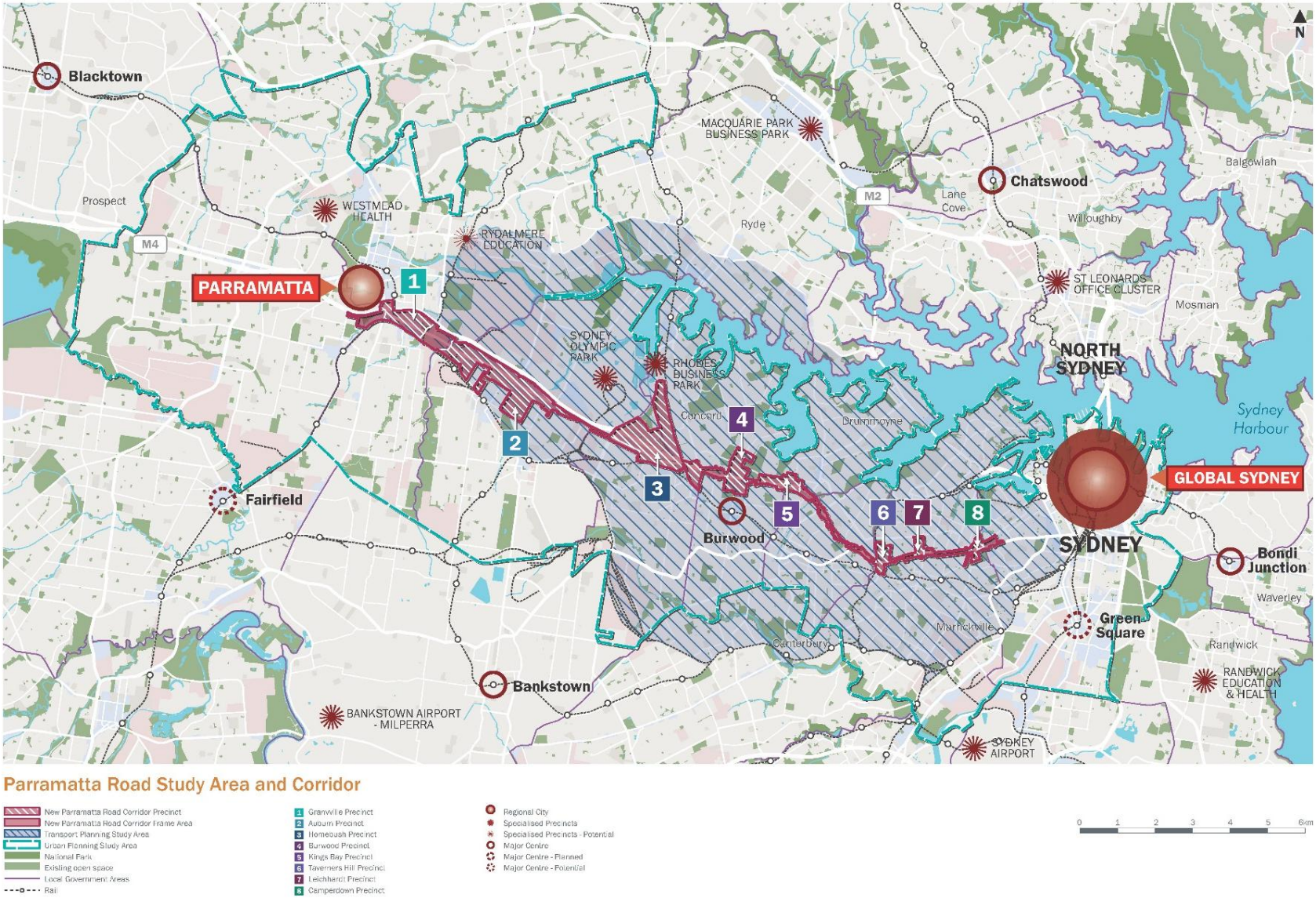

Figure 1: Parramatta Road Corridor Study Area and Corridor

1.3. PARRAMATTA ROAD URBAN TRANSFORMATION PROGRAM

The Parramatta Road Urban Transformation Program (PRUTP) is the integrated, cross-agency project established by the NSW Government in 2013 to explore, capture and deliver on opportunities for urban transformation along the Corridor resulting from the WestConnex Motorway and in line with *A Plan for Growing Sydney*.

The PRUTP incorporates three key deliverables:

- An Urban Transformation Strategy for the Parramatta Road Corridor to establish a framework for the future growth and development of the Corridor. This document is known as the *Draft New Parramatta Road Urban Transformation Strategy*.
- A transport infrastructure program for the Corridor. This document is known as the *Draft Sydney CBD to Parramatta Strategic Transport Plan*.
- A $200 million program of local urban amenity improvement works to deliver tangible public domain improvements to the Corridor aligned with its staged redevelopment. This document is known as the *Draft Parramatta Road Urban Amenity Improvement Plan*.

The PRUTP is led by UrbanGrowth NSW, the NSW Government's urban transformation delivery organisation. UrbanGrowth NSW leads an Integrated Project Team (IPT) that includes Transport for NSW, Roads and Maritime Services, WestConnex Delivery Authority, the Department of Planning and Environment (DPE), and the ten Councils along the Corridor.

The vision for the Parramatta Road Corridor is:

A high quality multi-use corridor with improved transport choices, better amenity and balanced growth of housing and jobs

1.3.1 The Draft New Parramatta Road Urban Transformation Strategy

The draft *New Parramatta Road Urban Transformation Strategy* (draft Strategy) articulates the long term growth vision for the Corridor. The purpose of the draft Strategy is to facilitate the coordinated transformation of Parramatta Road and its adjoining lands by integrating land use and built form with transport initiatives and public domain improvements. This integrated approach recognises the importance of the Corridor as a single strategic entity, by combining the benefits of applying a subregional response to 'big picture' issues with the depth of local knowledge required to plan for existing and future communities.

More specifically, the draft Strategy contains:

- a long-term vision for the transformation of the Parramatta Road Corridor;
- an Integrated Land Use and Transport Concept Plan that includes land use and development intensity, public and active transport initiatives, green space and links, key infrastructure and eight growth Precincts;
- guiding land use, transport and development and public domain principles that will apply to all land within the Corridor;
- Precinct Plans and associated building envelopes for each Precinct, providing more detailed principles and targets for growth and development, and actions for implementation; and
- an action-oriented framework for implementation and delivery including a high level program that should be considered in the assessment of land use and development proposals across the Corridor.

The draft Strategy will build on five principles to meet this vision:

- Plan for a diversity in housing and employment.
- Make the Corridor accessible and connected.
- Focus on community and places.
- Sustainability and resilience.
- Deliver, drive, facilitate and monitor action.

The full urban transformation of Parramatta Road to 2050 will deliver far-reaching benefits for Sydney:

- a targeted 40,000 homes, well-located to transport and services, with a diverse mix of housing types and choices, including affordable homes;
- $64 billion in economic benefits to the State, arising from new residential development;
- a productive business environment, to support viable and prosperous businesses, and a variety of employment opportunities that will deliver 50,000 new jobs;
- more efficient and reliable public transport, providing both east-west and north-south connections; and
- eight well-serviced and well-connected Precincts, each with diverse spaces, places and links for people to live in, work in, visit, connect with and enjoy.

1.3.2 The Draft Parramatta – Sydney CBD Strategic Transport Plan

The draft *Parramatta – Sydney CBD Strategic Transport Plan* (draft Transport Plan) sets the strategic context for current plans, proposals and interventions in the Sydney CBD to Parramatta Corridor. It is an integrated transport and land use plan that considers a holistic view of growth and renewal in the Corridor, as well as metropolitan, regional and local influences on future transport, housing and employment.

The draft Plan identifies a framework to guide future transport requirements and appropriate interventions at the regional, intermediate and local levels to guide future investment and to meet changing demands. Accordingly, the Draft Plan has informed the Draft Parramatta Road Urban Transformation Strategy.

1.3.3 The Draft Urban Amenities Improvement Program

The draft *Urban Amenities Improvement Program* (UAIP is a $200 million initiative under the Draft New Parramatta Road Urban Transformation Strategy to stimulate the transformation of the Parramatta Road Corridor.

The UAIP identifies a suite of early local amenity improvement works to help realise the vision of the Parramatta Road Corridor. The UAIP recognises that the Precincts and existing communities along the Corridor must respond to population growth and change. It also recognises that some existing infrastructure is ageing or unable to respond to the needs of communities as they grow and change. Local amenity infrastructure is therefore required to be delivered quickly to achieve positive social and economic outcomes.

UrbanGrowth NSW has jointly prepared the UAIP with the collaborating councils along the Corridor: the City of Sydney, Marrickville Council, Ashfield Council, City of Canada Bay Council, Burwood City Council, Strathfield Council, Auburn City Council, Parramatta City Council and Holroyd City Council.

1.4. PURPOSE OF THIS REPORT

Sustainability analysis has been undertaken to determine the benefits of urban transformation proposed within the Corridor. This Report describes the interventions that could be implemented to ensure future communities within the Corridor are sustainable, affordable and resilient.

The Report establishes metrics to define the success of the Draft New Parramatta Road Urban Transformation Strategy based on four key measures of success:

- **Transport use** (vehicle kilometres travelled per person per day);
- **Water consumption** (ML per person per year);
- **Greenhouse gas emissions** (tonnes per person per year); and
- **Household affordability** ($ per household per year).

1.5. OUR APPROACH

Analysis included in this report was undertaken using UrbanGrowth NSW's integrated sustainability, infrastructure and design tool, PRECINX. PRECINX is a tool used to evaluate the sustainability of a neighbourhood or large urban transformation projects. It is designed to test a project's social, economic and environmental performance against existing conditions, a business-as-usual base case, and can also calculate and the assess performance of an optimised scenario that relies on the introduction of additional interventions above and beyond existing or base requirements.

> PRECINX was integrated into the various project streams prepared under the PRUTP to provide a measurable and quantifiable basis to determine the potential benefits of the PRUTP and identify strategies to improve its performance and outcomes (see **Figure 2**).

Key land use and transport themes and principles were identified and adopted by the Integrated Project Team to apply to the PRUT. The analysis and strategies outlined in this report expand on and seek to measure these key principles. In order to assess the success and benefits of PRUT, Kinesis identified 19 indicators under four of the five Draft Strategy's principles:

1. **Plan for a diversity of housing and jobs to meet existing and future needs** (measured through land use mix, employment and housing provision).

2. **Reshape and better connect places and associated movement networks to better serve customers and encourage sustainable travel** (measured through car dependence, mobility choice, access to public transport and pedestrian and cycling facilities).

3. **Promote quality places and built form outcomes to transform the Corridor over time** (measured through the provision of pedestrian facilities, open space and street improvements).

4. **Create liveable local Precincts along the Corridor that are sustainable, resilient and make Sydney a better place** (measured through greenhouse gas emissions, resource consumption, car dependence and affordability outcomes).

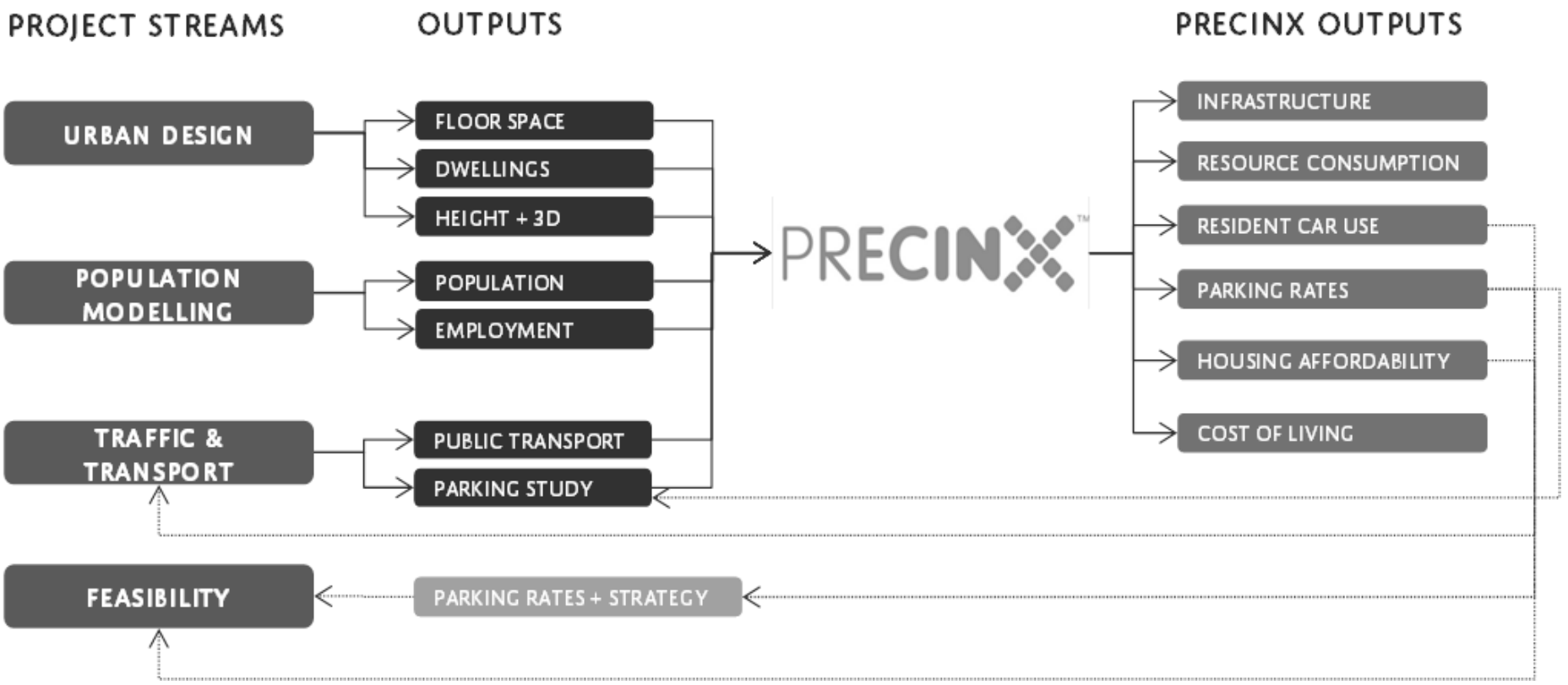

Figure 2: Relationship of PRECINX to PRUTP project streams

It should be noted that the fifth principle - **Establish an effective implementation, governance, monitoring and reporting framework** – was not measured by PRECINX given that it relates primarily to the administration of the Draft Strategy.

For the PRUTP, Kinesis has used PRECINX to test each of the proposed Precincts as well as determine the average performance of the Corridor. This has comprised testing three scenarios:

1. **Existing Conditions**, which measures how the Precincts perform currently in terms of travel behaviours and patterns, energy and water consumptions and costs, and proportion of landscaping and tree canopy cover.

2. **PRUTP Base Case** which assumes urban transformation takes place through development that proceeds under existing planning and development controls, such as current BASIX, Section J (BCA) and car parking requirements.

3. **PRUTP Optimised** which assumes urban transformation takes place through development that is includes sustainability interventions at either the Corridor and/or the precinct scale. The sustainability interventions are policy, planning or development controls that could be implemented by Council or the Department of Planning and Environment as part of a future strategic or statutory planning processes.

Finally, to establish whether or not PRUTP will, at a metropolitan level, have a positive or negative impact on the city, the results of each scenario were benchmarked against the **Sydney Metropolitan Average** (where available).

In order to determine the future potential of the Corridor, population, dwelling and employment growth over the next 30 years has been established using a complex growth model prepared by AECOM for UrbanGrowth NSW. The model is underpinned by a series of assumptions and is a capacity based tool that provides an indication of the potential growth which could be achieved under the Draft Strategy to 2050.

For the purposes of testing the Precincts, and particularly the PRUTP Base Case and PRUTP Optimised scenarios, Kinesis has worked with UrbanGrowth NSW's urban designers Cox, to develop an indicative urban transformation test scenario. The test scenarios are provided in **Table 2** but do not form part of the Draft Strategy. The primary purpose of the test scenarios is to test how future transformation could perform based on a range of business-as-usual or innovative sustainability interventions.

The interventions modelled for each Precinct are a combination of those discussed in later sections of this report.

1.6. KEY FINDINGS

The PRUTP has significant potential to reduce the cost of living, car dependency and resource consumption, when compared to housing the equivalent population on Sydney's fringe is shown in **Figure 3.**

The Base Case could be expected to deliver:

- A slight increase in per person greenhouse gas emissions due to higher concentration of high rise apartments;
- A reduction in per person potable water use, again due to a higher concentration of high rise apartments;
- A reduction in car use (up to 60%); and
- A reduction in car ownership (11% to 29%).

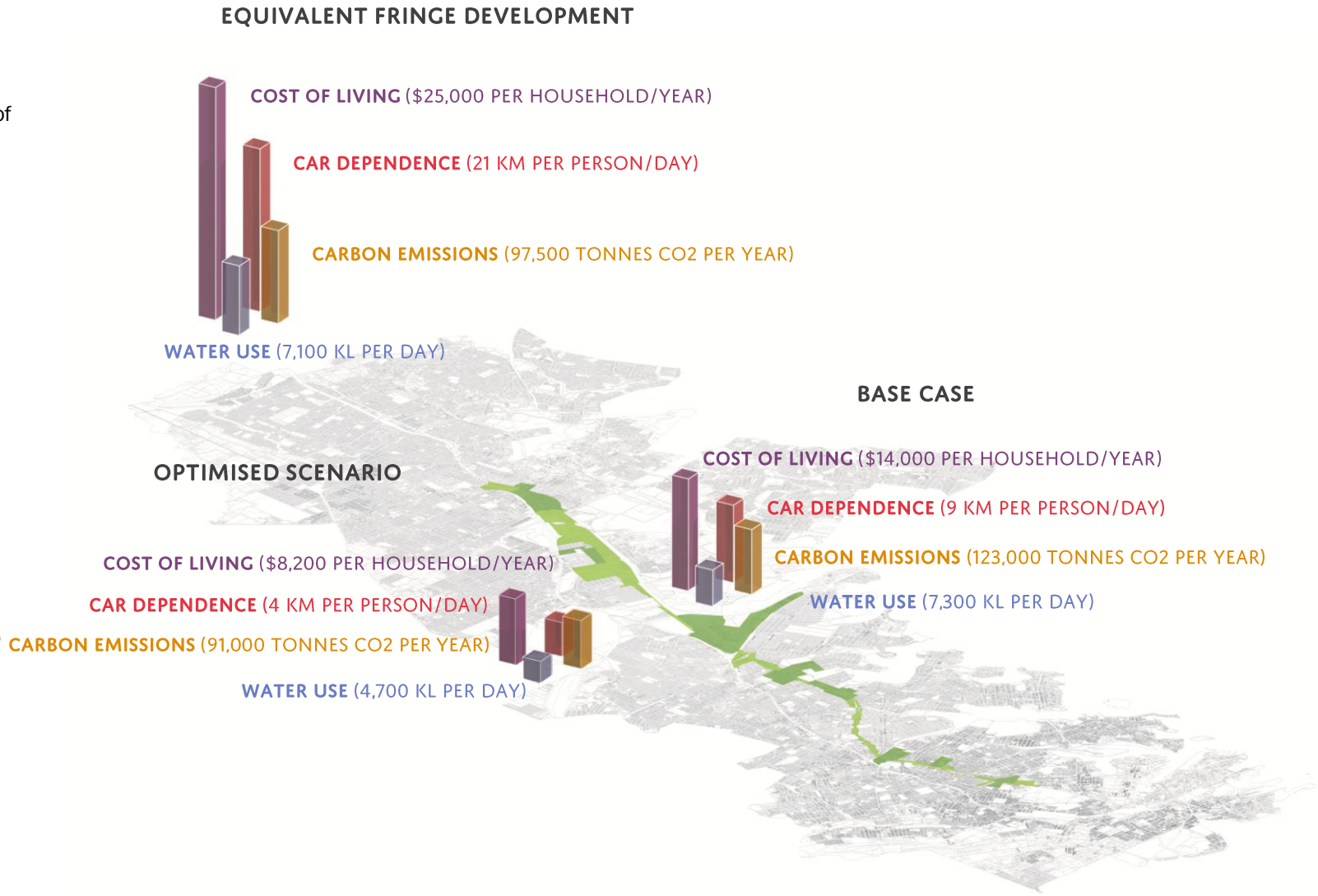

Figure 3: The benefits of urban renewal comparing PRUTP to housing the equivalent population on Sydney's fringe

1.6.1 Key Interventions for World Class Urban Renewal

In order to deliver world class urban renewal outcomes along the Corridor, the opportunity exists to strive for sustainability outcomes that exceed current requirements. Several key strategies have been identified and recommended as potential additional options to optimise development outcomes along the Corridor, as outlined below.

1. High Performance Buildings

Ensuring all new development is built to achieve higher than Base Case performance outcomes via increased BASIX and establishment of NABERS targets.

This intervention has the potential to deliver:

- 24 to 27% reduction in greenhouse gas emissions from lower electricity and gas consumption;
- 31 to 40% reduction in potable water consumption;
- 18 to 39% reduction in peak electricity demand
- 19% to 33% reduction in peak sewer load requirements, reducing the need for significant infrastructure upgrades; and
- 37 to 48% lower household costs and associated strata fees associated with energy, water and transport.

2. Reduced and Decoupled Strategic Parking

Reducing and decoupling car parking improves development feasibility, increases housing affordability and supports public transport objectives, established for the PRUTP.

This intervention has the potential to deliver:

- Reduced vehicle traffic and household car ownership rates throughout a Precinct;
- Lower construction costs associated with excavation and construction of underground parking;
- Between a $50,000 to $70,000 reduction in the sales price of a new apartment;
- Less energy demand for parking lighting and ventilation, equating to lower compliance costs with BASIX Energy Targets and lower energy costs for an apartment body corporate.
- The potential for private investment in the delivery of approximately car share pods, each servicing 8-12 households across the Precinct.

3. Urban Resilience and Infrastructure Delivery

Delivering recycled water and significant tree canopy to ensure a resilient and cool urban environment and public domain – an urban oasis that is cooler, more comfortable and more walkable on hot summer days.

This intervention has the potential to deliver:

- Significantly reduced potable water consumption for public space irrigation;
- Reduced electricity consumption and peak infrastructure demands from air conditioning through cooler streets;
- Significantly reduced sewer infrastructure requirements to the Corridor;
- Reliable and consistent source of water for public domain irrigation which is not reliant on rainfall patterns and is resilient to future variations in rainfall; and
- Reduced heat island effect and impacts of heat waves.

2. Understanding the Corridor

This section provides context to the development of the strategies and infrastructure solutions for PRUTP.

The Corridor is identified in A Plan for Growing Sydney as an urban renewal corridor that will be the focus for increased housing, economic activity and social infrastructure. The Corridor is proposed to be transformed through the implementation of the Draft New Parramatta Road Urban Transformation Strategy over the next 30 years. In 2050, the Corridor will have an estimated resident population of 70,000, approximately 40,000 new dwellings and 30,000 new jobs.

For the scope of this project, three key trends have been identified that require particular consideration:

- Travel, car ownership and parking trends
- Climate variability and trends
- Cost of living and affordability

2.1 TRAVEL, CAR OWNERSHIP AND PARKING

- Car ownership rates have been analysed by ABS Census statistical area (SA) 1 zones. Data is shown for 2011.
- Car ownership rates (average vehicles per household) vary significantly along the Corridor (**Figure 4**).
- There are a number of areas along the Corridor where existing households own less than 1 vehicle. This is primarily in areas close to the existing rail line and within walking distance of high frequency public transport.
- Households without vehicles are highest in the City of Sydney Local Government Area, however there are other pockets along the Corridor with high proportions of these households, including Parramatta, Granville, Strathfield and Ashfield (**Figure 5**).
- At a metropolitan level the following additional trends were also observed:
    1. Vehicle license rates for the younger demographic are falling. Across the Sydney Metropolitan Area, 1 in 4 people aged 18 to 35 do not have a license or own a car (Bureau of Transport Statistics, 2009).
    2. Currently, approximately 8% of City of Sydney residents are car share members. This is as high as 20% in high density, highly accessible locations such as Darlinghurst and Surry Hills.
- Travel patterns have been analysed to understand travel and containment patterns along the corridor. This data was sourced from the Bureau of Transport Statistic's Household Travel Survey and the ABS Census Journey to Work (2011).
- Employment containment can be measured by the percent of population who walk or cycle to work. High levels of containment currently exist within the City of Sydney Local Government Area and adjacent inner city locations. However, similar levels of containment can also be seen in and around the Parramatta CBD and Granville Precincts (**Figure 6**).
- Lower commute and trip times were observed in and around the Sydney and Parramatta CBDs. These times increase away from major employment hubs (**Figure 7 and 8**).

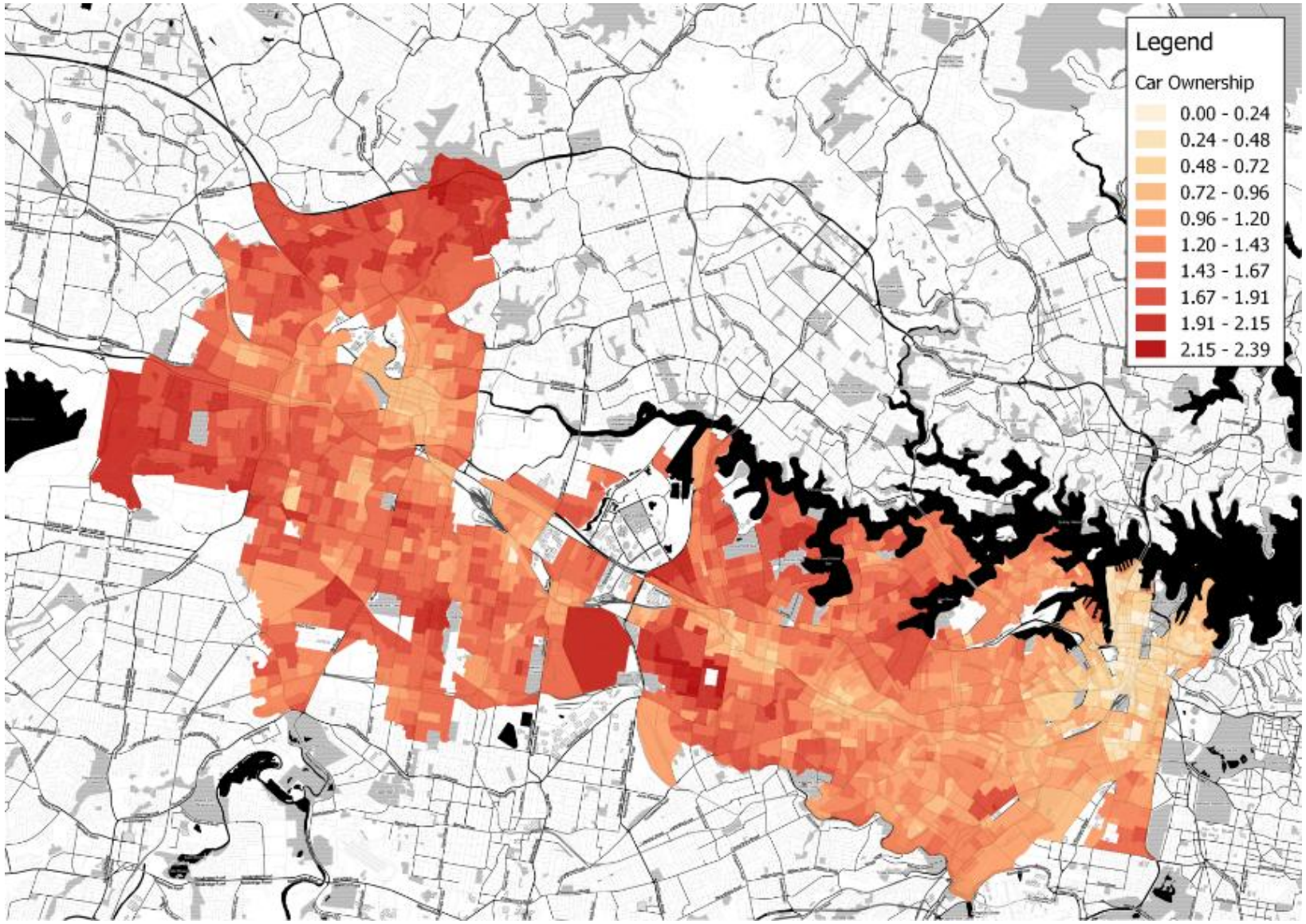

Figure 4: Average existing car ownership rates (ABS Census 2011)

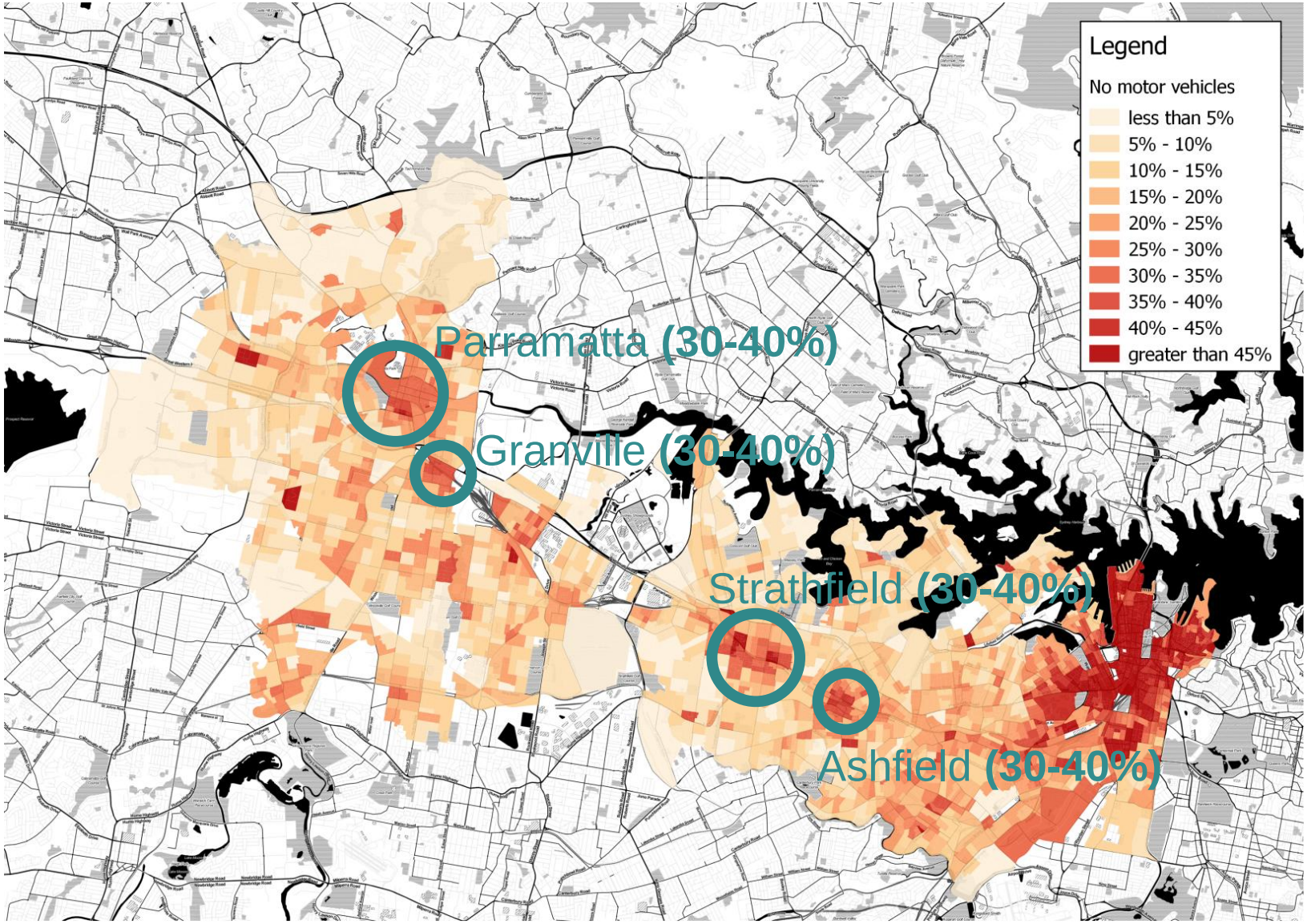

Figure 5: Percent of housing with no vehicles (ABS Census 2011)

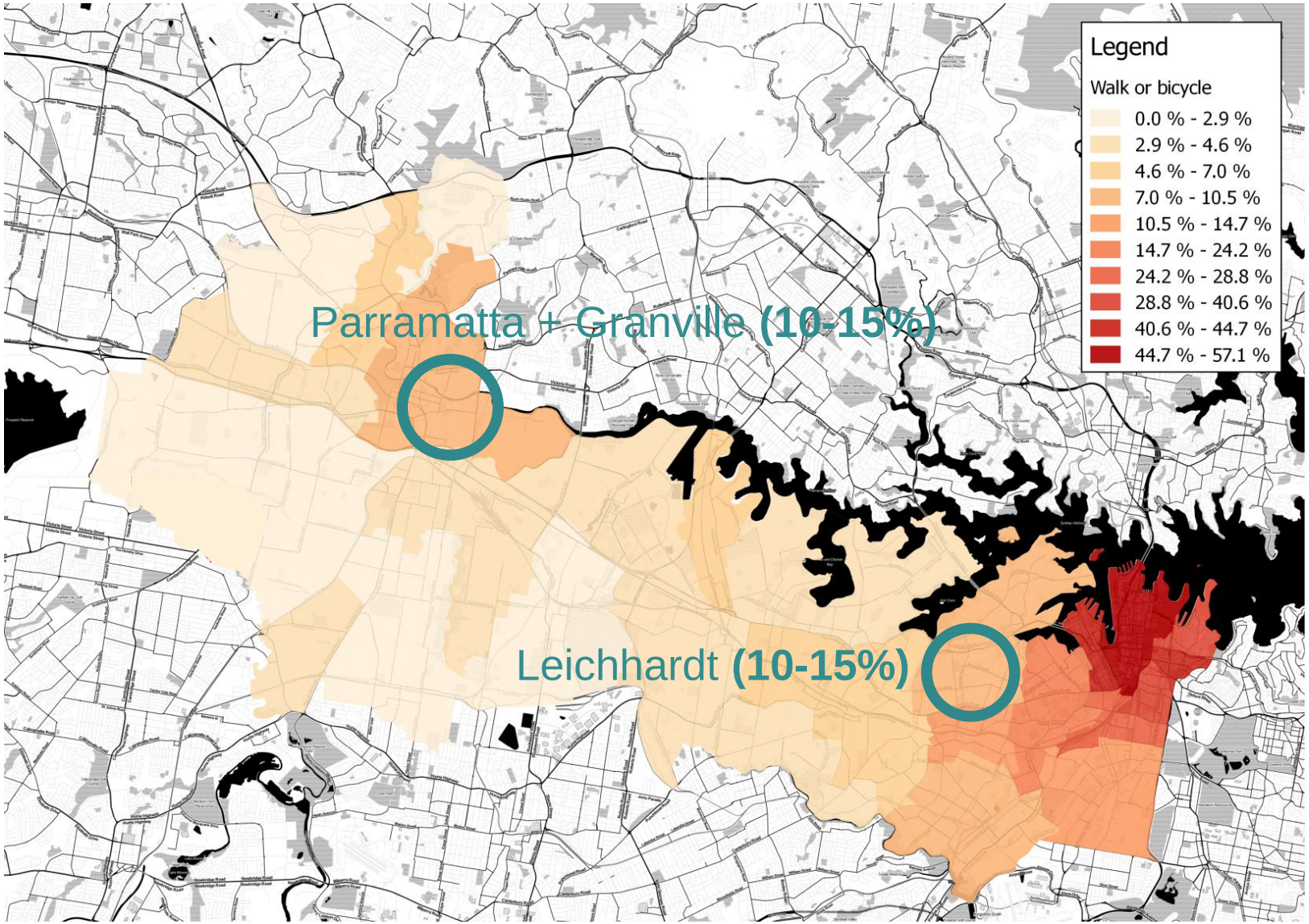

Figure 6: Percent of persons who walk or cycle to work (ABS census 2011)

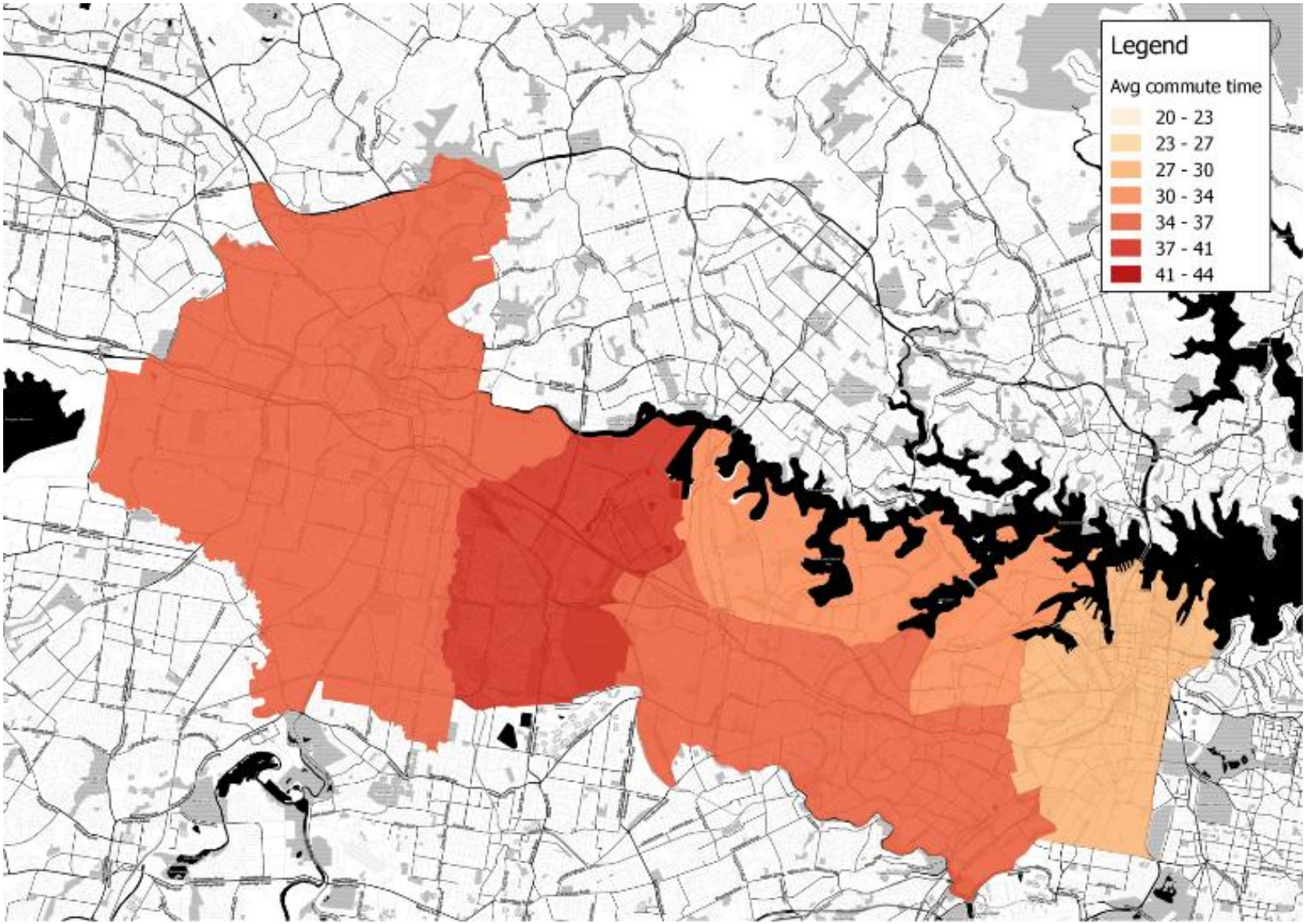

Figure 7: Average commute time in minutes (source: ABS census 2011)

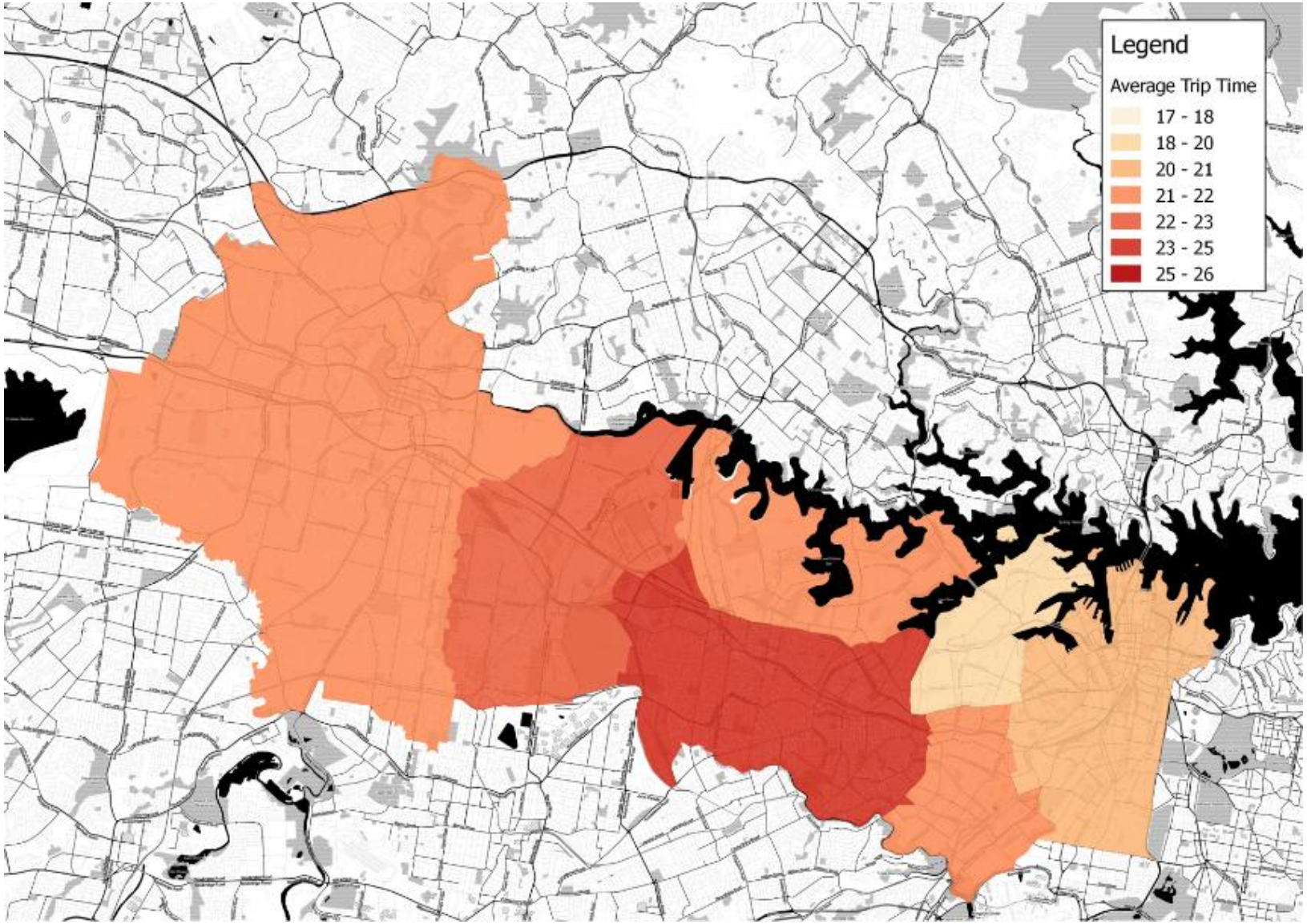

Figure 8: Average trip time in minutes for all tripe (ABS census 2011)

2.2 CLIMATE VARIABILITY AND TRENDS

Urban centres are hotter than their rural surrounds because dark roofs, car parks, paved areas and roads absorb and keep heat in the area. Lack of shade and high density buildings trapping heat increase the effect. This is intensified in areas like Western Sydney that do not have access to coastal breezes or nearby large bodies of water whose thermal mass serve to regulate temperature. Analysis of temperature records over the last 40 years shows that Western Sydney has seen a rise in annual temperatures above that experienced in coastal parts of the city (**Figure 9**). Residents of Blacktown, Richmond, Camden, Liverpool and Parramatta have all experienced this effect: the gap between coastal and Western Sydney temperatures has widened, and the number of extreme hot days has increased in the west[2].

From a climate projection perspective, the Corridor is located in the East Coast South sub-cluster. Climate projections published by the Department of Environment in partnership with CSIRO and the Bureau of Meteorology outline the following changes for this sub-cluster:

- Average temperatures will continue to increase in all seasons.
- More hot days and warm spells are projected with very high confidence. Fewer frosts are projected.
- Decreases in winter rainfall are projected.
- Increased intensity of extreme rainfall events is projected.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase.
- A harsher fire-weather climate in the future.

On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

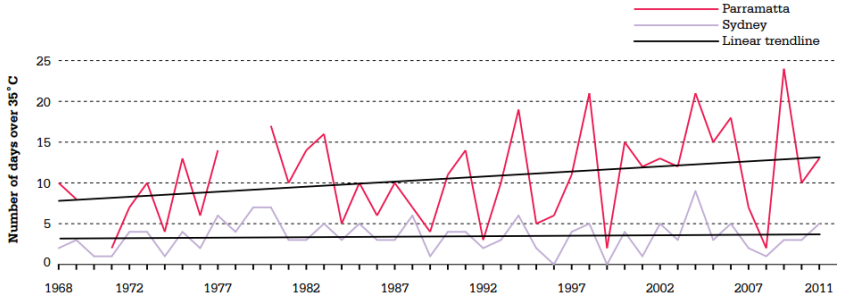

Figure 9: Measured days of 35 degrees for Parramatta and Sydney from 1968 to 2011 (source: BOM)

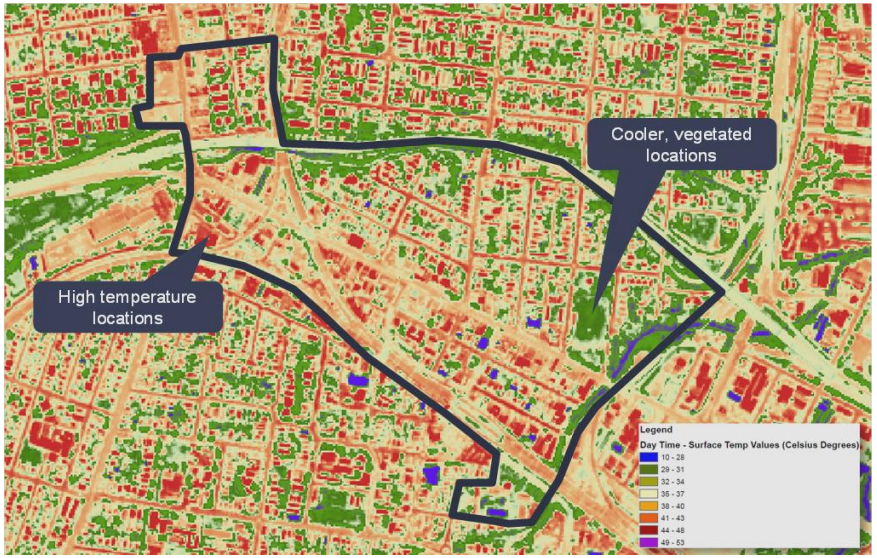

Figure 10: Relative land surface temperature from thermal imagery (aerial imagery acquired on 22/08/2013, 1:35 - 2:21 pm)

[2] Climate Commission, The Critical Decade, NSW Climate Impacts and Opportunities

In addition, Major heat waves are Australia's deadliest natural hazards. Major heat waves have caused more deaths since 1890 than bushfires, cyclones, earthquakes, floods and severe storms combined[3]. People living in urban environments can be more susceptible than non-urban dwellers to the effects of heatwaves as a result of the urban heat island. The urban heat island is effectively the difference between the land surface temperature and the average air temperature. This is caused by the prevalence in cities of heat-absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air, and a lack of shade and green space in dense urban environments.

Studies undertaken by the Parramatta City Council highlight a strong correlation between surface types and vegetation with lower land surface temperatures. Error! Reference source not found. shows the land surface emperature in and around the Granville Precinct in the middle of a spring day, highlighting the temperature variation between vegetated and non-vegetated urban environments.

2.3 COST OF HOUSING AND COST OF LIVING

Affordability is often considered only in the context of the cost of housing. However, when looking at average expenditure, costs associated with private vehicle usage can comparable to mortgage or rental housing costs (see **Figure 11**). Like housing, expenditure on transport is highly context specific.

It is also important to understand how planning for new development can affect household expenditure. For the PRUTP, how buildings are designed and where development occurs will affect household costs related to housing, transport and utilities (energy and water).

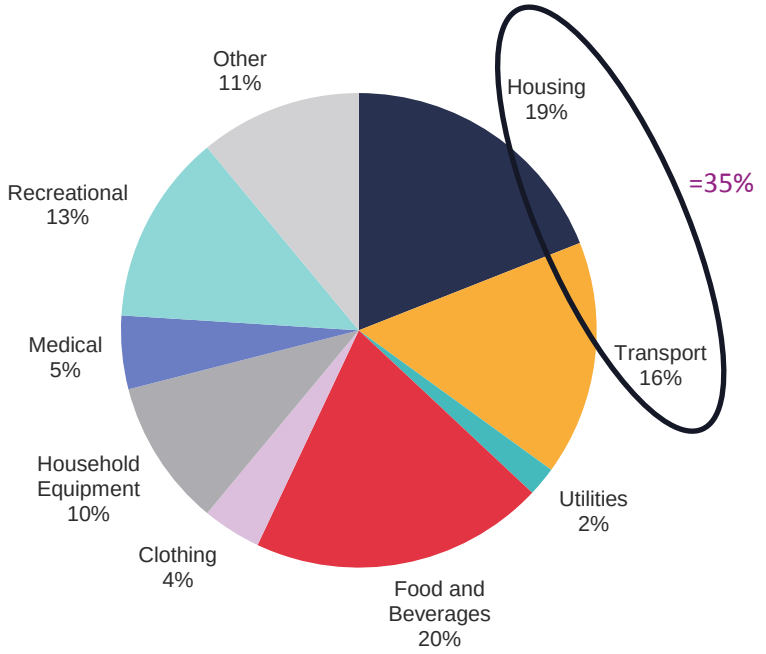

Figure 11: NSW average household expenditure (ABS Household Expenditure Survey 09-10).

[3] Department of Infrastructure and Regional Development (2013) State of Australian Cities

To better understand this variable, housing, transport and utility expenditure analysis was undertaken along the Corridor. Given the availability of data, this analysis was undertaken for each local government area and incorporated the following:

- Housing costs were calculated based on the purchase of a home at the median house and unit sales price in the LGA for the last 12 months, assuming 5% deposit, 30 year loan, 5% interest rate.
- Transport costs were calculated based on existing car ownership and travel patterns (car use and public transport use) in the LGA.
- Utility costs were calculated based on existing average energy and water consumption for the average household in the LGA, assuming current retail tariffs.
- For the purpose of this analysis, all other household expenditure including food, clothing, household items, medical and recreation was assumed to be the same across all areas (based on ABS Household Expenditure Survey).

The results of this analysis are shown in **Figures 12 to 15** showing housing and transport costs separately and as combined results. The results highlight the following:

- The general trend shows high household costs at the eastern end of the Corridor and higher transport costs at the western end of the Corridor.
- Both car ownership rates and travel patterns are a strong indicator of cost of living. After housing, transport is the highest household cost and the ability to affect transport costs can drive significant affordability outcomes.
- Utility costs are low when compared to housing and private vehicle ownership costs. However, significant household savings can still be achieved through more efficient housing design.

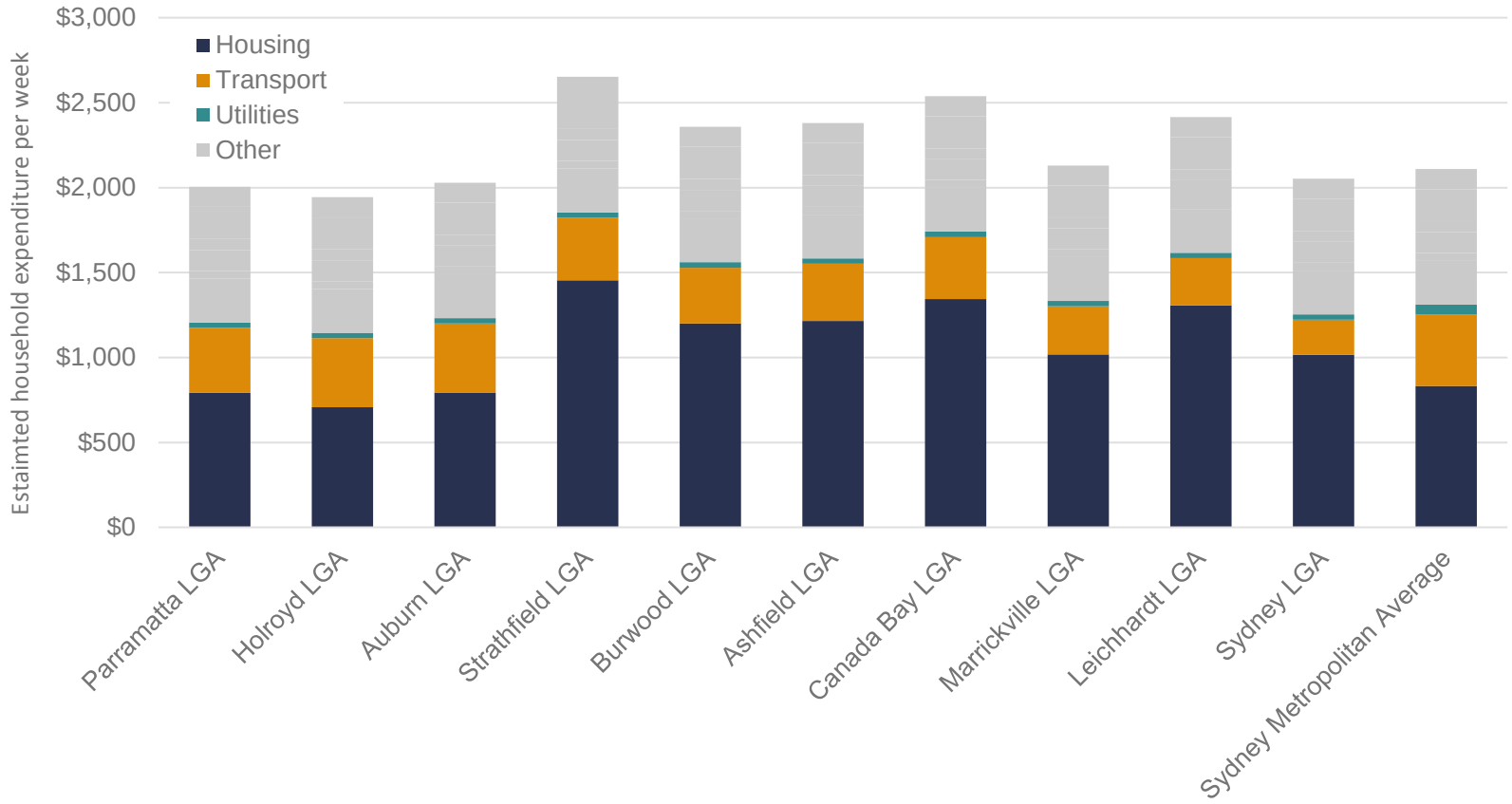

Figure 12: Estimated household expenditure highlighting housing, transport and utility costs compared to other expenses

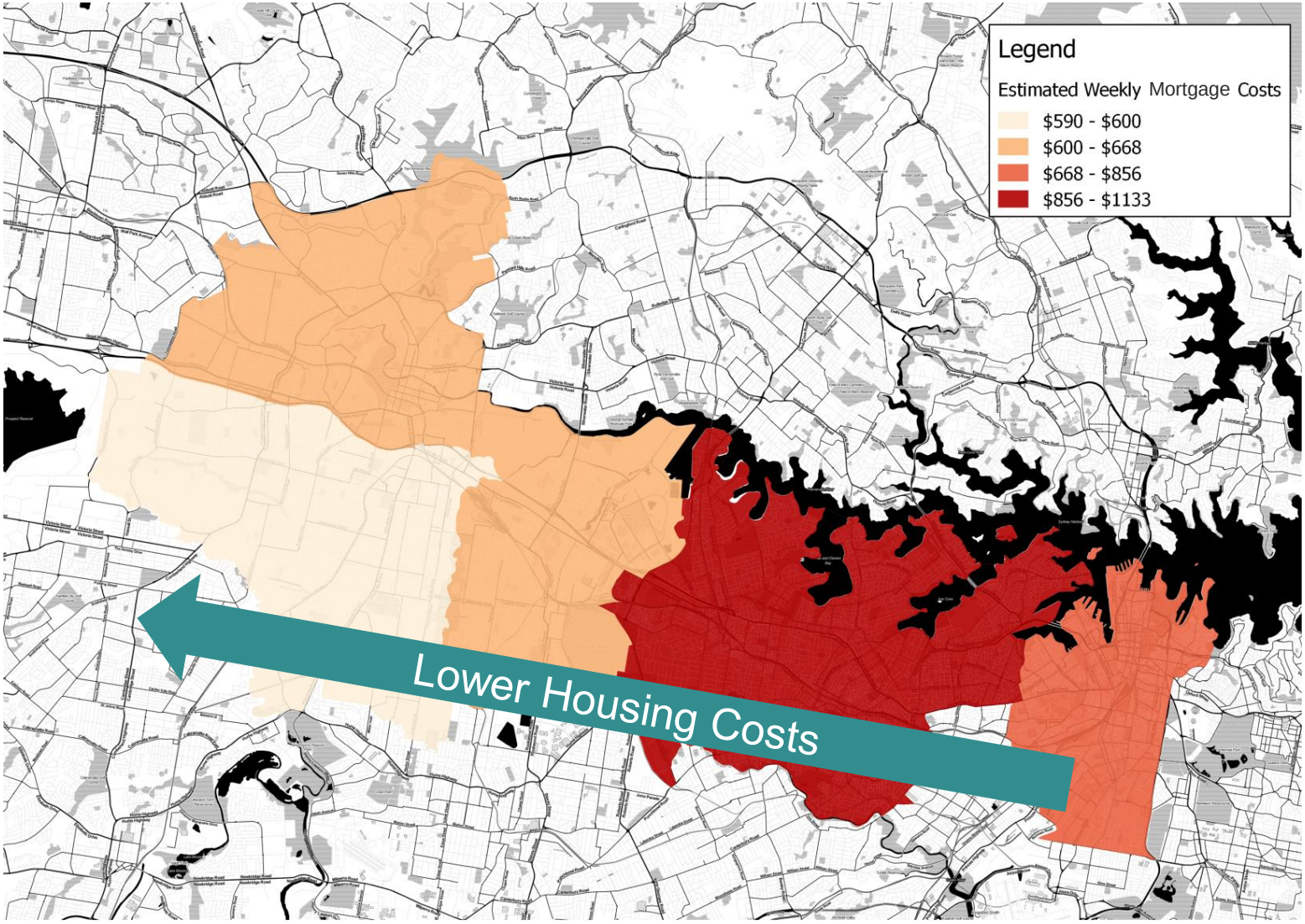

Figure 13: Estimated weekly mortgage costs based on based on the purchase of a home at the median house and unit sales price in the LGA

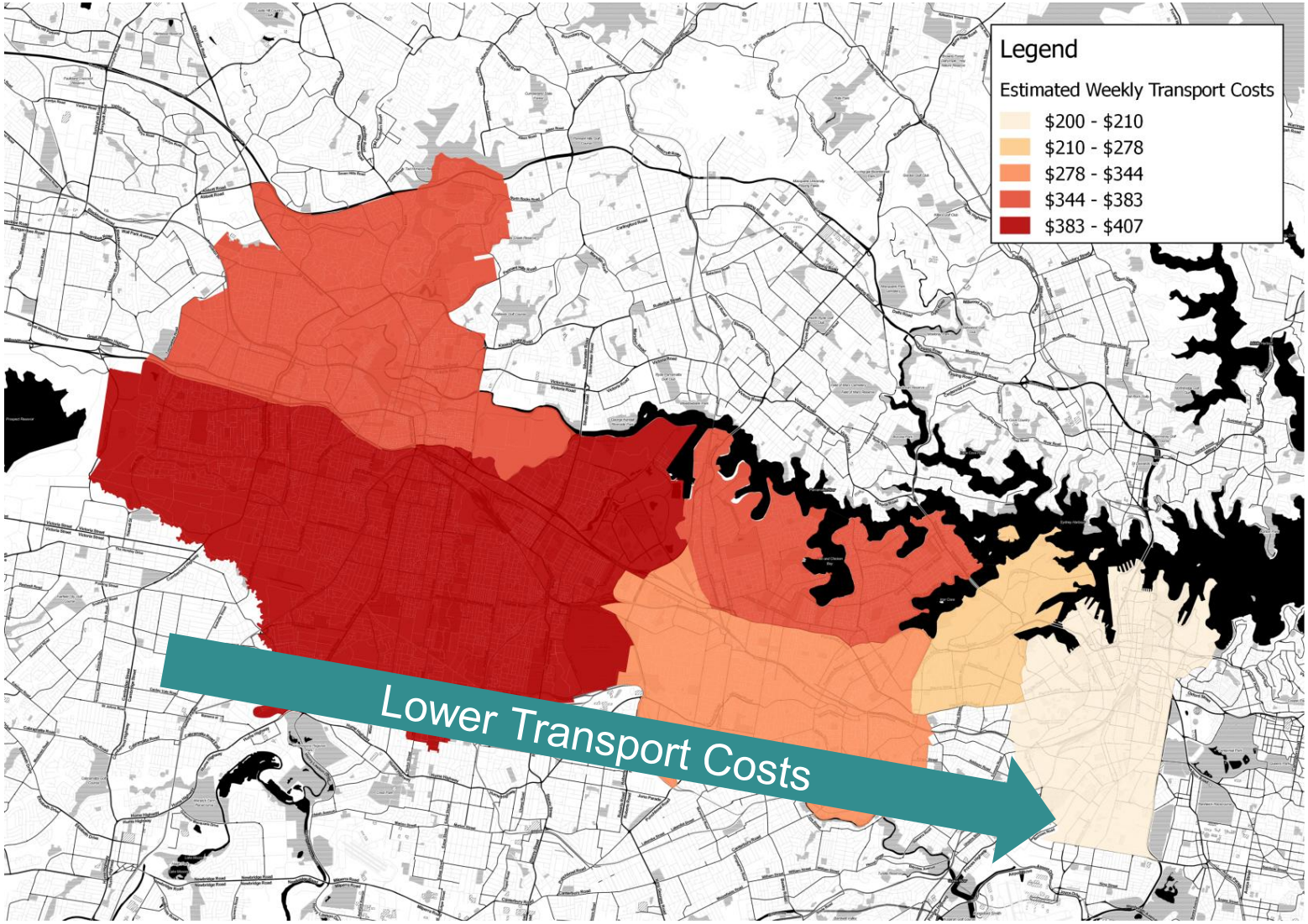

Figure 14: Estimated weekly transport costs based on existing car ownership and travel patterns (car use and public transport use) in the LGA

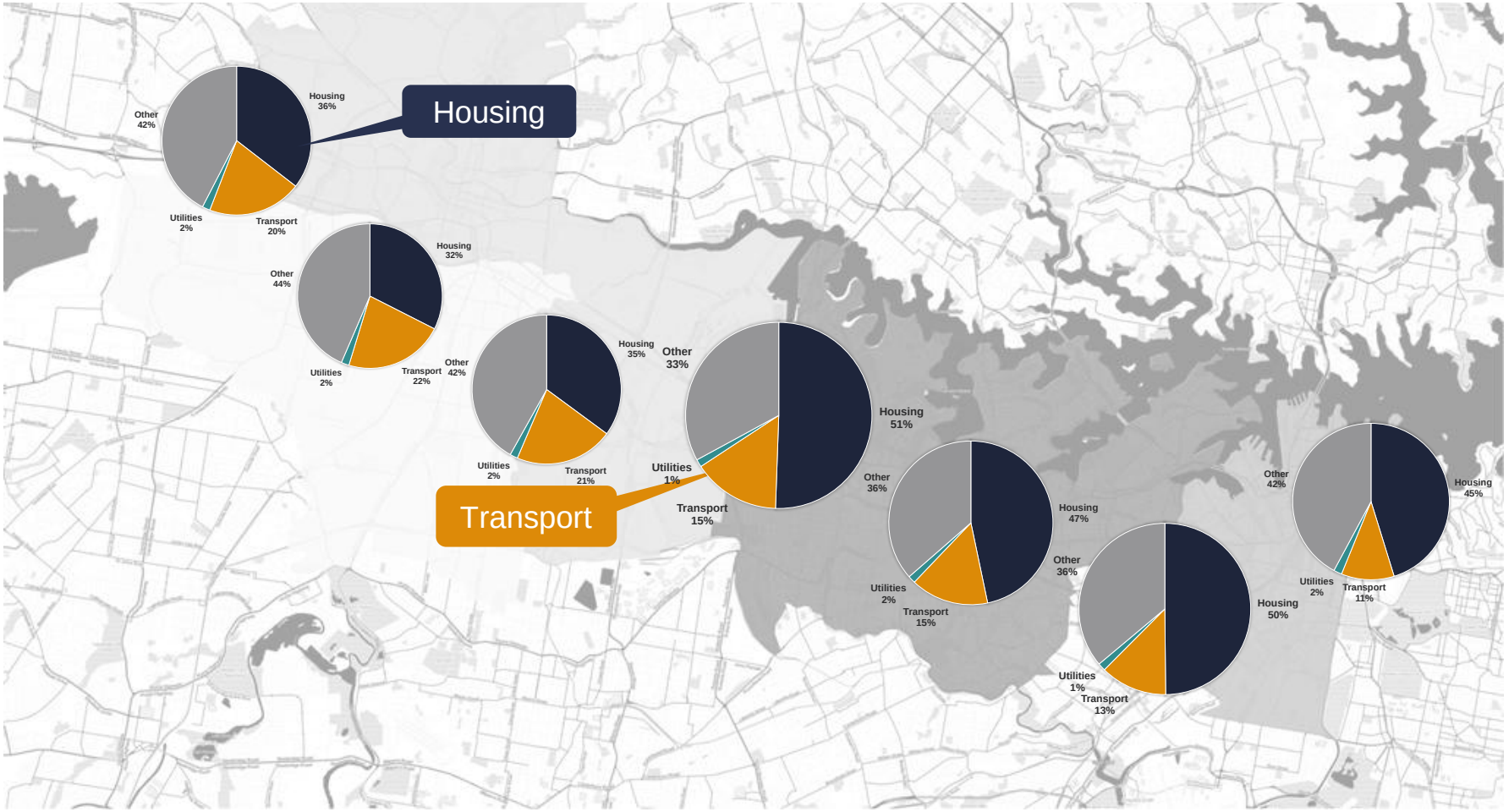

Figure 15: Relative household expenditure along the corridor highlighting housing, transport and utility costs compared to other expenses

3. Quantifying the Benefits of PRUTP

PRECINX has been applied to the PRUTP as the basis from which UrbanGrowth NSW can determine potential future strategies that could be implemented by Councils or the DPE when carrying out future strategic or statutory planning processes. The suite of potential strategies have been measured to determine whether they would deliver a tangible benefit or improvement.

Through workshops and discussions with the IPT, there was clear consensus that the PRUTP should seek to delivery "liveable communities" along the Corridor. Significant research has gone into defining indices and measures of liveability. Drawing on these previous studies, the following definition is used to define liveability:

"Liveability is the sum of the aspects that add up to the quality of life of a place, including its economy, amenity, environmental sustainability, health and wellbeing, equity, education and learning, and leadership".

A significant body of local and international work exists on community indicator frameworks to support the delivery of liveable communities. A high level desktop review of these frameworks identifies a number of key themes that relate to establishing a liveable community:

- Quality of life
- Built and natural environment
- Economic prosperity
- Access and opportunities
- Adaptability and flexibility

For the PRUTP, it is important to recognise the realistic and tangible outcomes that could be achieved. The IPT therefore developed a series of principles under the following key themes that relate to delivering liveable outcomes for the Corridor:

Measurable Indicator	Principle Addressed
Land Use Mix within precinct (%)	●
Number of jobs within each precinct (number)	●
Percent of dwelling types within each precinct (%)	●
Estimated percent reduction in vehicle kilometres travelled (%)	● ● ●
Estimated percent reduction in vehicle hours travelled (%)	● ● ●
Estimated car ownership rates (vehicles per household)	● ●
Potential car share take-up rate (%)	● ●
Average walk and wait time to frequent public transport (minutes)	● ●
Kilometres of safe, connected cycle ways within each precinct (km)	● ● ●
Kilometres of safe, connected pedestrian paths within each precinct (km)	● ● ●
Kilometres of green streets with high tree planting and canopy cover (km)	●
Amount of open space (ha)	● ●
Distance to open space (m)	● ●
Estimated greenhouse gas emissions (tonnes CO2-e/person/year)	●
Estimated water consumption (litres/person/day)	●
Percent of water reused/recycled within the precinct (%)	● ●
Estimated peak electricity demand (MW)	●
Estimated peak sewer loads (L/min)	●
Estimated cost of living ($ per household per year)	●

● Diverse Housing and Jobs
● Accessible and Connected
● Community and Places
● Resilient and Sustainable

Table 2: Established measures of success for the PRUTP

- Diverse Housing and Jobs
- Accessible and Connected
- Community and Places
- Resilient and Sustainable
- Deliver, Drive, Facilitate and Monitor Action

Kinesis worked closely with UrbanGrowth NSW to establish measurable indicators for each theme to quantify the outcomes of the project. These indicators are outlined in **Table 2.**

The PRUTP indicators have been used as the principle basis for analysing the benefits of the precinct plans along the Corridor and helping to identify key sustainability and infrastructure strategies to improve the liveability outcomes for PRUTP. This analysis is provided in the following sections of this report.

4. Precinct Analysis

For each Precinct along the Corridor, scenario analysis has been performed using the strategic infrastructure and urban design tool PRECINX. PRECINX is used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models.

Land use and development scenarios have been developed and provided by Cox Richardson Architects and Planners for each of the Precincts along the Corridor. In order to better understand the outcomes of the proposed Precinct Plans, Kinesis has adopted the assumptions listed below for modelling purposes. It should be noted that the assumptions do not have a significant impact on the strategies or results outlined in this report.

Drawing on the precinct plan information provided by Cox Richardson Architects and Planners, analysis was undertaken across each of the measures of success and indicators outlined in the previous section for two key scenarios:

1. PRUTP Base Case Scenario

- Estimated dwelling and floor space as provided by Cox Richardson Architects and Planners.
- Parking rates based on existing local parking ratios.
- All new development was modelled to meet BASIX and Section J building compliance.

2. PRUTP Optimised Scenario

- Drawing on the results of the Base Case Scenario, Kinesis identified a series of interventions and opportunities for each scenario to deliver optimised outcomes for the PRUTP.
- These interventions are:

1. **High Performance Buildings**
2. **Reduced and decoupled strategic parking**
3. **Urban Resilience and Infrastructure Delivery**

The key interventions and opportunities explored in the Optimised Scenario are outlined below.

4.1 PRECINCT ANALYSIS RESULTS

The results of the Base Case Scenario and Optimised Scenario analysis are documented for each precinct in Section 6 of this report. When reviewing these results, several comparisons can be made in the analysis of the indicators:

- ***Are we making the city better or worse***, this can be measured against what exists (Existing Scenario) and the Sydney Metropolitan Average.
- ***How does the PRUTP enable better outcomes***, this can be measured against the Base Case which highlights the performance of the PRUTP if development was delivered under current controls and the additional strategies outlined in the previous section of this report where not implemented.

4.2 HIGH PERFORMANCE BUILDINGS

Development along the Corridor will see significant growth in low, mid and high rise apartment living. Over 65% of dwellings are expected to be located in high or medium high rise residential building and apartment living is often seen as more sustainable than single houses, given the proximity to transport and services.

However, studies have shown that at a building level, energy consumption per person can be greater in high-rise apartments due to large common area energy demands associated with underground parking and common area lighting and ventilation demands[4]. This energy demand is often a significant component of residential apartment strata fees and provides a significant opportunity for both energy and cost savings for residents. In addition, high density development has limited potential for local energy generation from solar as the roof area to energy demand ratio is low.

Water demand, on the other hand, is typically lower in high density buildings as there is little demand for garden irrigation. At the same time, however, high density development has little opportunity to collect and reuse rainwater as the roof area to water demand ratio is low.

In addition, strata buildings are typically more challenging to retrofit than single dwellings due to multiple owners and the long, complex decision-making processes associated with strata buildings.

To address this, the environmental performance standard can be cost-effectively improved such that new buildings have a significantly higher performance at the start of their life. This is currently addressed by BASIX, requiring new buildings to be designed to achieve a 40% reduction in water demand and a 20% to 40% reduction in stationary greenhouse gas emissions. Recent trends in both energy consumption and new development specifications have highlighted the ability for these targets to be more stringent to drive excellence in building performance and deliver more sustainable, resilient and affordable building outcomes.

This can be seen in following three key areas:

1. **Current average consumption is approaching BASIX targets**. Residential electricity and gas consumption has, on average, reduced in recent years due to price signals, appliance and lighting efficiency and solar PV. The current average Sydney resident's stationary greenhouse gas emissions are approximately equivalent to BASIX Energy 25, i.e. existing homes perform the same as a new home that meets the BASIX Energy targets for mid-rise development.

2. **Recent developments are achieving beyond BASIX compliance.** Since the introduction of BASIX, Sydney has seen an increasing trend in over-compliance, particularly in BASIX Energy, i.e. new developments are achieving higher BASIX targets. In 2013/14, over 60% of new dwellings exceeded minimum requirements with BASIX Energy targets, with 23% exceeding by 8 or more points (**Figure 16**), reflecting the building industry's capacity and willingness to deliver high performance building outcomes.

3. **Local Councils are driving higher performance standards**. Councils have established planning controls that provide incentives to developments that exceed BASIX compliance. Bankstown Councils LEP 2001, Clause 30A provides for a FSR Bonus of 0.5:1 in the Bankstown CBD where developers can demonstrate that commercial buildings achieve 5-star NABERS Energy rating and 4.5-star NABERS Water rating and residential buildings achieve 10-point increase for BASIX Energy and BASIX Water 60 (see Case Study below).

[4] Myors et al (2005) Multi Unit Residential Building Energy and Peak Demand Study (http://www.transgrid.com.au/network/nsdm/Documents/Multi%20Unit%20Investigation%20Summary%20Report.PDF)

Given this context, best practice technology and design strategies were analysed by PRECINX to determine appropriate performance standards for new development along the Corridor. These strategies are equivalent to the following performance standard outcomes:

Residential buildings

- BASIX Energy: increase current target by up to 20 BASIX points
- BASIX Water: increase the target to 60

Non-Residential buildings (greater than 2,000m²)

- NABERS Energy: minimum 5-star performance
- NABERS Water: minimum 5-star performance

BASIX was always envisaged to be spatially and typology relevant. This is evidenced by the existing variation in targets between climate zones (for water) and typologies (for energy). Further, the original thinking behind BASIX was that it was envisaged to interact with land use and transport infrastructure. PRUTP is the project to enable this.

Given the scale of development, it is recommended that a higher BASIX and increased NABERS target should be considered in line with the analysis outlined in this report.

CASE STUDY
Linking Environmental Performance to Development Incentives

Clause 30A of Bankstown Local Environmental Plan (LEP) 2001 provides for Floor Space Ratio (FSR) Bonus of 0.5 on the FSRs allowed under the Local Area Plan for the Bankstown CBD on the condition that they achieve the following environmental design standards:

Residential component of a building:

- Energy target is a minimum 10-point increase in the BASIX score compared to current requirements.
- Water target is a minimum BASIX 60.

Non-Residential component of a building:

- Energy target is a maximum 135 kg of CO2/m2 per year (equivalent to a 5-star NABERS rating for commercial buildings)
- Water target is a maximum 0.47 kL/m2 per year for office (equivalent to a 4.5-star NABERS rating for commercial buildings)

As the FSR Bonus will increase the size of new buildings this will lead to increased environmental impact, in terms of increased greenhouse gas emissions from energy consumption and increased water consumption. The environmental performance standards established by Council seek to offset the impact of the increased floor space so that buildings which receive the FSR Bonus have the same environmental performance as buildings which do not.

Scenario	Energy	Water	Transport
Base Case	• BASIX Compliance • Section J Compliance	• BASIX Compliance • Section J Compliance	• Local existing parking controls
Optimised (Low Density)	• Improved thermal performance • Improved A/C efficiency • Improved appliance and hot water efficiency • Renewable Energy (Solar PV)	• Improved fixture and appliance efficiency • Rain tanks for rainwater re-use	• Reduced parking rates (average 0.5 spaces per dwelling) • Car share provision (approx. 20% take-up)
Optimised (High Density)	• Improved thermal performance • Improved A/C efficiency • Improved appliance and efficiency • Cogeneration for hot water • Renewable Energy (Solar PV)	• Improved fixture and appliance efficiency • Recycled water for internal and external uses coupled with significant public and building level green infrastructure	• Reduced parking rates (average 0.5 spaces per dwelling) • Car share provision (approx 20% take-up)

Table 3: Outline of the strategies modelled for PRUTP

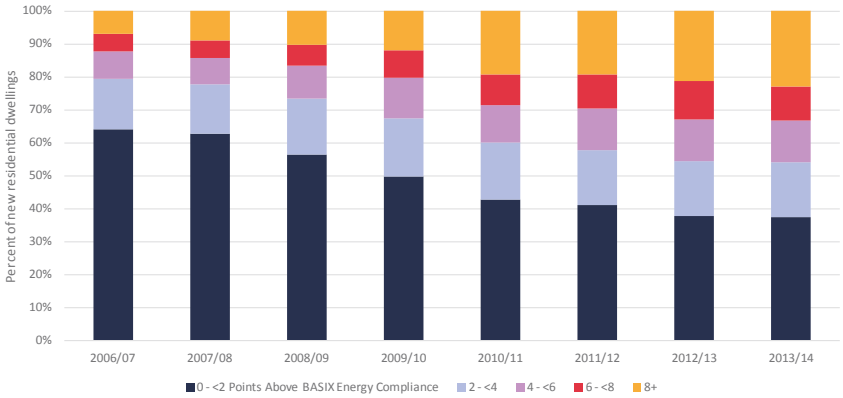

Figure 16: Annual BASIX Energy Compliance scores for new dwellings across the Sydney Metropolitan Region (NSW Department of Planning, 2015)

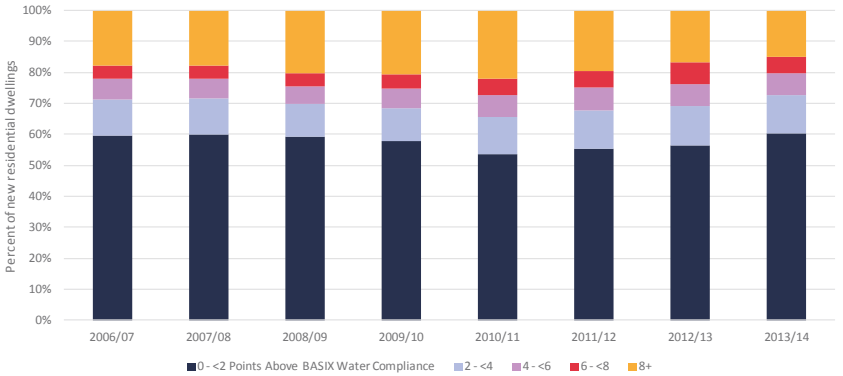

Figure 17: Annual BASIX Water Compliance scores for new dwellings across the Sydney Metropolitan Region (NSW Department of Planning, 2015)

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4.3 REDUCED AND DECOUPLED STRATEGIC PARKING

Metropolitan trends in car ownership and the desire for more walkable and urban environments lend themselves to a different approach to car ownership, parking and mobility strategies:

Analysis along the Corridor highlights that there is already an existing market for low car ownership with some areas having 30% to 40% of households without a vehicle (**Figure 18**). This is particular significant in major centres and areas with close proximity to public transport.

The RMS update to Guide to Traffic Generating Developments (2013) surveyed 10 high-rise residential buildings around Sydney that were close to public transport, greater than six storeys in height and almost exclusively residential in nature. Whole only a small sample, this survey showed an oversupply of car parking compared to demonstrated demand for car parking in all the surveyed high-density residential buildings[5].

At a metropolitan level, 1 in 4 people aged 18 to 35 do not have a license or own a car (BTS, 2009).

Both car ownership rates and travel patterns are a strong indicator of cost of living. After housing, transport is the highest household cost. The general trend shows high housing costs at the eastern end of the Corridor and high transport costs at the western end of the Corridor.

Currently, approximately 8% of City of Sydney residents are car share members. This is as high as 20% in high density, highly accessible locations such as Darlinghurst and Surry Hills.

Planning for the Precincts has the opportunity to achieve similar outcomes and therefore should consider how to accommodate and leverage off the above trends.

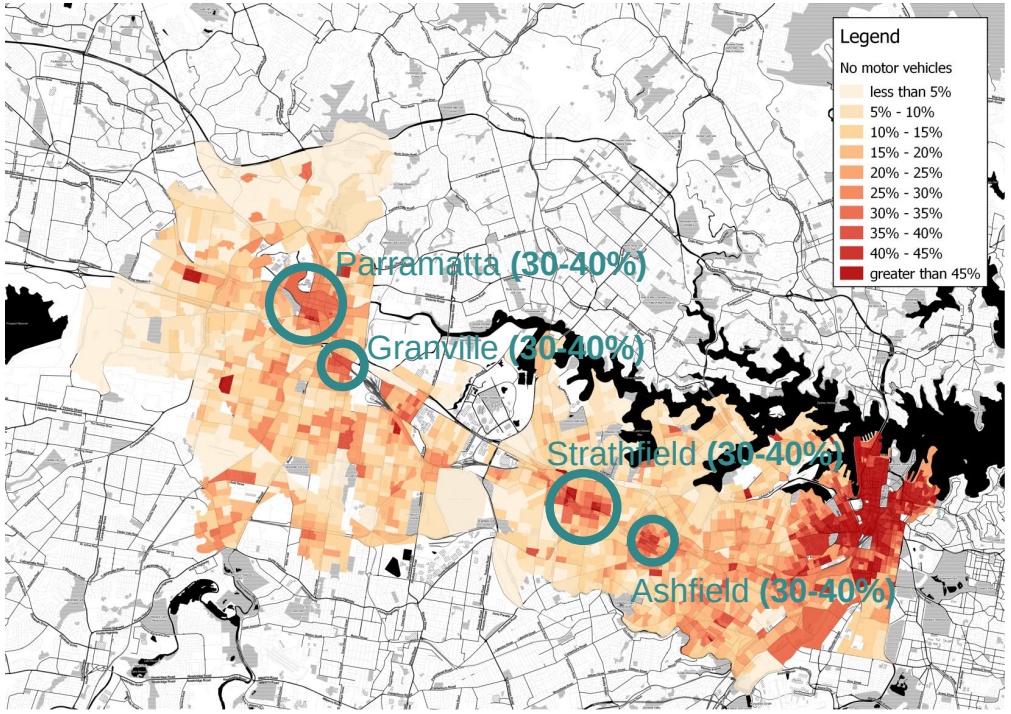


Figure 18: Percent of housing with no vehicles (Source: ABS Census 2011)

[5] RMS (2013) Update Traffic Surveys
http://www.rms.nsw.gov.au/trafficinformation/downloads/td13-04a.pdf

4.2.1 A Different Approach to Parking

Based on the accessibility, density and mix of use proposed for each Precinct, a different approach to parking could be pursued which seeks to achieve the principles of the PRUTP and delivers the outcomes sought for the Corridor. This strategic approach to parking and mobility incorporates the following elements:

Reduced Parking Ratios

Under current planning controls, it is estimated that the Corridor will see a ten-fold increase in the number of local vehicles. The Optimised PRUTP Scenario adopts average parking rates of 0.5 spaces per dwelling, reducing local parking and vehicles to approximately half of that under the Base Case. The immediate benefits of lowering parking rates are significant:

- Reduced vehicle traffic within the precinct;
- Lower construction costs associated with excavation and construction of underground parking;
- The sales price of a new apartment could be reduced by $50,000 to $70,000 by reducing its parking by one space;
- Less energy demands for parking lighting and ventilation would equate to lower compliance costs with BASIX Energy Targets and lower energy costs for an apartment body corporate; and
- The reduction in parking provides a business case for private investment in the provision of car share.

Decoupled Parking

To mitigate the risk of providing low off-street parking ratios, decoupled, adaptable and temporary car parking strategies are recommended.

Council or privately owned and operated parking stations at the periphery of each Precinct (as opposed to the centre) would address short term parking needs and enable the potential need for individual developments to supply car parking on-site. This would also minimise the impact of traffic in the Precinct and help support a gradual change in travel behaviour and patterns. This could be funded by a development fee in lieu of providing parking on-site, if considered appropriate.

Flexible Parking Ratio Provision

Generally parking ratios are established per dwelling. In addition to parking being managed more efficiently at the precinct level, parking provision can also be managed more efficiently at the building level.

Establishing parking rates for different dwelling types but allowing the provision to be disaggregated across a building will allow development to distribute the total delivered parking to different typologies allowing for a higher mix of housing with, for example, 2 parking spaces provided for some 3 bedroom apartments and no parking for some 2 bedroom apartments. The total provided parking would remain the same.

Parking Design Considerations

Several parking design considerations should be incorporated into the planning and development of both decoupled and on-site parking across each Precinct:

- Parking could be provided above ground and sleaved as a buffer to retail, commercial and residential development (**Figure 19**) as an appropriate response to environmental constraints such as noise or economic influences. This approach could be designed with appropriate floor to ceiling heights to enable transition to other uses over time as and when required. For example, if there is an identified long term potential to accommodate a new supermarket and specialty retail premises, above ground and sleaved parking would future proof land and provide an interim use (car parking). This could then be

decommissioned relatively easily when economic and market conditions support the introduction of the aforementioned retail space.

- Standalone above ground parking can also be designed to be flexible both in its current use (used for other community uses) or repurposed for other uses over time as parking requirements are reduced. For example (**Figure 20**), in Florida design firm, Herzog & de Meuron, demonstrated how a parking area could be adapted and eventually restricted into a community space, when a critical mass in the population had been achieved, and sufficient alternative public and active transport modes were available. Construction standards would need to incorporate appropriate floor to ceiling heights to enable the facility to be repurposed over time to and alternate use.

Car Share

Car share provides an alternative to traditional car ownership, allowing residents or businesses to use a shared vehicle fleet. Car share relies on the restriction of parking and car ownership in areas of high public transport and mobility choice, and is considered an additional strategy that could be explained as a means of supporting the transition to low car use and car ownership rates.

USING PARKING TO SLEAVE DEVELOPMENTS ALONG PARRAMATTA ROAD

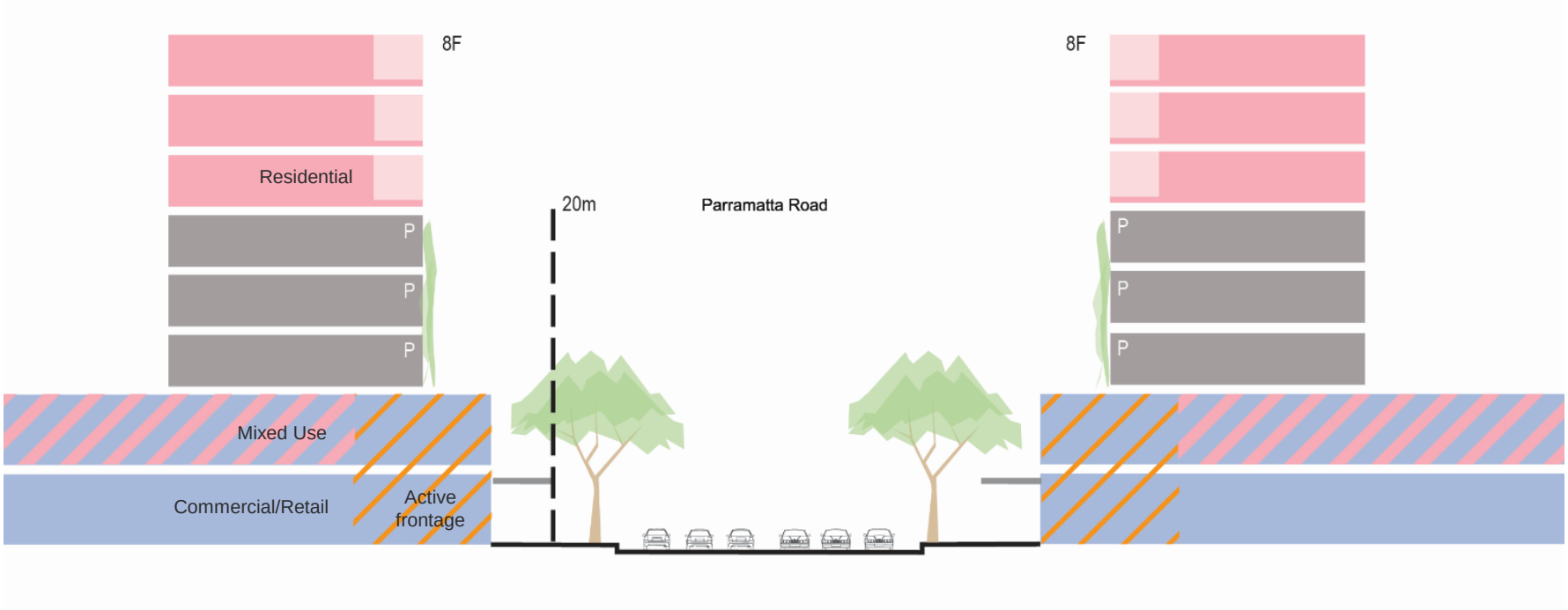


Figure 19: Using above ground parking to buffer residential development from Parramatta Road (20m noise boundary)

DESIGNING ABOVE GROUND PARKING AS AGILE, FLEXIBLE SPACE

Figure 20: 1111 Lincoln Road – designer built above ground parking for multiple use spaces (Miami, Florida)

4.4 URBAN RESILIENCE AND INFRASTRUCTURE DELIVERY

Under each Precinct Plan the number of dwellings and jobs is expected to increase considerably which will drive an increase in population. If developed under current building performance stands (BASIX and Section J), significant infrastructure upgrades for electricity, water and sewer will be required to support the increase in total and peak demands. High efficiency buildings, local energy generation and recycled water or rain water re-use would reduce the need for infrastructure upgrades.

The purpose of this strategy is to:

- Assist in the delivery of high performance building and precinct outcomes.
- Reduce the need for significant infrastructure upgrades along the corridor, in particular electricity peak demand and sewer augmentation; and
- Create resilient urban centres that support the improved public domain outcomes identified along the Corridor.

4.4.1 Resilient Infrastructure Delivery

This strategy effectively decouples public domain from potable water. While water reuse has traditionally been considered as a water conservation objective, recycled water from black and grey wastewater provides the opportunity to flip this goal on its head. In addition, urban renewal should seek to deliver a resilient and cool urban environment and public domain – an urban oasis that is cooler, more comfortable and more walkable on hot summer days.

Climate projections from CSIRO and the Bureau of Meteorology (BOM) highlight the need to build climate resilience into sustainable communities and for Granville, future projections estimate that average temperatures will continue to increase in all seasons and more hot days and warm spells.

Increased open space, green infrastructure and networks provides the potential to improve resilience against a changing climate and, furthermore, the effects of urban heat island. When compared to an un-vegetated public domain, a well-managed, lush tree canopy can reduce land surface temperature by up to 15 degrees on a 35 degree day.

Each Precinct has identified streets for reinforced streetscapes which include enhanced green corridors with increased verge planting and WSUD pavements. The delivery of this improved public space with inevitably higher irrigation demands from broad leaf canopy, soft surfaces and green walls and roofs can be effectively linked to recycled water to ensure an unlimited supply of water for this public and private domain.

Further, linking recycled water systems to public domain management enables a liveable, walkable, urban oasis. This is evident at Central Park where the green wall is part of the recycled water system, allowing constant irrigation and high use of treated recycled water on-site (further reducing sewer infrastructure requirements).

The delivery of integrated recycled water and public domain has the potential to deliver the following outcomes:

- Significantly reduce potable water consumption for public space irrigation;
- Reduce electricity consumption and peak infrastructure demands from air conditioning through cooler streets;
- Significantly reduce sewer infrastructure requirements to the Corridor;
- Ensure public domain irrigation demand is not reliant on rainfall patterns and is resilient to future variations in rainfall; and
- Reduce the heat island effect and the impact of heat waves

4.4.2 District Energy

It is clear that there are benefits to be explored in the coupling of district energy solutions with district water recycling and urban regeneration agendas. The analysis for high performance buildings was done agnostic of the way those services are delivered, i.e. building by building or precinct solutions (or combinations of both).

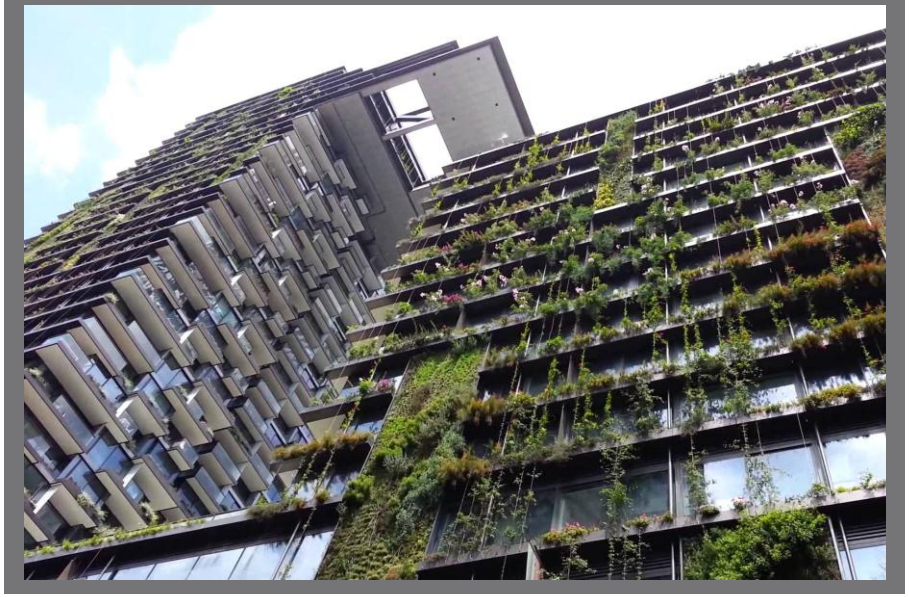
It would be considered prudent to ensure that given the 30-100 year life of these urban assets that they are designed to accommodate both approaches and future proof their owners and tenants against a rapidly changing energy services environment. There are clear examples globally where significant buildings are required to install appropriate services and plant space for ground or roof connection to accommodate the energy services provider of tomorrow.

Case Study – Recycled water and urban green space

Precinct scale recycled water systems are currently in operation in two locations across Sydney:

1. Central Park, currently supplying 1,400 customers with water for irrigation, toilet flushing and laundry use. A private water utility operates and maintains all water related infrastructure across the precinct. The recycled water system is housed in a Local Water Centre, built over four basement levels under the residential buildings. For more information see flowsystems.com.au/communities/central-park-water.

2. Discovery Point, is designed to serve 1,800 apartments, capturing 100% of wastewater from the apartments and non-residential and used for irrigation, toilet flushing and laundry as well as adjacent council parks and sporting fields. For more information see www.metrowater.nsw.gov.au/recycling/australand-discovery-point-wolli-creek.



5. Progressing to Implementation

When considering sustainability interventions, the Draft Strategy's 30+ year outlook will need to be acknowledged. This Report is based on best available data and trends, however it is imperative that the future development of the Corridor incorporates the notion that there will be different demographic, transport, technology and affordability drivers in 30 years.

This report provides a framework of potential opportunities available to the Precincts along the Corridor to deliver world class urban transformation in the short-medium term.

Following adoption of the Draft Strategy, Councils and/or DPE will need to consider whether to pursue the Base Case, or alternatively incorporate some or all suggested interventions under an Optimised Scenario which has the potential to deliver additional benefits above and beyond business as usual outcomes. Councils and/or DPE may also wish to explore additional/alternative interventions beyond those explored within this Report.

It is recommended that the following issues are considered as part of the future implementation of the Draft Strategy and the recommendations of this Report.

5.1 Transitional and Adaptable Space

Existing Council land and assets, such as parking stations, present the opportunity to be repurposed as future open space to meet the needs of future population and employment growth. Parking assets should therefore be managed as transitional facilities and adaptable multi-use spaces that are capable of housing decoupled parking, precinct energy or water infrastructure, as well as open space. If and when parking is no longer required, the full transition to open space could be achieved as illustrated in **Figure 21**.

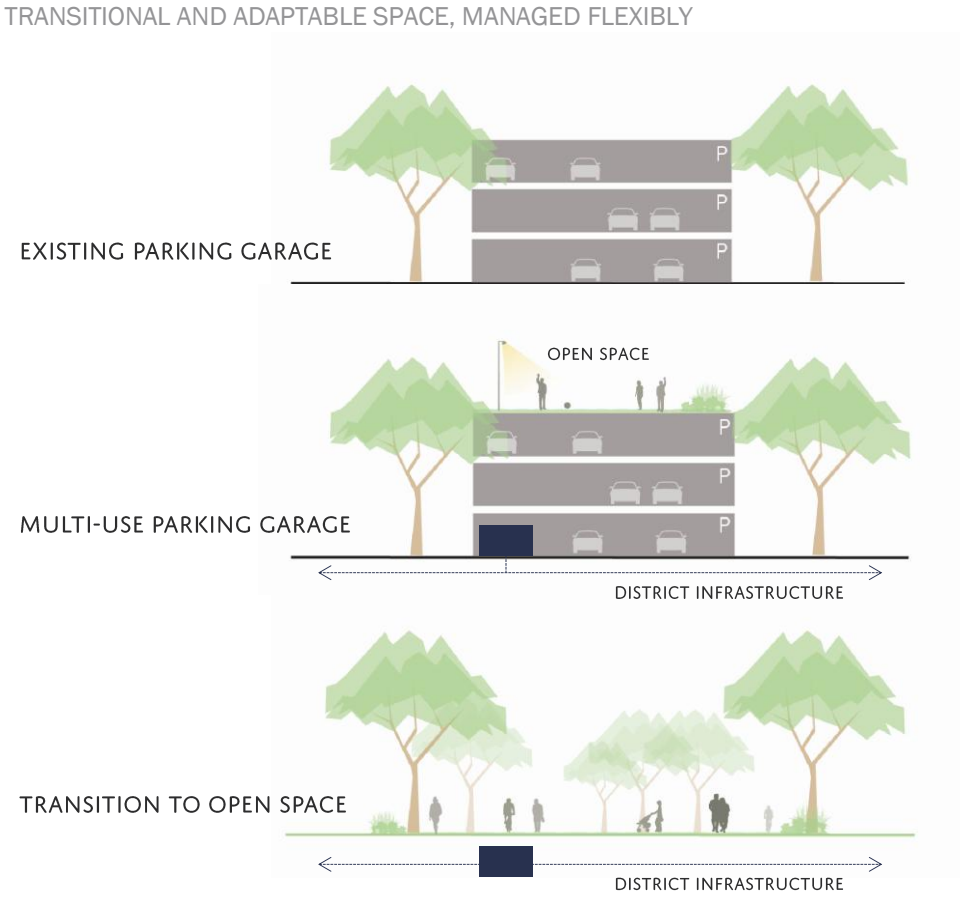


Figure 21: The transition of existing, Council owned, off-street parking to multi-use, transitional and adaptable space.

5.2 Autonomous Vehicles

The emergence of autonomous vehicles will reduce the need for parking and investment in underground parking. In particular, parking stations/basement parking may lose value as vehicles may no longer need to be parked or housed at origin or destination locations.

The strategies outlined in this report seek to minimise underground parking. The emergence of autonomous vehicles should further support the approach to more flexible and agile parking structures that can be adapted over time.

5.3 Continue to Drive New Building Standards

Trends in building performance have shown that current BASIX requirements are no longer driving best practice outcomes. BASIX was always intended to drive incremental improvements over time to ensure new development was always delivering an improvement on existing consumption benchmarks.

As new technologies emerge or become feasible, such as electric vehicles, battery storage and geothermal heating and cooling, building performance standards for residential and non-residential buildings should respond to ensure the benchmark of high performance buildings is maintained through the life of the delivery of the PRUTP. An increase in BASIX targets via a State Government led amendment should be pursued. Alternatively, consideration should be given to increasing BASIX targets on a precinct by precinct basis at the time of rezoning.

6. Performance Outcomes

PRECINX is used as a basis from which UrbanGrowth NSW can measure key components of the PRUTP. Under the four themes and associated principles, 19 indicators were determined for analysis and measurement through PRECINX under the four key Principles:

1. **Diverse Housing and Jobs** to meeting existing and future needs (measured through land use mix, employment and housing provision).

2. **Accessible and Connected** – reshape and better connect places and associated movement networks to better serve customers and encourage more sustainable travel (measured through car dependence, mobility choice, access to public transport and pedestrian and cycling facilities).

3. **Community and Places** – promote quality places and built form outcomes to transform the corridor over time (measured through the provision of pedestrian facilities, open space and street improvements).

4. **Resilient and Sustainable** – create liveable local precincts along the corridor that deliver sustainable, adaptable and resilient communities (measured through greenhouse gas emissions, resource consumption, car dependence and affordability outcomes)

The results for the each Precinct under the Base Case and Optimised scenarios are provided in the following pages of this report.

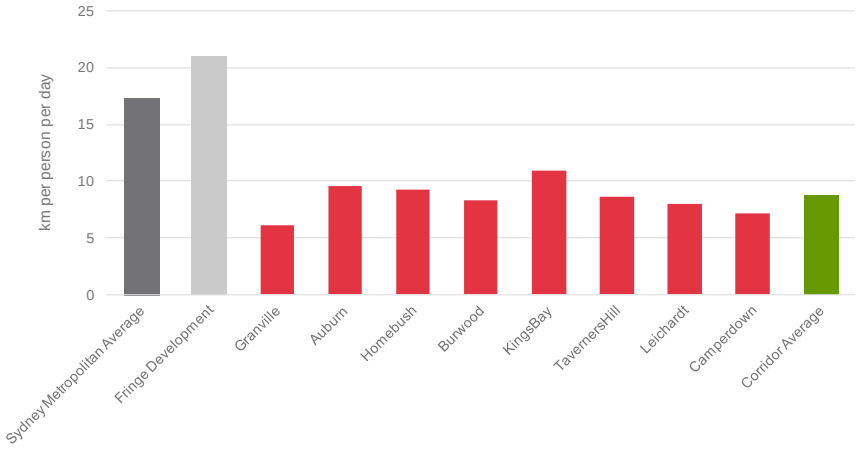
When reviewing these results, several comparisons can be made in the analysis of the indicators:

- ***Are we making the city better or worse***, this can be measured against what exists (Existing Scenario) and the Sydney Metropolitan Average.

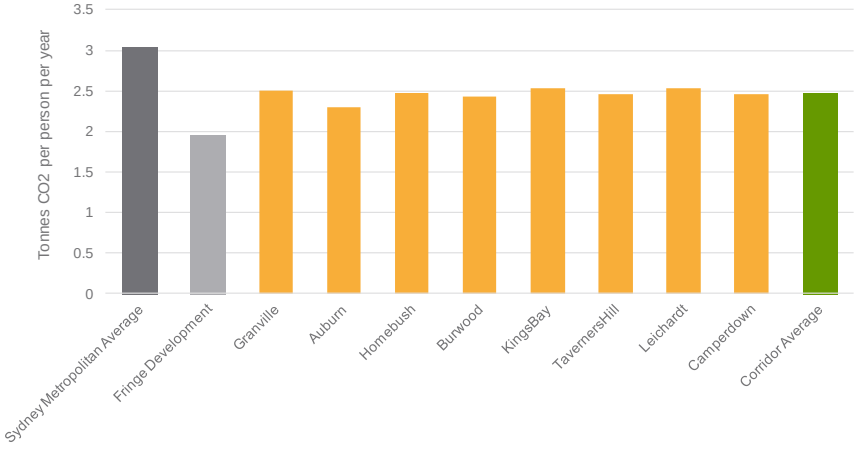
- ***How does the PRUTP enable better outcomes***, this can be measured against the Base Case which highlights the performance of the PRUTP if development was delivered under current controls and the additional strategies outlined in the previous section of this report where not implemented.

6.1 Key Results for the Corridor under the Base Case Scenario

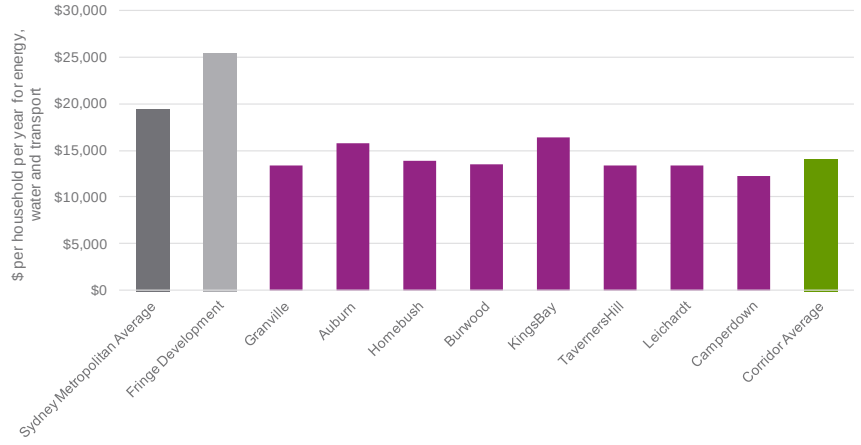
UP TO 60% LESS CAR DEPENDANCE



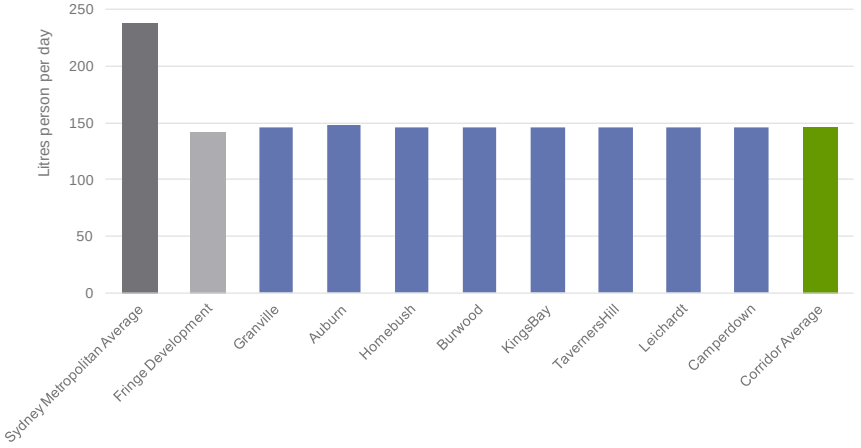
UP TO 25% LESS stationary emissions



UP TO 30% MORE AFFORDABLE LIVING

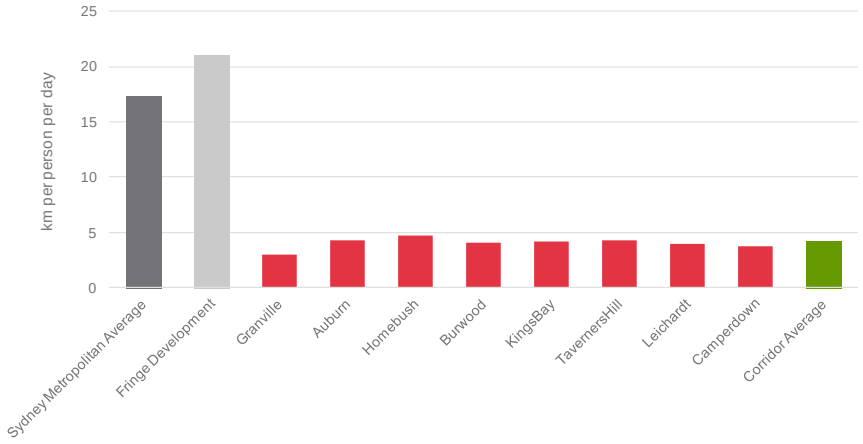


UP TO 40% LESS WATER USE

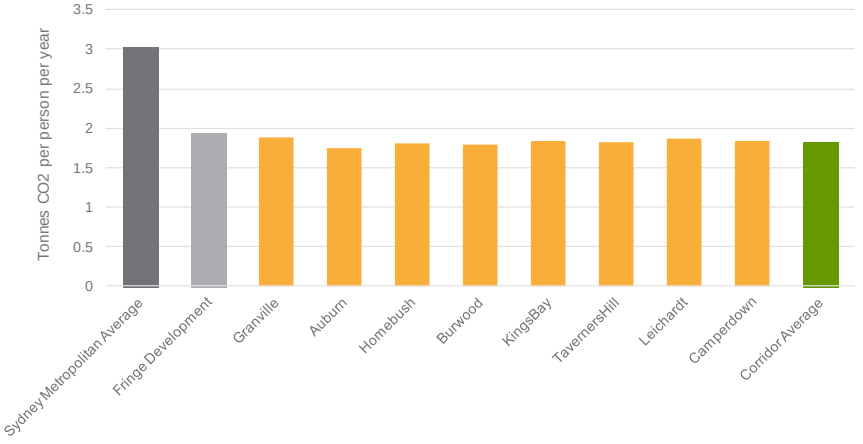


6.2 Key Results for the Corridor under the Optimised Scenario

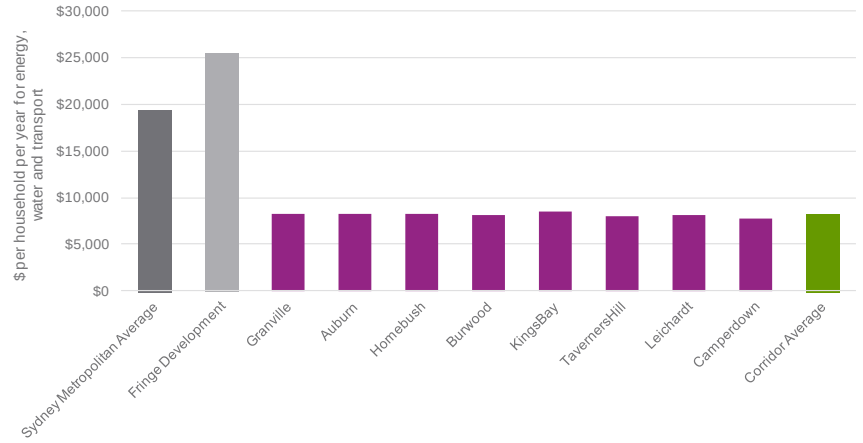
UP TO 70% LESS CAR DEPENDANCE



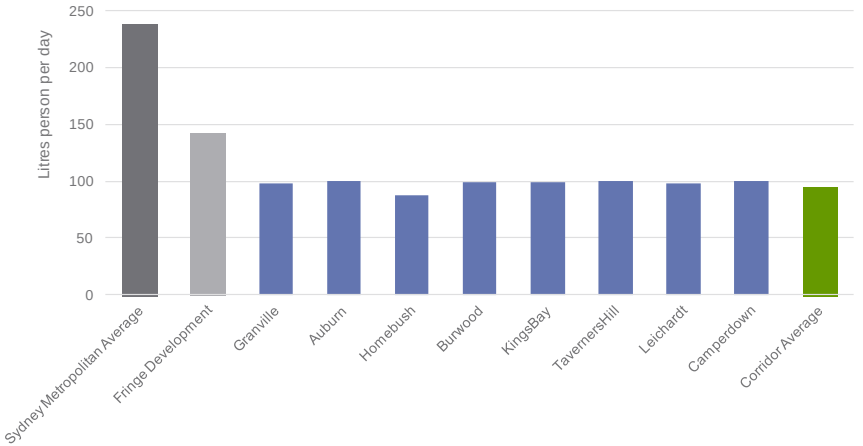
UP TO 40% LESS stationary emissions



UP TO 50% MORE AFFORDABLE LIVING



UP TO 60% LESS WATER USE



GRANVILLE – INDICATOR RESULTS

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.86	0.85	0.85
Estimated number of dwellings	-	500	7,276	7,276
Estimated number of jobs	-	1,470	4,051	4,051
Estimated vehicle kilometres travelled per person/day	20	15	6	3
Estimated vehicle hours per person/week	5.0	4.3	1.7	0.9
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.0	0.5
Car share potential (number of pods)	-	0	70	92
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	0.0	0.0
New pedestrian connections (km)	-	n/a	1.3	1.3
New green corridors (km)	-	n/a	1.7	1.7
Amount of zoned open space (ha)	-	3.1	10.5	10.5
Residential lots within walking distance to a large park (%)	-	74%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.5	2.5	1.9
Estimated water consumption (litres/person/day)	238	249	146	98
Percent of water reused/recycled within the precinct (%)	-	0%	0%	14%
Estimated peak electricity demand (MW)	-	-	28	21
Estimated peak sewer loads (kL/hr)	-	-	349	278
Estimated cost of living ($ per household/year)	$20,800	$18,700	$13,400	$8,200

OPTIMISING GRANVILLE

The Optimised Scenario for Granville would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver:

- **25%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **33%** reduction in potable water consumption;
- **23%** reduction in peak electricity demand and 20% reduction in peak sewer demand; and
- **16%** reduction in household utility costs (energy and water).

2. Car Dependence and Cost of Living

Compared to the Base Case, the Optimised Case would deliver:

- **50%** reduction in car use (kilometres travelled per person per day).
- **45%** reduction in car ownership.
- **47%** reduction in associated household costs.
- The potential for private investment in the delivery of approx. **100** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **23%** reduced peak electricity demand; and
- **20%** reduced peak sewer demand.

AUBURN – SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.00	0.67	0.67
Estimated number of dwellings	-	1,882	2,094	2,094
Estimated number of jobs	-	660	67	67
Estimated vehicle kilometres travelled per person/day	20	14	10	4
Estimated vehicle hours per person/week	5.0	4.2	2.9	1.3
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.2	0.6
Car share potential (number of pods)	-	0	19	25
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	467.0	467.0
New pedestrian connections (km)	-	n/a	3.1	3.1
New green corridors (km)	-	n/a	1.3	1.3
Amount of zoned open space (ha)	-	0.0	0.0	0.0
Residential lots within walking distance to a large park (%)	-	85%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	1.7	2.3	1.8
Estimated water consumption (litres/person/day)	238	n/a	148	100
Percent of water reused/recycled within the precinct (%)	-	0%	0%	16%
Estimated peak electricity demand (MW)	-	-	5	4
Estimated peak sewer loads (kL/hr)	-	-	88	70
Estimated cost of living ($ per household/year)	$20,800	$18,900	$15,800	$8,300

OPTIMISING AUBURN

The Optimised Scenario for Auburn would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver:

- **24%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **32%** reduction in potable water consumption;
- **18%** reduction in peak electricity demand and 20% reduction in peak sewer demand; and
- **21%** reduction in household utility costs (energy and water).

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver:

- **55%** reduction in car use (kilometres travelled per person per day);
- **53%** reduction in car ownership;
- **54%** reduction in associated household costs; and
- The potential for private investment in the delivery of approx. **30** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **18%** reduced peak electricity demand; and
- **20%** reduced peak sewer demand.

HOMEBUSH - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.86	0.59	0.59
Estimated number of dwellings	-	1,025	22,414	22,414
Estimated number of jobs	-	1,760	1,716	1,716
Estimated vehicle kilometres travelled per person/day	20	12	9	5
Estimated vehicle hours per person/week	5.0	2.9	2.3	1.2
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.0	0.6
Car share potential (number of pods)	-	0	204	271
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	2,081.0	2,081.0
New pedestrian connections (km)	-	n/a	5.6	5.6
New green corridors (km)	-	n/a	1.6	1.6
Amount of zoned open space (ha)	-	12.6	16.0	16.0
Residential lots within walking distance to a large park (%)	-	63%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.3	2.5	1.8
Estimated water consumption (litres/person/day)	238	n/a	146	88
Percent of water reused/recycled within the precinct (%)	-	0%	0%	22%
Estimated peak electricity demand (MW)	-	-	60	42
Estimated peak sewer loads (kL/hr)	-	-	910	608
Estimated cost of living ($ per household/year)	$20,800	$18,300	$13,900	$8,300

OPTIMISING HOMEBUSH

The Optimised Scenario for Homebush would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver

- **26%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **39%** reduction in potable water consumption;
- **30%** reduction in peak electricity demand and 33% reduction in peak sewer demand; and
- **16%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver

- **49%** reduction in car use (kilometres travelled per person per day)
- **46%** reduction in car ownership
- **47%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **270** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **30%** reduced peak electricity demand
- **33%** reduced peak sewer demand

BURWOOD - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.24	0.69	0.69
Estimated number of dwellings	-	1,056	8,632	8,632
Estimated number of jobs	-	2,180	885	885
Estimated vehicle kilometres travelled per person/day	20	7	8	4
Estimated vehicle hours per person/week	5.0	1.8	2.1	1.0
Estimated car ownership rates (vehicles per household)	1.5	1.3	1.0	0.5
Car share potential (number of pods)	-	0	80	108
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	2,247.0	2,247.0
New pedestrian connections (km)	-	n/a	0.9	0.9
New green corridors (km)	-	n/a	0.0	0.0
Amount of zoned open space (ha)	-	0.0	0.3	0.3
Residential lots within walking distance to a large park (%)	-	92%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.1	2.4	1.8
Estimated water consumption (litres/person/day)	238	n/a	146	99
Percent of water reused/recycled within the precinct (%)	-	0%	0%	16%
Estimated peak electricity demand (MW)	-	-	24	17
Estimated peak sewer loads (kL/hr)	-	-	337	267
Estimated cost of living ($ per household/year)	$20,800	$16,700	$13,500	$8,100

OPTIMISING BURWOOD

The Optimised Scenario for Burwood would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver

- **26%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **32%** reduction in potable water consumption;
- **29%** reduction in peak electricity demand and 21% reduction in peak sewer demand; and
- **14%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver

- **51%** reduction in car use (kilometres travelled per person per day)
- **47%** reduction in car ownership
- **48%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **100** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **29%** reduced peak electricity demand
- **21%** reduced peak sewer demand

KINGS BAY - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.41	0.72	0.72
Estimated number of dwellings	-	260	5,592	5,592
Estimated number of jobs	-	1,370	1,050	1,050
Estimated vehicle kilometres travelled per person/day	20	14	11	4
Estimated vehicle hours per person/week	5.0	3.0	2.3	0.9
Estimated car ownership rates (vehicles per household)	1.5	1.5	1.3	0.6
Car share potential (number of pods)	-	0	52	67
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	3,483.0	3,483.0
New pedestrian connections (km)	-	n/a	1.1	1.1
New green corridors (km)	-	n/a	1.9	1.9
Amount of zoned open space (ha)	-	0.0	0.9	0.9
Residential lots within walking distance to a large park (%)	-	69%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.2	2.5	1.8
Estimated water consumption (litres/person/day)	238	n/a	146	99
Percent of water reused/recycled within the precinct (%)	-	0%	0%	14%
Estimated peak electricity demand (MW)	-	-	17	12
Estimated peak sewer loads (kL/hr)	-	-	241	194
Estimated cost of living ($ per household/year)	$20,800	$18,600	$16,400	$8,500

OPTIMISING KINGS BAY

The Optimised Scenario for Kings Bay would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver

- **27%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **32%** reduction in potable water consumption;
- **28%** reduction in peak electricity demand and **19%** reduction in sewer demand.
- **13%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver

- **61%** reduction in car use (kilometres travelled per person per day)
- **55%** reduction in car ownership
- **56%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **70** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **28%** reduced peak electricity demand
- **19%** reduced peak sewer demand

TAVERNERS HILL - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.64	0.69	0.69
Estimated number of dwellings	-	367	4,306	4,306
Estimated number of jobs	-	300	436	436
Estimated vehicle kilometres travelled per person/day	20	10	9	4
Estimated vehicle hours per person/week	5.0	2.5	2.2	1.1
Estimated car ownership rates (vehicles per household)	1.5	1.1	1.0	0.5
Car share potential (number of pods)	-	3	40	54
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	0.0	0.0
New pedestrian connections (km)	-	n/a	0.3	0.3
New green corridors (km)	-	n/a	1.3	1.3
Amount of zoned open space (ha)	-	0.4	1.2	1.2
Residential lots within walking distance to a large park (%)	-	78%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.0	2.5	1.8
Estimated water consumption (litres/person/day)	238	n/a	146	100
Percent of water reused/recycled within the precinct (%)	-	0%	0%	14%
Estimated peak electricity demand (MW)	-	-	12	7
Estimated peak sewer loads (kL/hr)	-	-	167	134
Estimated cost of living ($ per household/year)	$20,800	$15,300	$13,400	$8,000

OPTIMISING TAVERNERS HILL

The Optimised Scenario for Taverners Hill would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver:

- **26%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **32%** reduction in potable water consumption;
- **39%** reduction in peak electricity demand and 20% reduction in peak sewer demand; and
- **14%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver:

- **51%** reduction in car use (kilometres travelled per person per day)
- **46%** reduction in car ownership
- **48%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **50** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **39%** reduced peak electricity demand
- **20%** reduced peak sewer demand

LEICHHARDT - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.52	0.73	0.73
Estimated number of dwellings	-	380	1,455	1,455
Estimated number of jobs	-	2,130	202	202
Estimated vehicle kilometres travelled per person/day	20	10	8	4
Estimated vehicle hours per person/week	5.0	2.1	1.7	0.8
Estimated car ownership rates (vehicles per household)	1.5	1.2	1.0	0.5
Car share potential (number of pods)	-	2	14	18
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	0.0	0.0
New pedestrian connections (km)	-	n/a	0.3	0.3
New green corridors (km)	-	n/a	0.4	0.4
Amount of zoned open space (ha)	-	0.0	0.1	0.1
Residential lots within walking distance to a large park (%)	-	100%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.3	2.5	1.9
Estimated water consumption (litres/person/day)	238	n/a	146	98
Percent of water reused/recycled within the precinct (%)	-	0%	0%	16%
Estimated peak electricity demand (MW)	-	-	4	3
Estimated peak sewer loads (kL/hr)	-	-	57	46
Estimated cost of living ($ per household/year)	$20,800	$16,600	$13,400	$8,100

OPTIMISING LEICHHARDT

The Optimised Scenario for Leichhardt would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver

- **26%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **33%** reduction in potable water consumption;
- **37%** reduction in peak electricity demand and 21% reduction in peak sewer demand; and
- **15%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver

- **51%** reduction in car use (kilometres travelled per person per day)
- **45%** reduction in car ownership
- **47%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **20** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **37%** reduced peak electricity demand
- **21%** reduced peak sewer demand

CAMPERDOWN - SUMMARY

Measurable Indicator	Sydney Metro	Existing	Base Case	Optimised
Land use mix	-	0.25	0.77	0.77
Estimated number of dwellings	-	426	1,202	1,202
Estimated number of jobs	-	560	244	244
Estimated vehicle kilometres travelled per person/day	20	10	7	4
Estimated vehicle hours per person/week	5.0	3.4	2.4	1.3
Estimated car ownership rates (vehicles per household)	1.5	1.1	0.9	0.5
Car share potential (number of pods)	-	1	14	15
Average walk + wait time to public transport (minutes)	-	9	9	9
New safe, connected cycle ways (km)	-	n/a	758.0	758.0
New pedestrian connections (km)	-	n/a	0.3	0.3
New green corridors (km)	-	n/a	1.5	1.5
Amount of zoned open space (ha)	-	0.1	1.1	1.1
Residential lots within walking distance to a large park (%)	-	100%	100%	100%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.0	2.5	1.8
Estimated water consumption (litres/person/day)	238	n/a	146	100
Percent of water reused/recycled within the precinct (%)	-	0%	0%	13%
Estimated peak electricity demand (MW)	-	-	4	3
Estimated peak sewer loads (kL/hr)	-	-	51	40
Estimated cost of living ($ per household/year)	$20,800	$15,300	$12,300	$7,700

OPTIMISING CAMPERDOWN

The Optimised Scenario for Camperdown would achieve:

1. High Performance Buildings

Compared to the Base Case, the Optimised Case would deliver

- **25%** reduction in greenhouse gas emissions from lower electricity and gas consumption;
- **31%** reduction in potable water consumption;
- **25%** reduction in peak electricity demand and 21% reduction in peak sewer demand; and
- **21%** reduction in household utility costs (energy and water)

2. Car Dependence

Compared to the Base Case, the Optimised Case would deliver

- **47%** reduction in car use (kilometres travelled per person per day)
- **42%** reduction in car ownership
- **43%** reduction in associated household costs
- The potential for private investment in the delivery of approx. **15** car share pods each servicing 8-12 households.

3. Infrastructure

Compared to the Base Case, the Optimised Case would deliver:

- **25%** reduced peak electricity demand
- **21%** reduced peak sewer demand

7. Key Assumptions

Metropolitan Sydney average benchmarks

Electricity	2,132 kWh per person/year
Gas	3,888 MJ per person/year
Water	237.8 L per person/day
Transport	19.98 km per person/day

Tariffs and rates

Household cost savings outlined in this report are based on current tariffs outlined below:

Residential Water	**Rate**	**Unit**
Mains tariff	2.232	$/kL
Recycled water tariff	2.068	$/kL
Service charge per dwelling	765	$/yr
Recycled water service charge	0	$/yr

Residential Grid Electricity	**Rate**	**Unit**
Applied tariff	0.2514	$/kWh
Solar feed-in tariff	0.06	$/kWh
Service charge per dwelling	289.16	$/yr

Residential Gas	**Rate**	**Unit**
Gas (first 3,775 MJ per qtr/remaining)	0.041/0.023	$/MJ
Service charge per dwelling	207	$/yr

Residential Transport	**Rate**	**Unit**
Fuel	1.50	$/L
Annual capital costs (devaluation)	6,642	$/yr
Annual registration/insurance	2,172	$/yr

Key Data Sources

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data
  - Data is from the representative weather station for the local climate zone
  - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia.
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