



WESTERN SYDNEY STREET DESIGN GUIDELINES

SECOND EDITION



April 2025

Acknowledgement of Country

The Western Sydney Planning Partnership acknowledges more than 60,000 years of continuous Aboriginal connection to the land that makes up NSW.

We acknowledge and pay our respects to the traditional custodians of Country within Western Sydney. As part of the world's oldest living culture, the traditional Aboriginal owners and custodians share a unique bond to the Country – a bond forged through thousands of years of travelling across lands and waterways for ceremony, religion, trading, and seasonal migration.

We acknowledge that Western Sydney is home to the highest number of Aboriginal people of any region in Australia and that the primary Aboriginal custodians with obligations for Country and connection to the place for many generations including the Dharug/Darug, Dharawal/Tharawal, Gundungurra/Gandangara, and Darkinjung people.



The Western Sydney Planning Partnership would like to acknowledge the generous financial support given by Transport for NSW and the significant input provided by many of its staff to the production of this second edition of the Western Sydney Street Design Guidelines.

Western Sydney Planning Partnership partner organisations:

Blacktown City Council, Blue Mountains City Council, Camden Council, Campbelltown City Council, City of Liverpool, Fairfield City Council, Hawkesbury City Council, Penrith City Council, Wollondilly Shire Council, NSW Department of Planning and Environment, Greater Cities Commission, Transport for New South Wales, and Sydney Water.

Disclaimer

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Readers should make their own inquiries and rely on their own advice when making decisions related to material contained in this publication.

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Better Streets for Western Sydney

The Western Sydney region is experiencing rapid growth, emerging as Australia's third-largest economy with a rapidly expanding population and employment base. Each year, tens of thousands of new residents, originating from all over 170 countries, choose to call this region home. The development of the Nancy-Bird Walton International Airport at Badgerys Creek, alongside urban development and infrastructure projects, marks a significant milestone for Western Sydney.

Substantial investment is underway to accommodate the needs of both existing and incoming residents by providing jobs, housing, and essential infrastructure.

This is being enabled through several re-zoning packages that will build new communities across Western Sydney. This development is occurring amidst a backdrop of social and environmental challenges including increasing congestion and a lack of sustainable transport options; environmental degradation and habitat loss; rising urban heat; and an epidemic of loneliness.

The design of Western Sydney's streets will play a pivotal role in addressing these challenges, including through improved health outcomes, enhanced accessibility, better amenity, and development viability.

The Western Sydney Street Design Guidelines seeks to contribute to the delivery of these outcomes for existing and future communities.

Introduction

Aerial view of Oran Park
(credit: Nearmap)

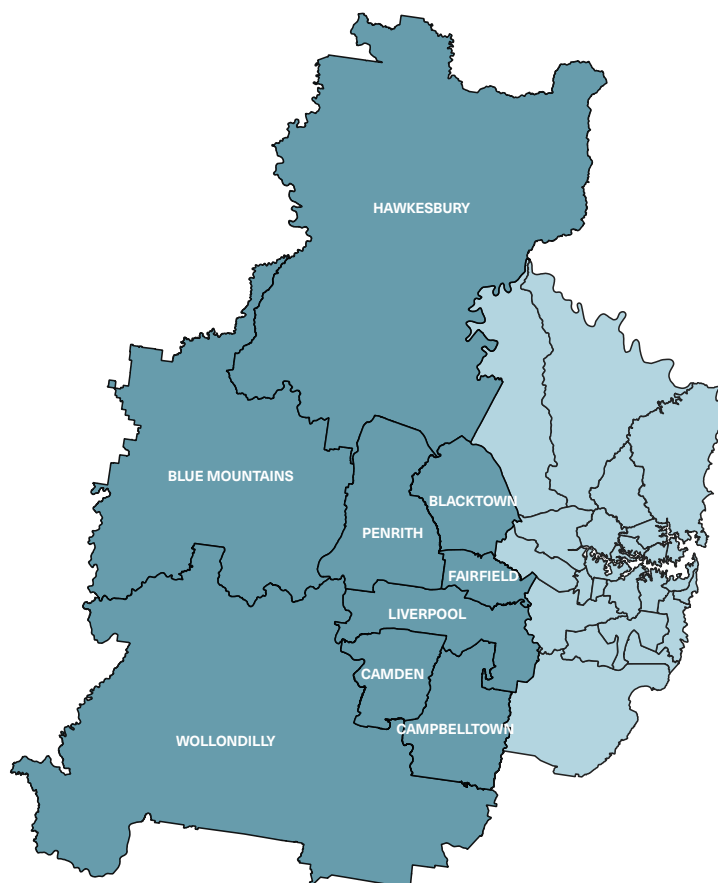
1.1 Foreword

Streets form the backbone of public space, often accounting for a quarter or more of the total land area in our cities and neighbourhoods. Streets typically make up around 80% of all public space in an urban area, with parks and squares comprising less than a fifth of our public spaces.

Streets are the spaces we move through and gather in, providing connection within our cities and to each other. They form an important part of the visual appeal of every neighbourhood. They need to balance community demands, functional requirements, climate pressures, amenity, and movement. Getting streets right is one of the most important demands of the urban landscape.

The design and establishment of new streets, and the embellishment of existing ones, plays an instrumental role in the success of a neighbourhood or centre and the health and happiness of the people that live in them. Since the 1950s, with the increase in suburban development and private vehicle ownership in Sydney, streets have been redefined with clear and defined rules about where traffic, stormwater, and utilities were located. As vehicle speeds and traffic volumes increased, the complex activities and diversity of users on our streets dramatically reduced. Streets became simpler, more efficient but more often than not, less attractive, hotter, dominated by cars, and less environmentally sustainable.

The Western Sydney Street Design Guidelines (Guidelines) seek to address this imbalance to create streets with improved environmental, social, and health outcomes for all street users. The Guidelines are focused on service provision to new greenfield development areas in Western Sydney. They do however have the potential to be applied to existing areas that are undergoing significant change and are in an appropriate setting.



The eight City Deal Councils plus Blacktown City Council

**AROUND 30% OF
OUR URBAN AREAS ARE
STREETS AND ROADS**



Typical composition of developed land in Sydney



1.2 Background

Western Sydney City Deal

In 2016 the Australian Government committed to the Smart Cities Plan. This Plan set out the Government's vision for productive and liveable cities that encourage innovation, support growth and create jobs. City Deals are the mechanism for delivering the Smart Cities Plan. They are a partnership formed between the three levels of government; Federal, State and Local.

The Western Sydney City Deal outlines a 20-year strategy to create world-class jobs and a great quality of life for residents in Western Sydney. It outlines 38 commitments that will help realise this vision.

The Western Sydney Planning Partnership (WSPP) was formed in 2018 in response to one of these commitments. It is a collaboration between State and Local Governments, and includes representation from the local councils of Blacktown, Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly, as well as key State agencies; NSW Department of Planning, Housing and Infrastructure, Industry and Environment, Sydney Water, and Transport for NSW.

The approval for the new Western Sydney Airport has stimulated new investment, both public and private, that will drive the development of large areas of existing agricultural land for housing, commercial, industrial, agribusiness and logistics uses. With this investment comes a generational opportunity to establish new and innovative design and engineering standards that will improve liveability and amenity.

The WSPP has been tasked with delivering one of the key commitments of the City Deal — to develop uniform local government engineering design standards for the region. The Street Design Guidelines for Western Sydney (the Guidelines) has been developed as part of this commitment. They are supported by the Engineering Design Manual for Western Sydney, a complementary document which provides the technical detail on designing and building the streets introduced in the Guide.

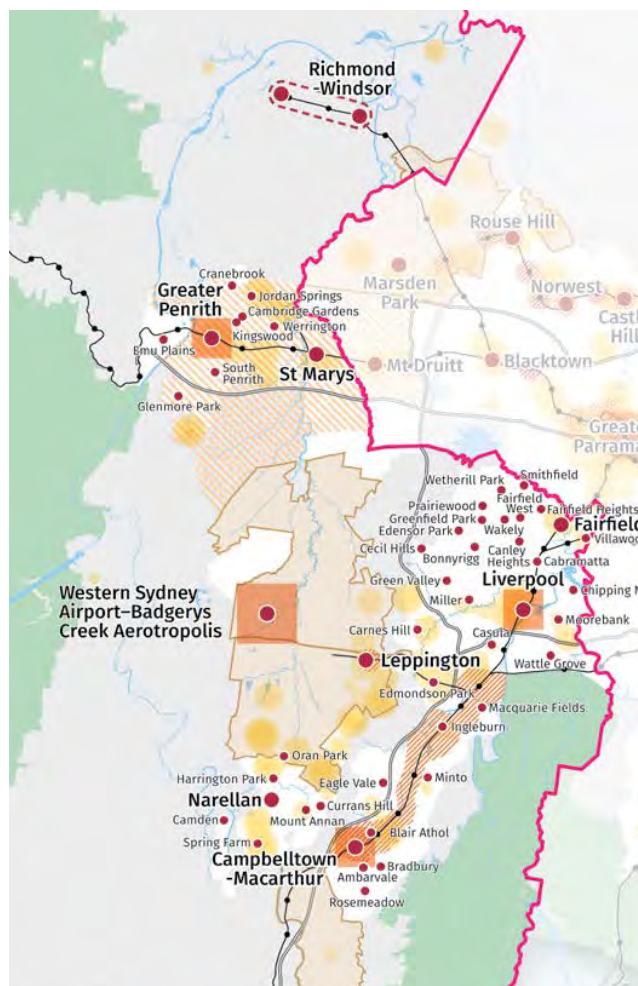
Western City District Plan

The NSW Government has committed to a Western Parkland City that sits within Greater Western Sydney and covers the local government areas that are part of the Western City Deal. The Western City District Plan outlines a range of priorities for housing, infrastructure, public space and centres.

The Western Parkland City is being developed as the third city in the Sydney Metropolitan area to complement the eastern Harbour City of Sydney and the central river City of Parramatta. The vision for a metropolis of three cities means residents in the Western City District will have quicker and easier access to a wider range of jobs, housing types and activities. This vision will improve the District's lifestyle and environmental assets.

Relevant key issues addressed in the plan include:

- Mitigating the urban heat island effect and providing cooler places by extending urban tree canopy and retaining water in the landscape
- Developing a range of housing, providing access to public transport and infrastructure including schools, hospitals and community facilities
- Linking walking and cycling paths, bushland and a green urban landscape which is framed by the Greater Blue Mountains World Heritage Area, the Scenic Hills and Western Sydney Parklands
- Enhancing and protecting South Creek, Georges River and Hawkesbury–Nepean river systems
- Protecting the District's natural landscapes, heritage and tourism assets, unique rural areas and villages



Western City District future housing supply
(source: Western City District Plan, Greater Sydney Commission, 2018)

1.3 The case for change

Streets as public spaces

Streets form the backbone of public space, often accounting for a quarter or more of the total land area in our cities and neighbourhoods. They typically make up around 80% of all public space in an urban area, with parks and squares comprising less than a fifth of our public spaces.

Streets are the spaces we move through and gather in. They form an important part of the visual appeal of every neighbourhood. They need to balance community demands, functional requirements, climate pressures, amenity, and movement. Getting streets right is therefore one of the most important demands of the urban landscape, and fundamental to achieving a resilient Sydney.

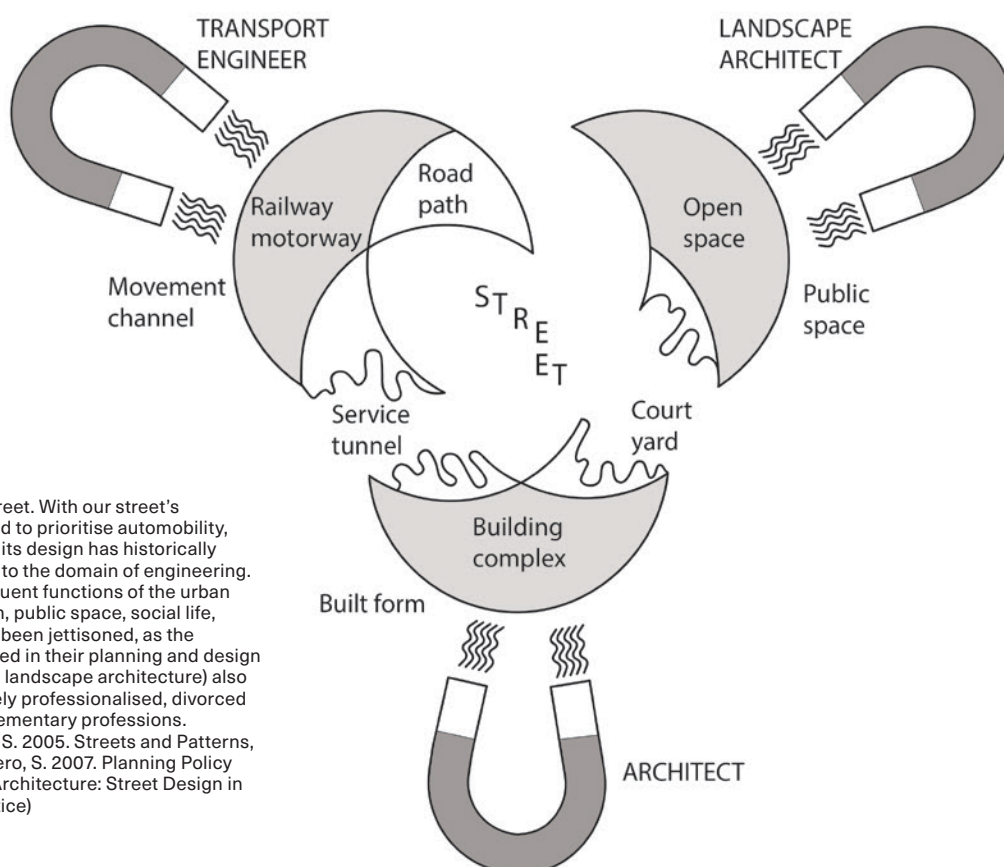
The design and establishment of new streets plays an instrumental role in the success of a neighbourhood or centre, and the health and happiness of the people that live in them.

Streets also play an important role in complete neighbourhoods—sustainable and resilient urban environments where people can live, work, and recreate within their local area. These neighbourhoods reduce

the need for extensive travel, easing the strain on streets while fostering healthier, more connected communities. By integrating a mix of housing, jobs, services, and recreational opportunities within walkable distances, complete neighbourhoods minimise reliance on private vehicles and promote active transport modes such as walking and cycling. Streets in such neighbourhoods become vibrant, multi-functional spaces that support diverse activities, enhance community interaction, and prioritise the well-being of people over vehicles.

Since the 1950s—with the increase in suburban development and private vehicle ownership in Sydney—streets were redefined with clear and defined rules about where traffic, stormwater, and utilities were located. As vehicle speeds and traffic volumes increased, the complex activities and diversity of users on our streets dramatically reduced. Streets became simpler, more efficient but more often than not, less attractive, hotter, dominated by cars and less environmentally sustainable.

This document seeks to address this imbalance to create streets with improved environmental, social and health outcomes for all street users.



Division of the street. With our street's function redefined to prioritise automobility, responsibility for its design has historically been transferred to the domain of engineering. The other constituent functions of the urban street—built form, public space, social life, and so on—have been jettisoned, as the disciplines involved in their planning and design (architecture and landscape architecture) also became separately professionalised, divorced from their complementary professions. (credit: Marshall, S. 2005. Streets and Patterns, as cited in Guerrero, S. 2007. Planning Policy and Landscape Architecture: Street Design in Theory and Practice)

Resilient Sydney

Between 2015 and 2020, Infrastructure NSW (INSW) conducted research into the impacts of the urban heat island effect. They concluded that unless the prevailing patterns of urban development in Western Sydney were modified, there would be significant future impacts on health budgets in response to increases in air temperature.

As a consequence, INSW recommended that action be taken to modify the prevailing patterns of urban development in order to:

- Reduce building footprints and increase permeable surfaces;
- Integrate water cycle management into the urban planning process; and
- Increase tree canopy

Resilient Sydney is part of a global movement known as the 100 Resilient Cities initiative, sponsored by the Rockefeller Foundation. The 100 Resilient Cities initiative was designed to help cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st Century. Cities in the network were provided with resources to develop a roadmap to resilience.

The resulting strategy established a set of goals and objectives designed to strengthen metropolitan Sydney's ability to survive and adapt in the face of increasing global uncertainty and local shocks and stresses.

The strategy was developed with the support of all of Sydney's metropolitan councils and contributors from the NSW Government, and business and community organisations. One of the five focus areas contained within the strategy related to "living with our climate".

Launched in 2018, the Resilient Sydney Strategy lays out a five-year plan for a cooler, more liveable and resilient future. The need for the Cool Suburbs Tool, a flagship action, was identified under the Turn Down the Heat Strategy, a collaborative, multi-sector approach to tackling urban heat in Western Sydney.

The Urban Heat Planning Toolkit is a key component within the Cool Suburbs initiative, developed to help local councils strengthen local planning provisions to reduce the impacts of heat. It focuses on strategies that can be implemented in both new development and redevelopment contexts, to reduce urban heat and adapt to a changing climate.

CROSS REFERENCE



Resilient Sydney Strategy 2018 (above) and its contributors (right)

Better subdivision and street design

A key improvement to the planning and design process is the need to integrate precinct subdivision and street design to ensure they are coordinated and working together to deliver better outcomes.

Subdivision influences everything from net residential density and housing type to lot frontages, driveway frequency, and on-street parking, all of which are major determinants of street function and ultimately spatial design. Ensuring subdivision and street design are integrated and concurrent is critical to delivering improved street design outcomes.

For example, after street reserve width, the biggest influence on the design of a street and the experience of living on that street is the number and location of driveway crossings, determined by lot widths and property access. This impacts key street design outcomes such as on-street parking, the location of street trees and subsequent urban tree canopy, play safety, and the like.

The design of a street should also fit its movement and place context, and factor in the street/lot interface and how subtle changes to this impact the spatial arrangement of key street design elements presented within this report and within the guidelines more generally.

Better street networks and mode shift

A car-centric street network leads to congestion, unattractive places, and poorer public and environmental health outcomes.

Without convenient and comfortable streets that support walking, cycling, and public transport, people will continue to drive out of both necessity and convenience. Too many parking spaces in well-connected areas can also lead to low walking, cycling, and public transport use.

A well-designed transport network across multiple scales—the district, neighborhood, and street—facilitates the efficient movement of people and goods while creating improved place outcomes. Increased walking, cycling, and on-road public transport use not only alleviates congestion, but provides substantial health, environmental, and economic benefits, fostering resilient communities that are more equitable, inclusive, and liveable.

Reducing the space dedicated to on-street car parking allows for the reallocation of space to footpaths, playgrounds, safe crossings, street trees, bus lanes, outdoor dining areas, bike lanes and much more.



Thornton Estate
(credit: Morton)



Light rail on Devonshire Street, Surry Hills
(credit: ASPECT Studios and Florian Groehn)

Better public spaces

Streets are the most common type of public space in urban areas. Streets provide a great opportunity to contribute to the identity and amenity of every neighbourhood.

Better Placed by the NSW Government Architect establishes the value of good design. The document identifies key concepts, good process, and objectives for good design outcomes. Good design in the built environment is informed by and derived from its location, context and social setting. It is place-based and relevant to and resonant with local character, and communal aspirations. It also contributes to the evolving local character and setting.

Increased density

The increase in density within release areas further necessitates the delivery of streets through good design. They should be welcoming and aesthetically pleasing, encouraging communities to use and enjoy local places.

The feel of a place, and how we use and relate to our environments is dependent upon the aesthetic quality of our places, spaces and buildings. The visual environment should contribute to its surroundings and promote positive engagement.

Good design everywhere

Good design creates user friendly, enjoyable and attractive spaces, which provide value to people, the place and the natural environment. Good design brings benefits socially, environmentally and economically, and builds on these benefits over time — continually adding value.



Main Street, Rouse Hill
(credit: Home789)

Improved health and wellbeing

It is acknowledged that current rates of walking and cycling in Western Sydney are well below desired levels.

High vehicle dependence, longer travel distances, unfavourable climate and a reduced emphasis on the provision of high-quality walking and cycling environments have contributed to very low take-up rates of active transport.

Most people in Sydney make at least two walking trips per day and around 15% walk all the way to work when they live in proximity to major centres and employment hubs. But on average each Sydneysider only walks for about 11 minutes each day leading to poor health outcomes.

Walking to school

More than 50% of children live less than 2 km from school. However, the number of children walking to school has dropped significantly over the last four decades. Reduced vehicle speeds, improved crossing design and better footpath environments will help to reverse this decline.

Making space now

To encourage a new generation of pedestrians and cyclists, safe and protected facilities should be included wherever possible. Designing streets with cycleways and shared paths that provide safe unhindered access for all ages and abilities is a priority to increase active lifestyles and reduce reliance on vehicles for local trips.



Safe journeys to school
(credit: Simon Wood)

Greener and cleaner streets

Western Sydney is growing quickly, and future street design should anticipate changed environmental factors as well as provide the best possible outcomes for communities in the region.

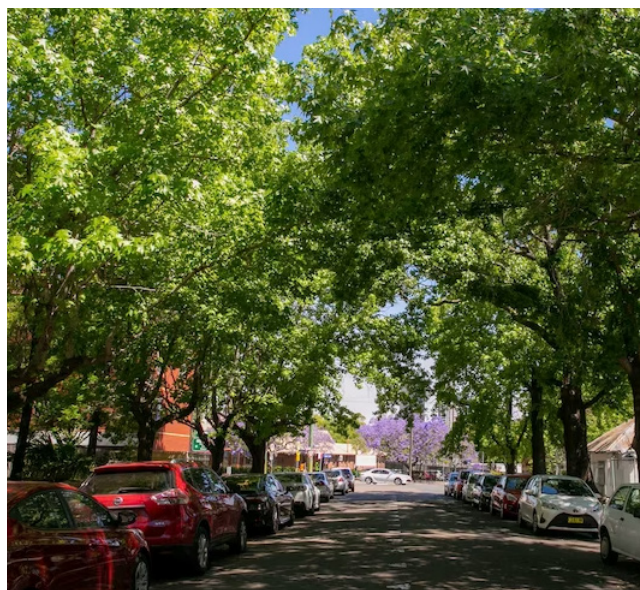
The improved retention and use of water in streetscapes is critical to establishing tree growth and healthy canopy, whilst reducing run-off pollution to local wetlands, creeks and rivers. A major factor in the liveability of every neighbourhood in the region will be the ability of surfaces in new developments to avoid retaining and re-radiating heat. This needs to be mitigated through new design and landscape measures.

More trees, cooler cities

There is overwhelming evidence good tree canopy reduces ambient temperatures and mitigates the urban heat island effect through shade and evapotranspiration. Ambitious targets to increase street trees and green space will help create liveable streets and communities in a part of Sydney that already has a high number of days with significant heat.

A better environment

Tree canopy extends animal habitat and increases the biodiversity of cities, serving as a home for animals and birds. Air quality is improved by removing fine particles from the air. Trees also mitigate the impact of climate change by acting as a storehouse for carbon dioxide. Permeable ground surfaces, raingardens and swales help to reduce nitrogen and phosphorus pollution in our creeks and rivers.



Galloway Street, North Parramatta
(source: Sydney Morning Herald)

Safer streets

Safer streets are fundamental to the health and wellbeing of Western Sydney's communities. A well-designed street network prioritises the safety of all users—pedestrians, cyclists, motorists, and public transport passengers—by reducing conflict points, managing vehicle speeds, and creating environments that encourage active movement.

A safer street is a more inclusive street. Design measures such as wider footpaths, protected cycling infrastructure, pedestrian-priority crossings, and traffic calming elements not only reduce accidents but also foster walkability and social interaction. By embedding safety into every design decision, we create places where people feel comfortable, children can move independently, and local businesses thrive.



A 'Safe Active Street' in Perth
(source: Department of Transport WA)

Design is both a process and an outcome – a way of thinking and a result of making. Better Placed must respond to both of these components in order to achieve its vision. Good design outcomes result from good processes.

Design processes should embrace uncertainty and diversity, filter inputs and reviews to continually refine design outcomes.

A design process involves a series of actions or steps taken to achieve a particular end. Design processes are not linear; they are iterative, collaborative and at times circular, where feedback and ideas are continually intertwined. Design processes help provide solutions to complex problems where many inputs and concerns are needed to be resolved simultaneously.

A good design process is based on an understanding of place through research, analysis and precedent studies and considers alternatives and options. Good process involves many diverse groups of people through consultation that synthesises their issues. Scenarios and options are sorted and improved with testing, competition and critical thinking.

— Better Placed, Government Architect NSW

1.4 A holistic design process

A holistic design process will underpin the delivery of the Guidelines in Western Sydney, ensuring successful outcomes for future streets. The process to design streets will involve working with stakeholders and various authorities, all of whom play a critical role in the design and delivery of streets in the Western Parkland City. This engagement should occur before, during and after an iterative design process in a meaningful way.

CROSS REFERENCE

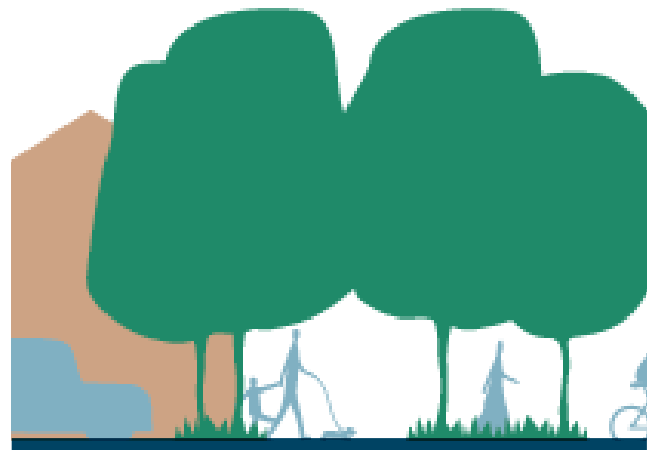


Supplement 1 to the Guidelines provides a template Development Control Plan chapter. It includes template development clauses and street designs to allow for incorporating the Guidelines' design guidance into Development Control Plans.



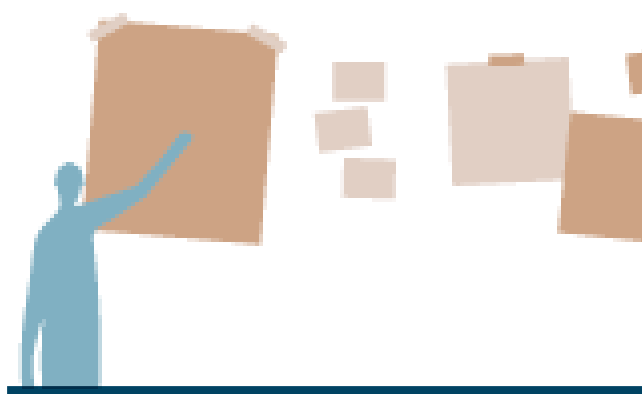
Governance

- Engage with the multiple agencies that will play a role in the various aspects of shaping and maintaining the street, and seek buy-in to the new parameters of street design
- Understand the responsibility for ongoing asset maintenance and how it is spread across numerous agencies, including Local Government and utility providers



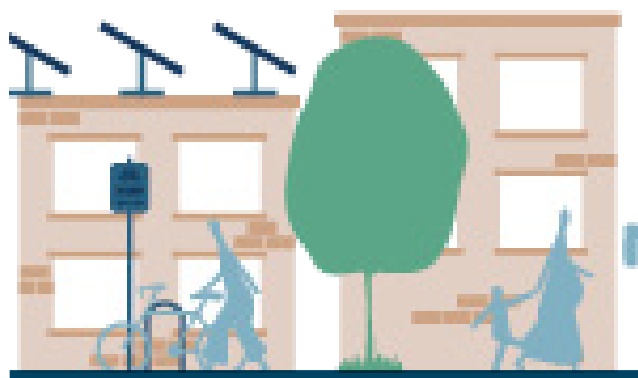
A clear vision

- Develop a clear vision for the street's look, feel and function in the future
- Draw on best-practice street design strategies and innovative examples that are most applicable to the local context
- Use best-practice precedents to explain and illustrate the vision for a street
- Agree what success looks like, how it will be measured, and against what subsequent iterative design options it can be tested



Iterative design + testing

- Generate and explore multiple solutions, challenging assumptions, conventional methods, mainstream ways of working
- Test the various requirements of stakeholders against agreed measures of success to balance aspirations and allocation of street space
- Inform options testing with analysis of environmental performance such as urban tree canopy mapping and urban heat
- Involve civil engineers, traffic consultants and landscape architects to work collaboratively to develop street designs
- Adopt trials and prototypes when initial budgets are limited as a way of testing community and stakeholder support for further investment in the long term



Delivering + monitoring

- Carry forward the vision and design intent through the design process and retain throughout delivery
- Monitor built outcomes and formalise case studies to provide lessons learned and inform iterations of the Guidelines and Engineering Design Manual for Western Sydney

Chapter 2.0

Designing Great Streets

Visualisation of the Western Sydney Aerotropolis Core
(credit: WSPP)



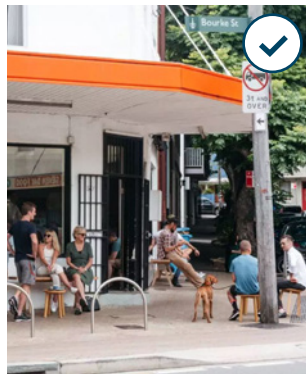
2.1 Street design objectives

The Guidelines are structured around eight street design objectives, which have been developed with and endorsed by the nine partner local councils as the result of an interactive stakeholder engagement process. The street design objectives set the aspirational vision for how the standards can drive best practice outcomes for Western Sydney communities.



Objective 1

Streets encourage social activation through their design.

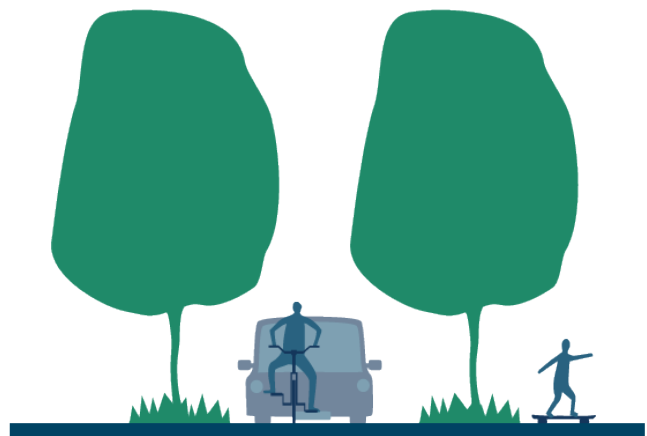


Why?

Streets are critical to the liveability of their urban contexts and need to serve a variety of community uses. Street space needs to be allocated to all street users, which, in some areas, will mean prioritising space for walking, cycling, planting and other uses.

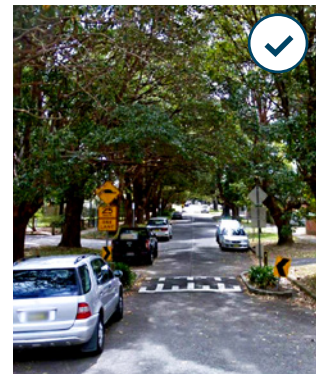
Potential barriers to implementation raised by stakeholders:

- Potential conflicts between traffic and alternate social uses of the street
- Consideration between different street users - pedestrians, cyclists, motorcyclists, public transport users, and drivers
- Existing streets may be narrow and require the removal of parking to achieve optimal footpath widths



Objective 2

Streets are self-explaining slow environments that are safe and comfortable for all users.



Why?

Vehicle speed is the main determinant of fatality or injury. Street environments need to reinforce the desired travel speed, naturally encouraging drivers to adapt their behaviour in a way that is compatible with the design, function and speed of a road.

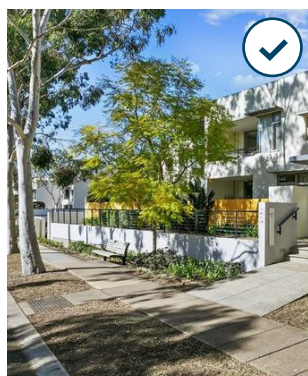
Potential barriers to implementation raised by stakeholders:

- Speeds cannot be reduced simply by changing the posted speed limit
- Different street types have different target speeds and context. Some roads, such as those with higher movement functions, can be expected to be a faster-speed environment



Objective 3

Streets are inclusive with footpaths on both sides.



Why?

Universal accessibility through public space is a basic human right. Footpaths on both sides of the street remove the need for inconvenient and unnecessary crossings for vulnerable street users and provide measurable public health benefits.

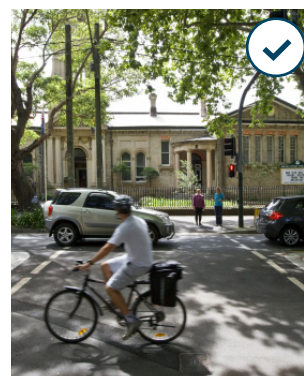
Potential barriers to implementation raised by stakeholders:

- Innovation in material use - additional concrete footpaths will increase impervious and heat capturing surfaces within streets
- Construction staging - coordination required with the construction of driveway crossovers
- Retrofitting existing streets - existing residents may disagree with footpaths in front of their property
- Extra maintenance costs for additional footpaths



Objective 4

Streets are safe for cycling, with separated bicycle facilities adopted for bicycle routes on busy streets.



Why?

Improving the mode share of cycling in Western Sydney will require a vast improvement in the provision of cycling infrastructure. This means delivering infrastructure before demand to encourage modal shift to cycling, and ensuring connectivity with broader cycling networks, particularly commuter networks. While cyclists can share the travel zone with vehicles in slow-speed environments, they require safe, physical separation in higher speed environments.

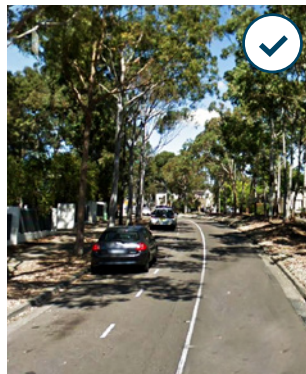
Potential barriers to implementation raised by stakeholders:

- Physical separation requires more space
- Increased conflict may arise at driveways and intersections. Poorly designed separated paths can lead to delays for cyclists and a reduction in safety
- Scepticism that a shift from shared paths to separated cycleways is of community benefit



Objective 5

Streets are designed to maximise continuous tree canopy on both sides.

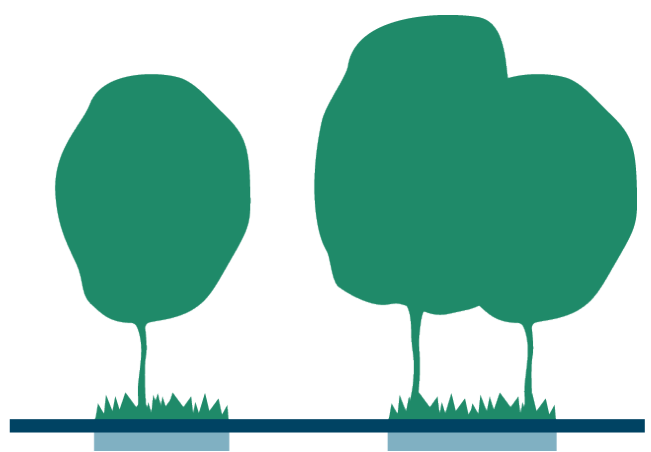


Why?

Western Sydney experiences significantly more urban heating, with residents increasingly exposed to high heat events. Street trees will play a critical role in reducing urban heating and improving health outcomes for people and the environment.

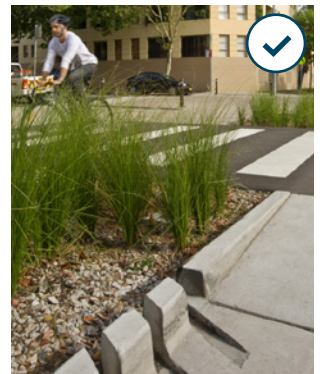
Potential barriers to implementation raised by stakeholders:

- Different tree spacing standards amongst local councils
- Consideration needs to be given to certain areas including Bushfire Prone Land and areas near the airport
- Consideration needs to be given to the width of the verge and the ability for trees to grow to mature sizes



Objective 6

Street design incorporates WSUD to manage stormwater and enhance environmental outcomes.



Why?

Western Sydney's waterways, particularly South Creek, will experience increasing pressure as future development within the region occurs. Treating water where it falls is the best way to alleviate these pressures.

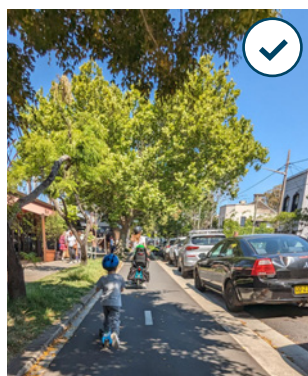
Potential barriers to implementation raised by stakeholders:

- Different requirements amongst local councils and lack of standardised best practice
- Ongoing maintenance costs can vary, and be prohibitively high if not properly considered
- Design and approval staging - site-specific considerations of WSUD features is required
- Construction staging - coordination is required to translate works on the ground



Objective 7

Street design optimises carriageway width to prioritise diverse uses and users beyond vehicular traffic.



Why?

Wide carriageways increase impervious, heat-trapping surfaces and encourage high-speed driving and the storage of private property within the street. We can reallocate street space to alternate street design objectives by narrowing carriageways, while still providing for on-road public transport on relevant street types to serve landuse activities to ensure all in the community have access to public transport services.

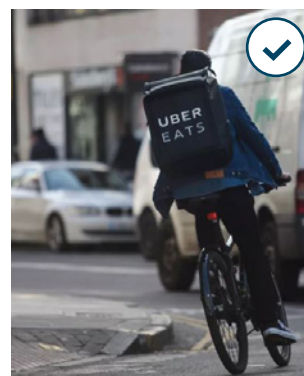
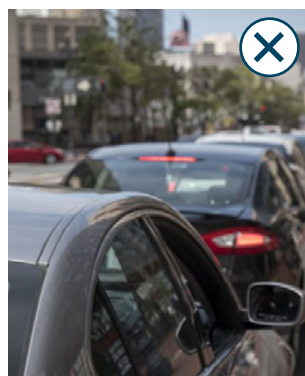
Potential barriers to implementation raised by stakeholders:

- Outcomes depend on the number of lots the street is servicing
- Central medians may inhibit the ability to reduce travel lane widths
- Additional physical space is required to run, turn, and stop buses safely, with bus stops provided that are easily accessible to all in the community



Objective 8

Future transport solutions maximise place outcomes for streets.



Why?

Future transport solutions will provide efficiencies within the transport network that will allow for a reduction in the amount of street space dedicated to private motor vehicles. Future transport technology must be harnessed to decrease driving, not merely make long drives more palatable. Redistributing street space to alternate uses is critical to this.

Potential barriers to implementation raised by stakeholders:

- Unknown ownership models for connected and autonomous vehicles
- Potential impact of electric vehicle infrastructure on street amenity and other street users
- Potential impact of micromobility on street amenity and other street users

2.2 Design guidance

Design considerations

In addition to consulting the Guidelines, designers also need to consider other factors in the design process. The list below is not exhaustive, but it does covers some of the common design considerations when working in Western Sydney.

Latent site conditions

There is a variety of soil types and conditions across the whole of Western Sydney. Heavy clay soils, or saline soils as an example, will need careful consideration throughout the design process. This is especially the case when considering WSUD elements and selecting plants.

Designers should familiarise themselves with the specific conditions of their site – and incorporate this research into the design of street features.

Ongoing maintenance

The ongoing maintenance of streets is, and will continue to be, a key consideration in the design and delivery of streets in Western Sydney. Fixed allocation of resources means that a rapid and uncoordinated increase in new assets which require additional or increased maintenance can be difficult for local councils to manage.

However, this must be balanced against the long-term risks for local areas. Without gradual improvements to local streets and suburbs, communities are likely to find themselves more vulnerable to longer and more severe summers. Residents are also more likely to see a decrease in the amenity of their built environment and quality of life.

For these reasons, it is critical to consider the costs and benefits of each improvement to a street. It is also important to consider that street improvements will continue to deliver benefits to the local community for decades to come.

Designers should ensure that the design of street features are supported by research and science, and that unnecessary maintenance tasks which provide no environmental benefit, such as clipping or regular pruning, are designed out

Fire danger

Much of Western Sydney is particularly vulnerable to bush fire risk. A changing climate only exacerbates the risk.

Organisations such as the Rural Fire Service have the authority and expertise to guide designers on designing for bush fire protection. More information can be found in 'Planning for Bush Fire Protection', Rural Fire Service (November 2019).

Designing for all abilities

A core objective of the Guidelines is to create streets which are accessible for everyone. This means considering Australian Standards 1428.1 as required by the Disability Discrimination Act 1992 (Cwth), as well as considering the comfort and ease with which more vulnerable community members can access the built environment.



Newington Boulevard, Newington
(credit: ASPECT Studios)

When spaces are designed for the most vulnerable, such as the elderly or parents with prams, the whole community benefits.

It is not the intent of this document to duplicate content already supplied elsewhere, such as in the Australian Standards. Further to this, the design guidance and requirements included in the Guidelines do not preclude the application of AS1428. If there is a perceived conflict, complying with statutory requirements should take precedence.

Crime Prevention Through Environmental Design

Crime Prevention through Environmental Design (CPTED) is a crime prevention strategy that focuses on the planning, design and structure of cities and neighbourhoods. The aim of CPTED is to reduce the likelihood of criminal activity.

Keeping communities safe, and not contributing to the likelihood of a crime being committed in streets should be an important consideration in the design of new streets. This may factor into the design process through planting selection and the location of lighting elements.

More information about CPTED can be found on the NSW Police Force website and local councils may have further information in their DCPs about their own CPTED design principles.

Safety in Design

Safety in Design (SiD) is a key consideration when designing new streets. SiD processes should be integrated into the design phase of all projects including new and refurbished streets. The SiD actions are dependent on the complexity of the design.

Integrating SiD in the design process might include design team workshops and producing safety design reports. It may also include maintaining a risk register which considers the risks stemming from the design into the construction, maintenance and future demolition or decommissioning of the project.

In the context of the designing streets, designers might consider the construction works and the way the street and its features, like WSUD features or planted areas, will be maintained in the future. Designers should confirm whether local councils have their own SiD processes to incorporate into projects.



Appian Way, Burwood
(credit: Google)

Structure of the street

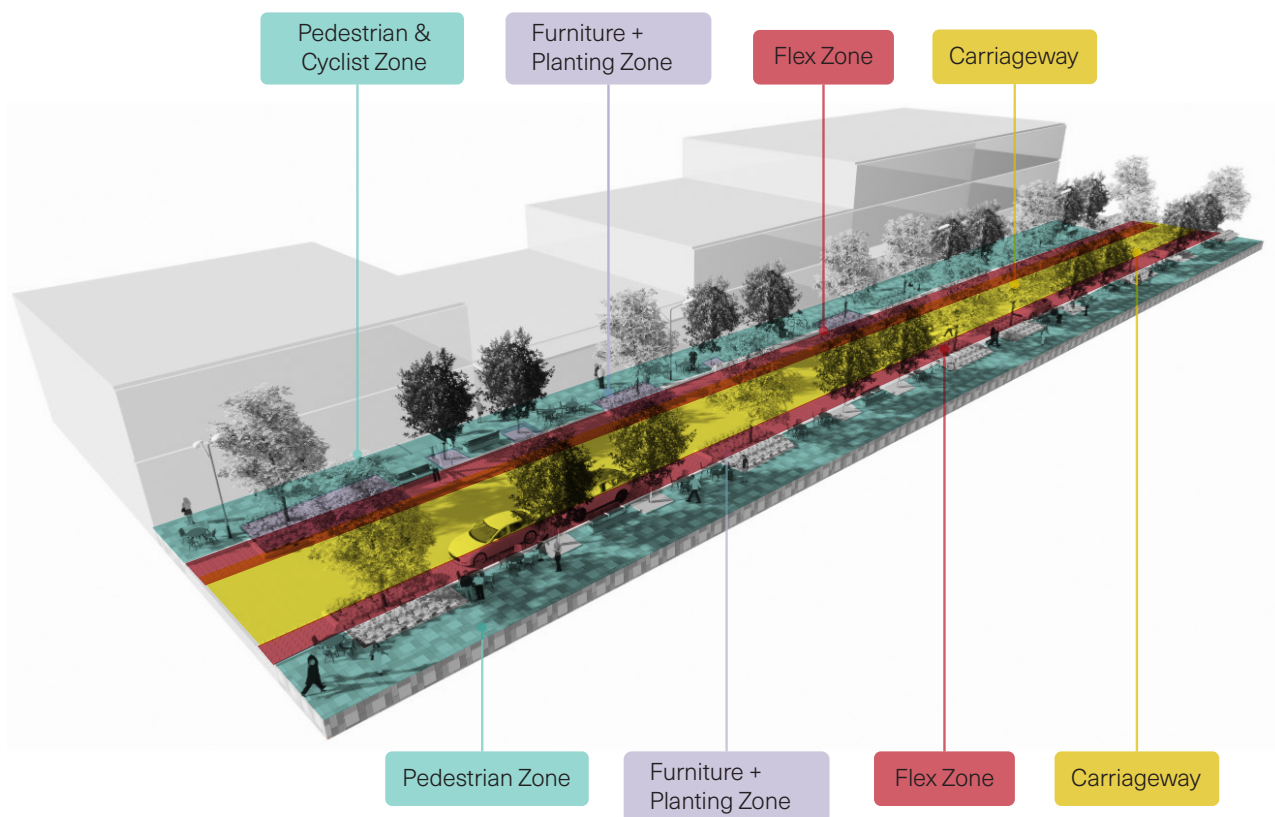
For ease, the Guidelines gives names to the different parts (zones) of streets – both streets generally and in the proposed Street Types. Not all streets will include all zones, but most streets will include at least two zones.

The Pedestrian Zone — an area, typically within the verge, provided for accessible pedestrian travel. Its total width will vary with street type and available street space. This zone must be clear of obstacles, including street furniture, street trees, outdoor seating, driveway ramping, and waste collection. It should be well-lit and functional in all weather conditions and meet accessibility standards.

The Cyclist Zone – sometimes merged with the Pedestrian Zone or Carriageway, and sometimes a distinct part of the street, the Cyclist Zone is somewhere designed for safe bike travel.

The Carriageway — refers to the part of the street dedicated to transport uses including motor vehicles, public transport, and cyclists where appropriate. This zone can be two-way, one-way, or become part of a shared environment.

The Furniture and Planting Zone — refers to a part of the street in which street furniture can be located clear of walking space. It is also a critical zone for meeting canopy cover and permeable area design requirements.



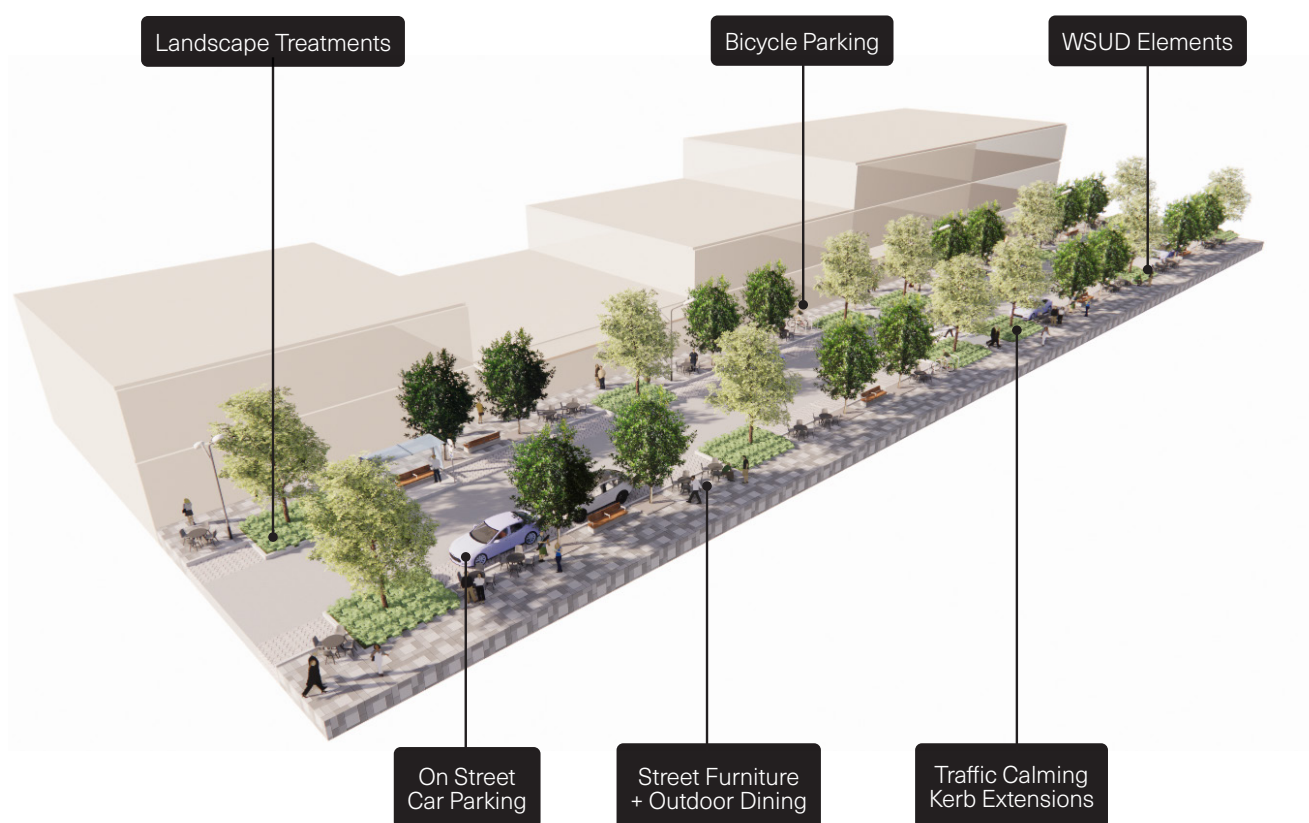
The Flex Zone — a flexible area that provides for street-specific design interventions depending on street type, location, and role within broader movement and environmental systems. This zone plays a critical role in achieving the street targets and objectives discussed throughout Chapter 3.0.

The Flex Zone can support the Planting Zone by including additional street trees, WSUD and understorey planting. It can also include a variety of furniture and fixtures like light poles, street furniture, traffic and parking infrastructure. Depending on verge width, the Flex Zone can include outdoor dining in commercial centres.

The uses and materials within the Flex Zone should be based on place-based analysis. Each Street Type sets a benchmark for the extent of permeable area (a combination of greenery and permeable surfaces) and extent of canopy cover. These are treated as targets and the Flex Zone should be appropriately designed to help reach and exceed these metrics wherever possible.

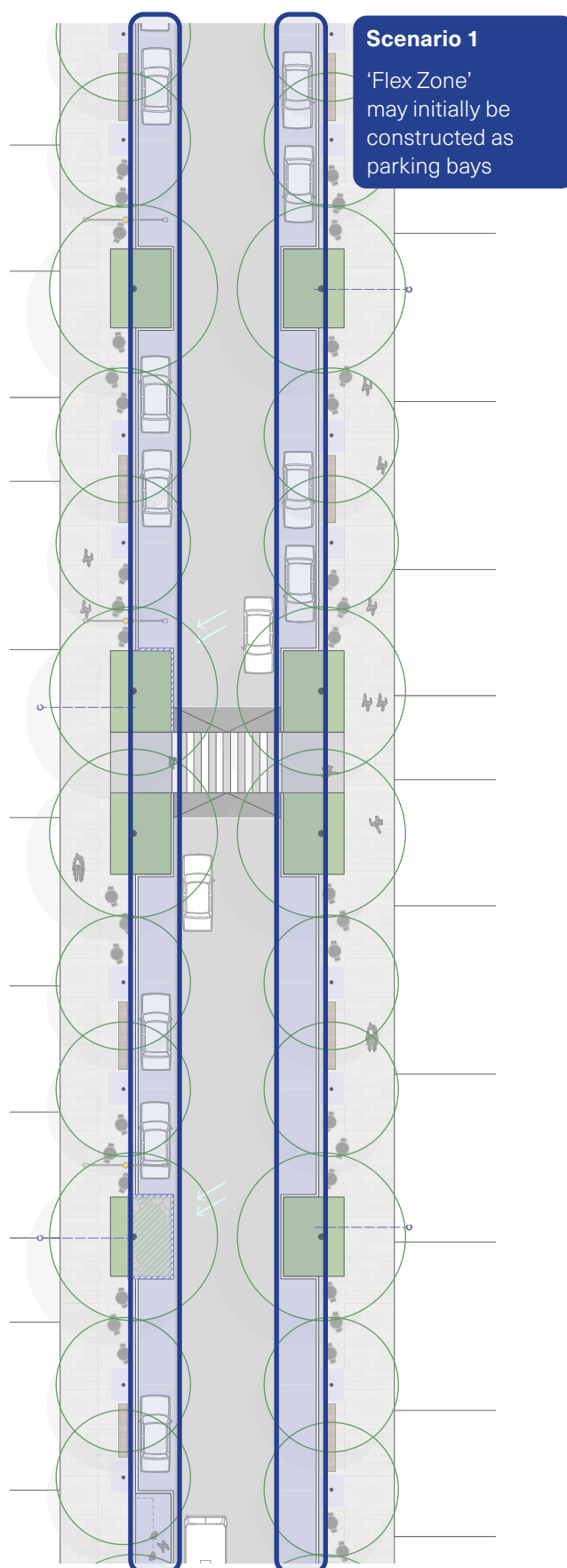
Some example uses within the Flex Zone include:

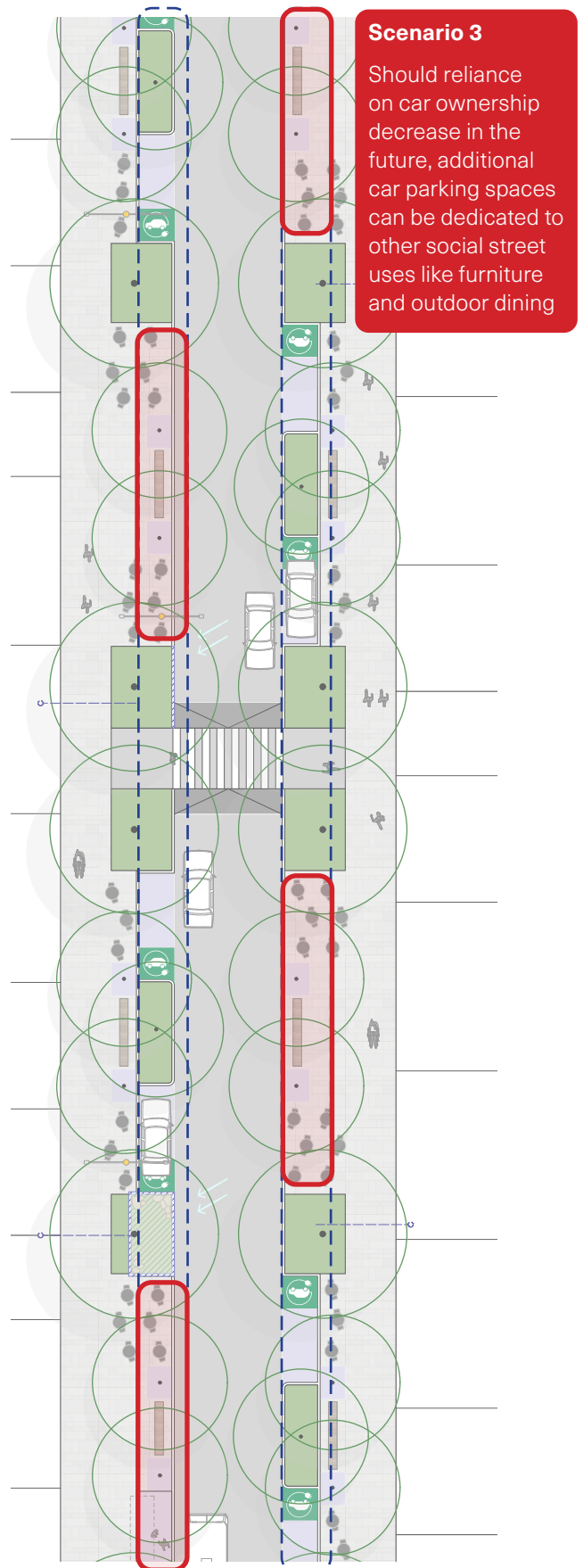
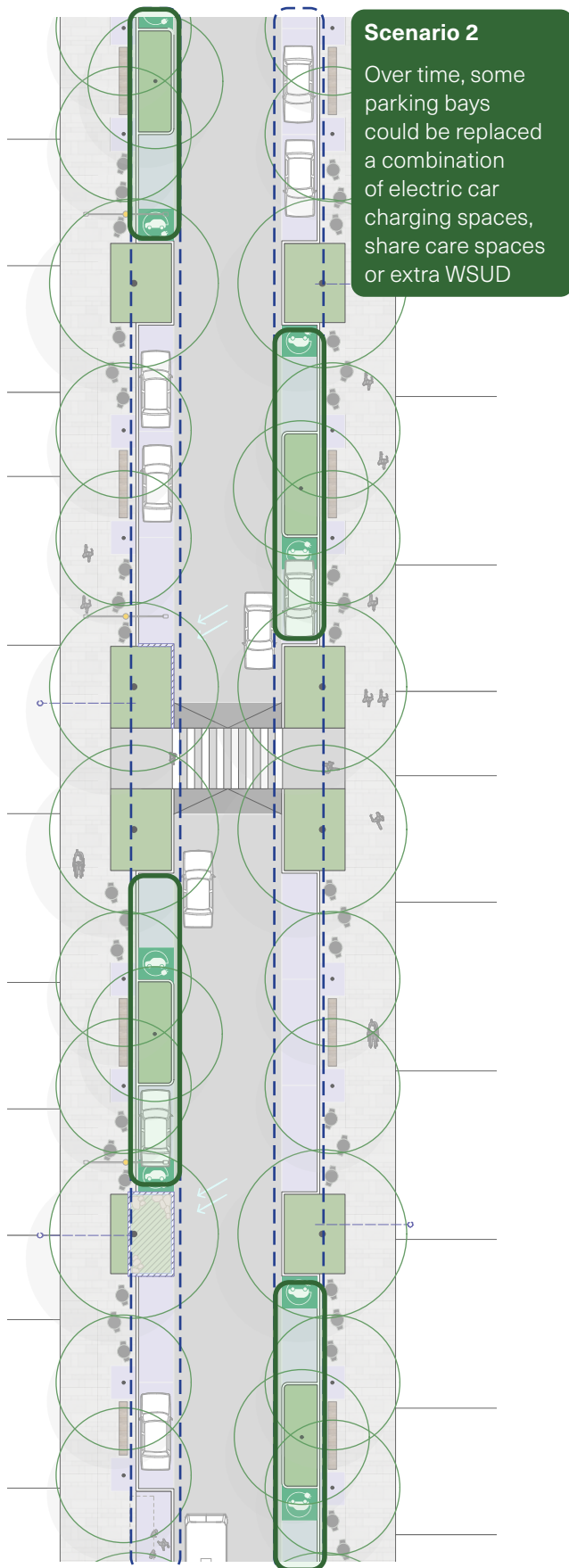
- Landscape treatments, tree planting, and WSUD features
- Street furniture and outdoor dining
- On-street car parking
- Bicycle parking
- Traffic calming kerb extensions



Staging

The following scenarios demonstrate the adaptability of Flex Zones. Each 'scenario' could easily represent three different high streets, or the same high street at three different phases of its evolution as community needs evolve.





2.3 Street types

Strategic alignment

A key component of the update to the Guidelines is to bring its street types into better alignment with the relevant Transport for NSW guidelines, in particular the Design of Roads and Streets Guide (DORAS). Other Transport for NSW guides referenced as part of this review include the Network Planning in Precincts Guide, Walking Space Guide, and Cycleway Design Toolbox.

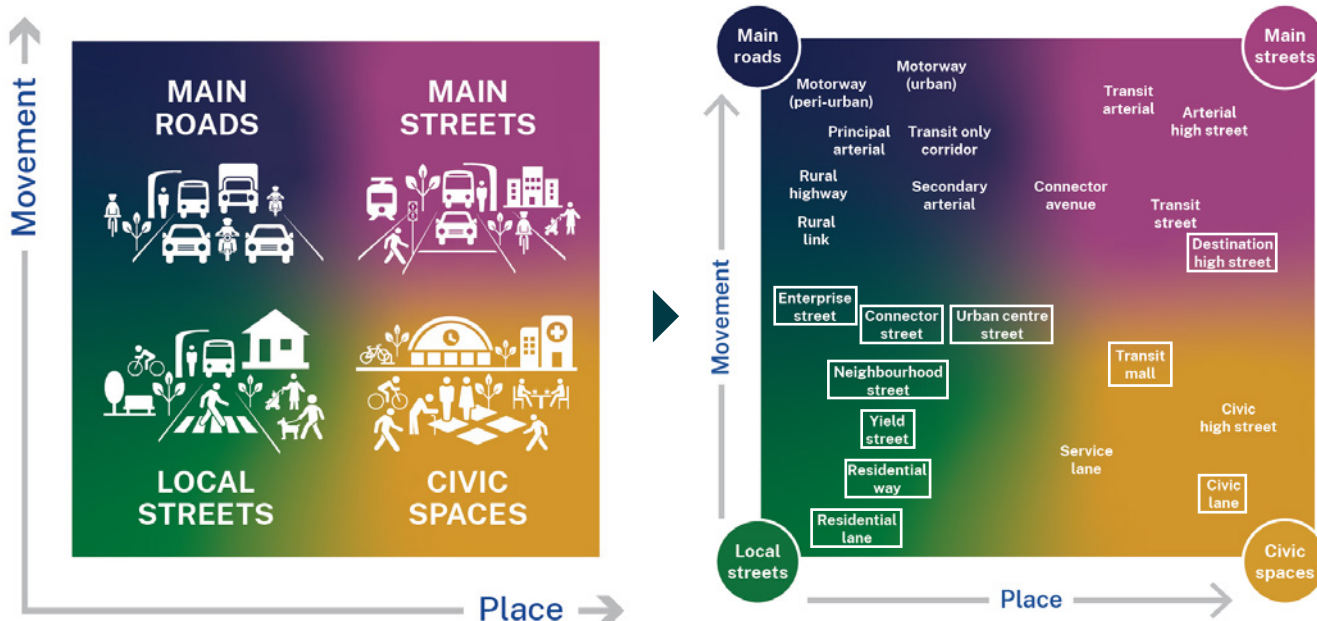
To support the DORAS principle of “contextual design”, the planning and design of the street network and hierarchy should emphasise the close coordination required between the street type choice, its detailed design, and the subdivision of lots or cadastral “Place” determinants. That is, the place consideration is not just about the public domain ‘things’ within the street reserve like trees, but integrated design along the street/lot interface.

The street types presented within the Guidelines primarily target the Local Streets included within DORAS, with additional street types included where determined relevant.

Street types include:

- Destination high street
- Transit mall
- Enterprise street
- Urban centre street
- Connector street
- Neighbourhood street
- Yield street
- Residential way
- Residential lane
- Civic lane

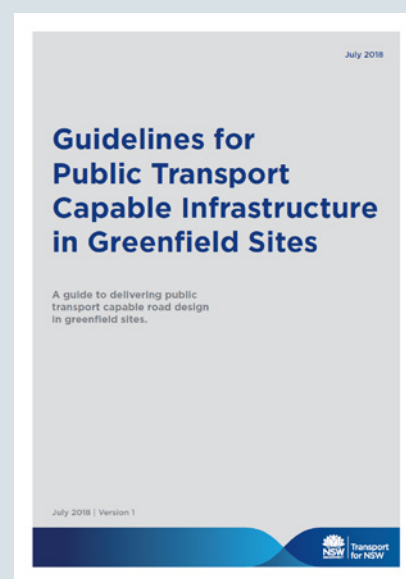
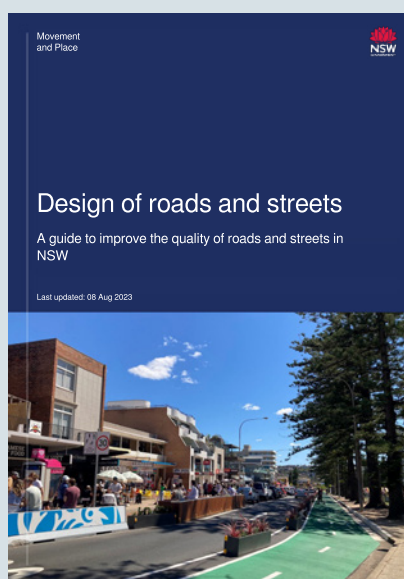
These street types are identified within the Movement and Place matrix below. The street designs presented herein are primarily intended to guide the design of new streets, however may be relevant for design updates to existing streets.



Transport for NSW's Movement and Place matrix (left) with street types presented in the Design of Roads and Streets Guide (right)

CROSS REFERENCES

The below suite of documents should be referred to in the preparation of subdivision and street design.



Suite of Transport for NSW strategic guidelines

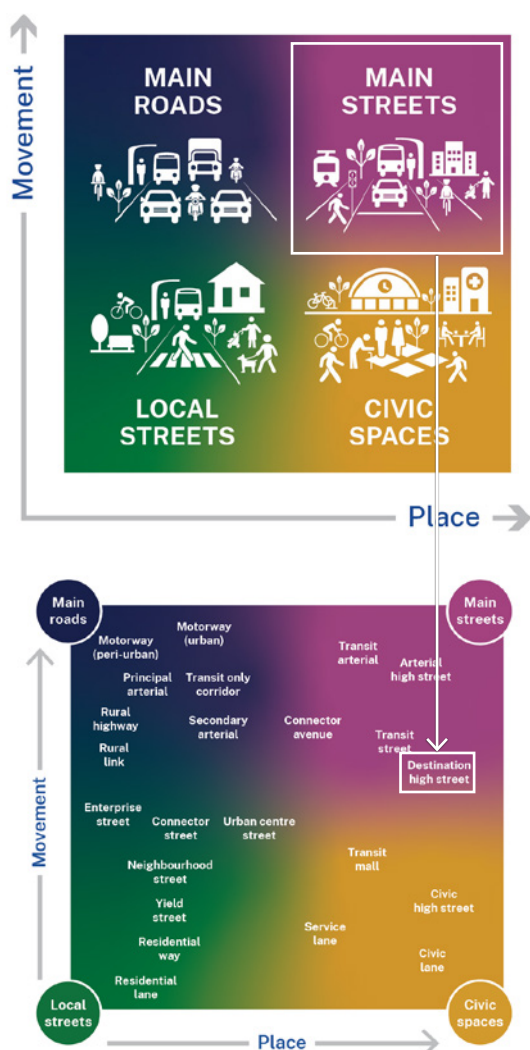
Destination High Street

Overview

Destination High Streets are unique to commercial centres. High quality public amenity and generous verge space are crucial to the various environmental and community uses unique to Destination High Streets.

Destination High Streets are designed to foster street life and activity. Pedestrian amenity is prioritised and assembling in the street is encouraged. Footpaths are designed to accommodate high pedestrian traffic alongside other footpath uses such as seating and retail spill out. Dedicated cycling facilities provide safe and convenient access to destinations for people riding bikes.

Alignment with Movement and Place



Street priorities

- Footpaths are generous and wide. Continuous footpath treatments are generally provided at intersections.
- Street components like kerb extensions are incorporated mid-block and at intersections
- Vehicle lanes allow for local bus routes. 'In-line' bus stops are provided for local routes to maintain bus priority and continuity of verge arrangement. Indented bus stops may be required on longer road segments or where buses are more frequent, to cater for operational needs, and dwelling for reasons other than setting down/picking up passengers (this should be planned in collaboration with TfNSW). Indented bus stop bays in the flex zone are to be 3m wide (locally), encroaching on the verge.
- Street tree planting provides a continuous tree canopy at maturity. Low-flow runoff passively irrigates street trees and planting
- WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes
- On-street vehicle parking is effectively integrated within the streetscape via indented parking bays that adopt permeable paving where suited to local soils
- Driveways are preferably located on rear lanes or side streets to minimise conflicts between vehicles and pedestrians

PERFORMANCE BASED FRAMEWORK

Road reserve	≥20m
Typical AADT	≤10,000
Freight access	Service and delivery vehicles
Posted speed	30-40km/h
Design speed	Same as posted speed
Design vehicle	B85 car
Check vehicle	Single unit truck/bus (12.5m)
Bus capable	Yes
Vehicle travel lanes	2x 3.2m (+ 0.3m buffer for bus capability)
Parking provision	Varies
Parking arrangement	2.3m indented parking bays
Walking	≥3.0m footpaths on both sides
Cycling	Within travel lane
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

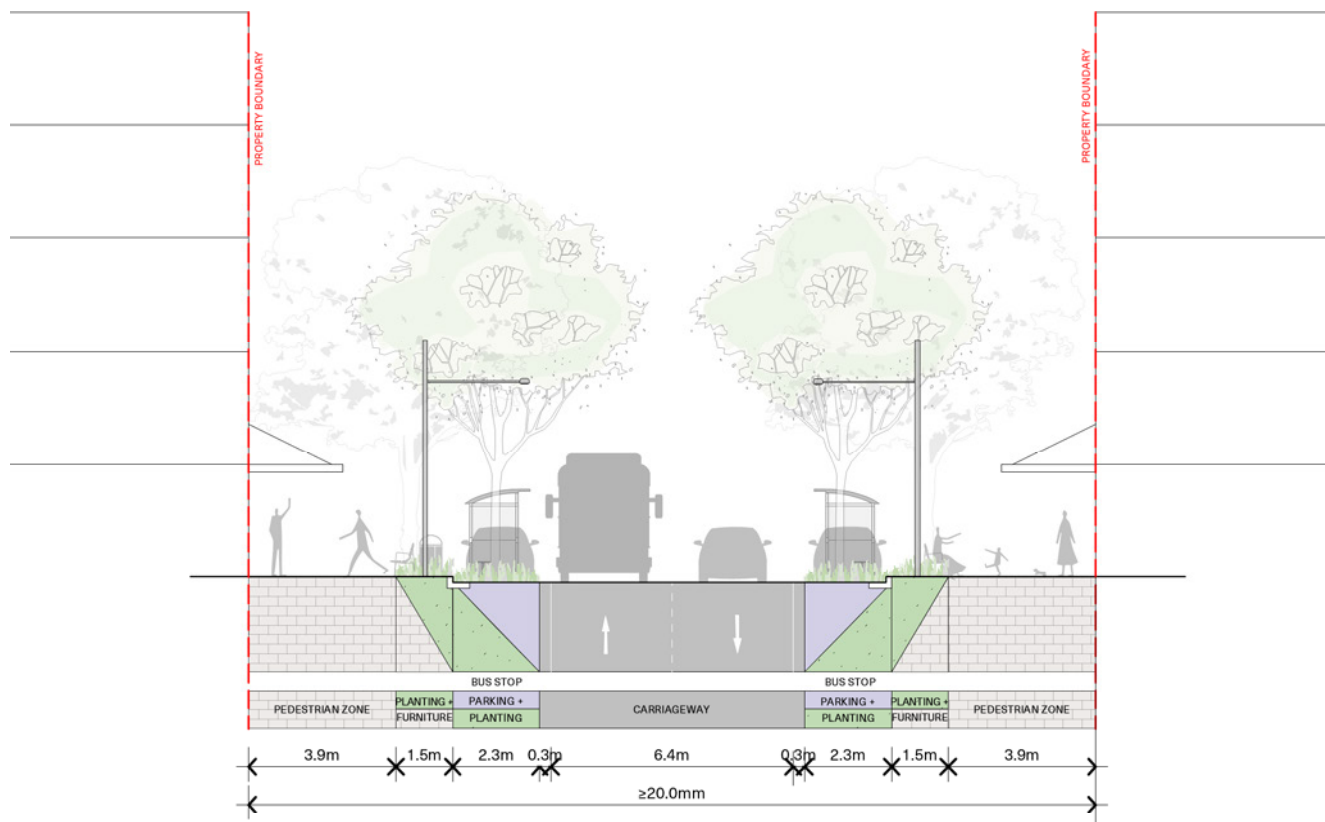


Precedent: Main Street, Rouse Hill (source: Google)

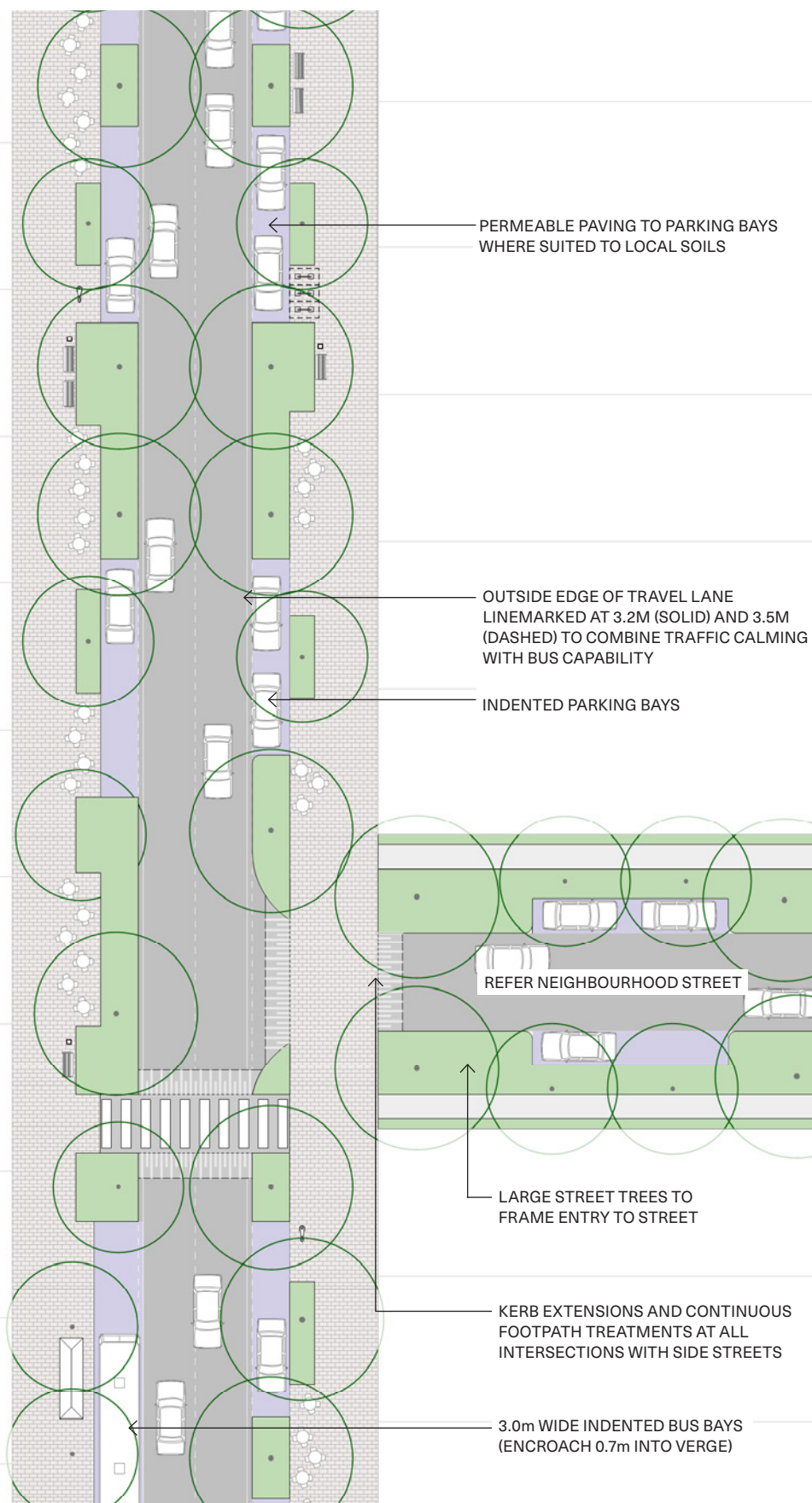


Precedent: High Street, Penrith (source: Google)

Typical cross section – Destination High Street



Typical concept plan – Destination High Street



Enterprise Street

Overview

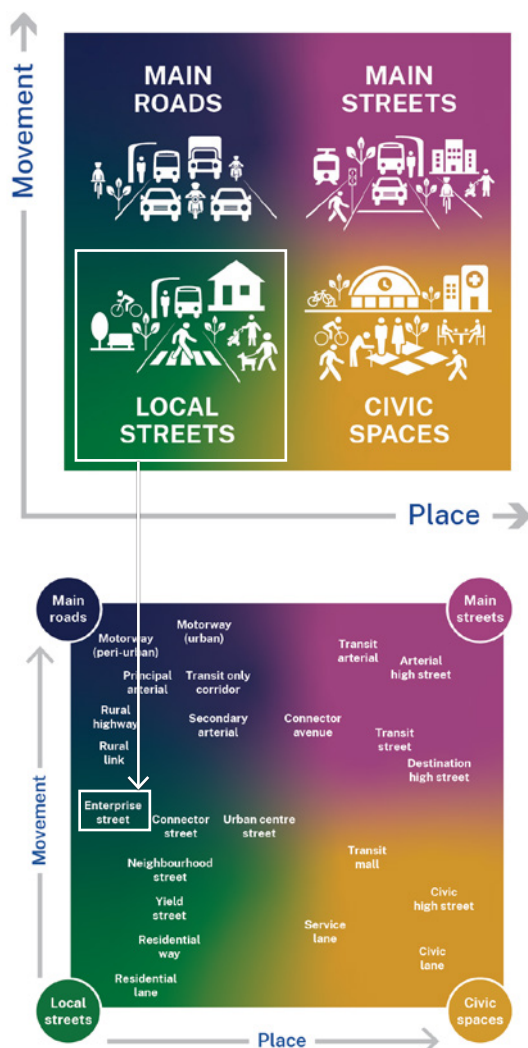
Enterprise Streets serve commercial and industrial areas, catering for both employees of these areas as well as people who deliver freight and servicing using light to heavy vehicles.

Areas within which Enterprise Streets are found are typically underserved by active and public transport, presenting an opportunity to affect sustainable mode shift by providing comfortable spaces for people to walk or ride.

Street priorities

- Paths are provided on both sides for continuous and universal accessibility
- A shared path provides a safe space for people riding bikes
- Indented bus stop bays in the flex zone are to be 3m wide (locally), encroaching on the footpath.
- Street tree planting provides a continuous tree canopy at maturity
- Low-flow runoff passively irrigates street trees and planting. WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes.
- On-street vehicle parking is effectively integrated within the streetscape via indented parking bays
- Turning movements of heavy vehicles and heavy goods vehicles
- Adopt a 26m B-double check vehicle if located on a D-double route

Alignment with Movement and Place



PERFORMANCE BASED FRAMEWORK

Road reserve	≥ 21.5m
Typical AADT	1,000 - 4,000
Freight access	Service and delivery vehicles
Posted speed	40-50km/h
Design speed	Same as posted speed
Design vehicle	19m semi-trailer
Check vehicle	19m semi-trailer
Bus capable	Yes
Vehicle travel lanes	2 x 3.2m (+ 0.3m buffer for bus capability)
Parking provision	Varies
Parking arrangement	2.3 - 3.0m indented parking bays (widen if needed for design vehicle such as freight/delivery vehicles to park without encroaching in travel lane)
Walking	1x ≥1.5m footpath + 1x ≥3.0m shared path
Cycling	1x ≥3.0m shared path
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	60% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

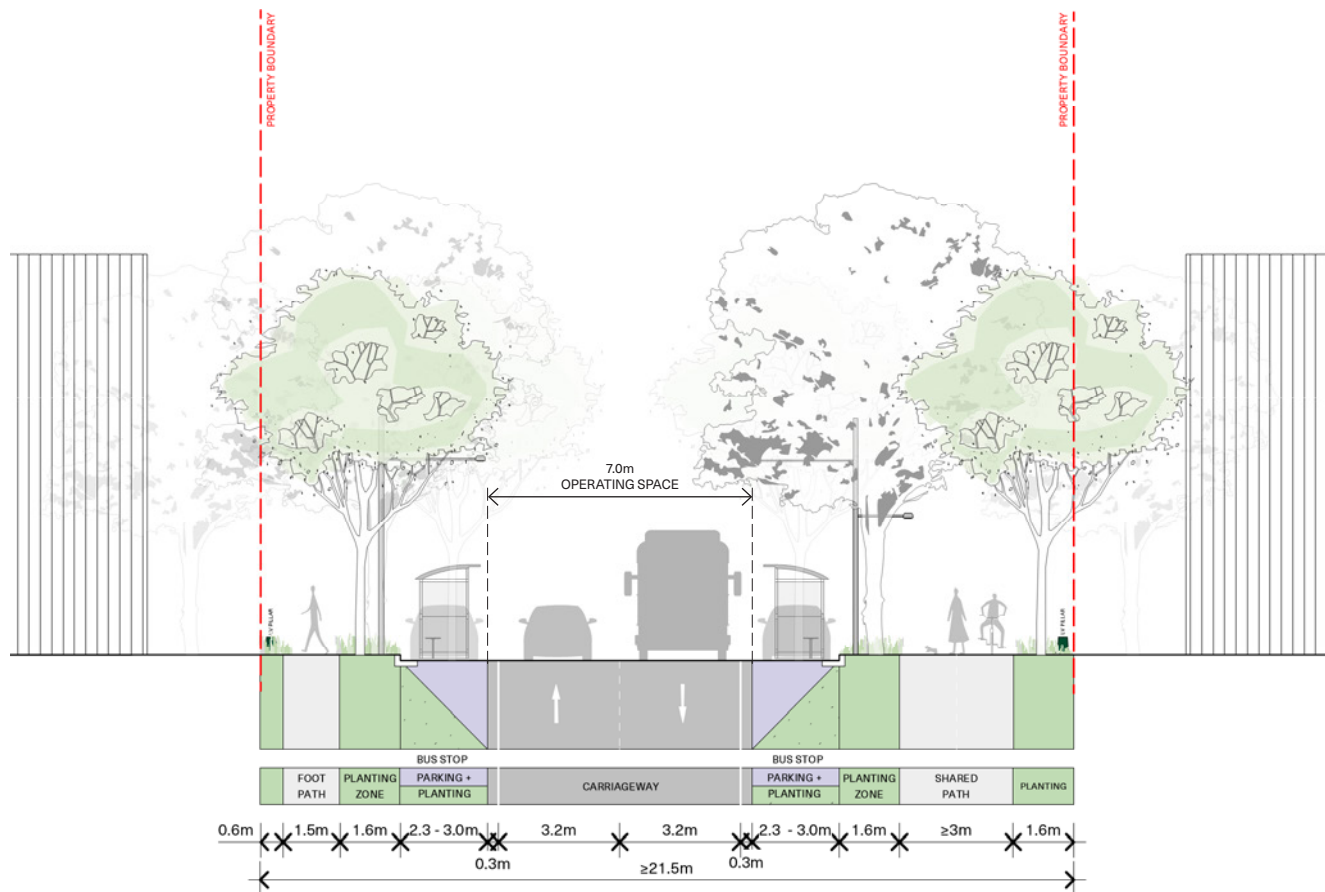


Precedent: Newton Road, Wetherill Park (source: Google)

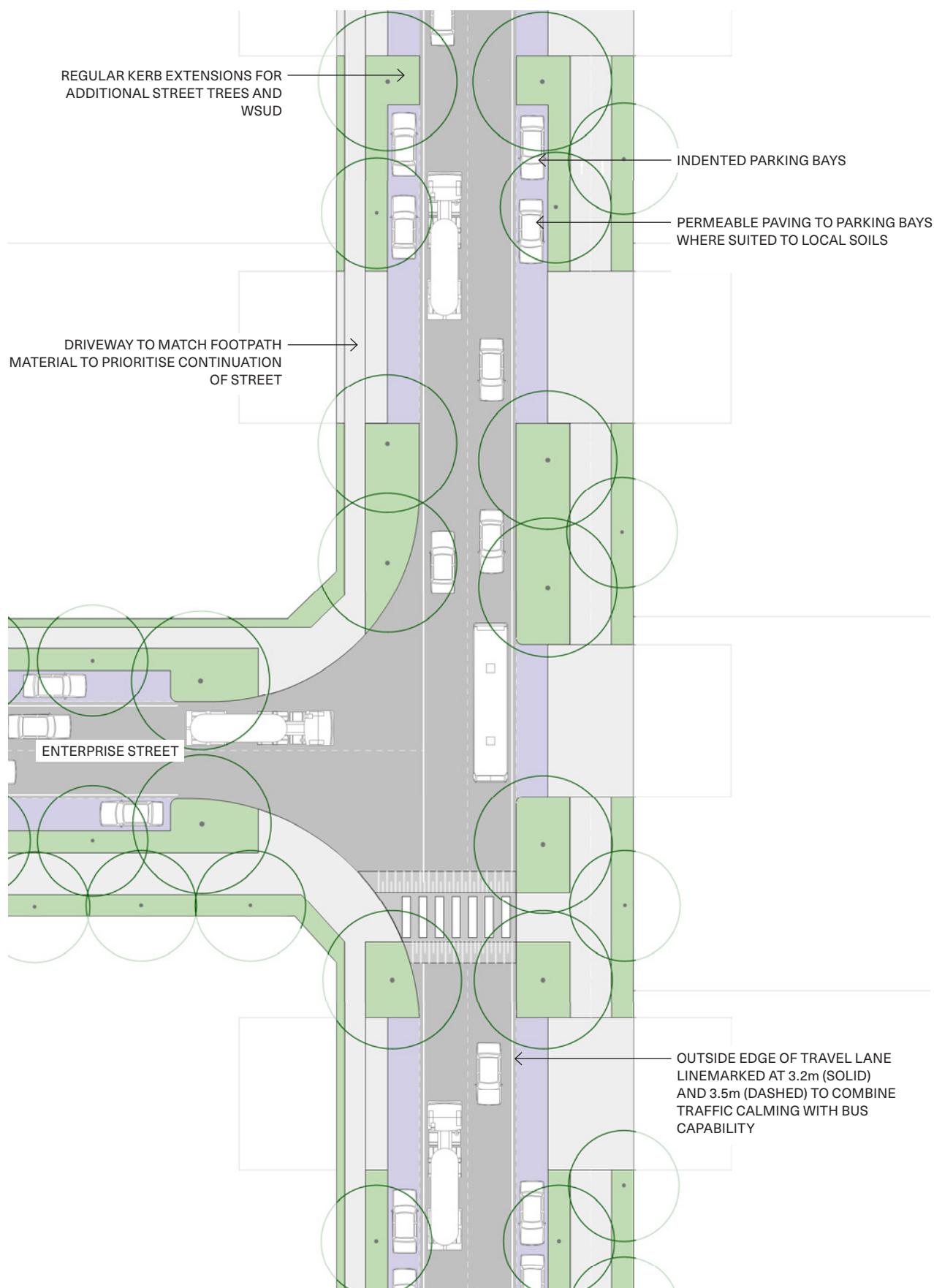


Precedent: Lockwood Road, Erskine Park (source: Google)

Typical cross section – Enterprise Street



Typical concept plan – Enterprise Street



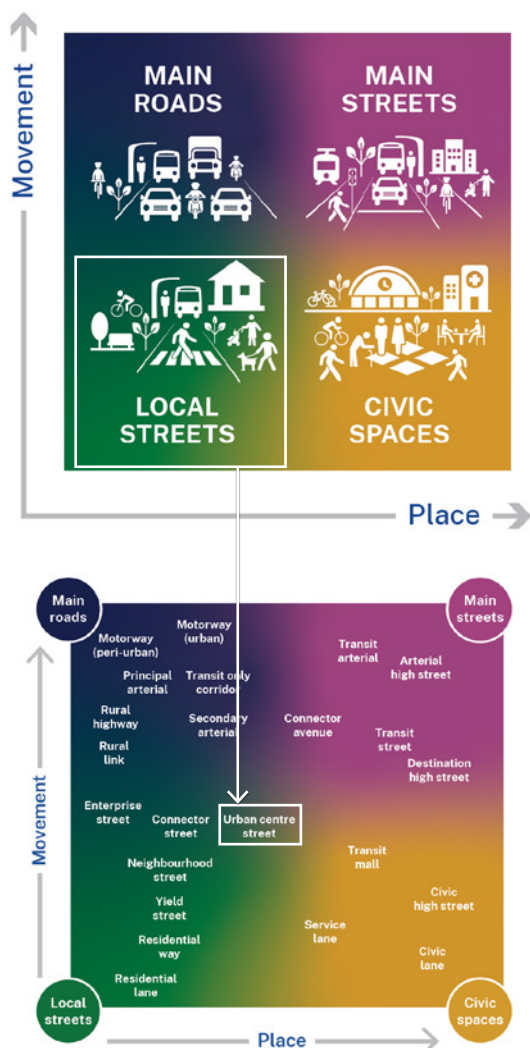
Urban Centre Street

Overview

Urban Centre Streets play a significant role in shaping the overall urban structure of an area. They are often fronted with a mix of commercial, civic, retail and residential buildings and open spaces. Their street edge is generally inconsistent, punctuated with areas of open space and building setbacks.

Street space allocation should prioritise the convenience, amenity, and safety for people walking, as well as allowing for uses of the street that encourage local economic activity and public space activation, while slower vehicle speeds creates a safer and more welcoming environment and enables more pedestrian and bicycle friendly intersections.

Alignment with Movement and Place



Street priorities

- Footpaths are generous and wide. Continuous footpath treatments are generally provided at intersections.
- Separated cycleways are provided for convenient access to destinations for people riding bikes
- Vehicle lanes allow for local bus routes. 'In-line' bus stops are provided for local routes to maintain bus priority and continuity of verge arrangement. Indented bus stops may be required on longer road segments or where buses are more frequent, to cater for operational needs, and dwelling for reasons other than setting down/picking up passengers (this should be planned in collaboration with TfNSW). Indented bus stop bays in the flex zone are to be 3m wide (locally), encroaching on the verge.
- Street tree planting provides a continuous tree canopy at maturity
- Low-flow runoff passively irrigates street trees and planting, with WSUD elements maximised to ensure neighbourhood-scale WSUD performance outcomes
- On-street vehicle parking is effectively integrated within the streetscape via indented parking bays that adopt permeable paving where suited to local soils
- Driveways are preferably located on rear lanes or side streets to minimise conflicts between vehicles and pedestrians

PERFORMANCE BASED FRAMEWORK

Road reserve	≥ 21.5m
Typical AADT	1,000 - 4,000
Freight access	Service and delivery vehicles
Posted speed	40-50km/h
Design speed	Same as posted speed
Design vehicle	8.8m service vehicle
Check vehicle	8.8m service vehicle 12.5m bus (if on bus route)
Bus capable	Yes
Vehicle travel lanes	2x 3.2m (+ 0.3m buffer for bus capability)
Parking provision	Varies
Parking arrangement	2.3m indented parking bays
Walking	≥3.0m footpaths on both sides
Cycling	≥2.5m separated cycleway or 2x ≥1.5m unidirectional cycleways
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

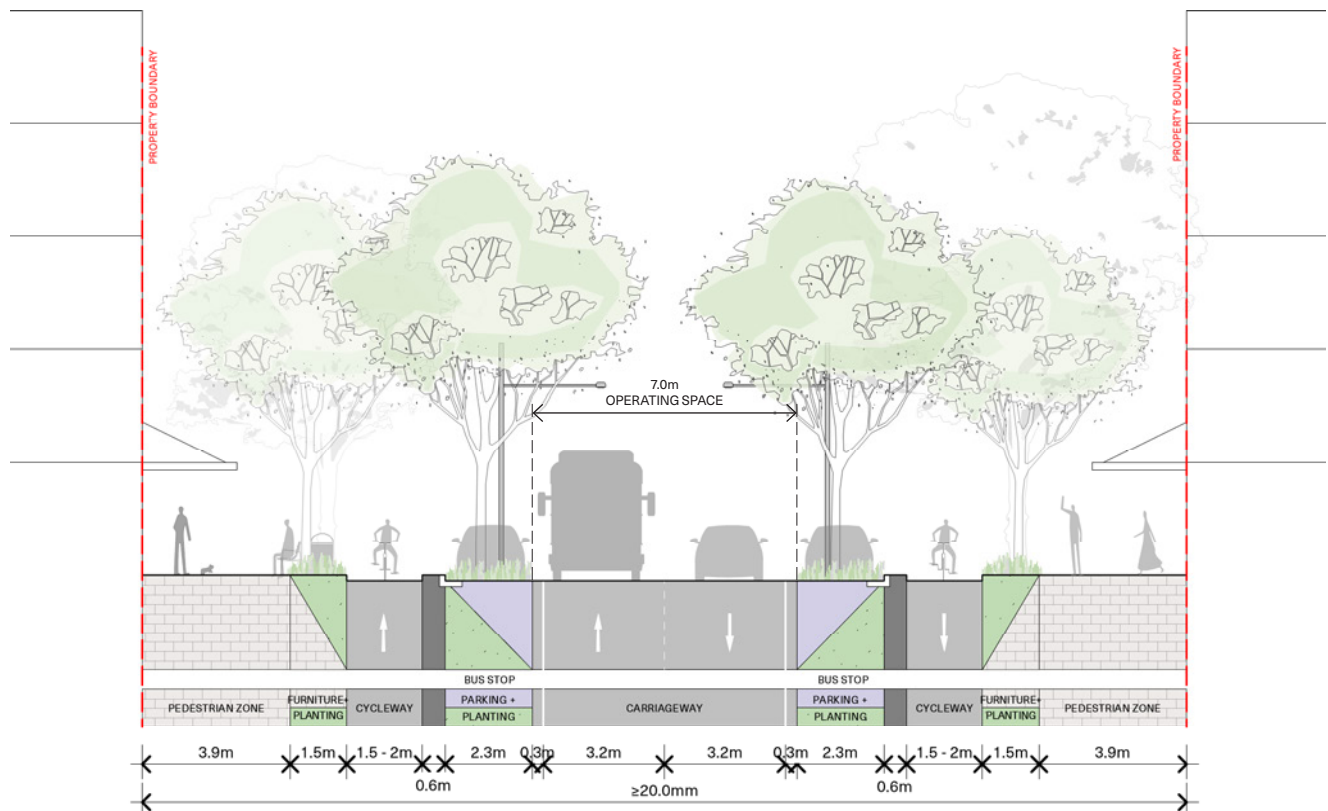


Precedent: Bigge Street, Liverpool (source: Google)

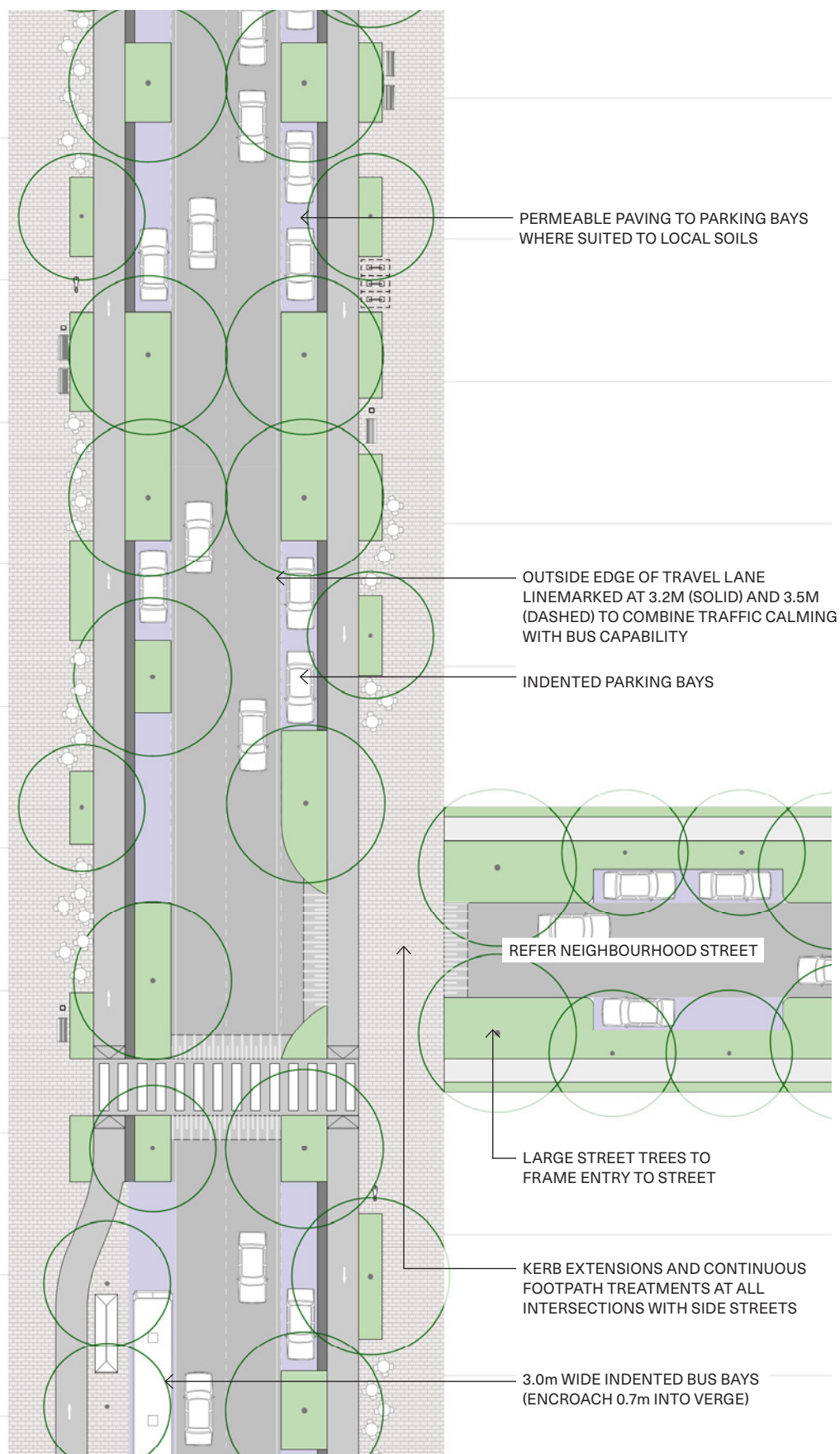


Precedent: Macquarie Street, Liverpool

Typical cross section – Urban Centre Street



Typical concept plan – Urban Centre Street



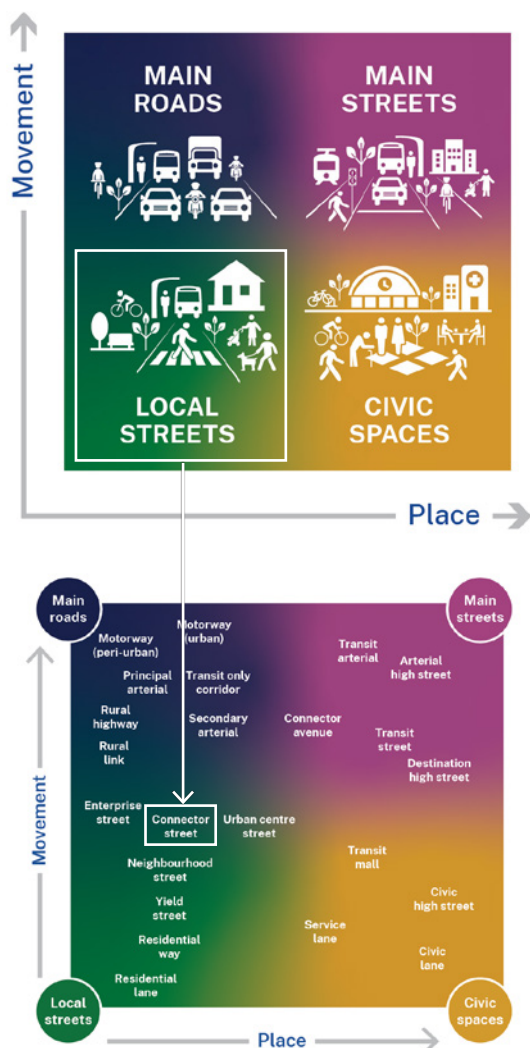
Connector Street

Overview

Connector Streets typically form the primary thoroughfare route into and through residential neighbourhoods. They provide important connections within and between neighbourhoods to key local destinations.

The character of Connector Streets is important to neighbourhood legibility and sense of place. Environment and local life predominate, and improved amenity is encouraged over the use of private vehicles. High quality walking, cycling and public transport facilities are all prioritised within these streets to promote sustainable travel options.

Alignment with Movement and Place



Street priorities

- Footpaths on both sides of the street for continuous and universal accessibility
- Cycling facilities provide neighbourhood-wide access for people riding bikes
- Vehicle lanes allow for local bus routes
- ‘In-lane’ bus stops are provided on local routes to maintain bus priority, maximise space for bus stop amenities, and minimise impacts on continuity of verge arrangement
- Pullover bus bays are provide on frequent routes for operational requirements
- Consult with Transport for NSW regarding the possibility of future conversion of the kerbside lane to a bus lane, in relation to lane width, landscape treatments, traffic calming, and the like
- Street tree planting provides a continuous tree canopy at maturity
- Low-flow runoff passively irrigates street trees and planting
- On-street vehicle parking is effectively integrated within the streetscape via indented parking bays that adopt permeable paving where suited to local soils

PERFORMANCE BASED FRAMEWORK

Road reserve	≥21.5m
Typical AADT	2,000 - 5,000
Freight access	Service and delivery vehicles
Posted speed	40-50km/h
Design speed	Same as posted speed
Design vehicle	8.8m service vehicle, 12.5m bus (if on bus route)
Check vehicle	12.5m bus/truck
Bus capable	Yes
Vehicle travel lanes	2x 3.2m (+ 0.3m buffer for bus capability)
Parking provision	Varies
Parking arrangement	2.3m indented parking bays
Walking	≥1.5m footpaths on both sides; or 1x ≥1.5m footpath + 1x ≥3.0m shared path
Cycling	≥2.5m separated cycleway; or 1x ≥3.0m shared path
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

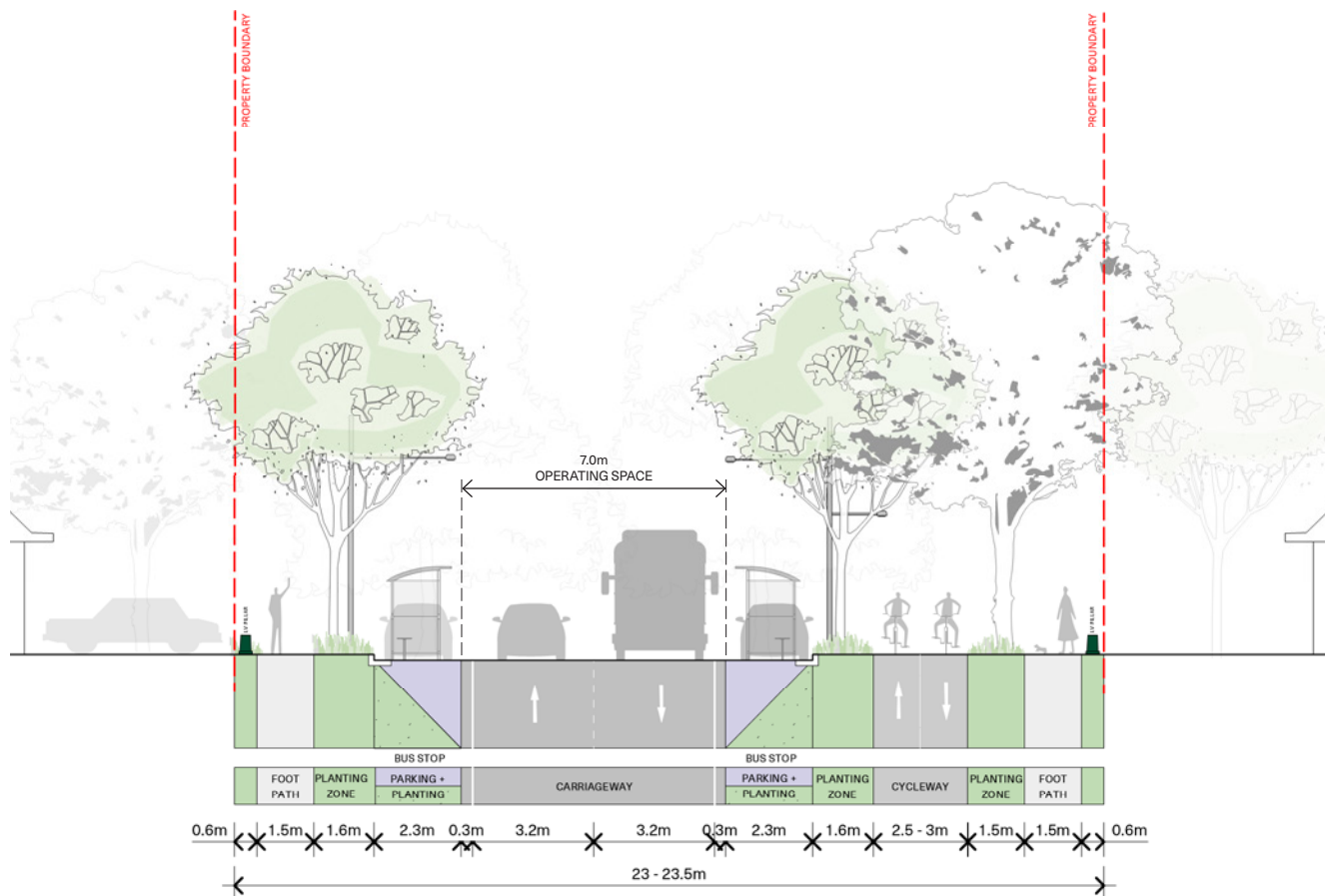


Precedent: Station Street, Penrith (source: Google)

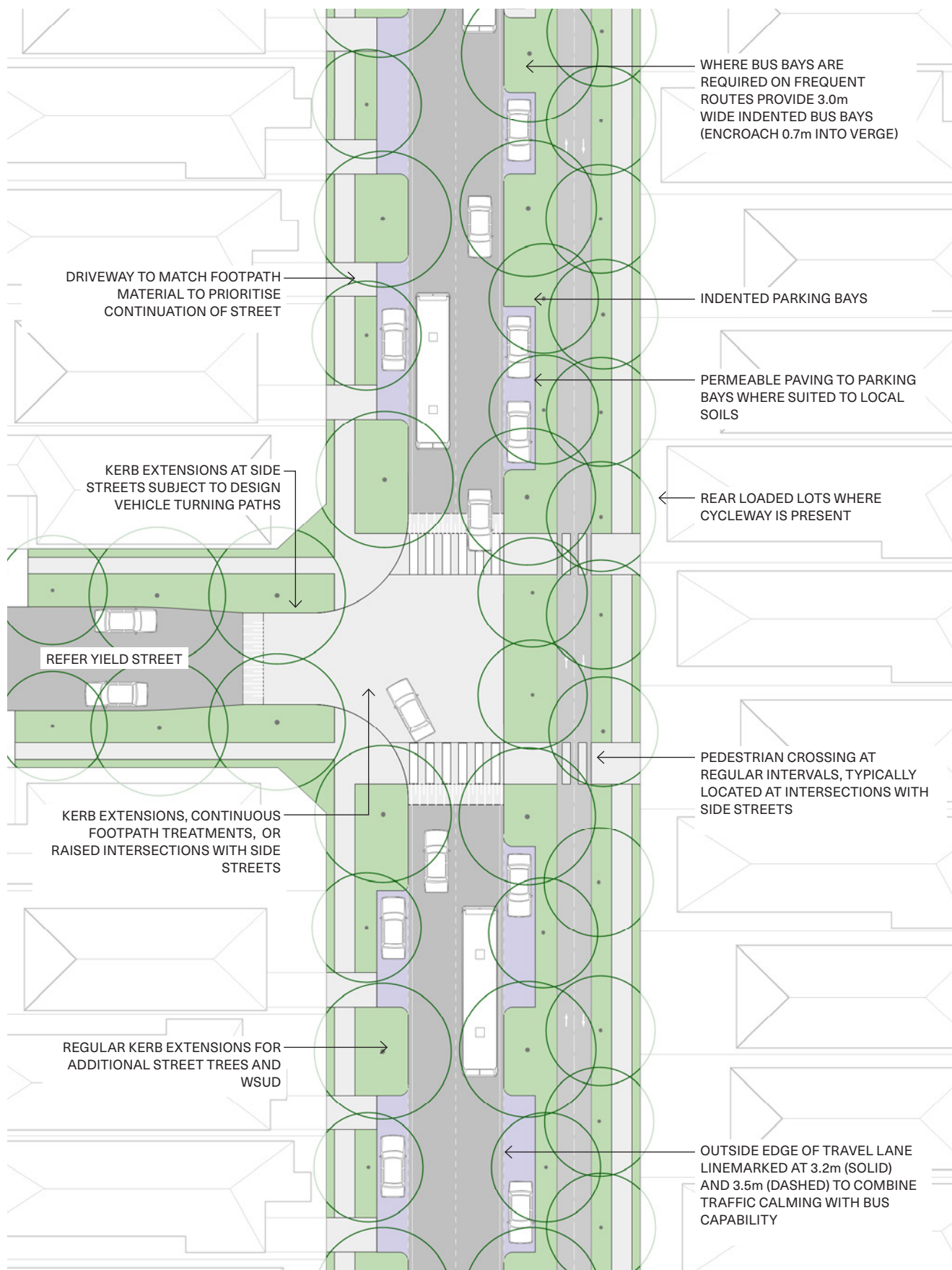


Precedent: Derby Street, Kingswood (source: Google)

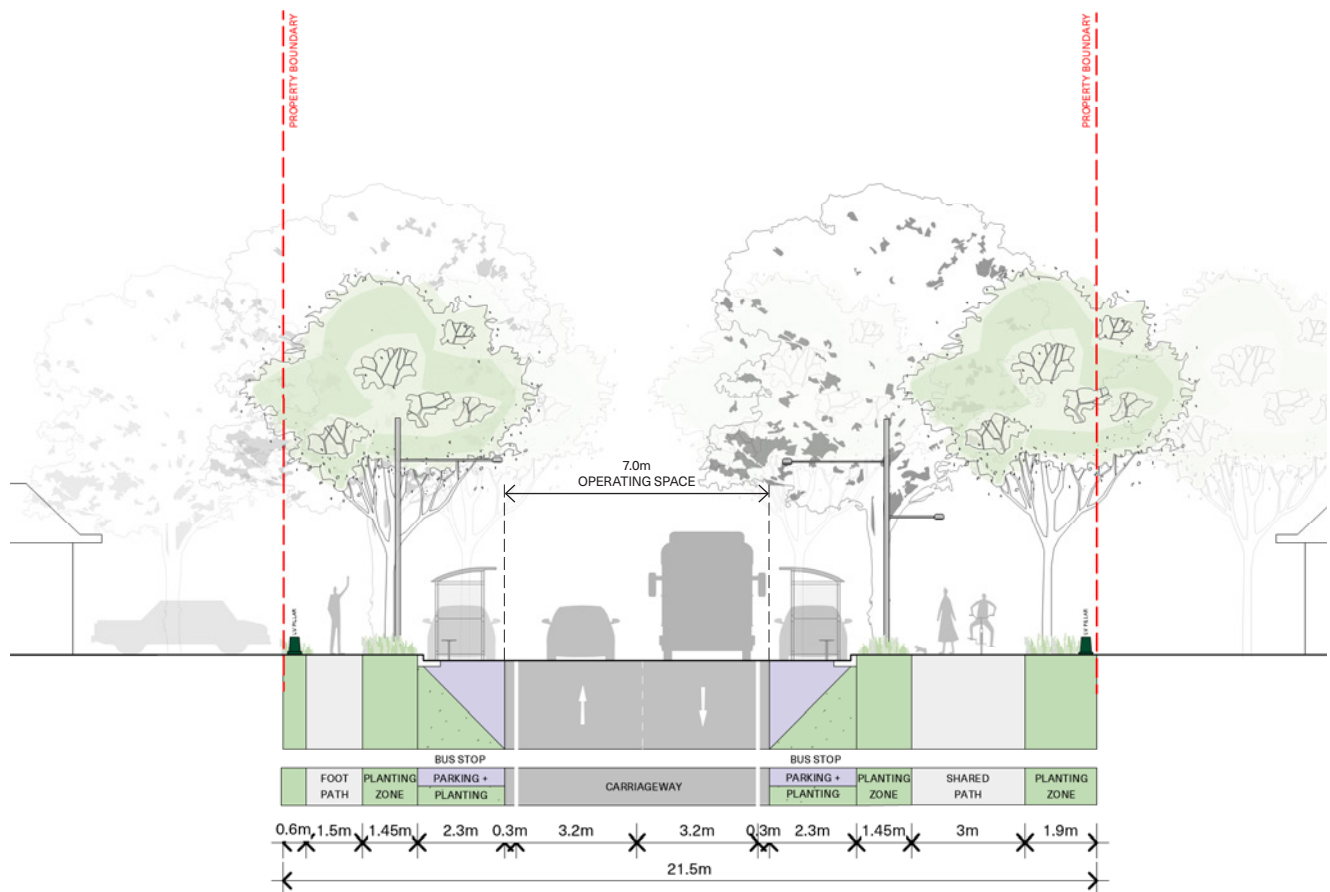
Typical cross section – Connector Street (separated cycleway)



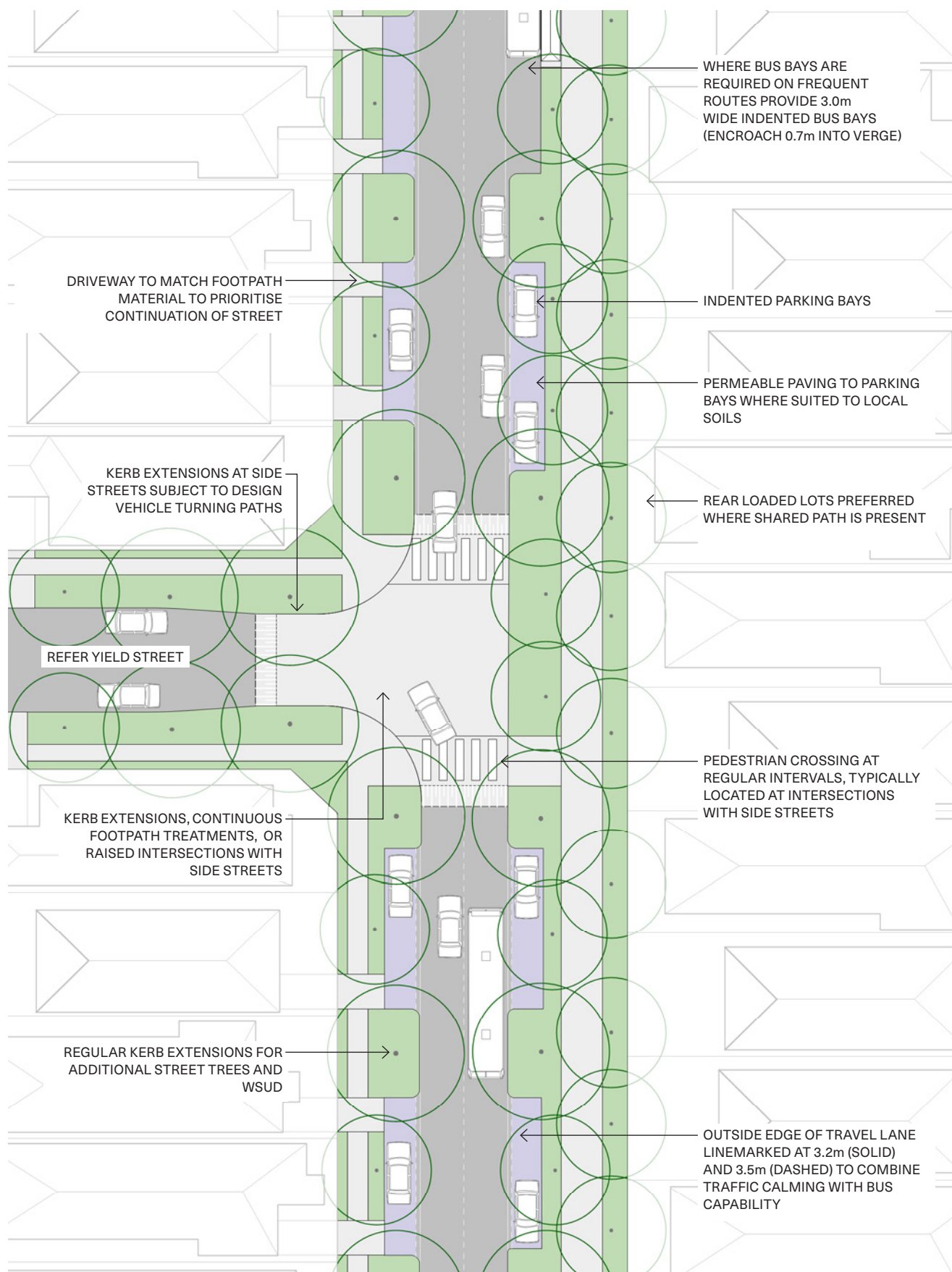
Typical concept plan – Connector Street (separated cycleway)



Typical cross section – Connector Street (shared path)



Typical concept plan – Connector Street (shared path)



Neighbourhood Street

Overview

Neighbourhood Streets are quiet, predominantly residential streets that are designed to maximise place outcomes and encourage people to spend time in a low speed environment.

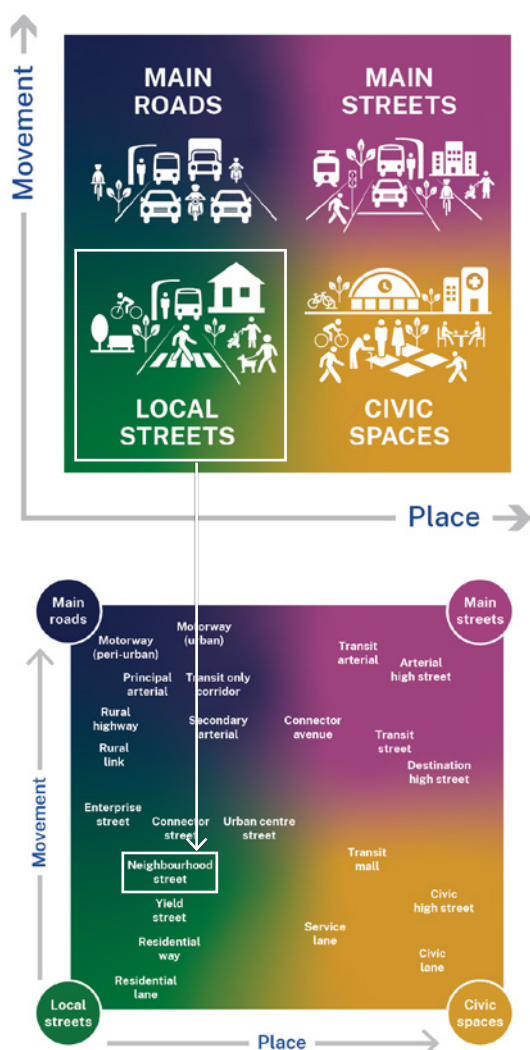
They are designed to accommodate low to medium levels of through-traffic around local destinations such as schools and open spaces.

Street trees and indented parking bays line both sides of a relatively narrow carriageway and verges give space to various environmental and community uses.

Street priorities

- Footpaths are provided on both sides for continuous and universal accessibility
- A slow street environment allows for cyclists of all ages to safely use the vehicle travel zone
- Street tree planting provides a continuous tree canopy at maturity
- Low-flow runoff passively irrigates street trees and planting
- WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes
- On-street vehicle parking is effectively integrated within the streetscape via indented parking bays that adopt permeable paving where suited to local soils

Alignment with Movement and Place



PERFORMANCE BASED FRAMEWORK

Road reserve	≥18m
Typical AADT	500 - 2,000
Posted speed	30-40 km/h
Design speed	Same as posted speed
Design vehicle	5.3m passenger car
Check vehicle	8.8m service vehicle, 12.5m bus (if on bus route)
Bus capable	Varies
Vehicle travel lanes	2 x 3.0m (3.2m on bus routes)
Parking provision	≤0.75 per lot
Parking arrangement	2.1m indented parking bays
Walking	≥1.5m footpaths on both sides
Cycling	Quietway - refer TfNSW Cycleway Design Toolbox
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

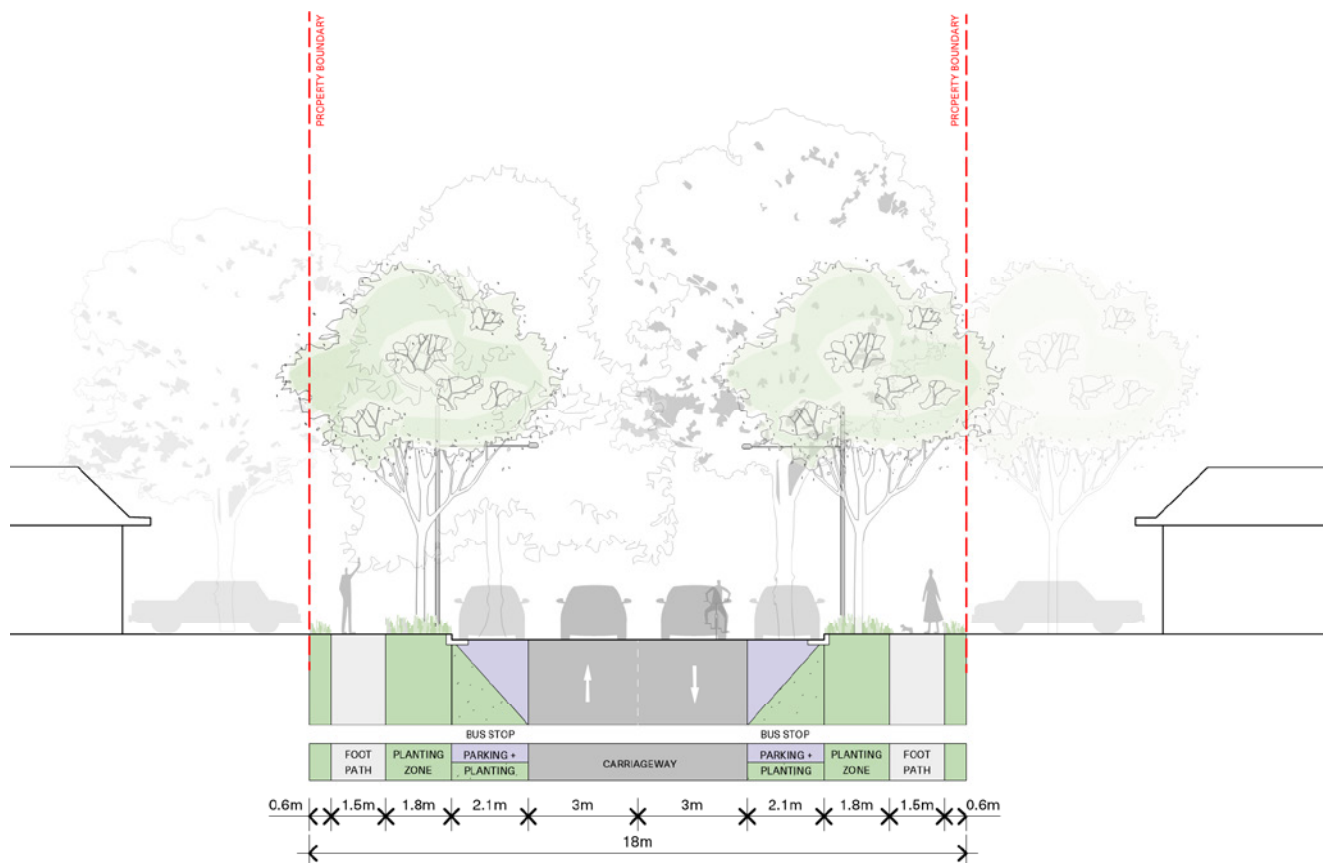


Precedent: Antwerp Street, Bankstown (source: Google)

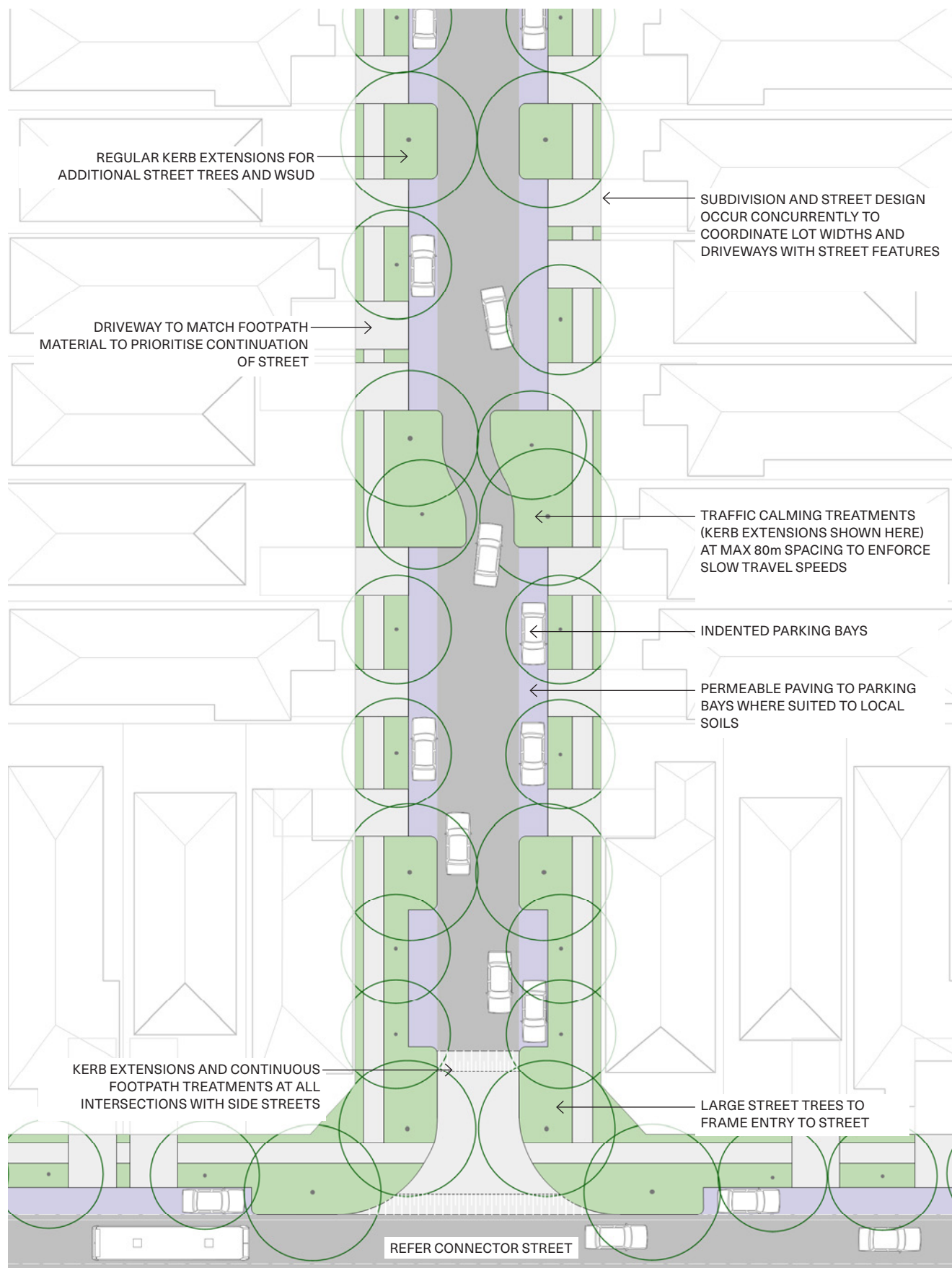


Precedent: Pennyroyal Boulevard, Denham Court (source: Google)

Typical cross section – Neighbourhood Street



Typical concept plan – Neighbourhood Street



Yield Street

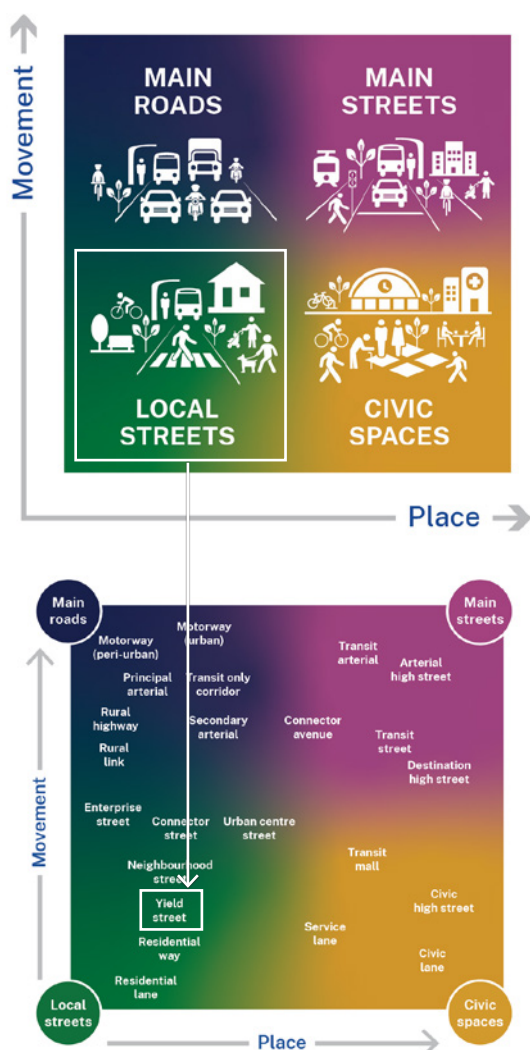
Overview

Yield Streets are quiet residential streets designed to be very slow speed environments. They are two-way, with a relatively low volume of traffic, providing an amenable living environment for residents and slow movement space for people travelling along the street.

Yield streets require slower, cooperative driving—people driving vehicles yield to one another where the available driving space is constrained by parked vehicles or other traffic calming measures.

Narrow carriageways also provide for larger verge dimensions, creating significant soil volumes for optimal street tree growth and canopy coverage of footpaths and the carriageway.

Alignment with Movement and Place



Street priorities

- *Note: This type is not appropriate in situations where demand for on-street parking is projected to be high (e.g. areas with several narrow lots, near shops, near train stations, or without frequent driveways). Otherwise, this will ultimately result in the street only functionally having a single travel lane, and require costly interventions such as indented parking bays.*
- Footpaths on both sides of the street for continuous and universal accessibility
- Very slow street environment allows for cyclists to safely use the vehicle travel zone
- Verges on both sides of the street provide adequate soil volume for optimal street tree growth and a continuous tree canopy at maturity
- All impervious surfaces graded to allow for passive irrigation of street planting
- WSUD systems are provided at key locations (e.g. intersections with other streets) to improve water quality.
- Design as 'very slow streets' with minimised carriageways and increased vehicle calming measures

PERFORMANCE BASED FRAMEWORK

Road reserve	≥16m
Typical AADT	500 - 2,000
Posted speed	20-40km/h
Design speed	Same as posted speed
Design vehicle	5.3m passenger car
Check vehicle	8.8m service vehicle
Bus capable	No
Vehicle travel lanes	=7.6m kerb-to-kerb two-way carriageway
Parking provision	≤0.75 per lot
Parking arrangement	Kerbside within carriageway to enforce yield for vehicles (no indented bays)
Walking	≥1.5m footpaths on both sides
Cycling	Quietway - refer TfNSW Cycleway Design Toolbox
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

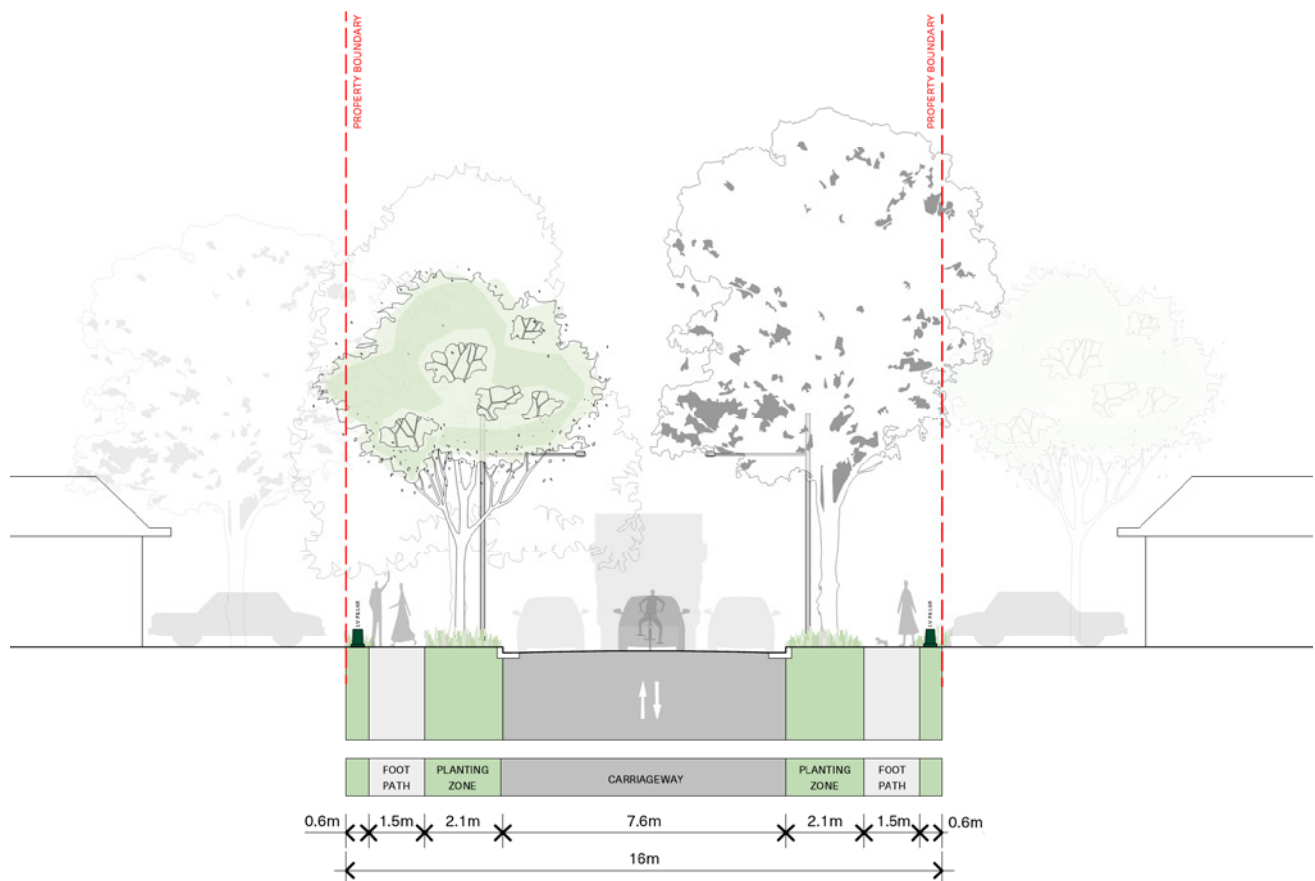


Precedent: Orth Street, Kingswood (source: Google)

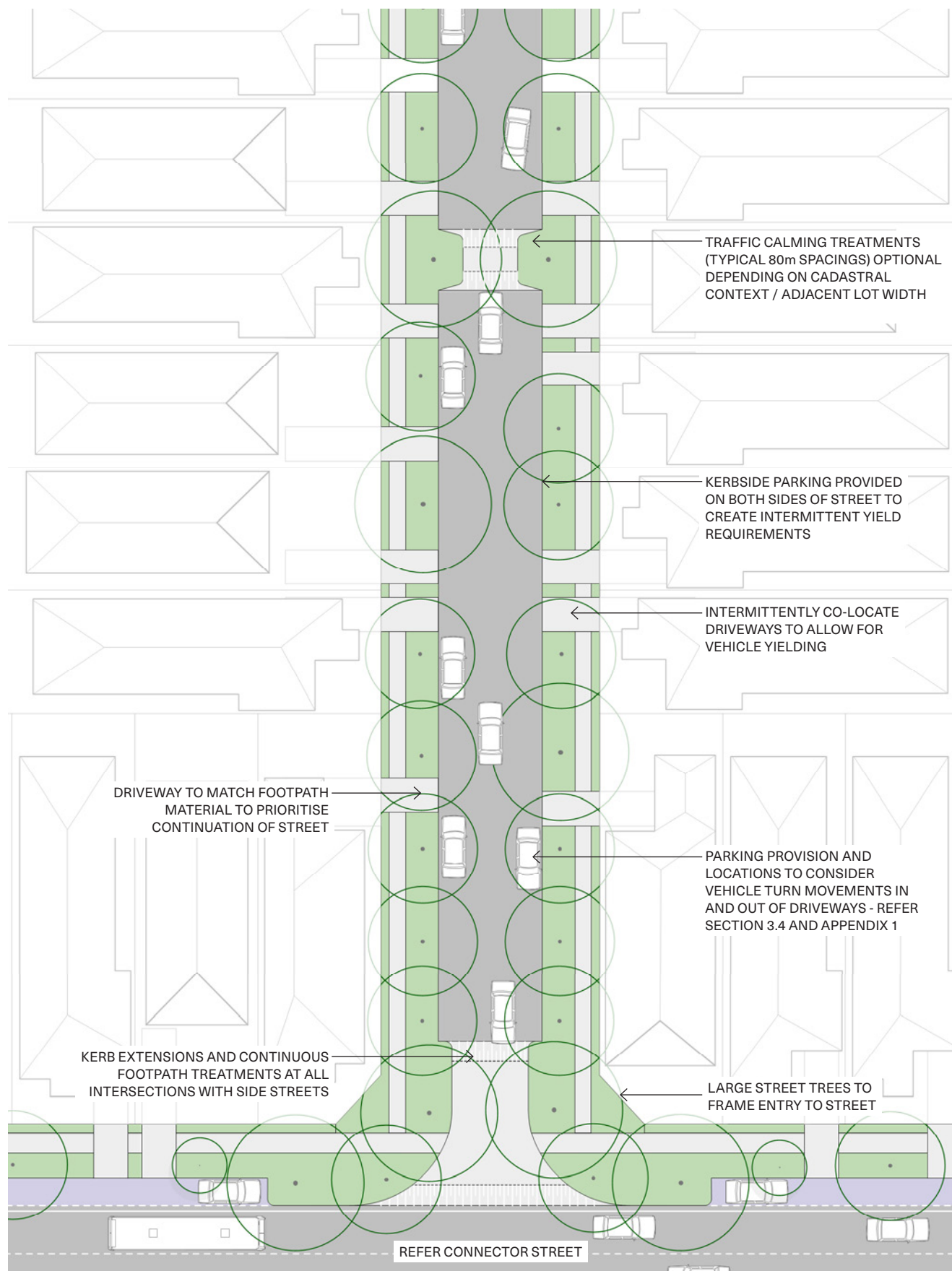


Precedent: Butler Crescent, South Penrith (source: Google)

Typical cross section – Yield Street



Typical concept plan – Yield Street



Residential Way

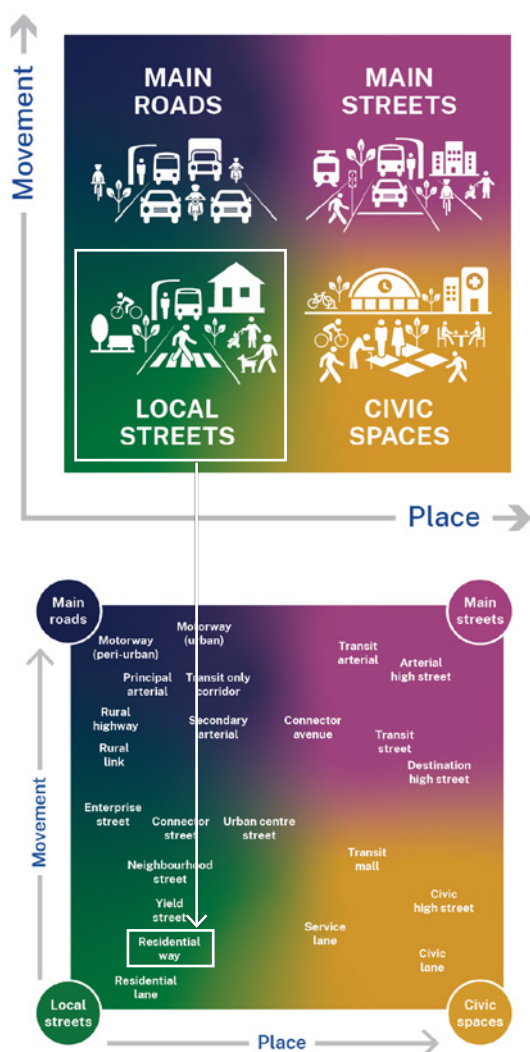
Overview

Residential Ways are very quiet residential streets that encourage a variety of place and movement uses, creating safe environments for all street users to spend time in. They provide a very low speed and volume of movement within a shared travel zone designed to prioritise pedestrian and environmental amenity. The use of traffic calming measures encourages informal sharing of street space between all street users. Residential Ways are designed to have a clearly identifiable shared zone character, with either unstructured car parking or car parking on one side. They are generally two-way but can be implemented as one-way streets so long as adequate traffic calming is provided to reinforce safe vehicle travel speeds.

Street priorities

- A very slow shared zone street environment is provided which allows for pedestrians, cyclists of all ages and vehicles to safely use the travel zone
- Active travel infrastructure facilitates connectivity to nearby public transport stops
- Verge swales are utilised to consolidate large areas of soil for optimal street tree growth and a continuous tree canopy at maturity
- All impervious surfaces are graded to allow for passive irrigation of street planting
- Permeability of parking bays is maximised with street trees and WSUD features integrated

Alignment with Movement and Place



PERFORMANCE BASED FRAMEWORK

Road reserve	≥14m
Typical lots served	≈10-15
Typical AADT	100 - 1,000
Posted speed	10-20km/h
Design speed	Same as posted speed
Design vehicle	5.3m passenger car
Check vehicle	8.8m service vehicle
Bus capable	No
Vehicle travel lanes	5.6m one or two-way shared zone
Parking provision	≤0.5 per lot
Parking arrangement	≤2.4m indented parking bays (with 'parking in bays only' signage)
Walking	1.2m footpath and within shared zone
Cycling	Within shared zone
Traffic calming	≤80m spacings Refer Section 3.4
WSUD	Passive irrigation (low flow) Swale (high flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥35%

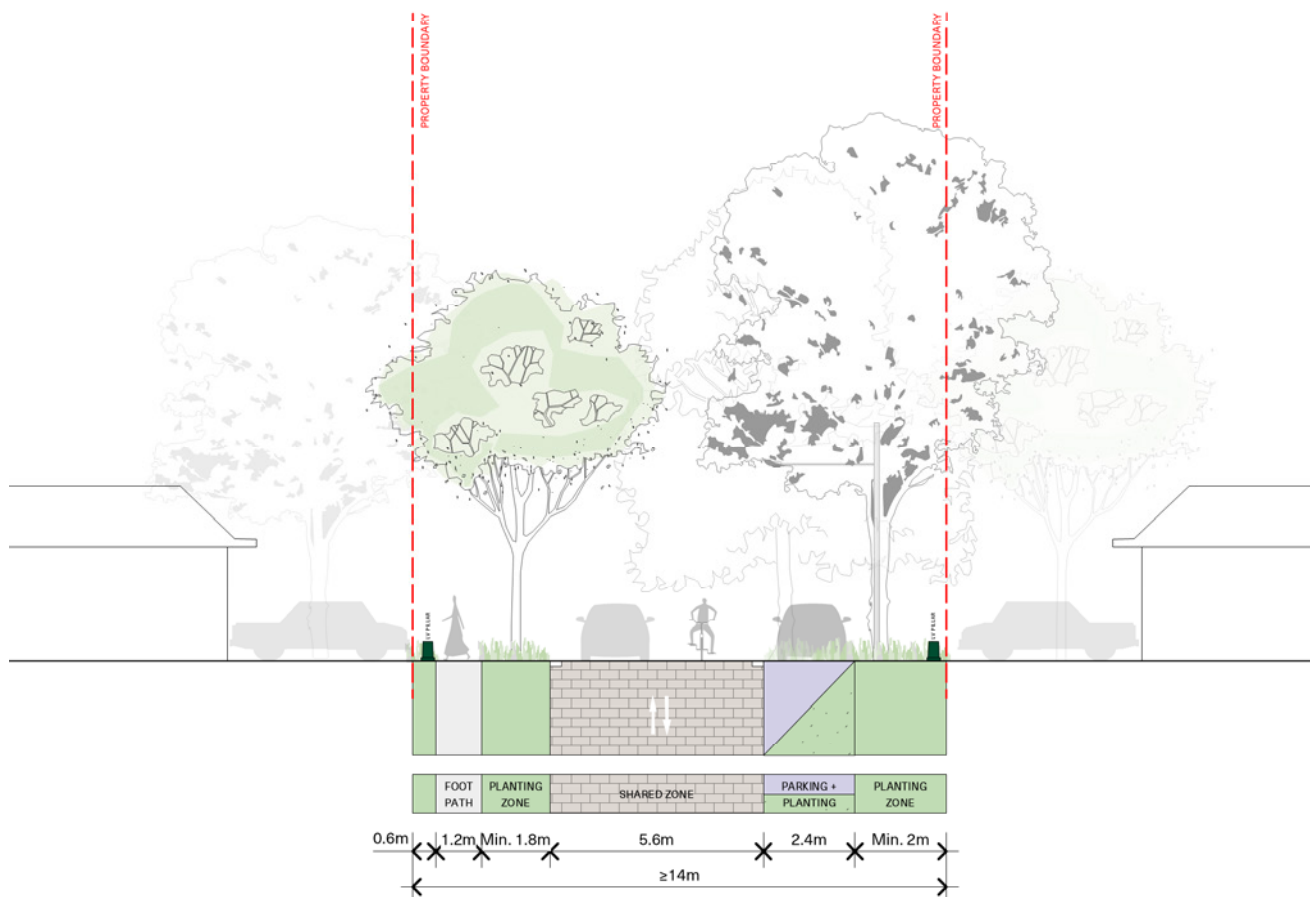


Precedent: Alliot Mews, Edmondson Park (source: Google)

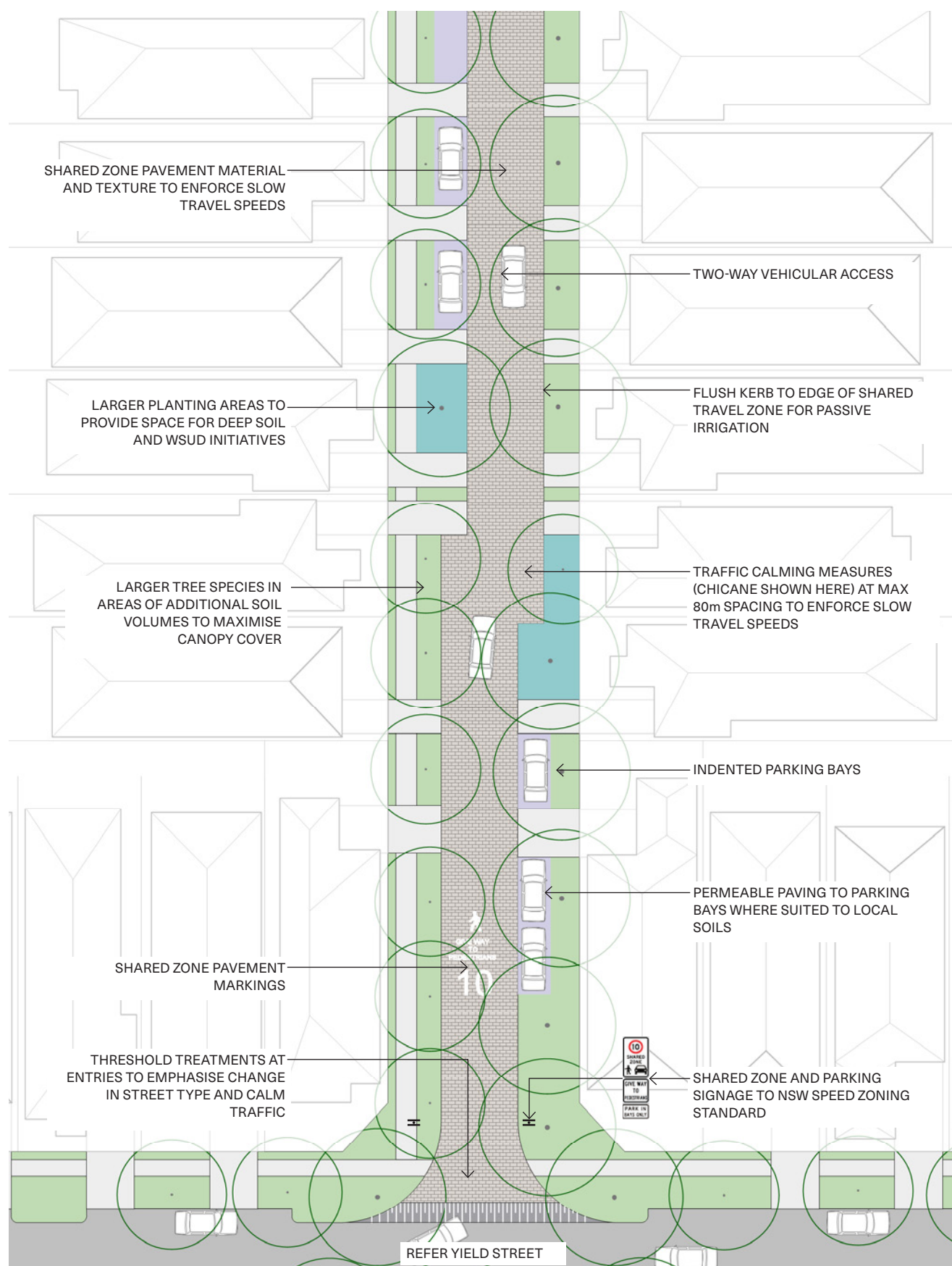


Precedent: Eckersley Way, Moorebank (source: ASPECT Studios)

Typical cross section – Residential Way



Typical concept plan – Residential Way



Residential Lane

Overview

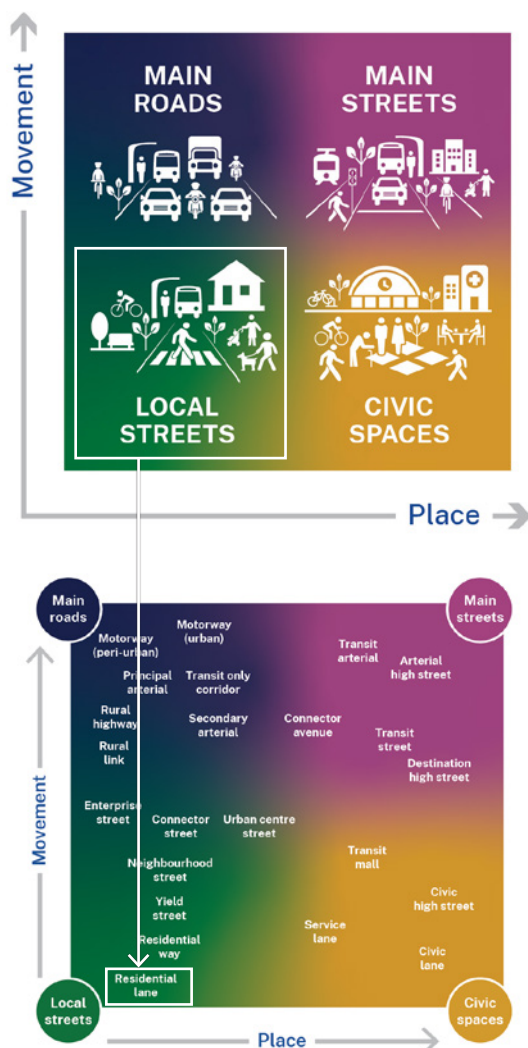
Residential Lanes provide access to the rear of dwellings. They are designed to be very slow, shared environments that allows for incidental community uses and placemaking by adjoining residents.

These streets are designed to accommodate safe pedestrian and cycle access. Elements such as planting, seating and lighting where applicable, ensure a safe shared zone where vehicle calming measures provide access to local access and service vehicles only.

Street priorities

- A very slow street environment is provided which allows for safe and accessible movement of all pedestrians
- A very slow street environment is provided which allows for cyclists to safely use the vehicle travel zone
- Street tree planting is integrated into the street design to provide shade and enhance the character of the residential laneway
- Low-flow runoff passively irrigates street trees and planting
- WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes
- Access to garages and private parking is facilitated from the laneway however parking within the laneway is discouraged primarily through spatial constraint

Alignment with Movement and Place



PERFORMANCE BASED FRAMEWORK

Road reserve	≤8m
Typical lots served	8-12m
Typical AADT	N/A
Posted speed	10km/h
Design speed	10km/h
Design vehicle	5.3m passenger car
Check vehicle	8.8m service vehicle
Bus capable	No
Vehicle travel lanes	≥5.5m shared zone
Parking provision	Nil
Parking arrangement	N/A
Walking	Shared zone
Cycling	Two-way cycling within shared zone
Traffic calming	Shared zone Refer Section 3.4
WSUD	Passive irrigation (low flow) Permeable paving
Tree canopy cover	40% (nom.) Refer Greener Neighbourhoods Guide
Permeability	≥20%

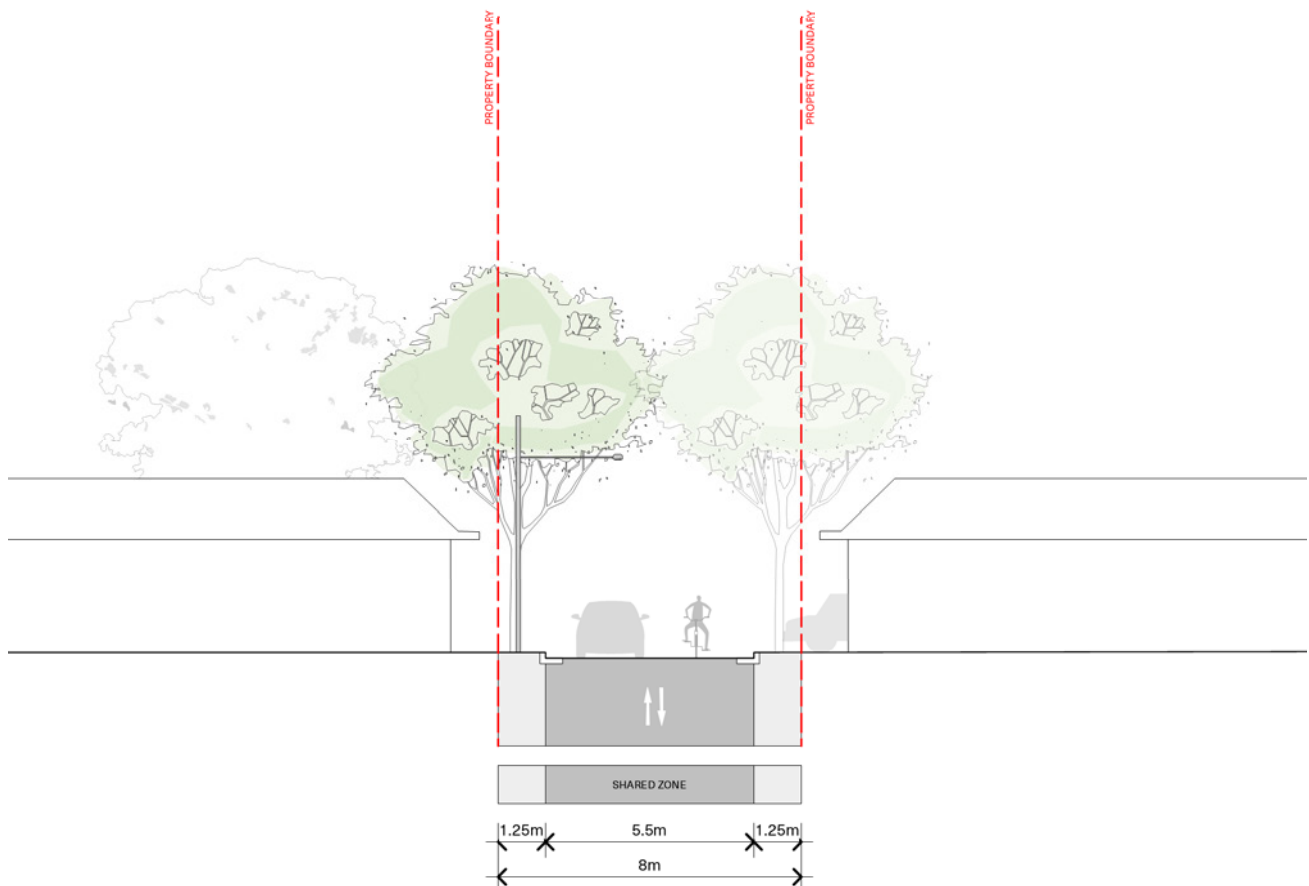


Precedent: Cresswick Walk, Moorebank (source: Google)

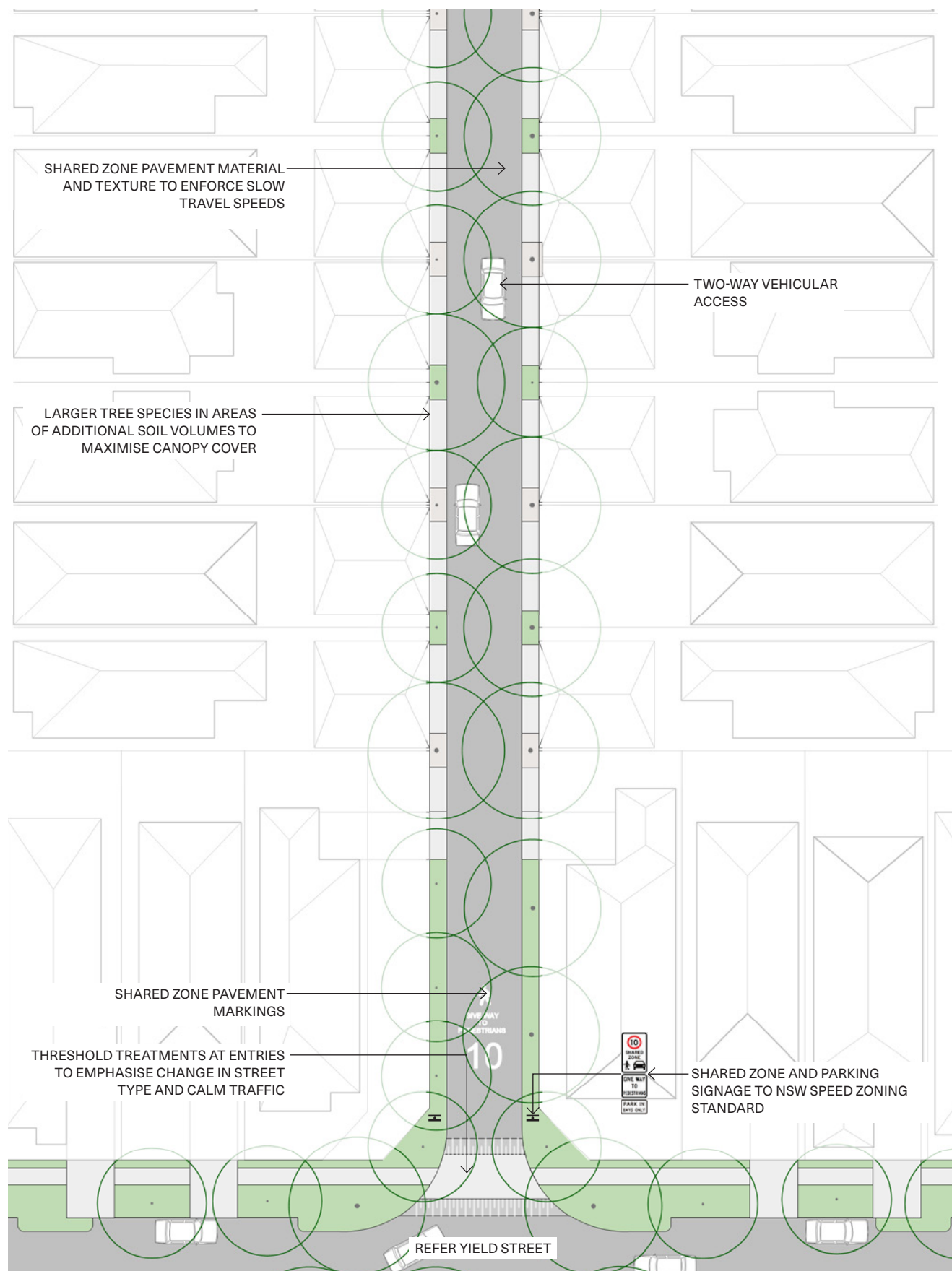


Precedent: Laneway, Crace ACT (source: Google)

Typical cross section – Residential Lane



Typical concept plan – Residential Lane



Civic Lane

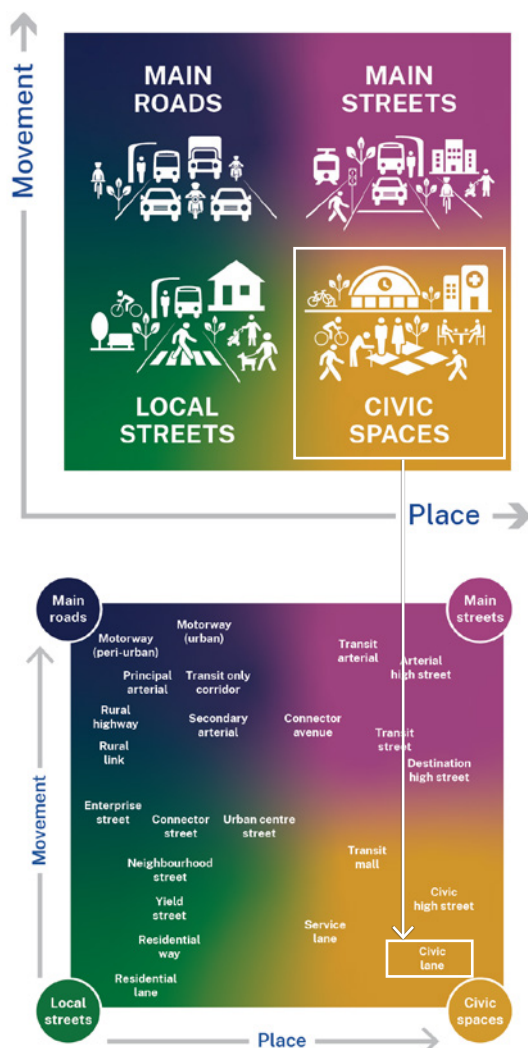
Overview

Civic Lanes are designed as very slow, shared environments. They balance the active, social functions of a laneway with the service-related functions of delivery and basement access to retail tenancies. Civic Lanes are first and foremost high quality public spaces which offer vibrancy within local street networks.

Civic Lanes are designed to accommodate pedestrian and cyclist safety with elements such as planting, seating, and lighting where applicable. This ensures a safe shared zone where vehicle calming measures provide for local access and service vehicles only.

Timed access arrangements for larger service vehicles are a useful strategy to ensure minimal conflicts between the social and service-based requirements of a civic lane.

Alignment with Movement and Place



Street priorities

- A very slow street environment is provided which allows the safe and accessible movement of all pedestrians
- A very slow street environment is provided which allows for cyclists to safely use the vehicle travel zone
- Street tree planting is integrated into the street design to provide shade and enhance the character of the retail laneway
- Low-flow runoff passively irrigates street trees
- WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes
- Driveways located ideally on rear lanes or side streets to minimise conflict between vehicles and pedestrians

PERFORMANCE BASED FRAMEWORK

Road reserve	≥7m
Typical lots served	N/A
Typical AADT	N/A
Posted speed	10km/h
Design speed	10km/h
Design vehicle	5.3m passenger car
Check vehicle	8.8m service vehicle
Bus capable	No
Vehicle travel lanes	One-way shared zone
Parking provision	As required
Parking arrangement	Interspersed with street trees
Walking	Shared zone
Cycling	Two-way cycling within shared zone
Traffic calming	Shared zone Refer Section 3.4
WSUD	Passive irrigation (low flow) Permeable paving
Tree canopy cover	40% (nom.) Refer Greener Neighbourhoods Guide
Permeability	N/A

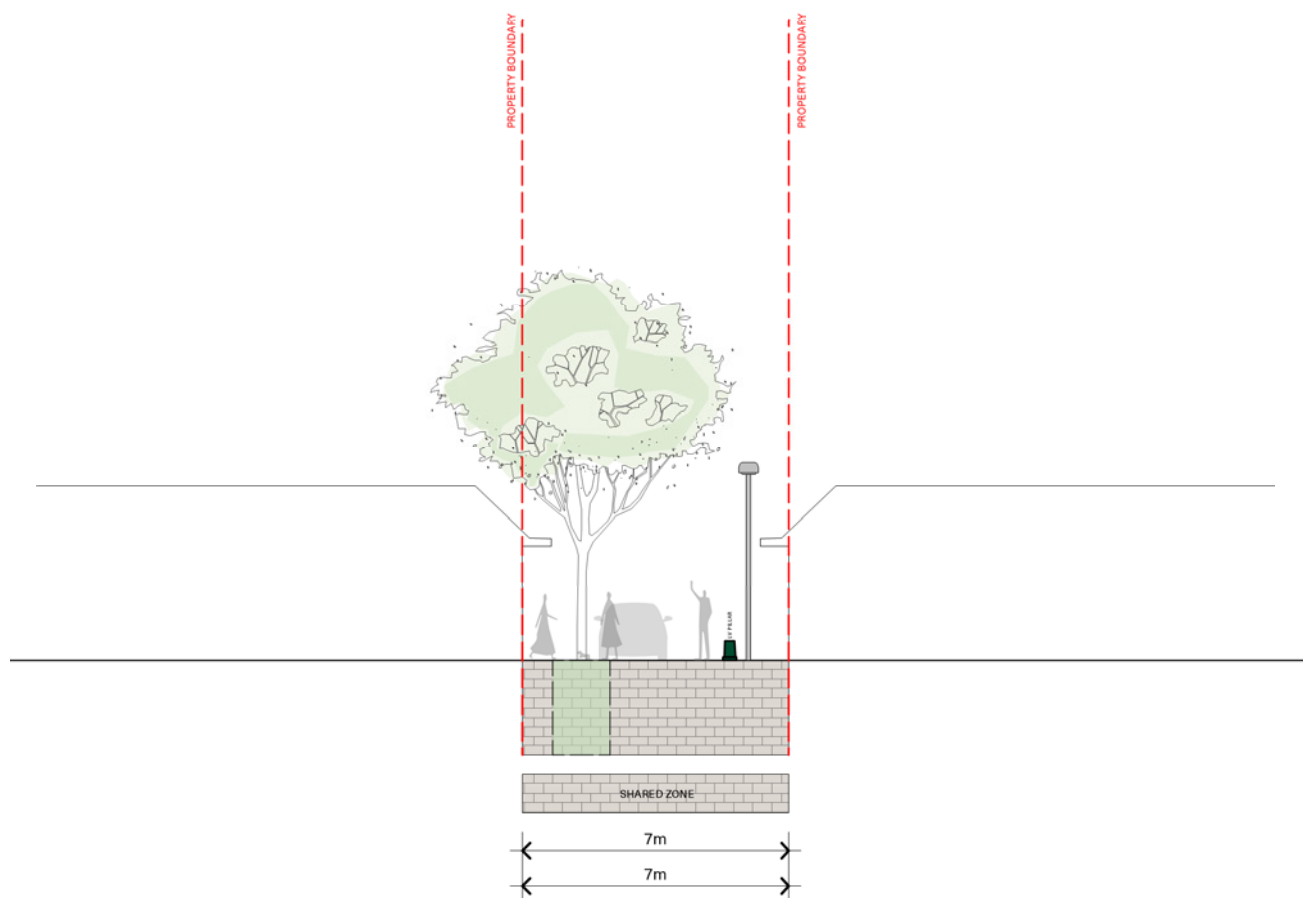


Precedent: Kensington Street (credit: Turf Design Studio)

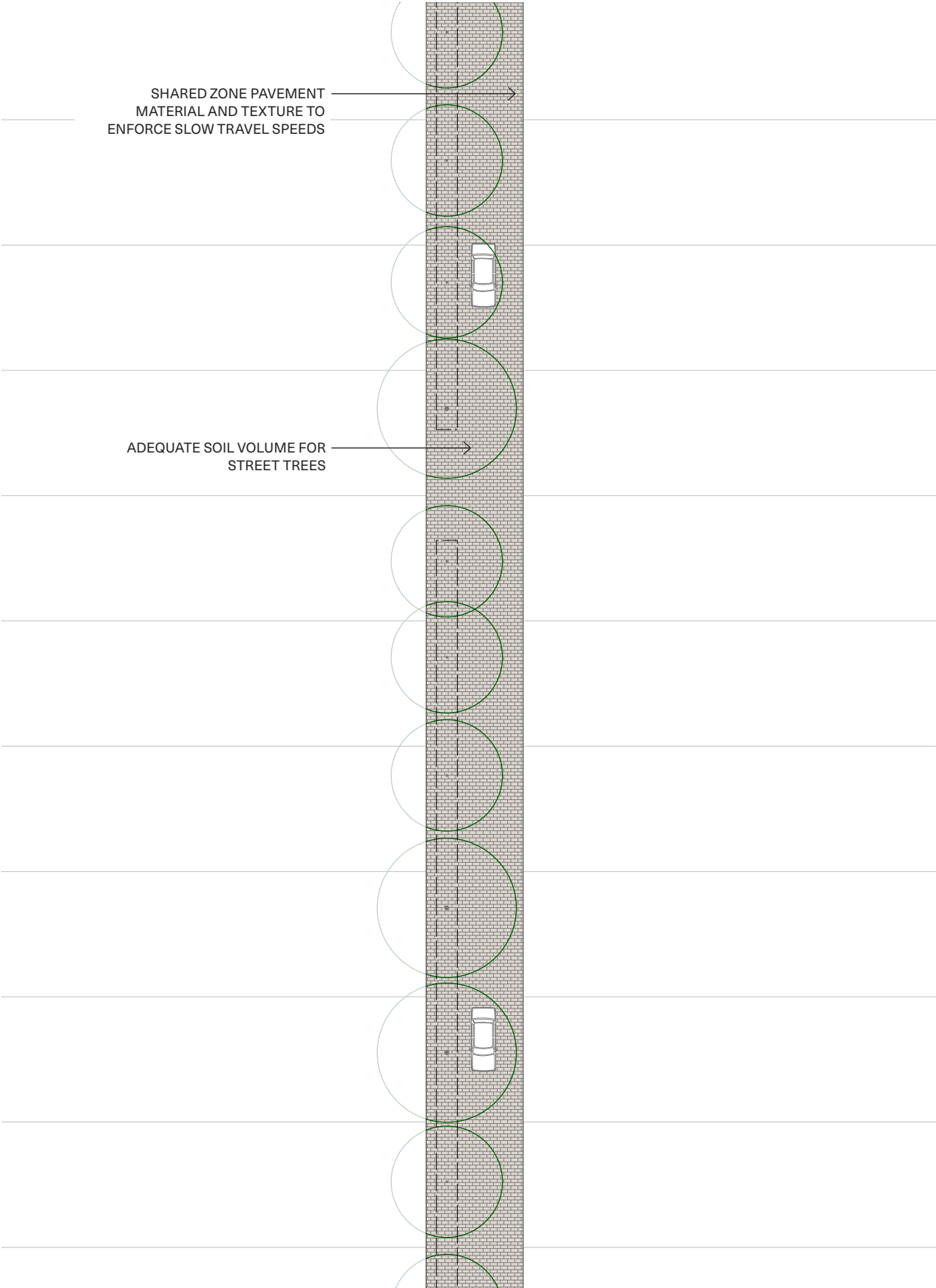


Precedent: York Lane, Sydney (source: Jugernauts)

Typical cross section – Civic Lane



Typical concept plan – Civic Lane



Transit Mall

Overview

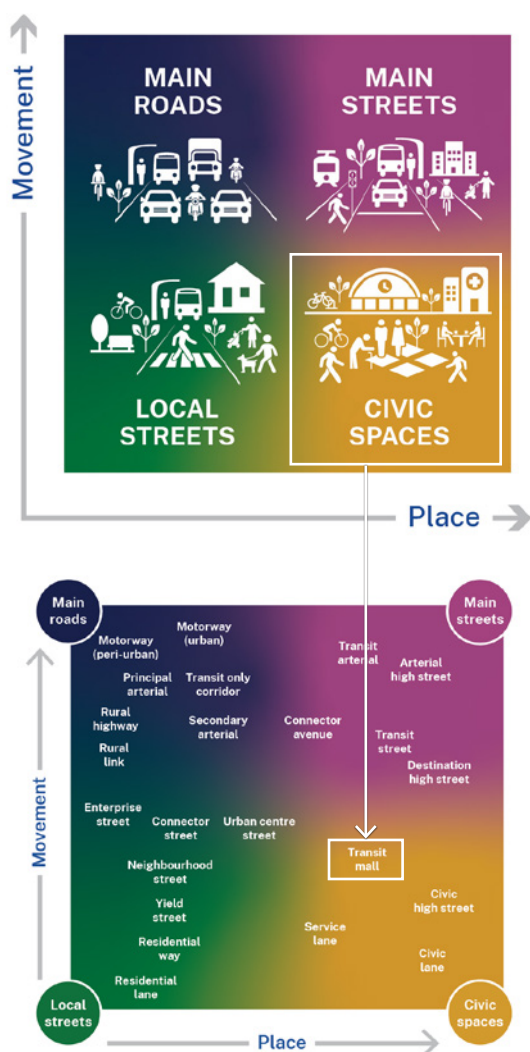
Transit mall streets are unique to commercial centres. High quality public amenity and generous pedestrian space is crucial to the various environmental and community uses designed to accommodate high pedestrian traffic.

Transit malls are designed to accommodate pedestrian and cyclist safety with elements such as planting, seating and lighting were applicable to create a vibrant shared zone.

Street priorities

- No vehicular access (apart from emergency) to provide a safe environment for pedestrians and cyclists
- Street tree planting provides a continuous tree canopy at maturity. Low-flow runoff passively irrigates street trees and planting.
- WSUD elements are maximised to ensure neighbourhood-scale WSUD performance outcomes
- Driveways located on rear lanes or side streets to restrict conflict between vehicles and pedestrians

Alignment with Movement and Place



PERFORMANCE BASED FRAMEWORK

Road reserve	≥18m
Typical AADT	Vehicle restricted
Freight access	Service and emergency vehicles (managed)
Posted speed	10 - 20km/hr
Design speed	Same as posted speed
Design vehicle	Largest bus operating in space
Check vehicle	Same as design vehicle
Bus capable	Yes
Vehicle travel lanes	2x 3.5m (for buses)
Parking provision	N/A
Parking arrangement	N/A
Walking	≥3.0m footpaths on both sides
Cycling	Provide alternate route on adjacent street
Traffic calming	Shared zone Refer Section 3.4
WSUD	Passive irrigation (low flow)
Tree canopy cover	70% (nom.) Refer Greener Neighbourhoods Guide
Permeability	N/A

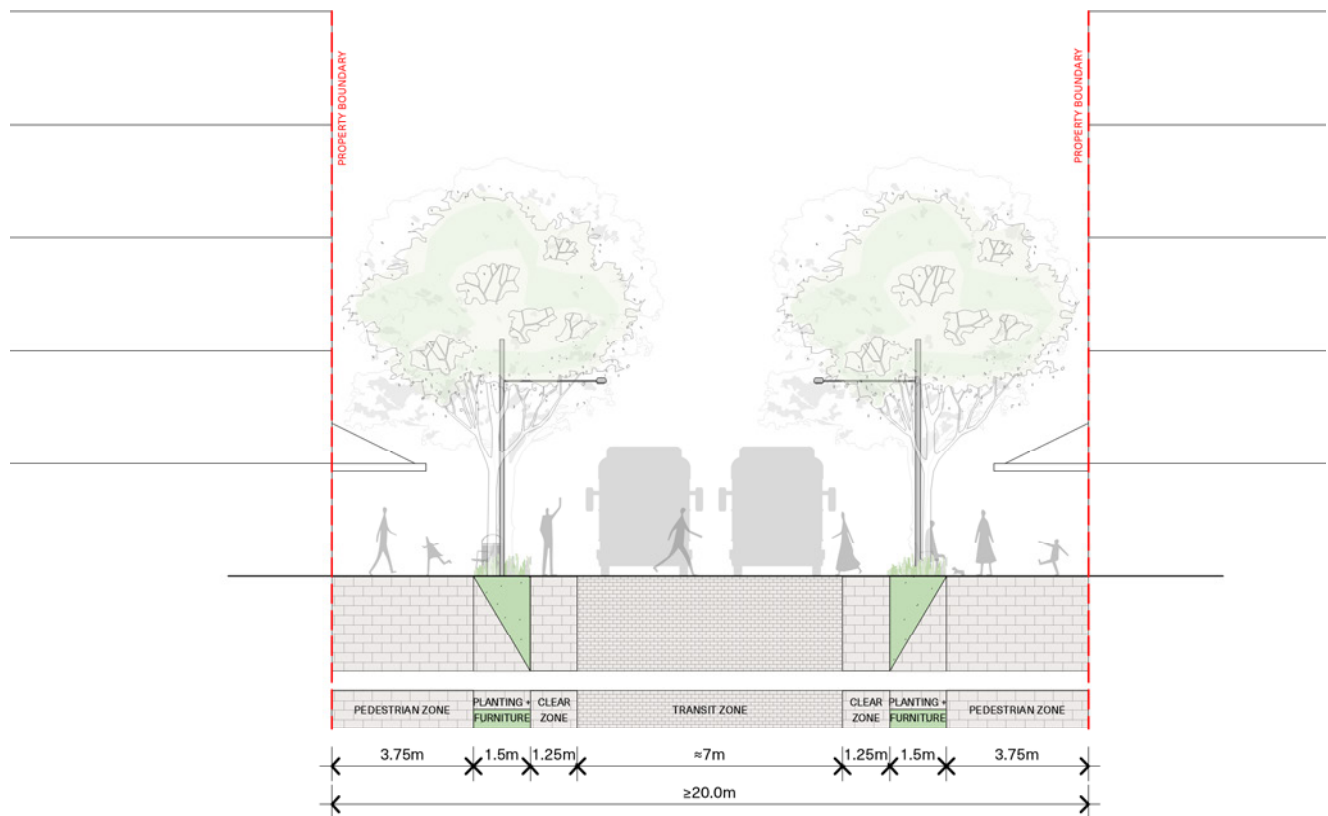


Precedent: Church Street, Parramatta (source: ABC)

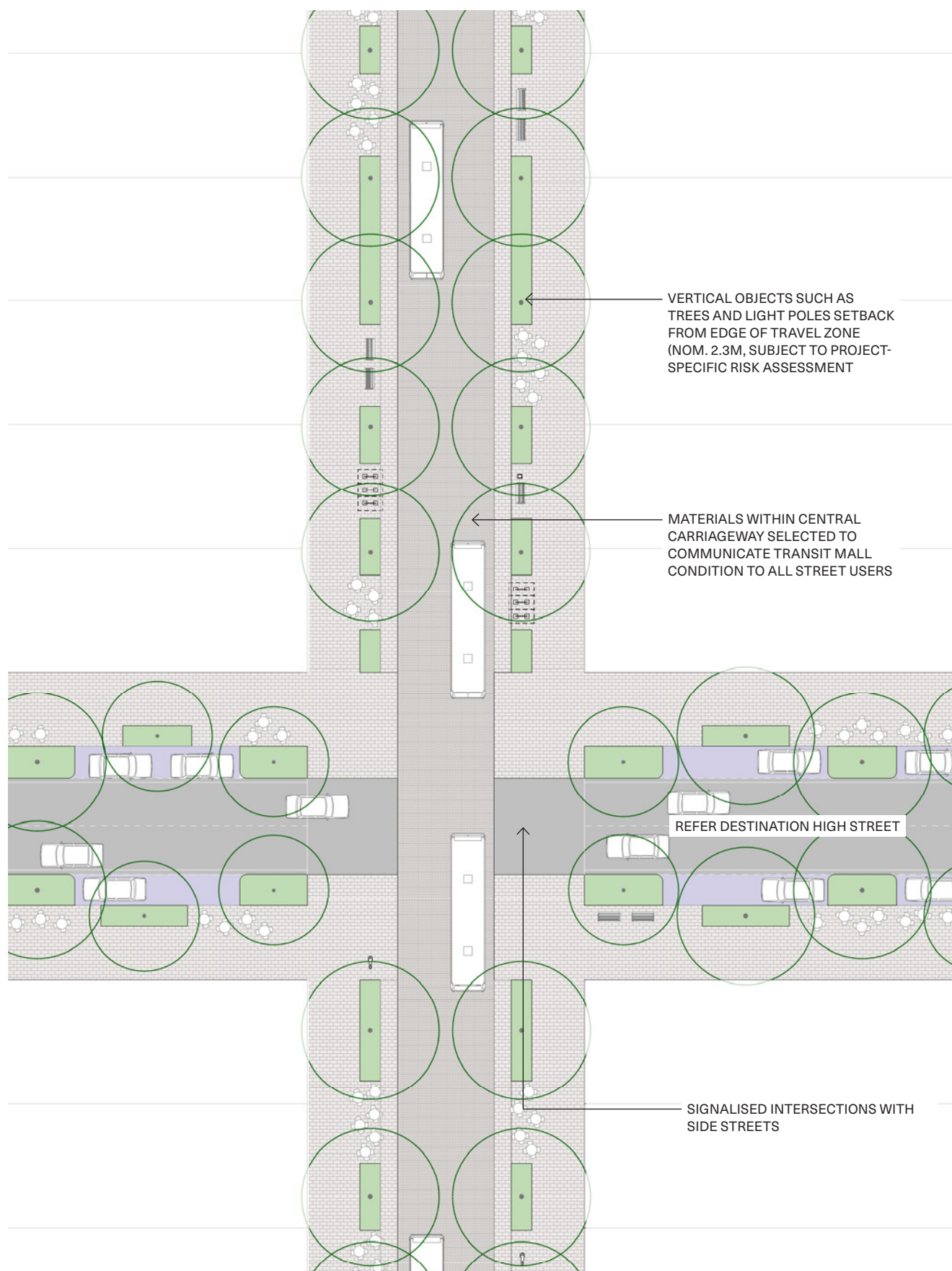


Precedent: George Street, Sydney (source: ASPECT Studios)

Typical cross section – Transit Mall



Typical concept plan – Transit Mall



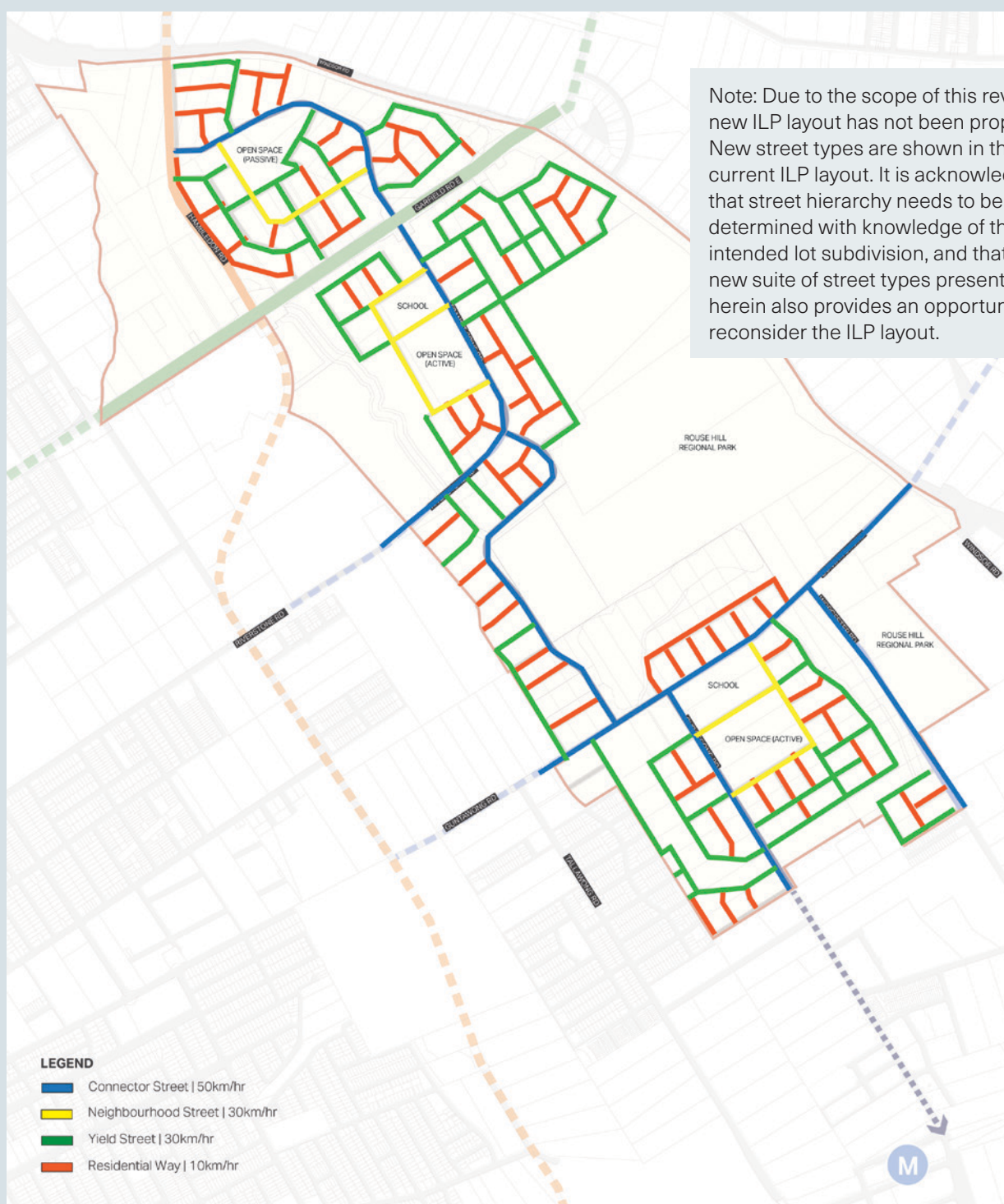
YIELD ANALYSIS

DRAFT ILP STREETS

Low Density	176,707m ²
Medium Density	453,981m ²
High Density	267,932m ²
Total Yield	898,620m²

PROPOSED NEW STREETS

Low Density	179,269m ²
Medium Density	457,878m ²
High Density	271,614m ²
Total Yield	908,761m²



Note: Due to the scope of this review, a new ILP layout has not been proposed. New street types are shown in the current ILP layout. It is acknowledged that street hierarchy needs to be determined with knowledge of the intended lot subdivision, and that the new suite of street types presented herein also provides an opportunity to reconsider the ILP layout.

Proposed updated street hierarchy adopting some of the street types presented herein.

CASE STUDY - MARIAN'S MANA, ORAN PARK

Marian's Mana at Oran Park is a masterplanned urban village in Oran Park, one of south west Sydney's fastest growing communities.

It is unique to other areas in Oran Park as it predominantly consists of attached terrace homes designed as a collaborative process between Greenfields Development Company and their builder partners with a strong focus on urban design.

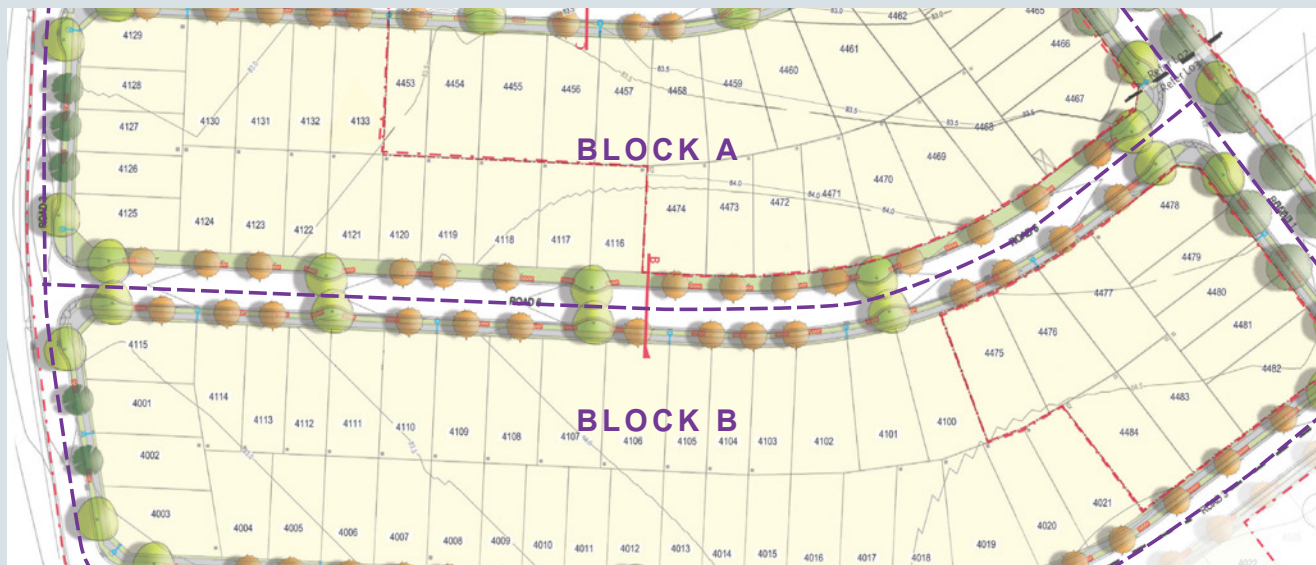
The streetscape character within Marian's Mana is a major contributor to the quality of the neighbourhood.

Development of this Second Edition of the Guidelines has involved consultation with Greenfields Development Company (GDC) to understand key lessons learnt from the unique street design process followed within Marian's Mana. These are presented below.

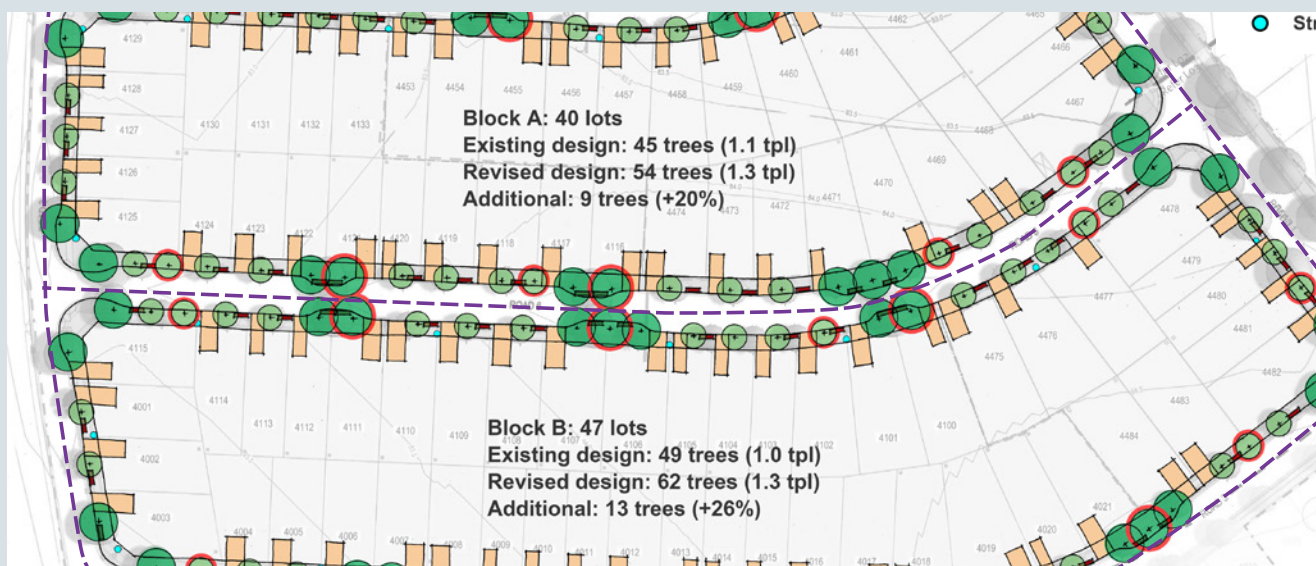
GDC also undertook a design study, presented on the following page, of an existing street design within Marian's Mana to explore opportunities for additional street tree planting. This involved an iterative process of testing kerb extension locations and potential impacts on driveways, and is a good illustration of the design process required to reach an optimal street design outcome that delivers on the objectives of the Guidelines.

KEY LESSONS

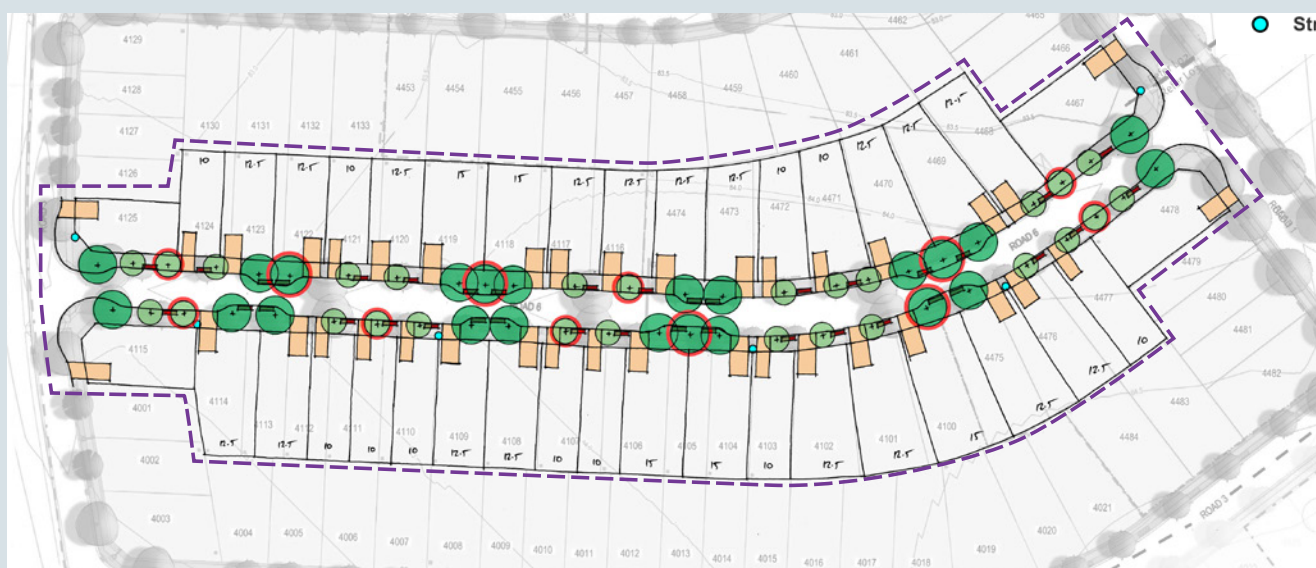
- S.88b covenants (under the Conveyancing Act 1919) were used to secure driveway locations and building envelopes early in the design process, which can only be altered with Council approval
- GDC engaged with both GDC-accredited builders and home buyers, ensuring they understand and accept driveway and envelope requirements. The accredited builders needed to be on board before fixing driveways and building envelopes, and customers need to understand these conditions before buying. Customers also need to agree to use only GDC's accredited builders.
- There was also a need to fix the location of street lighting and garbage bin pick up as part of the optioneering process
- So the approach goes beyond just planning to encompass the entire sales and construction process
- RFS requirements (no more than 15% canopy cover near bushland and elsewhere) often works against delivering the desired tree canopy. It is estimated that this can lead to up to 30% reduction in tree planting
- Council tree selection and maintenance policies also need to be considered, ensuring Council preferences for smaller, lower maintenance trees don't undermine tree canopy targets. GDC has sought to counter this by developing a Street Tree Masterplan to preclude unnecessarily small trees.
- Where possible, use a continuous kerbing machine (4.5m kerb radius) rather than 'handmade' kerb blisters to reduce cost and speed delivery. This also allows better access for street sweepers and garbage trucks.
- Often blister and landmark trees are too widely spread. Look to position and lock in driveway locations to provide for larger kerb blisters which can take two trees. This can be supported by co-locating larger lots side by side and by partly locating driveways on blisters.
- Lots located in front of larger kerb blisters may attract a lower sale price given the concomitant reduction in adjacent on street parking
- For the developer, there will always be the need to account for the additional cost of optioneering and for possible negative impacts on property values. Though there is typically a positive correlation between street tree canopy cover and property prices, this value may not be realised until trees are more mature.



Marian's Mana existing design



Marian's Mana revised design study with larger kerb extensions and more tree planting (source: Greenfields Development Company)



Marian's Mana revised design study with increased frequency of kerb extensions and tree planting (source: Greenfields Development Company)



Visualisation of a raised pedestrian and cycle crossing within Marian's Mana



Visualisation of a shared path along a neighbourhood street within Marian's Mana



Visualisation of an intersection with traffic calming threshold treatments within Marian's Mana



Visualisation of a local street within Marian's Mana

Chapter 3.0

Components of Great Streets

Bourke Street cycleway, Surry Hills
(credit: Simon Woods, City of Sydney)



3.1 Introduction

Overview

This chapter of the Guidelines covers the various components that need to be considered and coordinated throughout the planning, design, construction, and maintenance of streets.

Coordination of these elements is a significant factor in the quality and safety of a street and the legibility of its public domain. A high quality street design and considered arrangement of components:

- Ensures that the street's most vulnerable users are prioritised to create a safe environment for all
- Provides seamless integration of fixtures and elements within a structured and legible ground plane
- Coordinates critical components to avoid clashes that may produce adverse outcomes (above, at, or below ground level)

Street components included in this chapter are arranged into the sections listed on the right.

Further design requirements may be found in the Engineering Design Manual for Western Sydney, as noted in each section.



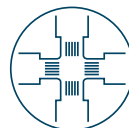
3.2 PEDESTRIANS AND CYCLISTS



3.3 THE GREEN AND BLUE GRID



3.4 VEHICLES



3.5 INTERSECTIONS



3.6 UTILITIES

Design guidance and design requirements

This chapter includes information for practitioners designing new and retrofitted streets in Western Sydney.

Within this section, Design Guidance and Design Requirements are provided for various street features and street details. Design Guidance encompasses optional metrics which can be implemented within the streetscape, while Design Requirements provides compulsory measures.

DESIGN GUIDANCE

Throughout this chapter, Design Guidance will appear in a light blue box like this.

Design guidance

Design Guidance has two purposes. Firstly, it can help to identify the most suitable street type for the local context. Secondly, Design Guidance provides metrics that contribute to the Street Objectives by supporting the Design Requirements. For example, when 'Cycling' is a Design Requirement, the Design Guidance might build on that with suggested cycle facilities.

DESIGN REQUIREMENTS

Throughout this chapter, Design Requirements will appear in a dark blue box like this.

Design requirements

Design Requirements are the mechanism for streets to deliver the Street Design Objectives. They are the primary way for designers to achieve greener, cooler, and safer streets in Western Sydney.

Metrics for Design Requirements are given in a variety of formats. Where a number or percentage is given, this should be measured per 1000m² of a typical road reserve.

3.2 Walking, bike riding and micromobility

Overview

The NSW Government wants walking and bike riding, known as active transport, to be the preferred way to make short trips and a viable, safe and efficient option for longer trips. This is supported by active transport policies and initiatives at the local level across Western Sydney.

The Guidelines has placed particular emphasis on the safety and amenity of people walking, bike riding, and using other micromobility modes. The amenity of drivers and vehicle movements is well represented in a range of other guidelines and policies. The Guidelines does not aim to replicate that information.

This section aims instead to synthesise and cross reference key government strategies to make it easier for designers to create safe streets for all users.

It is important to acknowledge that many street design components will work together to achieve more livable streets in Western Sydney. For example, continuous shade provided by trees is imperative if walking or bike riding for local trips is to be a reality for the majority of people living in Western Sydney. Most of Western Sydney is 6-9 degrees warmer than baseline, and much of the most built-up areas of Western Sydney suburbs exceeds 9 degrees over baseline. Therefore green and blue infrastructure will greatly support walking, bike riding, and micromobility, and should be read in conjunction with this section to maximise co-benefits.



Bourke Street Cycleway, City of Sydney
(credit: Simon Wood)

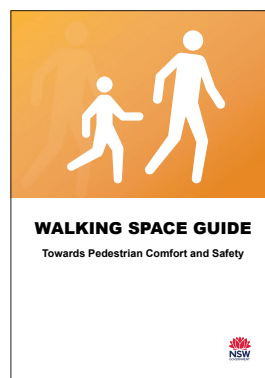
Footpath types

Footpaths play a vital role in our communities. They provide continuous access for pedestrians of all abilities along the street, promote healthy lifestyles through active transport, and provide space for all the informal activities that make suburbs and cities vibrant places to live.

Safe, accessible, and well-maintained footpaths are a fundamental and necessary investment for Western Sydney and have been shown to enhance public health and maximise social capital (NACTO, 2016).

There are several points to consider when selecting footpath type. For guidance, refer to Transport for NSW's Walking Space Guide. Footpath width should be considered in the context of broader environmental impacts. Wider footpaths contribute to urban heating as well as increased maintenance costs and embodied energy in materials. This must be weighed carefully against the benefits gained and the likely volume of pedestrian traffic.

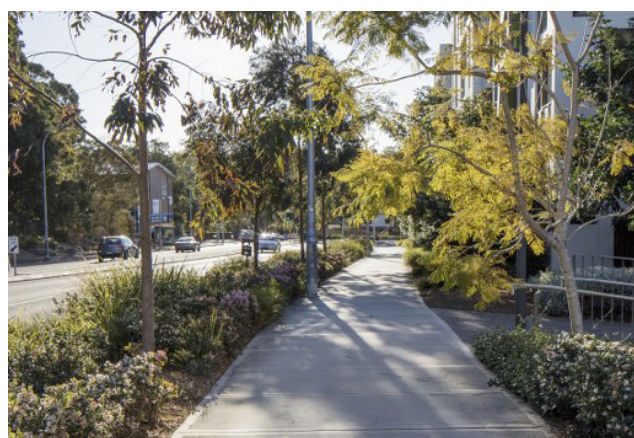
CROSS REFERENCE



Transport for NSW's Walking Space Guide provides a set of standards and tools to assist those responsible for Walking Spaces on streets, to ensure that sufficient space is provided to achieve comfortable environments which encourage people to walk.



Street trees shade the footpaths of Minogue Crescent, Forest Lodge.
(credit: ASPECT Studios and Simon Wood)



Shaded footpath along Minogue Crescent, Forest Lodge.
(credit: ASPECT Studios and Simon Wood)



High Street footpath with street trees, furniture and outdoor dining.
(credit: ASPECT Studios)



Shared path on Brickmakers Drive, Moorebank.
(credit: ASPECT Studios)

Continuous footpaths

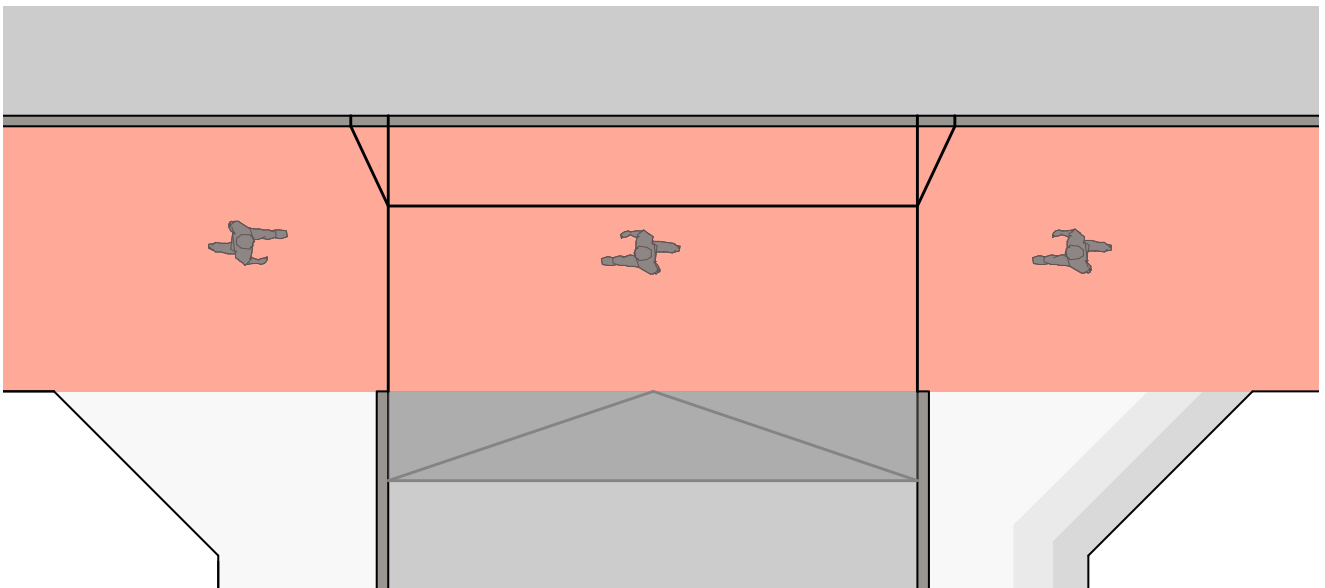
Continuous footpaths refer to a continuation of footpath surfaces across intersections with lower order streets. They assist in clearly communicating that pedestrians have priority at intersections.



Continuous footpath allow for safer pedestrian travel on Foveaux Street, Sydney. (credit: City of Sydney)

DESIGN GUIDANCE

- Provide continuous footpaths where pedestrian priority is desired at intersections with lower order streets. Slight changes in size of unit pavers through the crossover may be used to highlight to pedestrians the potential interaction with vehicles.
- Ensure paving in driveway is appropriate for weekly usage by garbage trucks
- Provide vehicle access through a dropped-kerb or similar kerb treatment, to slow vehicles and highlight the interaction with pedestrians
- Ensure clear sight lines for drivers and pedestrians is achieved when approaching and interacting in the crossover area
- Ensure the continuous footpath and adjacent infrastructure are configured to manage stormwater



Typical plan of a continuous footpath.

Kerb ramps

Kerb ramps are an important element in providing universal access through urban environments.

They provide access between the level of the footpath and carriageway for pedestrians - particularly those using wheelchairs and other mobility aids, as well as people pushing prams or carts.

Large corner radii make it difficult to provide compliant kerb ramps which allow for a continuous pedestrian line of travel. Therefore, it is important to use the smallest practical kerb return radius, to ensure that a safe and continuous path of travel can be provided.

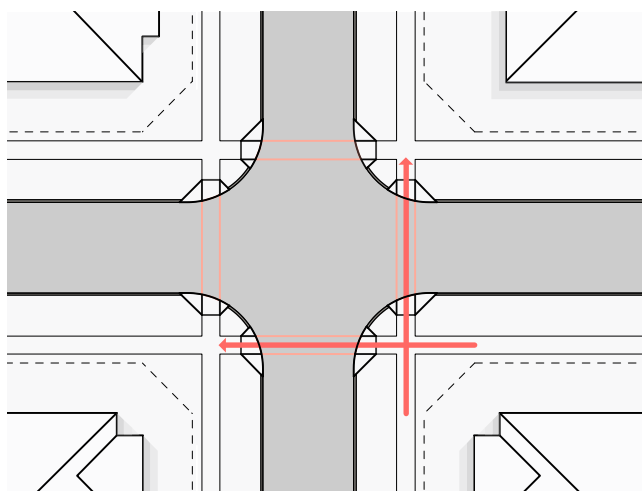
The diagrams below illustrate that whilst a smaller kerb return radius facilitates a continuous path of travel for pedestrians, a larger kerb return radius does not. This is undesirable as it does not prioritise active forms of transport such as walking, and is not the most intuitive path of travel, particularly for the visually impaired.

DESIGN GUIDANCE

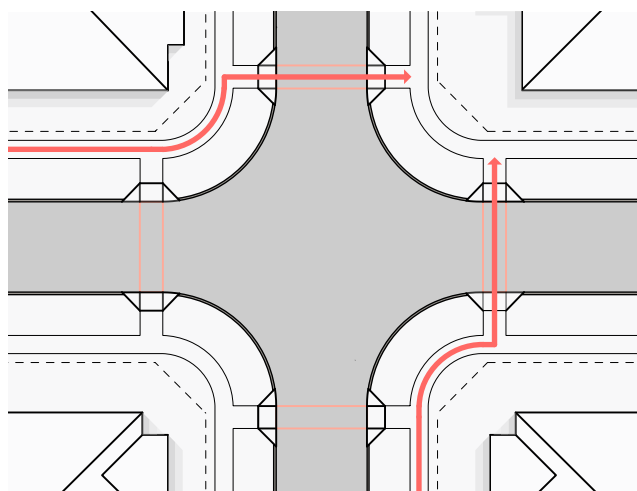
- Install kerb ramps at all intersections, pedestrian crossings, and mid-block crossings
- Minimise the length of a kerb ramp to avoid or reduce disruption to the path of travel on the footpath

DESIGN REQUIREMENTS

- Match kerb ramp paving to adjoining footpath materials
- Orientate kerb ramps in the direction of travel at all intersections and pedestrian crossings
- Locate kerb ramps within the corner area of the footpath, typically aligned with the street wall or property boundary, at footpath corners and street intersections
- Relocate conflicting existing physical elements clear of the crossing point. Where this is not possible, align kerb ramps clear of obstructions and maintain a direct line of sight to the opposite side of the street.



A smaller kerb return radius allows for safer Kerb ramp alignment at intersections.



A larger kerb return radius disrupts the pedestrian path of travel as kerb ramps are located offset from the adjoining footpath.

Driveway crossovers

Driveway crossovers, also known as access driveways, are the section of a driveway which crosses the public footpath, verge, or kerb.

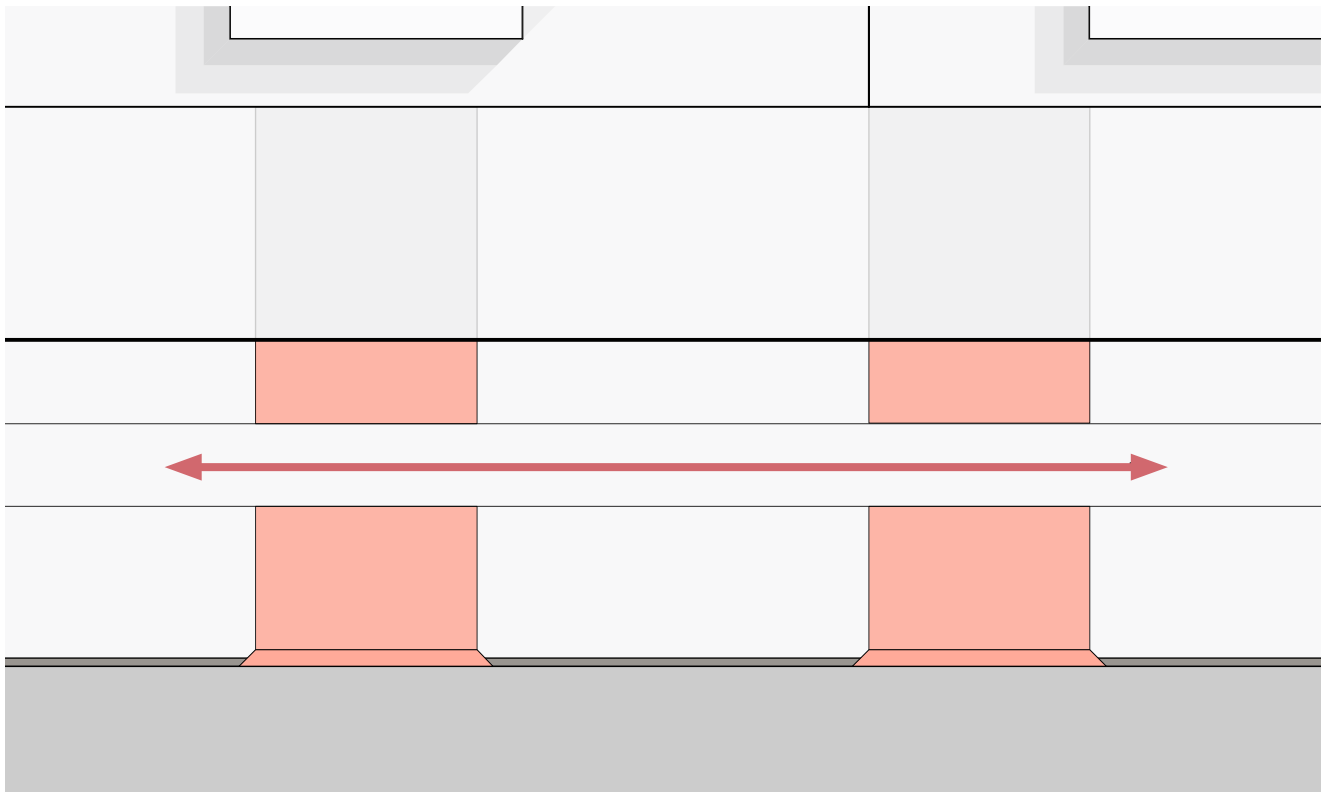
They should ensure vehicle access across the pedestrian path of travel in a way which does not compromise the quality of the street experience, including pedestrian safety, movement, and comfort.

DESIGN GUIDANCE

- Reinforce pedestrian priority across driveway crossovers to reduce impact upon pedestrian movement along the street
- Consolidate the location of driveways along a street to maximise footpath continuity
- Use the narrowest practicable width for driveways

DESIGN REQUIREMENTS

- Maintain footpath levels and cross falls
- Continue the footpath paving and materials throughout the driveway crossover



Typical plan of driveway crossovers.

Bike riding

It is important to provide safe ways for people riding bikes to use streets. The type of facilities provided will depend on many different factors, including the space available, likely vehicular traffic, anticipated and desired number of bicycle trips and lastly the overall local cycle network.

Transport for NSW's design principles for bike-friendly infrastructure are:

- Safe: Ensure that bicycle riders and other road users are provided with safe facilities
- Connected: Enable bicycle riders to reach their destinations easily via routes that are connected across the network
- Direct: Provide people cycling with the most direct route
- Attractive: Deliver safe and attractive surroundings that help to deliver well-designed public spaces
- Comfortable: Ensure that riders of all ages and abilities can ride at a speed they are comfortable with
- Adaptable: Incorporate flexibility in design to accommodate changes in user needs and demand over time

The street types presented in Chapter 2.0 illustrate a range of bike riding facilities. Designers should refer to Transport for NSW's Cycleway Design Toolbox for further information on the provision of bike riding facilities, including a range of facility types that can be applied to streets and intersections illustrated within the Guidelines.

CROSS REFERENCE



The Cycleway Design Toolbox provided guidance for practitioners on how to design for cycling and micromobility. The Toolbox provides practitioners with a range of design tools, being a comprehensive suite of best practice designs across a range of typical on- and off-road environments that can be tailored to their specific environment. It can be used to justify the planning, design and delivery of high-quality cycling infrastructure by demonstrating the positive impact on level of service for people cycling.

Kerb extensions

Well-designed intersections are crucial to create safe, efficient, and multimodal intersections.

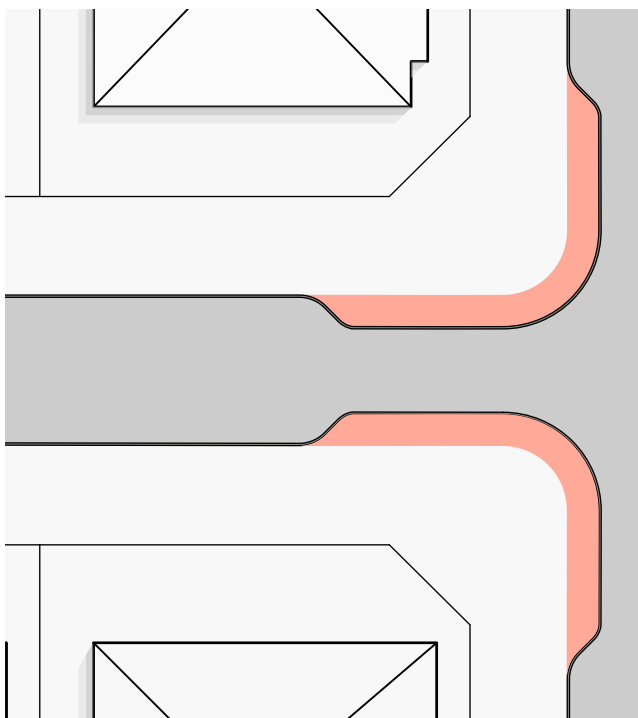
Intersections should reduce the risks of turning conflicts with fast moving vehicles by removing slip lanes where possible and introducing kerb extensions to allow for reduced corner kerb radii.

This enhances pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing turning vehicles, and visually narrowing the carriageway.

Pedestrian comfort and safety is increased through changes in geometry which reduce traffic turning speeds alongside key considerations such as the location of pedestrian crossing kerb ramps and raised pedestrian crossings.



Planted kerb extensions along Crown and Cleveland Street, Surry Hills.
Image - Crown, Cleveland & Baptist Street Upgrade, Tract Consultants



Typical plan of kerb extensions.

All upgrades or intersection geometry must be in accordance with the Australian Standards for Access as defined in AS 1428.1–1428.4 for pedestrian access on footpaths.

Kerb extensions are traffic calming elements which locally widen the verge and kerb line, and narrow the carriageway.

Kerb extensions improve street quality through traffic calming, improved pedestrian crossings, additional street tree and understorey planting, seating, outdoor dining, cycle parking and stormwater management.

For other examples of Traffic Calming, see Section 3.4.

DESIGN GUIDANCE

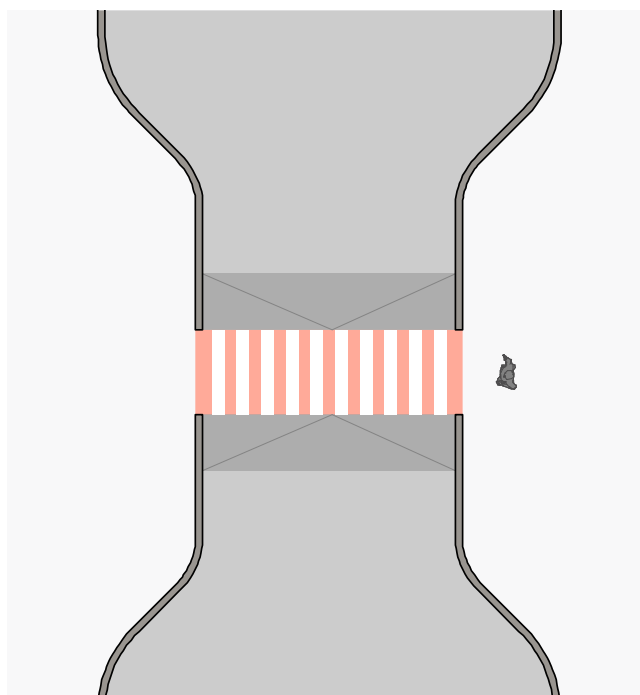
- Include kerb extensions at corners or mid-block. Consider them as an integral part of the overall street design, considering relevant site and traffic issues
- Design kerb extensions to enhance pedestrian safety by increasing pedestrian visibility, shortening crossing distances, slowing vehicles, and visually narrowing the carriageway
- Facilitate pedestrian circulation and avoid elements which compromise it, such as railings, bollards, and barriers
- Consider turning requirements for larger vehicles at intersections including two-way turns for bus routes, and freight/delivery vehicles. Undertake swept path analysis where necessary

DESIGN REQUIREMENTS

- Select materials within kerb extensions which match the adjoining footpath material, when not planted
- Consider stormwater drainage in the design of kerb extensions
- Consider vehicle sightlines when designing planted verges at intersections

Pedestrian crossings

Pedestrian crossings provide safe and designated points for people to cross the street. Good pedestrian crossings also improve driver awareness of intersections and enhance visibility of people as they cross the street.



Typical plan of a raised pedestrian crossing.

DESIGN GUIDANCE

- Adopt kerb extensions at pedestrian crossings to reduce the crossing width and calm traffic
- Use raised pedestrian crossings to emphasise crossing points, particularly at unsignalised midblock crossing locations
- Adopt a change in paving unit or colour to enhance the contrast between the carriageway and crossing

DESIGN REQUIREMENTS

- Maintain sight lines at crossing points to avoid conflicts and allow adequate space for people to use the crossing safely
- Utilise street elements such as lighting, street trees and landscaping to assist with visually narrowing and compressing the street at crossing locations
- Minimise corner radii to assist with creating appropriate vehicle speeds, reducing crossing distances, and minimising potential conflicts between street users
- Pedestrian crossings on streets with more than one travel lane in the same direction must be signalised



Raised pedestrian crossing on George Street, Redfern.
(credit: ASPECT Studios)



Raised signalised pedestrian crossing on Darling Street, Rozelle
(credit: Google)

Street furniture

Street furniture is the collective term for elements installed along the street, such as seats, rubbish bins, bicycle racks, bollards, drinking fountains, parking meters, utility poles, and traffic and parking signage.

Street furniture provides amenity and function for a variety of uses within the street.

DESIGN GUIDANCE

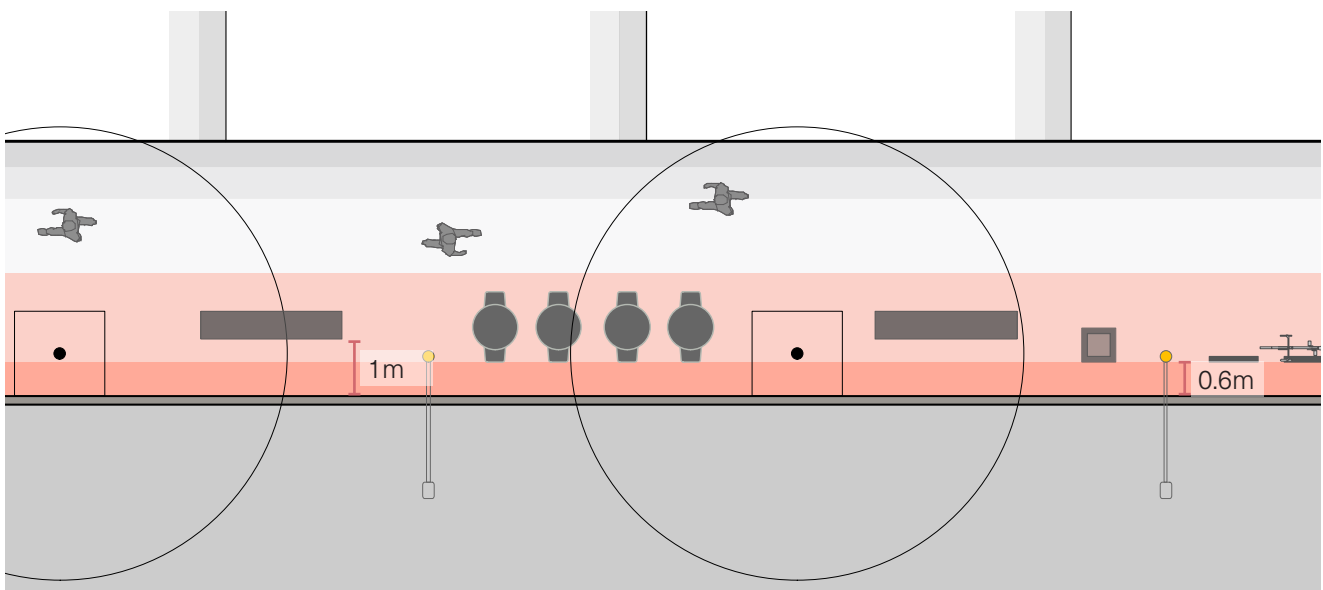
- Consider street furniture as a family of elements thoughtfully coordinated to contribute to the identity and character of the streetscape
- Co-locate street elements as often as possible in a way that contributes to street amenity and function. For example, seating should be located under street trees, or rubbish bins located near traffic signals at pedestrian crossings



Street furniture along the pathway, Harold Park.
(credit: ASPECT Studios and Simon Wood)

DESIGN REQUIREMENTS

- Locate street furniture within the Flex Zone or within kerb extensions in the Flex Zone
- Ensure street furniture is clear of pedestrian paths of travel and does not inhibit desire lines
- Roads planned to support bus services should have a minimum 0.8m recess of any fixed object from the kerb face at all bus stops and along all bus routes (including for kerb buildouts). Height of clearance from roadway is to be 4.5m
- Place bicycle racks in clusters clear of pedestrian paths of travel and where they do not inhibit desire lines



Typical plan of street furniture zone adjacent the kerb.

Outdoor dining

Outdoor dining provides an opportunity to activate streets and maximise trading opportunities for local businesses typically trading within adjoining buildings.

Outdoor dining encourages social use of the street space, activates public spaces and supports ground floor retail by providing additional trading space in the street.

DESIGN GUIDANCE

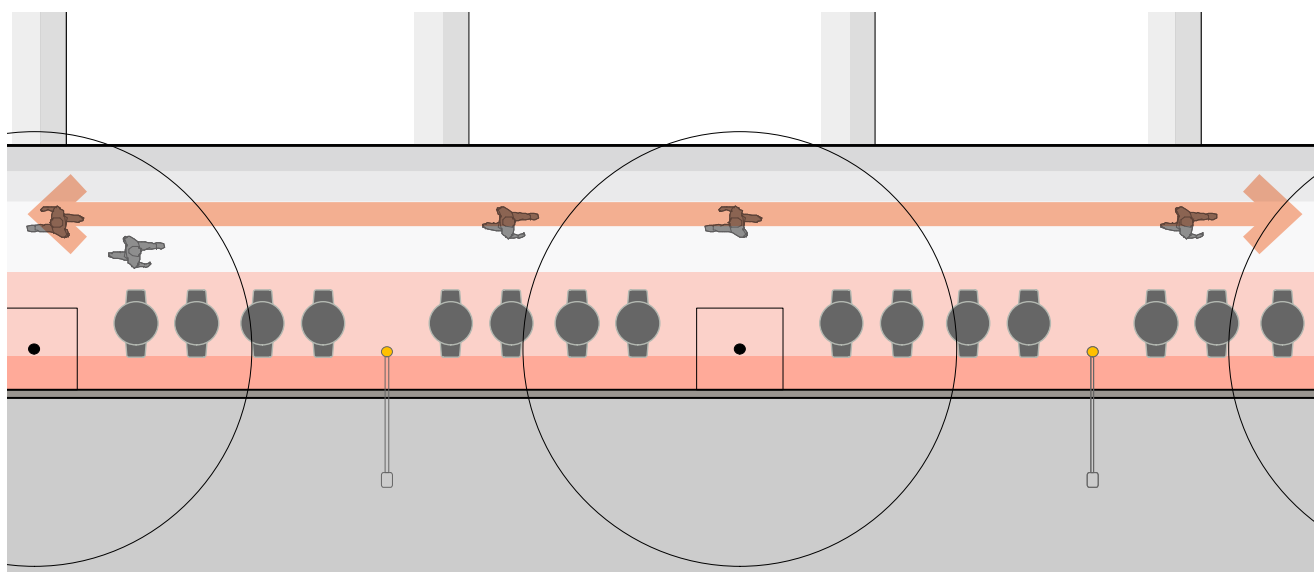
- Activate the street with comfortable outdoor dining spaces
- Locate outdoor dining areas to not have negative impact on adjoining footpath areas or introduce roadside hazards for passing cyclists and motorists
- Maximise street tree planting to provide amenity for outdoor dining areas

DESIGN REQUIREMENTS

- Footpaths are a minimum 3m in width to allow pedestrian path of travel to pass outdoor dining areas
- Provide a clear, unobstructed footpath zone



Outdoor dining on High Street, Penrith.
Image - (Google)



Typical plan of outdoor dining adjacent the kerb.

3.3 The green and blue grid

Street trees

Street trees are critical to achieving the Street Objectives. When properly selected, located, planted, and maintained, street trees can completely transform an urban environment. Trees are important visually – by unifying and coordinating streets and precincts. Trees also provide critical health and wellbeing benefits by providing comfortable streets to walk and cycle on, and cleaning the air. Perhaps most importantly for Western Sydney, street trees are an effective way to mitigate urban heat island effect. In addition to the aesthetic and climate benefits trees bring, there are a number of ways in which trees bring economic uplift. These include increased property prices in streets with mature trees, reduced electricity costs, and reduced road maintenance costs, as the shading of bitumen extends its life compared with bitumen in full sun.

Planting a mixture of tree species in a street enables appropriate species to be selected to suit the local microclimate, underlying soils and physical constraints. The use of a mixture of deciduous and local native species is highly recommended in order to achieve a balance of maximised summer shade as well as solar access during winter. In order to maximise the longevity and health of trees, provision of generous soil volumes in verges needs to be accounted for during the design

of streets. In areas where soil volumes are constrained, smaller species will be required to ensure the mature tree form is suitable for the available soil. A mixture of wide canopy species to create shade over the road surface, with narrower canopy species in constrained verges will create an attractive and climate-appropriate urban canopy. Mixing deciduous and local native species will also assist in meeting bushfire management considerations in areas adjoining bushland. Recent research has identified lists of both Australian and introduced tree species that are fire retardant and will greatly assist in reducing fire impact to properties.

Understory planting beneath trees provides another important ecological layer and can create habitat for insects, small birds and small fauna. Whilst turf verges assist in creating permeable surfaces around trees, a more diverse selection of understory planting can assist in lowering maintenance (reduced mowing) as well as bring both visual interest and increased biodiversity to streets. This is a particular focus for streets that are identified as 'Green Links' or 'Wildlife corridors' where connections between bushland areas and parks are required to allow safe movement of fauna.



Street trees providing shade and comfort on high pedestrian traffic streets at Australian National University (credit: ASPECT Studios)

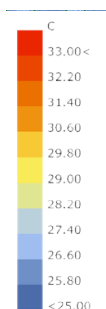


Street tree planting in the verge and median at Harold Park (credit: ASPECT Studios + Simon Wood)

CASE STUDY - STREET TREES AND URBAN HEAT

The Gurner Avenue Austral Master Plan was prepared by e8urban and Scape Design for Landcom and the Office of Strategic Land. It undertook an analysis of ambient temperature that compared typical street typologies as defined by the Austral DCP against a variety of shared zones based on the Guidelines.

The analysis showed the Guidelines' shared zones provided a 6-degree reduction in ambient temperature during summer. Tree spacing was found to be a determining factor, with the Master Plan adopting tree spacing from 4m to 8m, whereas the typical Austral DCP street typologies in adjacent recently developed areas were found to be resulting in spacings between 12m and 15m.



Ambient temperatures – Austral DCP street types



Ambient temperatures – Guidelines street types



Significant street tree planting shown in the Gurner Avenue Austral Master Plan
(credit: e8urban + Scape Design For Landcom)

There is overwhelming evidence that good tree canopy reduces ambient temperatures and mitigates the urban heat island effect through shade and evapotranspiration.

Western Sydney has a high number of significant heat days relative to the rest of Sydney and, in the context of a changing climate, the number of significant heat days is only set to increase.

Ambitious targets are being set across Western Sydney to increase tree canopy cover. These targets will help alleviate the urban heat island effect and create liveable streets and communities. However, many recently delivered local streets appear unlikely to achieve meaningful tree canopy coverage and a consequent reduction in ambient temperatures (refer case studies presented below and on the following page).

The following Design Guidance and Requirements refer to all tree types. We have also outlined additional metrics for trees by their type and application, be it in a verge or in a kerb extension.

Not all local councils use root barriers. For those that do, the following additional Design Guidance has been supplied.

CASE STUDY - LOCAL STREETS IN WESTERN SYDNEY

Local streets recently delivered across Western Sydney appear unlikely to reach urban canopy cover targets.



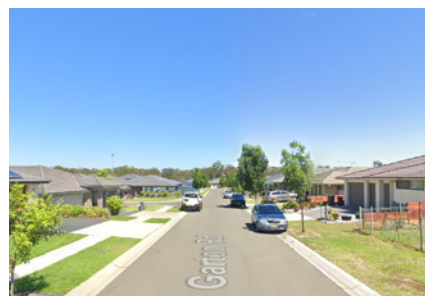
9.0m

Lotus Street, Marsden Park
Blacktown LGA
Road reserve: 16m



8.0m

Vandalay Road, Caddens
Penrith LGA
Road reserve: 16m



7.0m

Gartton Road, Spring Farm
Camden LGA
Road reserve: 14.2m

DESIGN GUIDANCE

- Select street tree species which are appropriate for local soil and climate conditions, balance the need for summer shade and winter sun, maximise biodiversity, and incorporate bushfire protection requirements
- Space street trees to create a continuity of tree canopy along the corridor, providing a visually attractive setting. Adjacent land uses may influence the pattern of spacing to accommodate active street entries and areas of parallel parking for access.
- Spacing of street trees must consider the distance from other street elements, such as lighting, driveways and waste collection areas
- Consider the impacts of climate change and the suitability of any new tree selections in a changed climate
- Select and appropriately locate tree species to ensure clearance for buses along bus routes and at bus stops

DESIGN GUIDANCE - ROOT BARRIERS

- Tree root barriers are to be applied to a maximum of two sides of a tree pit. When root barrier is installed as two parallel sides, a minimum distance of 1.5m between each side should be maintained
- Tree root barriers should prioritise the protection of utility assets - not the constriction of tree roots - and should be located to maximise access for tree roots to adjacent areas of soil
- Maximum depth of tree root barriers is 300mm when applied to protect pavement, and 900mm when applied to protect in-ground utilities
- Canopy cover calculations for street types must consider the potential stunting effect of tree root barriers

DESIGN REQUIREMENTS

- Refer to the Performance Based Framework for each street type presented in Section 2.0 as well as the [Greener Neighbourhoods Guide](#) (NSW DPHI) for urban tree canopy targets
- Streets are to be designed to incorporate as many trees as possible in order to provide the extensive urban tree canopy required to reduce ambient temperatures
- The number of street trees to be planted should not be tied to a development lot-related ratio (e.g. 1 tree per lot)
- The provision of on-street parking must be balanced with the need to plant street trees within the Flex Zone
- Streets are to be designed to provide the soil volumes, permeable surfaces, and passive irrigation appropriate for the establishment and growth of healthy and resilient street trees
- Ensure permeable surfaces surround the base of the tree
- Verge widths are to be maximised to provide adequate soil volume for optimal tree growth, with other design factors, such as the width of footpaths, balanced with the need for significant street tree growth
- Spacings between street trees should be reduced as much as practicable

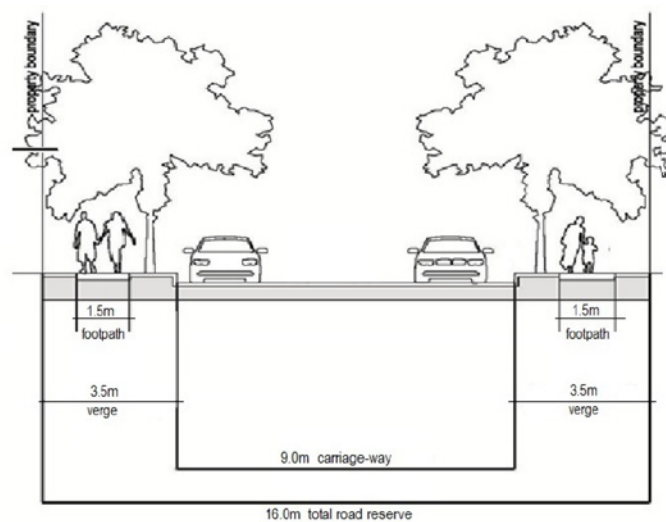


Street tree planting on Christiansen Boulevard, Moorebank
(credit: ASPECT Studios)

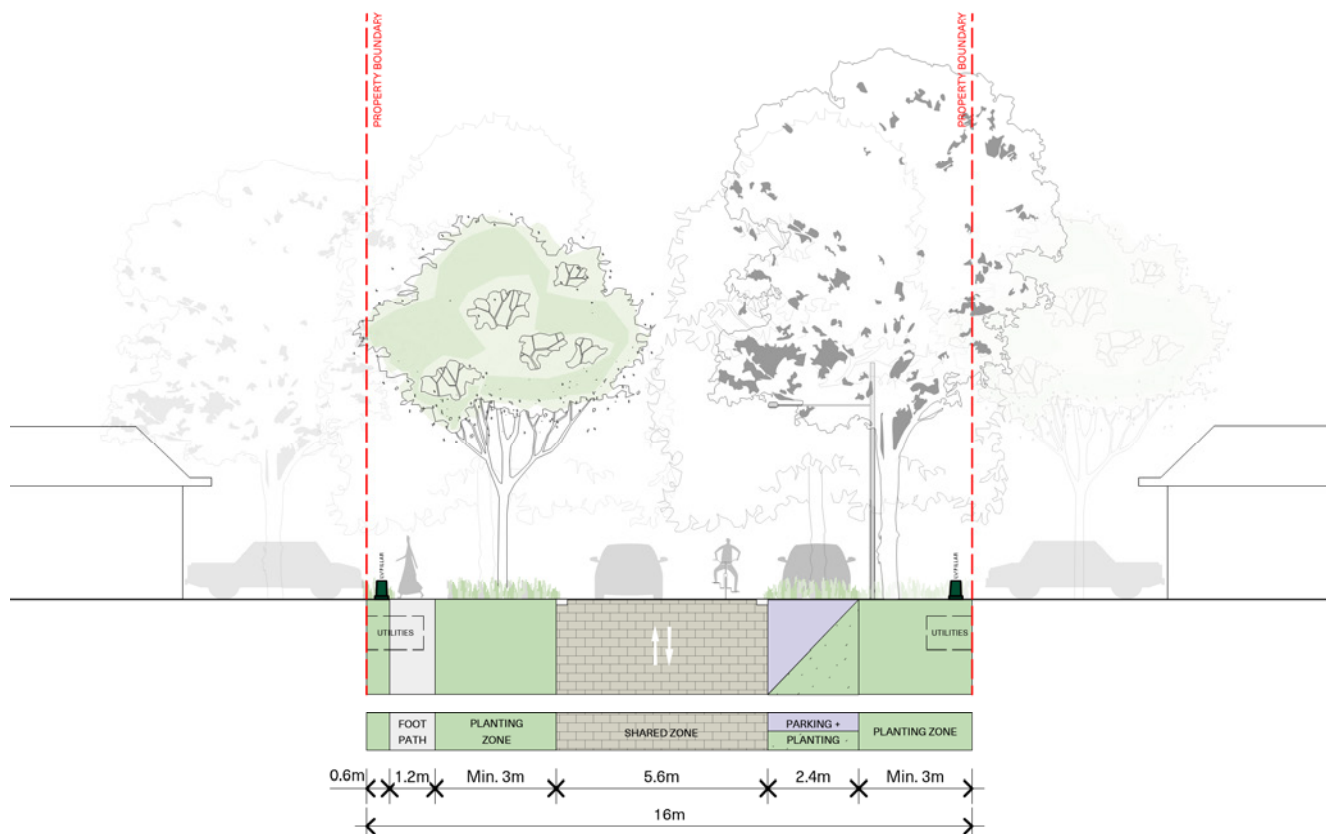
CASE STUDY - TREE CANOPY COVER

The following case study presents a comparison between the Local Street presented in Blacktown City Council's Growth Centre Precincts Development Control Plan 2010 and the Residential Way presented herein.

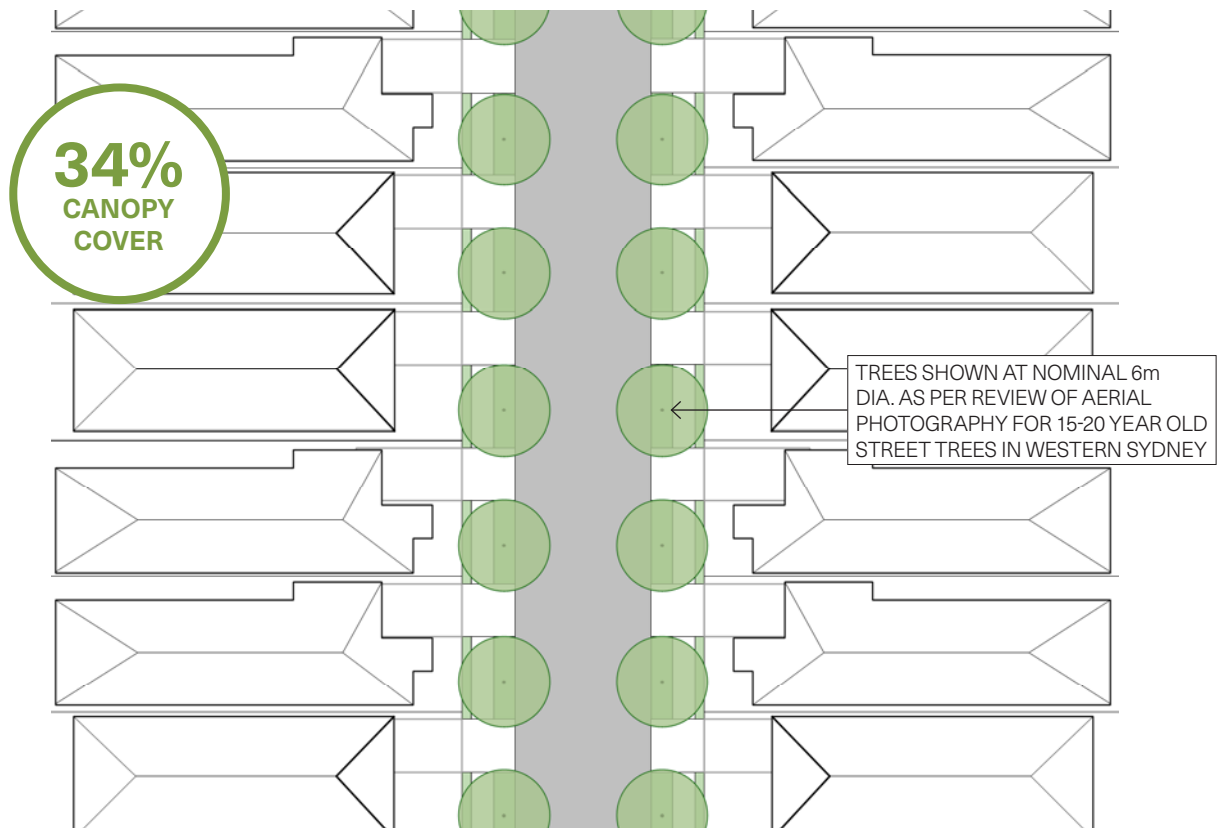
For the sake of comparison, the reserve width of the Residential Way has been adjusted to 16m to align with that of the Local Street.



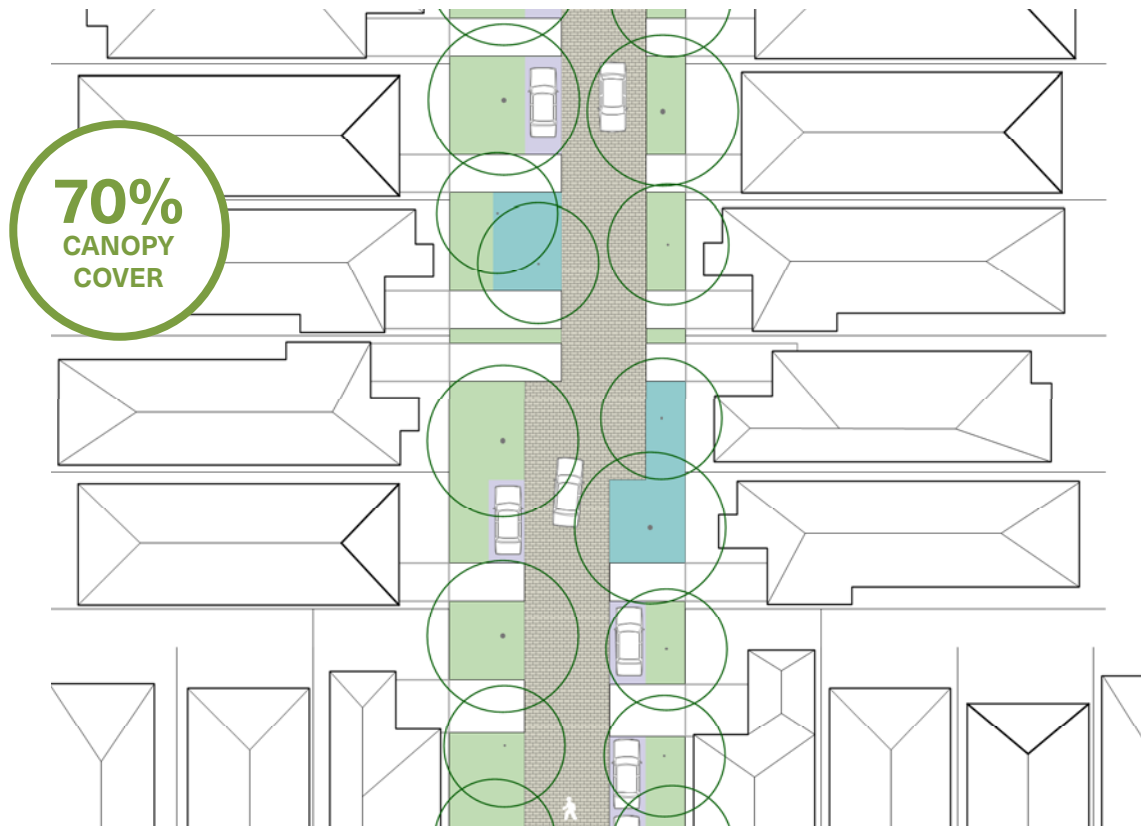
Typical cross section for Blacktown DCP Local Street



Typical cross section for Residential Way (16m variation)



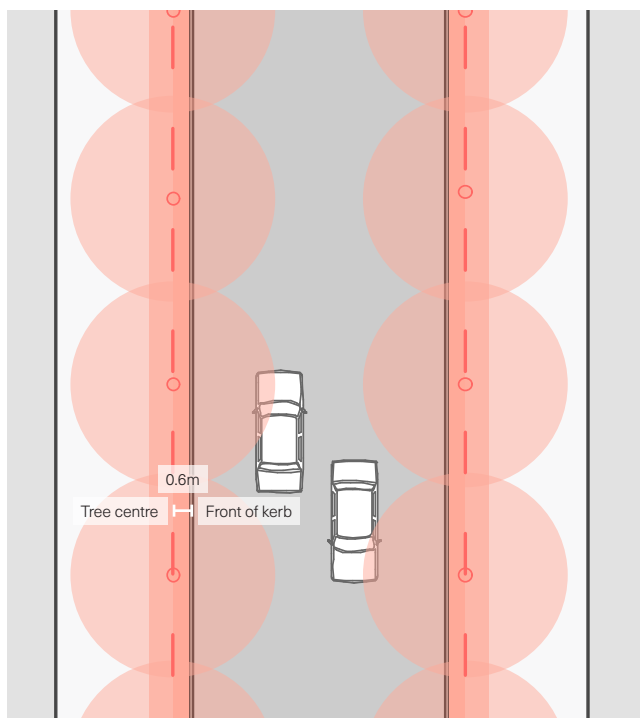
Typical canopy cover shown for Blacktown DCP street



Typical canopy cover shown for Residential Way

Street trees in the verge

Verge street trees are typically located to the back-of-kerb on both sides of the street, providing continuous lines of street trees. Verge street trees provide continuous canopy cover over the street corridor, including both the carriageway and verge areas. They also provide shade, amenity, and comfort for footpaths and cycleways.



Street trees in verges are to be planted a minimum of 600mm from the front of kerb

DESIGN GUIDANCE

- Implement a continuous row of street trees on both sides of the street to assist in achieving canopy coverage and street amenity for all street users
- Continuous rows of street trees should not rely on tree planting in kerb extensions or medians to achieve street tree planting and canopy cover
- Locate trees to avoid buses along bus routes

DESIGN REQUIREMENTS

- Provide a verge design (including provision of utilities, footpaths, cycleways, and driveways) that allows for a continuous row of verge street trees on both sides of the street
- Locate verge street trees as near as possible to the rear of the kerb to a minimum of 600mm from back of kerb
- Where trees are planted in coordination with parallel parking bays, the size of the tree pit and the location of tree planting must consider car overhangs and allow for enough space so as not to disturb the tree
- Where trees are planted along a bus route, the selected species must have a height clearance of 4.5m with a minimum 0.8m recess



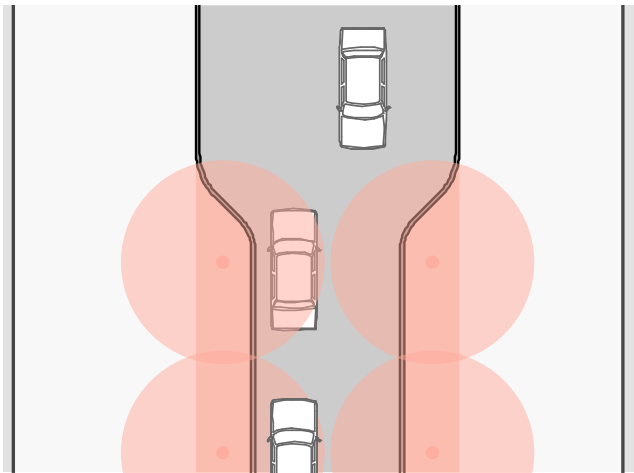
Verge tree planting on Minogue Crescent, Harold Park
(credit: ASPECT Studios + Simon Wood)



Verge tree planting in Marsden Park
(credit: ASPECT Studios)

Street trees in kerb extensions

Trees in kerb extensions are planted in line with kerbside car parking to increase street tree planting. Street trees in kerb extensions provide an opportunity to increase street tree canopy cover of streets by supplementing kerbside street trees with additional tree planting.



Street trees in kerb extensions

DESIGN GUIDANCE

- Plant street trees in kerb extensions to provide traffic calming by narrowing the perceived width of the carriageway for motorists moving along the street
- Provide street trees in kerb extensions to increase species variation, biodiversity, and variations in colour, form, and scale
- Locate trees to avoid buses along bus routes.
- Select tree species with regard to mature form—upright and fastigate branching trees will maintain a height clearance of 4.5m to taller vehicles



Street tree planting in a kerb extension at Harold Park.
(credit: ASPECT Studios + Simon Wood)



Street tree planting in kerb extension in Nagurra Place, Rozelle.
(credit: ASPECT Studios)

Street trees in the carriageway

Trees planted within the carriageway are planted in line with kerbside car parking to increase street tree planting.

Trees planted in the carriageway increase canopy cover and shading of road surfaces. They are particularly useful for retrofitting streets as they can keep works to existing kerbs and related stormwater infrastructure to a minimum.

Tree planting in carriageways can be retrofitted to streets to allow permeable ground surfaces to be added to older streets. This can be a low-cost way of introducing WSUD elements to streets in addition to the benefits of increasing tree canopy.



Street trees in the carriageway on Singleton Avenue, Kellyville
(credit: Google)



Street trees in the carriageway on Boronia Avenue, Epping
(credit: Google)



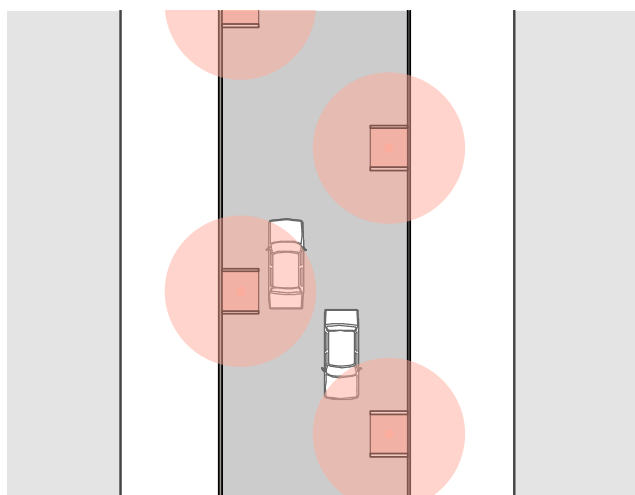
Street trees in the carriageway on Pennyroyal Boulevard, Denham Court
(credit: ASPECT Studios)

DESIGN GUIDANCE

- Plant street trees in the carriageway to provide traffic calming by narrowing the perceived width of the carriageway for motorists moving along the street
- Provide street trees within the carriageway to increase species variation, biodiversity, and variations in colour, form, and scale
- When street trees are retrofitted, a site-specific soil calculation can be used instead of soil volumes provided in 'Street tree soil volume'
- When street trees are new, soil volumes (imported soil mixes and structural soil) can continue below the adjacent road surface

DESIGN REQUIREMENTS

- Avoid trees in the carriageway where conflicts with buses are likely to preclude the provision of local bus routes



Street trees planted in the carriageway

Street trees in the median

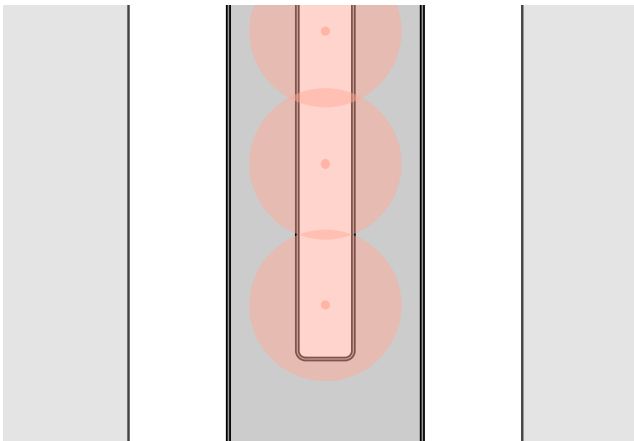
While the street types presented in Section 2 of the Guidelines do not include medians, the information presented here provides relevant guidance for potential variations to these. Median street trees are also relevant options for retrofitting existing street, where street trees are planted within landscape medians in the centre of the carriageway.

Street trees in medians provide an opportunity to increase street tree canopy cover of the carriageway as well as strengthening the landscape character of streets where appropriate.

Adding street trees to central medians visually narrows the width of a street and creates a slower speed environment. This can be an effective way of reducing traffic speed in local streets with wide road surfaces and no line marking. Central street tree planting can be in swales or raingardens or in medians with a raised kerb.

DESIGN GUIDANCE

- Implement median street trees to reduce the scale of overly wide carriageways, including retrofitting existing wide streets
- Utilise street trees in medians as traffic calming measures in streets where space allows medians without sacrificing other desired street uses such as outdoor dining space or separated cycling infrastructure
- Ensure the planting of street trees in medians allows for sight lines to intersections and pedestrian/bicycle crossings
- Ensure street tree canopies do not create conflicts along local bus routes



Street trees planted in central median



Median street trees in Harold Park.
Image - Harold Park Precinct, ASPECT Studios (Simon Wood)



Retrofitting median street trees in Primrose Avenue, Rosebery.
Image - (ASPECT Studios)

Street tree soil volume

Tree soil volume refers to the volume of growing media available to support the growth of street tree roots. Growing media is typically provided as suitable soil to a depth of about 1m within turf and planted verges.

Where space for turf or planting areas is constrained, structured cells or structural soil can provide the structural integrity needed for adjacent pavements together with the space needed for optimal tree root growth.

Sufficient soil volume needs to be provided for all new street trees to ensure they are able to grow at a reasonable rate, reach maximum canopy size, and maintain vitality for the duration of their useful life.

DESIGN GUIDANCE

- Optimum soil volumes are a priority for all streets
- Soil volume can be calculated by considering the availability of soil of suitable quality, and can include existing site soils in areas adjoining street tree planting and beyond adjacent property boundaries
- The environmental and economic benefits of street trees increase substantially if they remain viable for greater than 50 years



Structural cells can maximise subsurface soil volumes in urban areas (credit: CityGreen)

DESIGN REQUIREMENTS

- Meet minimum soil volume requirements for street trees as per Table C2.2 below. Where assumptions vary from those included in the table, refer to the provided resource to calculate project-specific soil requirements
- Tree roots typically grow within the top 500-600mm of soil depth and may occasionally grow to a greater depth. Do not include soil below a depth of 1000mm within soil volume calculations.
- Adjacent site soil can be included in soil volume calculations if it can be demonstrated that tree roots have unrestricted access to it
- Consider the alignment, space occupied, and possible restriction of natural root spread and development of service trenches when calculating available soil volumes

Tree size	Typical height	Recommended minimum soil volume	
		Per tree individual tree pit	Per tree in shared trench (typ. up to 3 trees)
Small	to 4m high	8.65m ³	5.80m ³
Small/medium	4–9m high	13.80m ³	9.20m ³
Medium	7–10 m	21.40m ³	14.25m ³
Tall	9–12	32.65m ³	21.80m ³
Tall & wide	8m+ canopy 14m+ wide	43.70m ³	29.15m ³

Table assumptions:

- Assume climatic growing conditions are dry, unreliable and /or hot or extreme conditions
- Assume soil suitability is not particularly fertile or effective
- Assume there is no maintenance, with no fertiliser applications, no mulch, no supplementary irrigation

Refer <https://www.elkeh.com.au/soils/> for bespoke tree soil volume calculations.

Paved tree pits

Paved tree pits refers to the planting of street trees in areas of paving which extends to the base of the tree and soil volumes are provided under adjoining paved surfaces.

Paved tree pits use hard surfaces around the base of street trees in constrained or urban environments, where alternate uses such as outdoor dining need to be prioritised.

Different examples of paved tree pit materials include bound granites or gravels, tree grates and permeable pavers. Ultimately – the paving finish to the base of the tree should tie in with the adjacent footpath, and therefore should be coordinated with council palettes.

DESIGN GUIDANCE

- Provide paved tree pits on high streets where space under and around trees can be used for alternate uses

DESIGN REQUIREMENTS

- Ensure minimum subsurface soil volumes are provided
- Maximise use of permeable pavers in paved areas around tree pits to provide water infiltration to subsurface soil



Terrabond tree pit
(credit: Resin Drives)



Terrabond tree pit
(credit: Google)

Planted tree pits and understorey planting

Understorey planting refers to low mass planting within verges, kerb extensions, and medians. Planted tree pits are tree pits which utilise planting to further enhance the visual and environmental amenity of street tree plantings.

Understorey planting expands the provision of planting in the streets which increases visual interest, biodiversity and fauna habitat. Including understorey planting in streets can reduce maintenance activities, such as mowing turf. In areas where verges are swales or raingardens, understorey planting plays a role in assisting in removing pollutants from the soil and water.

In high pedestrian activity areas, understorey planting can direct pedestrian movements to dedicated crossing points instead of fences and other barriers and in commercial centres, understorey planting can improve the amenity of the streetscape, especially adjacent areas of outdoor dining.

Some local councils have policies that encourage residents to take ownership of the verges in front of their properties to allow residents to utilise the space for growing edible or biodiversity species. Examples include bee/insect attracting planting, small fauna habitat planting, or herbs/vegetables. In general, measures that encourage residents to have a sense of ownership and pride for the planting adjacent their properties should be encouraged. Planting selections should avoid environmental weeds and plants that can grow higher than 800mm, to prevent creation of sight line issues.

DESIGN GUIDANCE

- Consider the ongoing maintenance requirements of understorey planting during the design phase to ensure the sustainability and longevity of planted areas
- Consider access to parked cars from footpaths

DESIGN REQUIREMENTS

- Ensure understorey planting adheres to best practice CPTED principles
- Ensure traffic visibility and clear sight lines are maintained



Planted verges give opportunity to grow herbs and vegetables
(credit: ASPECT Studios)



A biodiversity verge attracts native flora such as bees and insects
(credit: Gerald Moscarda)

WSUD features

Water sensitive urban design (WSUD) is an important feature for streets. There are many ways of achieving WSUD in built up areas. In streets, the objective is to capture, slow, and filter polluted stormwater to reduce the strain on existing waterways and stormwater infrastructure.

WSUD can effectively treat the pollutants from low flows, which account for 90-95% of the total annual runoff volume. Further to this, WSUD contributes to street tree health, a cooler environment through evapotranspiration, and can contribute to biodiversity in streets.

Broadly, WSUD aims to reduce the quantity of water entering the stormwater system and to improve the quality of this water.

The Guidelines sets a target of WSUD on every street, to a total size of 3-5% of impervious area (e.g. asphalt roadways, non-permeable paving), subject to site-specific modelling to achieve agreed water quality targets. This WSUD sizing target has been derived from MUSIC modelling (Planning Institute of Australia, 2016), which shows that for an area which is 50% effective impervious area (such as in private lots in housing areas) the ideal size of WSUD features is 2%. As the Guidelines' street types tend to be less permeable (65% impermeable), and often more polluted, a higher target of 3-5% has been set for WSUD features.

It is critical to allow space for WSUD feature in streets, and this allowance will allow designers to meet the more detailed water quality targets in DCPs, SEPPs, and EPIs.

This section provides two key WSUD elements which will help all streets meet their WSUD Design Requirements—WSUD tree pits, and raingardens and swales.

Although many other elements contribute to water-sensitive streets, such as permeable paving and passive irrigation kerbs, they do not contribute to the overall WSUD design requirement as they do not provide a significant capacity to filter stormwater. Irrespective, permeable paving and passive irrigation kerbs are still critical components to any holistic WSUD strategy in a street and should be incorporated to support dedicated WSUD features.

DESIGN GUIDANCE

- Integrate WSUD within other street elements such as kerb extensions and verges, as much as possible
- Give consideration to the staging and construction of WSUD elements to ensure that subsequent construction of residential housing and/or future stages of development does not damage WSUD elements

DESIGN REQUIREMENTS

- Design WSUD features ensuring that 100% of low flows of the road catchment run-off flows into the WSUD feature, and is on average between 3-5% of the catchment size (total impervious area), subject to site-specific modelling to achieve agreed water quality targets
- Consider overland flow requirements within the stormwater design, as the road and its kerbs are often used to direct overland flow in flood events
- Refer to the Engineering Design Manual for Western Sydney for further design requirements on WSUD elements and their application
- Ensure WSUD is stable (scour and mobilisation of material) in high flows

WSUD tree pits

An integrated WSUD street tree pit enables numerous objectives to be achieved in one space and maximises the benefit to street tree health.

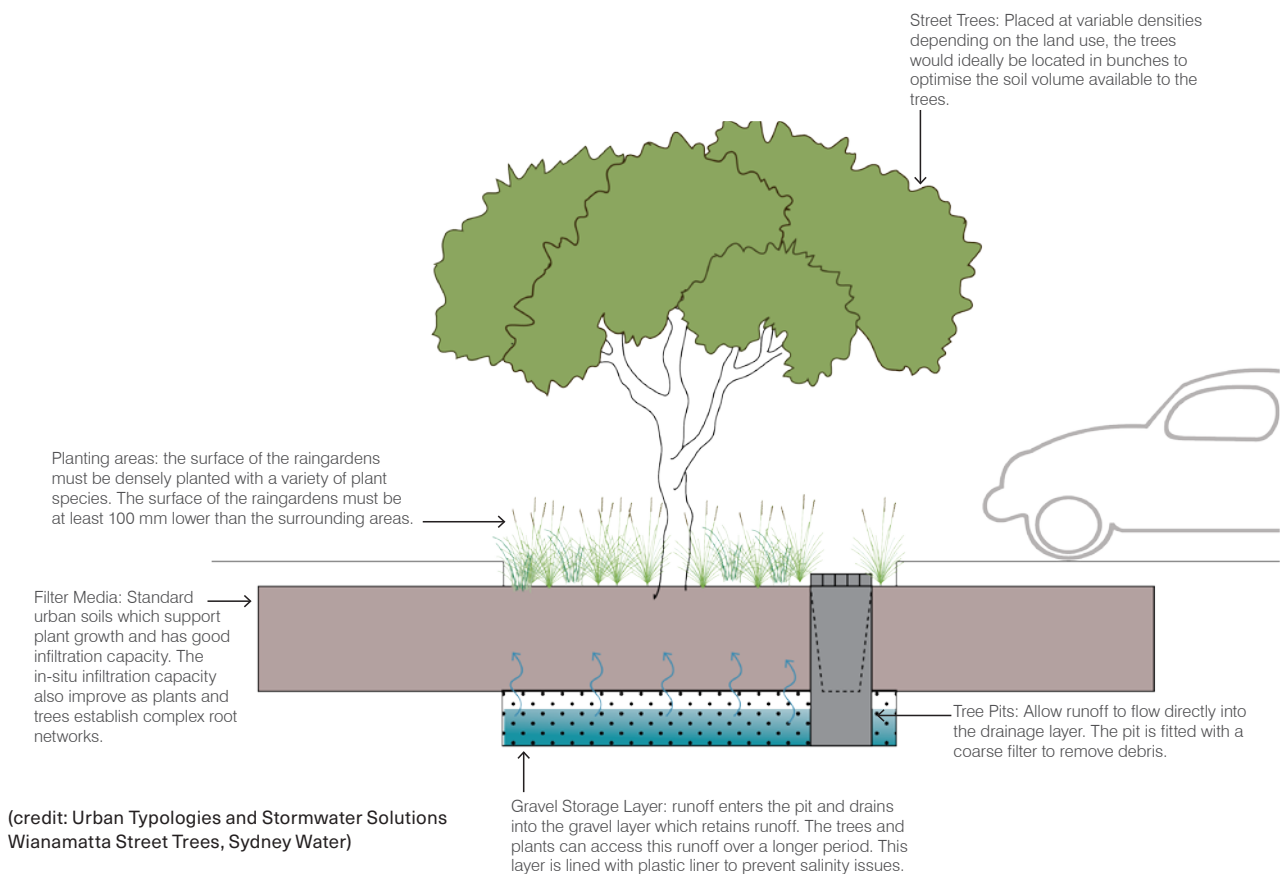
In all instances, a WSUD tree pit must be connected to the stormwater system to allow for passive irrigation, to optimise tree health and capture urban stormwater for reuse and nutrient take up

DESIGN GUIDANCE

- Design water inlets to control flows and enable maintenance

DESIGN REQUIREMENTS

- Refer Street tree design requirements
- Refer to general WSUD feature design requirements
- Directly connect the inlet stormwater pit to the gravel drainage zone and allow for bypass or overflow of high flows
- Match tree species selection to the water availability by checking catchment runoff characteristics
- Incorporate passive irrigation kerbs around the trees to maximise water infiltration
- Consider planting more than one tree in each stormwater connected pit where soil volume permits



Passive irrigation kerbs

Kerbs are typically located between the carriageway and the adjacent verge. Along with the gutter, their primary role is to divert errant vehicles, and to direct the flows of stormwater off the road surface into stormwater pits. For this reason, kerbs and gutters can provide important opportunities to further integrate passive irrigation or WSUD into streetscapes.

Passive irrigation kerbs are modified to enable better flow of water into landscaped areas adjacent to the carriageway. The adjacent page contains section drawings of typical passive irrigation kerb types and the site characteristics they are best suited to. Designs are not limited to what is provided. Indeed, any kerb or edge which is designed to divert water into tree pits and planted areas can be considered a passive irrigation kerb.

Inlet pit structures can also be modified to direct low flows to water treatment, while high flows are diverted to larger systems. This balance of where high and low flows should be directed is a critical component of the broader design of catchment water management and will influence the scale of downstream works and the ongoing maintenance burden of all systems.

DESIGN GUIDANCE

- Incorporate passive irrigation kerb types as often as possible into new and refurbished streets
- Modify kerbs, gutters and inlet pits as required to direct low flows to WSUD systems and divert high flows to larger systems, while ensuring vehicle safety



Kerbless areas for passive irrigation with inlet pits at Moorebank.
(credit: ASPECT Studios)



Kerb cuts for passive irrigation in Harold Park.
(credit: ASPECT Studios and Simon Wood)



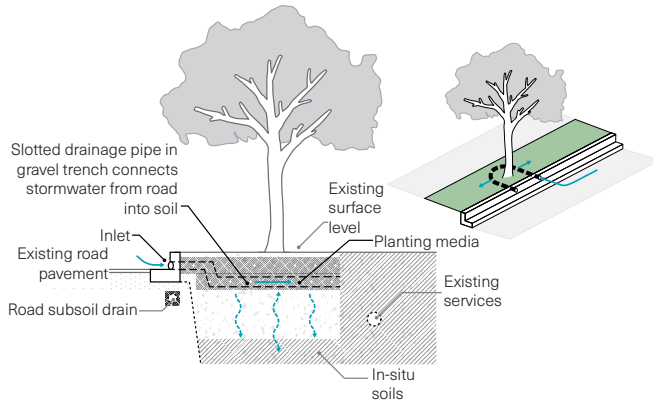
Kerb cuts for passive irrigation on Bourke Street, Surry Hills.
(credit: City of Sydney and Simon Wood)

Example 1 - No underdrainage

Typical site characteristics:

- No stormwater network
- Limited budget for retrofit

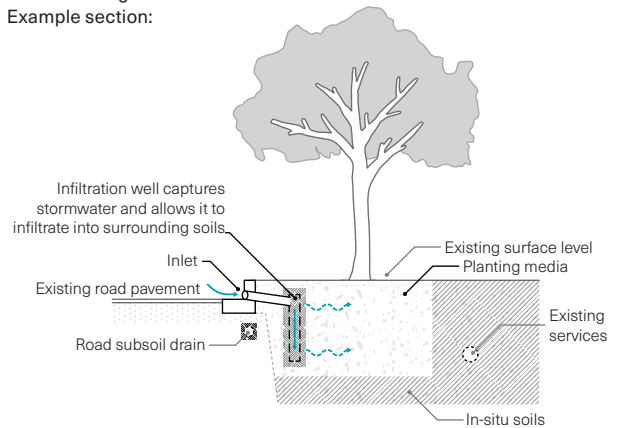
Example section:

**Example 2 - Infiltration trench/pit**

Typical site characteristics:

- No stormwater network
- Limited budget for retrofit

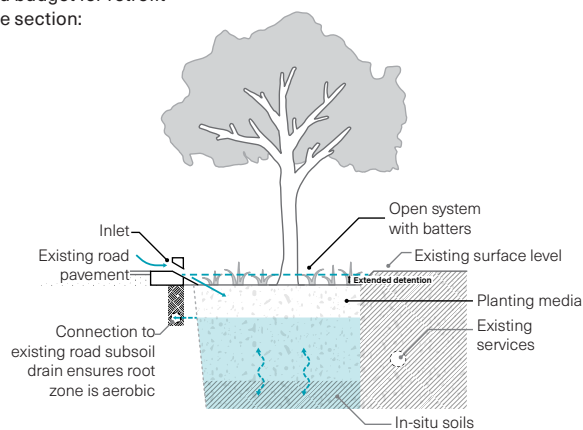
Example section:

**Example 3 - Elevated underdrainage**

Typical site characteristics:

- Existing road subdrain
- Limited budget for retrofit

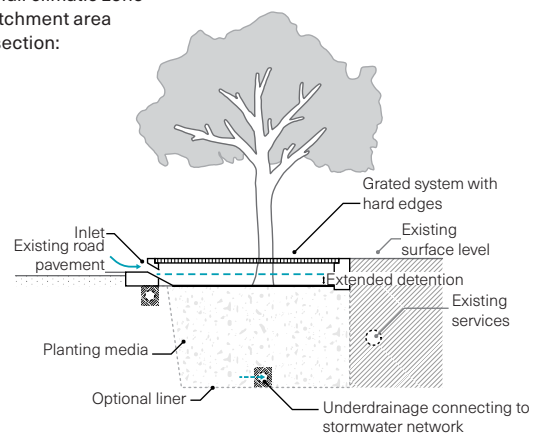
Example section:

**Example 4 - With underdrainage**

Typical site characteristics:

- Existing road stormwater network
- High rainfall climatic zone
- Large catchment area

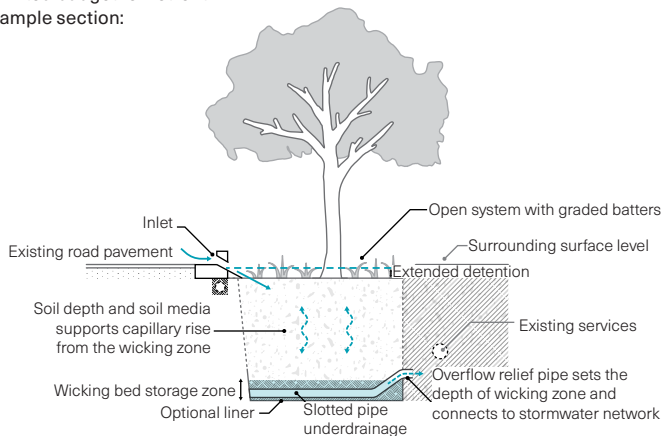
Example section:

**Example 5 - Elevated underdrainage**

Typical site characteristics:

- Existing road subdrain
- Limited budget for retrofit

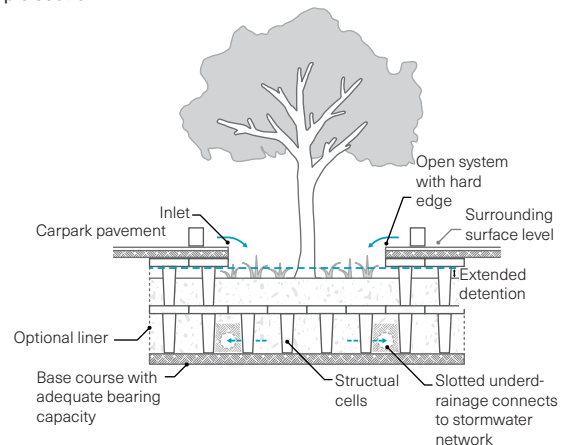
Example section:

**Example 6 - With underdrainage**

Typical site characteristics:

- Pavement required over system

Example section:



Examples of WSUD tree pit installation

(credit: Water Sensitive Cities "Examples of typical passive irrigation design components", Monash University)

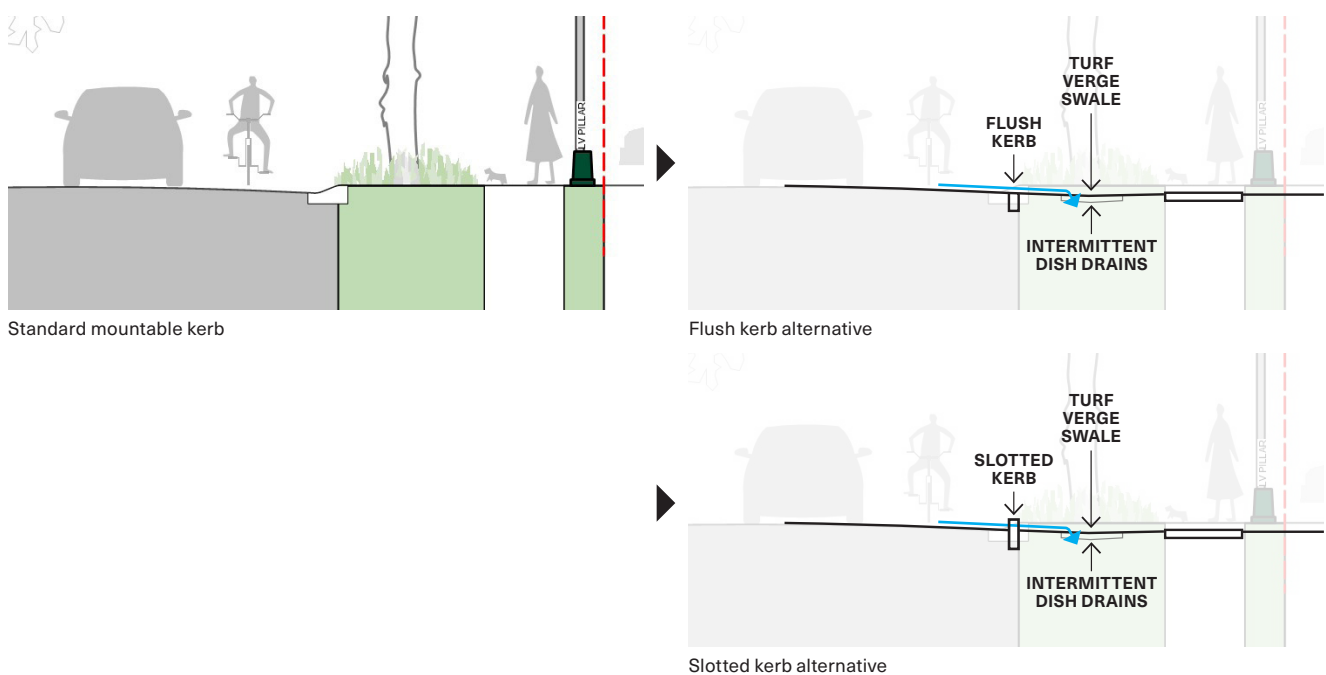
Lo-fi passive irrigation

Passively irrigated verges, or 'lo-fi WSUD', was once the norm in Australian suburban development. This section seeks to encourage a 'lo-fi' approach to working with water in the street. Passively irrigating verges needn't be complicated or involve complicated WSUD assets that are expensive to maintain.

The examples presented below illustrate approaches to allowing water to passively irrigate verges and street trees without significantly adding to maintenance requirements.



Passively irrigated turf verges, or 'lo-fi WSUD', was once the norm: Lane St, Laurieton (source: Google)



Permeable paving

Permeable paving refers to paved areas that allow water to infiltrate between pavers or through porous materials to the substrate below, enabling hard surfaces to perform water quality improvement, quantity reduction and cooling functions.

The sub-layer for permeable paving can be engineered to have an effective water treatment function, or simply to slow water before draining to the stormwater system, depending on site conditions and the frequency of vehicle use. It can be effective when placed next to a WSUD feature or street tree pit to expand the permeable zone draining to the tree's root zone.

Permeable paving is an excellent option in streets where there is limited space, and therefore limited ability to incorporate other permeable surfaces like planted verges. This is because permeable paving can be used for a carriageway or street parking while also meeting WSUD and permeability targets.

Permeable paving does have a higher installation cost than other road surface options such as asphalt, and other permeable surfaces such as planted verges. The cost can be reduced by consolidating areas of permeable paving. Permeable paving also requires maintenance, which asphalt does not. However, it does not require any specialist equipment and is as easily maintained as other types of paving, such as footpaths or other public spaces. Additionally, permeable paving can require less maintenance than other permeable surfaces such as planted verges. Lastly, maintenance can be minimised through design process by considering things like adjacent tree selections.



Permeable paving for street trees on Rider Boulevard, Rhodes
(credit: ASPECT Studios)

DESIGN GUIDANCE

- Use permeable paving instead of traditional impervious surfaces where appropriate, such as in parking bays, laneways, or driveways
- Ensure a thorough understanding of the underlying geology, how water will infiltrate, and how the permeable paving system will be maintained
- Maximise use of permeable paving adjacent to street tree planting to ensure the health and longevity of street trees

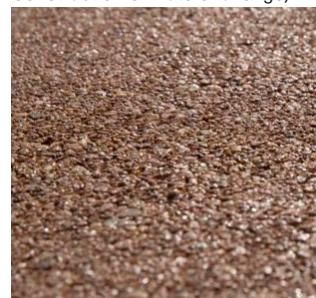
Permeable paving examples:



Permeable asphalt (credit: Construction Climate Challenge)



Ecotrihex pavers
(credit: Australian Paving)



Stoneset
Image - (Stoneset)



HydroSTON concrete pavers
Image - (HydroSTON)



Permeable car park paving.
Image - (ASPECT Studios)

3.4 Vehicles

Traffic calming

Traffic calming refers to the use of physical design measures, such as kerb extensions and lane narrowing, to create a balance between the movement and place functions of a street. It usually requires a change in a typical condition, alerting drivers to the potential presence of other road users and maintaining slow behavioural speeds.

The principle of self-explaining roads is one aspect of the safer roads approach. Self-explaining roads naturally encourage drivers to adapt their behaviour in a way that is compatible with the design, function, and speed of a road. Additionally, a self-explaining road can potentially reduce the need for a large number of traffic devices to control behaviour. (Roads and Maritime, 2014)

DESIGN GUIDANCE

- Ensure traffic calming contributes to the creation of self-explaining street environments where their appearance reinforces their intended function and speed posting
- Through the road conditions, drivers should feel uncomfortable exceeding the speed limit, and should be aware of the type of conditions ahead without excessive prompting from road signage

DESIGN REQUIREMENTS

- Adopt traffic calming design measures on all Local Residential and Mixed-Use Streets
- Traffic calming measures can take a number of forms. Acceptable examples are included in the adjacent diagram
- Maximise the use of traffic calming measures to achieve the other Street Feature Design Requirements. For example, provide soft landscape elements within kerb extensions to maximise permeable surfaces
- The design of traffic calming measures on bus routes is to consider bus operational requirements, and bus passenger safety and comfort requirements



Eckersley Way, Moorebank
(credit: ASPECT Studios)



High Street, Granville
(credit: ASPECT Studios)

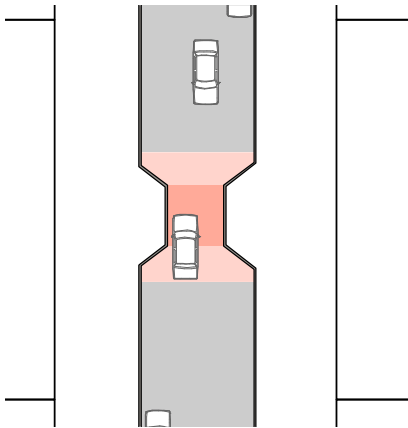


Diagram 1: Pinch Points

Pinch points are a narrowed section of the carriageway. Within a Yield Street, opposite motorists yield to one another at pinch points.

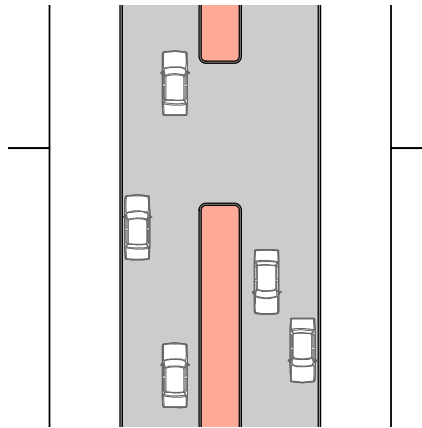


Diagram 2: Medians

Implementing raised medians in the middle of the carriageway narrows the overall carriageway width and allows for additional street tree planting.

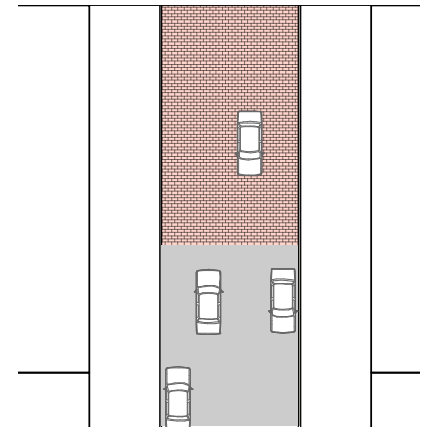


Diagram 3: Pavement Alteration

Changes in pavement signify a change in context, typically in which pedestrians are prioritised.

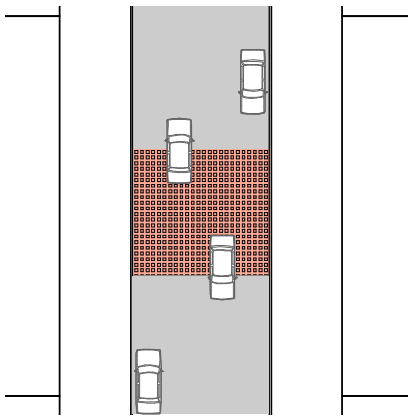


Diagram 4: Rumble Strips

Rumble strips can be of several different forms typically produced by cutting grooves within the pavement surface, or by adding plastic ribs to the carriageway.

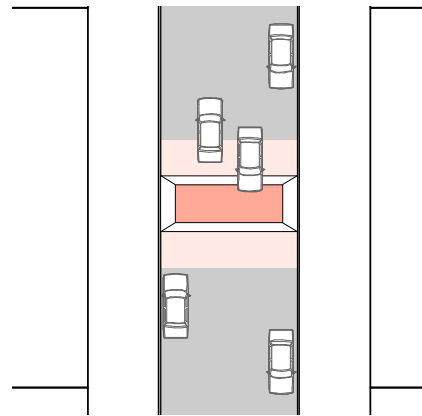


Diagram 5: Speed Humps

Speed humps are raised sections which slow and control traffic. The sizing and dimensions of speedhumps are dependent on the behavioural speed of the street.

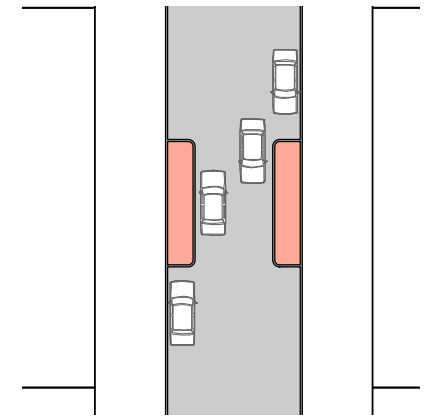


Diagram 6: Kerb Extensions (Retrofit)

Kerb extensions narrow the overall width of the carriageway resulting in vehicles having to reduce traffic speed. They can be detached from the kerb, avoiding modifications to stormwater assets and making them easy to retrofit on existing streets.

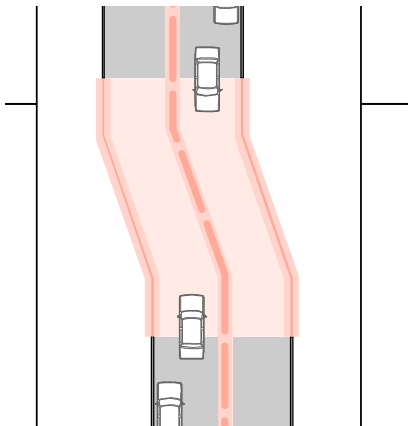


Diagram 7: Chicane

A Chicane is a sharp bend in the road from which drivers are expected to reduce speed to negotiate the alteration in the carriageway.

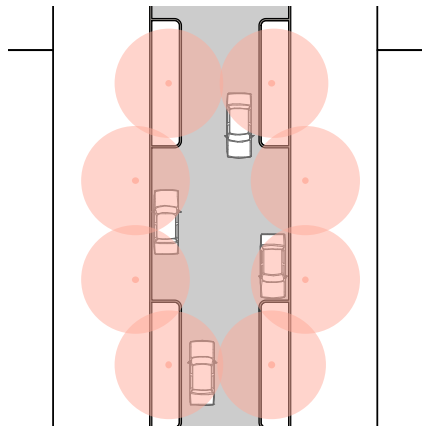


Diagram 8: Street Trees

A connected street tree canopy visually narrows the width of the carriageway and signifies to motorists they are entering a populated area.

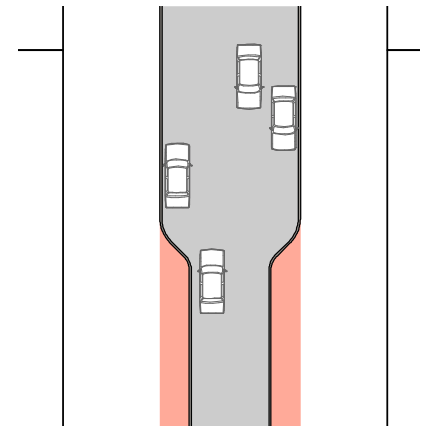


Diagram 9: Kerb Extensions

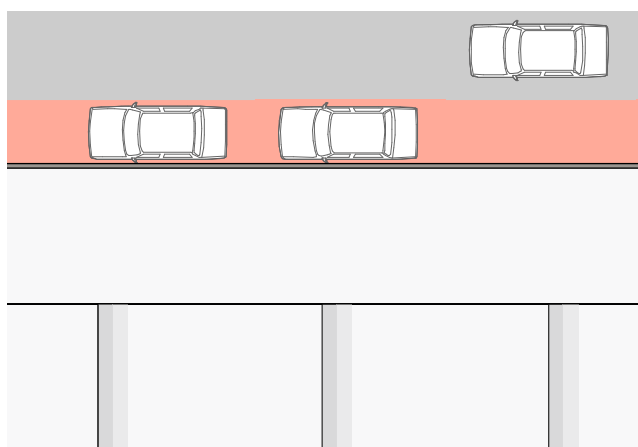
Kerb extensions are traffic calming elements which locally widen the verge and kerb line and narrow the carriageway.

Commercial on-street parking

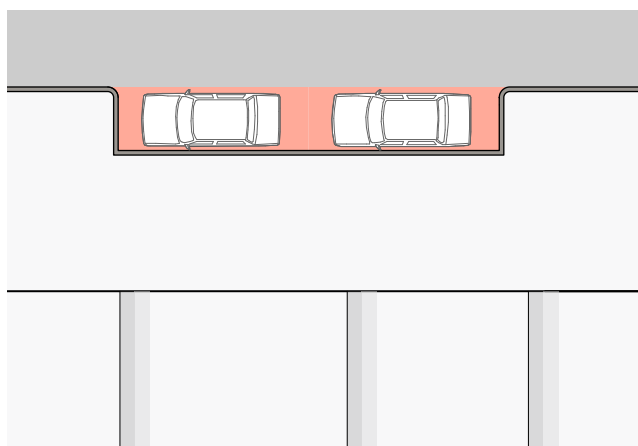
On-street parking refers to the provision of kerbside and indented parking for motor vehicles.

On-street parking in commercial streets allows visitors and workers to access local centres by car. Designated space for kerbside uses such as loading zones safely facilitate commercial activity on the street.

On-street parking can be a contentious issue due to the parking demand typically exceeding supply in mixed-use streets. Demand for kerbside parking can be managed through pricing and time restrictions in commercial centres.



Kerbside parking on a commercial street



Indented parking on a commercial street

DESIGN GUIDANCE

- Consider the kerbside space occupied by on-street parking against other street design objectives and stakeholder aspirations when designing on-street parking
- Regulate parking to avoid pushing parking demand into inappropriate spaces, such as verges, cycle lanes, and through-traffic lanes. Local councils can create a regulated market for parking by providing designated space for specific kerbside uses, such as loading zones, and by placing a value on general vehicle parking. A combination of purpose-based zones, time limits, and pricing can improve safety for all street users and make parking and loading significantly less time-consuming
- Reduce the number of vehicles cruising for parking, and the time spent by drivers doing so, by:
 - charging for parking during high-demand periods of the day or week; or
 - providing smart parking information to citizens and drivers so that they can select whether to drive at all, and where they should drive to and park
- When choosing a parking lane width within the ranges provided in Section 2, consider minimising the width of parking bays to reflect the vehicle type most likely to park in each location, to maximise street space for alternate uses

DESIGN REQUIREMENTS

- Refer to Chapter 2.0 for required parking lane widths
- Allow taxis, freight, and other private vehicles to load or unload in designated spaces without blocking through motor vehicle, cycle, and transit traffic
- Provide kerb space for taxis to queue while waiting to pick up passengers. These can be valuable near major destinations and transit stations to organise taxi hailing

Driveways

Driveways provide vehicle access from the carriageway to adjacent lots fronting the street.

It is important to consider the location of driveways along a street together with the provision of on-street parking to ensure that the appropriate vehicles can enter and exit driveways safely.

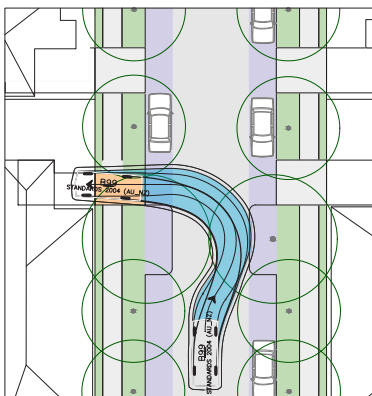
The Yield Street example below highlights the importance of considering the location of on-street parking to enable vehicle turning movements into driveways.

DESIGN GUIDANCE

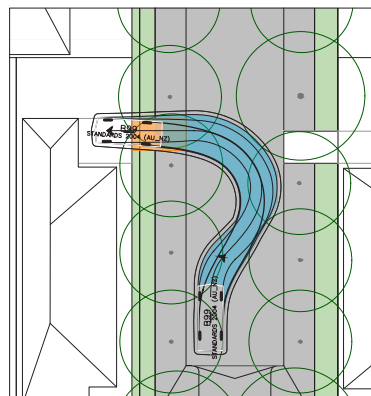
- Driveway widths should be minimised as much as practicable to reduce the impact of the driveway on the adjacent verge, including footpaths, bike paths and planting
- Trapezoidal-shaped driveways that taper from the kerb to the property boundary can be adopted to assist in reducing pavement without compromising vehicle turning movements

DESIGN REQUIREMENTS

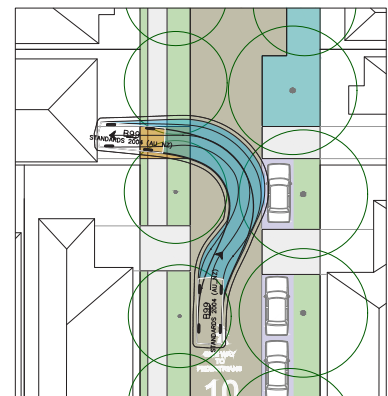
- Ensure the appropriate design and check vehicles can safely turn into and out of driveways, including consideration for on-street parking provisions and the potential impact of parked cars on vehicle turning movements



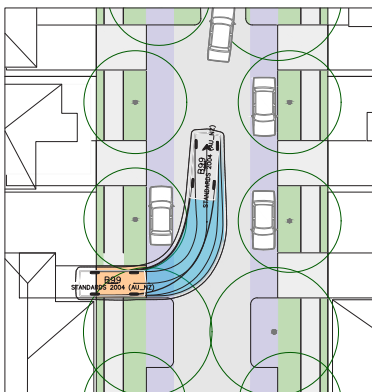
Neighbourhood Street turning path movement into driveway



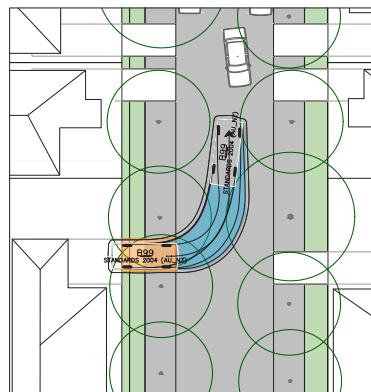
Yield Street turning path movement into driveway



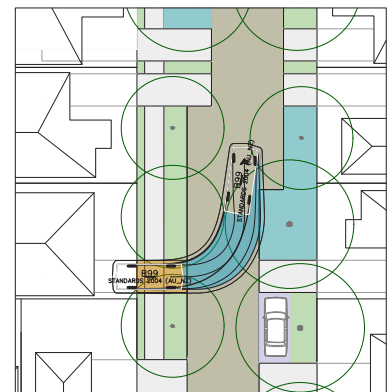
Residential Way turning path movement into driveway



Neighbourhood Street turning path movement out of driveway



Yield Street turning path movement out of driveway



Residential Way turning path movement out of driveway

Car share

Car sharing schemes operate shared-use fleets of passenger and light commercial vehicles for short term hire for personal and business uses. Customers book vehicles via computer or mobile apps that provide cost and location information.

Car share schemes provide convenient and affordable transport choices, encouraging reduced car ownership and enabling more sustainable travel habits. They offer an alternative option to private car ownership, while transferring the costs of purchasing and maintaining a private vehicle to the car sharing provider.

Car share schemes are typically supplied by the private sector but rely on on-street parking spaces, both fixed and non-fixed. Fixed parking spaces provide a marked parking space for the exclusive use of a car share vehicle. Non-fixed parking spaces operate on the basis of permit parking schemes. Both types are administered by local councils, as the relevant parking authority. Local councils are also solely responsible for enforcing car share parking spaces.

Anecdotal evidence reported by RMS suggests that enhanced markings increases compliance with car share only spaces. This includes the use of signage and painted treatments on the road surface.

In the long term, encouraging the use of car share schemes can be a viable way for local councils to reduce overall parking provision for private cars and costs associated with wider road corridors.

DESIGN GUIDANCE

- Reduce congestion and competition for parking spaces via implementing car share which allows a single vehicle to be used by several people
- Report monthly data on the use of individual spaces to gauge whether additional spaces are needed

DESIGN REQUIREMENTS

- Provide car sharing parking spaces on both Local Residential and Mixed-Use streets to encourage the use of car sharing to help discourage car ownership



Dedicated car share parking, Sydney (credit: Cars Guide)

Buses capable streets

Effective transit systems that encourage modal shift to public transport need to be supported by a range of critical infrastructure. Consultation with Transport for NSW has resulted in the provision of further design requirements for streets in Western Sydney. Different bus routes have different service frequencies, resulting in different street design requirements, particularly in relation to bus stop arrangement.

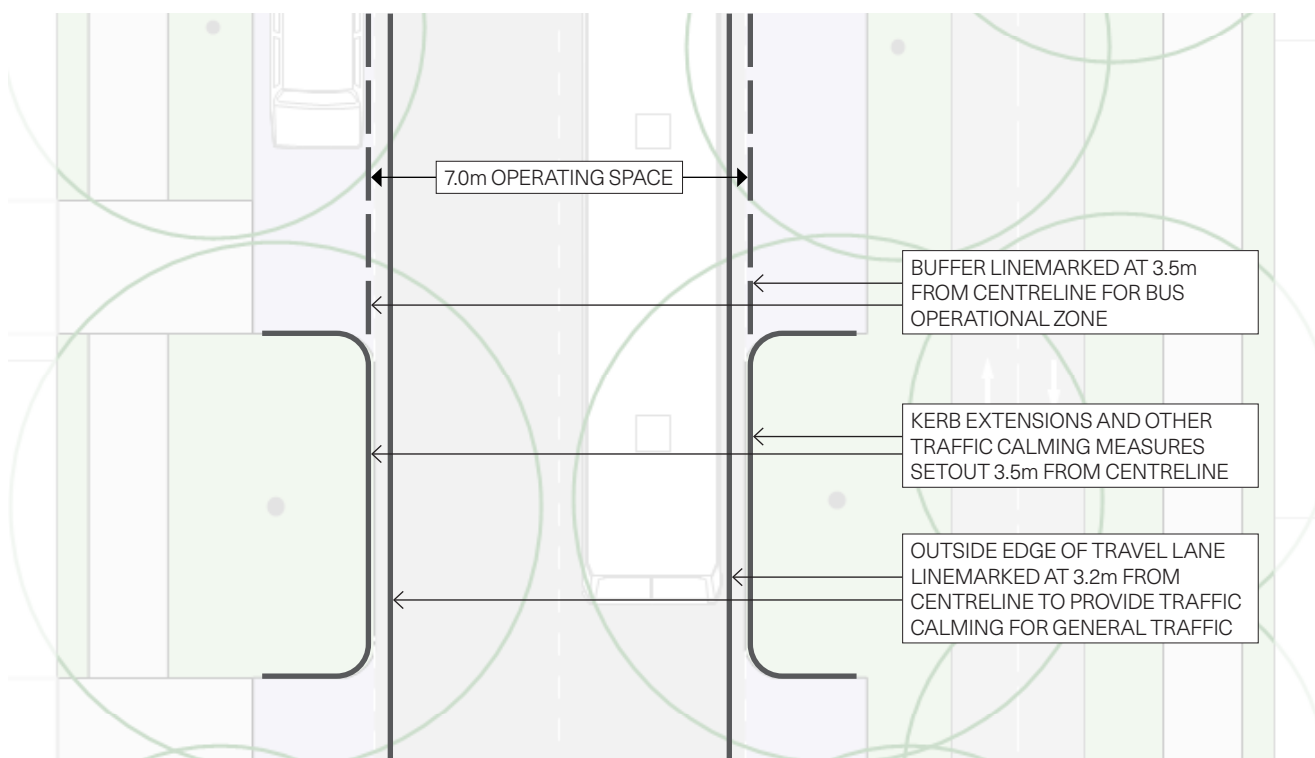
An opportunity should be provided for Transport for NSW bus service planners to input at the ILP, LEP, Planning Proposal or Masterplan stage in terms of local street layout, identifying future bus routes, street reservation widths for bus routes, location of landuses, and connections with immediately adjacent estates and precincts.

This would allow for the identification of logical future bus routes that ensure reasonable service coverage, as well as direct access to local and surrounding schools, shops, and services, as well as connections to rail services and major destinations. Road reserves need to be sufficiently sized to accommodate carriageways and intersections that support bus movement needs. The objective is also to ensure the walkability of neighbourhoods and the ability for residents to easily walk to bus stops.

An opportunity should also be provided for Transport for NSW bus service planners to input into draft DCPs and Masterplans to ensure the adequacy of provisions for future bus routes, including suitable carriageways and street designs that facilitate efficient and safe bus movements on relevant streets to provide high quality services.

DCPs and Masterplans should identify indicative bus stop locations to alert stakeholders including prospective property owners of their intended provision. Final positioning of bus stops will be subject to detailed engineering design. DCPs and Masterplans should include considerations for preferred bus stop types with a preference for kerbside or in-lane bus stops depending on passenger needs, fronting landuse and road traffic context.

DCP landscaping provisions should include considerations for kerbside plantings along bus routes and at bus stops. These types of details should be resolved in consultation with Transport for NSW, which would involve bus operators where required.

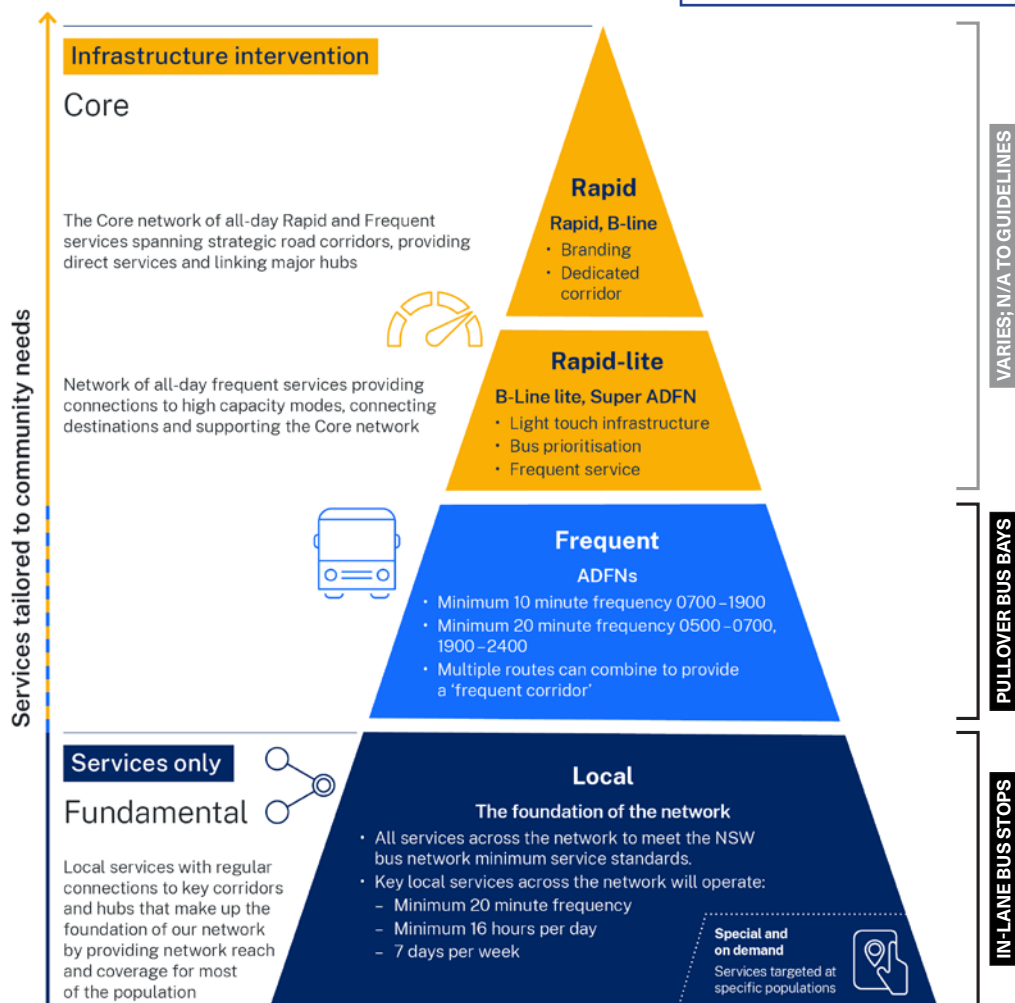


Bus capable traffic calming line marking

In new and established suburbs, ongoing delivery of quality bus services to communities relies on councils maintaining and enhancing street operating conditions for buses over time, including infrastructure adjustments, traffic management or bus priority measures to address issues as they arise. Ongoing improvements to pedestrian access to bus stops and rail stations is also key to facilitating greater public transport use.

DESIGN REQUIREMENTS

- Consult with Transport for NSW bus service planners ILP, LEP, Planning Proposal or Masterplan stage
- Provide 7.0m kerb-to-kerb operating space with linemarking with 3.2m travel lanes to calm general traffic
- Use a bus as the design vehicle for turning movements on bus routes with frequent service type or higher
- Roads planned to support bus services should have a minimum 0.8m recess of any fixed object from the kerb face at all bus stops and along all bus routes (including for kerb buildouts). Height of clearance from roadway is to be 4.5m



Transport for NSW's current bus route classification shown in relation to bus stop arrangement
(credit: [NSW Bus Industry Taskforce Second Report](#), Oct 2023)

Bus stop configuration

In-lane stops are the preferred stop arrangement in all local streets and town centre environments. They involve the use of kerb extensions to bring the footpath into the parking lane to meet the traffic lane.

This allows buses to stop in the traffic lane, which reduces bus delays compared with other stop arrangements, allowing buses to stop and re-enter traffic flow easily.

In-lane stops also make it much easier for the bus to park parallel to the stop for DDA-compliant boarding, while providing a wider bus passenger waiting area clear of the footpath, and allow additional space for stop amenity such as street trees or understorey planting.

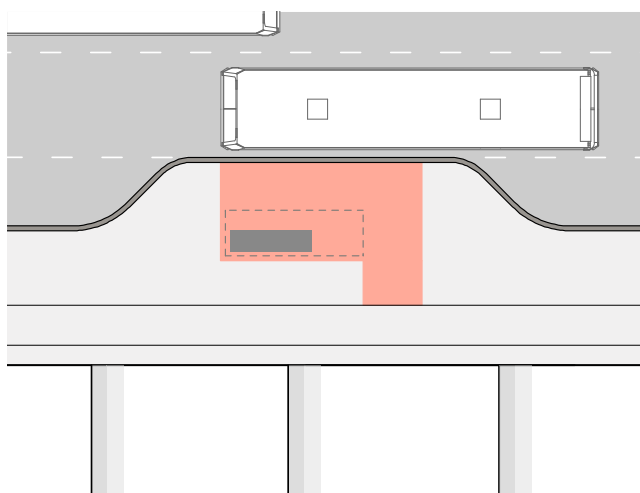
In-lane stops should be considered in town centres where both bus passengers and shoppers will benefit from the added space. They are also suitable in local streets where traffic numbers are low and traffic calming is desirable.

This stop arrangement occupies the shortest possible length of kerb in areas with significant demand for alternate use of the kerb, such as loading bays and parking.

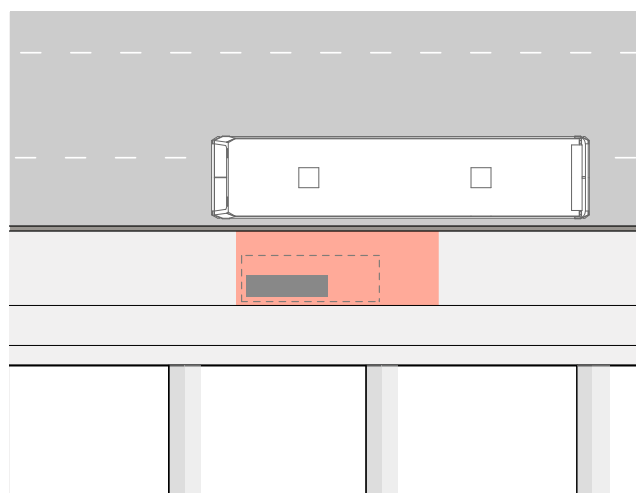
Kerbside stops are currently the most common form of bus stop layout across Western Sydney, as they allow other vehicles to pass a stopped bus. However, a reduction in verge street trees is required in the vicinity of the stop, which will have a detrimental impact on streetscape amenity and customer experience.

For this reason, kerbside stops are only preferred on higher-order streets with high traffic volumes or with two lanes of traffic in each direction. Kerbside stops also work well where bus lanes are provided, so long as the stopped bus does not significantly delay following buses on high-frequency routes.

Kerbside stops need to be marked clearly to ensure cars do not park in them, or park too close, making entry to or exit from the stop difficult.



Typical in-lane bus stop configuration



Typical kerbside bus stop configuration

DESIGN GUIDANCE

- Bus stops provide customers a designated, accessible waiting points with seating and shelter. Bus stops can integrate signage such as route numbers and names, wayfinding information, schedules, and maps
- Arrange bus stops to minimise impact on the space available for other street users and elements. Consider opportunities for reducing the footprint of bus stop infrastructure and lane arrangement to minimise overall footprint
- Provide seating for waiting passengers, and maintain clear paths for walking and universal access
- Prioritise transit services over private motor vehicles on all local streets, with stops that allow vehicles to load a footpath from the transit or travel lane without pulling out of traffic

DESIGN REQUIREMENTS

- Bus stops are clearly marked to indicate to passengers where a particular bus service stops
- Bus stop arrangement should be aligned with bus service frequencies, street environment and typical operating speed
- An in-lane bus stop arrangement should be adopted on local service routes
- A kerbside pullover bay arrangement should be adopted on frequent service routes
- Comfortable places to wait with seating and a concentration of shade trees, and ideally a bus shelter routes or where demand deems it necessary
- Bus stop positioning, size, and layouts are to be designed in consultation with Transport for NSW.



In-lane bus stop on Crown Street, Surry Hills
(credit: Google)

3.5 Intersections

Roundabouts

Roundabouts are circular islands at unsignalised intersections that route vehicles around the island rather than straight through an intersection.

Roundabouts organise and calm traffic by slowing travel speeds.

Motorists are required to give way to pedestrians using crossings, cyclists and vehicles already in the intersection.

DESIGN GUIDANCE

- Provide pedestrian crossings across all arms of the intersection and design them to clearly communicate where pedestrians should cross and that they have priority
- Use kerb extensions to shorten pedestrian crossing distances, protecting pedestrians while they wait to cross and to assist in preventing dangerous illegal parking close to intersection corners

DESIGN REQUIREMENTS

- Utilise elements such as mountable kerbs to minimise the size of roundabouts whilst adhering to Design & Check Vehicle requirements
- Consider the use of other elements to calm traffic and maximise safety when designing roundabouts e.g. pedestrian crossings, kerb extensions, understorey planting, and street trees



Abercrombie Street, Darlinghurst
(credit: ASPECT Studios)

Corners

Corners occur where two roads intersect and are a fundamental element of the street environment, contributing to safety, accessibility, and comfort.

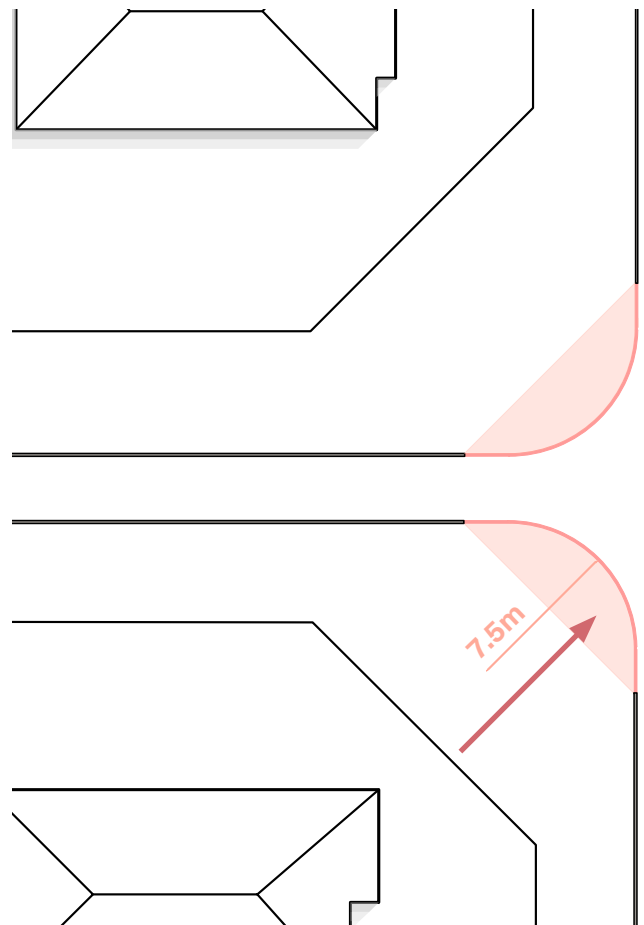
They assist with traffic calming and establish priority for pedestrians and other vulnerable street users at intersections.

DESIGN GUIDANCE

- Minimise road carriageway widths to reduce intersection size and provide more space within the road corridor for alternate uses
- Adopt a consistent corner radius throughout a precinct to achieve a coherent public domain

DESIGN REQUIREMENTS

- Adopt a corner radius in line with Chapter 2.0 to reduce turning speed, expand the pedestrian area, maximise sight lines and create a safer environment for all users
- Adopt kerb extensions to maximise sight lines and reduce pedestrian crossing distances



Safer corners with a kerb return radius of 7.5m

Swept paths and turning movements

Swept paths and turning movements have a significant impact on corner design and therefore directly influence the experience and safety of the street for vulnerable users such as pedestrians and cyclists.

Swept paths are used to calculate kerb and corner radii to ensure that vehicles can undertake turn movements at intersections. Designing for comfortable use by the occasional large truck often results in overly wide roads or high speed turns by cars, and opportunities are lost to create space for other, more frequent users such as pedestrians and therefore should be avoided.

Chapter 2.0 of the Guidelines includes kerb return radii as design requirements for most street types. Using swept path analysis, these radii were shown to allow the recommended Design Vehicle and Check Vehicle for each street type to move through the intersection within the allowable parameters of the NSW Road Rules 2014 (Rule 133) and Austroads Design Vehicles and Turning Path Templates Guide.

Site specific swept path analysis will need to be used to determine suitable radii for intersections with sub-arterial roads, for intersections with local industrial streets and atypical intersections.

DESIGN GUIDANCE

- Select a Design Vehicle and a Check Vehicle appropriate to the street type as recommended in Chapter 2.0 of the Guidelines
- Accommodate the swept paths and turning movements of vehicles that frequently make turns (the Design Vehicle) and use geometric techniques such as shifting stop line locations to accommodate less frequent vehicle types (the Check Vehicle)
- Use advance stop bars or other elements to accommodate movements by Design Vehicles
- Do not widen existing intersections to permit larger vehicles to turn
- Tailor elements for the most vulnerable street user to ensure safe street design
- When designing an atypical intersection, use both a Design Vehicle and a Check Vehicle to determine intersection turn radii and consider that the Check Vehicle is an infrequent presence on the street and may use multiple lanes to make turns

Cycling through intersections

Providing safe and comfortable cycling facilities at intersections is critical to encouraging mode shift to cycling.

Intersections should be designed to provide bicycle riders with a safe, comfortable and legible route in the street environment.

One-way paired paths use a protected intersection design. A key feature of this design are the four islands at each corner of the intersection which separate cyclists and pedestrians from motor traffic. The size of the islands can be modified to suit turning requirements of larger vehicles.

On approach to intersections, bicycle paths ramp down to road grade and bend out to the cycle crossing points. This intersection design places cyclists ahead of turning traffic and in highly visible locations clear of turning vehicles.

Two-way paths at signalised intersections pose challenges for signalling as the two-way cycle flow on one side of a two-way carriageway creates multiple conflict points.

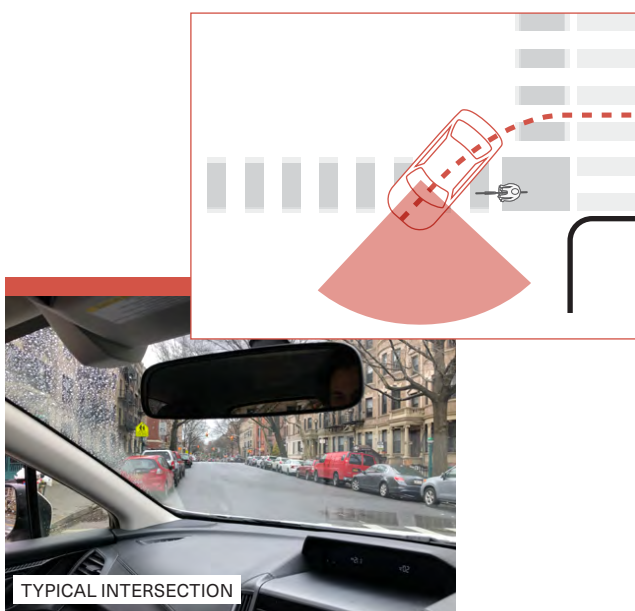
CROSS REFERENCES



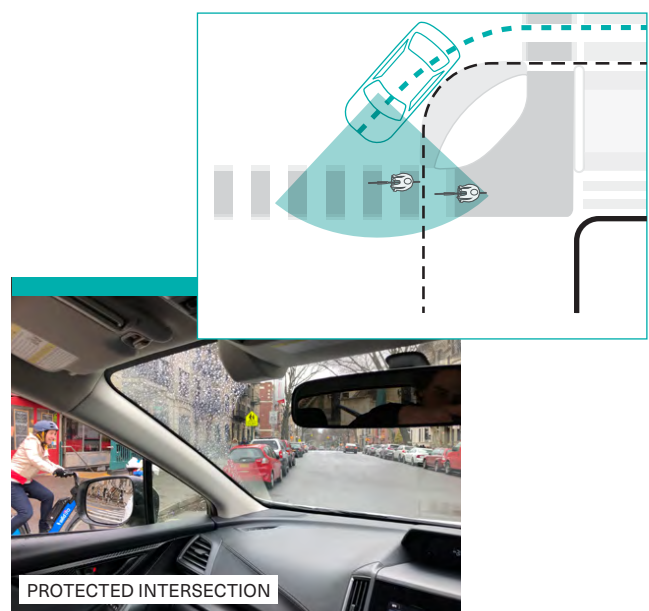
The Cycleway Design Toolbox provided guidance for practitioners on how to design for cycling and micromobility. The Toolbox provides practitioners with a range of design tools, being a comprehensive suite of best practice designs across a range of typical on- and off-road environments that can be tailored to their specific environment. It can be used to justify the planning, design and delivery of high-quality cycling infrastructure by demonstrating the positive impact on level of service for people cycling.



Don't Give Up at the Intersection provides detailed guidance on intersection design treatments that reduce vehicle-bike and vehicle-pedestrian conflicts. This guidance covers protected bike intersections, dedicated bike intersections, and minor street crossings, as well as signalisation strategies to reduce conflicts and increase comfort and safety.



TYPICAL INTERSECTION
Protected intersections improve cyclist visibility.
(credit: NACTO)



PROTECTED INTERSECTION

3.6 Utilities

Overview

Streets need to be designed in coordination with utilities such as stormwater, sewer, electricity, gas, telecommunications, and digital infrastructure. The installation, maintenance, and repair of utilities involves effort from many public and private agencies to ensure planning is coordinated and integrated.

In accordance with council and utility requirements, streets must provide enough room for utility spacing and depth of cover. Utilities should be installed prior to completion of new footpath, verge, and road works. All building connections should be installed up to the property line.

Advance notice and coordination between agencies regarding planned maintenance work is one of the most effective tools for reducing impacts on street users, residents, and businesses.

Energy saving utilities and green infrastructure such as swales, planting areas and permeable paving, reclaimed water systems, district cooling and heating, and automated waste collection systems should all be considered as part of planning new precincts.

Utilities need to be underground as often as possible to achieve urban tree canopy targets. However, some above-ground infrastructure will be required. This needs to be considered amongst other street uses and urban amenity.

CROSS REFERENCE

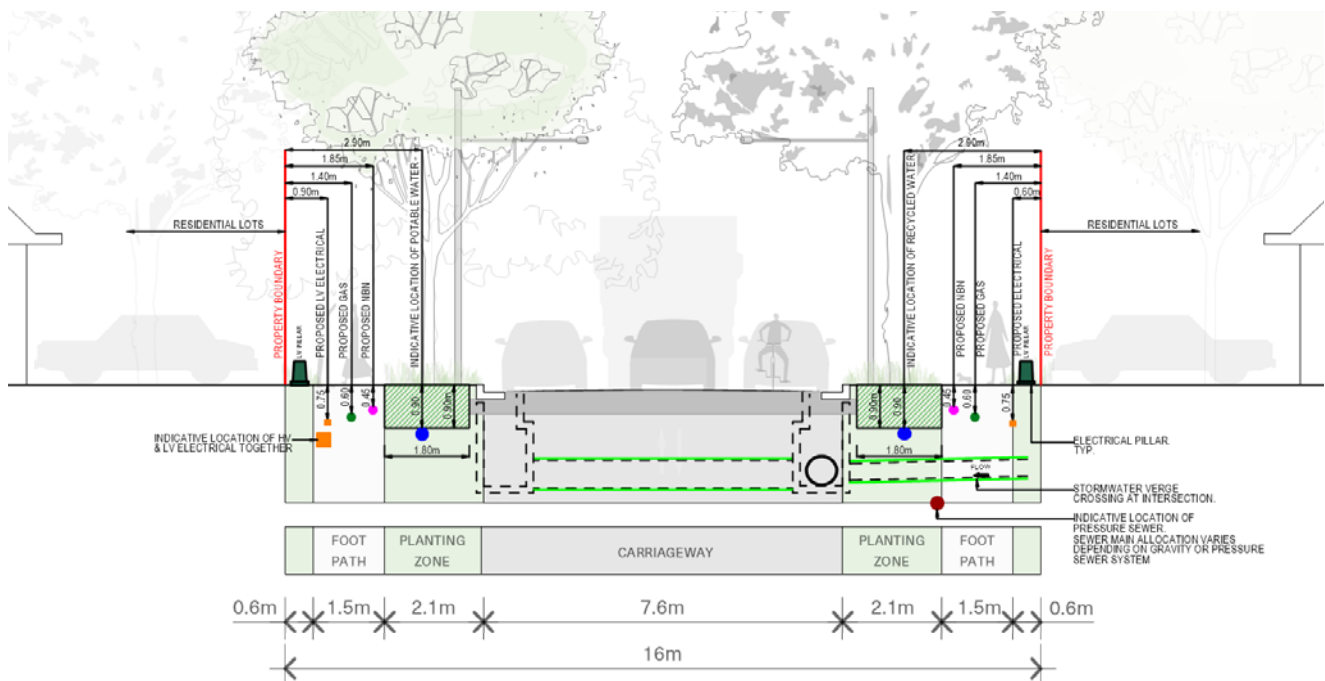


Guide to Codes and Practices for Streets Opening, NSW Streets Opening Coordination Council, 2018

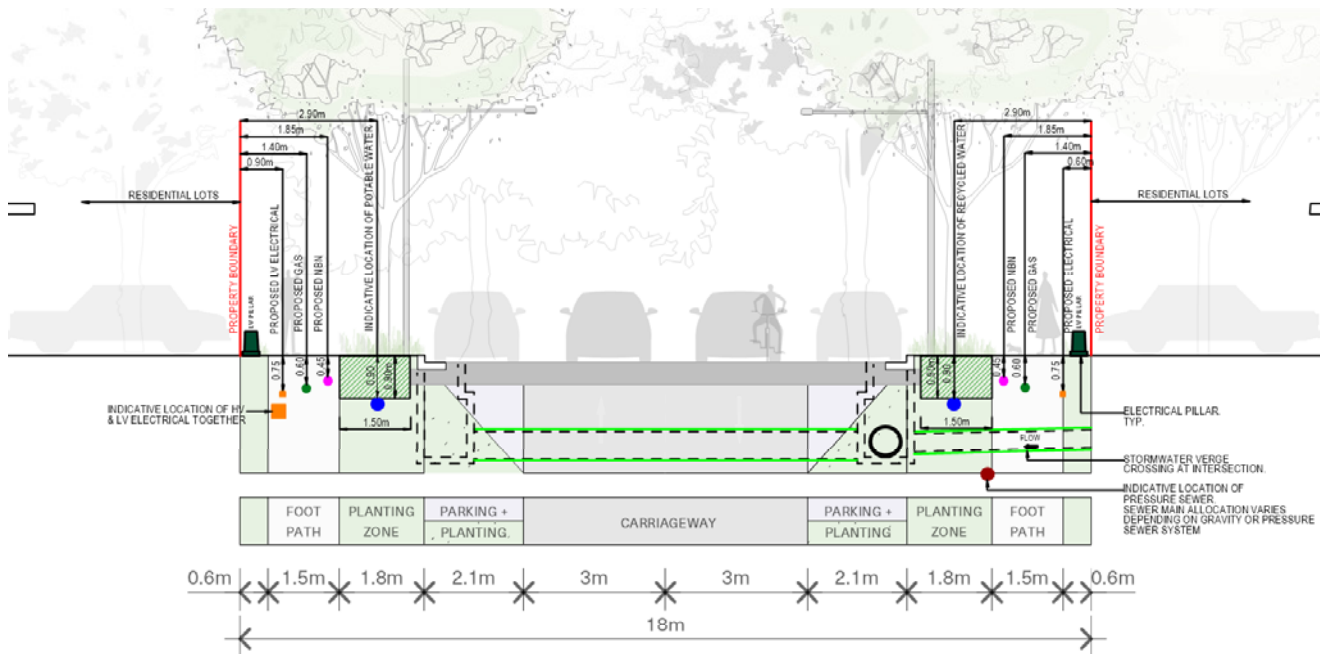
Typical utility allocations

The typical utility allocations presented within this section are examples of how adequate street tree soil volume can be provided in the context of underground utility easements.

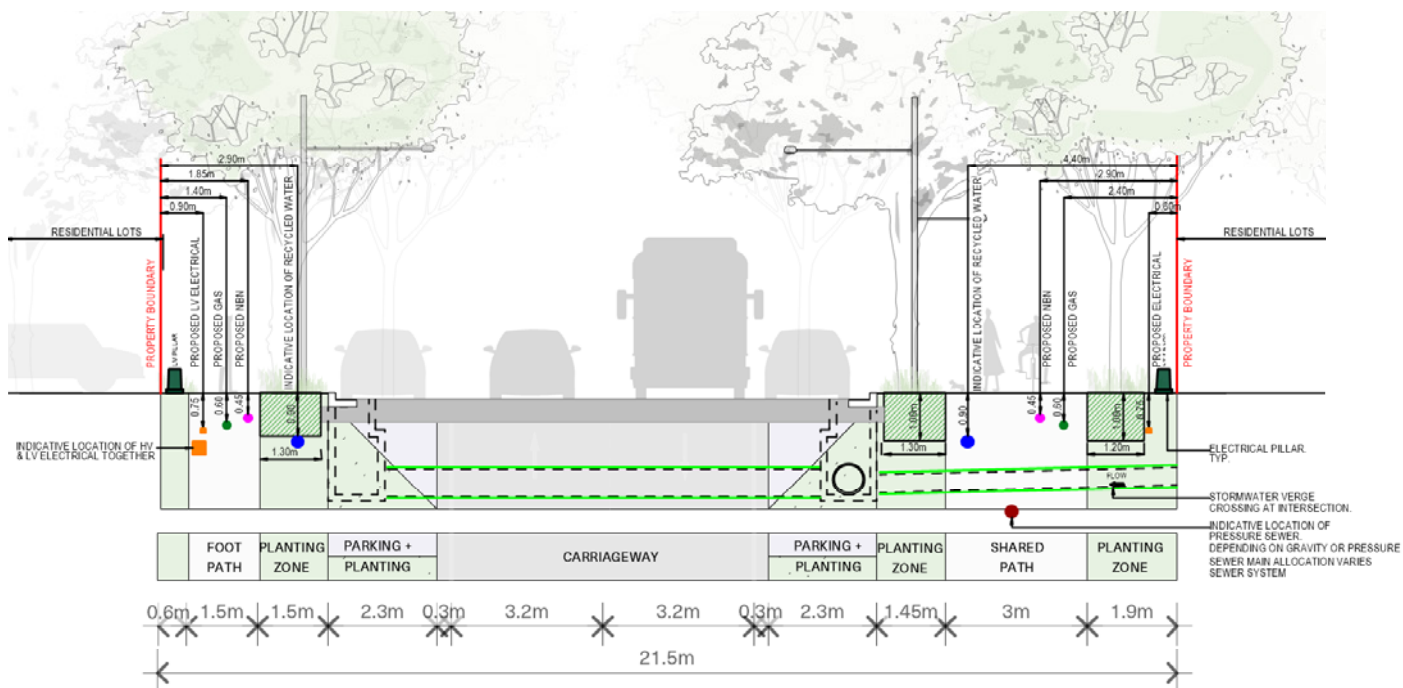
The drawings presented here are typical and for illustrative coordination purposes only. These should be read in conjunction with relevant authority guidelines. Proposed utility offset and depth values are nominal only for planning purposes. Required clearances may vary subject to the main sizes. Potable water is to be located on the opposite verge to pressure sewer and recycled water if mains are under separate ownership.



Yield Street example utility allocation



Neighbourhood Street example utility allocation



Connector Street (shared path) example utility allocation

Shared utility trenches

Shared utility trenches combine multiple utilities within a compact area of the street verge to reduce the overall space dedicated to in-ground utilities, and to maximise opportunities for other street elements.

Shared trenching helps to deliver the Guidelines' design objectives, such as:

- Allocating more space for deep soil planting to encourage improved tree canopy
- Allocating more space in the verge for WSUD
- Providing adequate and well-designed footpaths

Other benefits could include lower overall costs, particularly in new subdivisions. This is subject to arrangements that ensure suitable protection, support, and access throughout the life of the utilities.

An indicative shared utility trench section is provided below for information. The section illustrates an example of how shared trenching could work and is not proposed as a standard detail. Designers and local councils will need to continue coordination with utility providers.

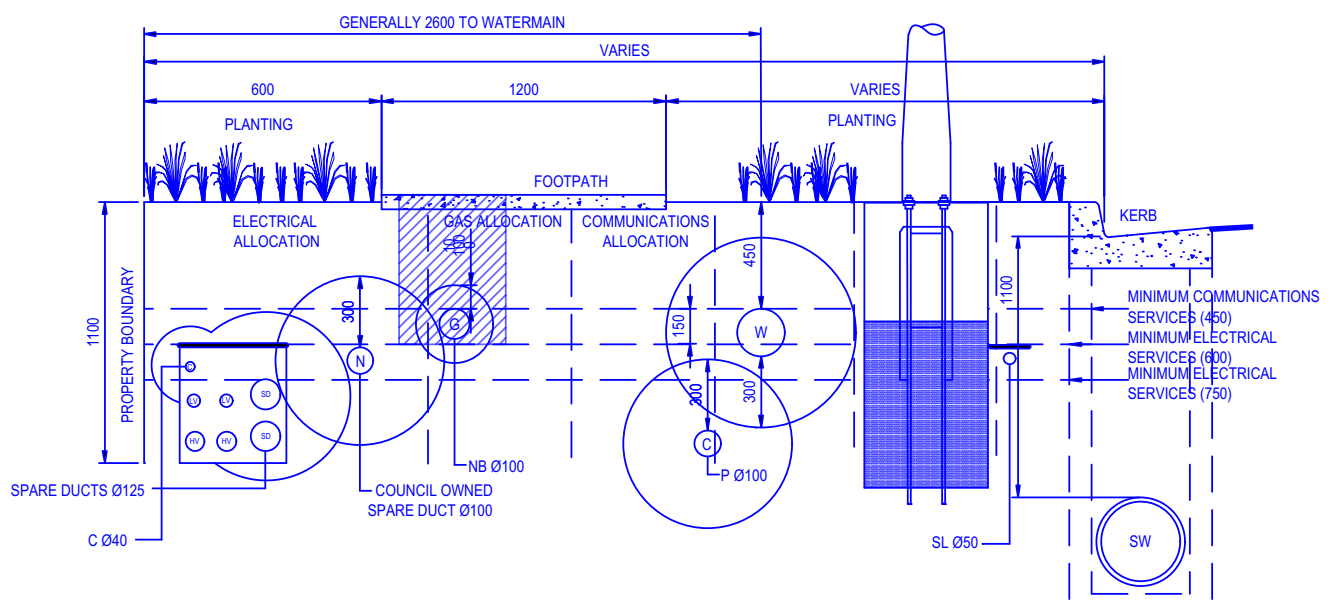
All street types included in Chapter 2.0 of the Guidelines are compatible with the shared utility trench sections provided.

DESIGN GUIDANCE

- Tree root barriers should prioritise the protection of utility assets - not the constriction of tree roots - and should be located to maximise access for tree roots to adjacent areas of soil
- Refer to general Street Tree Design Guidance

DESIGN REQUIREMENTS

- Where conditions allow, combine multiple utilities in local streets within shared utility trenches to support the delivery of the Street Design Objectives
- Refer to the Engineering Design Manual for Western Sydney for further detail on shared utility trenching



Indicative Shared Utilities Trench as shown in the Engineering Design Manual for Western Sydney (credit: ACOR)

Multi-function poles

Multi-function poles are street poles that accommodate several functions and services on the same pole.

Installation of multi-function poles reduces the total number of poles installed in the street. This reduces street clutter, improves streetscape amenity, and minimises potential conflicts with street users.

Multi-function poles will become increasingly important with the rollout of technologies such as 5G. Sharing of infrastructure may be passive - where providers share mobile network infrastructure like transmission, power, cables, ducts, cooling systems, and towers, with each operator installing their own antennas and electronic equipment. Likewise, sharing of infrastructure may be active – where providers jointly invest in and share antennas, electronic equipment and even spectrum.

Potential services which would be incorporated into multi-function poles includes:

- TransportNSW signals and signage
- Street lighting
- Telecommunications and digital infrastructure (such as mobile cellular network providers)
- Council requirements (such as CCTV, signage and lighting)

DESIGN GUIDANCE

- Reduce street clutter and improve street amenity by implementing multi-function poles
- Consideration to the placement of multi-function poles should be given in regard to avoiding mature street tree canopy
- Consider adding additional arms to Multi-function poles where adjacent amenity requires extra lighting
- Co-locate multi-function poles with other street elements such as street furniture
- Placement of multi-function poles to be a min 600mm from the face of kerb
- Placement of multi-function poles to be avoided within bus zones or set back at least 800mm to minimise risks of buses striking these when pulling in and out of stops, and to avoid obstructing passengers boarding and alighting buses at stops



Multi-function poles allow for multiple light fixtures at ANU, ACT.
Image - (Multipole)

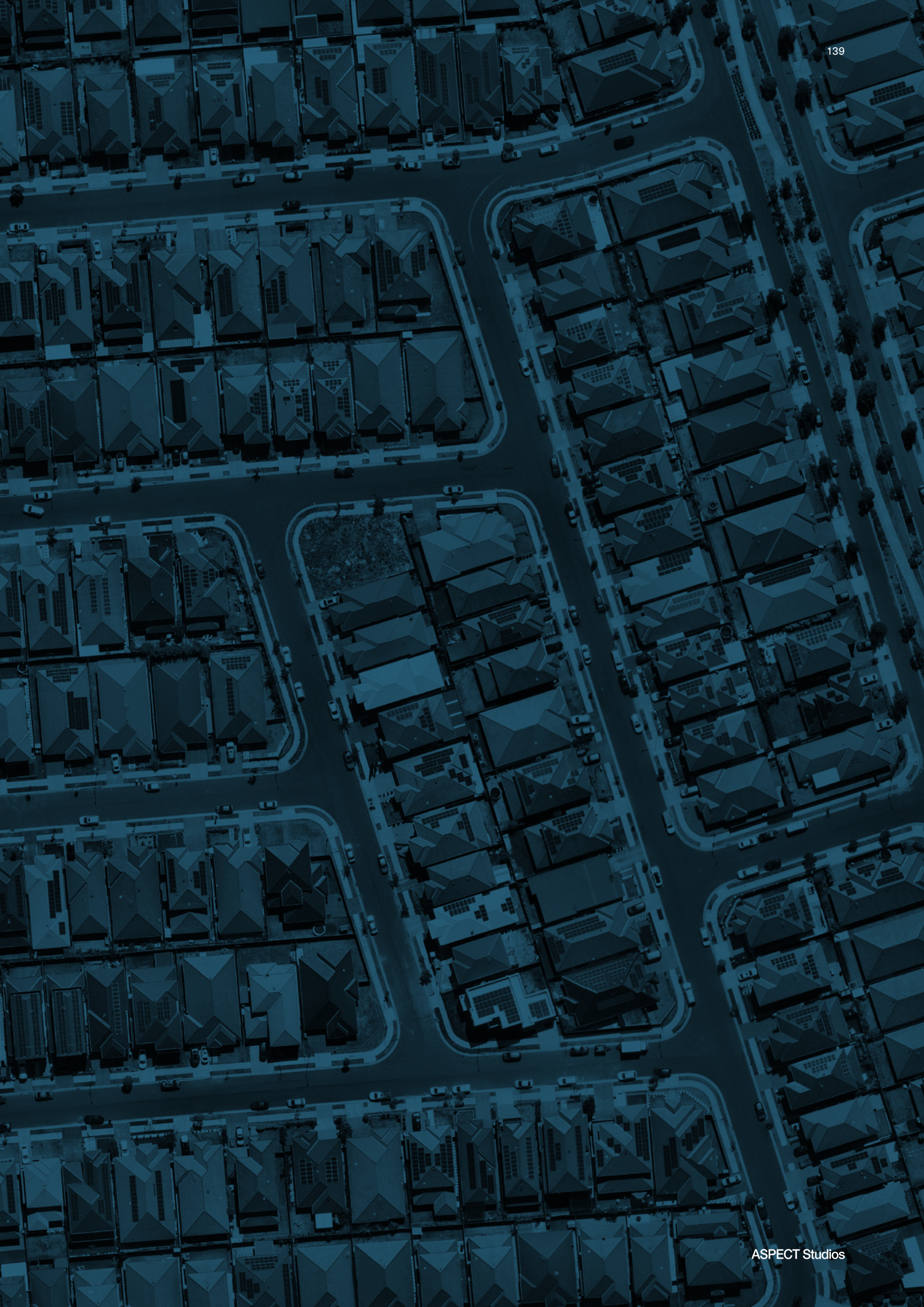


Multi-function poles can combine services infrastructure with banners.
Image - (Hub Group)



Retrofitting Streets

Aerial view of Marsden Park
(credit: Nearmap)



4.1 The need to retrofit

Overview

While much of the Guidelines is primarily targeted at new streets within Western Sydney's growth areas, there is a pressing need to consider the region's existing streets.

This section presents strategies for retrofitting streets and includes case studies that illustrate the implementation of these strategies in Sydney and elsewhere. These strategies reflect a snapshot of potential retrofit initiatives based on the findings of WSPP's post-implementation review of the Guidelines, and are not intended to limit retrofit options available to Councils and practitioners.

The performance of proposals to retrofit streets should be measured against the Performance Based Frameworks provided for the relevant street type within Chapter 2.0 of the Guidelines.

Strategies include:

- Speed zoning
- Traffic calming
- Reallocating street space
- Greening

Speed zoning

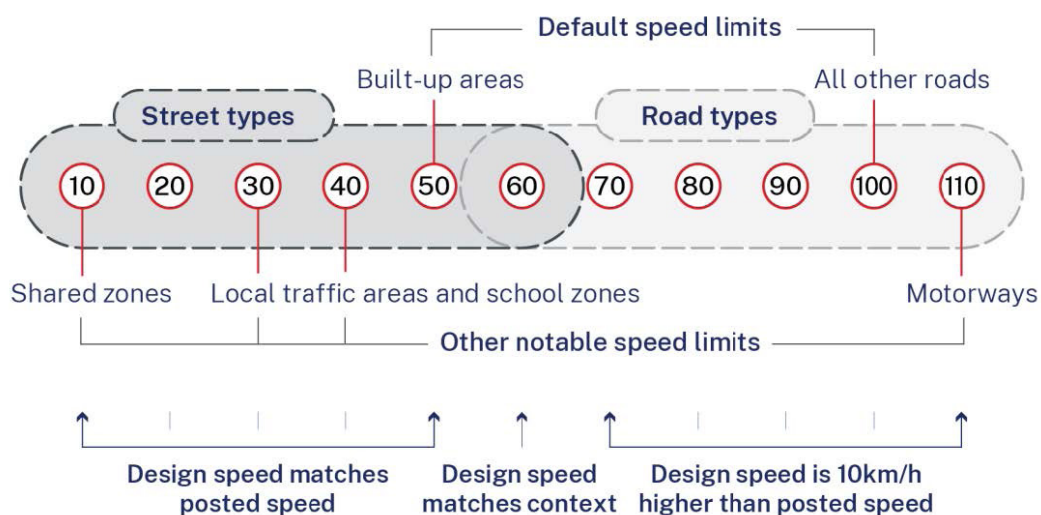
Speed is the biggest single factor involved in road deaths, contributing to around 40% of road fatalities each year in NSW. Speed limits are one of the simplest and most proven strategies for controlling and regulating driving speeds. (NSW Speed Zoning Standard, TfNSW, 2023)

Speed plays a pivotal role in ensuring road safety within a Safe System approach. Extensive research consistently underscores the direct correlation between vehicle speed and the frequency and severity of road crashes. Higher speeds increase the likelihood of crashes and exacerbate the risk of severe injuries or fatalities that result from crashes. The force of impact and subsequent trauma outcomes are directly influenced by vehicle speed.

Statistical models have demonstrated that even a minor increase in average speed, such as 1%, can lead to a substantial rise in the frequency of fatal crashes, up to 4%. Therefore, setting appropriate speed limits is crucial for managing crash risks and mitigating the impact forces experienced by road users.

Slower speeds also provide other environmental benefits as well as improvements in local amenity. Slower speeds reduce fuel consumption and subsequent carbon emissions. They also reduce noise pollution, improving the experience of the street for people using other modes such as walking and cycling, as well as reducing the negative health consequences of noise pollution for people living in adjacent properties.

Implementing a default speed limit of 30–40km/h for the whole network within a precinct is recommended, with additional low-speed zones near areas such as schools, hospitals, and other sensitive locations.



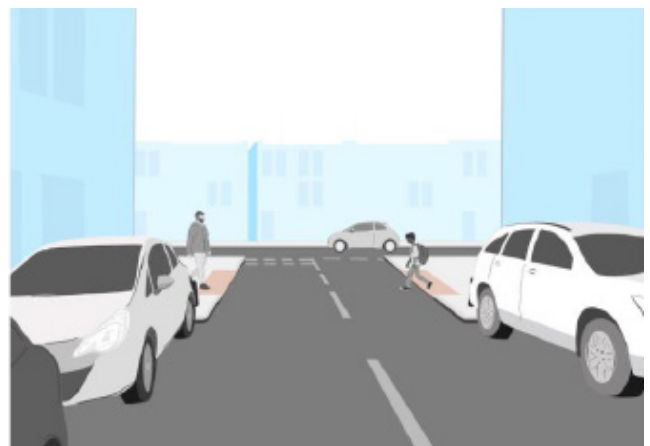
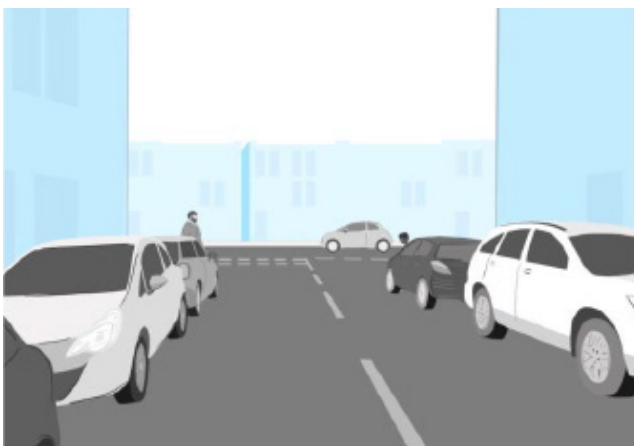
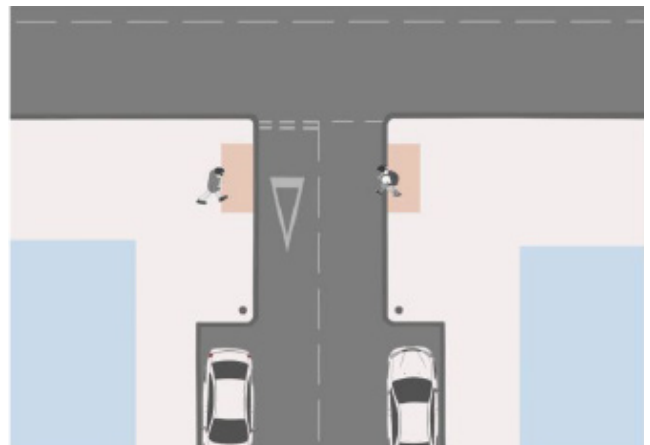
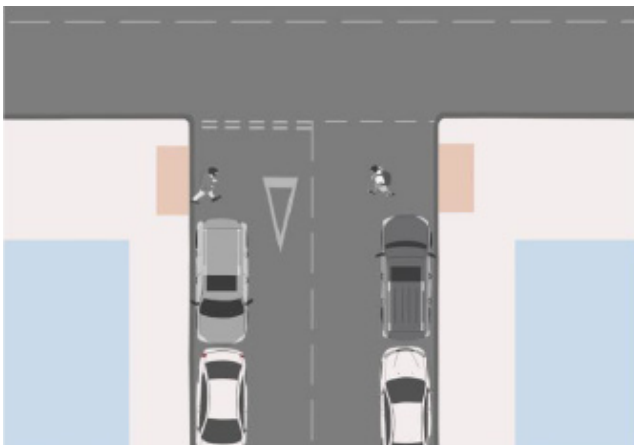
Context for self-explaining roads for the design of streets and roads (NSW Speed Zoning Standard, TfNSW, 2023)

Traffic calming

Streets should be purposefully designed to reduce vehicle travel speeds, and traffic calming initiatives play an important role in achieving this.

Traffic calming refers to the use of physical design measures—such as raised thresholds and crossing points, alternate pavement selections, lane narrowing, kerb build outs, canopy coverage, and on-street parking—to create a balance between the movement and place functions of a street.

These initiatives are essential to providing street environments that are safer and more comfortable for all street users, particularly pedestrians and cyclists.



Effects of build outs at standard junctions
(credit: Inclusive Design at Continuous Footways, Living Streets, 2023)

Reallocating street space

Reallocating street space is one of the primary means through which the aims and objectives of the Guidelines can be implemented within existing streets.

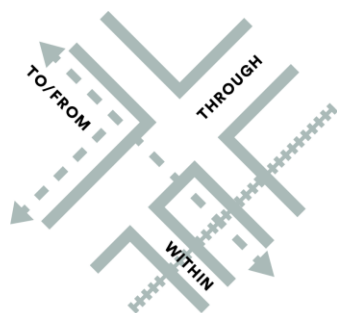
Transport for NSW's Road User Space Allocation Policy ensures that the allocation of street space is a deliberate exercise that considers the place, function, and movement requirements of a street.

Reallocating street space considers the limited amount of space available to accommodate competing user needs and considers users of the street as presented within the hierarchy diagram below.

Principles for street space allocation include:

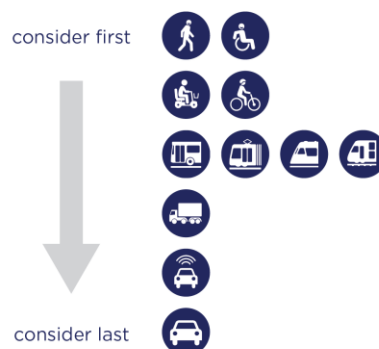
- Realise a balance between place and the movement of people and goods by first establishing a network vision and primary road functions based on strategies and plans
- When allocating road user space based on the network vision and road functions, consider all road users in order of: walking (including equitable access for people of all abilities); cycling (including larger legal micro-mobility devices); public transport; freight and deliveries; and point to point transport ahead of general traffic and on-street parking for private motorised vehicles
- Facilitate the movement of goods and servicing of property in a manner that responds to the local movement and place context
- Aim for the reduction of the mode share of private motor vehicle trips within built up areas
- Where it is not practicable to allocate physical space in line with these principles, dynamically allocate road user space
- Implement measures over time to achieve the strategic intent and outcomes identified as part of strategies or plans
- Track how these road space allocation principles are being implemented against the strategic intent and outcomes identified as part of strategies or plans
- Adhere to these principles ahead of any guidance that seeks to protect or maintain private vehicle level of service

1 Establish Primary Road Function



Balance between place and the movement of people and goods based on strategies and plans

2 Order of Road User Space Considerations



Order of determination for allocating street user space
(credit: Road User Space Allocation Policy, Transport for NSW, 2023)

Greening and cooling

Streets are a major heat source in urban areas such as Western Sydney. The unshaded asphalt of streets absorbs heat during the day, increasing surface and ambient temperatures of the street and surrounding areas. At night, these surfaces release this absorbed heat and increase overnight temperatures.

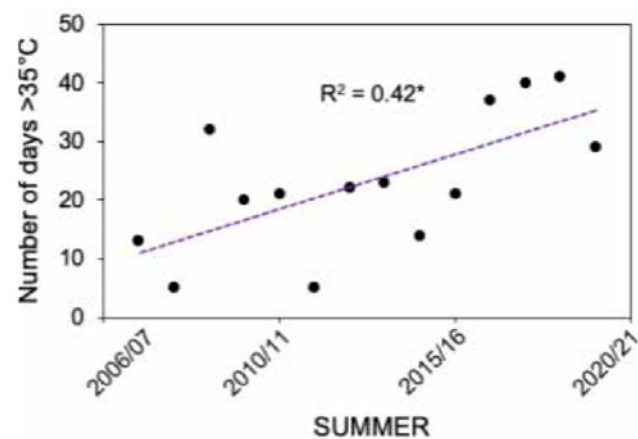
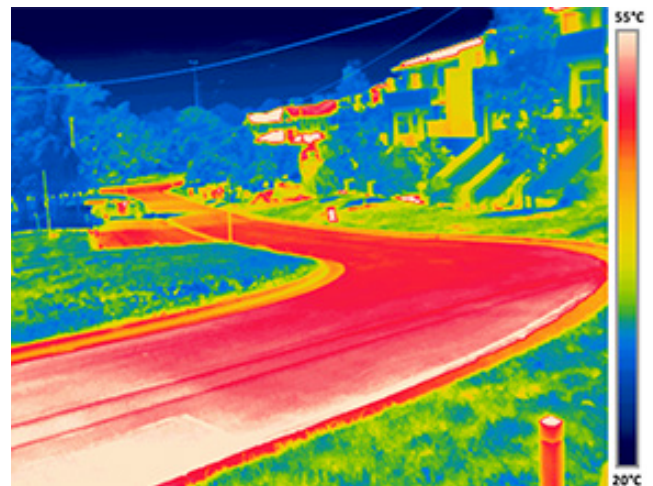
Greening streets can include comprehensive street tree planting or the replacement of paved surfaces with planted areas.

Cooling streets includes incorporating WSUD initiatives that keep water where it falls, or undertaking surface treatments (such as 'pavement painting') that lighten dark paved surfaces to reduce heat absorption.

Reference should also be made to the [Greener Neighbourhoods Guide](#) (NSW DPHI) for tree canopy targets.



Unshared streets generate significantly more heat
(credit: City of Parramatta)



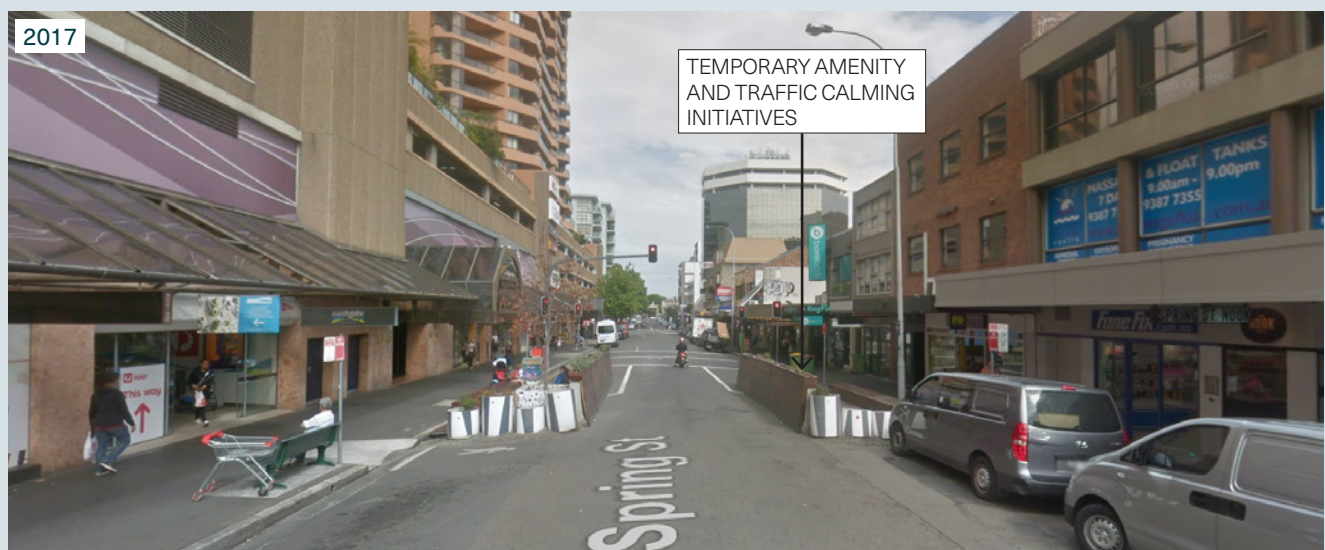
Total number of hot days as recorded at Richmond in Western Sydney
(credit: Wicked Urban Challenges in Western Sydney, WSU, 2022)

4.2 Case studies in retrofitting streets

This section presents case studies of existing streets that have been retrofitted with one or more strategies for retrofitting streets.

CASE STUDY - REALLOCATING STREET SPACE IN SPRING STREET, BONDI JUNCTION

The following case study presents the progressive reallocation of street space at Spring Street, Bondi Junction to reduce vehicle travel lane width, increase tree planting, and provide a separated cycleway.



CASE STUDY - GREENING PRIMROSE AVENUE, ROSEBERY

Primrose Avenue was planted with new median street trees to improve safety by slowing traffic and provide new trees and shrubs for more shade.



CASE STUDY - CROWN STREET, SURRY HILLS

Crown Street was upgraded in 2015 with public domain improvements between Devonshire Street and Cleveland Street. Kerb extensions were introduced at Crown Street's intersection with Lansdowne Street to reduce crossing distances and improve amenity in conjunction with a new pedestrian crossing.



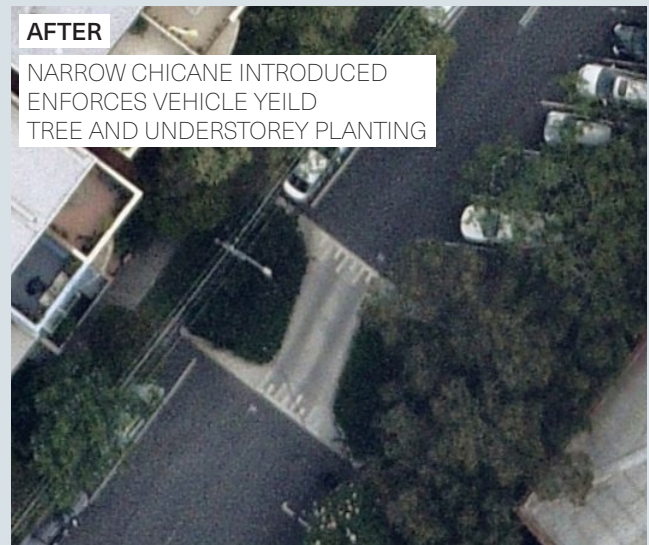
CASE STUDY - TRAFFIC CALMING IN ALEXANDRIA

The City of Sydney has progressively implemented traffic calming measures throughout the neighbourhood of Alexandria. While each individual installation is relatively small, they combine to provide traffic calming on a neighbourhood scale.

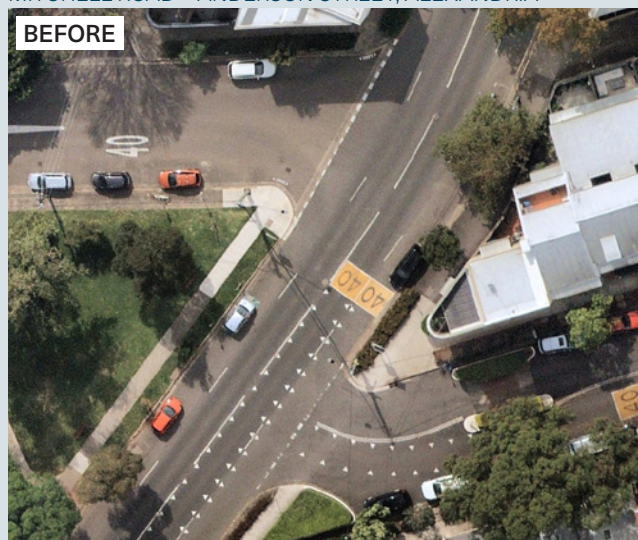
LAWRENCE STREET, ALEXANDRIA



LAWRENCE STREET, ALEXANDRIA



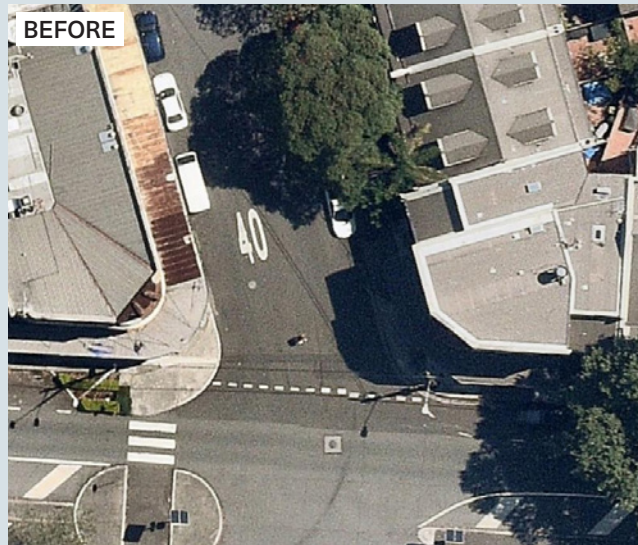
MITCHELL ROAD + ANDERSON STREET, ALEXANDRIA



MITCHELL ROAD + BUCKLAND LANE, ALEXANDRIA



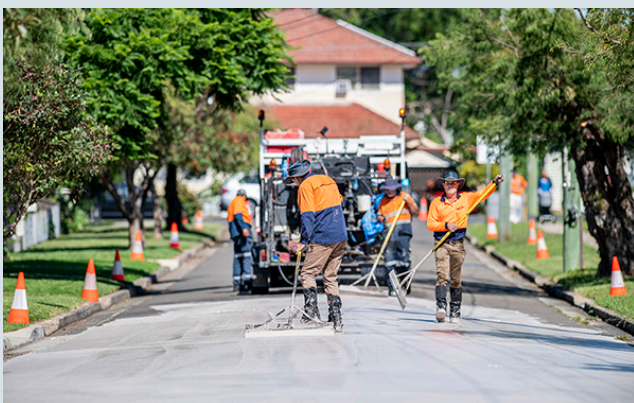
SWANSON STREET + PARK STREET, ALEXANDRIA



CASE STUDY - COOL ROADS TRIAL 2021

The surface treatment illustrated here (CoolSeal) reduced surface temperature of asphalt during the day by an average 6°C when compared with an untreated surface, however there was an increased 'feels like' temperature on treated asphalt due to the reflected solar radiation during the day.

ROSLYN AVENUE, NORTHMEAD



CoolSeal installation at Roslyn Avenue, Northmead
(credit left: George Gittany Photography, credit right: Google)

Chapter 5.0

Resources

5.1 Acronyms

AADT Average Annual Daily Traffic counts published by RMS.

AS Australian Standard

CPTED Crime Prevention Through Environmental Design

DCP Development Control Plan

DDA Act Disability Discrimination Act, 1992.

EP&A Act Environmental Planning and Assessment Act 1979 (NSW)

GANSW The Government Architect NSW

GSC Greater Sydney Commission

LEP Local Environmental Plan

LGA Local Government Area

RMS Roads and Maritime Services

TFNSW Transport for New South Wales

WSA Co. Western Sydney Airport Corporation

WSPP Western Sydney Planning Partnership

WSUD Water sensitive urban design

5.2 Glossary of terms

Active Transport: Non motorised travel modes including walking and cycling.

Arterial Road: The main or trunk roads of the State road network that predominantly carry traffic between regions.

Asphalt/Asphaltic Concrete: A dense, continuously graded mixture of coarse and fine aggregates, mineral concrete filler and bitumen usually produced hot in a mixing plant.

At-grade: Road at ground level, not on embankment or in a cutting.

Austroroads: The peak organisation of Australasian road transport and traffic agencies that provides guidelines for design of streets.

Autonomous Vehicle: A vehicle that is capable of sensing its environment and moving safely with little or no human input or direction.

Bollard: A short steel or concrete post used to prevent traffic from entering a footway or public space whilst allowing pedestrians or cyclists access.

Boulevard: A form of street defined by its greater width, buildings and substantial trees that line it and can be a major element of city structure.

Buffer Planting: A strip of planting between Footway and Road that provides a physical and visual buffer between the movement of vehicles and pedestrians.

Boundary: Property boundary between the street corridor and developed land.

Car Share: A model of car rental where people rent cars for short periods of time, with dedicated on street parking areas.

Carriageway: The portion of a roadway used for the movement of vehicles including shoulders and parking lanes.

Centreline: The basic line that defines the axis or alignment of the centre of a road.

Cul-de-sac: a turning circle area at the end of a no-through road. Also No-through Road, Close, Court or Place.

Cyclist: Person using a bicycle.

Cycleway: A dedicated paved area for bicycles, usually two way and located above street level or in a public space or parkland.

Dish Drain: A scooped concrete gutter without a kerb that directs stormwater to a drainage point.

Divided Road: A road with a separate carriageway for each direction of travel created by placing a median between opposing traffic directions.

Drainage Grate: A gridded metal panel within the gutter that allows water to flow into the underground stormwater system.

Driveway: a paved path for vehicles to cross the footpath to access property usually leading to a car park, garage or car port.

Driveway Ramp: A flat transition area on the kerb to allow vehicles to access a driveway.

Footpath Crossing: An area where vehicles are permitted to cross a footway. See Driveway and Driveway Ramp.

Footpath: A paved area for the use of pedestrians on a Footway.

Footway: An area open to the public designated for the movement of pedestrians, cyclists and other non- and motorised modes.

Green Grid: A network of high quality green spaces that connect town centres, public transport hubs, and major residential areas.

Gutter: An area usually built as part of the kerb arrangement that directs rainwater to flow to a drain or raingarden.

Flex Zone: A flexible portion of the road corridor design that can allow for a variety of other design measures.

Frangible: Planting or structures which break under the impact of a motor vehicle.

High Pedestrian Activity Area (HPAA): Areas of high pedestrian activity, near shopping strips, train stations, bus interchanges and services such as medical centres and hospitals. Maximum speed limit is 40km/h.

Intersection: A place where two or more roads/streets meet.

Kerb: A concrete or stone barrier between the footway and road surface. See Roll Kerb, Upstand Kerb. Dish Kerb, Flush Kerb.

Roll Kerb: a rounded concrete kerb that a vehicle can drive over.

Upstand Kerb: a vertical concrete or stone kerb usually 150 mm in height.

Dish Kerb: a scooped kerb that also drains stormwater.

Flush Kerb: a narrow concrete strip that marks and divides a level road pavement and footway.

Redirective Kerb: *Elsholz* style concrete kerbs are shaped to deflect vehicles from medians and footpath areas

Kerb Extension: A protrusion of the footway to reduce the kerb-to-kerb crossing distance between two footways for pedestrians. Also assists in passive reduction of travel speeds.

Kerb Ramp: A paved (usually concrete) ramp graded down from the top surface of a footpath to the surface of an adjoining street surface. It is designed primarily for pedestrian, pram, bicycle, wheelchair and mobility usage and commonly found in urban areas at corners and crossing points where pedestrian activity is expected.

Laneway: A narrow, usually single lane width roadway for service and garage access.

Lay By: A part of the road where vehicles may pull over, clear of the through traffic.

Light Pole: A steel pole located on the footway for the purposes of lighting the public domain.

Light Rail: On street form of tram or urban rail transit, usually operating within it's own right and right-of-way.

Local Road or Local Street: Roads that have a low speed limit, have a small footprint, serve local communities and that are generally conducive to walking and cycling. *RMS definition: A road or street used primarily for access to abutting properties.*

Local Traffic Area (LTA): an area of local streets that have a speed limit of 40 km/h. The lower speed limit ensures greater safety for all road users.

Median: A raised division between two vehicle lanes. A central area separating traffic travelling in the opposite directions.

Median Strip: A raised and planted division between two vehicle lanes

Mews: A group of houses with a shared zone access area for pedestrian access and parking.

Mobility Scooter: An electrically powered scooter designed for people with restricted mobility, typically those who are elderly or disabled. Permitted to use footways.

Multi-Function Poles: Street poles which can

accommodate multiple services including lighting, 5G and traffic signalling.

Nature Strip: see Verge

No Through Road: A street or road that does not connect to another street.

Parking Bay: A dedicated area for vehicle parking.

Parallel Parking: Vehicle parking located parallel to the kerb.

Pavement: The hard finished surface area of the vehicle roadway or footpath, usually asphalt, concrete, stone or unit pavers.

Pedestrian: A person on foot or using a mobility aid.

Pedestrian Crossing: A marked area to cross a street. See Zebra Crossing.

Pedestrian Refuge: A raised area in a roadway that provides protection from moving vehicles.

Permeable Pavement: Pavement materials that allows water to flow through to subground areas.

Power Pole: A steel pole to support overhead powerlines or communications.

Pit Lid: A trafficable access point for underground services.

Public Domain: A community's shared public space.

Raingarden: A porous garden area usually in the roadway that allows rainwater to enter the soil to support trees and plants. A designed depression storage or a planted hole that allows rainwater runoff from impervious urban areas, like roofs, driveways, walkways, car parks, and lawn areas, the opportunity to be absorbed.

Road Furniture: A general term covering all signs, street lights and protective devices for the control, guidance and safety of traffic and convenience of road users.

Road Reserve: A legally defined area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel.

Roundabout: An intersection where all traffic travels in one direction around a central island.

Riparian Zone: Relating to the planting and topography of a waterway.

Run Off: That part of the rainfall on a catchment that

flows as surface discharge past a specified point.

School Zone: An area with a maximum of 40 km/h vehicle speed limit around schools. In force on all days which are not a weekend, a public holiday or a publicly notified school holidays.

Shared Mobility: Refers to the shared use of a vehicle, bicycle, scooter or other transportation modes.

Shared Path: A pathway used for both cyclists and pedestrians, usually located on the side of the road.

Shared Zone: A street, road or network of roads where the road space is shared safely by vehicles, cyclists and pedestrians. The maximum speed limit is 10 km/h.

Shoulder: The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement.

Smartpole: An integrated light pole with the ability to add other components such as banners, CCTV, signs, planters, telecom equipment etc.

Speed Hump: A raised area of concrete or asphalt designed to slow vehicles.

Stormwater: Excess rainwater not absorbed in the area where it falls.

Street Furniture: A general term covering all items installed in the footway that supports the amenity and use of the street such as seats, benches, bubblers, bins, bicycle racks and bus shelters.

Street Tree: A tree planted within the street corridor on the verge, roadway, usually close to the Kerb.

Swale: A shallow, grassy drainage channel for stormwater.

Swept Path: The envelope swept out by the sides of the vehicle body, or any other part of the structure of the vehicle that defines the road geometry parameters.

Town Centre: A built up area of mixed uses, including commercial, retail, civic, educational and recreational.

Traffic Calming: Physical design and control to improve safety for motorists, pedestrians and cyclists including road narrowing, vertical and horizontal deflection, speed limits and closure of streets.

Traffic Controls: Traffic lights and signs.

Tree Canopy: The mass effect of tree foliage that provides shade and fauna habitat.

Tree Guard: A structure surrounding a juvenile tree to protect it from vehicle and other impacts.

Underground Services: Utility services that are located under the road surface, verge, cycleway or footpath.

Urban Heat Effect: Through the reduction of green areas and tree canopy and an increase in paved and built surfaces that absorb and reradiate heat in urban areas, they become warmer than the unbuilt areas surrounding them.

Utility: Supplier of services such as electricity, water, gas and telecommunications.

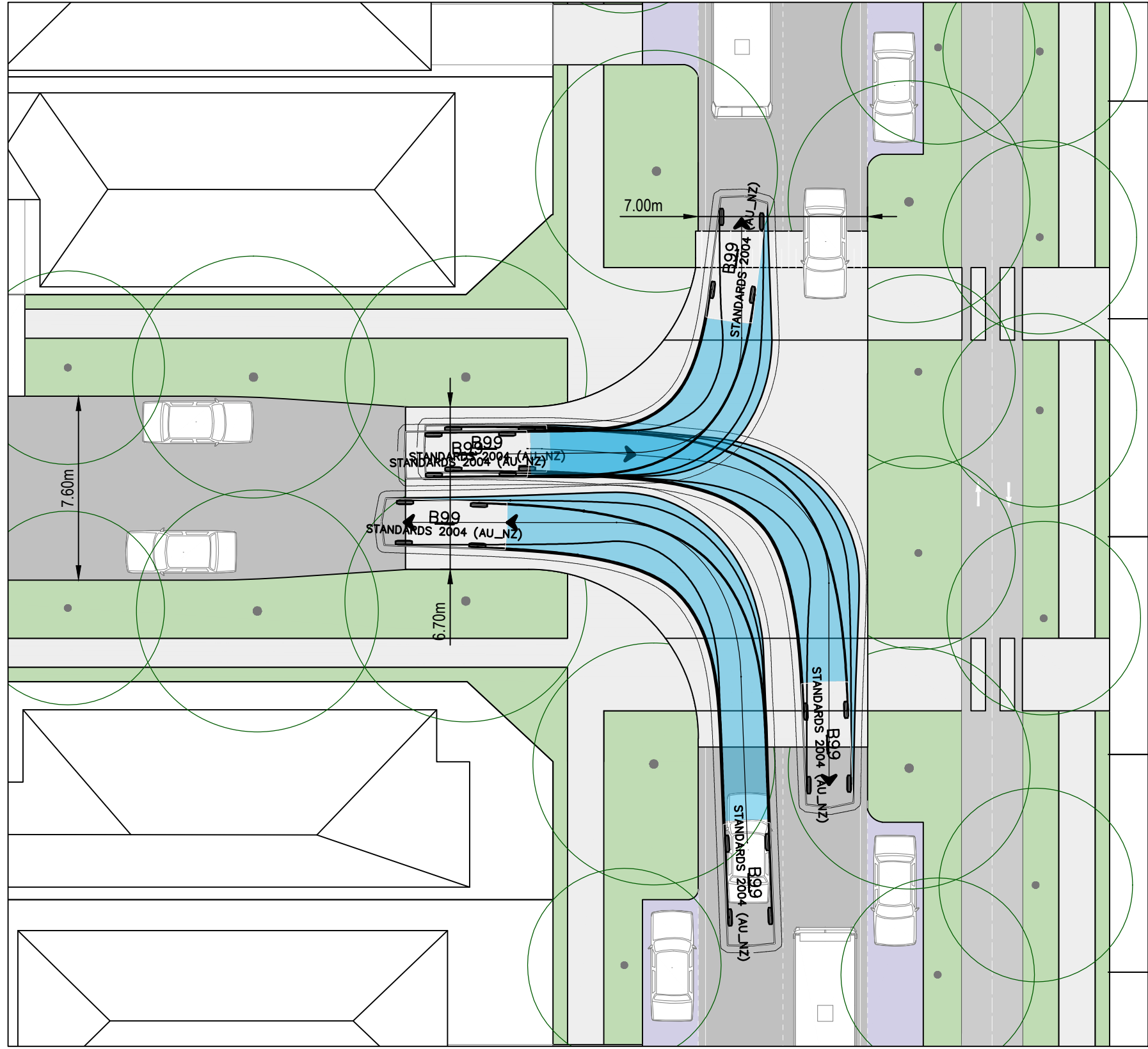
Travel Lane: A dedicated area for movement of vehicles usually marked by painted lines or reflective markers.

Verge: A strip of grass or garden between the kerb and footpath. That portion of the street corridor that is neither carriageway nor footpath.

Water Sensitive Urban Design (WSUD): The planning and management of all components of the hydrological cycle in urban settings in ways that deliver multiple benefits such as enhancing water quality and liveability. Establishing a sustainable approach to the design of stormwater drainage systems which integrates natural systems such as open raingardens, swales, bio-infiltration and wetlands within the public domain and road corridor to improve water run-off quality and management.

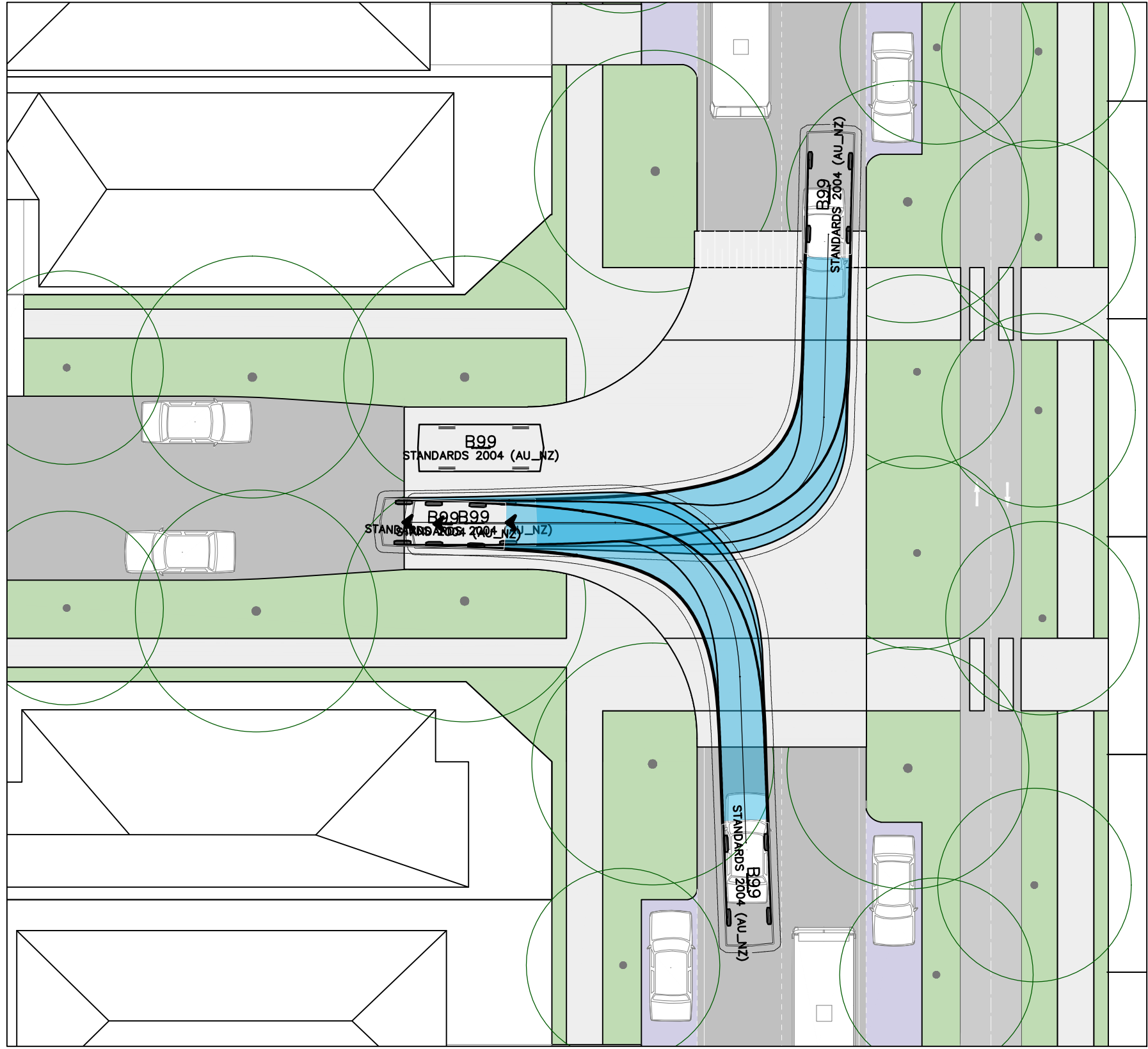
Zebra Crossing: A marked and illuminated pedestrian crossing marked by painted bars on the road surface.

Appendix 1 - Vehicle turning paths



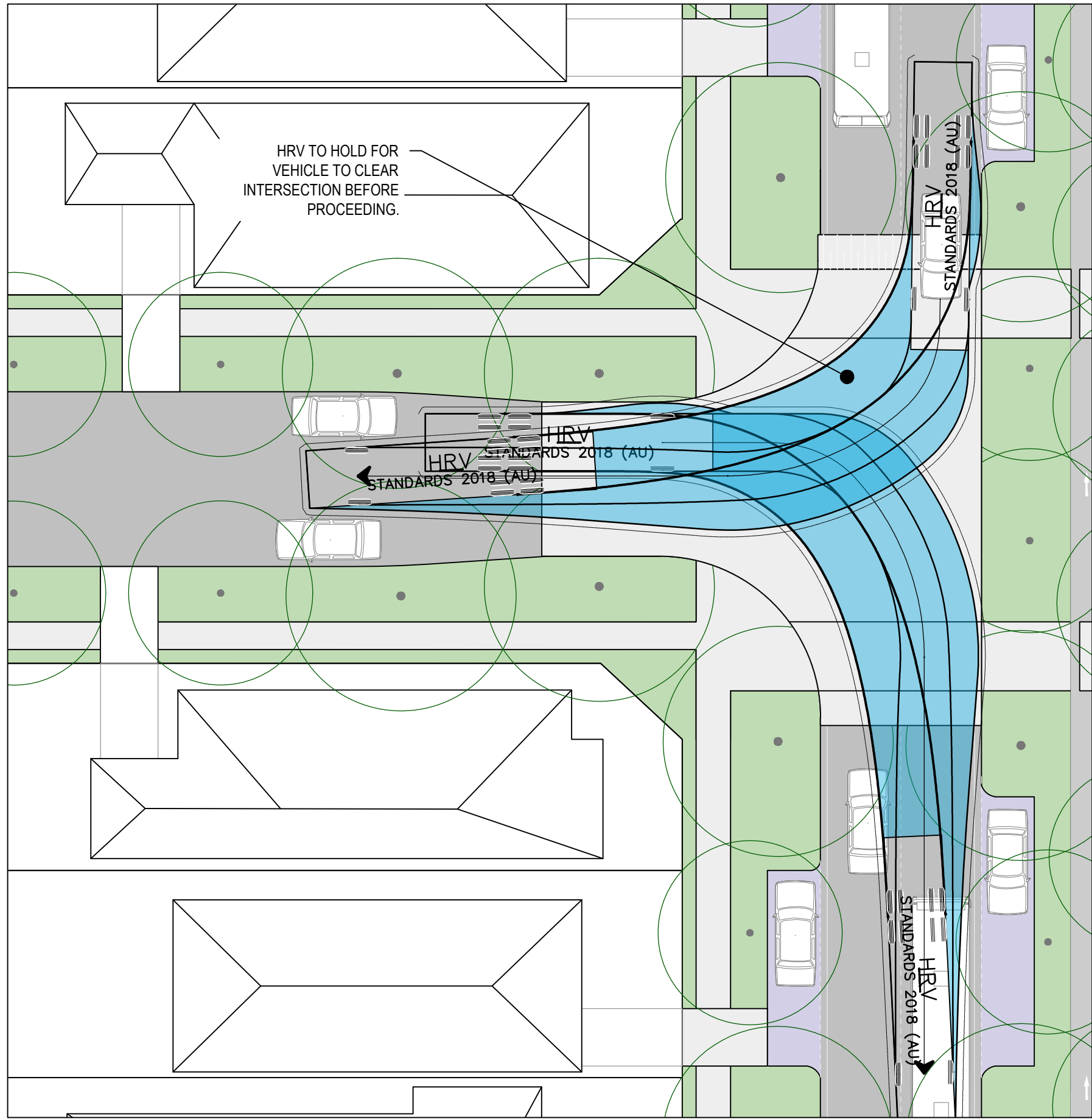
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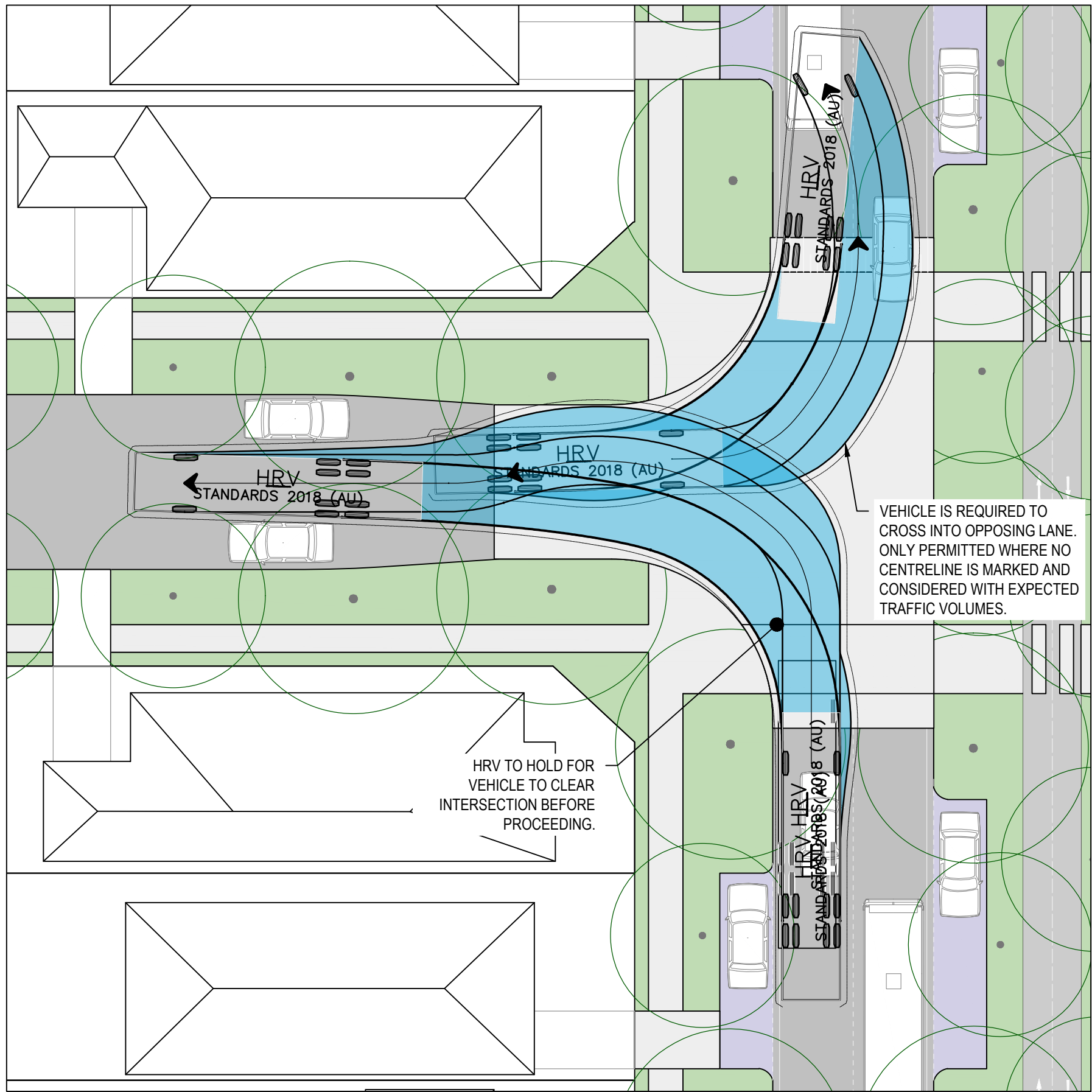
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SCALE 1:200



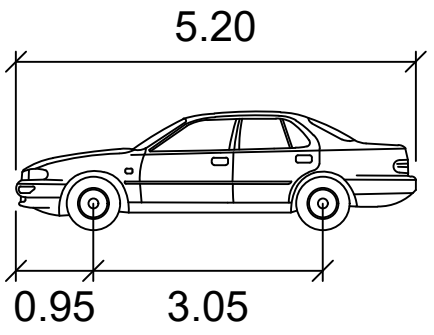
CONNECTOR PLAN (SEPARATE CYCLEWAY) - TURNING PATH 3

SCALE 1:200



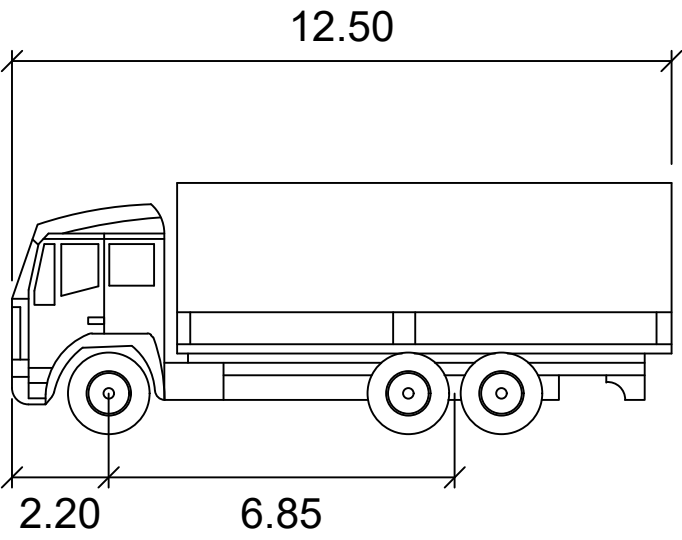
CONNECTOR PLAN (SEPARATE CYCLEWAY) - TURNING PATH 4

SCALE 1:200



B99

	meters
Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9



HRV

	meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 36.7

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
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1	24/10/2024	ISSUED FOR INFORMATION	JSH	RH	RH	

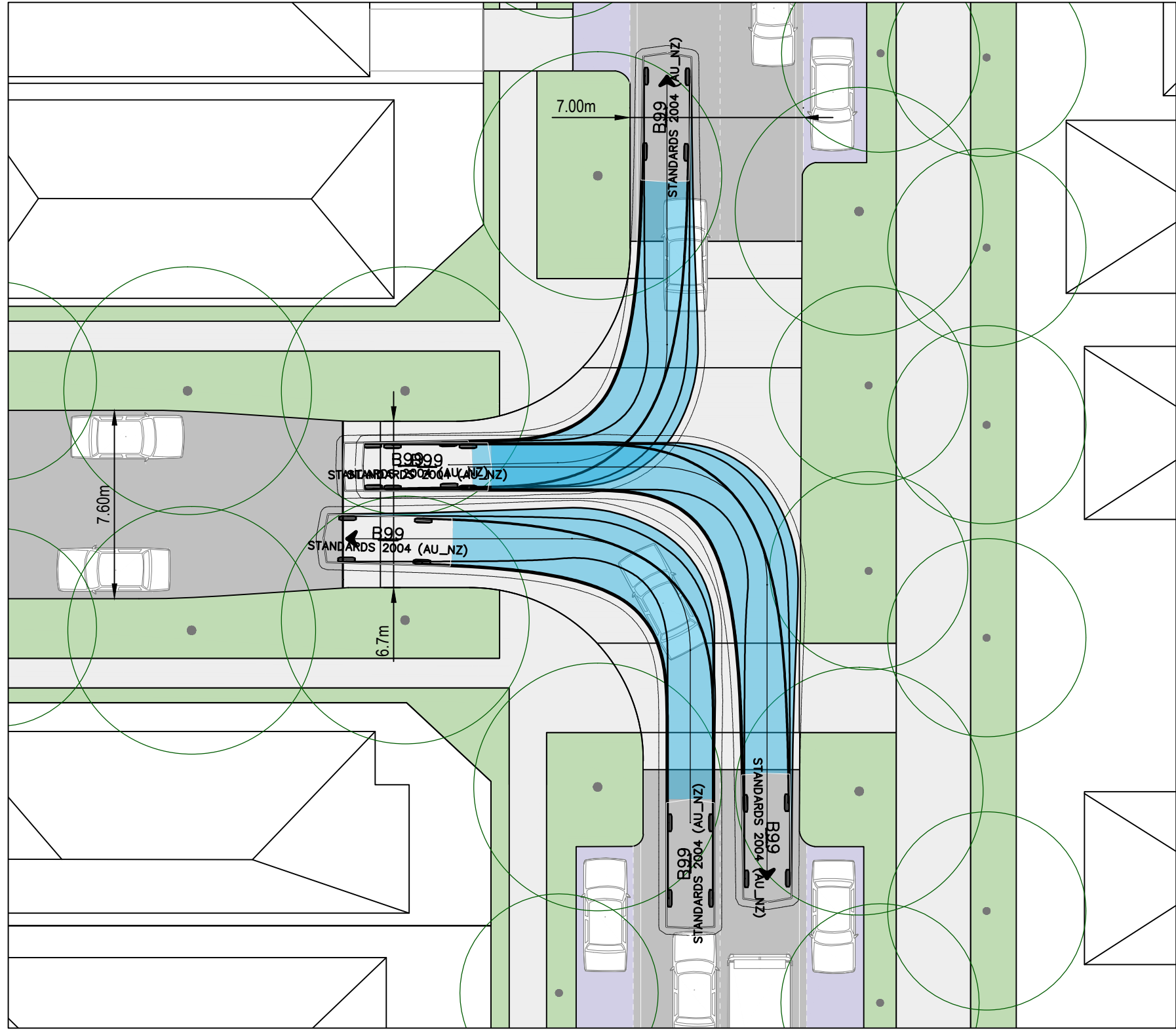
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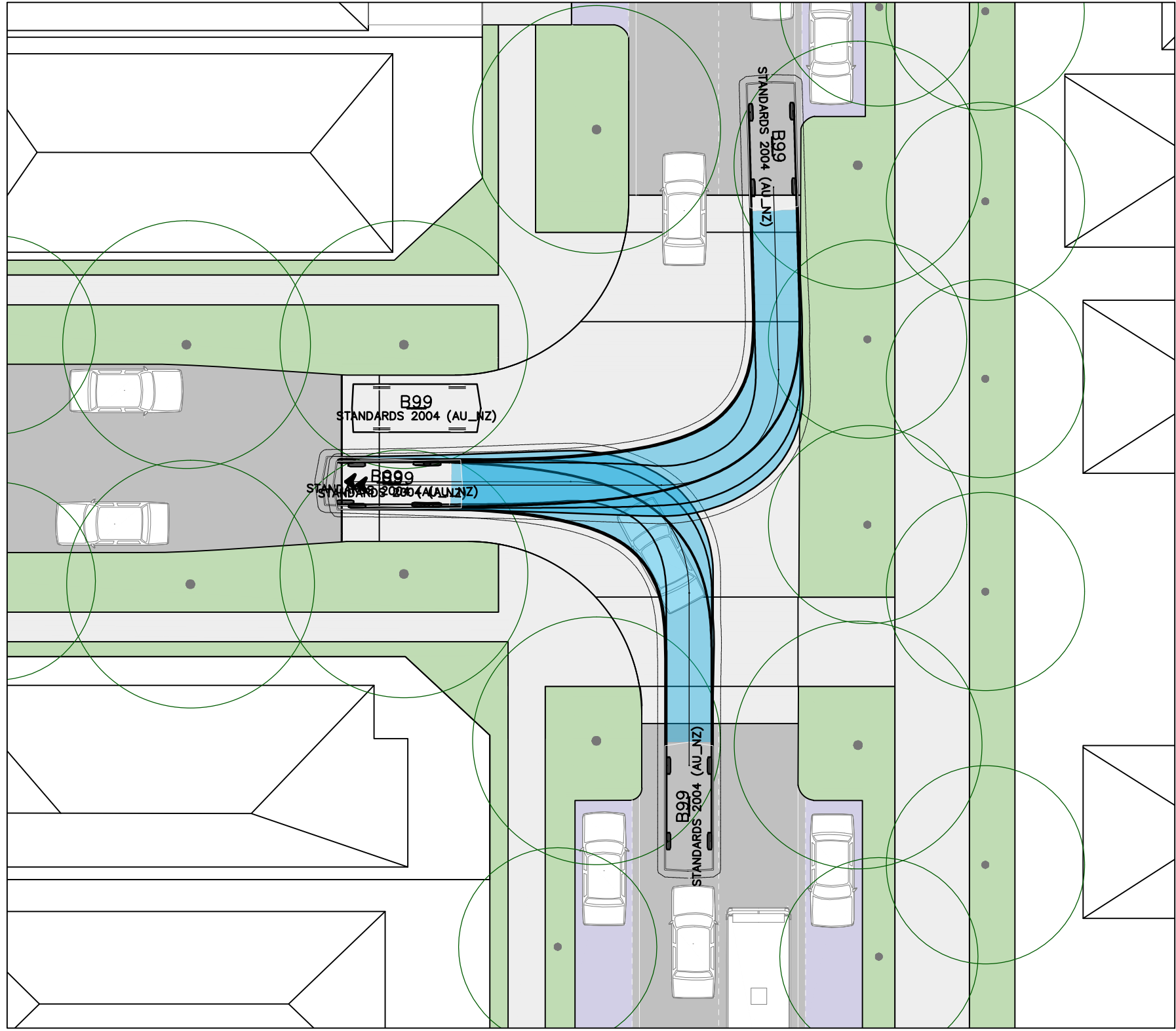
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Size	A1	Revision	1
Datum	AHD		



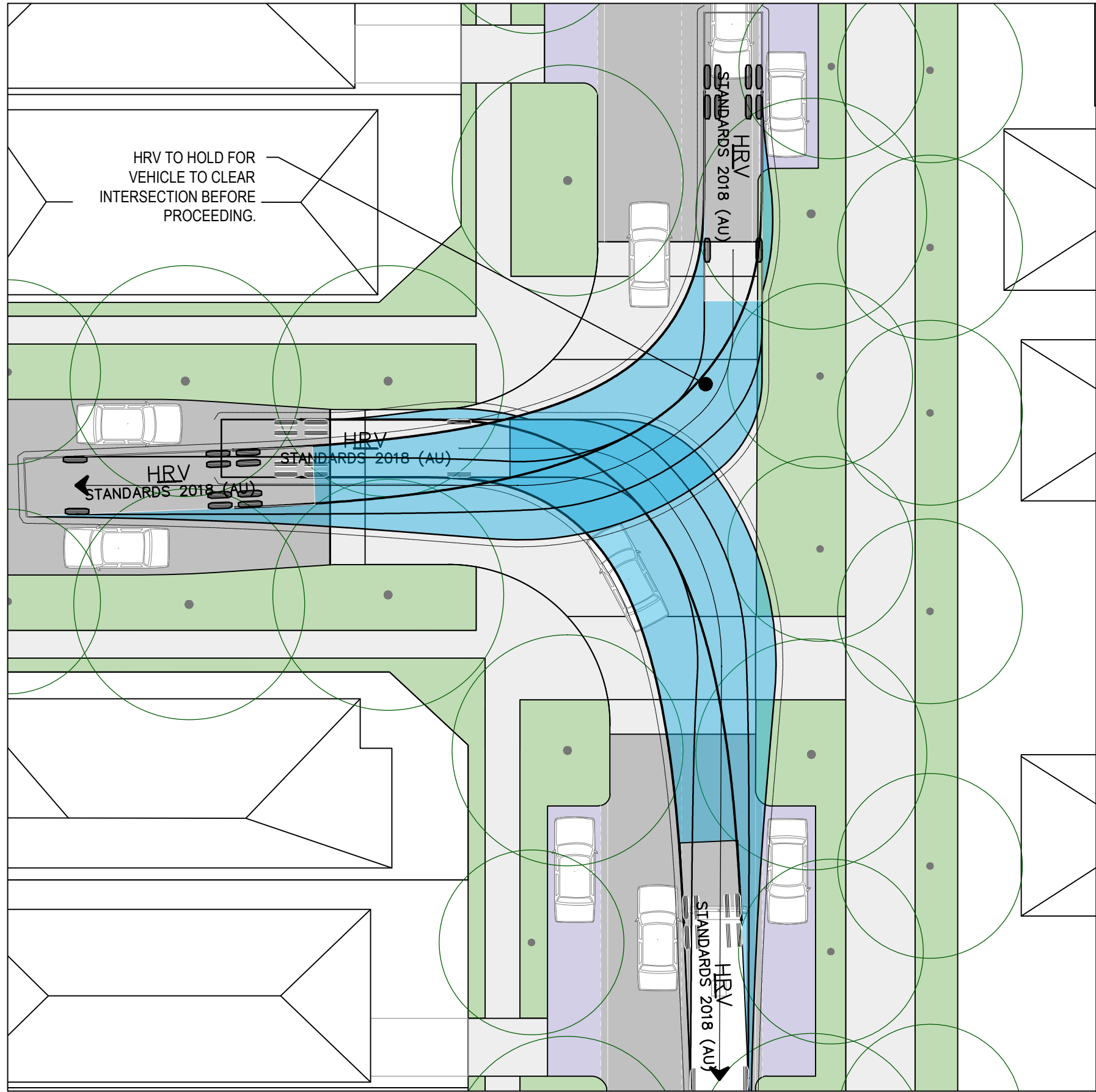
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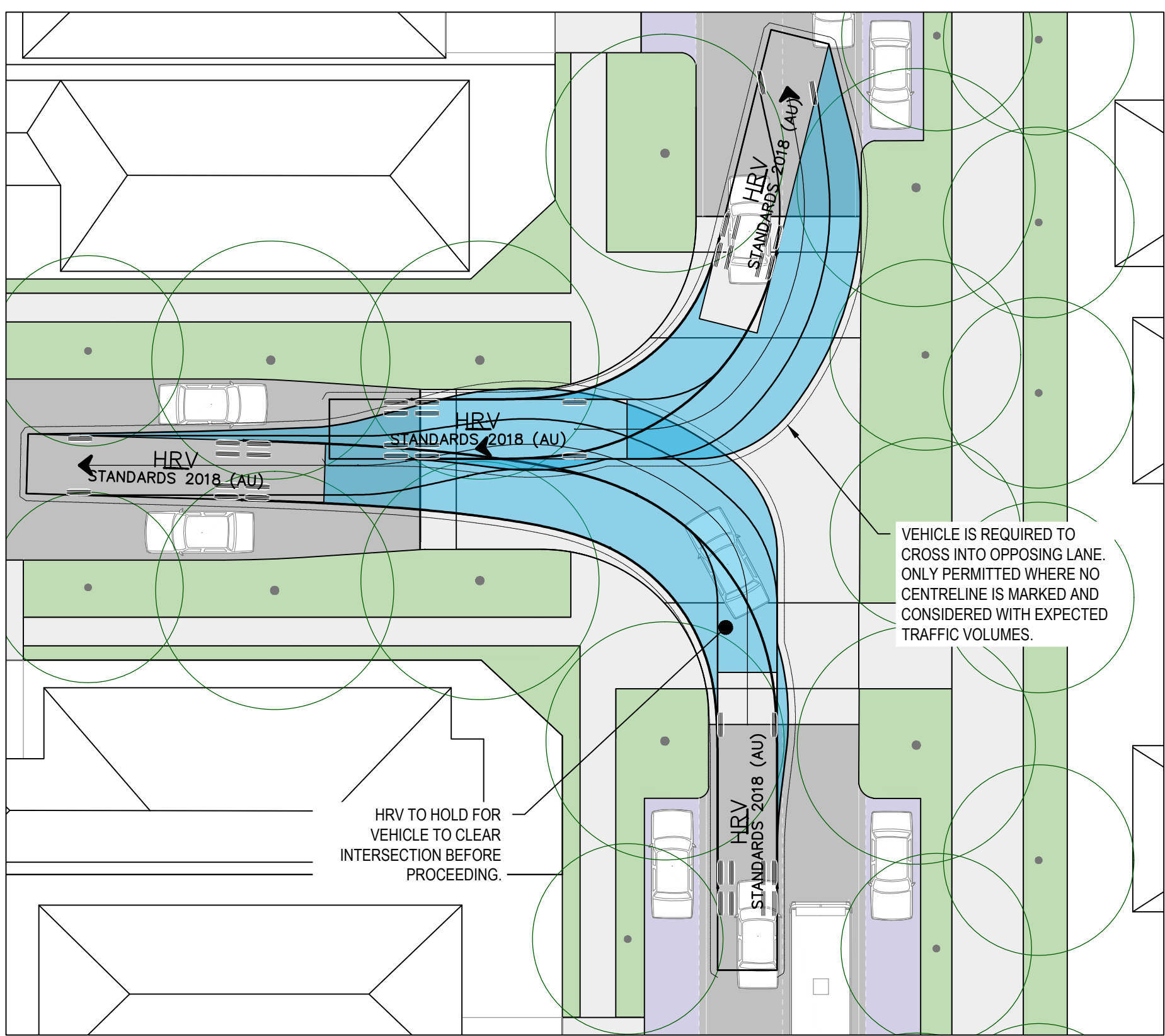
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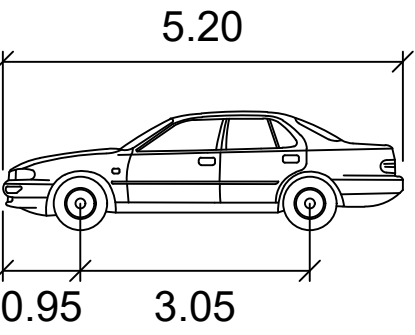
CONNECTOR PLAN (SHARED PATH) - TURNING PATH 3

SCALE 1:200



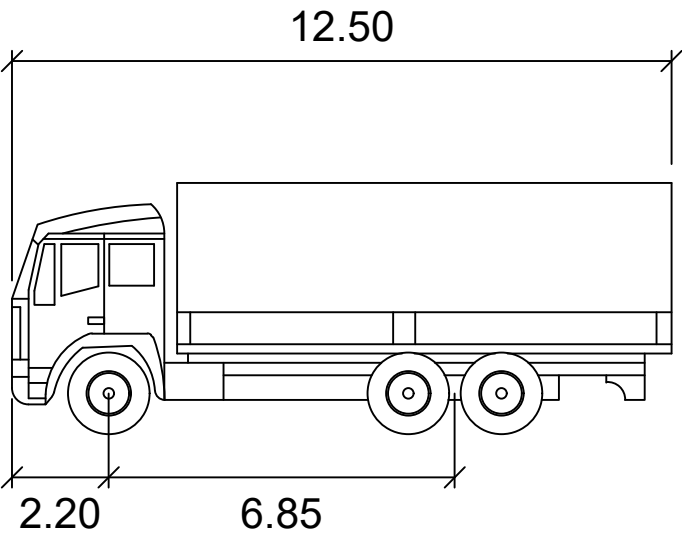
CONNECTOR PLAN (SHARED PATH) - TURNING PATH 4

SCALE 1:200



B99

	meters
Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9



HRV

	meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 36.7

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
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1	24/10/2024	ISSUED FOR INFORMATION	JSH		RH	RH

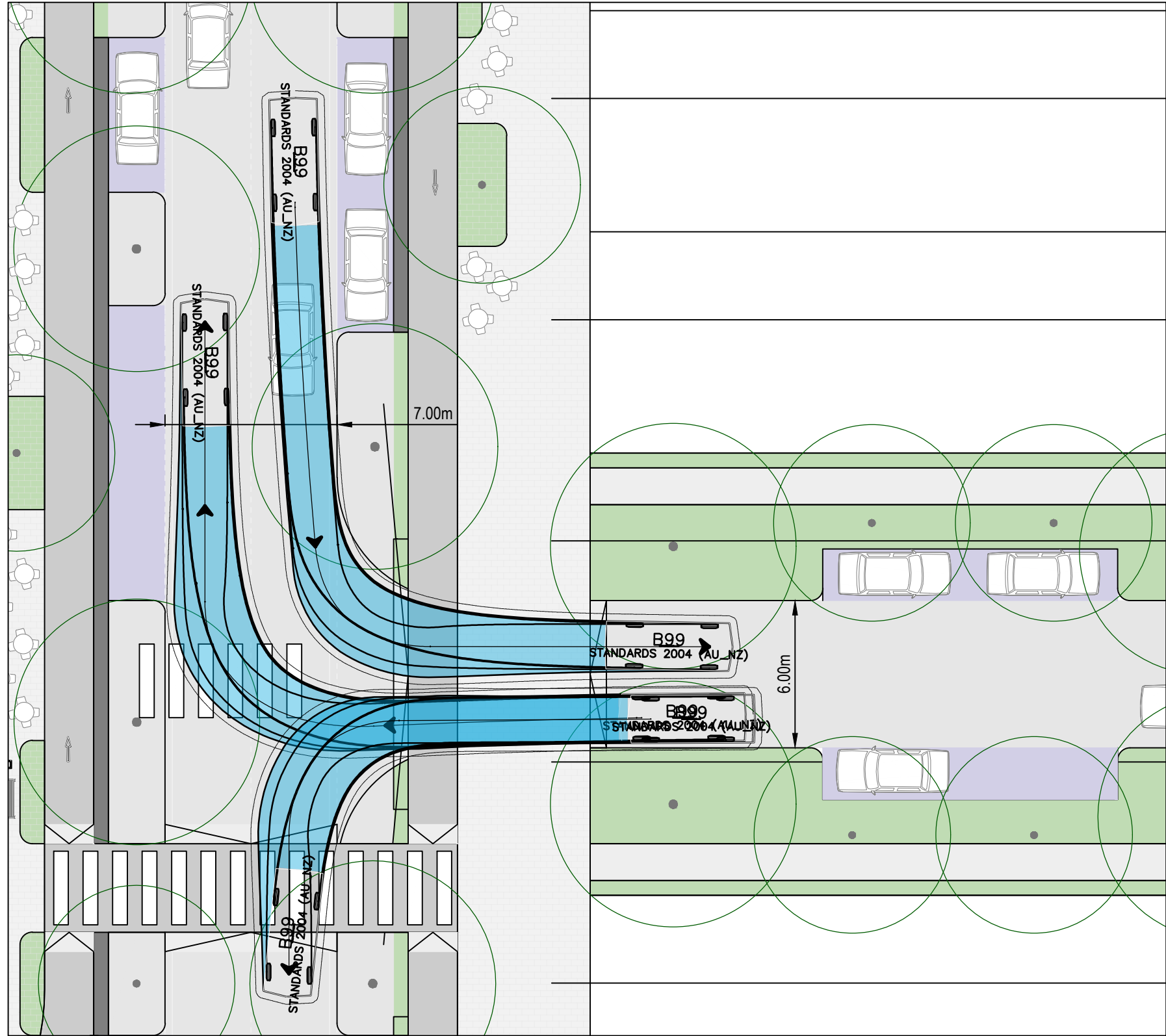
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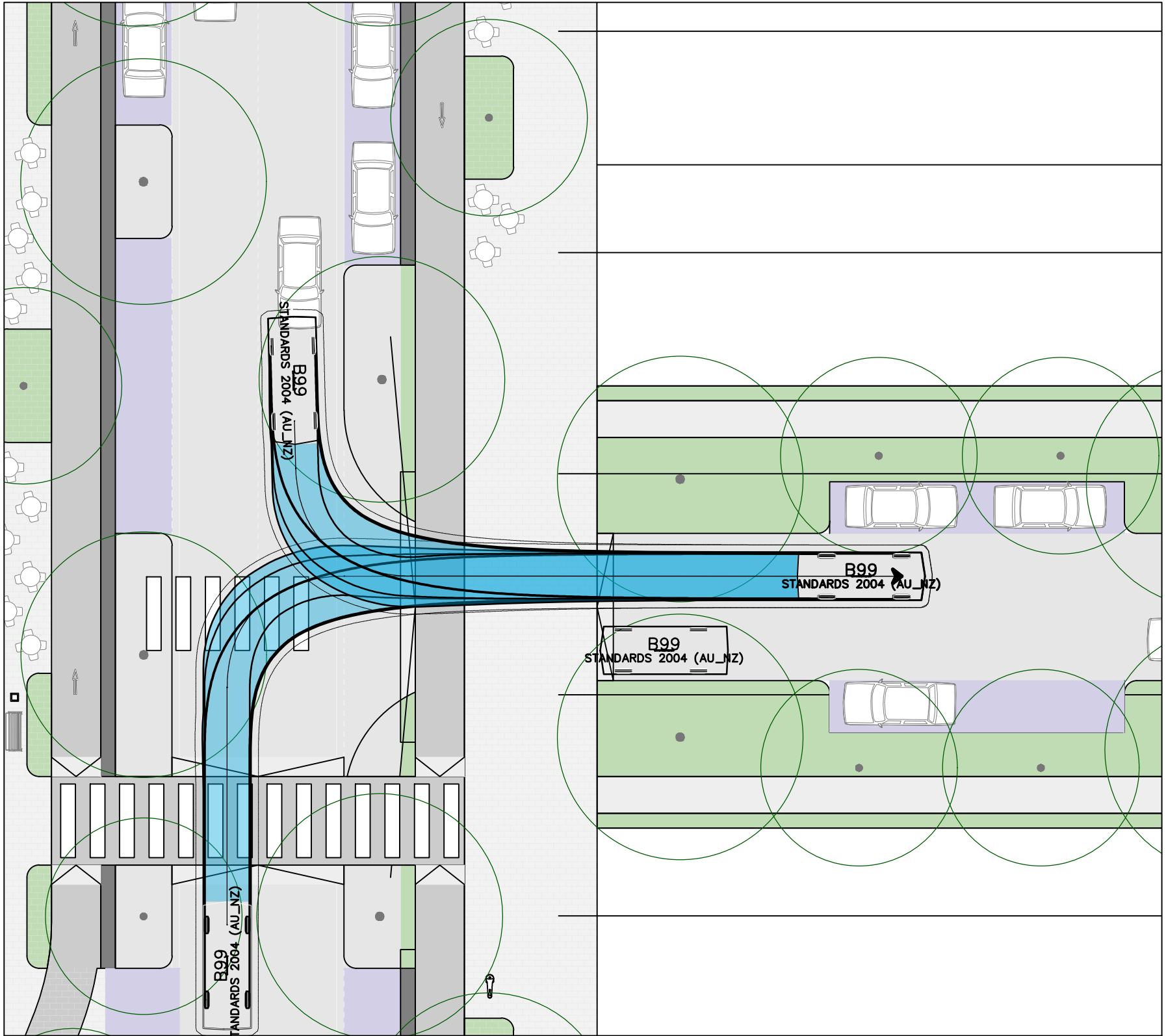
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Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS CONNECTOR STREET - SHARED PATH SHEET 02

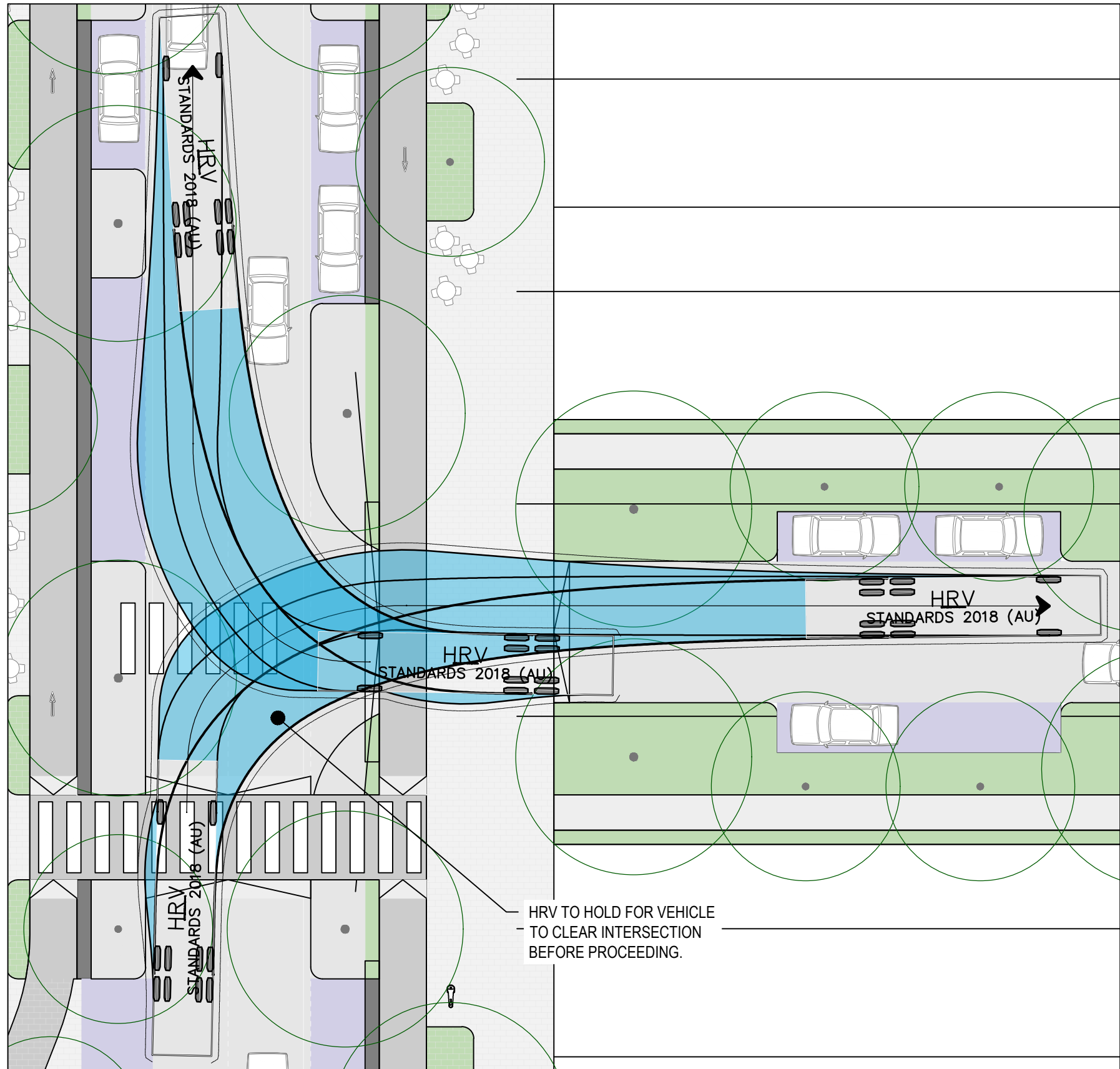
Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0002-240074-00
Size	A1	Revision	1
Datum	AHD		



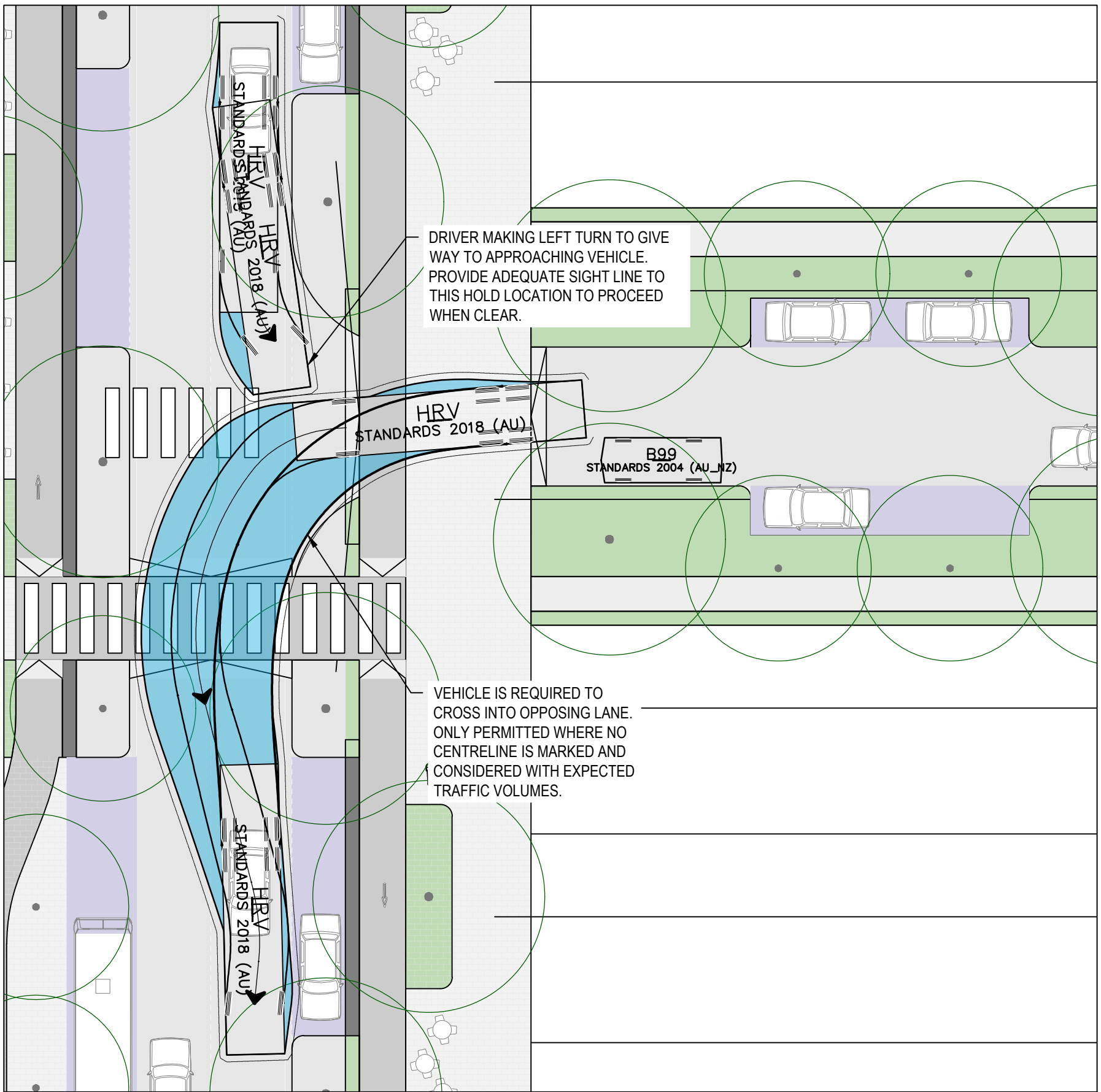
HIGH STREET - TURNING PATH 1
SCALE 1:200



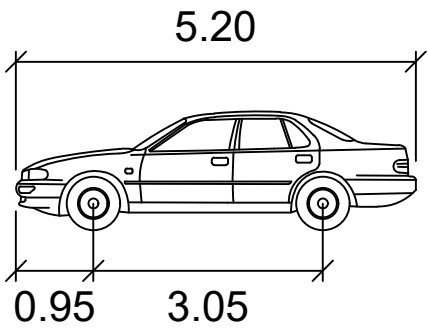
HIGH STREET - TURNING PATH 2
SCALE 1:200



HIGH STREET - TURNING PATH 3
SCALE 1:200

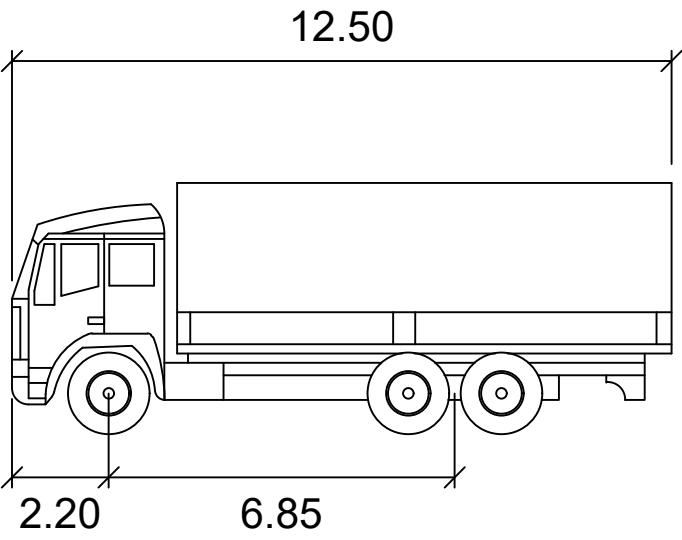


HIGH STREET - TURNING PATH 4
SCALE 1:200



B99

	meters
Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9



HRV

	meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 36.7

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH	RH	RH	
1	24/10/2024	ISSUED FOR INFORMATION	JSH	RH	RH	

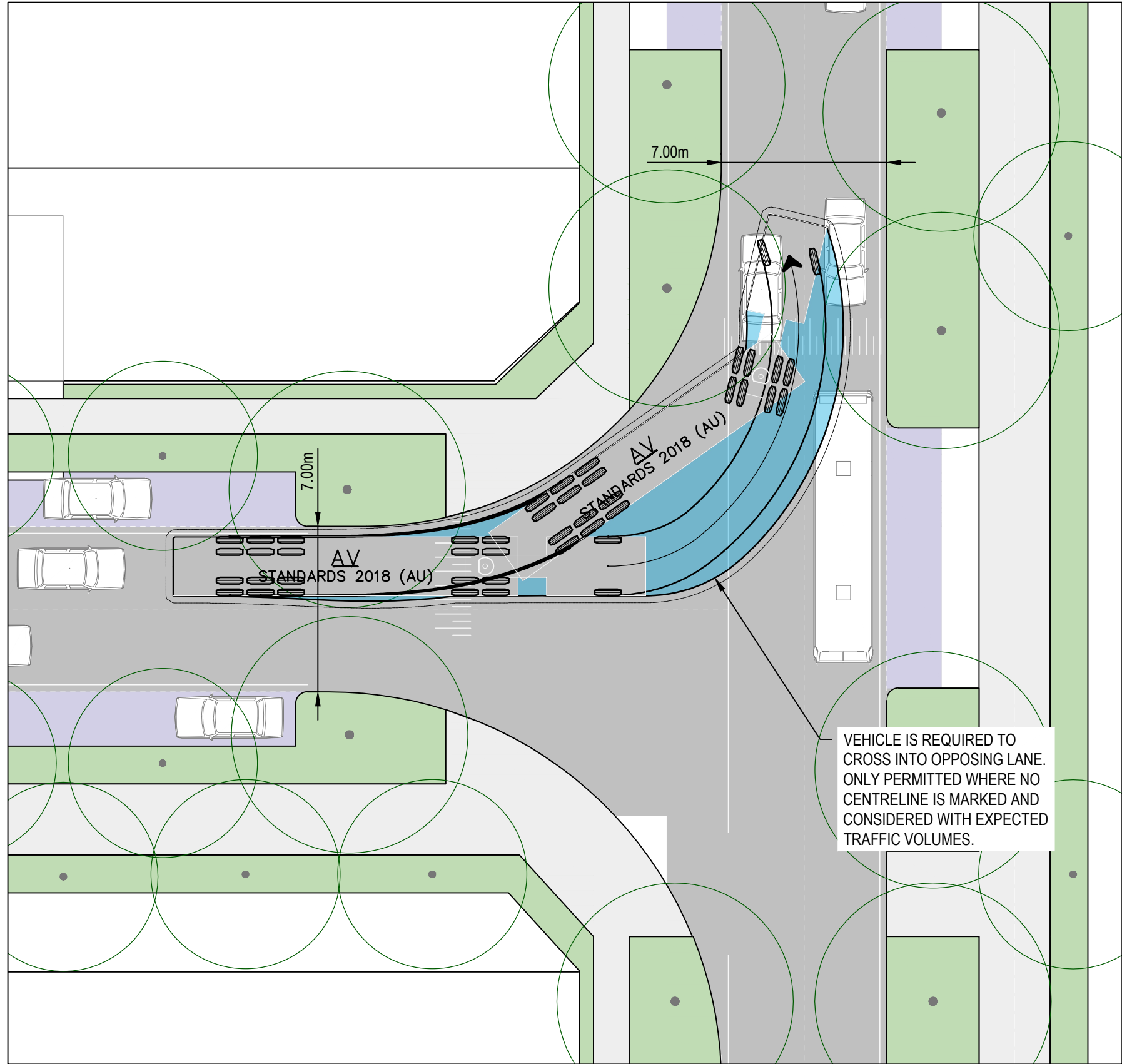
Client	ASPECT STUDIOS
--------	----------------

Scale	0 5 10 15 20m SCALE 1:200 @A1
North	
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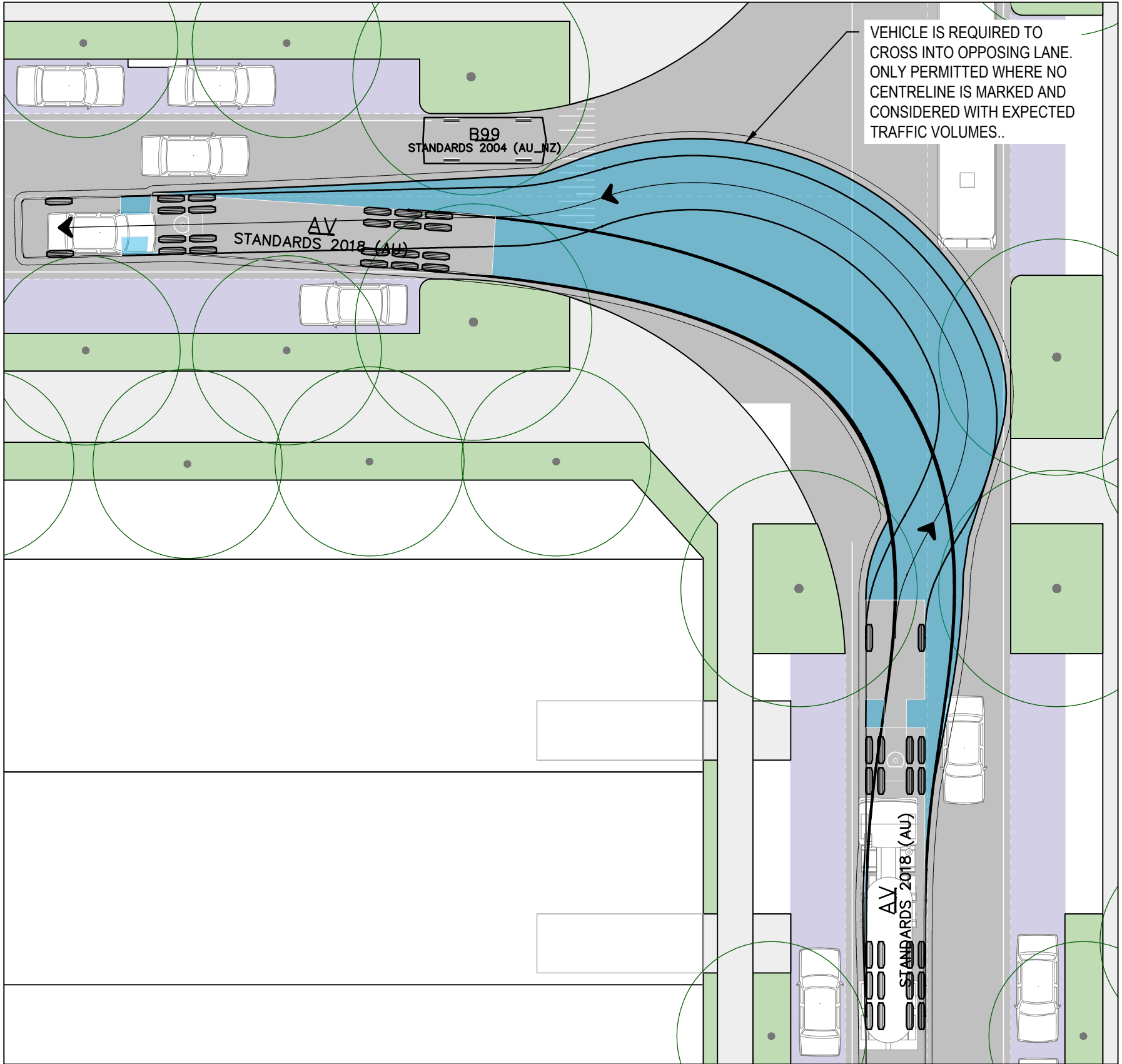
Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS HIGH STREET SHEET 03

Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0003-240074-00
Size	A1	Revision	1
Datum	AHD		



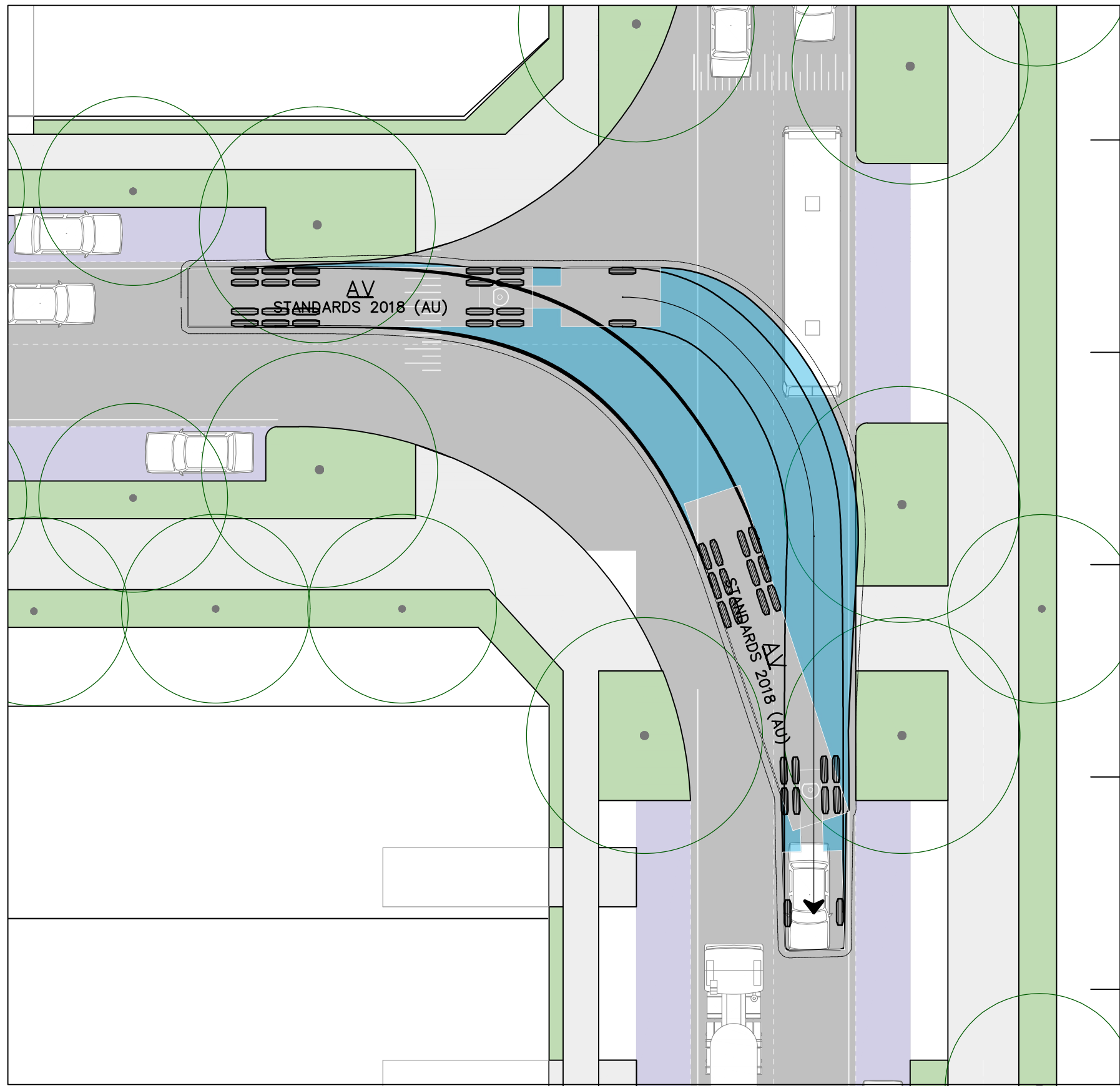
ENTERPRISE STREET - TURNING PATH 1

SCALE 1:200



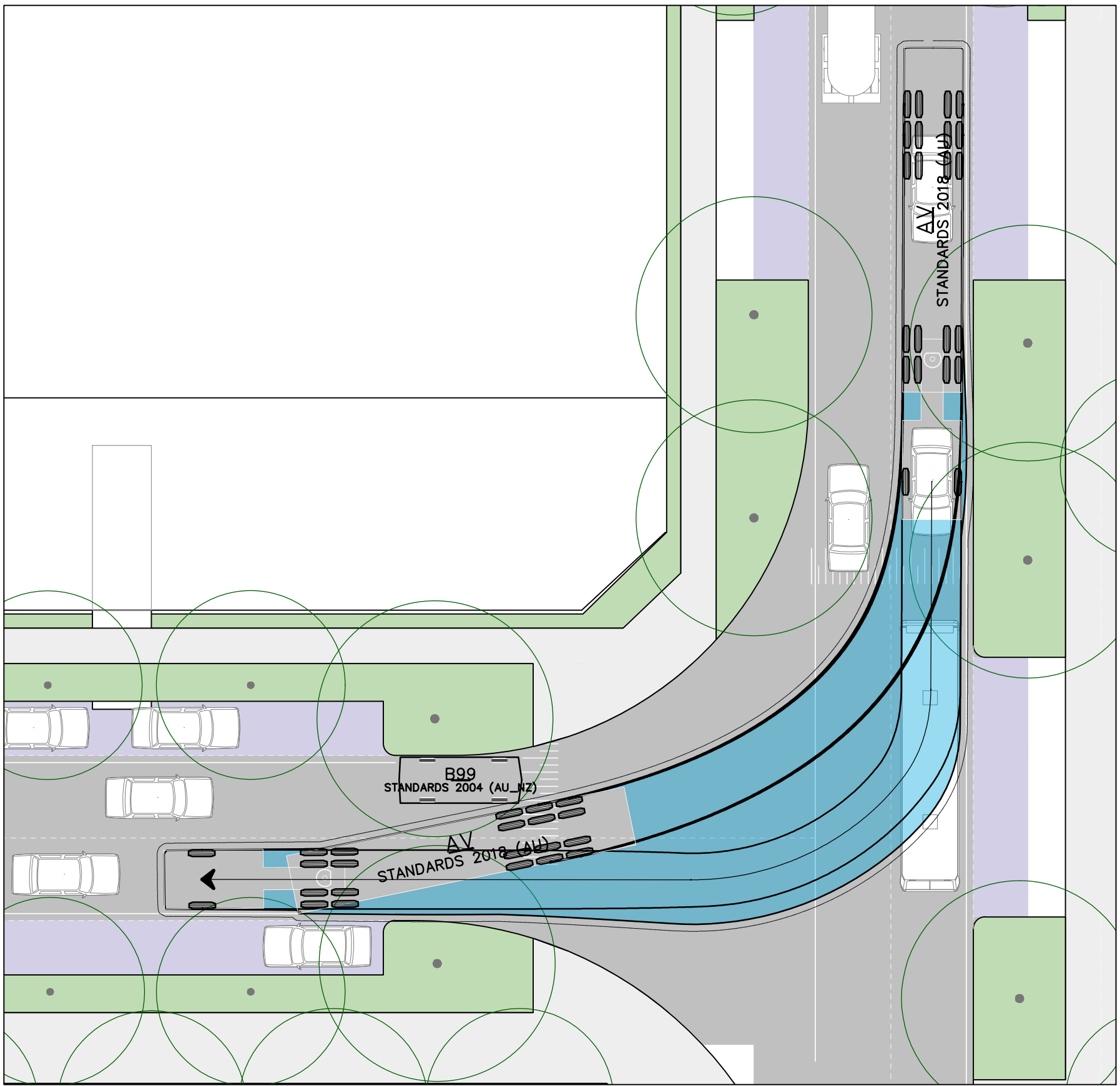
ENTERPRISE STREET - TURNING PATH 2

SCALE 1:200



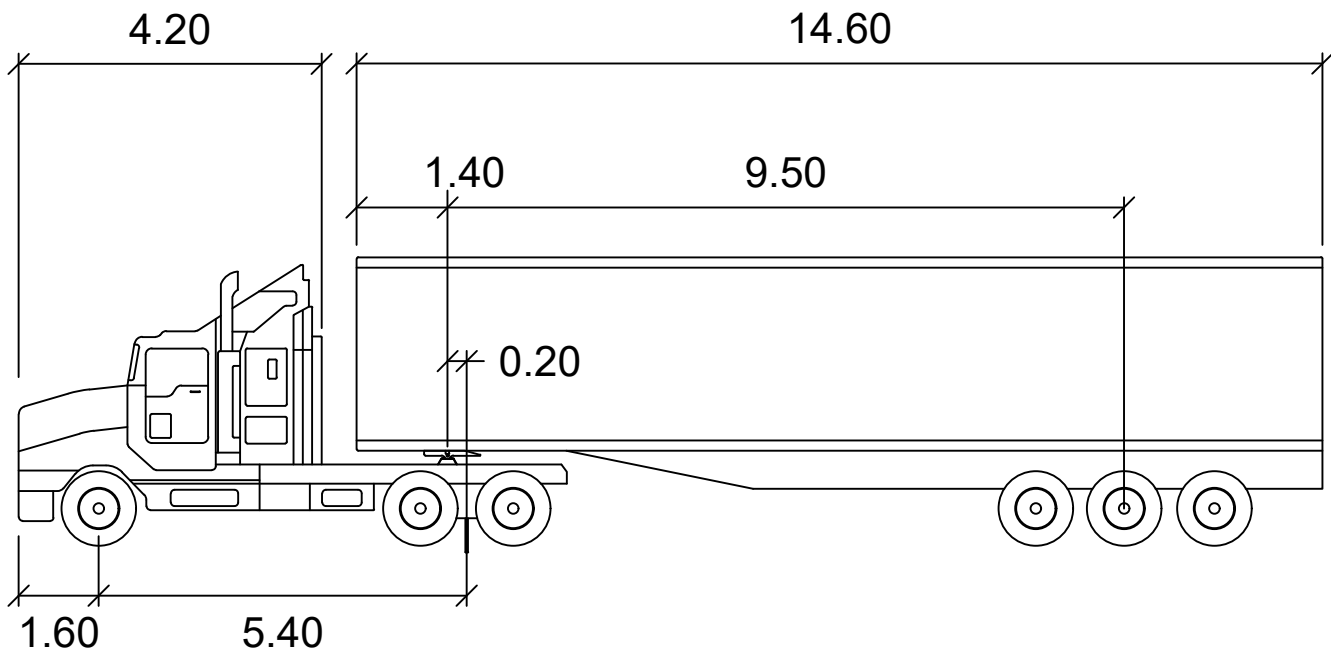
ENTERPRISE STREET - TURNING PATH 3

SCALE 1:200



ENTERPRISE STREET - TURNING PATH 4

SCALE 1:200



AV

Tractor Width	: 2.50	Lock to Lock Time
Trailer Width	: 2.50	Steering Angle
Tractor Track	: 2.50	Articulating Angle
Trailer Track	: 2.50	

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH		RH	RH
1	24/10/2024	ISSUED FOR INFORMATION	JSH		RH	RH

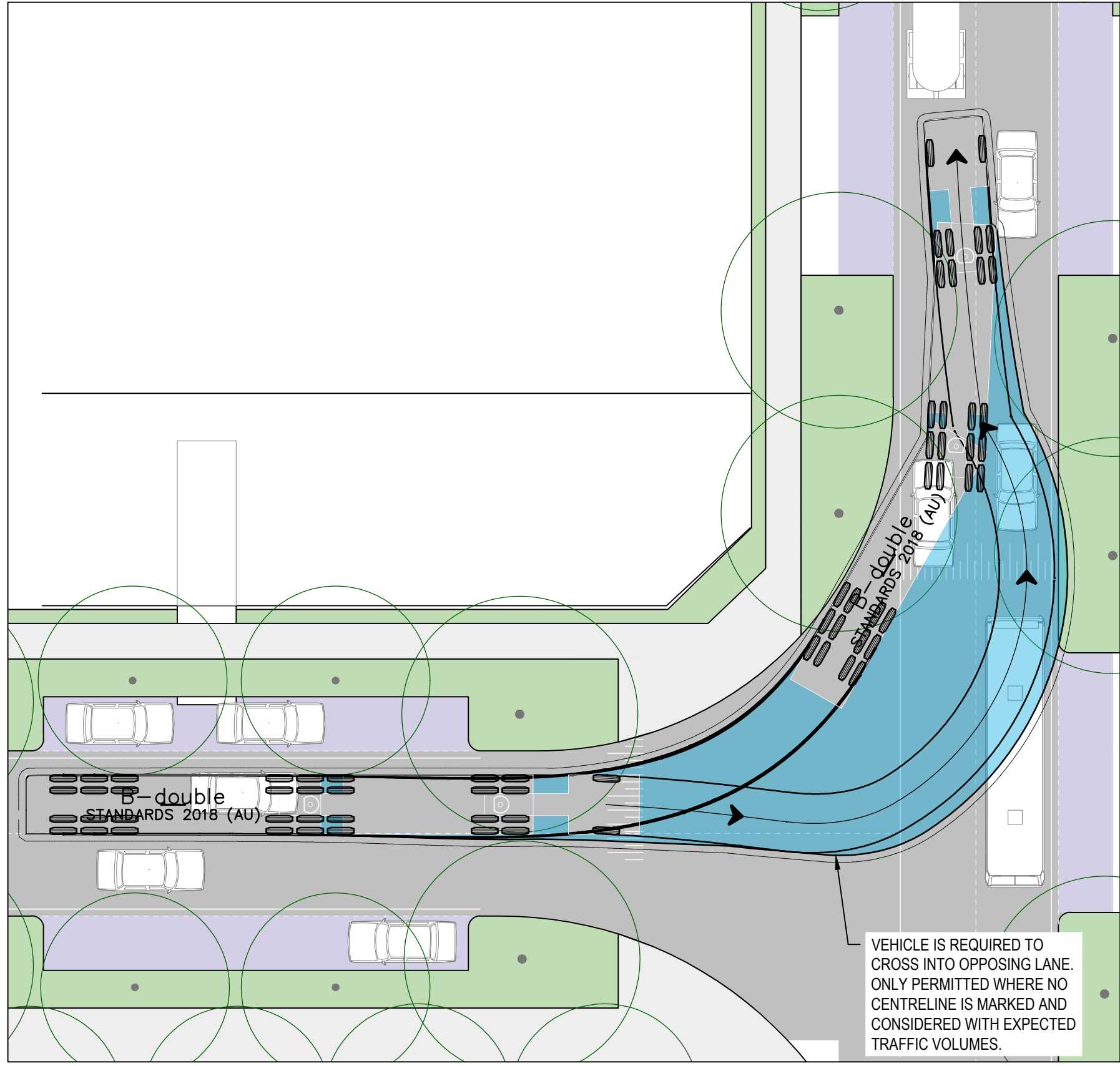
Client	ASPECT STUDIOS
--------	----------------

Scale	0 5 10 15 20m SCALE 1:200 @A1
North	
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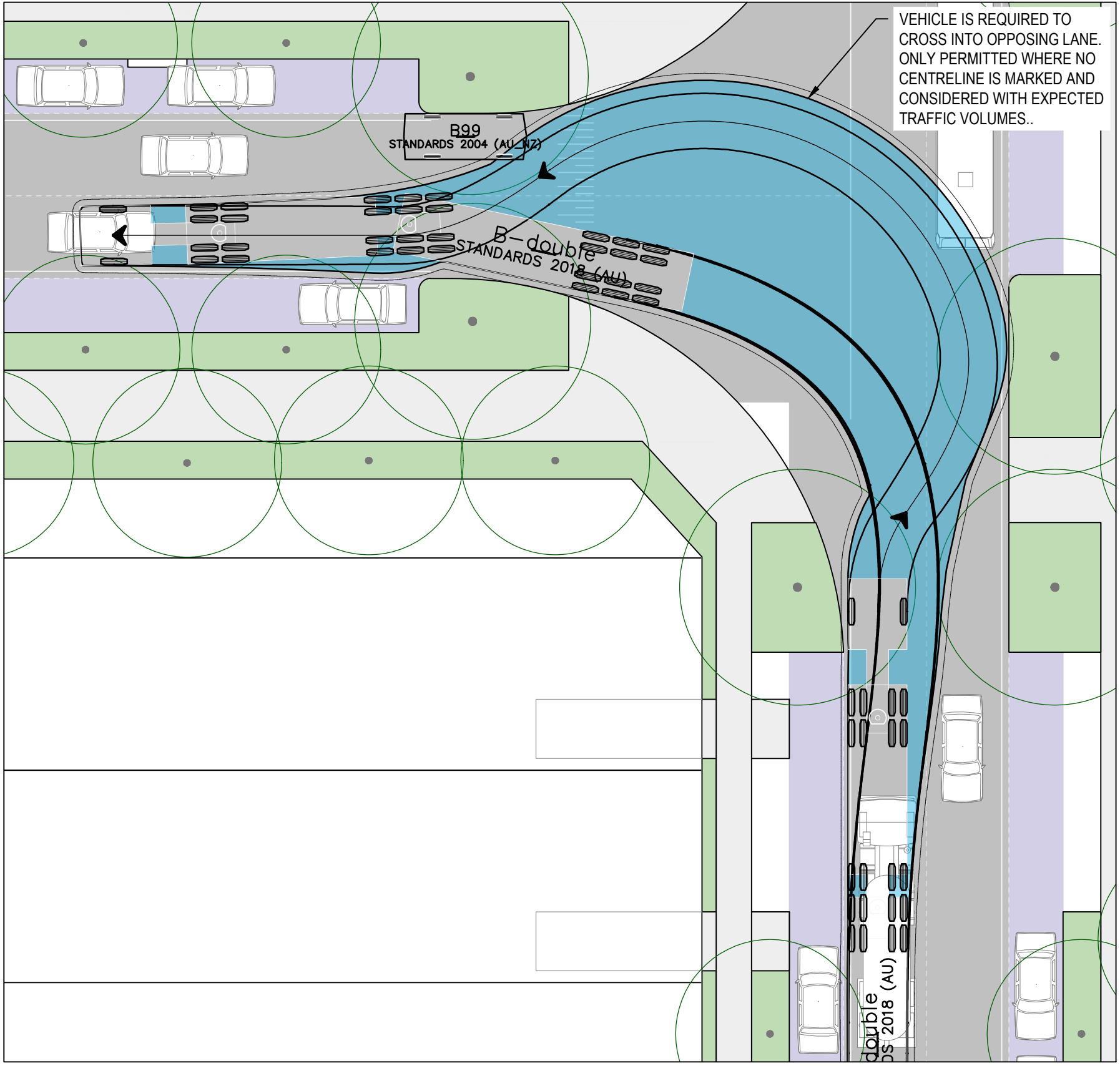
Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS ENTERPRISE STREET SHEET 04

Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0004-240074-00
Size	A1	Revision	1
Datum	AHD		



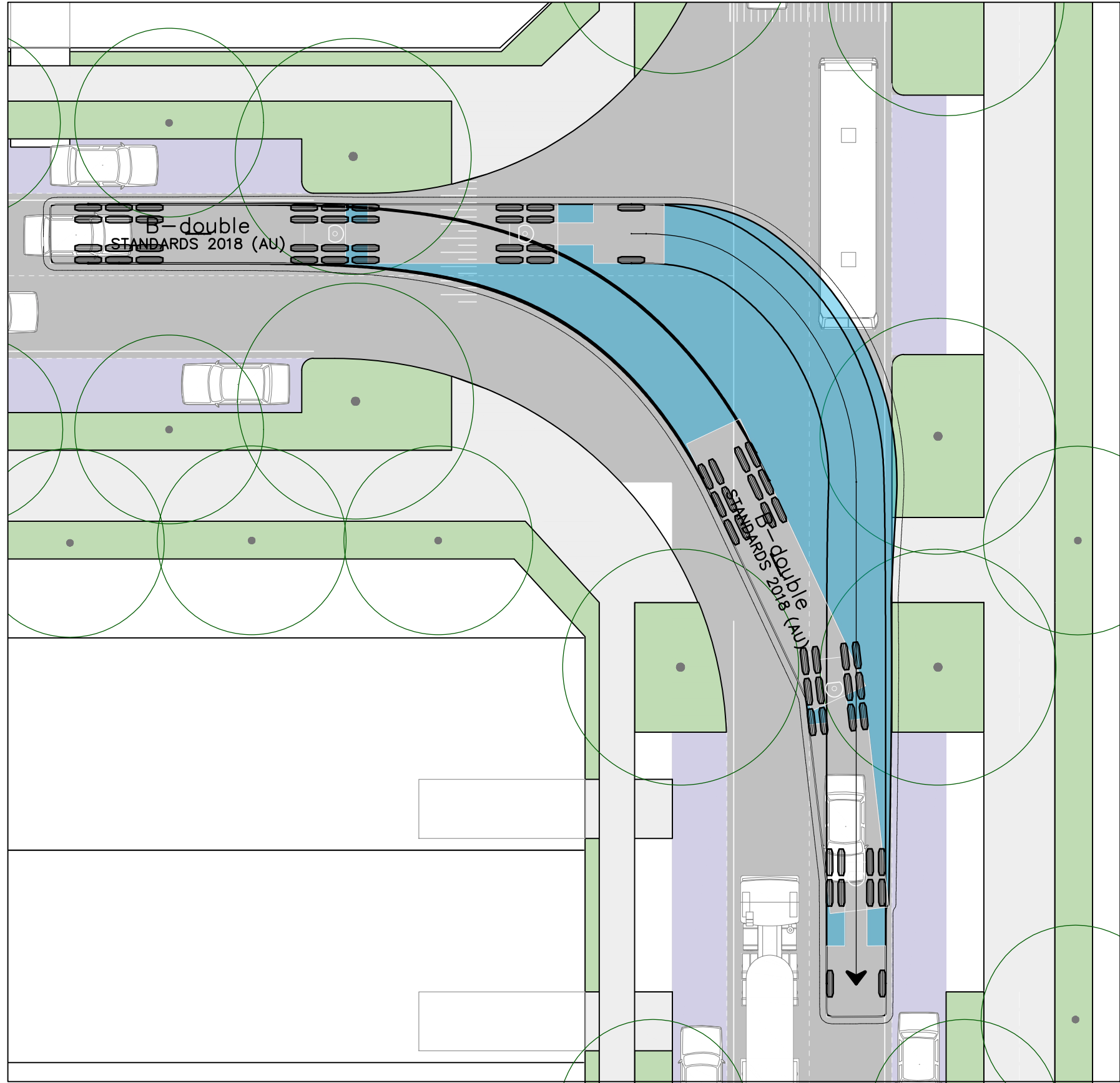
ENTERPRISE STREET - TURNING PATH 5

SCALE 1:200



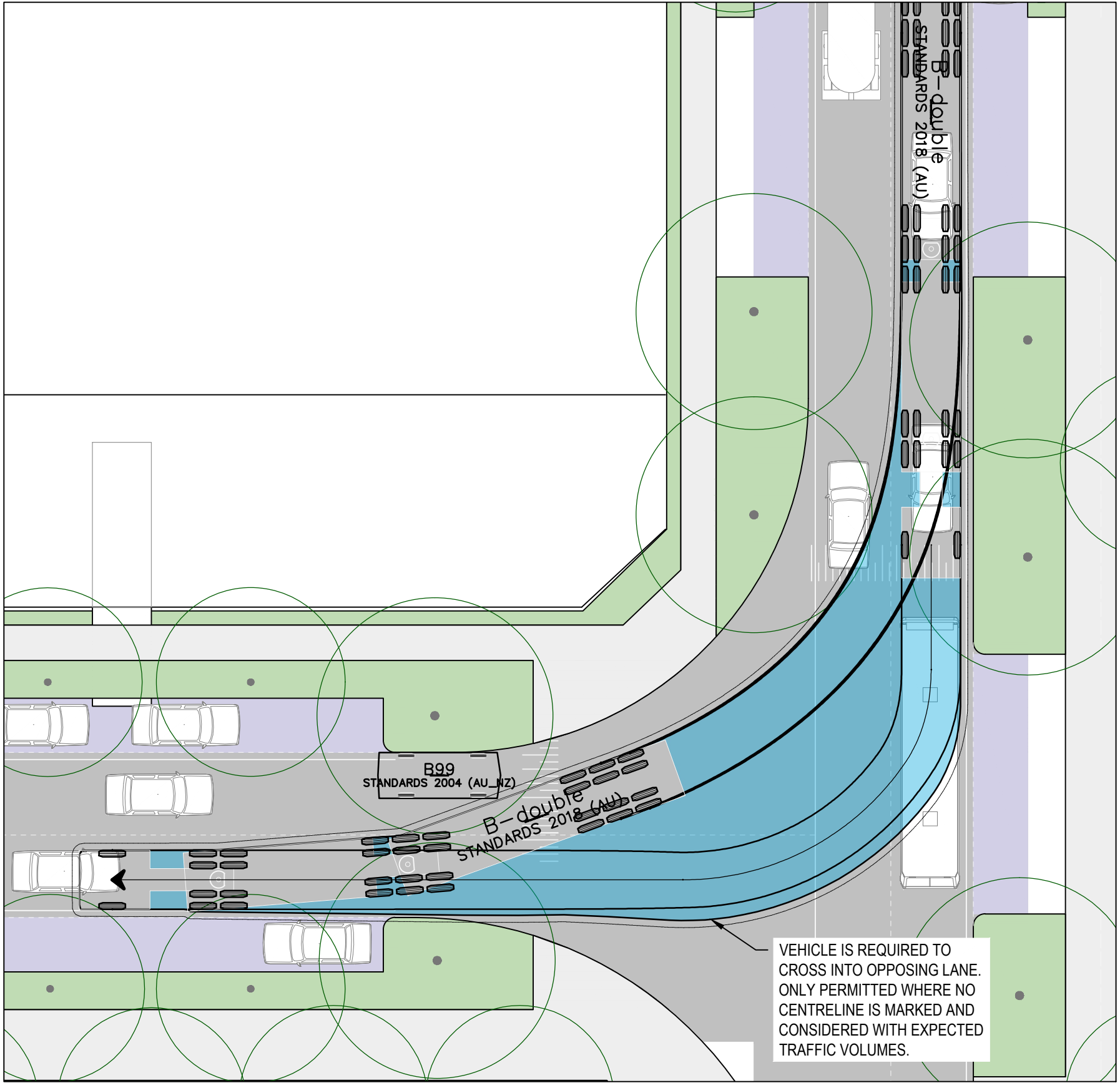
ENTERPRISE STREET - TURNING PATH 6

SCALE 1:200



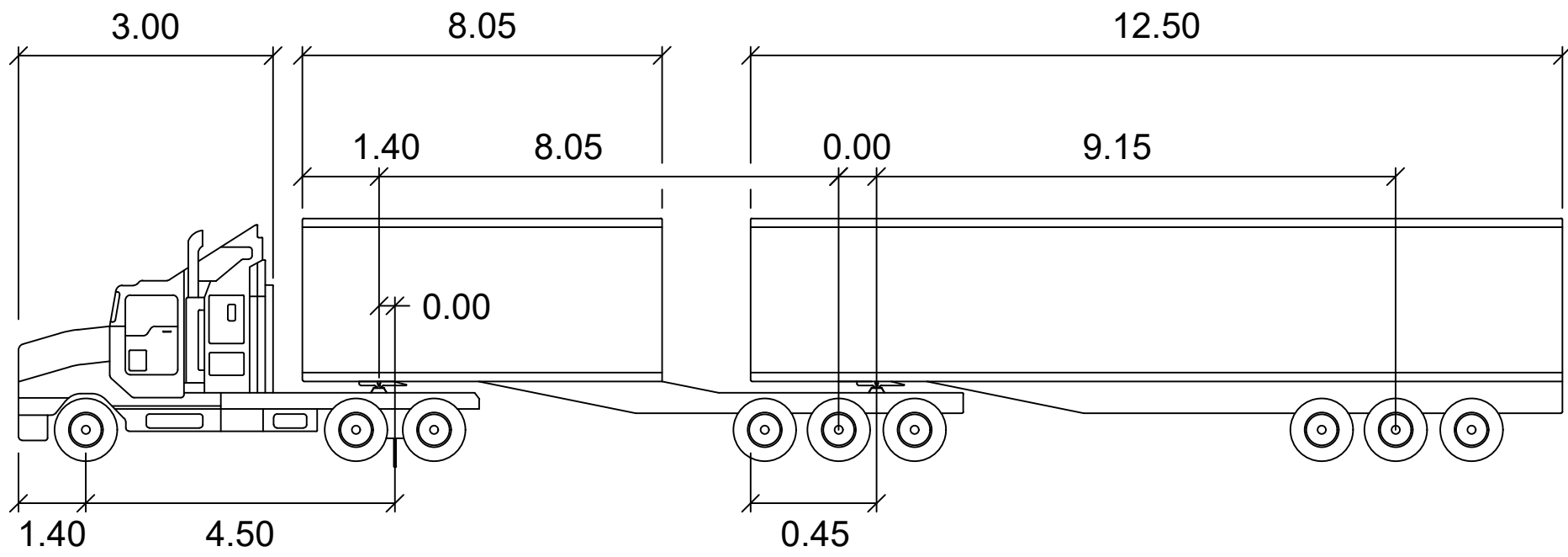
ENTERPRISE STREET - TURNING PATH 7

SCALE 1:200



ENTERPRISE STREET - TURNING PATH 8

SCALE 1:200



B-double

	Tractor Width	: 2.50	Lock to Lock Time	: 6.0
	Trailer Width	: 2.50	Steering Angle	: 23.4
	Tractor Track	: 2.50	Articulating Angle	: 70.0
	Trailer Track	: 2.50		

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH		RH	RH
1	24/10/2024	ISSUED FOR INFORMATION	JSH		RH	RH

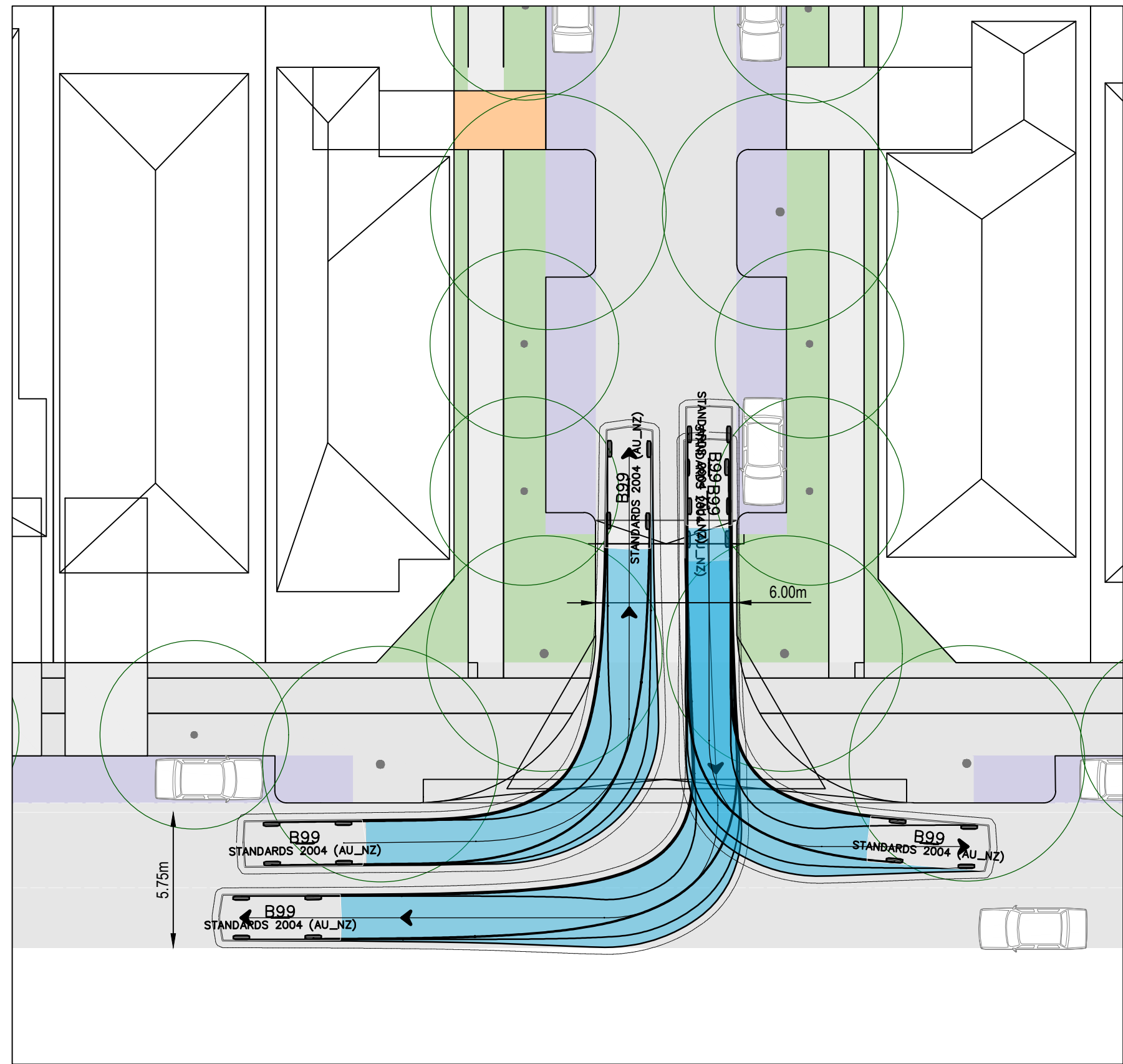
Client	ASPECT STUDIOS
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Scale	0 5 10 15 20m SCALE 1:200 @A1
North	
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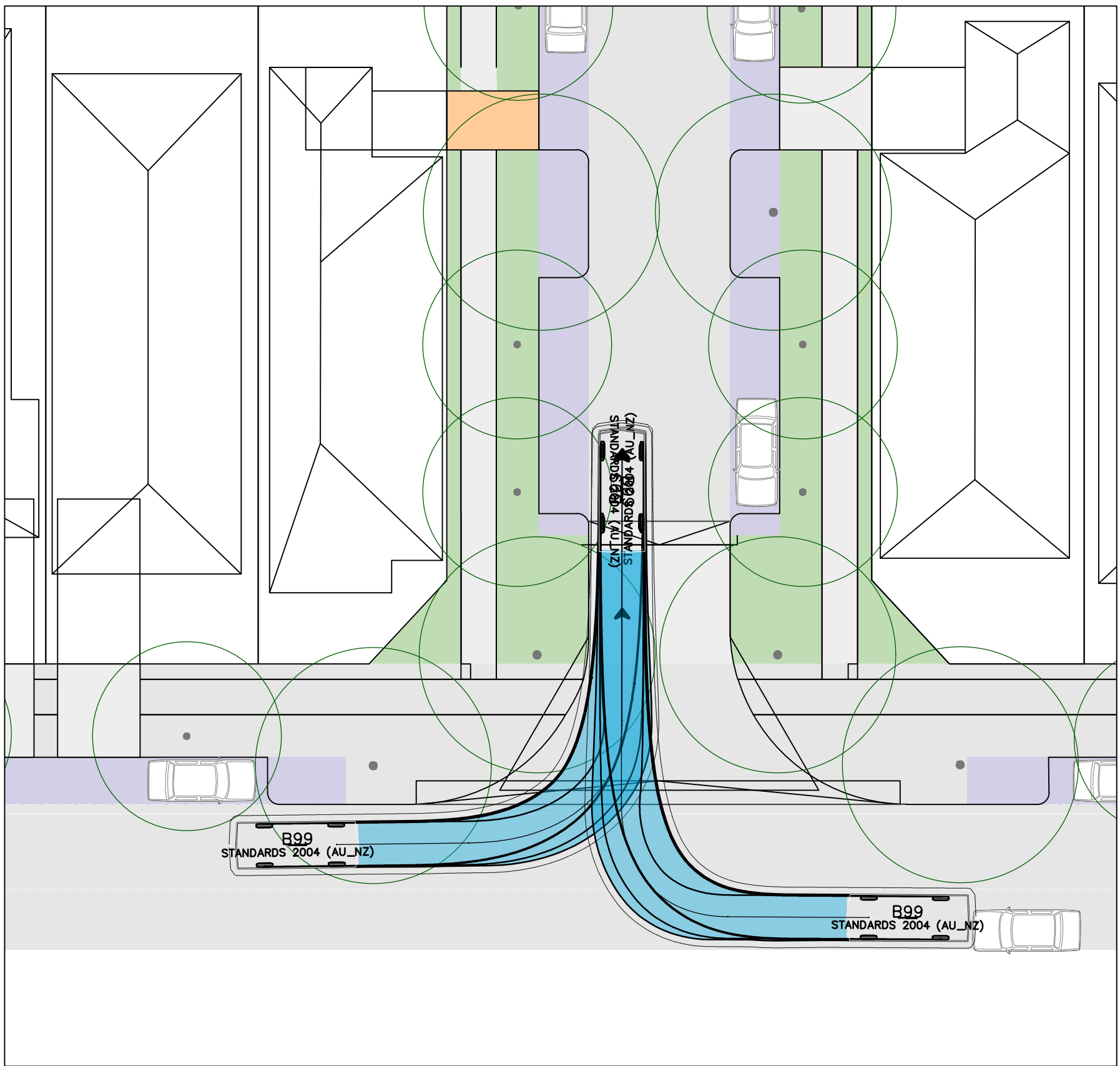
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Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS ENTERPRISE STREET SHEET 05

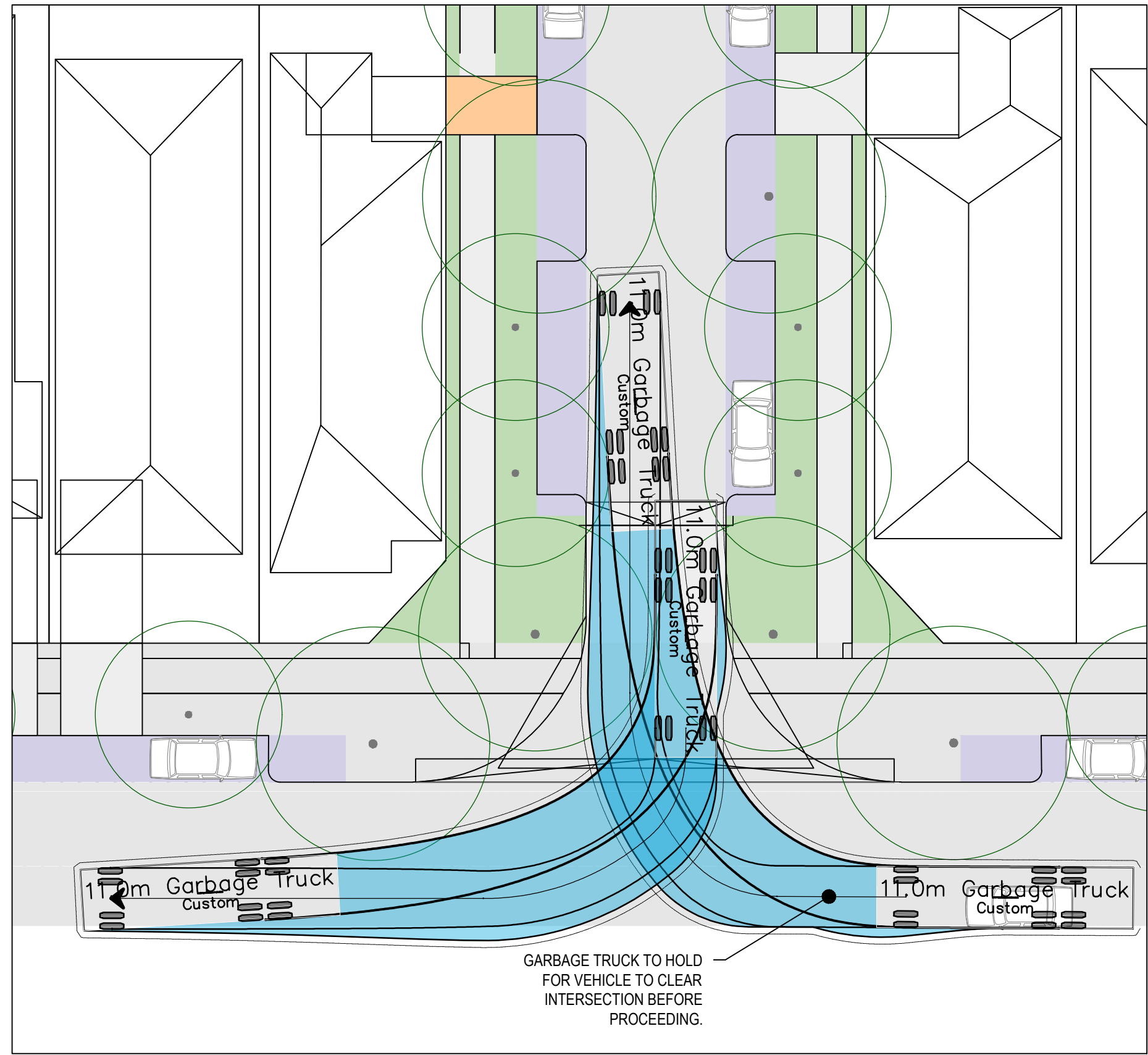
Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0005-240074-00
Size	A1	Revision	1
Datum	AHD		



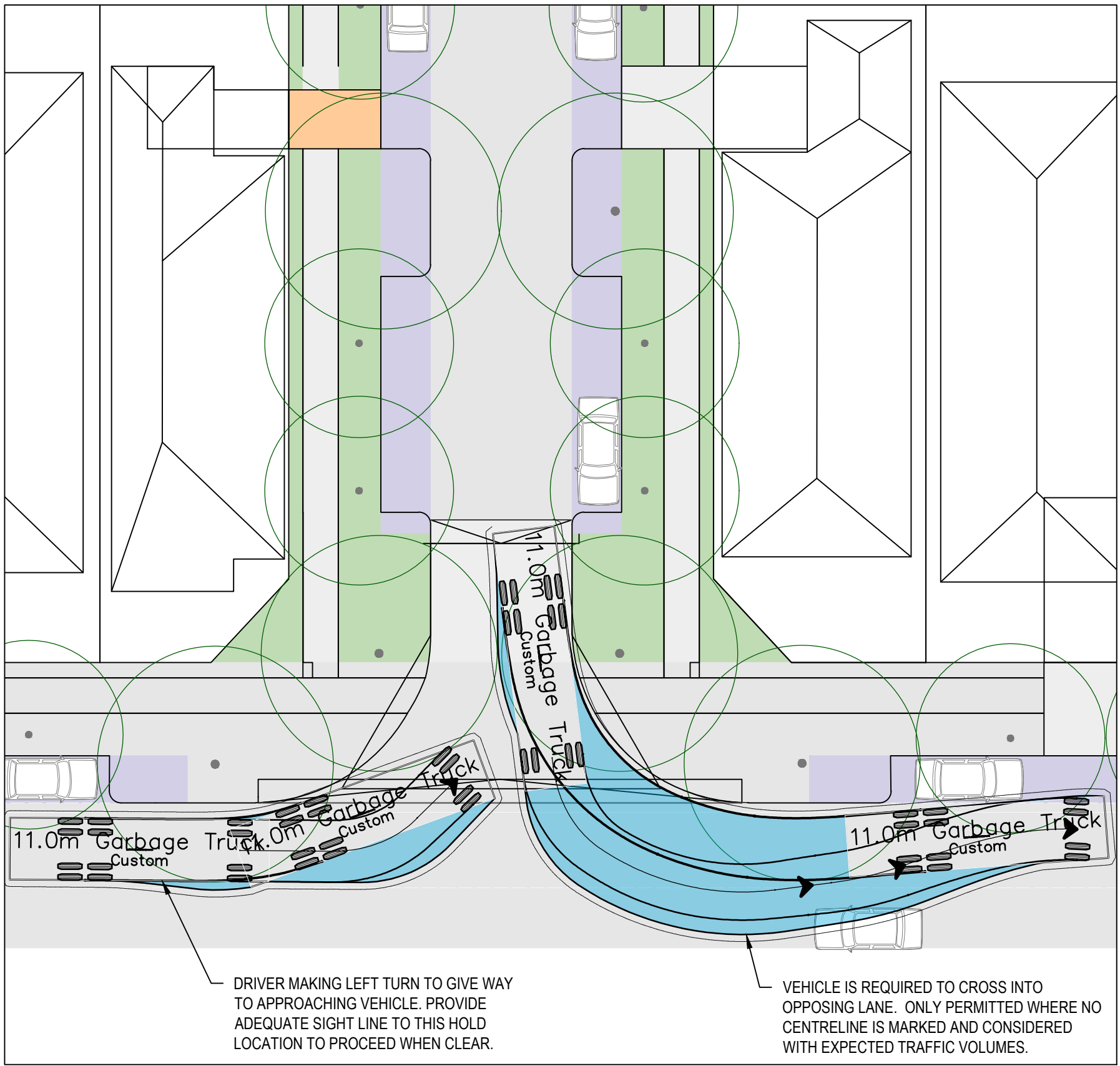
NEIGHBOURHOOD STREET - TURNING PATH 1
SCALE 1:200



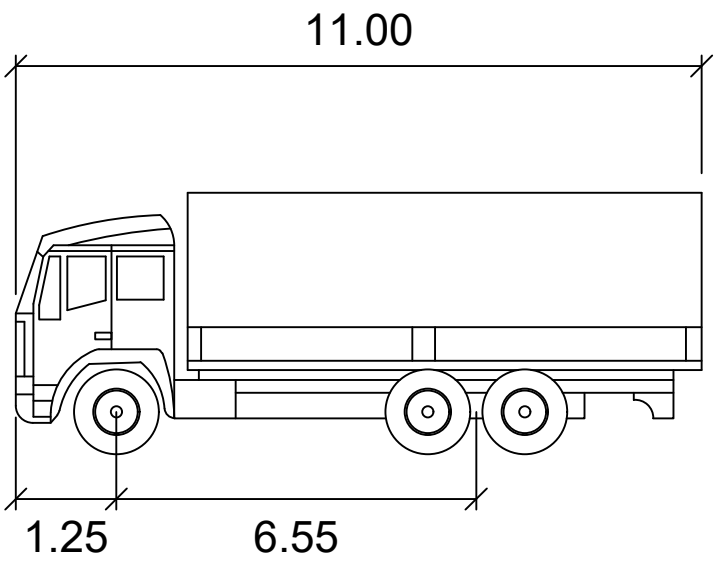
NEIGHBOURHOOD STREET - TURNING PATH 2
SCALE 1:200



NEIGHBOURHOOD STREET - TURNING PATH 3
SCALE 1:200

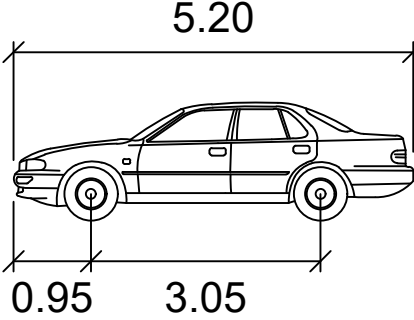


NEIGHBOURHOOD STREET - TURNING PATH 4
SCALE 1:200

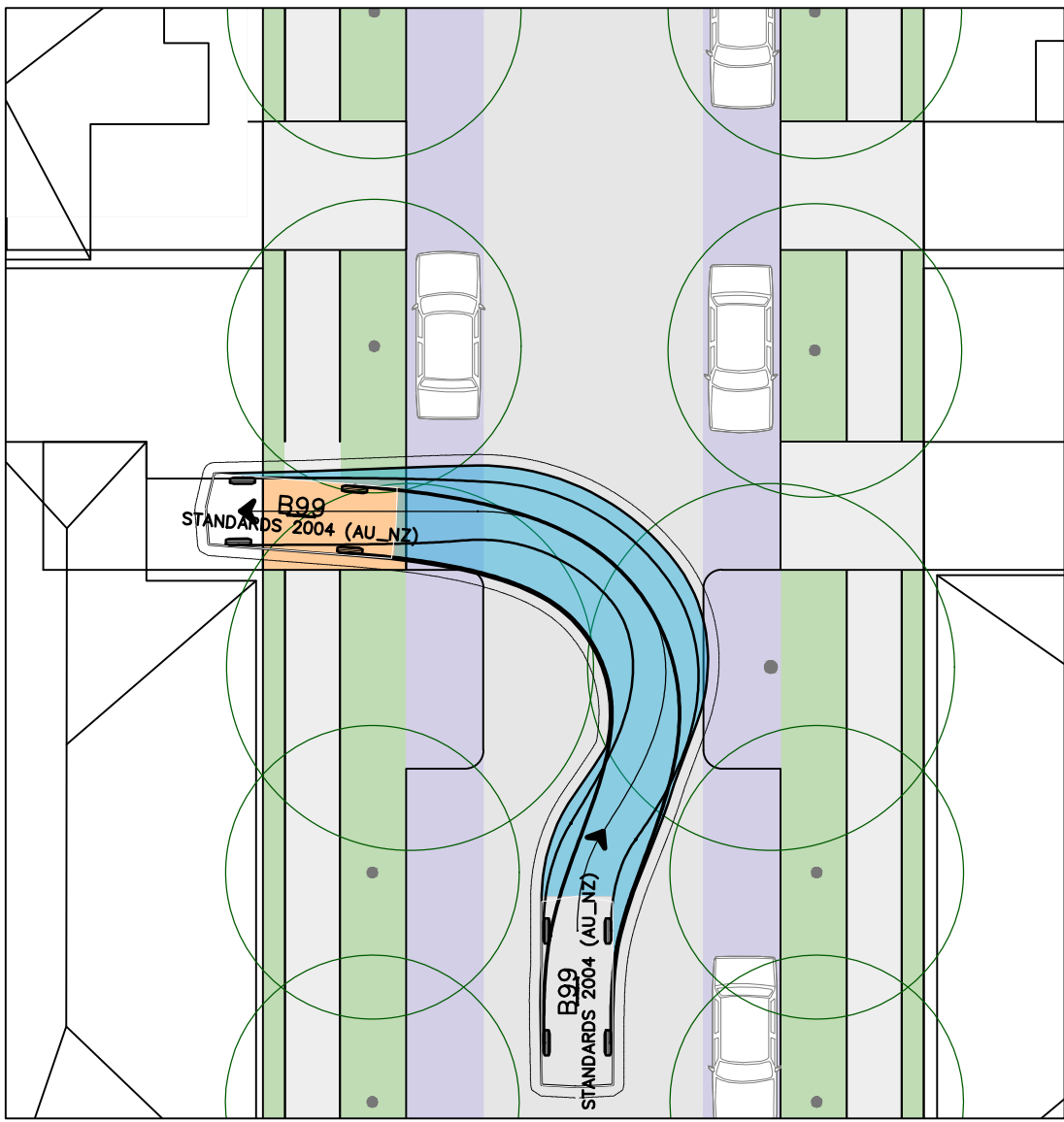


11.0m Garbage Truck

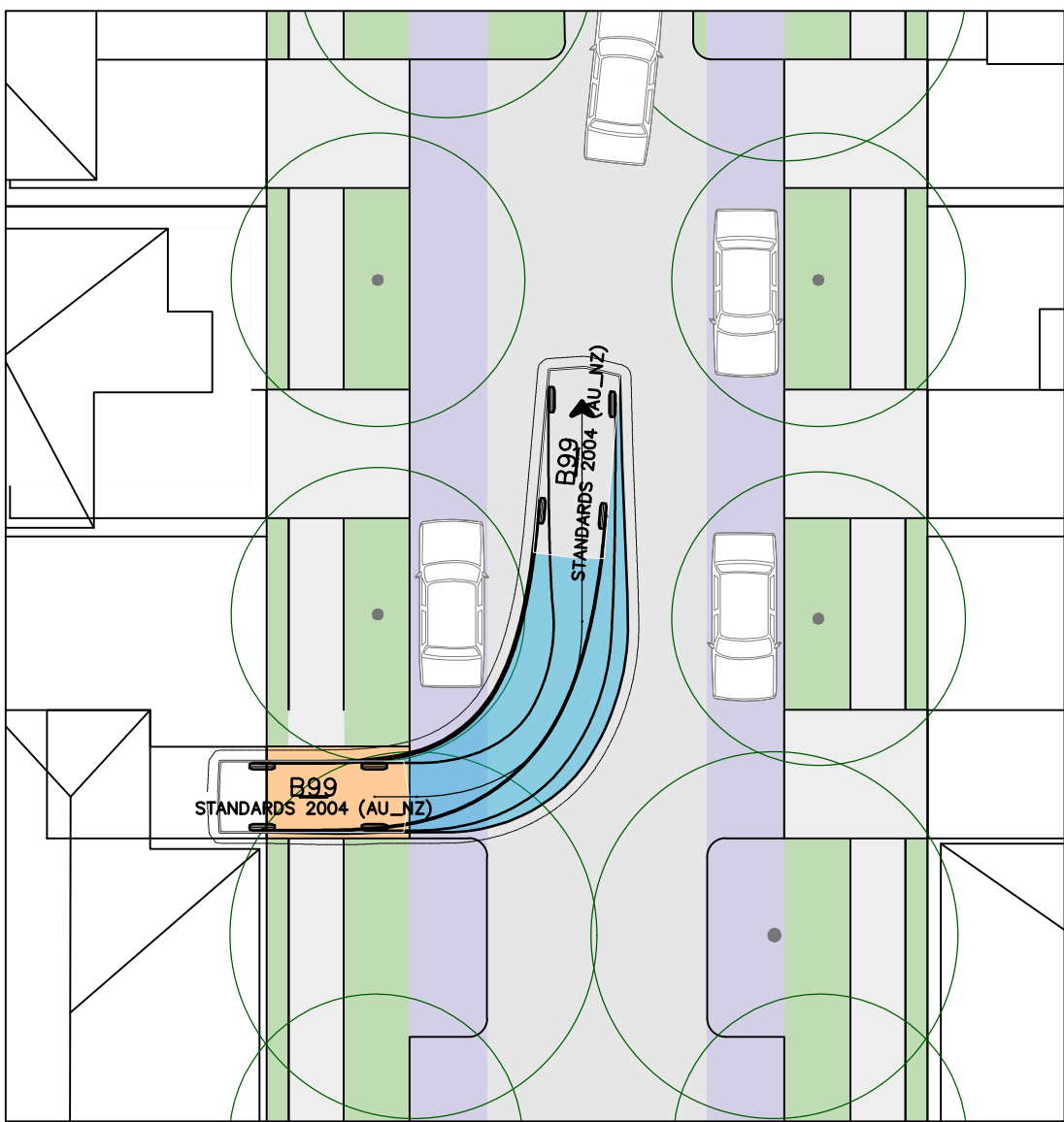
	meters
Width	: 2.62
Track	: 2.62
Lock to Lock Time	: 6.0
Steering Angle	: 37.4



B99	meters
Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9



NEIGHBOURHOOD STREET - TURNING PATH 5
SCALE 1:200



NEIGHBOURHOOD STREET - TURNING PATH 6
SCALE 1:200

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH		RH	RH
1	24/10/2024	ISSUED FOR INFORMATION	JSH		RH	RH

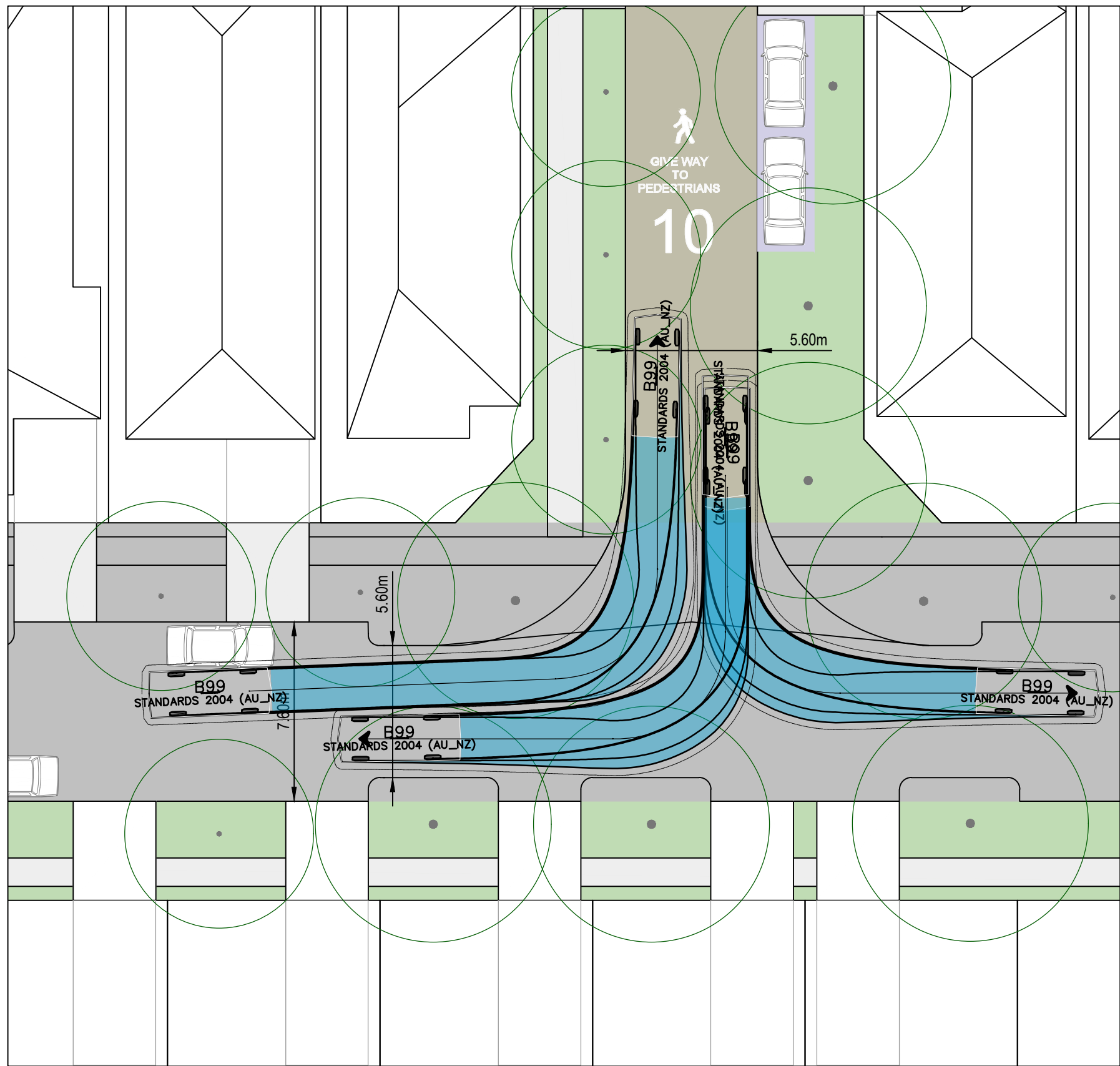
Client	ASPECT STUDIOS
--------	----------------

Scale	0 5 10 15 20m SCALE 1:200 @A1
North	
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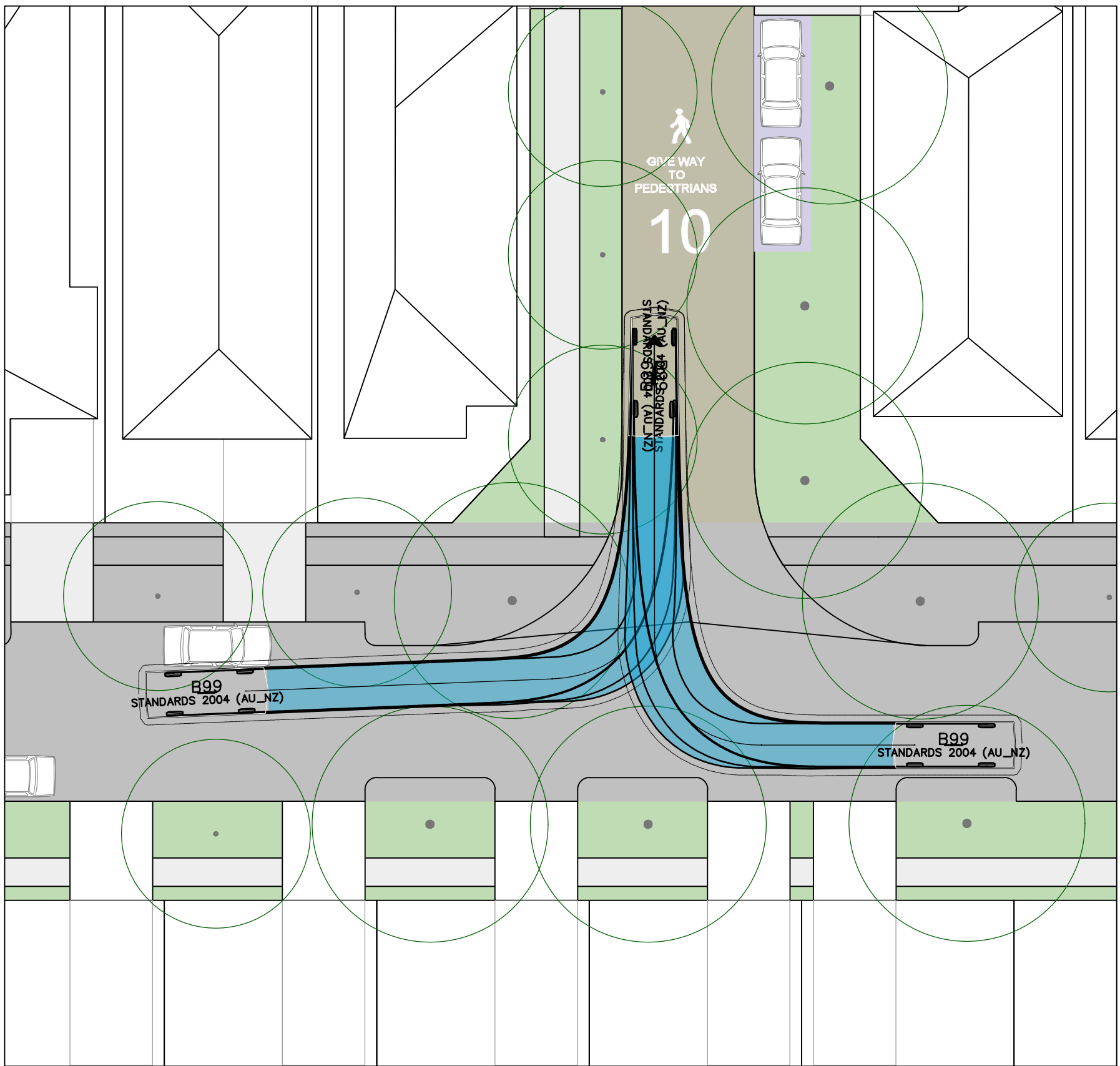
Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS NEIGHBOURHOOD STREET SHEET 06

Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0006-240074-00
Size	A1	Revision	1
Datum	AHD		



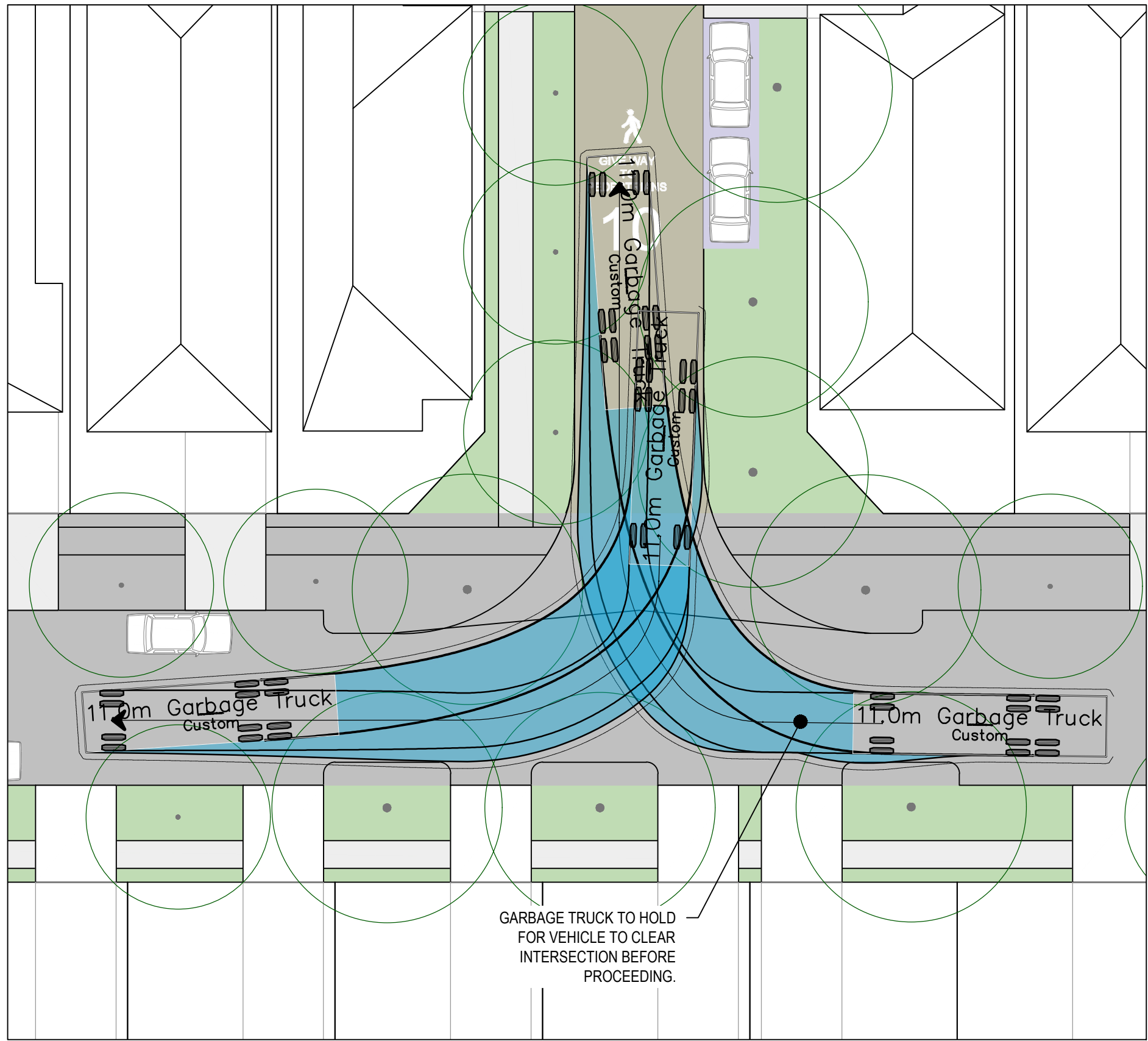
RESIDENTIAL WAY - TURNING PATH 1

SCALE 1:200



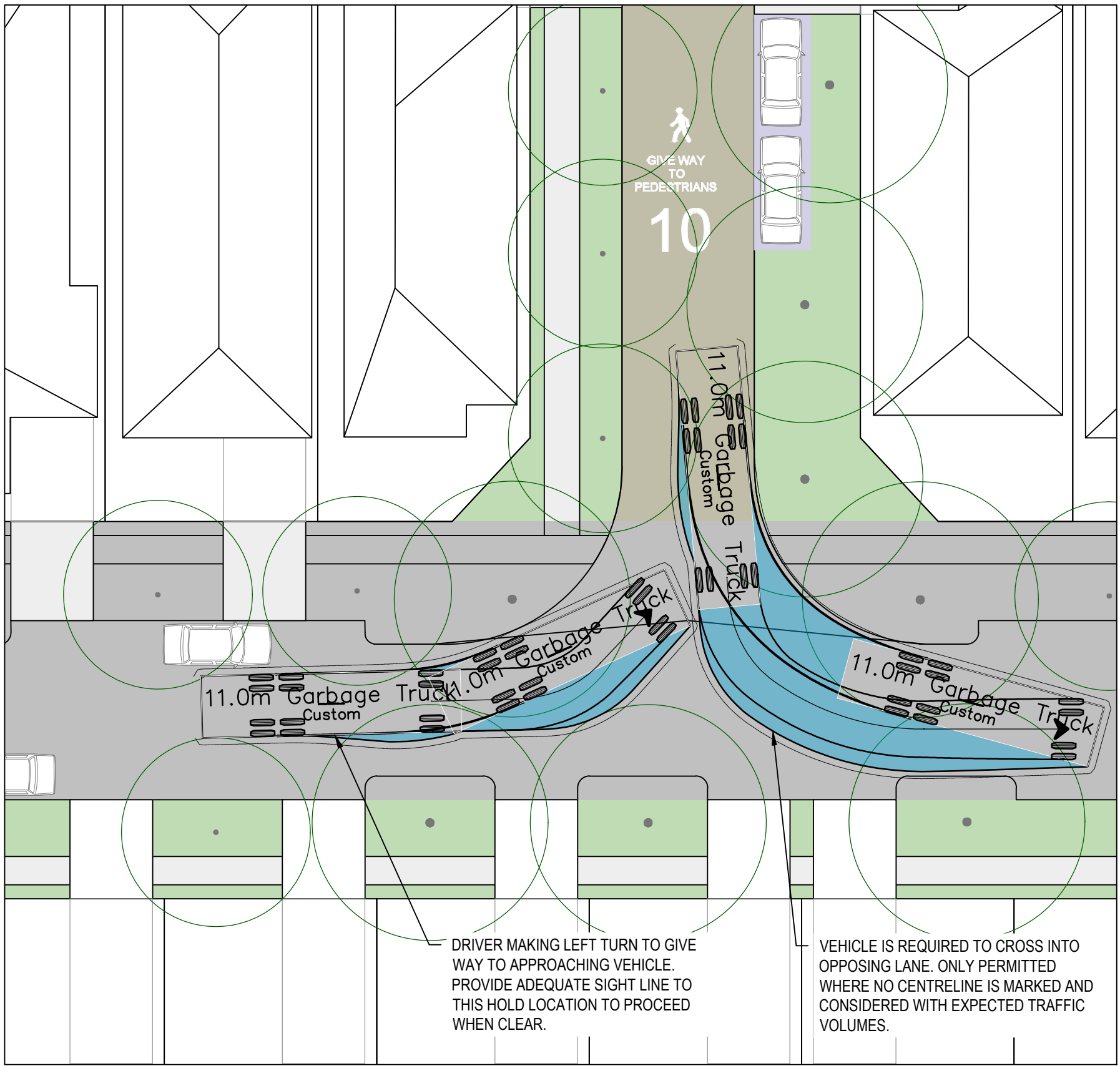
RESIDENTIAL WAY - TURNING PATH 2

SCALE 1:200



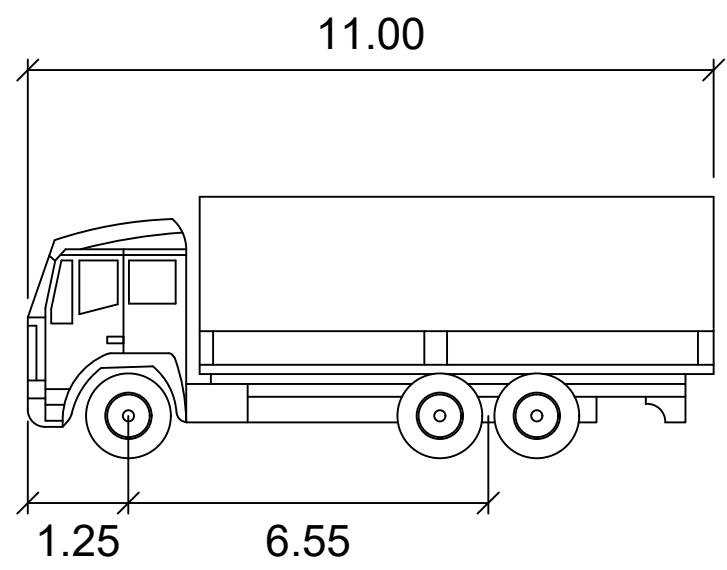
RESIDENTIAL WAY - TURNING PATH 3

SCALE 1:200



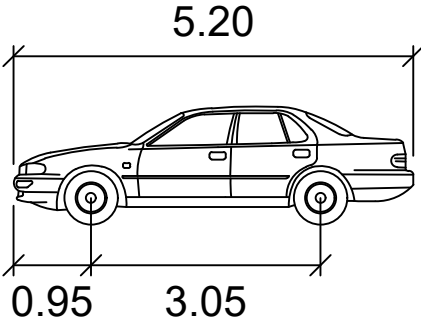
RESIDENTIAL WAY - TURNING PATH 4

SCALE 1:200



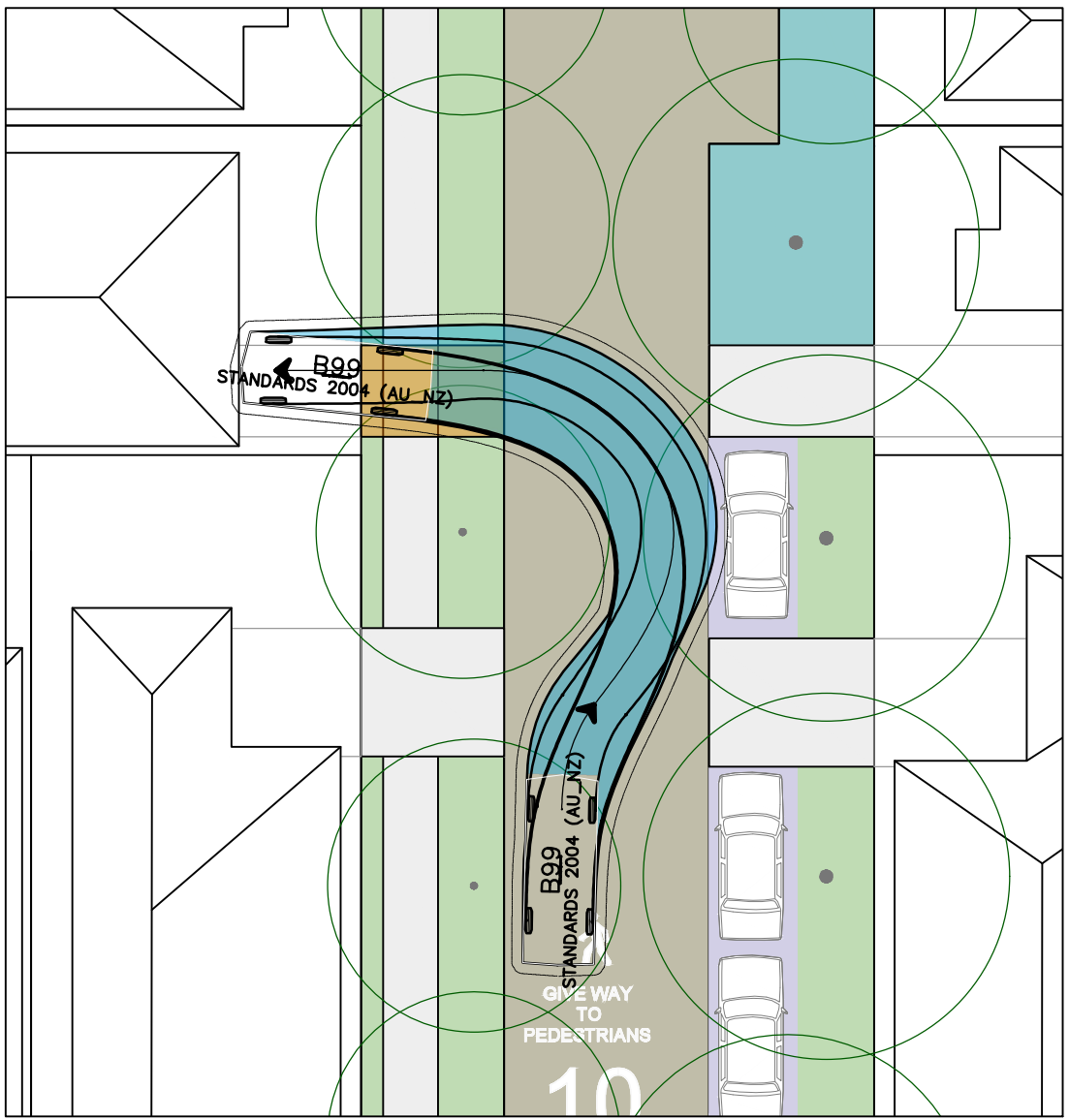
11.0m Garbage Truck

Width	: 2.62
Track	: 2.62
Lock to Lock Time	: 6.0
Steering Angle	: 37.4



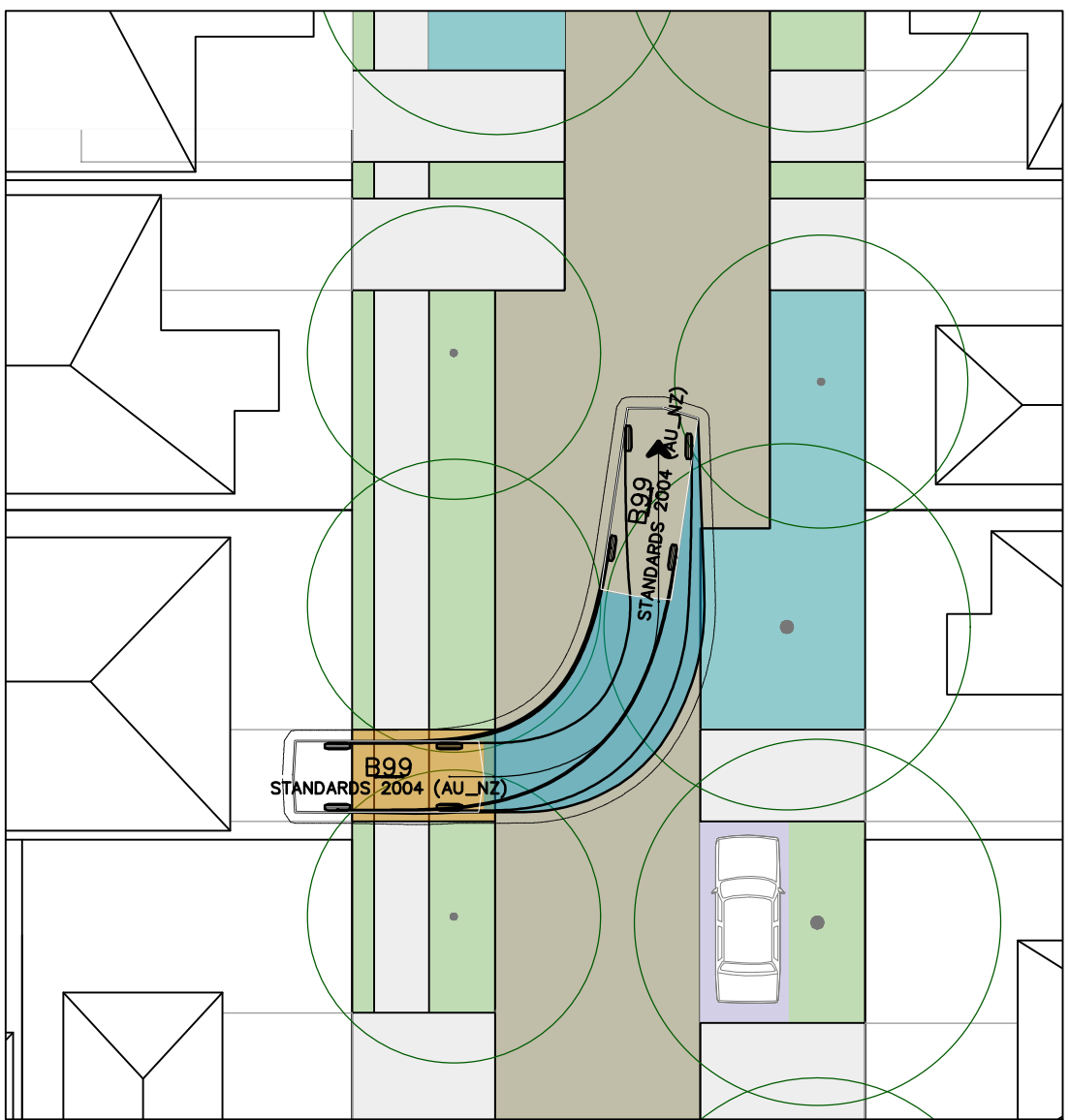
B99

Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9



RESIDENTIAL WAY - TURNING PATH 5

SCALE 1:200



RESIDENTIAL WAY - TURNING PATH 6

SCALE 1:200

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH		RH	RH
1	24/10/2024	ISSUED FOR INFORMATION	JSH		RH	RH

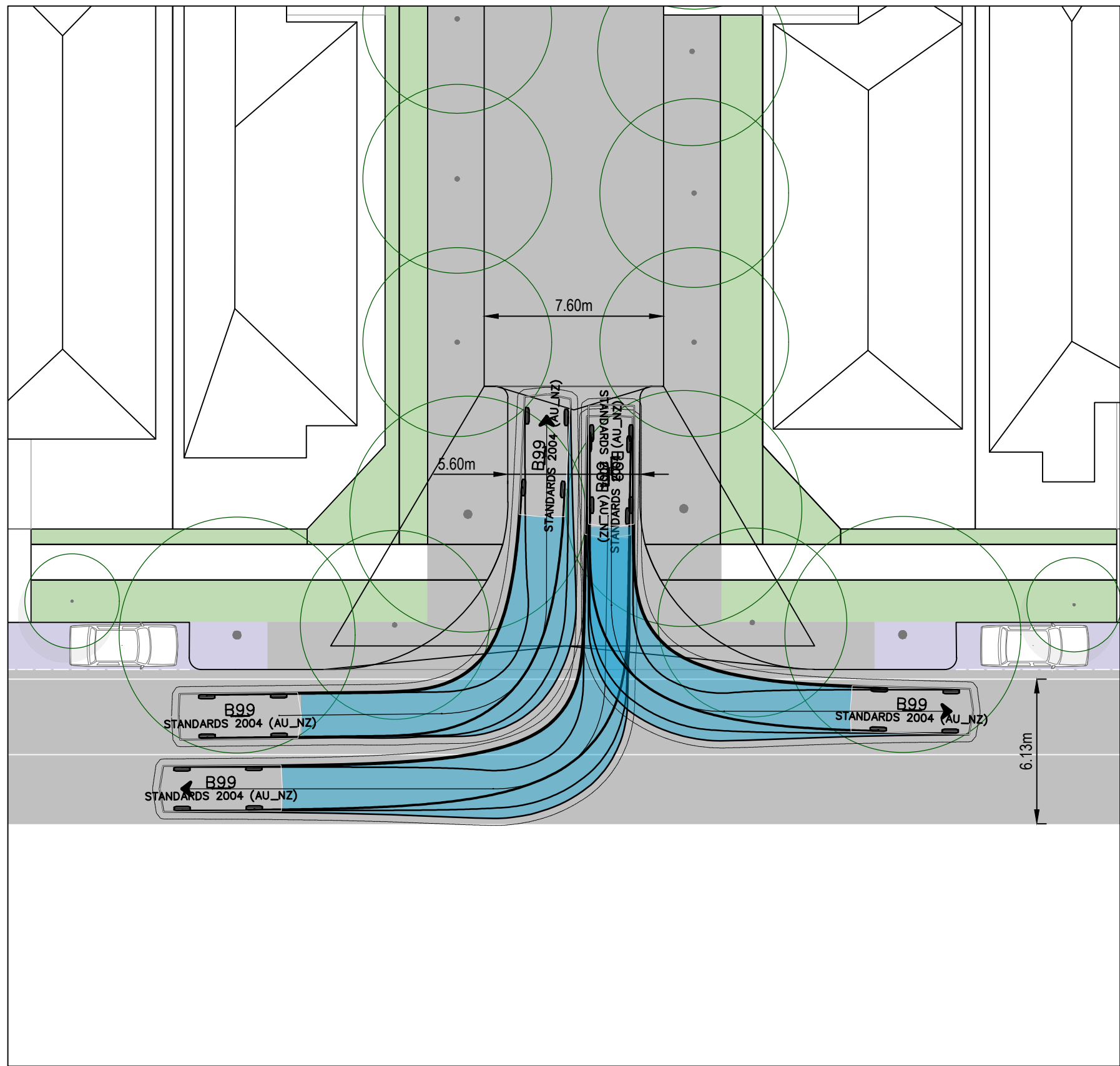
Client	ASPECT STUDIOS
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Scale	0 5 10 15 20m SCALE 1:200 @A1
North	
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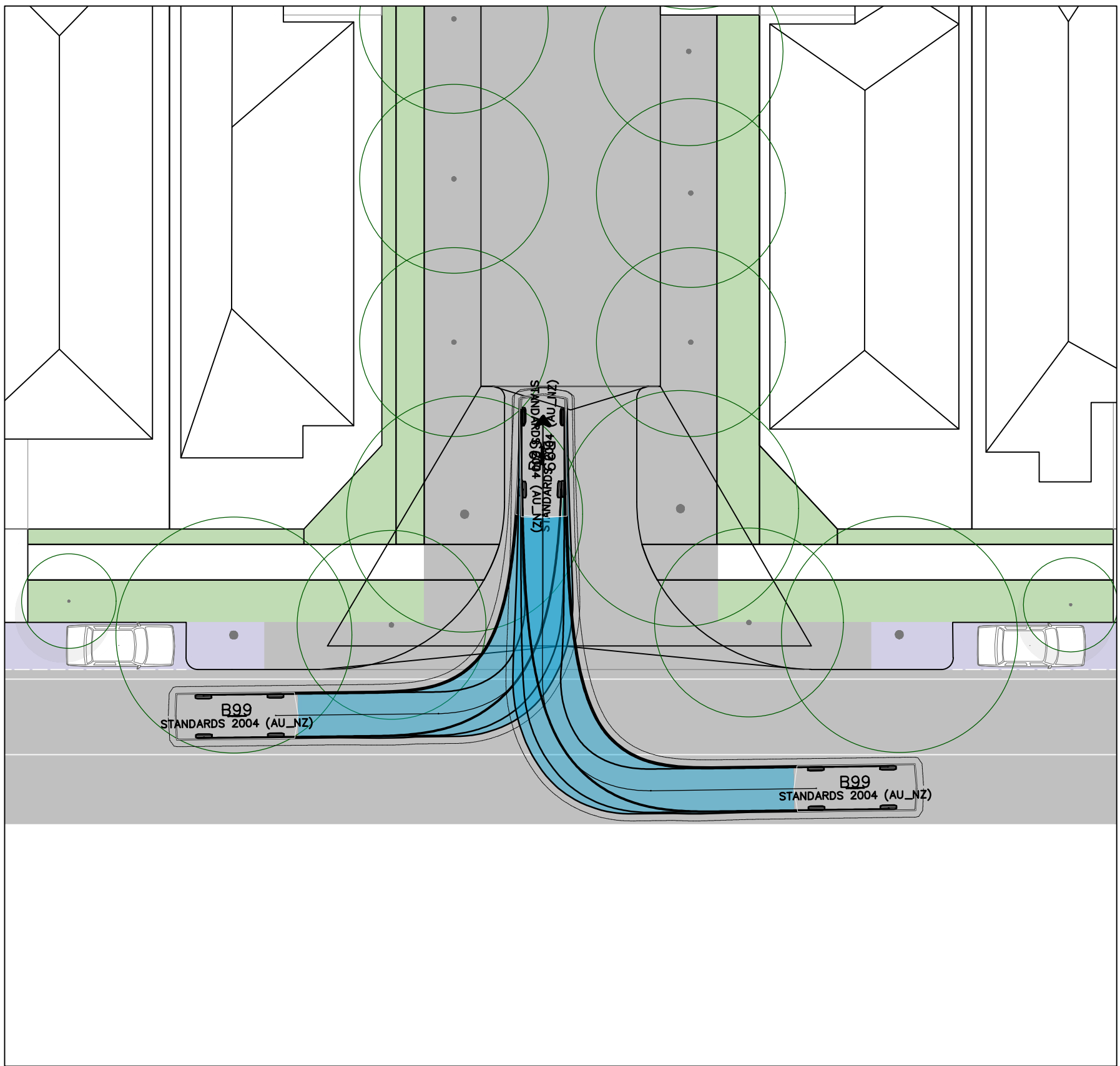
Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS RESIDENTIAL WAY SHEET 07

Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0007-240074-00
Size	A1	Revision	1
Datum	AHD		



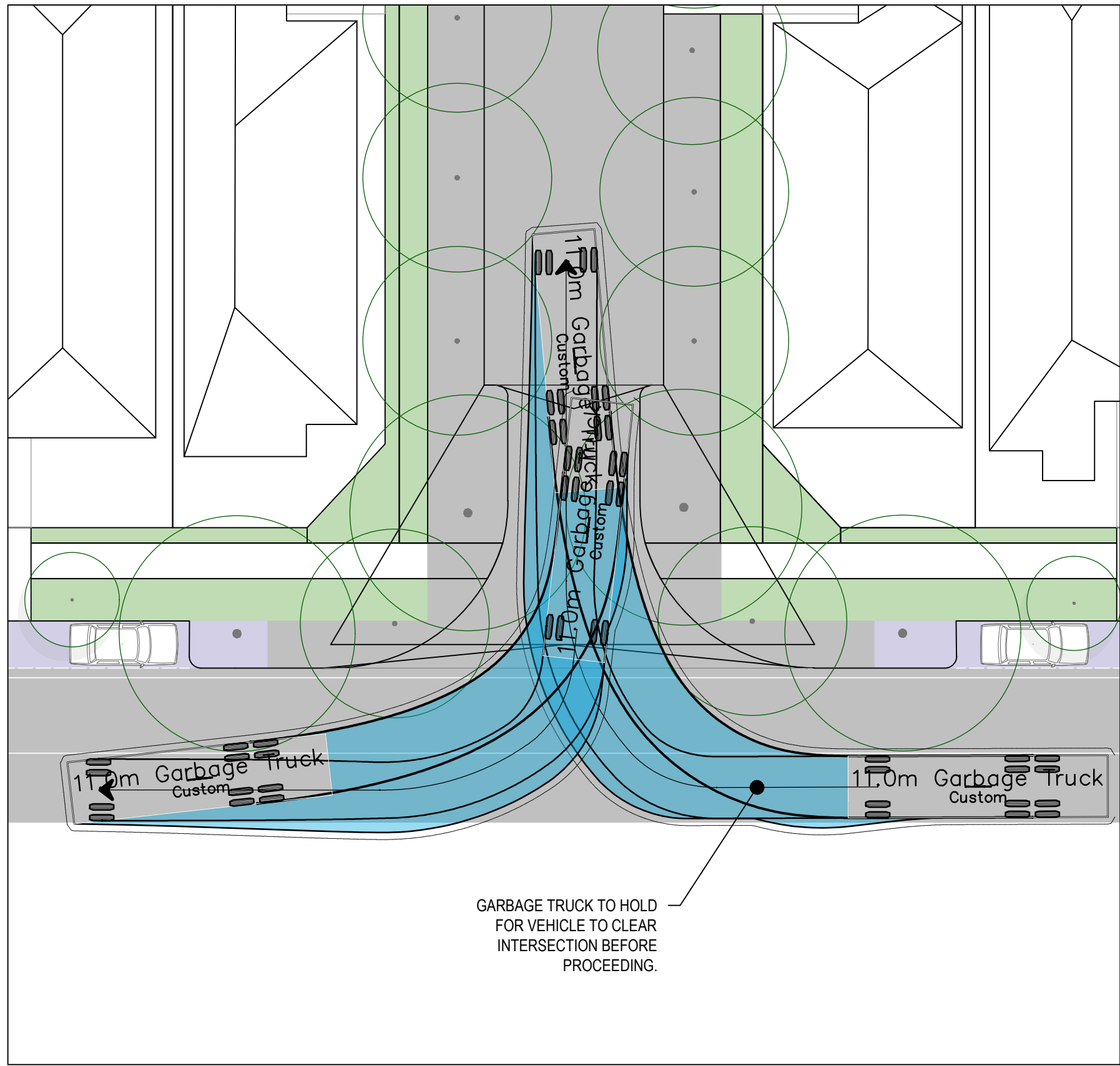
YIELD STREET - TURNING PATH 1

SCALE 1:200



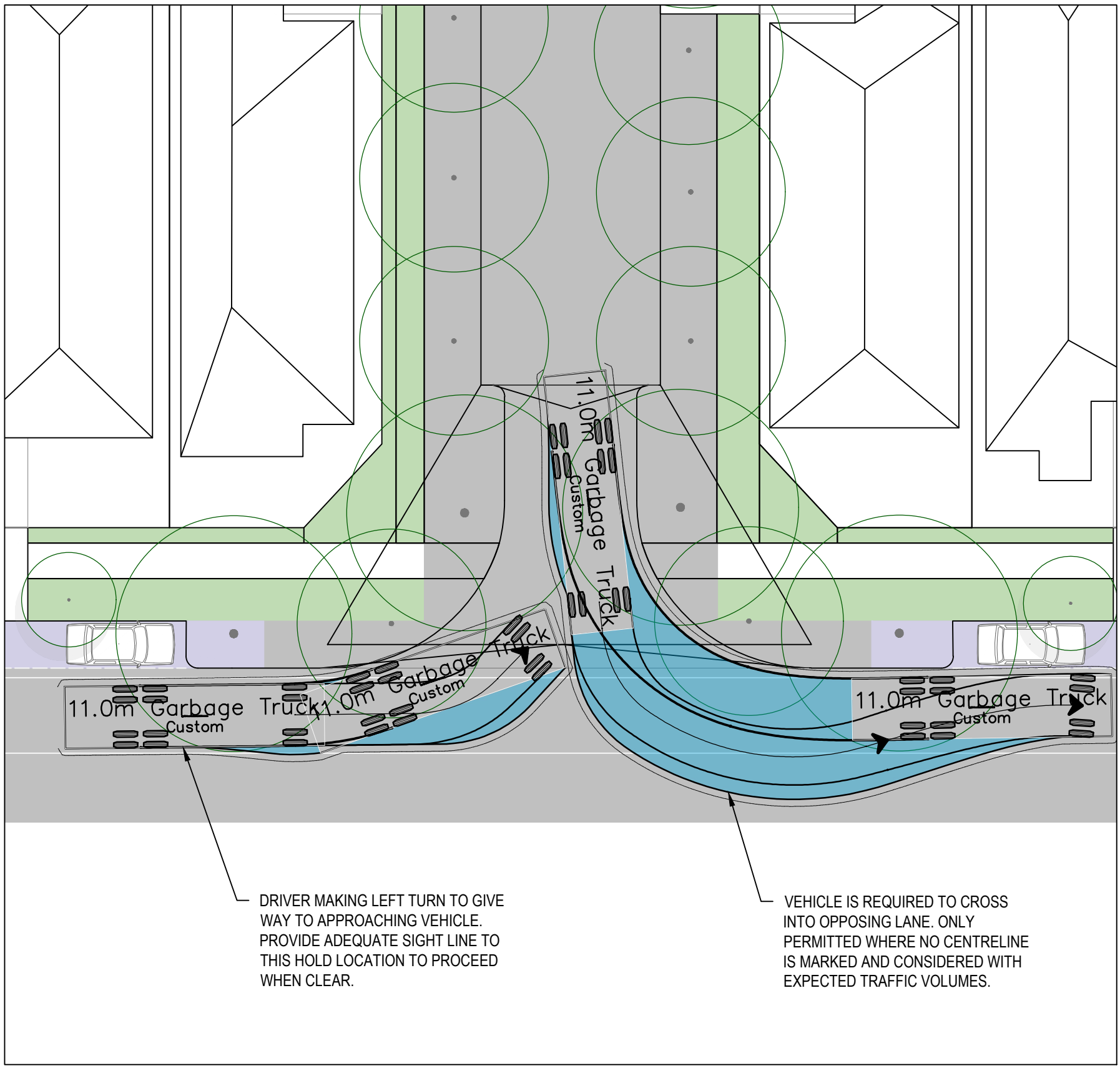
YIELD STREET - TURNING PATH 2

SCALE 1:200



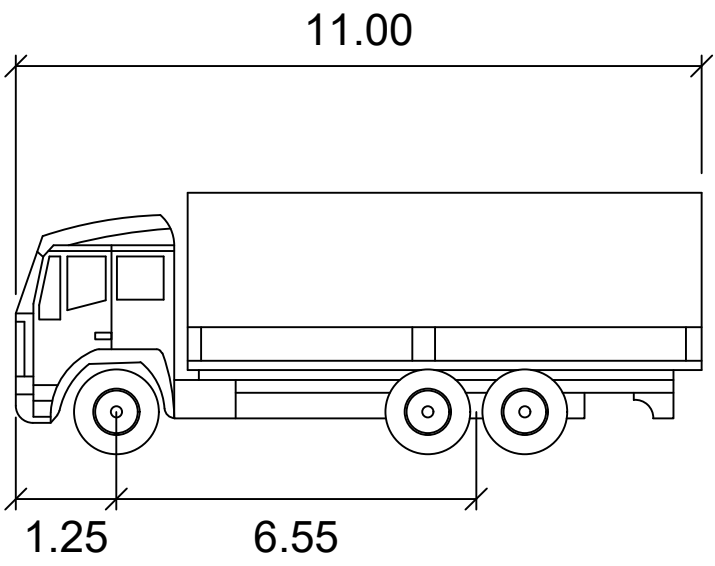
YIELD STREET - TURNING PATH 3

SCALE 1:200



YIELD STREET - TURNING PATH 4

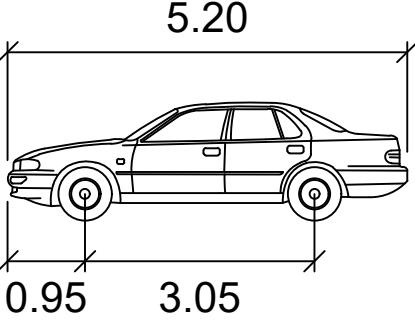
SCALE 1:200



11.0m Garbage Truck

Width : 2.62
Track : 2.62
Lock to Lock Time : 6.0
Steering Angle : 37.4

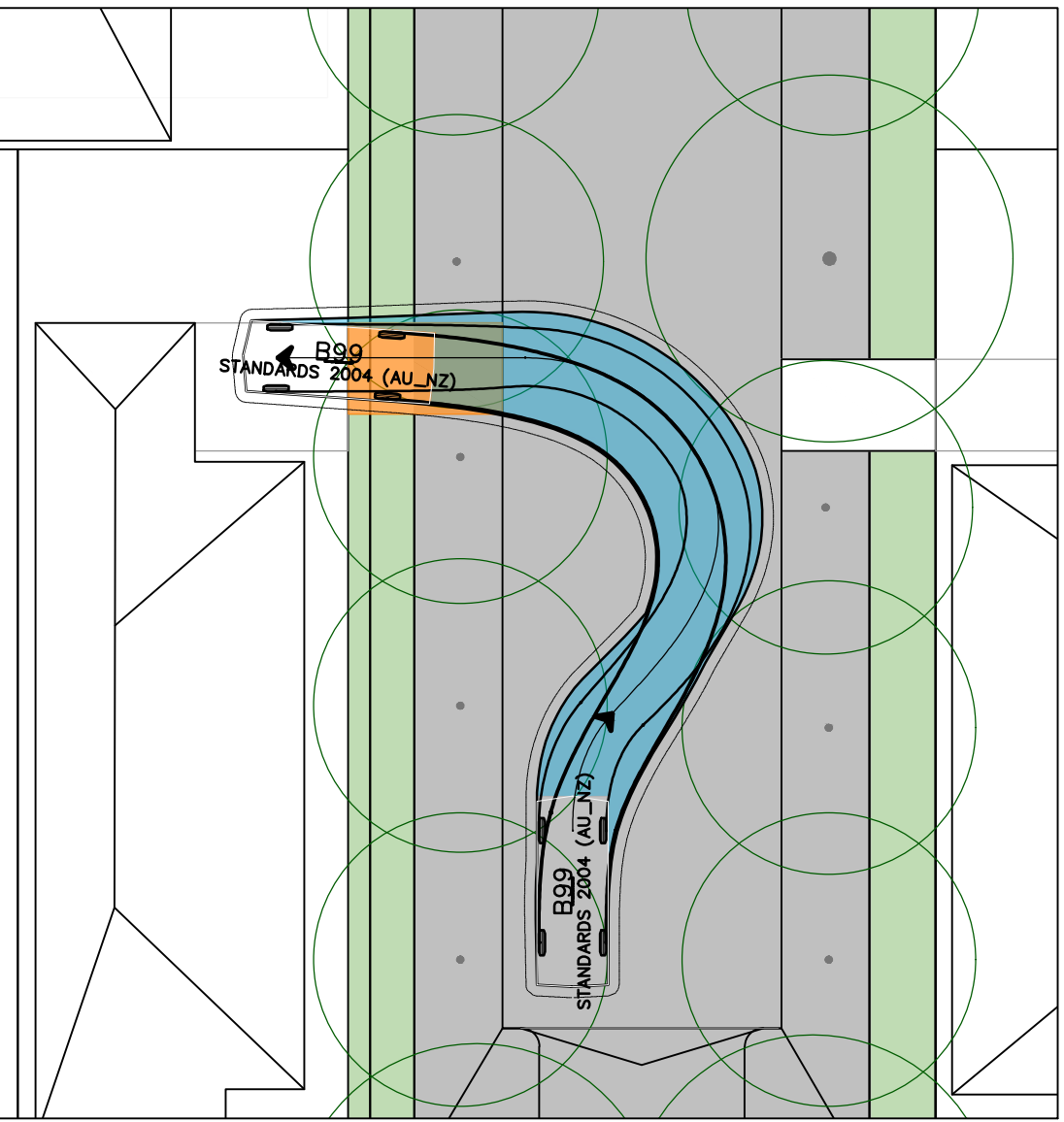
meters



B99

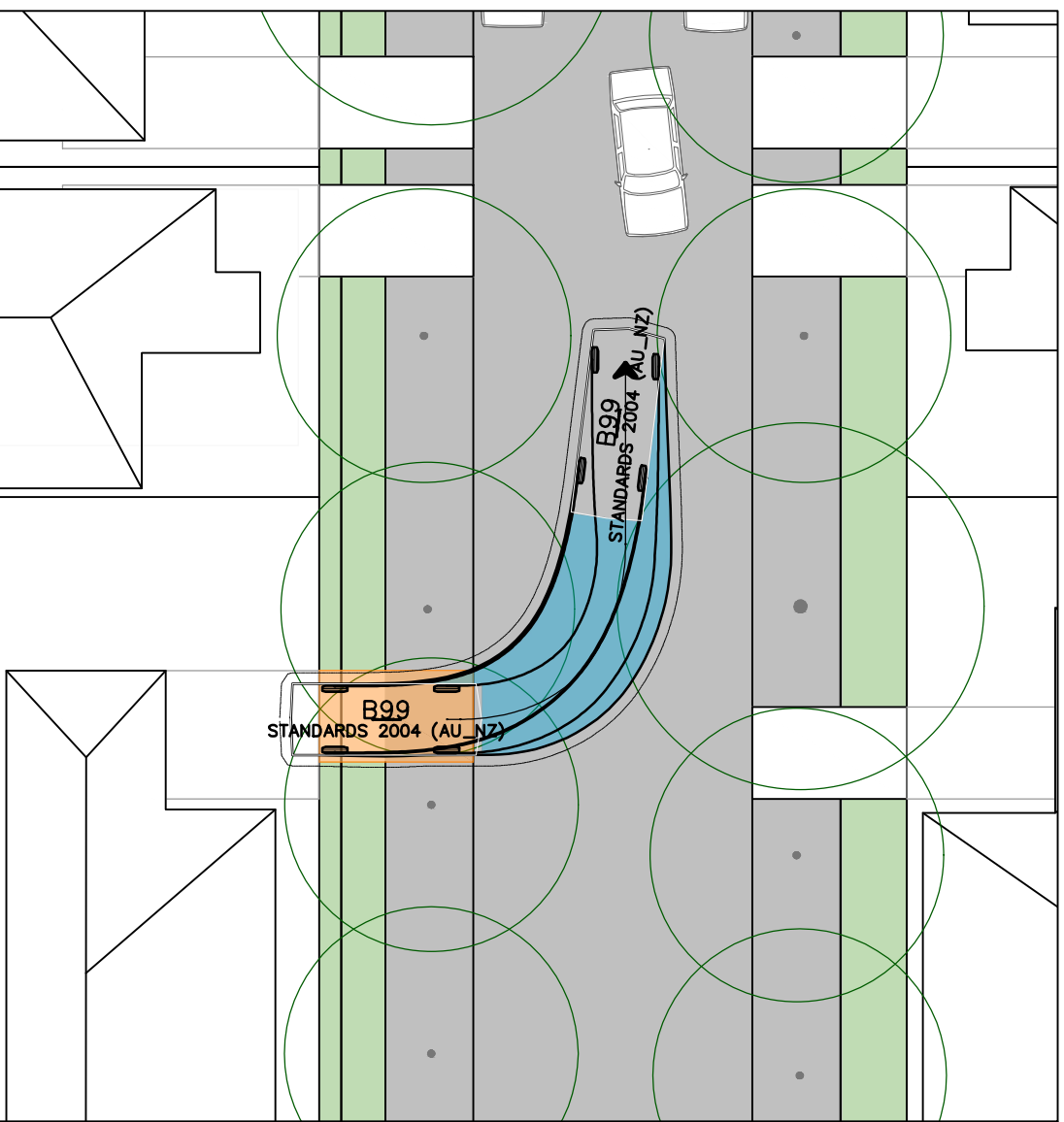
Width : 1.94
Track : 1.84
Lock to Lock Time : 6.0
Steering Angle : 33.9

meters



YIELD STREET - TURNING PATH 5

SCALE 1:200



YIELD STREET - TURNING PATH 6

SCALE 1:200

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	13/01/2025	ISSUED FOR INFORMATION	JSH	RH	RH	
1	24/10/2024	ISSUED FOR INFORMATION	JSH	RH	RH	

Client	ASPECT STUDIOS
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Scale	0 5 10 15 20m SCALE 1:200 @A1
North	

enspire
Enspire Solutions Pty Ltd Level 4, 153 Walker Street, North Sydney NSW 2060 ABN: 71 624 801 690 Phone: 02 9922 6135 enspiresolutions.com.au

Project	WESTERN SYDNEY STREET DESIGN GUIDELINES CIVIL ENGINEERING ADVICE
Title	TURNING PATHS YIELD STREET SHEET 08

Scale	1:200	Status	FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
First Issue Date	24/10/2024	Project Number/Drawing Number	SK0008-240074-00
Size	A1	Revision	1
Datum	AHD		

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