



PART B

ENVIRONMENTAL IMPACT ASSESSMENT

11.0 Project-wide issues

This chapter includes an assessment of environmental issues resulting from the construction and the operation of the Project, where these issues are not precinct-specific and/or are applicable to the Project as a whole. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 11.1)
- Biodiversity (Section 11.2)
- Historic heritage (Section 11.3)
- First Nations heritage (Section 11.4)
- Hydrology, flooding, water quality, and groundwater (Section 11.5)
- Soils and contamination (Section 11.6)
- Socioeconomic impacts (Section 11.7)
- Land use and property (Section 11.8)
- Air quality (Section 11.9)
- Climate change risk (Section 11.10)
- Greenhouse gas generation (Section 11.11)
- Materials, waste, and resources (Section 11.12)
- Hazards and risk (Section 11.13).

Precinct and site-specific matters, such as noise and vibration, and landscape character and visual amenity, are discussed in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site). Some of the environmental issues assessed in this chapter are also assessed further at a precinct-specific level in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

Details of the Project design and operations, and indicative construction approach and methodology, are provided in Chapter 5 (Project description) and Chapter 6 (Construction) respectively.

Key impacts from the construction and operation at a Project-wide level are summarised below and assessed in further detail throughout this Project-wide assessment chapter.

Environmental impact overview – construction

Traffic and transport

Construction of the Project would cause temporary disruptions to the existing road network due to increased construction traffic, altered site access, changes to parking arrangements, and partial or full road closures. Key roads affected would include Commonwealth Avenue, State Circle, and Adelaide Avenue, with additional closures on King George Terrace, Macquarie Street, Bligh Street, and National Circuit under the National Triangle-Barton alignment option. These disruptions would redistribute traffic across surrounding routes, leading to decreased volumes on major roads near construction sites and increased volumes on parallel and arterial roads such as King Edward Terrace, Flynn Drive, Tuggeranong Parkway, and Monaro Highway. Travel times during peak hours could increase by over five minutes for motorists and bus routes, particularly along State Circle.

A travel demand management strategy (TDMS) would be implemented to reduce peak-hour traffic by five to ten percent, encouraging alternative travel modes and off-peak travel. Additionally, staged construction would limit the simultaneous unavailability of up to 1,183 off-street and 590 on-street parking spaces across precincts.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other conservation values in the landscape by minimising the extent of vegetation clearance and the construction footprint. This has resulted in the avoidance of impacts to listed ecological communities, and would avoid impacts to up to 75% of native vegetation within the Project area. Regardless, construction of the Project would require clearance of up to 5.72 ha of native vegetation including up to 19 hollow bearing trees of which up to 6 are suitable Gang-gang Cockatoo breeding habitat.

The Project would also impact up to 9.88 ha of potential Golden Sun Moth (*Synemon plana*) habitat and up to 5.64 ha of foraging habitat for the Superb Parrot (*Polytelis swainsonii*), Gang-gang Cockatoo (*Callocephalon fimbriatum*) and Diamond Firetail (*Stagonopleura guttata*) generally within the

Parliament House precinct (along State Circle) and the Yarra Glen precinct (along Adelaide Avenue and Yarra Glen).

A Biodiversity Offset Strategy has been developed for the Project, and would be updated to reflect further avoidance or minimisation of biodiversity impacts achieved through ongoing design development. The Strategy focuses on sustainable habitat offsets for the Golden Sun Moth, Superb Parrot and Gang-gang Cockatoo.

Historic heritage

The Project aims to preserve Canberra's heritage character by minimising deviations from planned geometries, reducing tree removal, adopting wire-free track sections, use of green track along sections of the alignment, appropriate landscaping and aligning with the Designing with Country framework. Notwithstanding, construction of the Project would impact historic heritage places and values, including listed heritage places, landscape-level heritage associated with Canberra's planned geometry, natural heritage, and potential archaeology.

Construction work would result in the following significant impacts to heritage cultural landscapes, relevant to the Project-wide context:

- Parliament House Vista (listed on the Commonwealth Heritage list): Up to significant impacts from the National Triangle-Barton alignment option due to the loss of a historic road section and tree removal, with replacements planned. Both alignment options would involve temporary construction compounds and activity which would indirectly impact the vista
- Canberra: The Planned National Capital (not formally listed): Impacts associated with tree removal, temporary construction compounds and activity which would temporarily modify the experience of Canberra as a city
- Roads on national land – Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle (not formally listed): Tree removal, road widening, and kerb realignment along Commonwealth Avenue leading to reduction of the historical geometry of the National Triangle
- Parliament House and surrounds (not formally listed): Impacts associated with large-scale construction works, involving the removal of trees from the inner verge of State Circle (with plans for revegetation); and minor visual impacts from temporary construction compounds and equipment.

Other heritage sites near the Project could be affected by indirect impacts from landscape changes and construction-related vibration. These more localised impacts to heritage places discussed separately in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site). Mitigation strategies would include careful design integration, vibration management through monitoring and testing, and landscaping and site rehabilitation post-construction.

Socioeconomic

Socioeconomic impacts during construction of the Project would include disruptions to local amenity, road users, businesses, and cultural events, alongside potential impacts on health, wellbeing, and heritage. Construction activities could strain labour resources, affect parking availability, and disrupt waterway users near Commonwealth Avenue. Economic impacts on adjacent businesses are also anticipated. To address these challenges, an overarching Community Engagement and Social Management Plan would be implemented, incorporating strategies for community engagement, business and labour support, and water user management.

Other impacts

Other potential construction environmental impacts identified in this Project-wide assessment chapter include:

- Hydrology, flooding, water quality and groundwater: Potential construction related impacts could include stormwater pollution from runoff, sedimentation from lakebed disturbances, and contamination from fuel or chemical spills. Deep excavations and dewatering activities may also temporarily affect groundwater. Additionally, construction in flood-prone areas could disrupt hydrological conditions, alter drainage pathways, and increase flood risks

- **Soils and contamination:** Excavations would generate excess fill material, and would be managed and classified per regulatory standards, with reuse prioritised. In the Commonwealth Avenue precinct, there is a high likelihood of encountering acid sulfate soils, posing risks of sulfuric acid release and heavy metal mobilisation. Additionally, construction could cause soil and water contamination from chemical spills, disturbed contaminated soil, or sedimentation during lakebed works
- **Land use and property:** The majority of the Project would be carried out within existing road reserves. While there would be minor encroachments into some privately-leased properties, the Project would not involve residential or private property acquisition that would physically displace individuals or communities. The Project would temporarily restrict public access to construction areas, including some recreational spaces like Magna Carta Place and Woden Town Park, which would be restored post-construction
- **Climate change risk:** The Project may be affected by climate change risks from flooding, extreme heat, bushfires and storms which could result in delays or increased construction costs. These hazards could impact worker safety, damage materials, and disrupt construction
- **Greenhouse gas generation:** Construction would generate greenhouse gas emissions, with estimates of up to 102,900 tonnes CO₂-equivalent. These emissions would mainly result from fuel consumption, vegetation clearing, and the embodied energy of construction materials (Scope 1 and Scope 3). No Scope 2 emissions are expected due to the ACT's renewable electricity grid. Efforts to reduce emissions would focus on minimising fuel use and selecting sustainable materials.

During construction, the Project is also expected to have minor impacts relating to First Nations heritage, materials, waste and resources, and hazards and risk.

Environmental management and mitigation measures proposed to address the specific impacts of the Project are detailed in Chapter 21 (Environmental management and mitigation measures).

A Construction Environmental Management Plan (CEMP) (or plans) would provide a framework for construction environmental management, and would include several sub plans and mitigation measures. An Environmental Management Plan outline (addressing both construction and operational aspects) has been developed for the Project to guide the development of the CEMP and sub plans, and is included as Appendix L (Environmental Management Plan outline).

Environmental impact overview - operation

Traffic and transport

The Project would enhance transport capacity, accommodating an additional 2,400 people per hour in each direction while improving pedestrian and cycling connectivity by providing new bridges, shared paths, and bike parking.

The Project would require minor modifications to the existing road network, including lane adjustments, intersection upgrades, and some road closures, including the removal of the Yarra Glen roundabout. Traffic modelling indicates that most travel time changes would be under five minutes, though some routes, particularly in the AM peak, may experience longer delays due to background traffic growth and changes in traffic patterns. Bus services along Commonwealth Avenue, State Circle, and Adelaide Avenue may experience minor delays, particularly for the R2 and R4 services, though these are linked more to broader congestion trends than the Project.

While the Project would provide a reliable alternative to driving, reducing reliance on congested roads, it is just one component of a larger integrated transport strategy. Long-term, additional investments in public transport, road network improvements, and policies that promote active and sustainable transport would also be necessary to mitigate Canberra's projected increase in congestion.

Historic heritage

Operational impacts on historic heritage would occur through changes to historic cultural landscapes, heritage vistas, and the visual setting of significant sites.

During operation, the Project is expected to moderately to significantly impact the Commonwealth Heritage listed Parliament House Vista along with other heritage values, views and vistas. The Project

would alter the visual character of these heritage values through the introduction of new light rail infrastructure, including bridge spans and station platforms. While efforts will be made to minimise visual impacts through wire-free running and integrated design, heritage views along Commonwealth Avenue, Kings Avenue, and the National Triangle may be permanently modified. The Project would also involve tree removal and replacement, which may affect the symmetry and historic landscape character of heritage precincts.

Although vibration impacts from light rail operations are not expected to cause structural damage, ongoing vibration monitoring and mitigation measures will be implemented to protect heritage buildings. Minor impacts on natural heritage may also occur, particularly in relation to historic trees and biodiversity linkages. Ongoing design development would seek to identify opportunities to reduce impacts to heritage values.

Hydrology, flooding, water quality, and groundwater

The Project would result in increased impervious surfaces, leading to higher surface runoff and pollutant loads across several subcatchments. Modelling indicates a 5-6% increase in total suspended solids, nitrogen, and phosphorus for the State Circle East alignment, and 3-5% for the National Triangle-Barton alignment. Water-sensitive urban design (WSUD) measures would be integrated to minimise additional pollutant discharge. Flood modelling has assessed potential impacts up to a 1% AEP (major flood event) and a climate change scenario (+20% rainfall), with generally small increases in flood depths at a few locations, typically within a few centimetres. Only one private property is expected to experience a negligible increase in flood levels. In some areas, flood levels are expected to decrease due to improved drainage provided by the Project. Ongoing design refinements and updated flood assessments would help manage and minimise adverse flood risks, and help maintain Canberra's existing hydrological balance.

Other impacts

Other operational environmental impacts identified in this Project-wide assessment chapter include:

- **Hazards and risk:** The Project would incorporate comprehensive safety and risk management measures to ensure public and environmental safety. Key potential risks would include collisions with pedestrians, cyclists, and vehicles. These risks would be minimised through physical separation of tracks, signage, lighting, and public education programs. Risks from overhead electric wires would be extremely low and managed through strict safety protocols. A small portion of the Project would traverse bushfire-prone areas, but the risk of a bushfire event is low, and emergency response plans would be in place to mitigate potential threats. Extreme weather events and infrastructure malfunctions pose operational risks but would be managed through climate adaptation strategies and regular safety reviews. Crime Prevention through Environmental Design (CPTED) and Gender-Sensitive Urban Design (GSUD) would also enhance passenger security and accessibility at light rail stops
- **Greenhouse gas emissions:** The operational phase of the Project, compared with the construction phase, would generate low levels of greenhouse gas emissions, primarily from fuel use for maintenance and transport (Scope 1) and embodied energy in replacement materials (Scope 3). As the Project would use 100% renewable electricity from the ACT grid, it would not produce Scope 2 emissions
- **Socioeconomic:** The Project would boost economic activity, business growth, and urban revitalisation by improving transport connectivity and accessibility. Local businesses adjacent to the Project, such as retail and real estate businesses, would benefit from increased foot traffic, while employment and training opportunities would support the local economy. Urban improvements and GSUD initiatives would enhance community safety and wellbeing.

During operation, the Project is also expected to have negligible to minor impacts on biodiversity, First Nations heritage, soils and contamination, land use and property, air quality, climate change risk, and materials, waste and resources.

Environmental management and mitigation measures proposed to address the specific impacts of the Project are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental

Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

11.1 Traffic and transport

This section describes the potential impacts of the Project on traffic and transport across the Project area. Further detail on the traffic and transport assessment is provided in Technical Report 1 – Traffic and transport.

More localised impacts are discussed separately in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport.

11.1.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: population and employment, transport mode share, road network, active and public transport networks, and micromobility.

Study area

The study area for this assessment is based on the Project area, with an additional buffer to incorporate the surrounding road network (referred to as the Project study area). The Project study area is shown on Figure 11-1.

Any reference to individual precincts throughout Section 11.1 refers to the corresponding precinct study areas shown on Figure 11-1. The Mitchell Depot site has also been assessed, separate to the precincts.

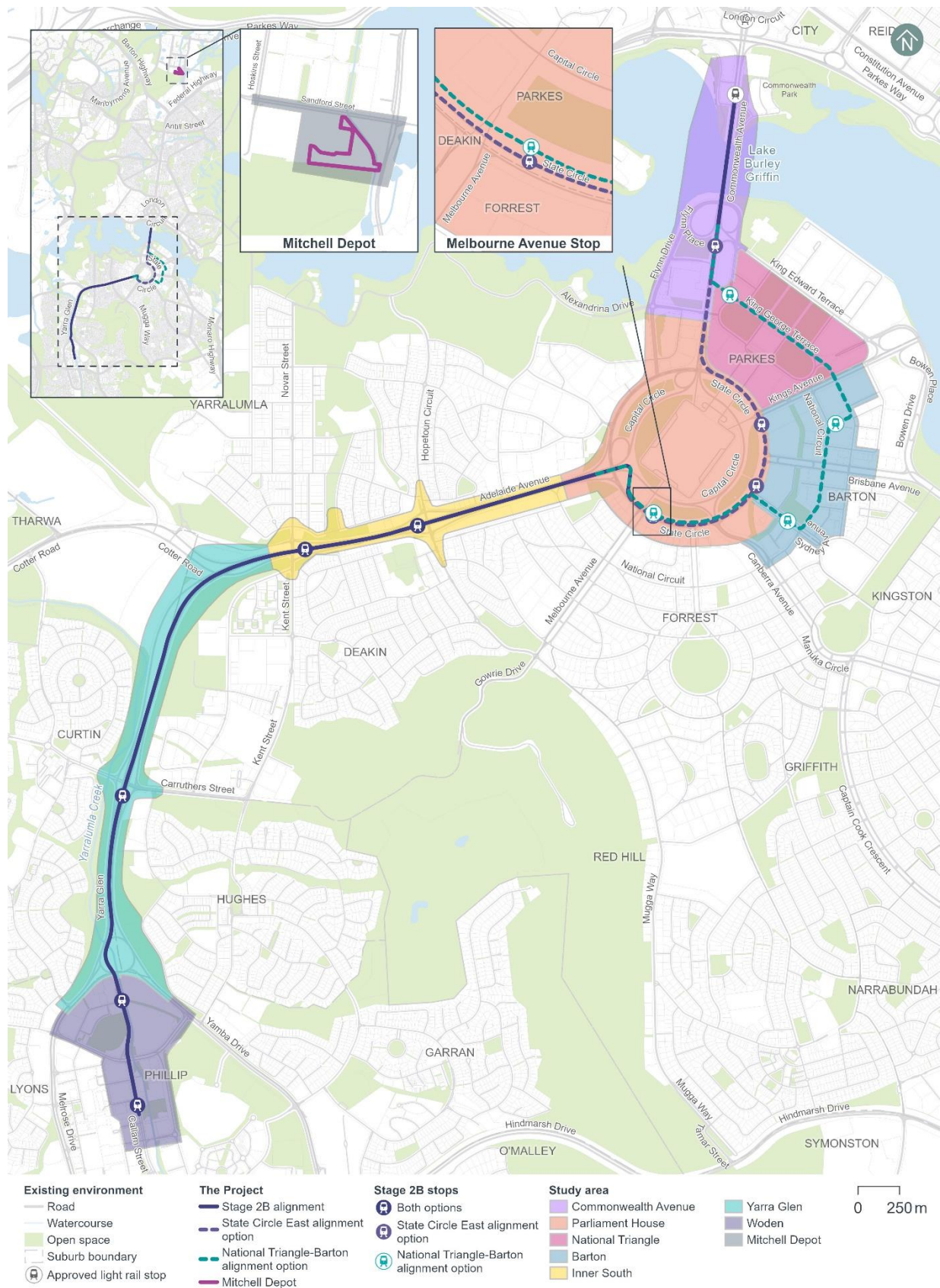


Figure 11-1 Project study area – traffic and transport

Population and employment

Existing population statistics for the Project area have been obtained from the Australian Bureau of Statistics (ABS) Census 2021 data for the Parkes, Barton, Forrest, Yarralumla, Deakin, Curtin, Hughes, and Phillip areas which are the statistical areas within the Project area, as shown on Figure 11-2.

The data obtained for the traffic and transport assessment indicates these SA2 statistical areas have a combined residential night-time population of about 24,000 people. Residents and employees across these suburbs also generated approximately 10,300 and 39,000 trips to work with the labour force participation (15-85 years) in the area being around 70%.

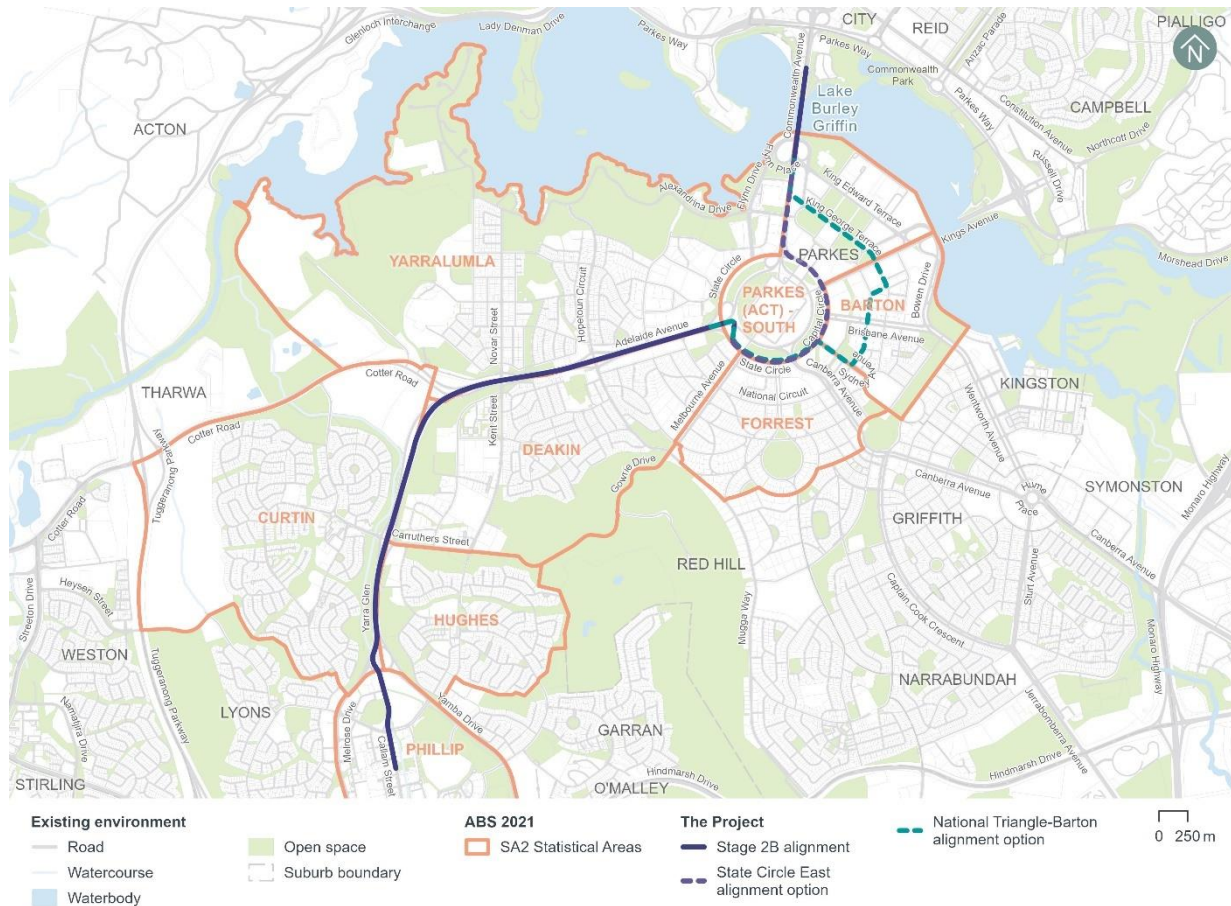


Figure 11-2 Statistical areas which surround the Project's study area

Transport mode share

Transport mode share describes the percentage of travellers using a particular type or mode of transport and the number of associated trips made. The journey to work mode share data indicates the following about mode share in 2021:

- Employees of the analysed statistical areas, who live outside these statistical areas mostly drove to work (84%), with 8% using public transport modes and 7% using active transport modes, as shown on Figure 11-3
- Residents of the analysed statistical areas mainly drove to work (77%), with 14% using active transport modes and 8% using public transport, as shown on Figure 11-4.

While it is acknowledged that the ABS Census 2021 was undertaken during the COVID-19 pandemic, ABS Census 2016 data indicates similar mode share information to the data obtained in 2021.

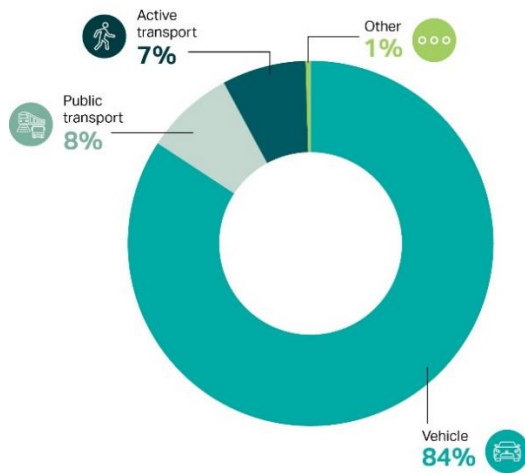


Figure 11-3 2021 journey to work mode share for non-resident employees

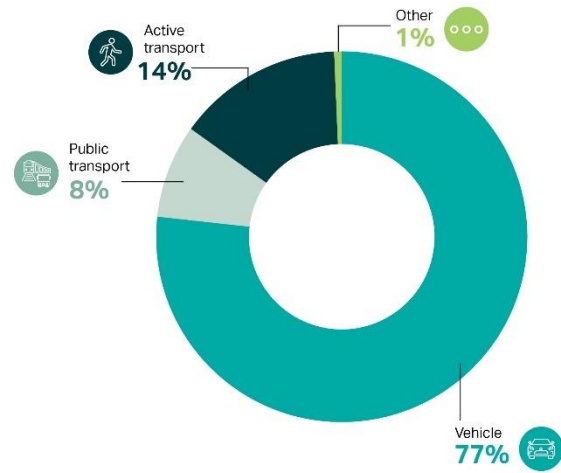


Figure 11-4 2021 journey to work mode share for resident employees

Road network

The road network within and surrounding the study area varies from low speed (40-60 km/h) urban roads with high-place value, to high-speed arterial roads (70-80 km/h).

Key arterial roads include the following:

- Commonwealth Avenue, Adelaide Avenue, Yarra Glen, and Yamba Drive form part of a north-south arterial traffic route through the study area, connecting Phillip and north Canberra. Commonwealth Avenue serves as the gateway to the City centre from the south
- State Circle and Capital Circle are arterial roads that circulate Parliament House and facilitate connections between Commonwealth Avenue and Adelaide Avenue, as well as other key roads within the study area, including Kings Avenue, Brisbane Avenue, and Canberra Avenue
- Kings Avenue, Brisbane Avenue, and Canberra Avenue are arterial roads within the Barton precinct and facilitate east-west movement between Parliament House and other arterial roads through Canberra including Morshead Drive and the Monaro Highway.

Active transport network

Canberra's pedestrian pathways and cycling network comprise the following types of routes:

- Principal cycle routes: Connect each district of the ACT with the City, town centres, Queanbeyan and other major destinations
- Main cycle routes: Connect with group centres and major destinations
- Local cycle routes: Connect to schools and local shops at the suburban level as well as local destinations within town centres.

The principal cycle routes within and surrounding the study area are shown on Figure 11-5. The C4 City to Tuggeranong via Woden cycling route is the key cycling route through the study area which comprises a shared path. Figure 11-5 indicates consideration is being given to the future expansion of this cycling route to also provide connection along Commonwealth Avenue, State Circle (west), and Adelaide Avenue.

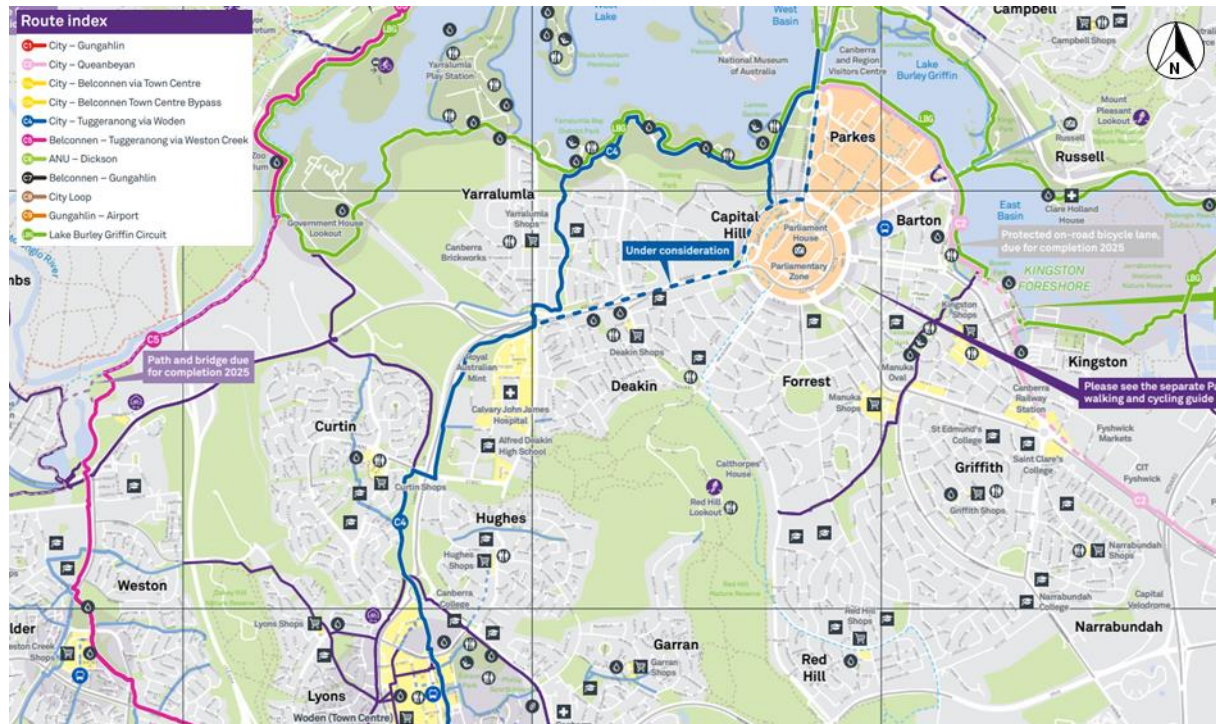


Figure 11-5 Principal community routes (Transport Canberra, 2023)

Public transport network

The public transport network within and surrounding the study area includes both standard and rapid bus services. Rapid bus routes are frequent direct bus routes that run between town centres and other key destinations. These routes operate at least every 15 minutes between 7:00 am and 7:00 pm on weekdays, with frequent service outside of these hours. The R2, R4, R5, R6, R7, and R10 routes serve as key rapid routes within the study area and operate along Yarra Glen, Adelaide Avenue, Capital Circle and/or Commonwealth Avenue. The study area is also supported by several other standard bus services with varying frequencies during peak and off-peak periods.

An overview of the public transport network operating within and around the study area is provided in Figure 11-6.

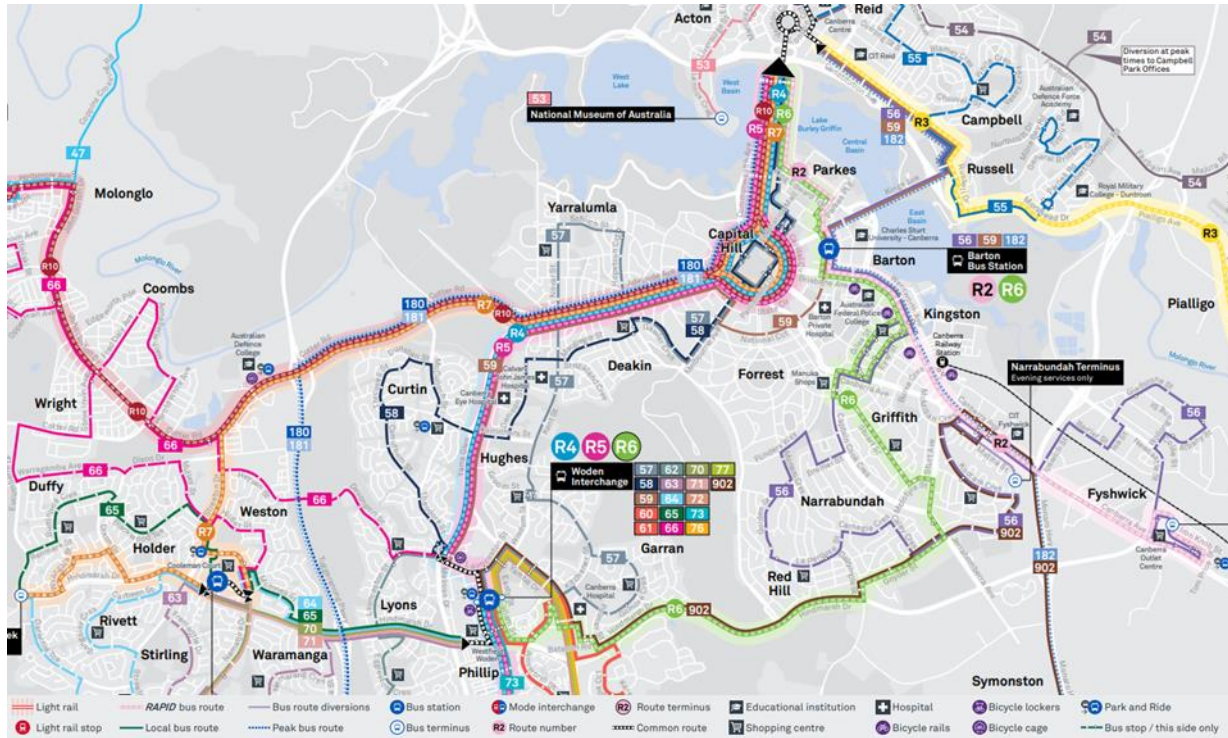


Figure 11-6 Public transport network map (Transport Canberra, 2023)

Micromobility

Dockless e-scooters are active within the ACT and the study area. These devices are dispersed across various locations in the study area, and are accessible to users who locate and pay for the hire through a mobile phone app.

Specific micromobility parking sites have been designated in central Canberra based on anticipated demand. Private operators are encouraged to use these designated parking areas when rebalancing their fleet.

Future conditions without the Project

Public transport in Canberra is currently provided by a bus network and the existing Light Rail line between Gungahlin and the City (LRS1). Despite the broad coverage of the bus network, there is a limit to its capacity to meet the needs of a growing city and to support its projected population growth.

Significant year on year population growth is projected in the ACT through to 2041, leading to increased travel demand across the ACT. The ABS data highlights that car travel is the predominant transport mode for journeys to and from work in Canberra now and into the future. Therefore, majority of the forecast travel demand growth would be via private vehicle travel, resulting in increased traffic demand (and pressure) on the ACT road network.

Without changes in government policy to alter trip behaviours and patterns, coupled with major transport infrastructure investment, future development within the Commonwealth Park to Woden corridor is anticipated to lead to a decline in traffic speeds, increasing travel time and impeding access to employment opportunities, community facilities, and social and recreational activities. As a result, the ACT would face a highly congested road network during weekday peak hours by 2031. Due to this peak hour congestion, some drivers may choose to travel earlier or later to avoid delays, a phenomenon known as peak spreading.

To mitigate the impacts of future growth on the road network, the ACT Government is considering a mix of transport improvement projects, including road, public transport, and active travel enhancements, many of which are discussed in the ACT Infrastructure Plan update – Transport (ACT Government, 2024). The Project is a priority project, addressing growth within the City to Woden corridor. Combined

with other planned infrastructure projects and the potential for mode shift from private vehicle and toward light rail, it aims to create a more efficient and less congested road network over time.

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

11.1.2 Potential impacts – construction

Modelling was undertaken to understand how construction of the Project potentially impacts the operation of the road network, as well as general vehicle and bus travel times. Potential impacts to public transport, active transport, and road safety due to network changes were also considered.

The modelling methodology includes comparing the 2031 without Project scenario with the 2031 with construction scenarios during the weekday AM and PM peak hours. The 2031 without Project scenario includes all committed transport infrastructure to serve as a future baseline against which the Project can be assessed. The planned road network improvements included in the future year scenarios were agreed with Transport Canberra and City Services (TCCS).

Construction of the National Triangle-Barton alignment option would require various block closures within the National Triangle and Barton precincts in addition to lane modifications and closures along the Project alignment. Block closures would be staged to minimise the traffic and transport impacts of the construction works. In this regard, three construction scenarios were modelled for the National Triangle-Barton alignment option for three different stages of block closures, while only one construction scenario was modelled for the State Circle East alignment option. The three construction scenarios that were modelled for the National Triangle-Barton alignment option include:

- Construction scenario 1: King George Terrace block closure is in place
- Construction scenario 2: Macquarie Street, Bligh Street, and National Circuit block closure between Kings Avenue and Brisbane Avenue is in place
- Construction scenario 3: National Circuit block closure between Brisbane Avenue and Sydney Avenue is in place.

Due to forecast congestion in 2031 with the Project’s construction and the associated temporary construction traffic arrangements which would result in reduced road network capacity, some traffic is predicted not to be able to start or finish its journey within the road network peak hours.

Considering this, a travel demand management strategy (TDMS) will be implemented to encourage drivers to make their journey either earlier or later in the peak period to avoid delay, or change to alternative modes of travel. It is estimated that the TDMS would reduce traffic volumes across the road network by 5 to 10% during the AM and PM peak hours.

A summary of the potential traffic and transport impacts during construction of the Project is provided below and discussed further in Technical Report 1 – Traffic and transport, with the assumption that the TDMS is in place.

A construction strategy has been developed detailing working hours, construction compounds, estimated workforce, and haulage routes, which is discussed further in Chapter 6 (Construction).

Traffic volume changes due to temporary construction traffic arrangements

Traffic volume difference plots for the study area and its surrounds have been produced from modelling. Traffic modelling has been carried out to highlight changes in traffic volumes in 2031 between with and without construction of the Project. Changes in traffic during the AM peak hour (8:00 am to 9:00 am) and PM peak hour (5:00 pm to 6:00 pm) are discussed in the following sections.

State Circle East alignment option

Key changes in 2031 traffic volumes for the State Circle East alignment option, comparing scenarios with and without the Project's construction, include:

- AM peak hour:
 - Traffic volumes would decrease on key roads along or immediately adjacent to the Project's construction, including Commonwealth Avenue, State Circle, Capital Circle, Canberra Avenue, Adelaide Avenue, Cotter Road and Yarra Glen
 - Traffic volumes would increase along outer arterial roads, including Tuggeranong Parkway, Hindmarsh Drive, Mugga Way and Parkes Way
 - Traffic volumes would also increase along alternative travel routes through the precincts, such as Flynn Drive, Kings Avenue and Bowen Drive
 - These traffic volume changes reflect the expected traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) and increased congestion within the study area and further afield due to reductions in traffic lanes and speed limits during the Project's construction, particularly along Commonwealth Avenue, State Circle, Adelaide Avenue and Yarra Glen
 - In addition, the closure of the section of Melrose Drive between Theodore Street and Yarra Glen during the upgrade of Melrose Drive/Yarra Glen/Yamba Drive intersection would result in traffic volume increases along alternative routes including Launceston Street and Theodore Street.
- PM peak hour:
 - Traffic volumes would decrease on key roads along or immediately adjacent to the Project's construction, including Commonwealth Avenue, State Circle, Capital Circle, Kings Avenue, Brisbane Avenue, Canberra Avenue, Adelaide Avenue and Yarra Glen
 - Traffic volumes would increase along outer arterial roads, including Tuggeranong Parkway, Cotter Road, Lady Denman Drive, Hindmarsh Drive, Mugga Way and the Monaro Highway
 - Traffic volumes would also increase along alternative travel routes through the precincts, such as King Edward Terrace, Bowen Drive, Flynn Drive, National Circuit, Empire Circuit, and Hopetoun Circuit
 - These traffic volume changes reflect the expected traffic reassignment and increased congestion within the study area and further afield due to reductions in traffic lanes and speed limits during the Project's construction, particularly along Commonwealth Avenue, State Circle, Adelaide Avenue and Yarra Glen
 - In addition, the closure of the section of Melrose Drive between Theodore Street and Yarra Glen during the Melrose Drive/Yarra Glen/Yamba Drive intersection upgrade would result in traffic volume increases along alternative routes including Launceston Street, Theodore Street and McCulloch Street.

National Triangle-Barton alignment option

Key changes in 2031 traffic volumes for the National Triangle-Barton alignment option, comparing scenarios with and without the Project's construction, include:

- AM peak hour:
 - Traffic volumes would decrease on key roads along or immediately adjacent to the Project's construction, including Commonwealth Avenue, State Circle, Capital Circle, Canberra Avenue, Adelaide Avenue, and Yarra Glen
 - Traffic volumes would increase along outer arterial roads, including Tuggeranong Parkway, Cotter Road, Hindmarsh Drive, Mugga Way and the Monaro Highway
 - Traffic volumes would also increase along alternative travel routes through the precincts, such as Flynn Drive, Kings Avenue, Brisbane Avenue, and Bowen Drive
 - These traffic volume changes reflect the expected traffic reassignment and increased congestion within the study area and further afield due to reductions in traffic lanes and speed limits during the Project's construction, particularly along Commonwealth Avenue, State Circle, Adelaide Avenue, and Yarra Glen
 - In addition, the following traffic reassignment patterns are expected in and adjacent to the National Triangle and Barton precincts:
 - In construction scenario 1, when the King George Terrace block closure is in place, traffic would instead use King Edward Terrace to travel through the National Triangle precinct and to other roads further afield surrounding the precinct
 - In construction scenario 2, when the Macquarie Street, Bligh Street and National Circuit block closure between Kings Avenue and Brisbane Avenue is in place, traffic would instead use adjacent roads including State Circle, Brisbane Avenue, Bowen Drive and Blackall Street
 - In construction scenario 3, when the National Circuit block closure between Brisbane Avenue and Sydney Avenue is in place, traffic would instead use adjacent roads, including State Circle, Kings Avenue, Brisbane Avenue, Macquarie Street, Bowen Street and/or Telopea Park.
- PM peak hour:
 - Traffic volumes would decrease on key roads along or immediately adjacent to the Project's construction, including Commonwealth Avenue, State Circle, Capital Circle, Canberra Avenue, Adelaide Avenue and Yarra Glen
 - Traffic volumes would increase along outer arterial roads, including Tuggeranong Parkway, Cotter Road, Hindmarsh Drive, Mugga Way and the Monaro Highway
 - Traffic volumes would also increase along alternative travel routes through the precincts, such as King Edward Terrace, Flynn Drive, Melbourne Avenue, Bowen Drive, Hopetoun Circuit, and Kent Street
 - These traffic volume changes reflect the expected traffic reassignment and increased congestion within the study area and further afield due to reductions in traffic lanes and speed limits during the Project's construction, particularly along Commonwealth Avenue, State Circle, Adelaide Avenue and Yarra Glen
 - In addition, the following traffic reassignment patterns are expected in and adjacent to the National Triangle and Barton precincts:
 - In construction scenario 1, when the King George Terrace block closure is in place, traffic would reassign to King Edward Terrace to travel through the National Triangle precinct and to other roads further afield surrounding the precinct
 - In construction scenario 2, when the Macquarie Street, Bligh Street and National Circuit block closure between Kings Avenue and Brisbane Avenue is in place, traffic would reassign to adjacent roads including Bowen Drive and Blackall Street

- In construction scenario 3, when the National Circuit block closure between Brisbane Avenue and Sydney Avenue is in place, traffic would reassign to adjacent roads, including State Circle, Brisbane Avenue, Macquarie Street, Bowen Drive and/or Telopea Park.

Additional construction-related traffic

As discussed in Section 6.7.2 of Chapter 6 (Construction), construction activities would generate up to 25 vehicle movements during the road network peak hours per precinct. This equates to an additional vehicle every two minutes, which would be manageable, particularly given that this increase in traffic would be distributed across various haulage routes.

The maximum hourly construction vehicle movements would occur from 6:00 am to 7:00 am and 6:00 pm to 7:00 pm, coinciding with the worker shift changeover periods. These worker shift changeover periods would be outside the road network peak hours and would generate up to 125 vehicle movements per hour per precinct.

Off-peak traffic volumes on the surrounding road network are lower than during the weekday peak hours, as demonstrated by the weekday average daily traffic volume profiles for Commonwealth Avenue, State Circle, Adelaide Avenue, and Yarra Glen presented in Chapter 12 (Commonwealth Avenue precinct), Chapter 13 (Parliament House precinct), Chapter 16 (Inner South precinct) and Chapter 17 (Yarra Glen precinct). Specifically, the daily traffic volume profile for these roads indicates traffic volumes are typically 70-80% lower between 6:00 am and 7:00 am compared to the AM road network peak hour (8:00 am to 9:00 am), and 30-50% lower between 6:00 pm and 7:00 pm compared to the PM road network peak hour (5:00 pm to 6:00 pm). As such, the additional construction traffic generated during the worker shift changeover periods from worker trips and construction activities at the construction compounds and ancillary facilities could also be accommodated within the existing road network.

General vehicle travel times

Vehicle travel times along key routes have been used to determine the relative impacts or benefits of the Project during construction. Construction travel time routes for general road users have been selected based on the primary travel routes to key land uses within the study area, particularly through areas of the road network that would be impacted by temporary traffic arrangements.

A total of five travel time routes have been considered as part of the construction assessment, listed below and shown on Figure 11-7.

- Construction route 1 – City centre to/from National Gallery via Commonwealth Avenue
- Construction route 2 – Glenloch Interchange to/from Sydney Avenue via State Circle
- Construction route 3 – Callam Street to/from National Circuit via State Circle
- Construction route 4 – Callam Street to/from Parkes Way via State Circle
- Construction route 5 – Callam Street to/from Brisbane Avenue via State Circle.

These five travel time routes provide a representative sample of potential impacts to general vehicle travel times within the study area due to the construction of the Project. There would be other routes available to drivers during construction of the Project that are not identified in this assessment and as such the potential travel time impacts presented may not be reflective of impacts experienced by all drivers during construction of the Project.

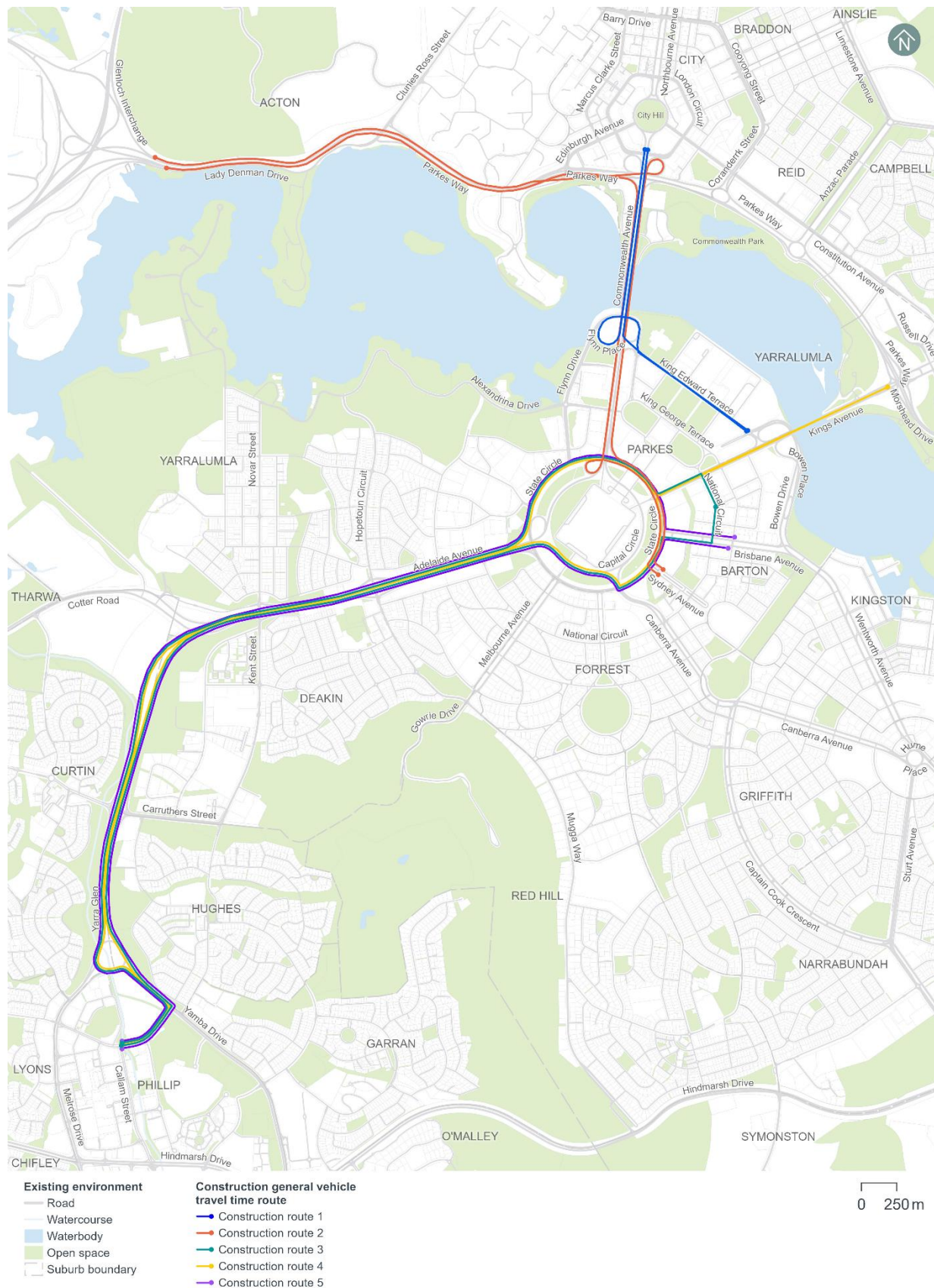


Figure 11-7 Assessed construction general vehicle travel time routes

State Circle East alignment option

Construction travel routes were modelled to compare weekday peak hour vehicle travel time with and without the Project's construction. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- A reduction in travel time is expected for the following routes:
 - AM peak hour:
 - Construction route 2 – Between Glenloch Interchange and Sydney Avenue via State Circle: around a two to three minute decrease (improvement) in the northbound direction
 - Construction route 5 – Between Callam Street and Brisbane Avenue via State Circle: around a two to three minute decrease (improvement) in the northbound direction
 - PM peak hour:
 - Construction route 5 – Between Callam Street and Brisbane Avenue via State Circle: up to a four minute decrease (improvement) in both directions

The travel time improvements are due to a combination of the following:

- The temporary construction traffic arrangements causing broader traffic reassignment and, therefore, less traffic volumes on some key roads including Yarra Glen, Adelaide Avenue, State Circle and Commonwealth Avenue
- The network improvements that were implemented for the with construction scenarios
- Notable increases in travel time of more than five minutes are expected for the following routes due to the various lane reductions, traffic staging arrangements and/or speed limit reductions which results in higher congestion and delay in certain locations along the route:
 - AM peak hour:
 - Construction route 2 – Between Glenloch Interchange and Sydney Avenue via State Circle: around a seven minute increase (deterioration) in the southbound direction
 - PM peak hour:
 - Construction route 2 – Between Glenloch Interchange and Sydney Avenue via State Circle: around a six to seven minute increase (deterioration) in the southbound direction
 - Construction route 3 – Between Callam Street and National Circuit via State Circle: around a nine to 10 minute increase (deterioration) in the southbound direction
 - Construction route 4 – Between Callam Street and Parkes Way via State Circle: around a six to seven minute increase (deterioration) in the southbound direction
- Travel time increases during the weekday peak hours for all other routes would generally be five minutes or less.

National Triangle-Barton alignment option

Construction travel routes were modelled to compare weekday peak hour vehicle travel time with and without the Project's construction. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- A reduction in travel time is expected for the following routes:
 - AM peak hour:
 - Construction route 1 – Between the City and National Gallery via Commonwealth Avenue: around a two to three minute decrease (improvement) in the northbound direction during construction scenarios 1, 2 and 3
 - Construction route 3 – Between Callam Street and National Circuit via State Circle: around a one to two minute decrease (improvement) in the northbound direction during construction scenarios 2 and 3

- Construction route 4 – Between Callam Street and Parkes Way via State Circle: around a 30 second decrease (improvement) in the northbound direction during construction scenarios 2 and 3
- Construction route 5 – Between Callam Street and Brisbane Avenue via State Circle: around a two to four minute decrease (improvement) in the northbound direction during construction scenarios 1, 2 and 3
- PM peak hour:
 - Construction route 3 – Between Callam Street and National Circuit via State Circle: around a 30 second decrease (improvement) in the northbound direction during construction scenarios 1, 2 and 3
 - Construction route 5 – Between Callam Street and Brisbane Avenue via State Circle: around a one to three minute decrease (improvement) in the northbound direction during construction scenarios 1, 2 and 3

The travel time improvements would be due to a combination of:

- The temporary construction traffic arrangements causing broader traffic reassignment and, therefore, less traffic volumes on Yarra Glen, Adelaide Avenue and State Circle
- The network improvements that were implemented for the construction scenarios
- Notable increases in travel time of more than five minutes are expected for the following routes due to the various lane reductions, traffic staging arrangements and/or speed limit reductions which results in higher congestion and delay in certain locations along the route:
 - AM peak hour:
 - Construction route 2 – Between Glenloch Interchange and Sydney Avenue via State Circle: around a six to 15 minute increase (deterioration) in the northbound and/or southbound direction during construction scenarios 1, 2 and 3
 - PM peak hour:
 - Construction route 2 – Between Glenloch Interchange and Sydney Avenue via State Circle: around a 13 to 14 minute increase (deterioration) in the northbound direction during construction scenarios 1, 2 and 3
- Travel time increases during the weekday peak hours for all other routes would generally be five minutes or less.

Public transport

The Project would integrate with the existing and approved Light Rail network (Light Rail Stage 1 (LRS1) and Light Rail Stage 2A (LRS2A)). This would result in temporary impacts to the approved Commonwealth Park Stop when connecting the Project to the stop. It is anticipated that these works would occur outside the existing light rail hours of operation to avoid service shut-down periods.

Bus travel times along the following key bus routes have been used to determine the relative impacts or benefits of the Project during construction:

- R2: between Fyshwick and Aranda
- R4: between Woden and Aranda
- Route 59: between Woden and the city centre.

These bus routes travel on parts of the network that would be impacted by the Project's construction and operation. They provide a representative sample of potential impacts to bus travel times within the study area as a result of the construction and operation of the Project.

The sections of the bus routes used for travel time assessments are shown on Figure 11-8.

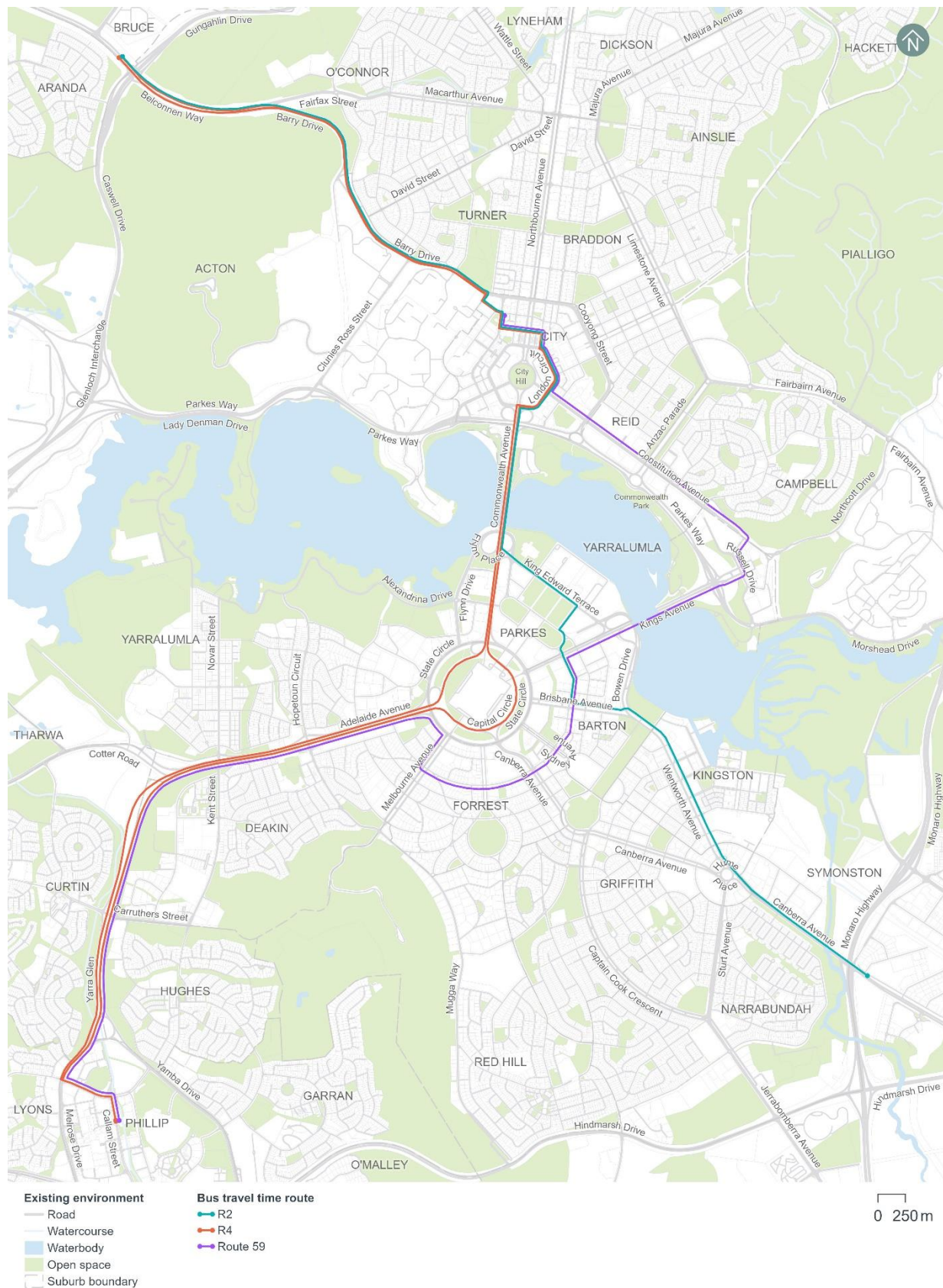


Figure 11-8 Assessed bus travel time routes

State Circle East alignment option

Bus travel times were modelled to compare weekday peak hour travel time with and without the Project's construction. Bus stop relocations would not be required for this alignment option as no full road closures would be required. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- A reduction in travel time is expected for the following routes:
 - AM peak hour:
 - R2: around a three to four minute decrease (improvement) in the southbound direction
 - R4: around a 30 second decrease (improvement) in the northbound direction
 - PM peak hour:
 - Route 59: around a two minute decrease (improvement) in the southbound direction

The travel time improvements are due to a combination of:

- The temporary construction traffic arrangements causing broader traffic reassignment and, therefore, less traffic volumes on Yarra Glen, Adelaide Avenue, State Circle and/or Commonwealth Avenue
- The network improvements that were implemented for the with construction scenarios
- Notable increases in travel time of more than five minutes are expected for the following routes due to the various lane reductions, traffic staging arrangements and/or speed limit reductions:
 - R4: around a five to six minute increase (deterioration) in the southbound direction during the PM peak hour
- Travel time increases caused by the various lane reductions, traffic staging arrangements and/or speed limit reductions would generally be five minutes or less for all other routes during the weekday peak hours.

National Triangle-Barton alignment option

Some bus stops may need to be temporarily relocated, and bus routes temporarily rerouted due to full road closures during construction of the Project. This includes bus stops and bus routes that would be impacted by the temporary full road closures required during construction along Melrose Drive between Theodore Street and Yarra Glen for both alignment options, and along King George Terrace, Macquarie Street, Bligh Street and National Circuit for the National Triangle-Barton alignment option only.

Bus travel times were modelled to compare weekday peak hour travel time with and without the Project's construction. The travel time calculations consider minor diversions of the R2 and 59 bus routes to adjacent roads to avoid the block closures considered in the three construction scenarios that were modelled for the National Triangle-Barton alignment option. These modelled bus diversions are indicative only for the purposes of this assessment and would be refined as part of ongoing design development and construction planning. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- A reduction in travel time is expected for the following routes:
 - AM peak hour:
 - R2: around a one to three minute decrease (improvement) in both directions during construction scenario 2, and a two to four minute decrease (improvement) in the southbound direction during construction scenarios 1 and 3
 - R4: around a four to five minute decrease (improvement) in the northbound direction during construction scenarios 1, 2 and 3
 - Route 59: around a 30 second decrease (improvement) in the northbound direction during construction scenario 2

- PM peak hour:
 - R2: around a three minute decrease (improvement) in the southbound direction during construction scenario 1
 - R4: around a one minute decrease (improvement) in the northbound direction during construction scenario 1
 - Route 59: around a three to four minute decrease (improvement) in the southbound direction during construction scenario 1

The travel time improvements are due to a combination of:

- The temporary construction traffic arrangements causing broader traffic reassignment and, therefore, less traffic volumes on Yarra Glen, Adelaide Avenue, State Circle and/or Commonwealth Avenue
- The network improvements that were implemented for the construction scenarios
- Notable increases in travel time are expected for the following routes due to the various lane reductions, traffic staging arrangements and/or speed limit reductions:
 - AM peak hour:
 - R4: around a six minute increase (deterioration) in the southbound direction during construction scenario 1
 - Route 59: around a five to six minute increase (deterioration) in the northbound direction during construction scenario 1
 - PM peak hour:
 - R2: around a seven to 11 minute increase (deterioration) in the northbound direction during construction scenarios 1 and 2, however noting the travel time increases from 2031 conditions without construction and any travel demand management measures would remain less than 10 minutes
 - R4: around a six to eight minute increase (deterioration) in the southbound direction during construction scenarios 1 and 2
 - Route 59: around a six to nine minute increase (deterioration) in the northbound direction during construction scenarios 2 and 3, and around an eight minute increase in the southbound direction during construction scenario 3
- Travel time increases during the weekday peak hours for all other routes would generally be five minutes or less.

Active travel

Modifications to the road network and access limitations in the Project area would affect pedestrian and cycling paths. However, alternative access arrangements for pedestrians and cyclists would be maintained throughout the construction works with minimal diversion from the desired line. During block closures, a pedestrian path, with provisions for cyclists would maintain connectivity. The Project would therefore have minimal impact to pedestrian and cyclist movements and travel times.

All pedestrian and cycle facility adjustments would be undertaken in accordance with *AS 1428 DDA and Disability Standards Accessible Public Transport*.

Car parking and kerbside uses

Off-street car parking and on-street kerbside uses (including car parking, loading zones, taxi zones and other kerbside uses) that may be temporarily unavailable during construction of the Project are listed in Table 11-1. Construction works are likely to be staged, so the temporary loss of car parking and kerbside uses across the Project area may be less at any given time during the construction program. Further detail on the location of these parking and kerbside uses within each individual precinct is provided in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

Table 11-1 Summary of off/on-street parking and kerbside uses that may be temporarily unavailable during construction of the Project

Precinct	Alignment option			
	State Circle East		National Triangle-Barton	
	On-street ¹	Off-street	On-street ¹	Off-street
Commonwealth Avenue	5 spaces	766 spaces	15 spaces	766 spaces
Parliament House	46 spaces	0 spaces	46 spaces	0 spaces
National Triangle	8 spaces	32 spaces	129 spaces	32 spaces
Barton	0 spaces	0 spaces	291 spaces	0 spaces
Inner South	62 spaces	0 spaces	62 spaces	0 spaces
Yarra Glen	0 spaces	0 spaces	0 spaces	0 spaces
Woden	44 spaces	380 car + 11 motorcycle spaces	44 spaces	380 car + 11 motorcycle spaces
Mitchel Depot	0 spaces	5 spaces	0 spaces	5 spaces
Total	165 spaces	1,183 car and 11 motorcycle spaces	587 spaces	1,183 car and 11 motorcycle spaces

Note 1: does not include parking loss as a result of any potential bus/coach zone relocations

Emergency vehicle access

Temporary traffic arrangements during construction of the Project would primarily involve lane modifications or a reduction in the number of travel lanes on certain roads which would not impact existing emergency vehicle access.

During any block or intersection closures, protocols would be implemented on-site including a requirement for traffic controllers to assist with emergency access through work areas if required. This includes at the Australian Federal Police building in Barton. As such, emergency vehicle access would be maintained through the Project area during construction.

Road safety

The construction activities would generate additional heavy vehicle activity within the study area and along the adjoining road network. This could increase the risk of collisions involving a heavy vehicle. Measures are proposed to minimise the road safety risks associated with the construction works such as full road closures, barriers between traffic and adjacent work, 40 km/h traffic environments, and the establishment of a Construction Traffic Management Plan (CTMP). Further detail on management and mitigation measures can be found in Chapter 21 (Environmental management and mitigation measures).

Special events

The construction of the Project may affect large-scale community events that occur in the area particularly in and around the city centre and the National Triangle precinct through changes to vehicle access and parking.

Locations where special events typically occur within or adjacent to the study area include:

- Along Lake Burley Griffin within the Commonwealth Avenue and National Triangle precincts: events including, but not limited to, Enlighten Festival, New Years Eve fireworks and Floriade
- Manuka Oval: various large sporting events.

Considering the expected attendance of some of the larger special events within the surrounding area, special event planning would be required during construction of the Project. This would include coordination between key stakeholders including Events ACT or other event organisers with the aim to minimise the cumulative impact of construction of the Project and special events.

11.1.3 Potential impacts – operation

The operation of the Project is anticipated to have potential impacts on the road network, vehicle travel times, public transport, active transport, parking, and road safety. A summary of these potential impacts is provided in the sections below and discussed further in Technical Report 1 – Traffic and transport.

A summary of road network changes can be found in Section 5.9 of Chapter 5 (Project description).

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

In the context of the overall future traffic and transport network assessment, a key benefit of the Project would be the introduction of an additional transport mode choice within the Commonwealth Park to Woden corridor, with the capacity to accommodate an additional 2,400 people per hour in each direction. Light rail would be generally unaffected by traffic network congestion that would impact buses and cars. The Project would also deliver the transport-related Project benefits outlined in Chapter 2 (Need for the Project).

Public transport integration

The ACT Government continues to seek opportunities to expand and improve public transport. This includes integration of light rail and bus services with the intention to increase reach and frequency of public transport across Canberra. Subject to the Project approvals process and as part of ongoing design development, consultation with key stakeholders would be ongoing. This would include review of existing bus network arrangements to identify and optimise opportunities for integration of the bus network with the Project.

Some bus stops and routes may require modification or rationalisation to accommodate the Project or changes to road networks. Impacted services would be adjusted in consultation with Transport Canberra, to enable continued access.

Network performance

State Circle East alignment option

Forecast network performance statistics have been drawn from the traffic modelling to provide an understanding of the overall road network impacts of the Project in 2031 and 2041. Key findings are as follows:

- Total vehicle kms travelled, total vehicle travel time, average vehicle speeds and the total traffic demand would be similar in both the without Project and with Project scenarios during the AM and PM peak hours
- By 2041, peak demand conditions with or without the Project are likely to start earlier and finish later than it does currently to accommodate greater forecast traffic demand arising from increased population and changes to land use. Due to forecast congestion, some of this traffic is predicted to be unable to start or finish their journey within the peak period. Some drivers would, therefore, choose to make their journey either earlier or later in the peak period to avoid delay. This behaviour is called 'peak spreading'.

Further detail on road network performance within each individual precinct is provided in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site) and Technical Report 1 – Traffic and transport.

National Triangle-Barton alignment option

Forecast network performance statistics have been drawn from the traffic modelling to provide an understanding of the overall road network impacts of the Project in 2031 and 2041. Key findings are as follows:

- Total vehicle travel time and average vehicle speeds reduce slightly with the Project during the AM and PM peak hours, which results in a reduction of around 7% in the total vehicle kms travelled during both peak hours. Total traffic demand would be similar in both the without Project and with Project scenarios during the AM and PM peak hours
- By 2041, peak demand conditions with or without the Project are likely to start earlier and finish later than it does currently to accommodate greater forecast traffic demand arising from increased population and changes to land use. Due to forecast congestion, some of this traffic is predicted to be unable to start or finish their journey within the peak period. Some drivers would, therefore, choose to make their journey either earlier or later in the peak period to avoid delay. This behaviour is called 'peak spreading'.

Further detail on road network performance within each individual precinct is provided in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site) and Technical Report 1 – Traffic and transport.

General vehicle travel times

The Project would reduce the capacity of some roads along its alignment where there would be traffic lane reductions or the introduction of new light rail signal phases at intersections. This has the potential of impacting vehicle travel times on adjacent roads through the study area. Consequently, traffic reassignment would occur on surrounding roads as drivers seek alternative routes to maintain travel times.

A total of 14 travel time routes have been adopted for the operation assessment, listed below and shown on Figure 11-9. These include direct and alternative travel routes to key land uses within the study area to understand the relative impacts of the Project and any associated traffic reassignment in the wider network.

- Operational route 1 – State Circle to/from Barry Drive via Commonwealth Avenue
- Operational route 2 – State Circle to/from Glenloch Interchange via Commonwealth Avenue
- Operational route 3 – State Circle to/from Glenloch Interchange via Kings Avenue
- Operational route 4 – State Circle to/from Limestone Avenue via Kings Avenue
- Operational route 5 – State Circle to/from City via Commonwealth Avenue
- Operational route 6 – State Circle to/from City via Kings Avenue
- Operational route 7 – Glenloch Interchange to/from City
- Operational route 8 – Barry Drive to/from City via Northbourne Avenue
- Operational route 9 – Monaro Highway to/from Commonwealth Avenue via Brisbane Avenue
- Operational route 10 – Monaro Highway to/from Commonwealth Avenue via Canberra Avenue
- Operational route 11 – Monaro Highway to/from Kings Avenue via Hindmarsh Drive, Flinders Way, and Melbourne Avenue
- Operational route 12 – Hindmarsh Drive to/from Commonwealth Avenue via Mugga Way and Melbourne Avenue
- Operational route 13 – Hindmarsh Drive to/from Kings Avenue via Yarra Glen and Adelaide Avenue
- Operational route 14 – Tuggeranong Parkway to/from Commonwealth Avenue via Adelaide Avenue.

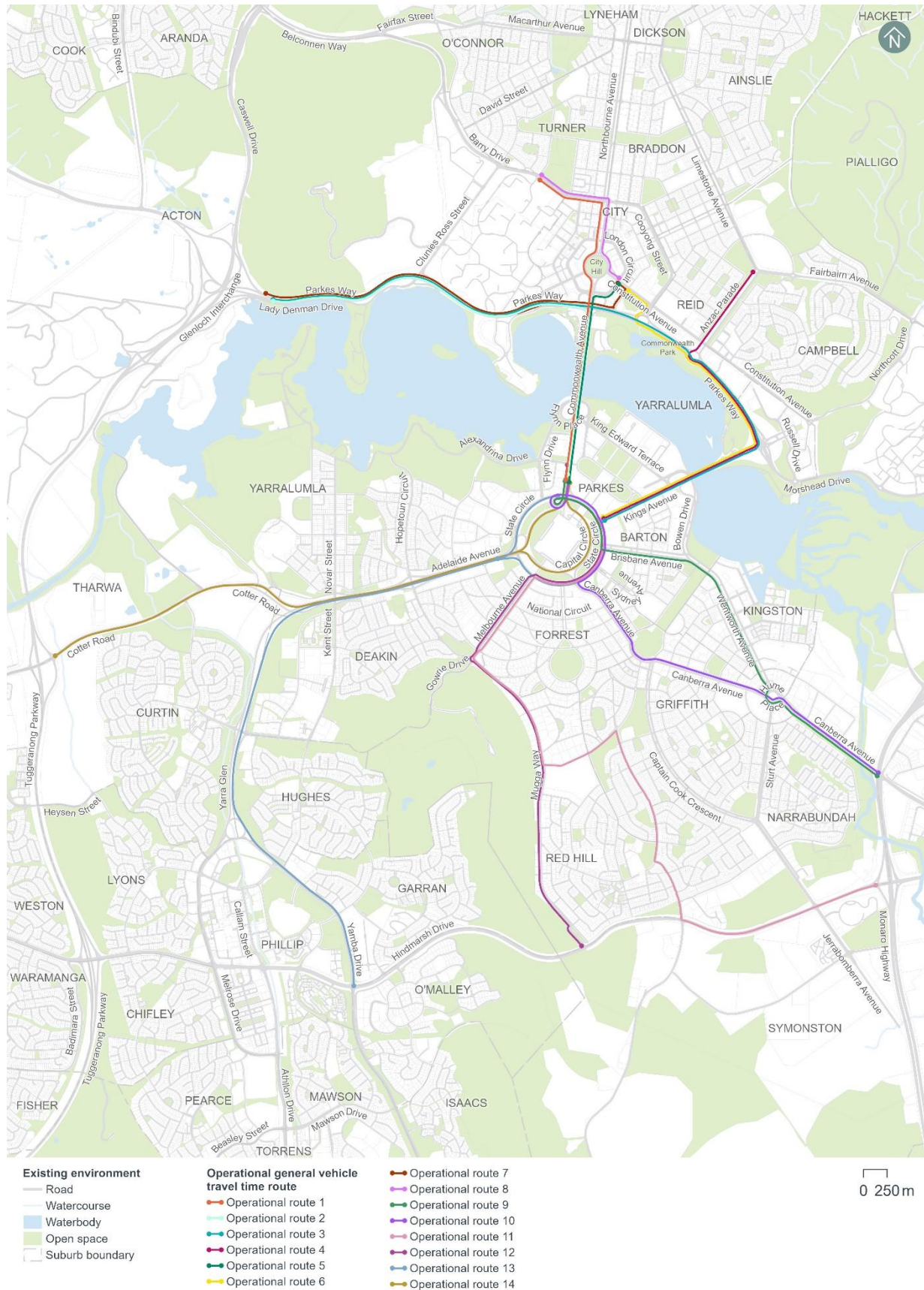


Figure 11-9 Assessed operational general vehicle travel time routes

By 2031, the study area road network would be heavily congested due to significant year on year population growth and associated increased traffic demand across the ACT. When a road network is already highly congested, minor increases in traffic volumes or minor reductions in road capacity can result in much larger relative increases in vehicle delays and travel times. As such, any large travel time increases presented in this section are not solely representative of the proportional increase in travel time attributed just to the Project, but rather the Project impacts on top of the transport challenges faced by an already congested future road network.

As noted earlier in this chapter, to mitigate the impacts of future growth on the road network, the ACT Government is considering a mix of transport improvement projects, including road, public transport, and active travel enhancements, many of which are discussed in the ACT Infrastructure Plan update – Transport (ACT Government, 2024).

Specifically, there are currently two primary routes across Lake Burley Griffin for traffic between the city centre and Northbourne Avenue and State Circle and its surrounds, including Commonwealth Avenue and Kings Avenue. As the population increases, travel demand will grow. By 2031 (or shortly after), these routes are expected to reach capacity. However, the Project would provide increased passenger carrying capacity for one of these routes, with the potential to carry substantially greater passenger numbers (an additional 2,400 people per hour in each direction), which is the equivalent of more than two traffic lanes of road vehicles in each direction on Commonwealth Avenue. The Project would also provide reliable travel times between these locations and beyond.

State Circle East alignment option

Operational travel time routes were modelled to compare weekday peak hour vehicle travel time with and without the Project in 2031 and 2041 scenarios. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- Travel time increases (deterioration) with the Project would generally be less than five minutes for most routes during the weekday peak hours in both 2031 and 2041 scenarios
- For some routes, a reduction (improvement) in travel time is expected with the Project due to less congestion and delay in certain locations along the route because of traffic reassignment
- Increases (deterioration) in travel time of more than five minutes are expected for the following routes due to higher congestion and delay in certain locations along the route:
 - AM peak hour:
 - Operational route 1 – Between State Circle and Barry Drive via Commonwealth Avenue: around a six minute increase (deterioration) in the southbound direction in 2041
 - Operational route 2 – Between State Circle and Glenloch Interchange via Commonwealth Avenue: around a 11 to 12 minute increase (deterioration) in the eastbound direction in 2031 and 2041
 - Operational route 3 – Between State Circle and Glenloch Interchange via Kings Avenue: around a seven to 10 minute increase (deterioration) in the southbound direction in 2031 and 2041
 - Operational route 5 – Between State Circle and city via Commonwealth Avenue: around a seven minute increase (deterioration) in the southbound direction in 2041
 - Operational route 7 – Between Glenloch Interchange and the city centre: around a six to seven minute increase (deterioration) in the eastbound direction in 2031 and 2041
 - PM peak hour:
 - Operational route 3 – Between State Circle and Glenloch Interchange via Commonwealth Avenue: around a 10 to 11 minute increase (deterioration) in the southbound direction in 2041
 - Operational route 4 – Between State Circle and Limestone Avenue via Kings Avenue: around a 11 to 12 minute increase (deterioration) in the southbound direction in 2041

- Operational route 6 – Between State Circle and city via Kings Avenue: around a 10 to 11 minute increase (deterioration) in the southbound direction in 2041
- Operational route 13 – Between Hindmarsh Drive and Kings Avenue via Yarra Glen and Adelaide Avenue: around a six minute increase (deterioration) in the southbound direction in 2041
- Operational route 14 – Between Tuggeranong Parkway and Commonwealth Avenue via Adelaide Avenue: around a five to six minute increase (deterioration) in the westbound direction in 2041.

National Triangle-Barton alignment option

Operational travel routes were modelled to compare weekday peak hour vehicle travel time with and without the Project in 2031 and 2041 scenarios. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- Travel time increases (deterioration) with the Project would generally be less than five minutes for most routes during the weekday peak hours in both 2031 and 2041 scenarios
- For some routes, a reduction (improvement) in travel time is expected with the Project due to less congestion and delay in certain locations along the route as a result of traffic reassignment
- Increases (deterioration) in travel time greater than five minutes are expected for the following routes due to higher congestion and delay in certain locations along the route:
 - AM peak hour:
 - Operational route 1 – Between State Circle and Barry Drive via Commonwealth Avenue: around a six to seven minute increase (deterioration) in the southbound direction in 2041
 - Operational route 2 – Between State Circle and Glenloch Interchange via Commonwealth Avenue: around a nine to 10 minute increase (deterioration) in the eastbound direction in 2031 and 2041
 - Operational route 3 – Between State Circle and Glenloch Interchange via Kings Avenue: around an eight to 10 minute increase (deterioration) in the southbound direction in 2031 and 2041
 - Operational route 5 – Between State Circle and city via Commonwealth Avenue: around a five to six minute increase (deterioration) in the southbound direction in 2041
 - Operational route 7 – Between Glenloch Interchange and city: around a five to six minute increase (deterioration) in the eastbound direction in 2031 and 2041
 - Operational route 10 – Between Monaro Highway and Commonwealth Avenue via Canberra Avenue: around a six minute increase (deterioration) in the southbound direction in 2031
 - PM peak hour:
 - Operational route 8 – Between Barry Drive to/from city via Northbourne Avenue: around a five to six minute increase (deterioration) in the northbound direction in 2031.

Public transport travel times

State Circle East alignment option

Bus travel times were modelled to compare weekday peak hour vehicle travel time with and without the Project in 2031 and 2041 scenarios. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- Travel time increases (deterioration) with the Project would generally be less than five minutes for most bus routes during the weekday peak hours in both 2031 and 2041
- Travel times would improve (decrease) with the Project in 2031 in the northbound direction for the R2 during the AM peak hour and the northbound direction for Route 59 during the PM peak hour. This is due to less congestion and delay along these routes as a result of traffic reassignment

- Similarly, travel times would improve (decrease) with the Project in 2041 during the AM peak hour in the northbound direction for the R4 and northbound direction for Route 59
- Notable increases (deterioration) in travel time of more than five minutes are expected for the following routes due to higher congestion and delay in certain locations along the route:
 - AM peak hour:
 - R2: around a six to nine minute increase (deterioration) in the southbound direction in 2031 and 2041
 - R4: around a five to six minute increase (deterioration) in the southbound direction in 2041
 - PM peak hour:
 - R2: around a seven to eight minute increase (deterioration) in the northbound direction in 2041 and 10 to 15 minute increase (deterioration) in the southbound direction in 2031 and 2041
 - Route 59: around a six to seven minute increase (deterioration) in the northbound direction and 13 to 14 minute increase (deterioration) in the southbound direction in 2041.

National Triangle-Barton alignment option

Bus travel times were modelled to compare weekday peak hour vehicle travel time with and without the Project in 2031 and 2041 scenarios. Key impacts have been listed below and are discussed further in Technical Report 1 – Traffic and transport.

- Travel time increases (deterioration) with the Project would generally be less than five minutes or would improve (decrease) for all bus routes during the weekday PM peak hour in both 2031 and 2041 scenarios
- Notable increases (deterioration) in travel times greater than five minutes are only expected in the AM peak hour for the following routes due to higher congestion in certain locations along the route:
 - R2: around an eight to nine minute increase (deterioration) in the southbound direction in 2031 and 2041
 - R4: around a six to nine minute increase (deterioration) in the southbound direction in 2031 and 2041
 - Route 59: around a three to six minute increase (deterioration) in the northbound direction in 2031 and six to nine minute increase (deterioration) in the southbound direction in 2031 and 2041.

Active travel

Active travel arrangements for the Project have been considered in relation to the existing cycling and pedestrian network and the ACT Government Active Travel Plan 2024-2030. Key considerations for active travel arrangements for the Project have included the identification of priority corridors, access to light rail stops, and the integration into the existing and planned network to support long-term future network planning.

To promote more continuous active travel links through the area, new active travel links and infrastructure provided as part of the Project would enhance the active travel network overall. This would include:

- Four new pedestrian and cyclist bridges
- Shared paths to connect with the existing and/or planned active travel network
- Bike/scooter parking provisions near stops
- Modifications to existing active travel pathways (such as on road cycleways, off road shared pathways and dedicated off road cycleways) to accommodate or integrate with the Project

- Shared paths to reinstate affected active travel links.

Car parking and kerbside

Off-street car parking and on-street kerbside uses (including car parking, loading zones, taxi zones and other kerbside uses) that would be permanently removed and are listed in Table 11-2. Further detail on the location of these parking and kerbside uses within each individual precinct is provided in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

Table 11-2 Summary of off/on-street parking and kerbside uses permanently removed as part of the Project

Precinct	Alignment option			
	State Circle East		National Triangle-Barton	
	On-street ¹	Off-street	On-street ¹	Off-street
Commonwealth Avenue	0 spaces	0 spaces	0 spaces	20 spaces
Parliament House	31 spaces	0 spaces	0 spaces	0 spaces
National Triangle	0 spaces	0 spaces	30 spaces	0 spaces
Barton	0 spaces	0 spaces	115 spaces	1 space
Inner South	3 spaces	0 spaces	3 spaces	0 spaces
Yarra Glen	0 spaces	0 spaces	0 spaces	0 spaces
Woden	0 spaces	83 car + 6 motorcycle spaces	0 spaces	83 car + 6 motorcycle spaces
Mitchel Depot	0 spaces	0 spaces	0 spaces	0 spaces
Total	34 spaces	83 car and 6 motorcycle spaces	148 spaces	104 car and 6 motorcycle spaces

Note 1: does not include parking loss as a result of any potential bus/coach zone relocations

Emergency vehicle access

The Project includes several new turn restrictions and intersection modifications, as detailed in Section 5.9 of Chapter 5 (Project description). However, emergency vehicles could continue to perform these movements if required under light and siren conditions. Similarly, emergency vehicles would be able to use the light rail alignment during emergency situations.

Therefore, the Project is expected to have a minor impact on emergency vehicle access.

Road safety

The introduction of light rail vehicles (LRVs) within the roadway presents a risk of possible vehicular, pedestrian, or cyclist collision with the LRV. The following aspects have been included in the design to reduce the likelihood of a crash occurring with the LRVs, and/or reduce the crash severity if a crash were to occur:

- Right turn movements across the light rail track would only be permitted at signalised intersections and in a separate signal phase to the LRVs
- For the majority of the Project alignment, the LRV corridor would be located within existing road reserves and separated from other vehicles by a kerb or other physical barrier
- Speed reductions along some of the roads adjacent to the Project alignment.

The Project presents the following road safety benefits:

- Providing new signalised pedestrian crossings to improve pedestrian safety along the alignment, particularly near new light rail stops

- Providing new signalised intersections along the alignment would likely reduce the risk of intersection crashes associated with drivers taking risks when giving way at currently unsignalised intersections
- Providing other minor intersection modifications within the study area such as kerb modifications to reduce vehicle turning speeds and/or improve pedestrian safety
- Speed reductions along many of the roads adjacent to the Project alignment, which would reduce the likelihood and severity of potential crashes.

Project safety is assessed under the Rail Safety National Law and ongoing design development would be subject to detailed safety reviews to identify requirements for mitigation to reduce the risk of incidents arising from collisions.

11.1.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole.

11.2 Biodiversity

This section describes the potential impacts of the Project on biodiversity across the Project area. Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity.

Potential impacts within each precinct are summarised in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

Species protected under both Commonwealth and ACT legislation have been considered in this assessment. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legal framework for the protection and management of Matters of National Environmental Significance (MNES), including nationally and internationally important flora, fauna, ecological communities. The *Nature Conservation Act 2014* (NC Act) is the primary legislation in the ACT for the protection of native flora and fauna, and for the management of the conservation reserve network. The NC Act establishes the ACT Conservator for Flora and Fauna, the ACT Parks and Conservation Service, and other entities. Further information on other relevant Commonwealth and ACT legislation is discussed in Section 2 of Technical Report 2 – Biodiversity and in Chapter 8 (Legislation and policy).

The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 3 of Technical Report 2 – Biodiversity.

11.2.1 Existing environment

This section provides an overview of the existing biodiversity values within the Project area. This section describes the existing ecological communities within the Project, identifies those which are vulnerable and threatened, and, following identification of avoidance areas to minimise potential impacts, assesses those potentially impacted by the clearance footprint of the Project. Key terms used in this section and throughout the biodiversity assessment include:

- Project area – the area where Project construction activities would occur, as described in Section 6.1 of Chapter 6 (Construction). It is within an existing urbanised area where the majority of the vegetation is exotic grassland and exotic landscape plantings
- Avoidance area – the area identified in the Project design to avoid direct impacts to areas of biodiversity sensitivity
- Clearance footprint – the area identified to be cleared of vegetation as part of Project construction.

Species and ecological communities listed on the EPBC Act and NC Act have been reviewed for their presence in the vicinity of the Project area and noted if they are assessed in the EIS (refer to Table 11-3).

Table 11-3 Screening of species and ecological communities to be assessed in the EIS

Name	Presence near the Project Area	Assessed in the EIS
Threatened Ecological Communities		
Natural Temperate Grasslands of the South Eastern Highlands	This community is known to occur in small patches within the areas adjacent to the Project area.	Assessed
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	The Project area is unlikely to support this community, due to the low lying landscape which is not favourable for this community.	Not assessed further
Threatened fauna		
Golden Sun Moth (<i>Synemon plana</i>)	This species has been consistently recorded numerous times within the Project area.	Assessed
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	The Gang-gang Cockatoo is known to occur in the landscape.	Assessed
Superb Parrot (<i>Polytelis swainsonii</i>)	There are multiple known records of this species within the Project area.	Assessed
Swift Parrot (<i>Lathamus discolor</i>)	Suitable foraging habitat is located within the Project area.	Assessed
Southern Whiteface (<i>Aphelocephal leucopsis</i>)	Suitable foraging habitat is located within the Project area in Mitchell Depot.	Assessed
Brown Treecreeper (southeastern) (<i>Climacteris picumnus victoriae</i>)	Suitable foraging habitat is located within the Project area in Mitchell Depot.	Assessed
Striped Legless Lizard (<i>Delma impar</i>)	Grasslands within the Project area may support this species.	Assessed
Canberra Grassland Earless Dragon (<i>Tympanocryptis lineata</i>)	The nearest known population is greater than 5 km from the Project area. It is highly unlikely that this species would exist within the Project area.	Not assessed further
Key's Matchstick Grasshopper (<i>Keyacris scurra</i>)	Potentially suitable habitat exists within the Project area.	Assessed
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	A roosting camp is located near the Project area in Commonwealth Park.	Assessed
Perunga Grasshopper (<i>Perunga ochracea</i>)	Potentially suitable habitat exists within the Project area.	Assessed
Canberra Raspy Cricket (<i>Cooraboorama canberrae</i>)	Potentially suitable habitat exists within the Project area.	Assessed
Threatened flora		
Button Wrinklewort (<i>Rutidosia leptorhynchoides</i>)	This species may occur within natural temperate grassland within the Project area.	Assessed

Name	Presence near the Project Area	Assessed in the EIS
Small Purple-pea (<i>Swainsona recta</i>)	This species may occur within remnant patches of native grassland within the Project area.	Assessed
Matted Flax-lily (<i>Dianella amoena</i>)	It is unlikely that this species occurs within the Project area. However, targeted surveys were completed as it was identified as a focal species for the Project.	Assessed
Hoary Sunray (<i>Leucochrysum albicans</i> subsp. <i>tricolor</i>)	This species may occur within natural temperate grassland within the Project area.	Assessed

Desktop review and field surveys

A desktop review has been conducted to identify any known biodiversity values in the Project area. This has included searching relevant databases, species profiles for fauna species and populations, species habitat preferences, and other information relating to the Project area. Published broad-scale mapping within a minimum 10 km search area has been used to identify species that may occur in, utilise, or transit through the Project area. Further detail on relevant database searches is provided in the Chapter 10 (Assessment methodologies).

A search of the EPBC Act 'Protected Matters Search Tool' (PMST) has identified that two threatened ecological communities, 58 threatened species and 13 migratory species may occur within a 10 km radius of the Project area (Department of Climate Change, Energy, Environment and Water, 2024). There are no registered trees listed under the ACT *Urban Forest Act 2023* located in the Project area (ACT Government, 2024).

Field surveys have been carried out by qualified field ecologists within the Project area between 2021 and 2024. The objective of the field surveys was to confirm the presence and extent of native vegetation (as defined under the NC Act) and the ecological communities, species and species habitat that occur or have the potential to occur within the Project area.

Habitat connectivity

The ACTmapi 'Significant Species, Vegetation Communities and Registered Trees' layer includes habitat connectivity for generalist, woodland, and forest bird species across Canberra, based on the presence and density of the trees.

The habitat connectivity value for generalist species is mostly low within the Project area however, there are patches with medium connectivity value, between the Parliament House and Woden precincts.

A moderate level of habitat connectivity is provided for forest species in all Project precincts except the Mitchell Depot site. This habitat connectivity is provided by the distribution of planted trees and shrubs. The plantings also provide important linkages along the Yarralumla Creek and into Red Hill Nature Reserve within the Yarra Glen precinct. The Project area supports large patches of native and exotic plantings that provide important habitat connectivity, enabling animals to move between core habitat areas within the urban landscape. This includes many mature native and hollow-bearing trees.

The Project area exhibits a high connectivity value for forest bird species within the corridor between the Molonglo Valley and Red Hill Nature Reserve located between the Parliament House and Woden precincts. The Project area sits across an important flight corridor for the Superb Parrot (*Polytelis swainsonii*), with breeding pairs travelling between the Molonglo Valley nesting trees and the Red Hill Nature Reserve to forage multiple times per day. ACTmapi also indicates that the National Triangle and Barton precincts contain relatively important functional vegetation canopy connections for the local area.

Vegetation assessment

Native and non-native vegetation within the Project area is comprised of the following five communities:

- ACT01.2 Tablelands Dry Tussock Grassland – natural temperate grassland (Moderate diversity) (0.01 ha)
- Non-Local Native Groundcover (0.58 ha)
- Landscape Plantings – Native (20.52 ha)
- Landscape Plantings – Exotic (29.31 ha)
- Exotic grassland (49.75 ha).

These vegetation communities are discussed further in the following sections with a summary of the extent of each in Projects provided in Table 11-4 and shown on Figure 11-10 to Figure 11-17.

While the Project area extends over Lake Burley Griffin, the lake edge is a built structure with grassy banks. No riparian vegetation communities are present. There are also no threatened aquatic ecological communities in Lake Burley Griffin.

Table 11-4 Extent of vegetation communities within the Project area

Vegetation community	Area (ha)								
	Common-wealth Avenue precinct	Parliament House precinct	National Triangle precinct	Barton precinct	Inner South precinct	Yarra Glen precinct	Woden precinct	Mitchell Depot site	Total
ACT1.2 Tablelands Dry Tussock Grassland (Moderate diversity)	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Non-local native ground cover	0.07	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.58
Landscape plantings – Native	1.38	8.17	1.16	0.29	3.33	3.92	1.61	0.66	20.52
Landscape plantings – Exotic	5.63	1.17	3.40	8.07	1.62	8.09	1.33	0.002	29.31
Exotic grassland	6.67	9.78	1.93	2.23	4.31	23.10	0.95	0.78	49.75



Figure 11-10 Vegetation communities, hollow-bearing, and mature trees in the Commonwealth Avenue precinct

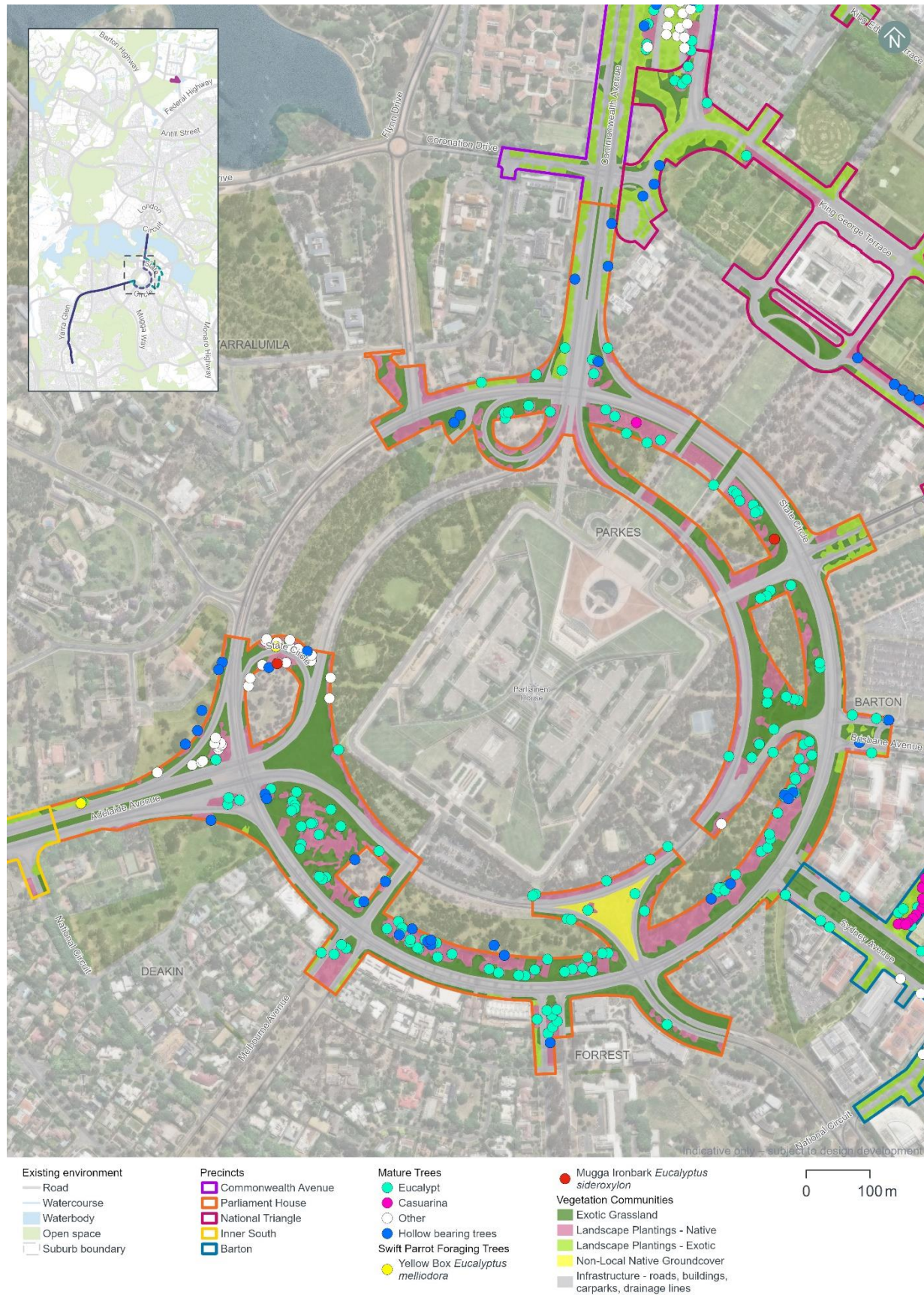


Figure 11-11 Vegetation communities, hollow-bearing, and mature trees in the Parliament House precinct

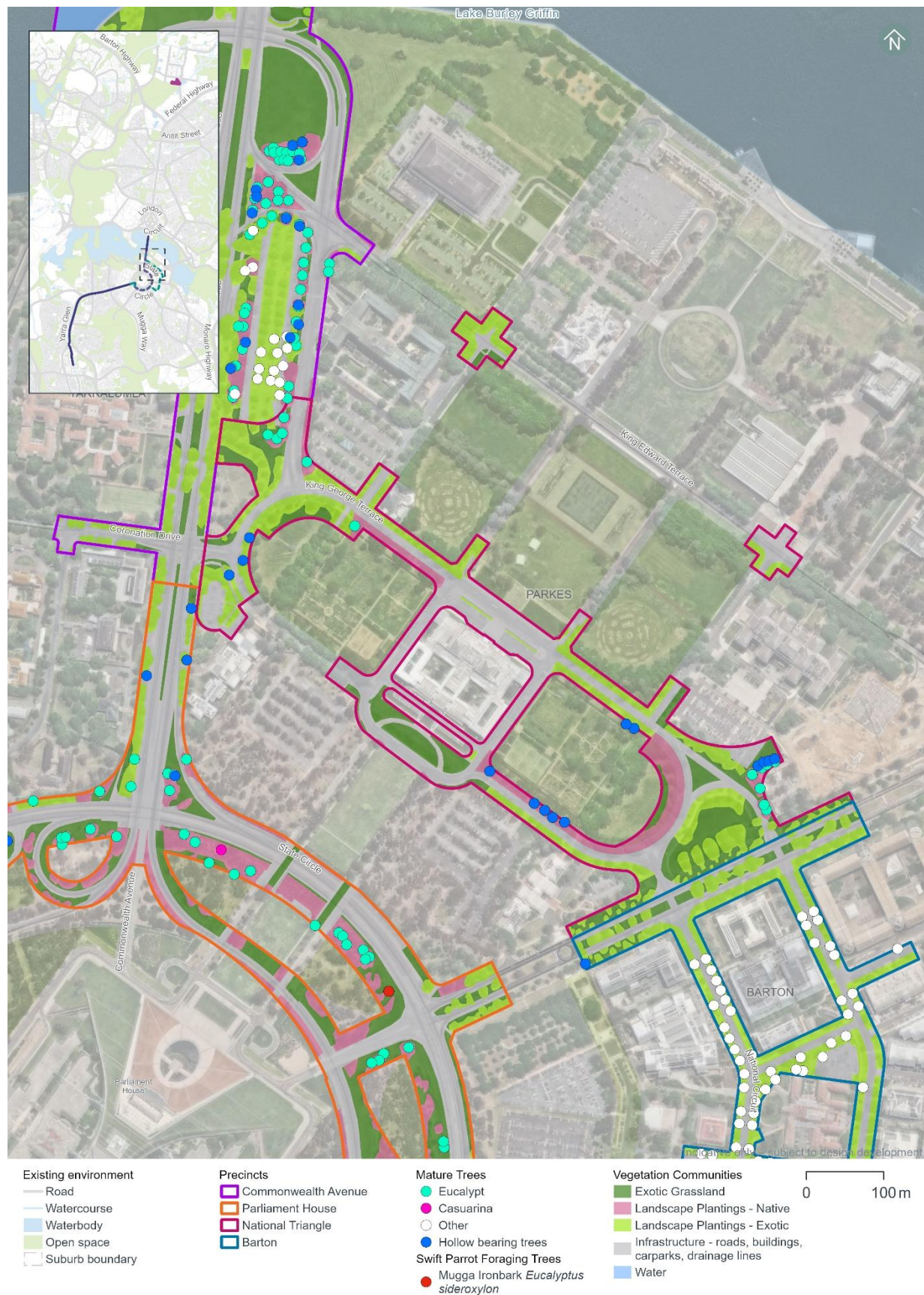


Figure 11-12 Vegetation communities, hollow-bearing, and mature trees in the National Triangle precinct

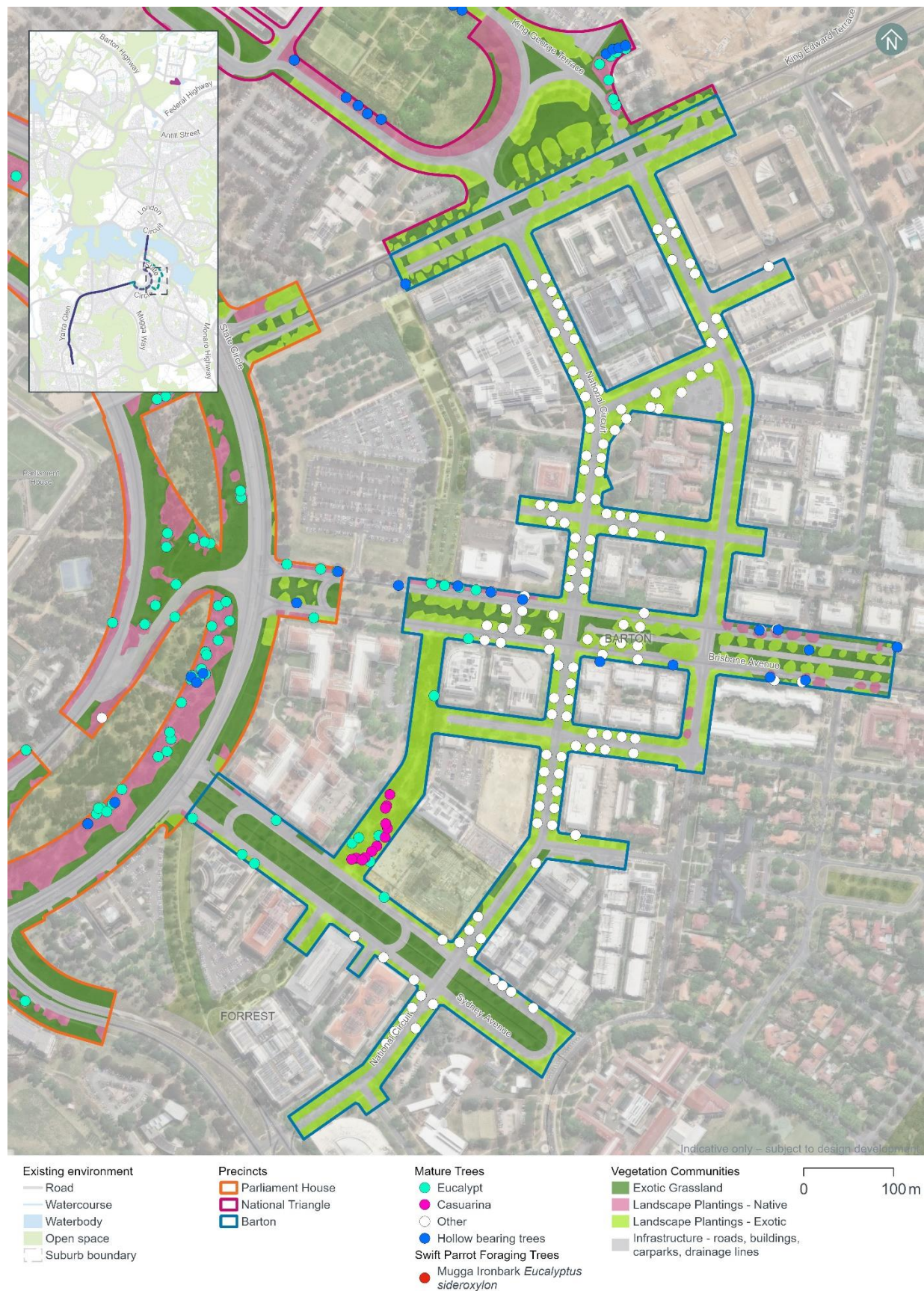


Figure 11-13 Vegetation communities, hollow-bearing, and mature trees in the Barton precinct

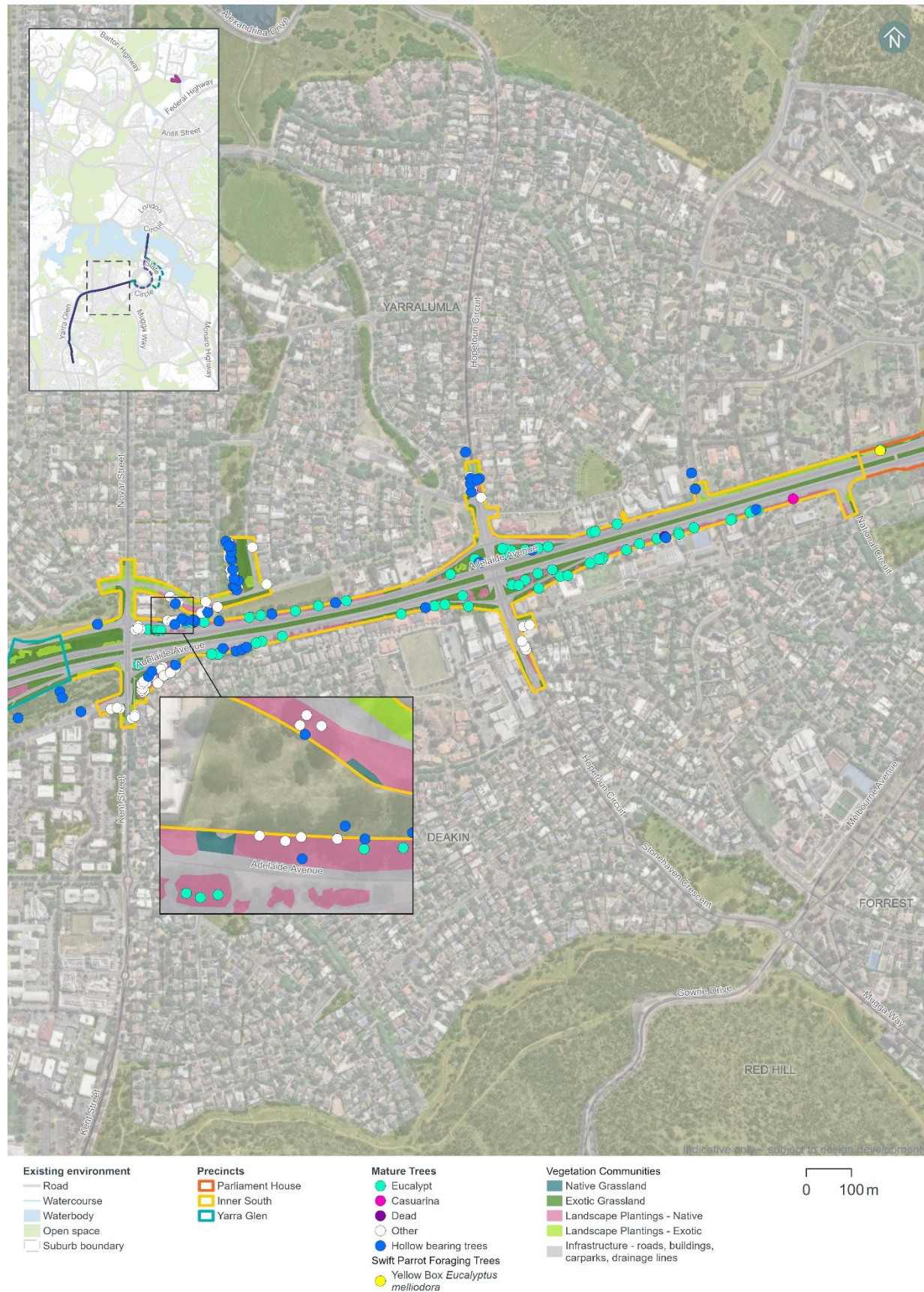


Figure 11-14 Vegetation communities, hollow-bearing, and mature trees in the Inner South precinct



Figure 11-15 Vegetation communities, hollow-bearing, and mature trees in the Yarra Glen precinct

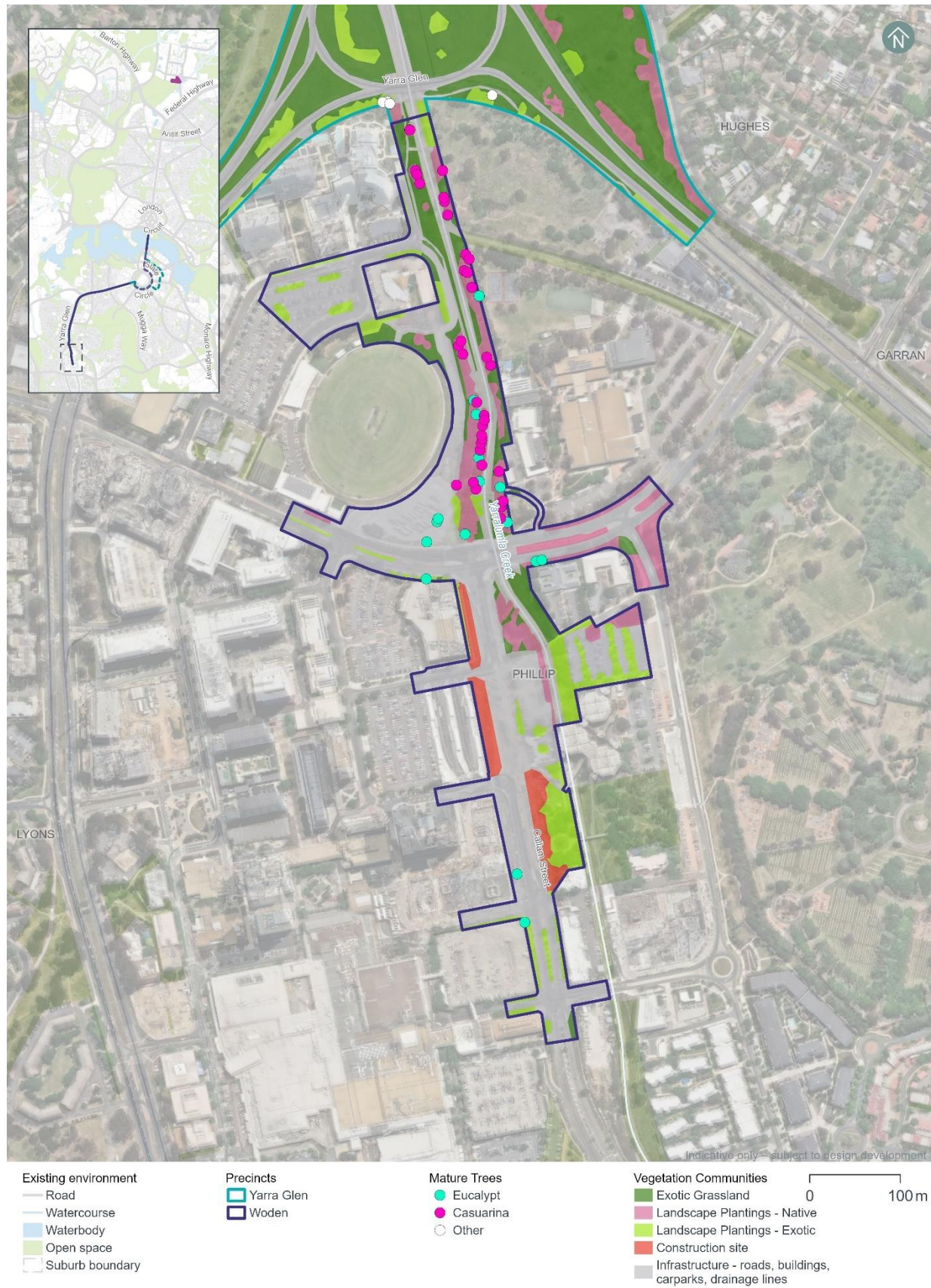


Figure 11-16 Vegetation communities, hollow-bearing, and mature trees in the Woden precinct

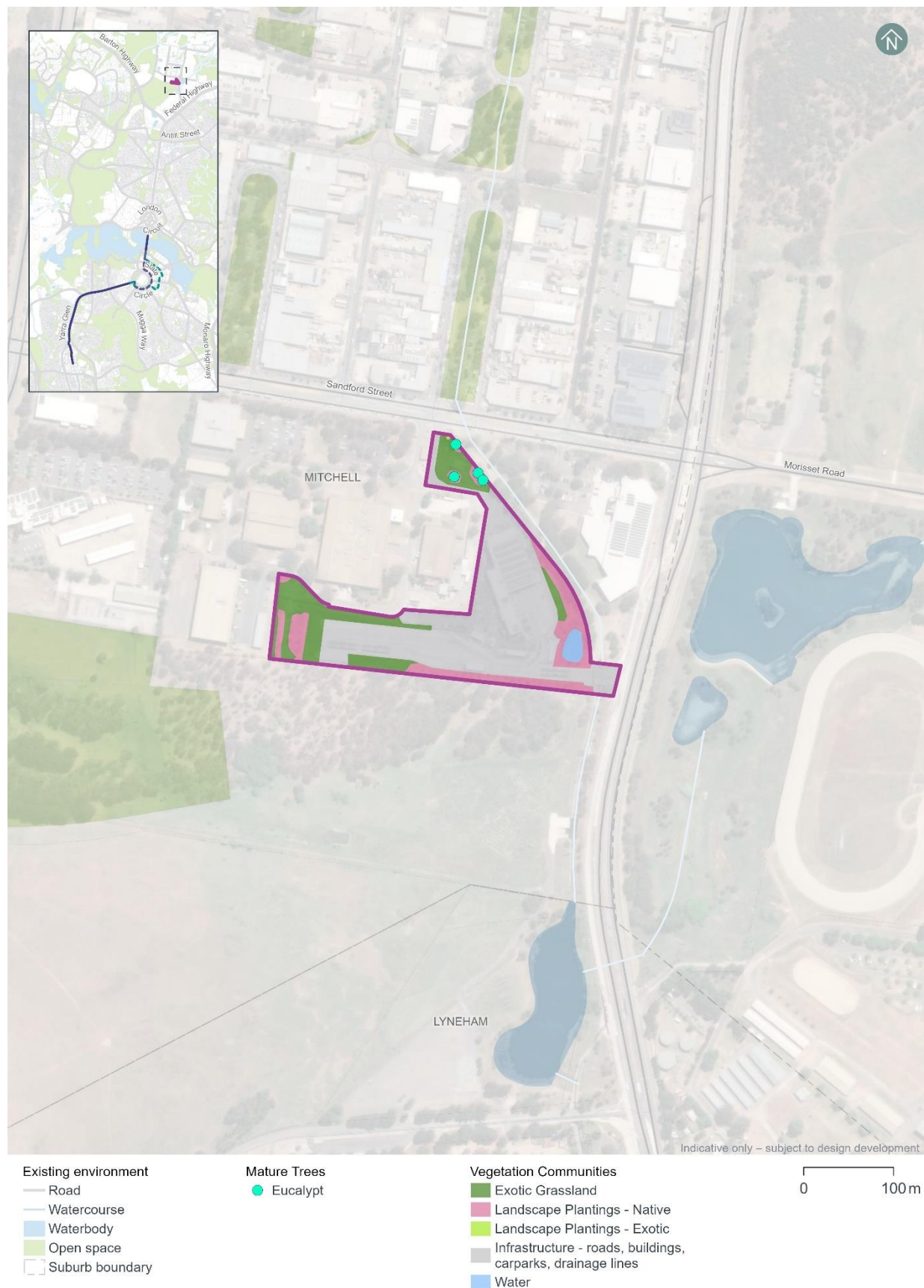


Figure 11-17 Vegetation communities, hollow-bearing, and mature trees in the Mitchell Depot site

ACT01.2 Tablelands Dry Tussock Grassland

The Project area contains two small patches of ACT01.2 with a combined extent of 0.01 ha, located in the Inner South precinct. These patches have been assessed against the listing criteria under the EPBC Act listed 'Natural temperate grassland of the South Eastern Highlands', a critically endangered ecological community.

The two patches within the Project area are situated on either end of a larger patch of ACT01.2 (0.09 ha), which is surrounded by Landscape Plantings – Native. Taking the size of the larger patch into account, the total extent of ACT01.2 is below the minimum threshold to be classified as EPBC Act or NC Act Natural temperate grassland.

Non-local native ground cover

Two patches of non-local native grasses with a combined extent of 0.58 ha have been recorded within road medians in the Commonwealth Avenue and Parliament House precincts. The patches are dominated by couch grass (*Cynodon dactylon*), a non-local native species. Other native and exotic species including windmill grass, African lovegrass, and Chilean needlegrass are also present in these patches.

Landscape Plantings – Native

The Landscape Plantings – Native vegetation community is a planted local and non-local native tree species community with mixed native and exotic understorey. A total extent of 20.52 ha has been identified within the Project area with most located in the Parliament House, Inner South, and Yarra Glen precincts. The plantings are often found adjacent to main roads, or acting as a screen between the road and residential areas. Common local species identified in the vegetation community include river she-oak, red box, brittle gum, and yellow box. Non-local plantings include blue gum, argyle apple, and black cypress pine (*Callitris endlicheri*). Planted native shrubs include Cootamundra wattle and green wattle (*Acacia decurrens*).

Other recorded species include swamp dock (*Rumex brownii*), kidney weed (*Dichondra repens*), climbing saltbush (*Einadia nutans*), poison rock fern, star cudweed, yellowish bluebell (*Wahlenbergia luteola*), tufted bluebell, narrow leaved New Holland daisy, cut-leaf goodenia (*Goodenia pinnatifida*), fuzzweed (*Vittadinia cuneata* var. *cuneata*), and sticky everlasting (*Xerochrysum viscosum*).

The groundcover in these patches is mostly a mixture of native and exotic perennial grasses, including the highly invasive Chilean needlegrass (*Nassella neesiana*), African lovegrass (*Eragrostis curvula*) and St. John's wort (*Hypericum perforatum*).

Landscape Plantings – Exotic

The Landscape Plantings – Exotic vegetation community is planted exotic trees with mixed native and exotic understorey. A total extent of 29.31 ha have been identified within the Project area. The plantings are mainly located within the Commonwealth Avenue, National Triangle, Barton, and Yarra Glen precincts adjacent to the road or are used as amenity features in front of residential buildings.

Dominant tree species include white poplar (*Populus alba*) and elm, with a groundcover dominated by exotic perennial grasses. These include Chilean needlegrass (*Nassella neesiana*) and exotic forbs including cranesbill geranium (*Geranium molle*), white clover (*Trifolium repens*), common sow thistle (*Sonchus oleraceus*), prickly lettuce (*Lactuca serriola*), common bittercress (*Cardamine hirsuta*), shepherd's purse (*Capsella bursa-pastoris*), lamb's tongues (*Plantago lanceolata*), common mallow (*Malva neglecta*), burr medic (*Medicago polymorpha*), and red-flowered mallow (*Modiola caroliniana*).

Exotic grassland

A total of 49.75 ha of the Exotic – grassland vegetation community has been identified within the Project area. Identified patches consist primarily of exotic perennial grass species such as Chilean needlegrass (*Nassella neesiana*), African lovegrass (*Eragrostis curvula*) and goose grass (*Eleusine tristachyna*).

Within the Exotic – grassland community, small patches (less than 0.05 ha) of disturbance tolerant native grasses have also been recorded. These patches support species including red-leg grass (*Bothriochloa macra*) and windmill grass (*Chloris truncata*). Young exotic trees including white poplar (*Populus alba*) and elm (*Ulmus* sp.), which have been planted in adjacent landscape plantings often occur within the grasslands. Other species include red-flowered mallow (*Modiola caroliniana*), common

cranesbill (*Geranium retrorsum*), red clover (*Trifolium pratense*), catsear (*Hypochaeris radicata*), dandelion (*Taraxacum officinale*), common sow thistle (*Sonchus oleraceus*), hairy brassica (*Hirschfeldia incana*), common mallow (*Malva neglecta*), lamb's tongue (*Stachys byzantina*), and black-berry nightshade (*Solanum nigrum*).

Hollow-bearing and mature trees

A total of 170 hollow-bearing trees and up to 619 mature trees have been recorded within the Project area which is summarised in Table 11-5 and shown on Figure 11-10 to Figure 11-17.

Most of the recorded hollow-bearing trees are species endemic to the ACT. This includes yellow box (*Eucalyptus melliodora*), Blakely's red gum (*E. blakelyi*), brittle gum (*E. mannifera*), apple box (*E. bridgesiana*), inland scribbly gum (*E. rossii*), ribbon gum (*E. viminalis*), red box (*E. polyanthemos*), and river she-oak (*Casuarina cunninghamiana*). Other common species include southern blue gum (*E. globulus*), argyle apple (*E. cinerea*), maiden's gum (*E. maidenii*), Wallangarra white gum (*E. scoparia*), and Mugga ironbark (*E. sideroxylon*). Exotic species with hollows include cedar (*Cedrus* sp.), Monterey pine (*Pinus radiata*), poplar (*Populus* sp.), oak (*Quercus* sp.), willow (*Salix* sp.), and elm (*Ulmus* sp.).

Evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance) has been recorded through survey. Other native animals including the common brush-tail possum (*Trichosurus vulpecula*) and Kreffts glider (*Petaurus notatus*) have also been recorded using hollows during surveys. The Project area also supports important trees that provide connectivity for superb parrot (*Polytelis swainsonii*) breeding pairs flying between the Molonglo Valley breeding habitat and the Red Hill Nature Reserve foraging habitat, multiple times per day.

Mature trees are predominantly *Eucalyptus* spp., with 53 mature she-oaks and two mature dead trees also recorded. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence within the Project area. The methodology used to determine the likelihood of occurrence is described in Chapter 10 (Assessment methodologies).

Table 11-5 Distribution of hollow bearing and mature trees across the Project area

Precinct	Number of hollow-bearing trees	Hollows					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Commonwealth Avenue	35	0	30	9	9	4	64
Parliament House	38	1	28	25	8	3	184
National Triangle	14	2	4	1	5	5	20
Barton	13	0	2	3	7	0	163
Inner South	41	8	23	26	32	1	95
Yarra Glen	29	13	28	10	7	2	68
Woden	0	0	0	0	0	0	51
Mitchell Depot site	0	0	0	0	0	0	4
Total	170	24	115	74	68	15	620

Threatened Ecological Communities

There are no threatened ecological communities listed under EPBC Act or NC Act present within the Project area. While the Project area contains ACT0.12 Tablelands Dry Tussock Grassland, the extent is below the minimum threshold to be classified as EPBC Act or NC Act listed Natural Temperate Grassland.

Threatened fauna habitat

Threatened fauna surveys have been carried out in November and December 2021, January to March 2022, August to December 2023, April 2024, and July 2024.

Threatened fauna habitat identified within the precincts are discussed in the following sections. Two species identified within the Mitchell Depot site only (Southern Whiteface (*Aphelocephala leucopsis*) and Brown Treecreeper (*Climacteris picumnus*)) are discussed separately in Chapter 19 (Mitchell Depot site).

Golden Sun Moth habitat

The Golden Sun Moth (*Synemon plana*) is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 17.99 ha of potential Golden Sun Moth habitat has been recorded in the Project area as summarised in Table 11-6 and shown on Figure 11-18 to Figure 11-24. The figures also show recorded Golden Sun Moth sightings.

The distribution of individuals and evaluation of populations of Golden Sun Moths in the Project area has been informed by field surveys completed by Umwelt (2021 and 2023), and supplemented with historical survey data from (ARUP, 2021) and (Biosis, 2019).

The most commonly occurring habitat condition in the Project area is high-density Chilean needlegrass habitat followed by low-density Chilean needlegrass habitat with the majority of this habitat located in the Parliament House and Yarra Glen precincts. The majority of the habitat within the Project area is low quality Chilean needlegrass dominated habitat, with only 0.03 ha considered high quality. A summary of the condition class criteria is provided in Table 3.8 of Technical Report 2 – Biodiversity.

Table 11-6 Golden Sun Moth habitat survey results (2021-2023) in the Project area

Precinct	High Quality (ha)	Medium Quality (ha)	Low Quality (ha)	Low-Density Chilean Needlegrass (ha)	High-Density Chilean Needlegrass Dominated (ha)	Total (ha)
Commonwealth Avenue	0.00	0.00	0.00	0.00	0.86	0.86
Parliament House	0.00	0.00	0.00	2.35	2.78	5.13
National Triangle	0.00	0.00	0.00	0.00	0.44	0.44
Barton	0.00	0.00	0.00	0.06	0.17	0.23
Inner South	0.03	0.00	0.07	0.27	0.61	0.98
Yarra Glen	0.00	0.00	0.06	4.85	5.43	10.34
Woden	0.00	0.00	0.00	0.01	0.00	0.01
Mitchell Depot site	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.03	0.00	0.13	7.54	10.29	17.99



Figure 11-18 Golden Sun Moth habitat and sightings in the Commonwealth Avenue precinct



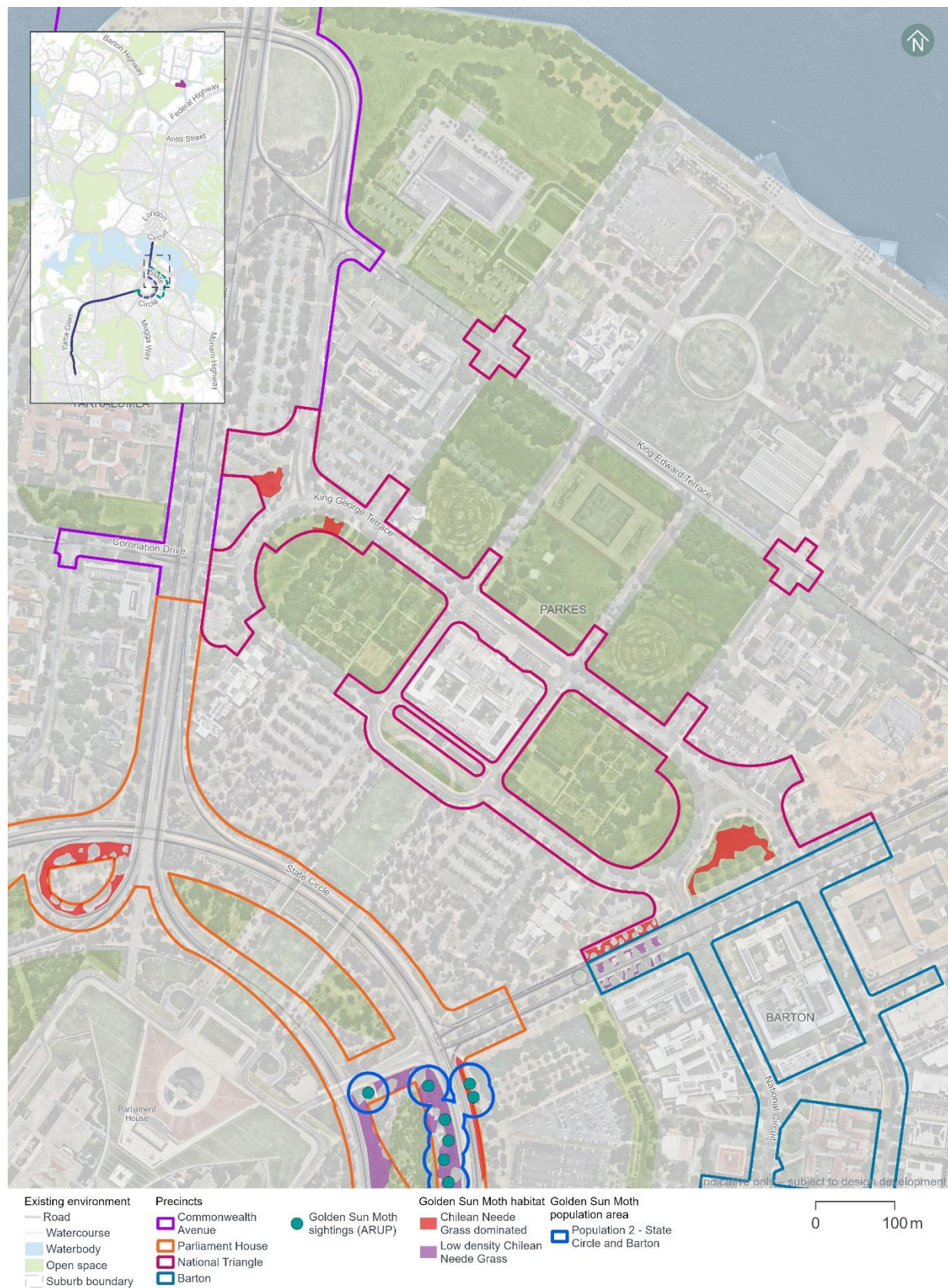


Figure 11-20 Golden Sun Moth habitat and sightings in the National Triangle precinct

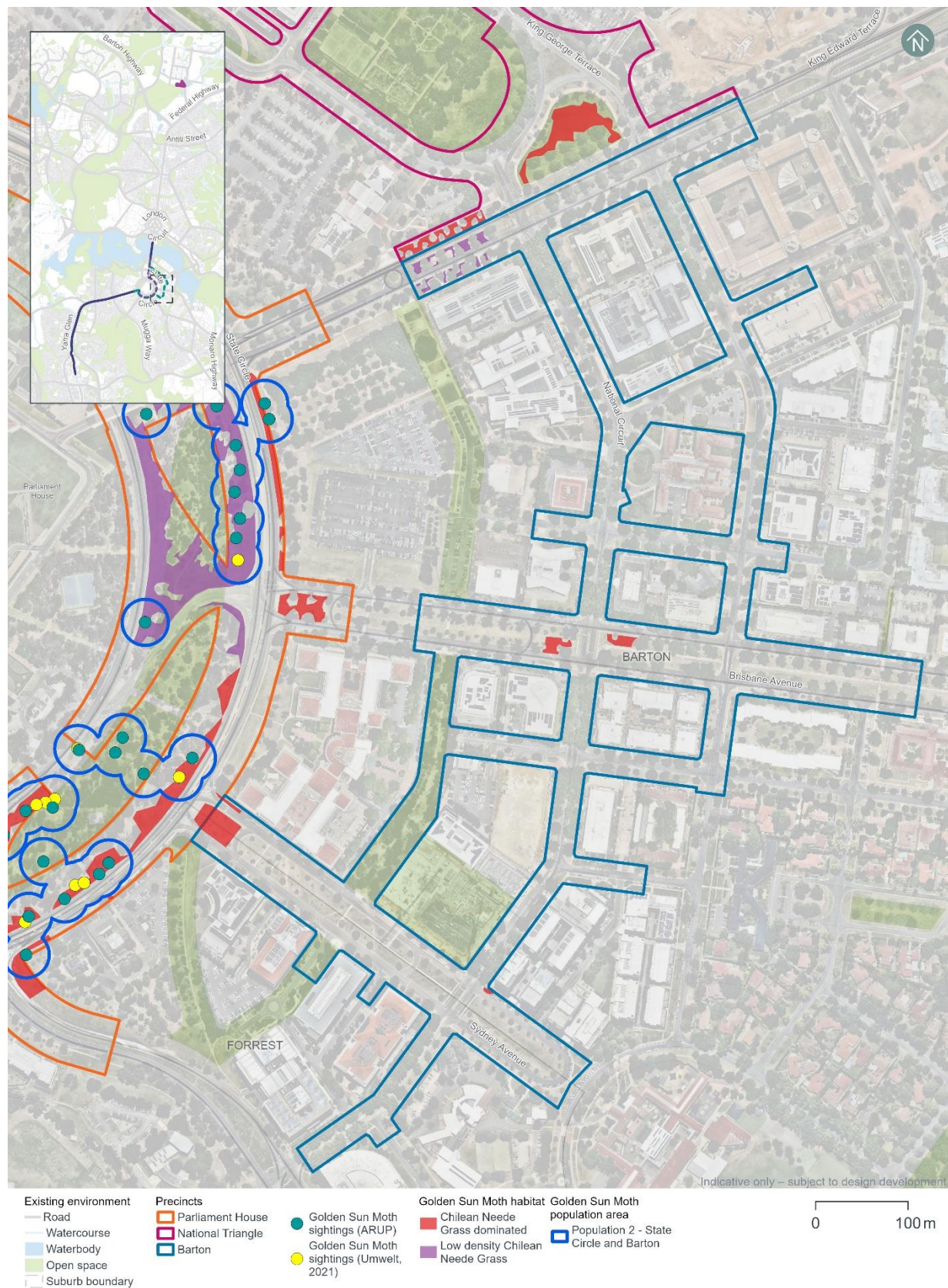


Figure 11-21 Golden Sun Moth habitat and sightings in the Barton precinct

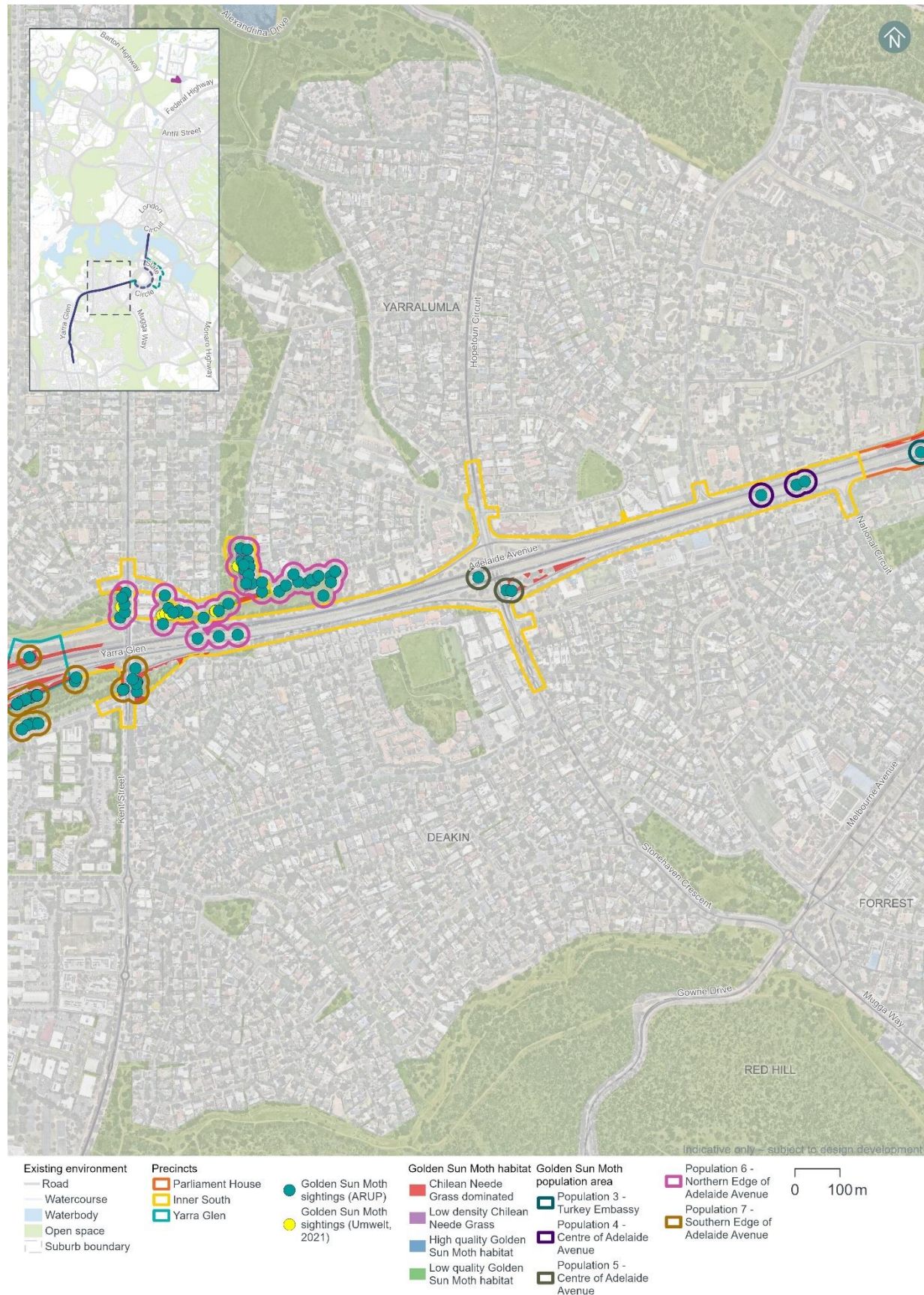


Figure 11-22 Golden Sun Moth habitat and sightings in the Inner South precinct

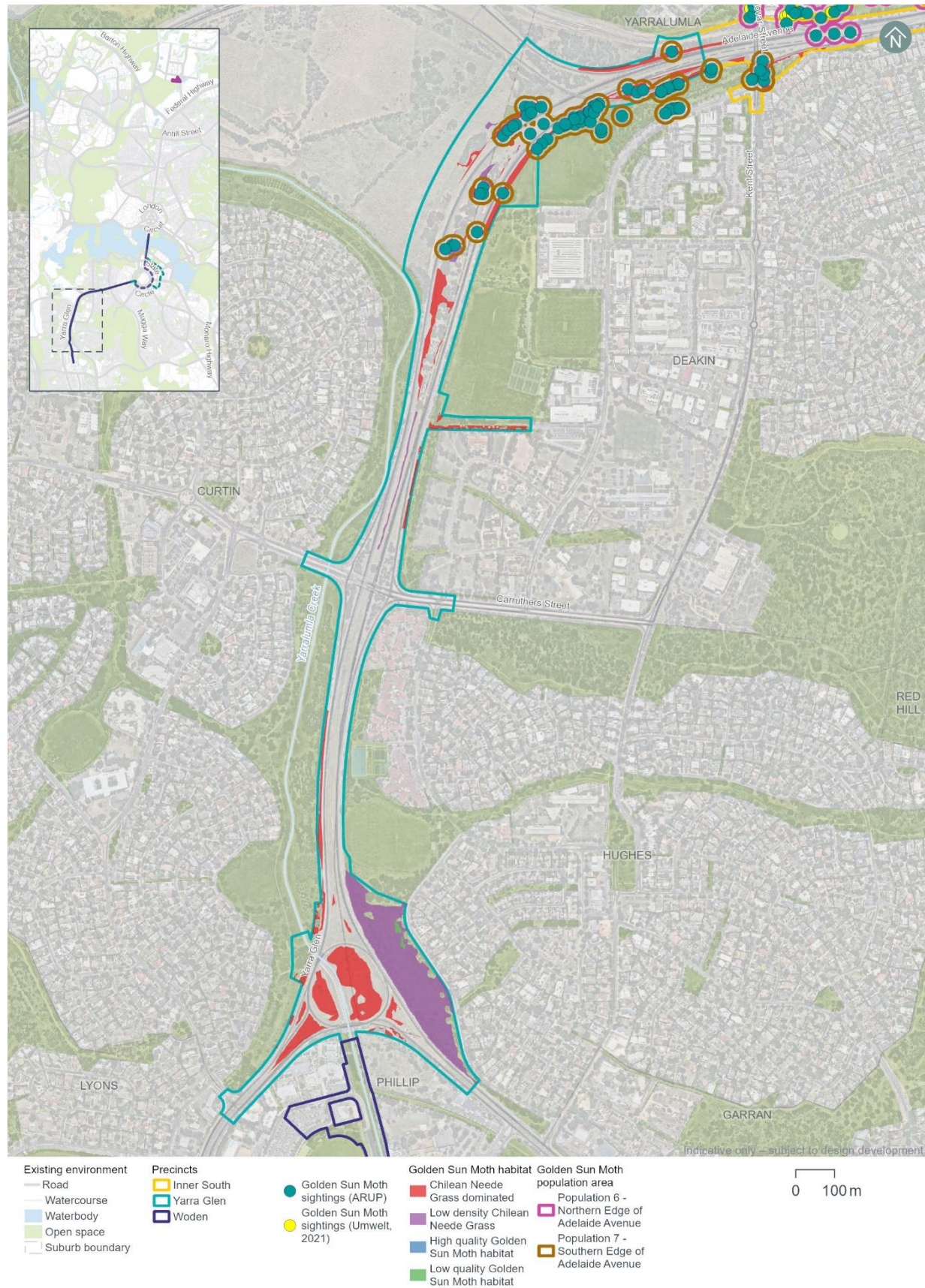


Figure 11-23 Golden Sun Moth habitat and sightings in the Yarra Glen precinct



Figure 11-24 Golden Sun Moth habitat and sightings in the Woden precinct

Golden Sun Moth populations are considered isolated if they occur greater than 200 m apart and taking into account habitat fragmentation and barriers to dispersal, such as obstacles over 1 m in height (Department of the Environment, Water, Heritage, and the Arts, 2009). The results of the targeted field surveys and data from (ARUP, 2021) and (Biosis, 2019) suggest that the Project area supports the following seven Golden Sun Moth populations (refer to Figure 11-18 to Figure 11-24):

- Population 1: Near Commonwealth Park (ARUP, 2021) (Commonwealth Avenue precinct).
- Population 2: Around State Circle and Barton (Parliament House and Inner South precincts)
- Population 3: On the western side of State Circle near the Embassy of Türkiye (Parliament House precinct)
- Populations 4 and 5: In the centre of Adelaide Avenue (Inner South precinct)
- Population 6: Along the northern edge of Adelaide Avenue near the Cotter Road Junction (Inner South precinct)
- Population 7: Along the southern edge of Adelaide Avenue near the Cotter Road Junction (Inner South and Yarra Glen precinct).

Gang-gang Cockatoo habitat

The Gang-gang Cockatoo (*Callocephalon fimbriatum*) is listed as endangered under both the EPBC Act and the NC Act. Gang-gang Cockatoos have been frequently observed within the Project area over the course of the field surveys. On multiple occasions, pairs (one male and one female) have been observed chewing at the entrance of a tree hollow and displaying potential breeding-like behaviour.

Consultation with the ACT Government ecologist has confirmed that breeding trees for the Gang-gang Cockatoo occur within 200 m of the Project area in Hughes, with other confirmed breeding trees known to occur in the broader area (including within the suburbs of Hughes, Deakin, Garran, and Red Hill and the Red Hill Nature Reserve).

The assessment of hollow-bearing trees has confirmed that 85 are suitable Gang-gang Cockatoo breeding trees as summarised in Table 11-7 and shown on Figure 11-25 to Figure 11-32. Trees have been categorised and prioritised based on their suitability as breeding trees:

- Priority 1 - tree contains a hollow(s) that show signs of Gang-gang Cockatoo nest preparation and/or have characteristics (i.e. depth, entrance, floor size and supporting limb) suitable for Gang-gang Cockatoo nesting
- Priority 2 - tree contains a hollow(s) that may be suitable for Gang-gang Cockatoo nesting in the future and are close to a confirmed Gang-gang Cockatoo nesting tree and/or Priority 1 tree
- Priority 3 - tree is a key foraging resource for Gang-gang Cockatoos.

Table 11-7 Number of suitable Gang-gang Cockatoo breeding trees in the Project area and priority for protection

Precinct	Priority level	Total
Commonwealth Avenue precinct	Priority 1 trees	4
	Priority 2 trees	6
	Priority 3 trees	3
Parliament House precinct	Priority 1 trees	13
	Priority 2 trees	6
	Priority 3 trees	4
National Triangle precinct	Priority 1 trees	5
	Priority 2 trees	2
	Priority 3 trees	0

Precinct	Priority level	Total
Barton precinct	Priority 1 trees	6
	Priority 2 trees	2
	Priority 3 trees	1
Inner South precinct	Priority 1 trees	11
	Priority 2 trees	6
	Priority 3 trees	15
Yarra Glen precinct	Priority 1 trees	0
	Priority 2 trees	0
	Priority 3 trees	0
Woden precinct	Priority 1 trees	0
	Priority 2 trees	0
	Priority 3 trees	0
Total	Priority 1 trees	39
	Priority 2 trees	23
	Priority 3 trees	23
	Total	85

Foraging habitat for the Gang-gang Cockatoo is widespread in the Project area (confirmed through consultation with the ACT Government ecologist), including in built-up areas. The Project area supports 20.52 ha of foraging habitat, which includes all patches of Landscape Plantings – Native, the majority of which is found in the Parliament House, Inner South, and Yarra Glen precincts (refer to Table 11-8 and Figure 11-25 to Figure 11-32).

Table 11-8 Extent of Gang-gang Cockatoo foraging habitat in the Project area

Precinct	Gang-gang Cockatoo foraging habitat (ha)
Commonwealth Avenue	1.38
Parliament House	8.17
National Triangle	1.16
Barton	0.29
Inner South	3.33
Yarra Glen	3.92
Woden	1.61
Mitchell Depot site	0.66
Total	20.52



Figure 11-25 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Commonwealth Avenue precinct

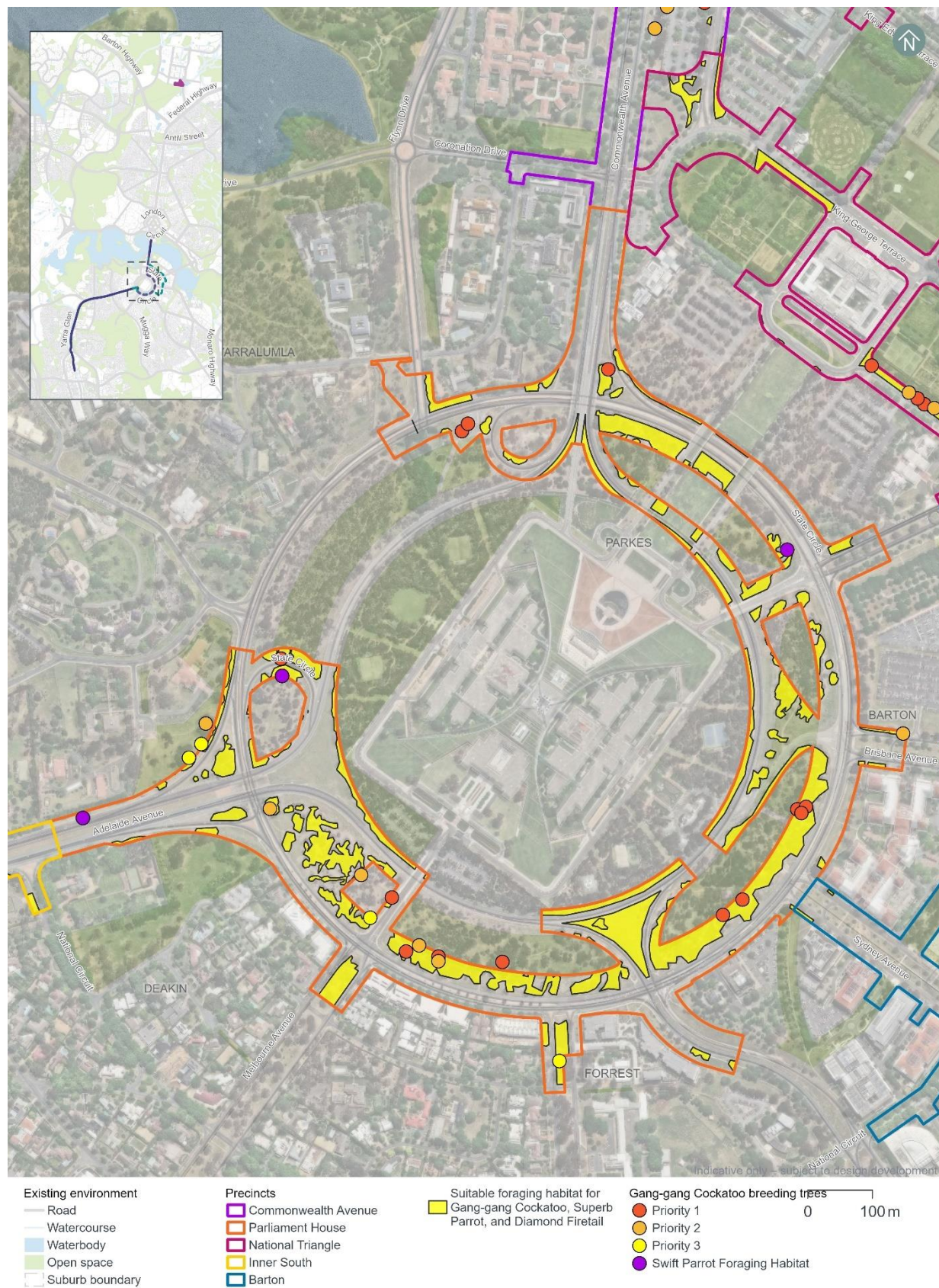


Figure 11-26 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Parliament House precinct

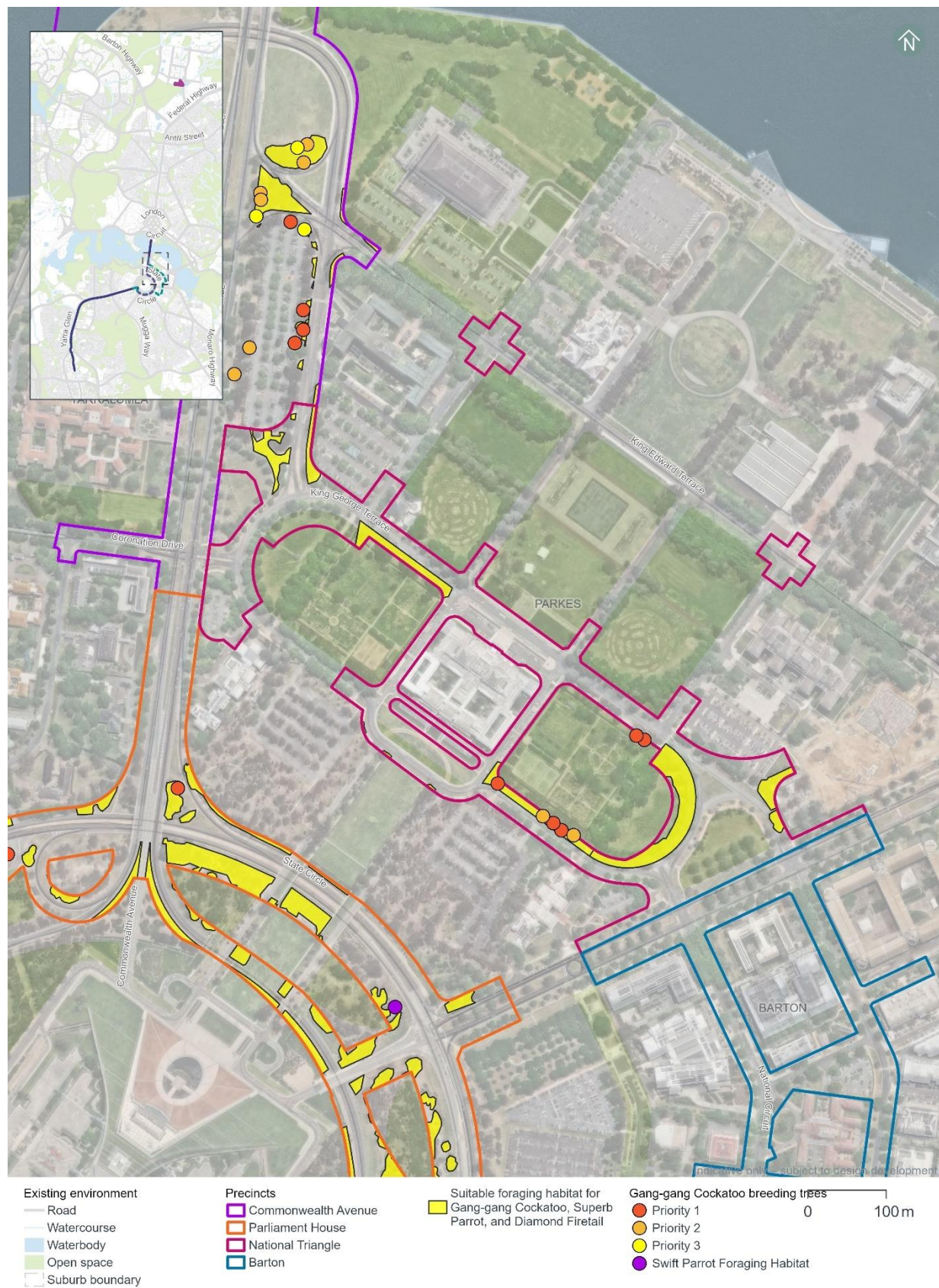


Figure 11-27 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the National Triangle precinct

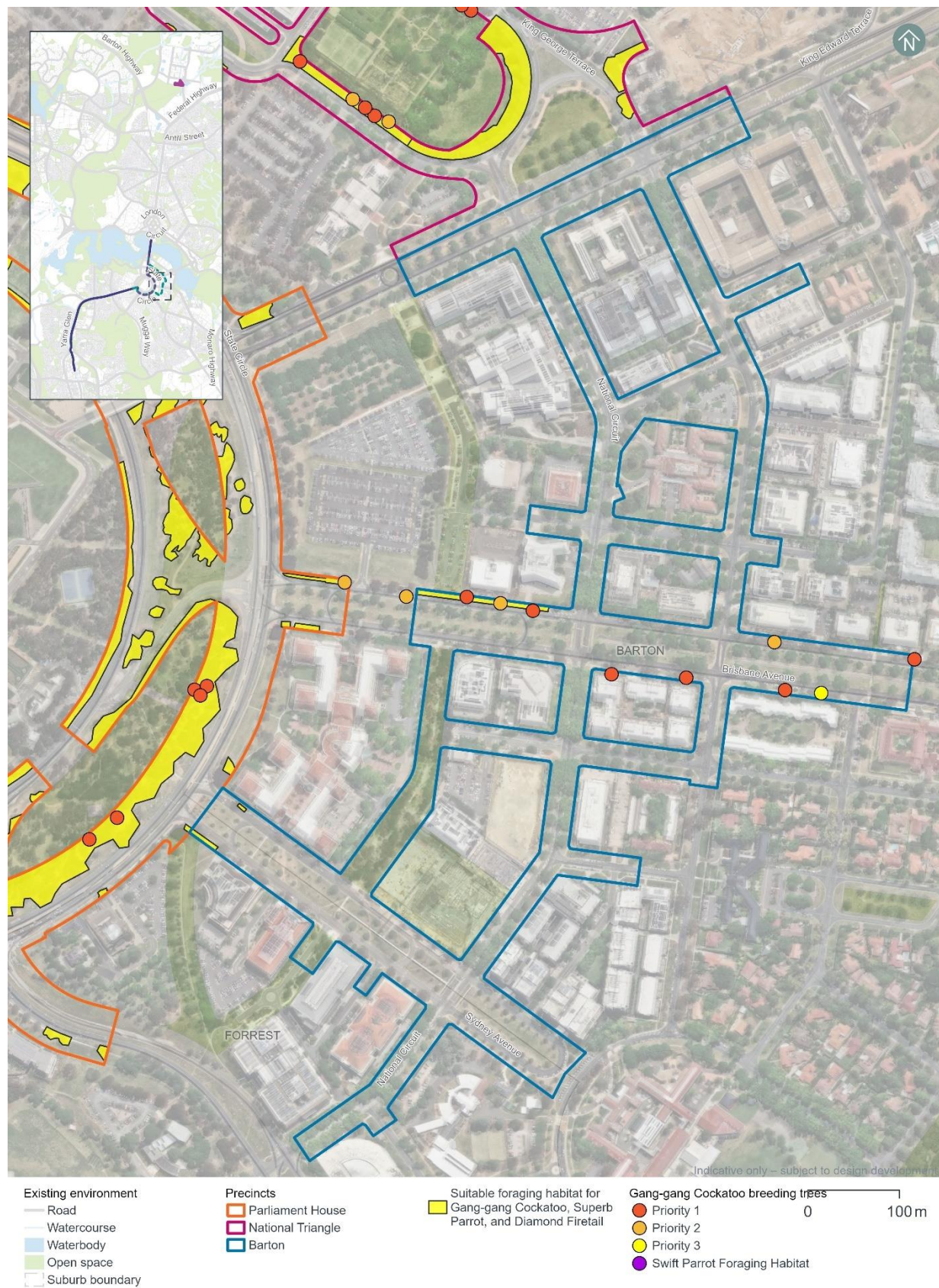


Figure 11-28 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Barton precinct

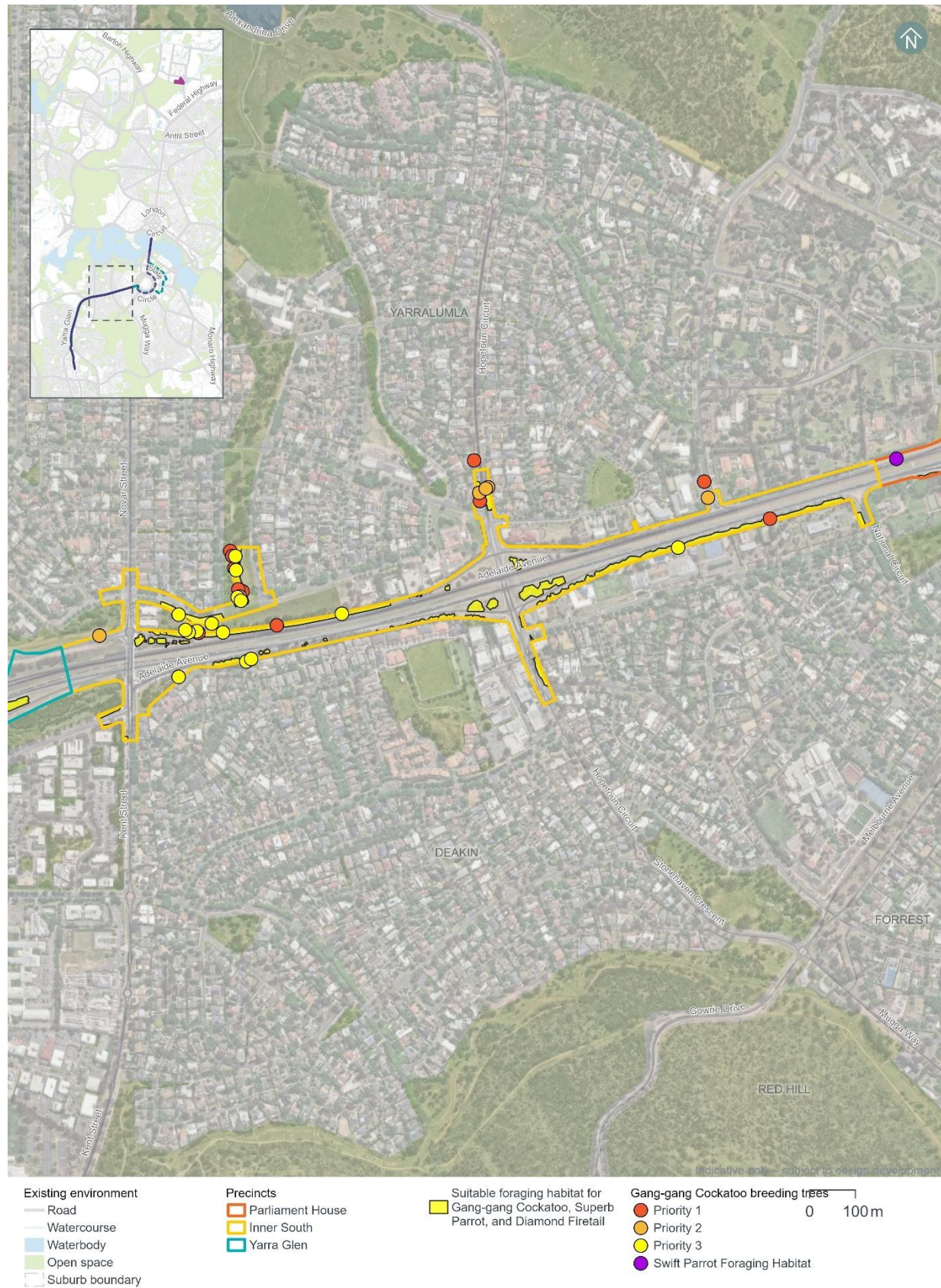


Figure 11-29 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Inner South precinct



Figure 11-30 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Yarra Glen precinct



Figure 11-31 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Woden precinct



Figure 11-32 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Mitchell Depot site

Superb Parrot habitat

The Superb Parrot (*Polytelis swainsonii*) is listed as vulnerable under both the EPBC Act and the NC Act. Superb Parrots have been regularly observed in the Project area over the course of the field surveys.

The Project area supports 20.52 ha of Superb Parrot foraging habitat with the majority found in the Parliament House, Inner South, and Yarra Glen precincts as summarised in Table 11-9 and shown on Figure 11-25 to Figure 11-32. This includes all patches of Landscape Plantings - Native.

Of the 11 preferred eucalypt foraging species for the Superb Parrot in the ACT (ACT Government, 2019), eight were recorded in or adjacent to the Project area. Other preferred species common in the Project area were river she-oak (*Casuarina cunninghamiana*), elm (*Ulmus* spp.), Monterey pine (*Pinus radiata*), and scattered wattle (*Acacia* spp.) trees.

Table 11-9 Extent of Superb Parrot foraging habitat in the Project area

Precinct	Superb Parrot foraging habitat (ha)
Commonwealth Avenue	1.38
Parliament House	8.17
National Triangle	1.16
Barton	0.29
Inner South	3.33
Yarra Glen	3.92
Woden	1.61
Mitchell Depot site	0.66
Total	20.52

Swift Parrot habitat

The Swift Parrot (*Lathamus discolor*) is listed as critically endangered under both the EPBC Act and the NC Act. Habitat critical to the survival of this species includes all preferred foraging species within known and likely foraging habitat on the Australian mainland. Preferred foraging species recorded in the Project area include Mugga ironbark (*Eucalyptus sideroxylon*) and yellow box (*Eucalyptus melliodora*) (Department of Climate Change, Energy, Environment and Water, 2024).

Swift Parrots preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees. The migratory nature of the species means that they require a large network of resources (Department of Climate Change, Energy, Environment and Water, 2024).

The Project area supports two mature Mugga ironbark trees and two mature yellow box trees. These are located in the Parliament House precinct and are shown on Figure 11-26.

Diamond Firetail habitat

The Diamond Firetail (*Stagonopleura guttata*) is listed as vulnerable under both the EPBC Act and the NC Act. All patches of Landscape Planting – Native across the Project area (except for the Mitchell Depot site) (19.87 ha) may provide suitable habitat for the Diamond Firetail as shown on Figure 11-25 to Figure 11-32. However, these patches do not support any fallen timber or large logs, in which this species may forage for insects. The understory is also subject to a regular mowing regime meaning that the grasses are unlikely to be provided opportunity to seed. These factors mean that the potential habitat in the Project area is unlikely to be high quality and preferred by the species.

Perunga Grasshopper habitat

The Perunga Grasshopper (*Perunga ochracea*) is listed as endangered under the NC Act. The two small patches (0.01 ha) of moderate quality grassland (ACT01.2) within the Inner South precinct could be considered potential habitat for the Perunga grasshopper.

Canberra Raspy Cricket habitat

The Canberra Raspy Cricket (*Cooraboorama canberrae*) is not listed under the EPBC Act or NC Act, but is nonetheless recognised as rare. The two small patches (0.01 ha) of moderate quality grassland (ACT01.2) within the Inner South precinct could be considered potential habitat for the Canberra raspy cricket.

Striped Legless Lizard habitat

The Striped Legless Lizard (*Delma impar*) is listed as vulnerable under both the EPBC Act and NC Act. The two small patches (0.01 ha) of moderate quality grassland (ACT01.2) within the Inner South precinct could be considered potential habitat for the striped legless lizard. While this patch is subject to routine mowing, due to the quality of the patch there is potential for it to support the species.

Grey-headed Flying-fox

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as vulnerable under both the EPBC Act and the NC Act. A colony of Grey-headed Flying-fox occurs within Commonwealth Park, adjacent to the northern shoreline of Central Basin and approximately 350 m east of Commonwealth Avenue precinct.

The camp in Commonwealth Park is not currently considered nationally significant (Department of Climate Change, Energy, the Environment and Water, 2024), however it is likely to in the future and could become one at any time. Actions that may impact on nationally important flying-fox camps may include the dispersal of animals through disturbance by noise (Department of Environment, 2015).

Murray Cod

The Murray Cod (*Maccullochella peelii*) is listed as vulnerable under the EPBC Act. A fish survey in 2012 demonstrated that the populations of large bodied native fish in Lake Burley Griffin were entirely dependent on ongoing stocking (Beitzel et. al. 2018). The most recent release was of 44,000 Murray Cod in January 2025 (National Capital Authority, 2025). The presence of this species is therefore confirmed.

The population of Murray Cod within Lake Burley Griffin is not recognised as an important population of the species.

Threatened flora

Targeted threatened flora survey were undertaken in areas identified as suitable habitat for the hoary sunray, the button wrinklewort, the small purple-pea and the matted flax-lily in patches of native grassland. No threatened or rare flora species, including the button wrinklewort, hoary sunray, matted flax-lily nor small-purple pea, were identified in the Project area. Impacts to threatened or rare flora species are therefore not anticipated and have not been assessed further.

Pest plants

Nine pest plants declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Project area, as summarised in Table 11-10.

Table 11-10 Pest plant and class within the Project area

Pest Plant		Weeds of National Significance	Precinct
Botanical Name	Common Name		
<i>Nassella neesiana</i>	Chilean needlegrass	Yes	Common across all precincts
<i>Nassella trichotoma</i>	Serrated tussock	Yes	Yarra Glen - Scattered

Pest Plant		Weeds of National Significance	Precinct
Botanical Name	Common Name		
<i>Eragrostis curvula</i>	African lovegrass	No	Parliament House – Scattered to moderate density patches near main roads Inner South - Scattered to moderate dense patches near main roads Yarra Glen - Scattered to large dense patches Woden – Common
<i>Hypericum perforatum</i>	St John's wort	No	Parliament House – Scattered and isolated Yarra Glen - Scattered and isolated
<i>Pinus radiata</i>	Monterey pine	No	Inner South – Planted adjacent to main roads Yarra Glen – Planted adjacent to main roads
<i>Populus alba</i>	White poplar	No	Yarra Glen – Planted along median strip and roadside Woden – Planted along the roadside
<i>Cotoneaster</i> sp.	Cotoneaster	No	Inner South – Scattered and isolated
<i>Hedera helix</i>	English ivy	No	Yarra Glen - Scattered
<i>Pyracantha angustifolia</i>	Firethorn	No	Woden - Scattered

11.2.2 Potential impacts – construction

The following sections summarise the potential direct and indirect impacts of the Project on biodiversity during construction of the Project.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other conservation values in the landscape. Through this process, a clearance footprint has been defined, as shown on Figure 11-33 to Figure 11-40. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of four communities as summarised in Table 11-11.

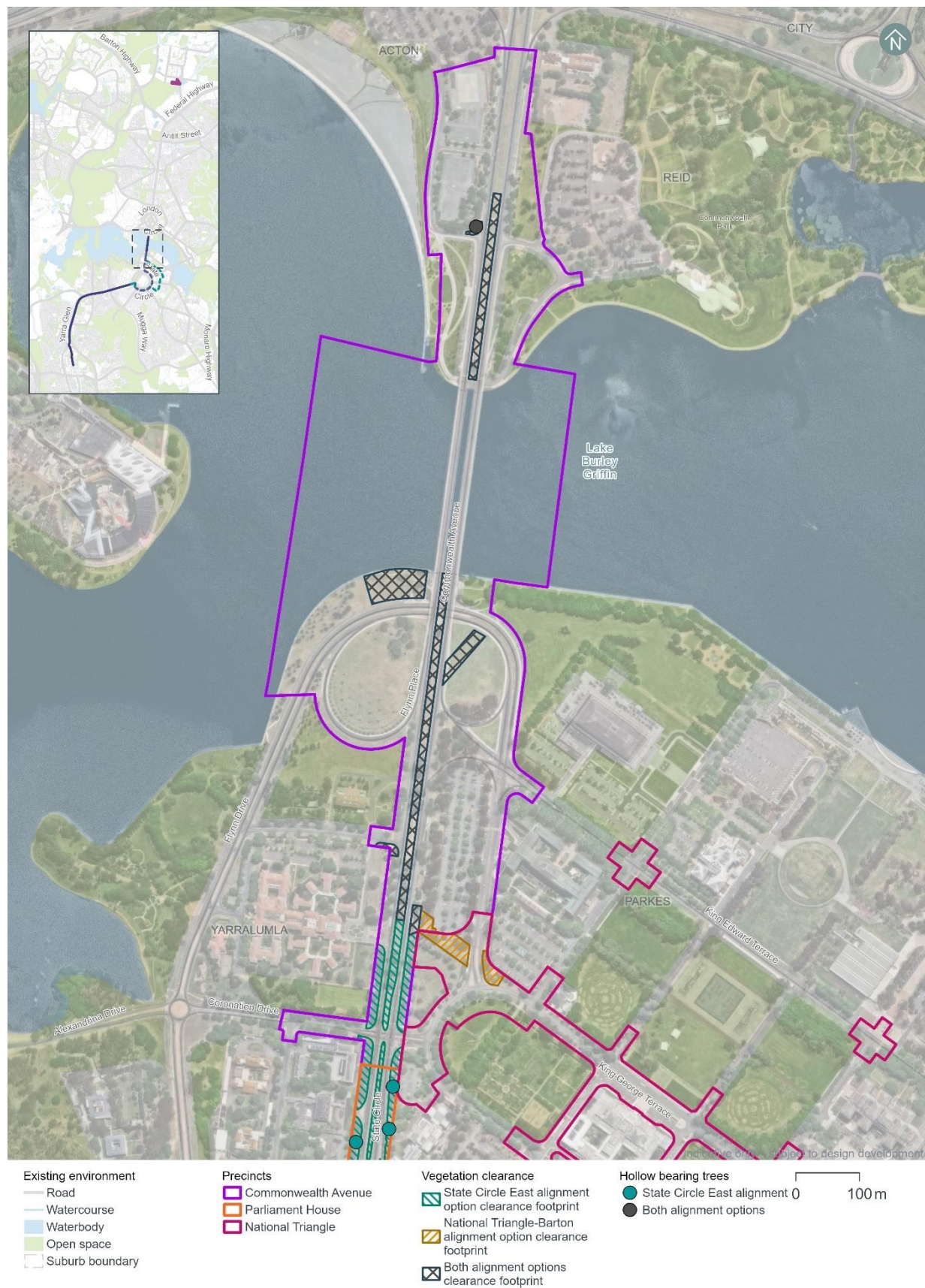


Figure 11-33 Clearance footprint in the Commonwealth Avenue precinct

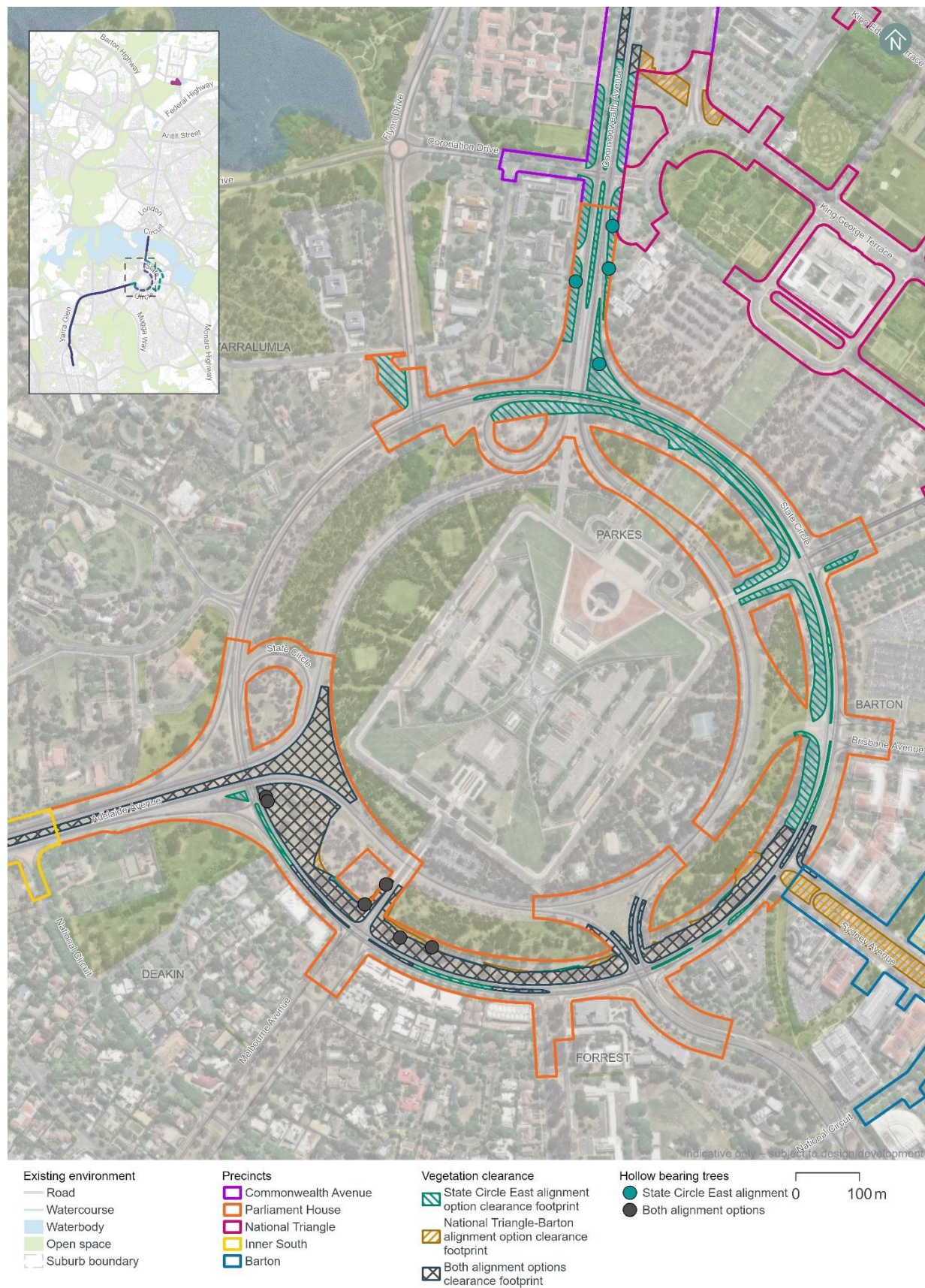


Figure 11-34 Clearance footprint in the Parliament House precinct

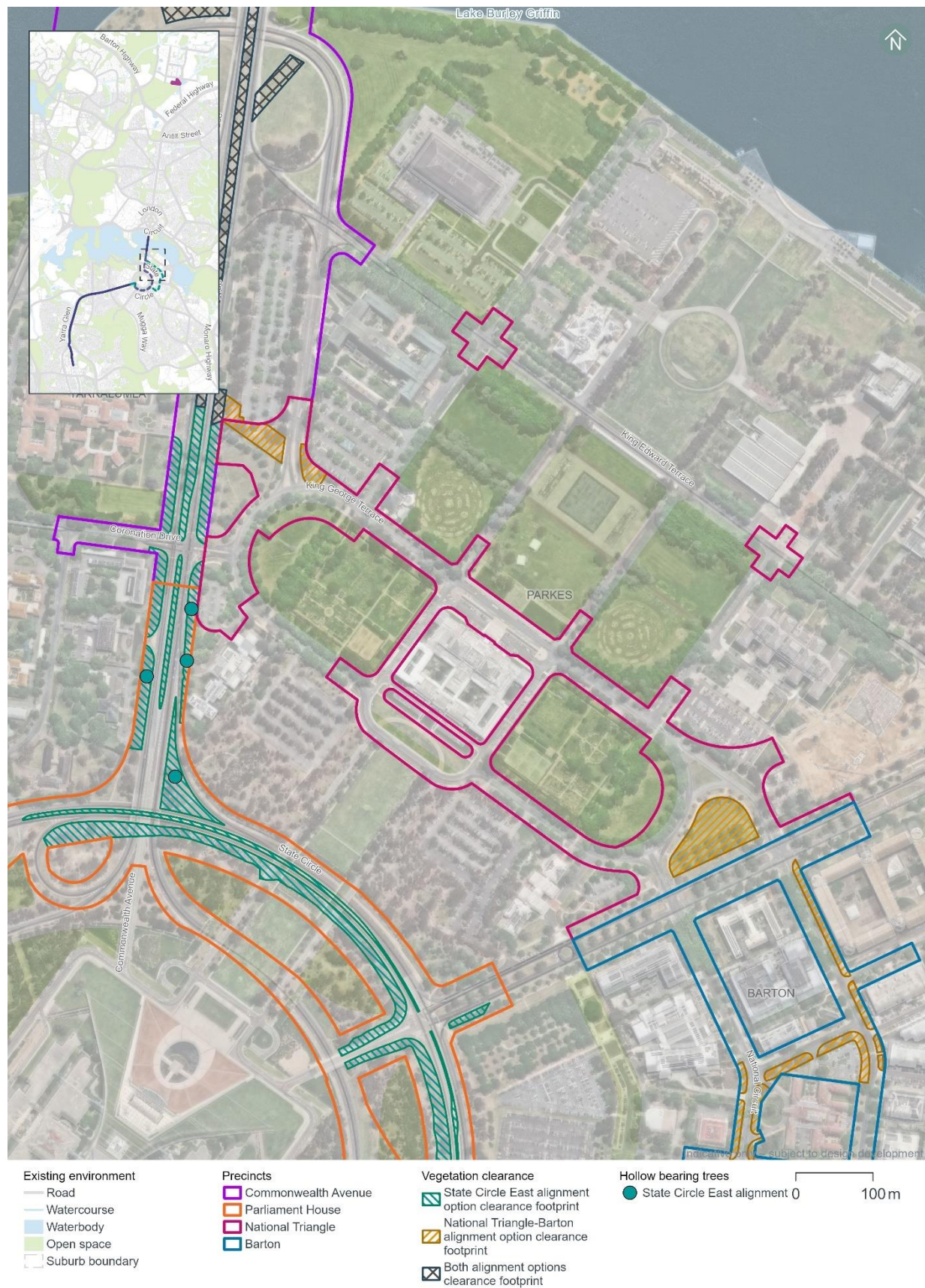


Figure 11-35 Clearance footprint in the National Triangle precinct

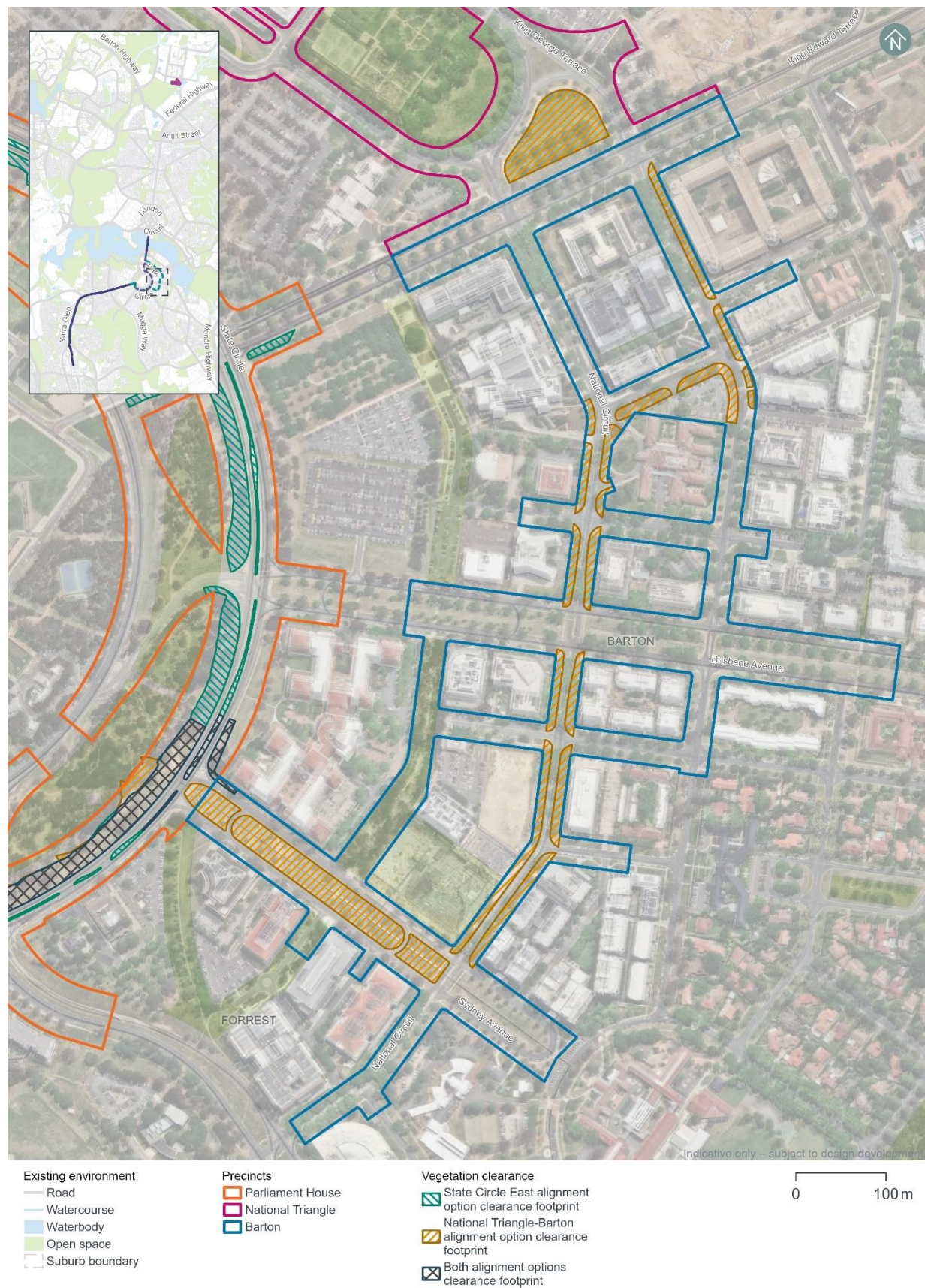


Figure 11-36 Clearance footprint in the Barton precinct



Figure 11-37 Clearance footprint in the Inner South precinct



Figure 11-38 Clearance footprint in the Yarra Glen precinct



Figure 11-39 Clearance footprint in the Woden precinct

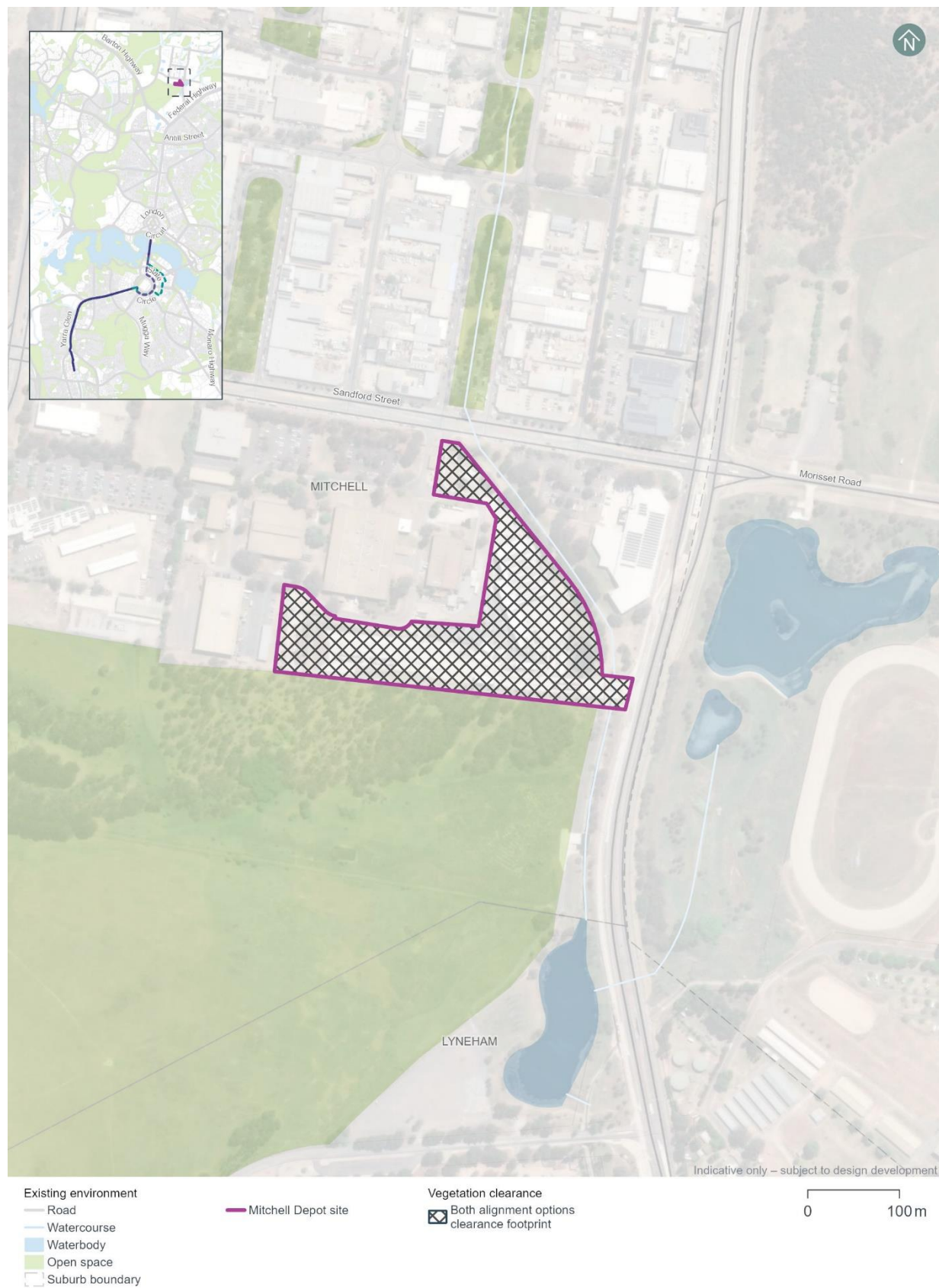


Figure 11-40 Clearance footprint in the Mitchell Depot site

Table 11-11 Extent of vegetation communities within the clearance footprint across precincts and alignment options

Vegetation Community	Area (ha)								Alignment option		Commonwealth land
	Common-wealth Avenue precinct	Parliament House precinct	National Triangle precinct	Barton precinct	Inner South precinct	Yarra Glen precinct	Woden precinct	Mitchell Depot site	State Circle East	National Triangle-Barton	
Non-local native ground cover	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08
Landscape plantings – Native	0.01	2.46	0.08	0.00	0.41	1.68	0.65	0.66	5.64	5.06	2.55
Landscape plantings – Exotic	0.95	0.31	0.41	1.34	0.17	1.87	0.10	0.00	3.36	4.40	1.67
Exotic grassland	1.13	4.23	0.40	0.94	2.44	12.42	0.48	0.78	21.42	21.39	5.76

The Project would impact 5.64 ha or 5.06 ha of the Landscape Plantings – Native vegetation community for the State Circle East and National Triangle-Barton alignment options, respectively.

The Project is likely to impact 126 or 116 mature native trees in the State Circle East and National Triangle Barton alignment options, respectively. This would include impact to 19 or 15 hollow bearing trees (refer to Table 11-12 and Figure 11-33 to Figure 11-40) which are known to support native arboreal mammals, in addition to threatened species such as the Gang-gang Cockatoo. Only a portion of these hollow bearing trees were confirmed as suitable breeding habitat for the Gang-gang Cockatoo and are described further below.

Table 11-12 Distribution of hollow bearing and mature native trees across the clearance footprint

Precinct	Number of hollow-bearing trees	Hollows					Number of mature native trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Commonwealth Avenue	1	0	1	0	0	0	1
Parliament House	10	0	14	6	4	0	60
National Triangle	0	0	0	0	0	0	3
Barton	0	0	0	0	0	0	0
Inner South	0	0	0	0	0	0	19
Yarra Glen	9	1	13	6	1	2	28
Woden	0	0	0	0	0	0	31
Mitchell Depot site	0	0	0	0	0	0	4
State Circle East alignment option	19	1	28	12	3	2	126
National Triangle-Barton alignment option	15	1	24	11	5	2	116

Threatened fauna

Potential impacts on threatened fauna habitat across the clearance footprint are discussed in the following sections.

Golden Sun Moth

The Project would impact 9.88 ha or 9.60 ha of suitable Golden Sun Moth habitat that occurs in the State Circle East and National Triangle Barton alignment options, respectively. The most common habitat condition is high-density Chilean needlegrass habitat followed by low-density Chilean needlegrass habitat as summarised in Table 11-13.

Table 11-13 **Extent of suitable Golden Sun Moth habitat within the clearance footprint and alignment options**

Precinct or alignment option	High Quality (ha)	Medium Quality (ha)	Low Quality (ha)	Low-Density Chilean Needlegrass (ha)	High-Density Chilean Needlegrass Dominated (ha)	Total (ha)
Commonwealth Avenue	0.00	0.00	0.00	0.00	0.00	0.00
Parliament House	0.00	0.00	0.00	1.10	1.37	2.47
National Triangle	0.00	0.00	0.00	0.00	0.23	0.23
Barton	0.00	0.00	0.00	0.00	0.11	0.11
Inner South	0.00	0.00	0.00	0.27	0.16	0.43
Yarra Glen	0.00	0.00	0.06	4.22	2.71	6.99
Woden	0.00	0.00	0.00	0.01	0.00	0.01
Mitchell Depot site	0.00	0.00	0.00	0.00	0.00	0.00
State Circle East alignment option	0.00	0.00	0.06	5.58	4.24	9.88
National Triangle Barton alignment option	0.00	0.00	0.06	5.17	4.37	9.60

Gang-gang Cockatoo

The Project would impact 5.64 ha or 5.06 ha of suitable Gang-gang Cockatoo foraging habitat that occurs in the areas to be cleared for State Circle East and National Triangle-Barton alignment options respectively (refer to Table 11-14). This is consistent with the extent of the Landscape Plantings - Native community as summarised in Table 11-11.

Table 11-14 **Extent of suitable Gang-gang Cockatoo and Superb Parrot foraging habitat within the clearance footprint and alignment options**

Precinct	Extent of suitable foraging habitat (ha)
Commonwealth Avenue	0.01
Parliament House	2.46
National Triangle	0.08
Barton	0.00
Inner South	0.41
Yarra Glen	1.68
Woden	0.65
Mitchell Depot site	0.66
State Circle East alignment option	5.64
National Triangle Barton alignment option	5.06

Within the clearance footprint, State Circle East and National Triangle-Barton alignment options would support six or five suitable Gang-gang Cockatoo breeding trees, respectively. Of these, three in the

State Circle East alignment option and two in the National Triangle Barton alignment option are determined to be the highest priority for protection (Priority 1). These trees would be impacted by the Project and are summarised in Table 11-15.

Table 11-15 **Number of suitable Gang-gang Cockatoo breeding trees in the clearance footprint and priority for protection**

Tree priority level	Precinct								Alignment option		Commonwealth land
	Commonwealth Avenue	Parliament House	National Triangle	Barton	Inner South	Yarra Glen	Woden	Mitchell Depot	State Circle East	National Triangle Barton	
Priority 1	0	3	0	0	0	0	0	0	3	2	3
Priority 2	0	2	0	0	0	0	0	0	2	2	2
Priority 3	0	1	0	0	0	0	0	0	1	1	1
Total	0	6	0	0	0	0	0	0	6	5	6

Superb Parrot

Superb Parrots have been regularly observed in the Project area over the course of the field assessment. The Project would impact 5.64 ha or 5.06 ha of suitable Superb Parrot foraging habitat that occurs in the State Circle East and National Triangle-Barton alignment options, respectively. This is consistent with the extent of the Landscape Plantings - Native community as summarised in Table 11-11.

Swift Parrot

Swift Parrots preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees. The migratory nature of the species means that they require a large network of resources (Department of Climate Change, Energy, Environment and Water, 2024). The clearance footprint supports only one mature Mugga ironbark tree, which is located in the Parliament House precinct.

Diamond Firetail habitat

The Project would impact 5.64 ha or 5.06 ha of potential Diamond Firetail habitat within the State Circle East and National Triangle-Barton alignment options, respectively. The extent of potential habitat aligns with the distribution of the Landscape Planting – Native vegetation community as shown in Table 11-11.

Perunga Grasshopper, Canberra Raspy Cricket, and Key's Matchstick Grasshopper

Although the ACT01.2 Tablelands Dry Tussock Grassland community has been found in the Project area, it is not present within the clearance footprint. Therefore, the Project would not impact any potential habitat for the Perunga Grasshopper, Canberra Raspy Cricket or the Key's Matchstick Grasshopper.

Striped Legless Lizard

Field surveys have determined that the clearance footprint does not support the Striped Legless Lizard as the ACT01.2 Tablelands Dry Tussock Grassland community is not present.

Native burrowing animals

The potential for native burrowing species to be impacted by the Project has also been considered, including the Common Wombat (*Vombatus ursinus*), Rakali (*Hydromys chrysogaster*), Short-beaked Echidna (*Tachyglossus aculeatus*), Rosenberg's Goanna (*Varanus rosenbergi*), Platypus (*Ornithorhynchus anatinus*), and the Eastern long-neck Turtle (*Chelodina longicollis*). These species are unlikely to occur within the clearance footprint and are unlikely to be impacted by the Project.

Murray Cod

Murray Cod within Lake Burley Griffin are not recognised as being part of an important population. Only those within the Murrumbidgee River are in an important population in the ACT (National Murray Cod Recovery Team, 2010). Since the 1960s, Lake Burley Griffin has been regularly stocked Murray Cod. A fish survey in 2012 demonstrated that the populations of large bodied native fish in the lake were entirely dependent upon ongoing stocking (Beitzel et. al. 2018). The most recent release was of 44,000 Murray Cod in January 2025 (National Capital Authority, 2025). The Project would not significantly impact this species.

Significant Impact Assessments

A Significant Impact Assessment has been undertaken for each species listed under the EPBC Act that may be affected by the Project, consistent with the *MNES: Significant Impact Guidelines* (Department of Environment, 2013). The outcomes of the Significant Impact Assessments are summarised in Table 11-16.

Table 11-16 Summary of Significant Impact Assessments

Species	Summary of impact assessment
<p>Golden Sun Moth (<i>Synemon plana</i>) – vulnerable</p>	<p>The Project would impact 9.88 ha or 9.60 ha of Golden Sun Moth habitat, for the State Circle East and National Triangle-Barton alignment options, respectively.</p> <p>The results of field surveys for Golden Sun Moth have varied over the years with higher numbers recorded in 2019-2020 compared with lower numbers in 2021-2023. This is likely due to different environmental conditions such as milder and wetter conditions. In this context, the lower results cannot be used with confidence to determine the extent of occupied habitat or the level of connectivity between populations within the clearance footprint.</p> <p>For this reason, all potential Golden Sun Moth habitat has been considered occupied for the purpose of this assessment. Department of Agriculture, Water, and the Environment (2021) states that as the species has specialised habitat requirements with a fragmented distribution, all occupied habitat is important for the breeding activity of the associated subpopulation and the recovery of the species. Assuming that all potential habitat is occupied by the species, it is likely that the Project would adversely affect habitat critical to the survival of the Golden Sun Moth.</p> <p>Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measures BD1, BD2, and BD12, will be implemented to manage construction impacts to the Golden Sun Moth.</p>
<p>Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>) – endangered</p>	<p>The Project would impact 5.64 ha or 5.06 ha of suitable Gang-gang Cockatoo habitat for the State Circle East and National Triangle-Barton alignment options, respectively. The Project would also impact six or five suitable Gang-gang Cockatoo breeding trees, that occur in the State Circle East and National Triangle-Barton alignment options, respectively.</p> <p>Habitat critical to the survival of the Gang-gang Cockatoo includes all foraging habitat during both the breeding and non-breeding season (excluding exotic feeding grounds such as ornamental trees, shrubs, and hedges) (Department of Agriculture, Water, and the Environment, 2022). Habitat critical to survival includes hollow-bearing trees with both known, or potential Gang-gang Cockatoo hollows.</p> <p>In accordance with (Department of Agriculture, Water, and the Environment, 2022), actions that would remove habitat critical to the survival of the species would interfere with the recovery of the Gang-gang Cockatoo population. This Project would therefore interfere with the recovery of the species and would result in a significant impact on the Gang-gang Cockatoo.</p> <p>Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measures BD1, BD2, and BD6, will be implemented to manage construction impacts to the Gang-gang Cockatoo.</p>

Species	Summary of impact assessment
Superb Parrot (<i>Polytelis swainsonii</i>) – vulnerable	<p>The Project would impact 5.64 ha or 5.06 ha of suitable Superb Parrot habitat for the State Circle East and National Triangle-Barton alignment options, respectively. The clearance footprint would be located in an important flight corridor for the species. Data from the ACT Government suggests that 60% of all hatchlings originate from just six breeding pairs from the Molonglo Valley nesting site.</p> <p>The Superb Parrot Recovery Plan (Baker-Gabb, 2011) states that the species requires vegetated corridors to move between breeding and foraging habitat, and that degradation and destruction of movement corridors is a key factor implicated in the species' decline. Actions that will remove critical habitat may interfere with the recovery of Superb Parrot. The Project may therefore interfere with the recovery of the species and may result in a significant impact on the Superb Parrot.</p> <p>Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measures BD1, BD2 and BD11, will be implemented to manage construction impacts to the Superb Parrot.</p>
Swift Parrot (<i>Lathamus discolor</i>) – critically endangered	<p>The Project is likely to impact one of the four trees within the Project area that are considered critical to the survival of the Swift Parrot, being a mature Mugga ironbark tree located in the Parliament House precinct. This tree exists near the intersection of State Circle and Kings Avenue within the proposed clearance footprint. While options to retain this tree would be considered during ongoing design development and construction planning for the Project, due to the generally low visitation of the species to the ACT, the removal of this single isolated tree is unlikely to significantly impact the species.</p> <p>Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measures BD1 and BD2, will be implemented to manage construction impacts to the Swift Parrot.</p>
Diamond Firetail (<i>Stagonopleura guttata</i>) – vulnerable	<p>The Project would impact 5.64 ha or 5.06 ha of potential Diamond Firetail habitat for the State Circle East and National Triangle-Barton alignment options, respectively. The extent of potential habitat aligns with the distribution of the Landscape Planting – Native community.</p> <p>Habitat critical to the survival of the species includes eucalypt, acacia or casuarina woodlands, open forests, and other lightly timbered habitats, with low tree density, large logs, and little litter cover and areas with high grass cover for foraging. Areas of the Landscape Planting – Native community that would be directly affected by the Project have an understory that is regularly mowed meaning that the grasses are unlikely to be provided opportunity to seed. Grass seed is a major component of the diet for the Diamond Firetail, and therefore its use of habitat with the Project clearance footprint is likely to be limited. The species is most likely to use the clearance footprint as transitory habitat on its way to other higher quality patches of habitat in the landscape.</p> <p>Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measures BD1 and BD2, will be implemented to manage construction impacts to the Diamond Firetail.</p>

Species	Summary of impact assessment
Grey-headed Flying fox (<i>Pteropus poliocephalus</i>) – vulnerable	The Project may temporarily and indirectly disrupt the Grey-headed Flying-fox colony at Commonwealth Park during the construction phase, particularly through noise, vibration and lighting impacts. In the context of the location of the camp within a highly modified urban context that is subject to a large amount of activity, the risk to the species from construction would be low. Mitigation measures in Chapter 21 (Environmental management and mitigation measures), such as measure BD7, would however be put in place to minimise risk, especially from temporary construction noise. Based on a precautionary significant impact assessment for the species, it is unlikely that the Project would significantly impact the Grey-headed Flying-fox.

Threatened flora

No threatened flora species have been detected during field surveys in the clearance footprint. The Project is therefore not expected to directly impact any threatened flora species.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space within the clearance footprint may be indirectly impacted by the Project if appropriate mitigation and management measures are not implemented. Indirect impacts of construction activities have been summarised in Table 11-17.

Table 11-17 Indirect impact assessment of construction activities

Indirect impact	Description
Spread of invasive species off site	<p>Invasive plants may be inadvertently brought into or spread beyond the clearance footprint on equipment and machinery during Project construction. A total of nine weed species listed under the PP&A Act including two Weeds of National Significance have been identified in the Project area (refer to Table 11-10). The risk of further spread of these weed species from the clearance footprint to adjacent areas and the risk of introduction and spread of different weed species would be mitigated through implementation of weed management measures discussed in Section 11.2.4. The implementation of such measures would substantially reduce the potential for adverse impacts on Natural temperate grassland, Golden Sun Moth, Gang-gang Cockatoo and Superb Parrot habitat, and mature native and hollow-bearing trees adjacent to the clearance footprint.</p> <p>Construction works associated with the Project are unlikely to result in the introduction of invasive fauna species.</p>
Noise and vibration impacts	<p>Noise and vibration generated by construction works would potentially indirectly impact fauna located adjacent to the works.</p> <p>The indicative construction program for the Project (refer to Section 6.1 of Chapter 6 (Construction)) indicates that construction works in proximity to threatened species habitat (namely, Golden Sun Moth, Gang-gang Cockatoo and Superb Parrot habitat) is expected to occur over a period of up to five years. Noise and vibration from construction works would be highly variable and would depend on many factors, including fluctuations in the timing of activities, location of mobile noise and vibration sources, and shielding or reflections from buildings or local terrain. The Project therefore has the potential to generate noise and vibration over a prolonged period during construction, which may be intensive at times, thereby impacting nearby fauna. However, the majority of the Project works would be adjacent to major roadways that already produce a considerable amount of noise.</p>

Indirect impact	Description
	The risk of noise from construction activities on breeding Gang-gang Cockatoos is unknown. While they commonly nest in urban areas, the risk to breeding success from construction noise is considered undesirable. Measures to mitigate this risk are outlined in Section 11.2.4 which will include activities to avoid disturbance in the breeding season. Similar measures will also be applied to noisy works in proximity to the Grey-headed Flying-fox camp in Commonwealth Park.
Erosion, sedimentation, and dust impacts	<p>Erosion and sedimentation have the potential to impact biodiversity values adjacent to the clearance footprint during the construction phase. This risk would be mitigated through development and implementation of an Erosion and Sediment Control Plan (ESCP), to ensure that adjacent hollow-bearing trees and mature native trees, threatened species habitat and other biodiversity values are not adversely impacted by overland surface water flows or sediment movement from the clearance footprint (refer to mitigation measure HF1 in Chapter 21 (Environmental management and mitigation measures)).</p> <p>Dust has the potential to adversely impact biodiversity values during ground disturbing works during construction. Potential impacts include dust deposition on vegetation, which could reduce vegetation health and growth and affect vegetation integrity. Dust Impacts to ecological receivers during construction have been assessed as part of the air quality impact assessment presented in Section 11.9 (Air quality), including identified of appropriate dust management and mitigation measures in response to assessed risks of impact.</p>
Waste impacts	Waste generated by the Project has the potential to impact biodiversity values adjacent to the clearance footprint, including threatened species and habitat. Risks associated with the use and storage of fuel, and the management of waste would be managed through the implementation of standard waste management measures detailed in a Construction Environmental Management Plan(s) (CEMP(s)) (refer to mitigation measure MR1 in Chapter 21 (Environmental management and mitigation measures)). Adherence to the CEMP(s) would minimise the risk of adverse impacts on biodiversity values adjacent to the clearance footprint.
Increased light pollution on sensitive habitats and species	<p>Increased light pollution has the potential to impact biodiversity values including threatened fauna habitat. Many studies have demonstrated changed fauna behaviours as a result of increased light spill, including birds, reptiles, bats, and amphibians, which can modify flying, foraging, and breeding activities. Minimising direct light spill and ensuring that post development light levels are not significantly higher than predevelopment levels will be key mitigation measures.</p> <p>The clearance footprint would be located within an existing transport corridor and highly developed urban areas which currently include urban and street lighting. Changes in light pollution from the Project are likely to be relatively minor in this context and design development for the Project would seek to be generally consistent with existing lighting levels.</p>
Fauna strike by construction vehicles	Mortality of native wildlife due to vehicle strike during construction of the Project is possible, however, due to the location within and adjacent to existing roadways, it is unlikely to significantly increase as a result of the Project.

Values adjacent to the Project area

The Project area is within a highly modified landscape. A desktop review of previous ecological studies identified two small patches (0.65 ha) of PCT ACT0.1 adjacent to the Project area, within the Inner South and Yarra Glen precincts. These patches would not be directly impacted by the Project, and any potential indirect effects would be managed through mitigation strategies.

Threatened species, including the Striped Legless Lizard and Golden Sun Moth, have the potential to occur within grassland areas. The grassland areas adjacent to the Project area are subject to an extensive and regular urban mowing program, with the grassland structure therefore inconsistent with the habitat requirements for the Striped Legless Lizard. Targeted surveys undertaken in potential habitat within the Curtain Horse Paddocks (Umwelt, 2022b) and in the patch of natural temperate grassland in the Inner South precinct (Umwelt, 2023) failed to detect the species. It is considered highly unlikely that this species occurs in the adjacent landscape. While Golden Sun Moth habitat occurs throughout the local landscape, patches are small and highly fragmented. The Project is unlikely to result in fragmentation of habitat to the extent that existing populations would become disconnected.

Due to the modified nature of the landscape, it is also considered unlikely that the Project would significantly fragment habitat for threatened birds and mammals.

11.2.3 Potential impacts – operation

The following section summarises the potential impacts of the Project on biodiversity as a result of the operation of the Project.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space within the clearance footprint may be indirectly impacted by the Project if appropriate mitigation and management measures are not implemented. Indirect impacts of operation activities have been summarised in Table 11-18.

Table 11-18 Indirect impact assessment of operational activities

Indirect impacts	Description
Noise and vibration impacts	<p>Operation of the Project would likely generate noise and vibration which may indirectly impact fauna located adjacent to operational infrastructure.</p> <p>Noise and vibration impacts on nearby threatened fauna from operation of the LRVs is expected to be minimal, if detectable, given existing noise and vibration levels from vehicles using the current road network. Other anthropogenic background noise would also contribute to masking the intermittent noise contributions from passing LRVs. TPSs and the works at the Mitchell Depot site have been designed and would implemented to generate minimal change in existing environmental noise levels, as demonstrated through the noise modelling carried for the Project (refer to Technical Report 9 – Noise and vibration).</p>
Increased light pollution on sensitive habitats and species	<p>Light pollution would be associated with lighting along the Project corridors and at light rail stops. The Project would be located within an existing transport corridor and highly developed urban areas which currently include urban and street lighting. Minimising direct light spill and ensuring that post development light levels are not significantly higher than predevelopment levels will be a key mitigation measure. Increased light pollution from the Project is unlikely to result in a significant impact on biodiversity values.</p>

Indirect impacts	Description
Fauna strike by light rail vehicles	Mortality of native wildlife due to LRV strike during light rail operation is possible. This may include strike to wombats, and kangaroos travelling between green areas such as between the North Curtin Residential Area and Deakin. The Project would be located within an existing transport corridor, which includes major transport routes for vehicles including public transport. As such, the addition of LRVs is unlikely to significantly increase the risk of fauna strike.
Fauna strike with over-head lines	<p>Fauna strike with over-head lines used by the light rail and associated infrastructure can be a significant source of mortality for some bird species. Species considered most at risk are large terrestrial and wetland birds, as well as some small, fast-flying species (Jenkins <i>et al.</i> 2010), although this is more often associated with electrical transmission lines. However, over-head lines would be located from Hopetoun Circuit Stop in the Inner South precinct continuing for the remainder of the light rail alignment to the south, also running through Yarra Glen and Woden precincts.</p> <p>Birds that often fly at heights where over-head lines are located, and are not familiar with local habitat features, have the greatest collision risk with line infrastructure. For species that are tied to terrestrial habitats, such as canopy, understorey or ground feeders, the risk of collision is low as they rarely fly at heights where they may encounter electricity lines.</p> <p>Species considered at potential risk from collision with over-head lines for the Project include, Superb Parrot, Gang-gang Cockatoo, Grey-headed Flying-fox and White-throated Needletail.</p> <p>The Gang-gang Cockatoo Conservation Advice (Department of Agriculture, Water, and the Environment, 2022), National Recovery Plan for the Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>) (Department of Agriculture, Water, and the Environment, 2021) and Swift Parrot conservation advice (Department of Environment and Energy, 2016) do not list the risk of collision with over-head lines as a threat to the survival or recovery of these species. However, the construction of the over-head lines for the Project would introduce a novel feature to the landscape so there would still be a risk of collision as birds local to the area become accustomed to their presence. The likelihood of a direct strike is considered low, and the risk may reduce over time as species become accustomed to the new infrastructure.</p>

11.2.4 Management and mitigation measures

Avoidance of direct impacts

The Project has sought to reduce and avoid impacts to MNES and other biodiversity values in the landscape, through the development of a clearance footprint within the Project area (refer to Figure 11-33 to Figure 11-40). The establishment of this clearance footprint has reduced the extent of impact to conservation values, which is summarised in Table 11-19. The table summarises the extent of avoidance of total biodiversity values within the Project area by limiting the Project to the defined clearance footprint.

Opportunities to refine this further would be investigated as part of ongoing design development and construction planning, which may further reduce the extent of threatened fauna habitat affected by the Project.

Table 11-19 Summary of avoidance opportunities

Conservation value	Avoidance opportunity
Native vegetation	The Project would avoid 15.4 ha (72.9%) or 15.98 ha (75.7%) of native vegetation, as defined under the NC Act, in the State Circle East and National Triangle-Barton alignment options, respectively.
Natural temperate grassland	The Project would avoid 0.51 ha (100%) of EPBC Act and NC Act listed natural temperate grassland in the State Circle East and National Triangle-Barton alignment options.
Golden Sun Moth	The Project would avoid up to 8.11 ha (45.1%) or 8.39 ha (46.6%) of potential golden sun moth habitat in the State Circle East and National Triangle-Barton alignment options, respectively.
Gang-gang Cockatoo	The Project would avoid 14.88 ha (72.5%) or 15.46 (75.3%) of potential gang-gang cockatoo foraging habitat in the State Circle East and National Triangle-Barton alignment options, respectively. Additionally, both alignment options would avoid up to 81 suitable breeding trees.
Superb Parrot	The Project would avoid 14.88 ha (72.5%) or 15.46 (75.3%) of potential superb parrot foraging habitat in the State Circle East and National Triangle-Barton alignment options, respectively.
Swift Parrot	The Project would avoid three potential suitable foraging trees in both the State Circle East and National Triangle-Barton alignment options.
Diamond Firetail	The Project would avoid 14.88 ha (72.5%) or 15.46 (75.3%) of potential diamond firetail habitat in the State Circle East and National Triangle-Barton alignment options, respectively.
Perunga Grasshopper	The Project would avoid 0.51 ha (100%) of potential Perunga grasshopper habitat in both the State Circle East and National Triangle-Barton alignment options.
Canberra Raspy Cricket	The Project would avoid 0.51 ha (100%) of potential Canberra raspy cricket habitat in both the State Circle East and National Triangle-Barton alignment options.
Key's Matchstick Grasshopper	The Project would avoid 0.51 ha (100%) of potential Key's matchstick grasshopper habitat in both the State Circle East and National Triangle-Barton alignment options.

Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

11.3 Historic heritage

This section describes the potential impacts of the Project on historic heritage, including cultural landscapes, heritage views and vistas, and natural heritage. Further detail on the historic heritage assessment is provided in Technical Report 3 – Heritage.

More localised impacts on heritage places are discussed separately in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

11.3.1 Existing environment

This section provides an overview of the existing historic heritage context within the Project area.

Historical context

In 1820, the first Europeans visited the Canberra area. Since then, large swathes of the Canberra area were divided into various pastoral and agricultural landholdings through initial government land grants. Between 1908 and 1909 the Yass – Canberra location was selected as the future site of the Federal Capital Territory, with it being formalised in 1911.

In 1911 an international design competition, the Federal Capital Competition, was announced for the national capital. Walter Burley Griffin and Marion Mahony Griffin were successful, and the Griffin Plan was developed in association with the Federal Government. The Griffin Plan is a framework for development that shapes Canberra's character, national significance, and unique sense of place as a city in balance with its landscape. It designed the city with the natural topography in mind, situating it between hills and incorporating an artificial lake, Lake Burley Griffin. The Griffin Plan features grand avenues, landscape vistas, and hilltop lookouts.

From the 1920s, a number of notable structures were constructed including Hotel Canberra, Hotel Kurrajong, Old Parliament House, and the Presbyterian Church of St Andrew. During this time, Charles Weston was also appointed as Director of City Planning and Superintendent of Parks and Gardens, and completed a series of planting projects throughout the city.

Development within Canberra was limited during the Great Depression and World War II until 1958 when the National Capital Development Commission was established. This started a period of new architectural styles in Canberra, reflective of the modern movement occurring nationally and internationally. In the 1960s, Commonwealth Avenue Bridge was opened, Lake Burley Griffin was filled, and development commenced in the Woden area. In 1981, construction of the Australian Parliament House commenced and was officially opened by Her Majesty Queen Elizabeth II in 1988.

The significant heritage values of Canberra, telling the story of Australian democracy and the founding of the national capital, are closely interrelated and represented through the symbolism and function of the landscape. Together, multiple places and features in central Canberra such as the Parliamentary Zone, National Triangle, City and Capital Hills, Lake Burley Griffin, roads and green spaces, tree-lined boulevards, topography, views, and vistas create a culturally significant landscape with integrated heritage values.

The legacy of the Griffins' plan for the development of Canberra is physically represented by the historic character of the designed landscape. As the Griffins designed the city, others helped implement the plan. Charles Weston, Director of City Planning and Superintendent of Parks and Gardens, and John Murdoch, Chief Architect, designed and planted the Parliamentary Zone with avenues, formal plantings, 'outdoor rooms', and architecturally designed buildings, creating a city of appropriate status and high-quality design.

Through the 1950s to the 1980s, the expansion of Canberra by the National Capital Development Commission also represents a significant part of its history. The National Capital Development Commission's contribution was essential to shaping Canberra to the city it is today, for example by constructing Lake Burley Griffin, Commonwealth Avenue, and Parliament House.

Historic cultural landscapes

The places, items, and features of significance relevant to multiple Project precincts are described in Table 11-20. Other precinct-specific places, items, and features of significance are discussed separately in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

Table 11-20 Historic cultural landscapes relevant to the entire Project area

Landscape	Listing	Description
Parliament House Vista (including Aboriginal Tent Embassy) (refer to Figure 11-41)	Commonwealth Heritage List	<p>The Parliament House Vista along the Land Axis is the most iconic of the intentional vistas created in the Griffin Plan. The open sweeping vista along the Land Axis is a central view line experienced in two directions, terminating in Capital Hill at one end and Mount Ainslie at the other.</p> <p>The Aboriginal Tent Embassy is included in the Commonwealth Heritage List citation for the Parliament House Vista and is generally understood to be of high cultural significance to both the Aboriginal community and the wider population. This is due to it being significant as a place of political protest and action. The establishment of the embassy was a defining event which brought Aboriginal rights to an international arena. It represents the ongoing political struggle of Aboriginal people and is part of Australia's political heritage.</p>
Canberra: the Planned National Capital	Identified heritage values (not formally listed)	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation.
Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	Identified heritage values (not formally listed)	<p>Commonwealth Avenue and Kings Avenue are two of the three original major avenues for Canberra, and together with Constitution Avenue they form the Parliamentary Triangle. Their symmetry, tree-lined avenues, plantings, landscape setting, and geometry contribute to an understanding of the Griffin Plan. They are significant as individual places and as part of the broader historical urban designed landscape of Canberra.</p> <p>State Circle and Capital Circle encircles Parliament House, framing Capital Hill. The smoothed contours, grassed verge edges, and massed native plantings between State and Capital Circles are significant by creating a 'natural Australian' aesthetic as the appropriate setting for the nation's parliament and reflect the principles of Canberra as a designed city in the landscape.</p>

Landscape	Listing	Description
Parliament House and surrounds (refer to Figure 11-42)	Identified heritage values (not formally listed)	Parliament House is culturally significant as a creative and technical achievement in the way the architecture integrates with the landscape to symbolise the area as the centre of Canberra, and the focal point of the Parliamentary Triangle, expressing the Griffin Plan's concept for a capital that symbolises democracy.



Figure 11-41 Parliament House Vista, looking south-west across Lake Burley Griffin toward Old Parliament House



Figure 11-42 Parliament House and surrounds viewed from Parliament Drive looking north

Heritage views and vistas

In addition to the above historic cultural landscapes, the historic heritage assessment has identified primary and secondary views and vistas of heritage importance throughout the Project area. Identified primary and secondary views and vistas are outlined below.

Primary views and vistas:

- Parliament House Vista on Land Axis
- Kings Avenue and Commonwealth Avenue vistas to terminating hills
- Views from key public vantage points — Red Hill, Black Mountain, and Mount Ainslie
- Views to and from Commonwealth Avenue Bridge.

Secondary views and vistas:

- Views along and outwards from Commonwealth Avenue when travelling north and south
- Views to Capital Hill from secondary radiating avenues (Brisbane, Sydney, Canberra, Hobart, Melbourne, and Adelaide Avenues)
- Views within the Parliamentary Zone from Commonwealth Avenue intersections
- Views on Adelaide Avenue to distant hills
- Avenue views in Barton framed by trees, such as Macquarie Street, Bligh Street, and National Circuit.

Further detail is provided in Section 4.6 of Technical Report 3 – Heritage.

Natural heritage

Natural heritage sites or areas were identified across the Project area and are described in Table 11-21. These sites or areas have important natural features of biodiversity, geodiversity, and ecological

processes. Their natural heritage value is determined based on how significant these features are, considering their scientific, aesthetic, and life-support value.

Natural heritage values are distinct from ecological/environmental values as considered in Technical Report 2 – Biodiversity and do not negate or contradict the environmental values and impacts identified in that assessment.

Table 11-21 Natural heritage context

Natural heritage sites	Description
Vegetation communities of natural significance	Two relic trees next to the Melbourne Avenue extension and a third relic tree outside the Embassy of the Philippines are representative of the vegetation community, Box-Gum Grassy Woodland, which existed in the area before settlement, and is an endangered ecological community under the EPBC Act. The individual trees stand as examples of vegetation of the past and warrant protection where practicable for their representational value.
Wildlife populations of natural significance	The threatened fauna species, the Golden Sun Moth, protected under the EPBC Act and NC Act, has been noted to occur by surveys assessing the Project area. Occurrences of the Superb Parrot, and Gang-gang Cockatoo are also likely due to suitable habitat having been found within the Project area. Refer to Biodiversity sections in Chapter 11 (Project-wide issues) to Chapter 19 (Mitchell Depot site) for further discussion of these species. Occurrences of potential habitat for these species along the Project area is considered to be of low natural heritage value due to its low natural significance and lack of sustainable natural integrity.
Geodiversity and geoheritage	The State Circle Cutting (shown on Figure 11-52) is a long exposed rock face in central Canberra is listed on the Commonwealth Heritage List. It is a culturally and geologically significant natural heritage feature of the existing environment. It has high natural heritage value as it shows sandstone rafts, ripple marks, and a pallid zone assisting in the interpretation of the ancient geological landscape of the Canberra region. However, it has been significantly reduced in size by the previous excavation and flattening of the cutting and is also threatened by vibration damage due to traffic.

11.3.2 Potential impacts - construction

The following section summarises the potential impacts of the Project on historic heritage during construction. The impacts to heritage views and vistas have only been considered for the operation phase of the Project as these impacts are permanent.

Historic cultural landscapes

Each heritage cultural landscape relevant to the Project-wide context was assessed for potential construction impacts and the findings are summarised in Table 11-22.

Table 11-22 Construction impacts to the heritage values of the Project-wide historic cultural landscapes

Historic cultural landscapes	Construction impact - State Circle East alignment option	Construction impact - National Triangle-Barton alignment option
Commonwealth Heritage List		
Parliament House Vista (including the Aboriginal Tent Embassy)	Moderate to significant <ul style="list-style-type: none"> Construction compounds D, E, and F (refer to Chapter 6 (Construction) for further detail), within the heritage place could indirectly impact trees nearby Impacts from construction works which would result from removal of trees from the Commonwealth Avenue verge. 	Significant <ul style="list-style-type: none"> Construction compounds D, E, and F (refer to Chapter 6 (Construction) for further detail), within the heritage place could indirectly impact trees nearby Removal of trees between Commonwealth Avenue and Langton Crescent would reduce the landscape character of the Parliamentary Zone, albeit temporarily as tree replacement is proposed Loss of historic curved section of road that links Walpole Crescent and King George Terrace.
Identified heritage values (not formally listed)		
Canberra: The Planned National Capital	Significant <ul style="list-style-type: none"> Large-scale tree removal altering the historic design Minor visual impacts from temporary infrastructure Construction compounds, plant, and construction hoardings modifying the experience of Canberra as a city. 	
Roads on national land – Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	Significant <ul style="list-style-type: none"> Large-scale tree removal, road widening, and kerb realignment along Commonwealth Avenue leading to reduction of the historical geometry of the National Triangle Loss of Australian native trees and a large section of the grassed inner verge which contribute to the significant historic landscape character of the public domain landscape between State Circle and Capital Circle from the Commonwealth Avenue intersection to Adelaide Avenue Minor visual impacts from temporary infrastructure mainly along Commonwealth Avenue and on Capital Hill. 	Significant <ul style="list-style-type: none"> Large-scale tree removal, road widening, and kerb realignment along Commonwealth Avenue leading to reduction of the historical geometry of the National Triangle Loss of Australian native trees and a large section of the grassed inner verge which contribute to the significant historic landscape character of the public domain landscape between State Circle and Capital Circle from Sydney Avenue to Adelaide Avenue The impacts to State Circle would be partly mitigated through the conversion of the area to green track Minor visual impacts from temporary infrastructure mainly along Commonwealth Avenue, on Capital Hill, and on Kings Avenue.

Historic cultural landscapes	Construction impact - State Circle East alignment option	Construction impact - National Triangle-Barton alignment option
Parliament House and surrounds	Significant <ul style="list-style-type: none"> Construction works of a large scale and high intensity, involving the removal of trees from the inner verge of State Circle Minor visual impacts from temporary infrastructure (such as plant and equipment, compounds). 	

Natural heritage

Potential construction impacts to natural heritage values for vegetation communities and wildlife populations of natural significance are summarised below in Table 11-23.

Table 11-23 Construction impacts to natural heritage sites

Natural heritage sites	Construction impact
Vegetation communities of natural significance (relic trees)	<ul style="list-style-type: none"> Potential impacts arise from accidental damage of relic trees during construction, if the trees are not appropriately protected during construction Measures to protect and avoid harm to significant trees would be implemented as described in mitigation measures NH2, NH3, and NH4 in Chapter 21 (Environmental management and mitigation measures). For example, in accordance with NH4 protective buffers would be applied to trees with heritage values prior to the commencement of construction. However, should accidental damage of relic trees occur, this could sever linkages with historic natural environment of the localities, causing potential minor to significant heritage impacts.
Wildlife populations of natural significance (Golden Sun Moth, Gang-gang Cockatoo, and Superb Parrot habitat)	<ul style="list-style-type: none"> With low natural heritage value, construction impacts on the sites' natural heritage value would be minimal.
Geodiversity and geoheritage (State Circle Cutting)	<ul style="list-style-type: none"> For the State Circle East alignment option, potential indirect impacts to the cultural and heritage values of the State Circle Cutting have been identified, including vibration and accidental physical impact from construction activities. These potential impacts would be managed by establishing suitable protections, vibration monitoring and the selection of suitably sized plant and equipment for works adjacent to the cutting (refer further to management and mitigation measures NH3, NV5, and NV6 in Chapter 21 (Environmental management and mitigation measures)).

11.3.3 Potential impacts - operation

The following section summarises the potential impacts of the Project's operation on historic heritage.

Historic cultural landscapes

Each heritage cultural landscape relevant to the Project-wide context was assessed for potential operation impacts and summarised in Table 11-24.

Table 11-24 Operation impacts to the heritage values of the Project-wide historic cultural landscapes

Historic cultural landscape	Operation impact – State Circle East alignment option	Operation impact – National Triangle-Barton alignment option
Commonwealth Heritage List		
Parliament House Vista (including the Aboriginal Tent Embassy)	Moderate <ul style="list-style-type: none"> Operational impacts to Commonwealth Avenue from tree replacement, replanting and increased open areas in the central median, road widening and construction of light rail stops and other infrastructure would impact on the Parliament House Vista to the extent that they modify, obscure and diminish the expression of its planned geometry, historical designed landscape and other heritage values Increased public accessibility due to the Project would support the heritage values of the landscape. 	Significant <ul style="list-style-type: none"> The central Land Axis vista would be modified as LRVs would be a frequent but transient feature in front of Old Parliament House The use of wire free running and embedded track would reduce impacts to the Land Axis vista especially from a distance Construction of Treasury Stop would modify the historic landscape character The Project would obscure historic, designed road geometry by the closure of roads and the conversion of historic roads to green track, when these areas have never historically been grassed surfaces Introduction of new plantings would not reflect historic planting forms Increased public accessibility due to the Project would support the heritage values of the place.
Identified heritage values (not formally listed)		
Canberra: The Planned National Capital	Significant <ul style="list-style-type: none"> Road widening (notable modification of verge widths) would have high intensity, irreversible impacts on Commonwealth Avenue, State Circle, and Capital Circle Tree replacement with different species would be visually inconsistent with the historic plantings The landform modifications to accommodate the transition and level change from State Circle up onto Adelaide Avenue, insertion of light rail track, over-head wiring, light rail stops, LRV passbys, and replacement tree plantings from Adelaide Avenue to Woden would moderately alter the existing urban landscape character of the Planned National Capital. 	Significant <ul style="list-style-type: none"> Road widening (notable modification of verge widths) would have high intensity, irreversible impacts on Commonwealth Avenue, State Circle, Macquarie Street, Bligh Street, National Circuit, and Capital Circle Replacement of a historic curved road that links Walpole Crescent and King George Terrace with parkland would obscure historical road geometry Tree replacement with different species would be visually inconsistent with the historic plantings. Note that species selection and spacings would be refined during detailed design The landform modifications to accommodate the transition and level change from State Circle up onto Adelaide Avenue, insertion of light rail track, over-head wiring, light rail stops, LRV passbys, and replacement tree plantings from Adelaide Avenue to Woden would

Historic cultural landscape	Operation impact – State Circle East alignment option	Operation impact – National Triangle-Barton alignment option
		moderately alter the existing urban landscape character of the Planned National Capital.
Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	Significant <ul style="list-style-type: none"> • Covered section between Commonwealth Avenue and State Circle would alter the view line towards Parliament House • The Albert Hall Stop constructed in the median of Commonwealth Avenue would impact views north and south of Commonwealth Avenue • Encroachment from road widening into the State Circle inner verge would alter the historic road geometry • Road widening of Commonwealth Avenue would reduce the historic symmetry with Kings Avenue • Tree replacement with different species on Commonwealth Avenue would reduce the historic symmetry with Kings Avenue • No impacts to Kings Avenue are predicted. 	Significant <ul style="list-style-type: none"> • On Commonwealth Avenue, the turn of the light rail tracks east across the southbound carriageway of Commonwealth Avenue into the Parliamentary Zone, would alter significant views north and south along Commonwealth Avenue and alter the expression of the historic road geometry • The views north and south along Commonwealth Avenue would be partly obscured for short periods as LRVs pass by. • Encroachment into the State Circle inner verge for light rail infrastructure and the Melbourne Avenue Stop would alter the historic road geometry and landscape • Light rail infrastructure would reduce heritage values of the roads including the use of green track along State Circle, partially mitigated by wire free running • Tree replacement with different species on Commonwealth Avenue would reduce the historic symmetry with Kings Avenue.
Parliament House and surrounds	Significant <ul style="list-style-type: none"> • The light rail corridor would impact the inner verge of State Circle for a short distance between Melbourne Avenue and Adelaide Avenue intersection. This would intensely alter the green, naturalistic character of Capital Hill because State Circle would be widened resulting in the loss of grassed verge • The Project would impact the heritage values of Capital Hill by altering the significant smoothly contoured topography, by widening the road and introducing associated retaining walls within part of the inner verge. 	Significant <ul style="list-style-type: none"> • The light rail corridor along State Circle between Sydney Avenue and Adelaide Avenue intersections, and the Melbourne Avenue Stop opposite Melbourne Avenue would overlap with the inner verge of State Circle. However, green track would be used within the verge, partly mitigating the alteration to the naturalistic landscape • The Project would impact the heritage values of Capital Hill by altering the significant smoothly contoured topography, by widening the road and introducing associated retaining walls within part of the inner verge.

Heritage views and vistas

Operation impacts to the primary and secondary heritage views and vistas are summarised in Table 11-25. Refer to Section 6.3 of Technical Report 3 – Heritage for a detailed description of the impacts.

Table 11-25 Operation impacts to the heritage values of the primary and secondary views and vistas

Views and vistas	Operation impact
Primary	
Parliament House Vista on Land Axis (refer to Figure 11-43)	Moderate to significant
Kings Avenue and Commonwealth Avenue vistas to terminating hills (refer to Figure 11-44)	<ul style="list-style-type: none"> Commonwealth Avenue vista - significant Kings Avenue vista – minor.
Views from key public vantage points—Red Hill, Black Mountain, and Mount Ainslie	Moderate
Views to and from Commonwealth Avenue Bridge (refer to Figure 11-45)	Moderate to significant
Secondary	
Views along and outwards from Commonwealth Avenue when travelling north and south (refer to Figure 11-46 and Figure 11-47)	Moderate to significant
Views to Capital Hill from secondary radiating avenues (Brisbane, Sydney, Canberra, Hobart, Melbourne, and Adelaide Avenues)	Minor to moderate
Views within the Parliamentary Zone from Commonwealth Avenue intersections (refer to Figure 11-48, Figure 11-49, and Figure 11-50)	Moderate to significant
Views on Adelaide Avenue to distant hills	Moderate
Avenue views in Barton framed by trees (refer to example on Figure 11-51)	Significant



Figure 11-43 Indicative visualisation south-west along the Parliament House Vista towards Parliament House



Figure 11-44 Indicative visualisation looking south towards Parliament House along Commonwealth Avenue near the Albert Hall Stop (State Circle East alignment option)



Figure 11-45 Indicative visualisation under Commonwealth Avenue Bridge with light rail bridge in between, looking south



Figure 11-46 Indicative visualisation of Commonwealth Avenue looking south to Parliament House before Commonwealth Avenue Bridge



Figure 11-47 Indicative visualisation on Commonwealth Avenue looking north towards Lake Burley Griffin and City Hill at the Flynn Drive underpass



Figure 11-48 Indicative visualisation looking east into the Parliamentary Zone from Commonwealth Avenue outside Hotel Canberra (National Triangle-Barton alignment option)



Figure 11-49 Indicative visualisation looking east into the Parliamentary Zone from Commonwealth Avenue outside Hotel Canberra (State Circle East alignment option)



Figure 11-50 Indicative visualisation along King George Terrace looking south-east with green track replacing the road surface in the immediate foreground of image (National Triangle-Barton alignment option)



Figure 11-51 Indicative visualisation of Macquarie Street looking south from Kings Avenue showing retained trees on the left and replacement trees on the right (National Triangle-Barton alignment option)

Natural heritage

Potential operation impacts to natural heritage values for vegetation communities and wildlife populations of natural significance are summarised below in Table 11-26.

Table 11-26 Operation impacts to natural heritage sites

Natural heritage sites	Operation impact
Vegetation communities of natural significance (relic trees)	<ul style="list-style-type: none"> No potential operational impacts have been identified. Risks to the relic trees have been assumed to be effectively addressed through mitigation measures If not adequately protected during maintenance activities, damage to relic trees could sever linkages with historic natural environment of the localities, causing potential minor to significant heritage impacts.
Wildlife populations of natural significance (Golden Sun Moth, Gang-gang Cockatoo, and Superb Parrot habitat)	<ul style="list-style-type: none"> With low natural heritage value, operation impacts on the place's natural heritage value would be minimal.
Geodiversity and geoheritage (State Circle Cutting)	<ul style="list-style-type: none"> No potential operational impacts have been identified, including direct impacts, permanent impacts to the visual setting as a result of light rail infrastructure and operations, and operational vibration impacts.

11.3.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

11.4 First Nations heritage

This section describes the potential impacts of the Project on First Nations heritage. Further detail on the First Nations heritage assessment is provided in Technical Report 3 – Heritage.

Three of Canberra's four Representative Aboriginal Organisations (RAOs) have been consulted to inform this assessment. The RAOs were Buru Ngunawal Aboriginal Corporation, Mirrabee, and King Brown Tribal Group. The remaining RAO did not respond to invitations for consultation. Consultation was also undertaken with the broader Aboriginal community (including representatives of RAOs) by Balarinji as part of the Designing with Country process. Appendix I (Public Domain Master Plan) includes further details on the Designing with Country process and framework.

The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

11.4.1 Existing environment

This section provides an overview of the existing First Nations heritage context within the Project area. First Nations heritage refers to the intangible (mythological, ceremonial, historical) and tangible (archaeological) aspects of places relating to, or deriving from, the occupation of the country by First Nations people.

Historic context

Canberra has been occupied by Aboriginal people since around 25,000 years ago when the earliest evidence of human presence was dated to. During this time, Aboriginal people lived within an evolving landscape that ranged from a glacial sheet extending from the Snowy Mountains to Tasmania, to vast areas of grassy woodlands supporting megafauna. Aboriginal people travelled around the region temporarily staying in one location depending on food availability and seasonality before moving to another location. Since 1820, when the first Europeans visited the Canberra area, the landscape has been significantly modified into today's city. Notable changes include the urbanisation of Canberra, creation of Lake Burley Griffin, and development of the National Triangle around Capital Hill.

Landscape and archaeological context

The Project area was not found to be of specific Aboriginal cultural significance since no First Nations heritage sites were identified within the Project area and it has been subject to historical disturbance through ongoing urban development within Canberra. However, it is noted that the Project area sits within an important Aboriginal landscape. RAOs have identified the following elements of significance (shown on Figure 11-52):

- The Molonglo River is of high cultural significance due to its association with a creation story
- The geology of the State Circle Cutting for its representation of local stone and mineral resources (impacts to the State Circle Cutting are assessed in Section 11.3)
- Kurrajong (Capital) Hill (including its connection to Stirling Ridge) is of high cultural significance as a former ceremonial area
- The whole of the landscape encompassing the Project area, and all cultural associations with it are of ongoing cultural significance to all local Aboriginal people associated with the ACT. Although this landscape has been impacted over a century, its underlying cultural significance remains strong.

No archaeological sites were found within the Project area. This is likely because many predicted Aboriginal occupation sites around the lower slopes of Capital Hill and the minor ridges across the plain towards Woden would have been destroyed as part of urban development.

Listed heritage places

There are two items of First Nations heritage significance listed on the Commonwealth Heritage List in close proximity to the Project area, as described in Table 11-27.

Table 11-27 Listed First Nations heritage places relevant to the Project area

Commonwealth Heritage places	Description
Parliament House Vista including the Aboriginal Tent Embassy (shown on Figure 11-52)	<p>The Aboriginal Tent Embassy is included in the Commonwealth Heritage List citation for the Parliament House Vista and is generally understood to be of high cultural significance to both the Aboriginal community and the wider population.</p> <p>This is due to it being significant as a place of political protest and action. The establishment of the embassy was a defining event which brought Aboriginal rights to an international arena. It represents the ongoing political struggle of Aboriginal people and is part of Australia's political heritage.</p>
Artefact scatter, Amaroo, Gungahlin, and Kaleen (BHDS2)	<p>Low density artefact scatter BDHS2 has been previously recorded to the south of the Mitchell Depot site, in an area of parkland. Archaeological investigation in 2015 indicated that it did not extend into the Mitchell Depot site.</p> <p>The Mitchell Depot site is a highly disturbed landscape which holds no archaeological values. RAOs have confirmed that it also holds no cultural values.</p>

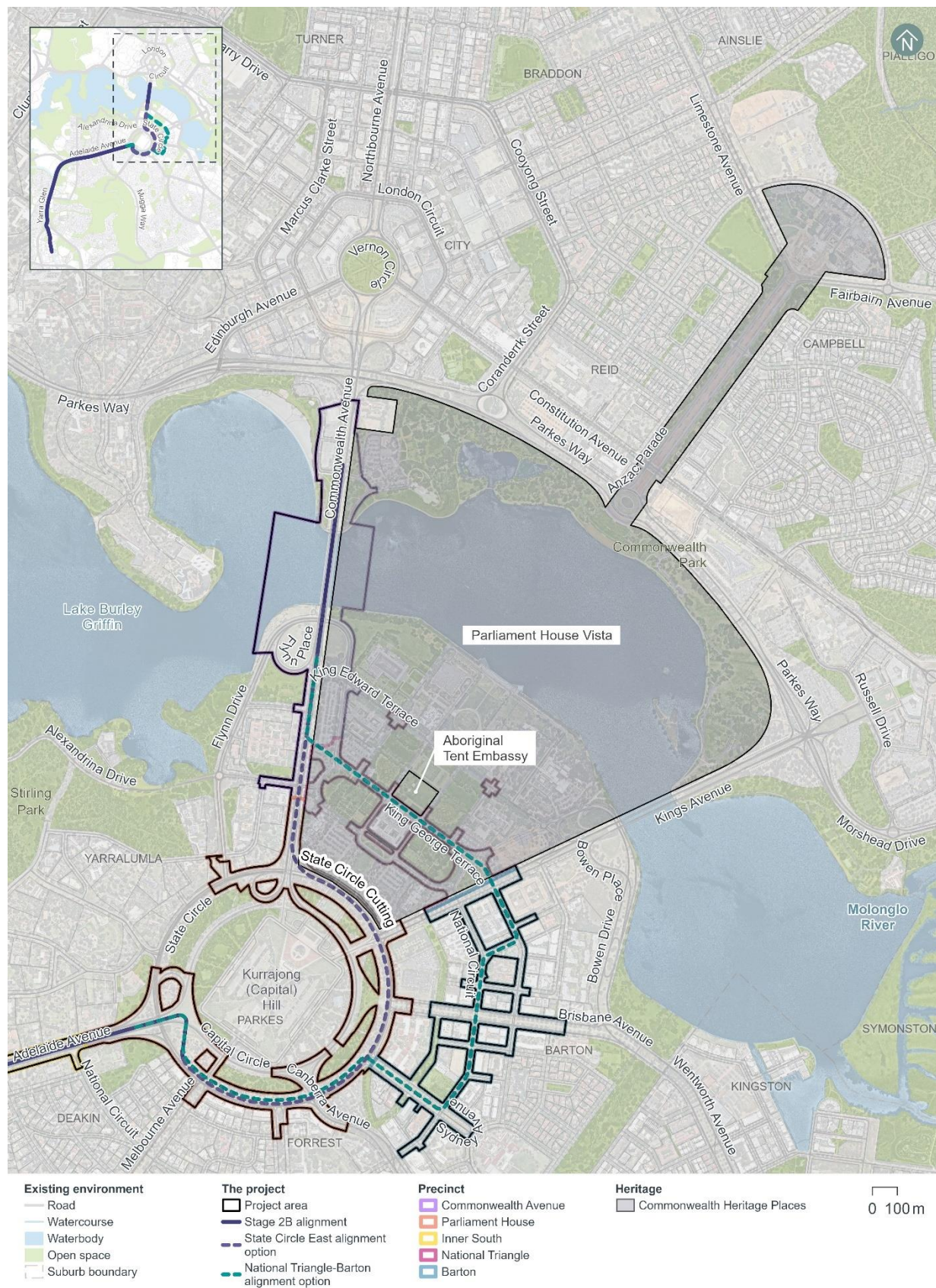


Figure 11-52 Places of First Nations heritage significance

11.4.2 Potential impacts – construction

The lack of recorded or anticipated archaeological sites and sensitivity zones combined with significant historical disturbance within the Project area indicates that direct archaeological impacts would not be expected during construction. In accordance with mitigation measure AH1 in Chapter 21 (Environmental management and mitigation measures), an unexpected finds protocol would be developed and enacted in the event that an item of First Nations heritage significance is encountered during construction.

For the National Triangle-Barton alignment option, the temporary construction areas would be established adjacent to the on King George Terrace. This could diminish the heritage values by indirectly constraining ongoing use of the Embassy by the Aboriginal community, and obscuring the connection between the Embassy and Old Parliament House, an important feature of understanding its historical significance. Further, Technical Report 9 – Noise and vibration identifies that the Embassy would likely be moderately noise affected (i.e. at times exposed to highly intrusive noise levels) during construction, and there is the potential for it to be impacted by vibration intensive equipment within the minimum working distances for the equipment. Noise and vibration could impact on the ability for the Aboriginal community to continue occupying the Embassy due to the intrusiveness of the noise and vibration. These impacts would be managed by establishing suitable protections, vibration monitoring and the selection of suitably sized plant and equipment for works adjacent to the Embassy (refer further to noise and vibration management measures such as NV5 and NV6 in Chapter 21 (Environmental management and mitigation measures)). Consultation with the Aboriginal Tent Embassy is recommended to confirm the assessed level of impact on this heritage item.

For the State Circle East alignment option, possible indirect impacts to the heritage values associated with the Aboriginal Tent Embassy could also occur, however this option would involve limited construction activity within the immediate vicinity of the Embassy. For both alignment options, possible indirect impacts may occur to the cultural storyline relating to the Molonglo River, due to the presence of light rail bridge construction works along Commonwealth Avenue over Lake Burley Griffin.

Overall, the Project would have minor impacts on Indigenous heritage values, associated with the potential indirect impacts that are predicted to occur.

11.4.3 Potential impacts – operation

During operation there would be no impact on Aboriginal archaeological or cultural values.

The Project would not impact the Aboriginal cultural landscape because of the high degree of development of the landscape already. However, RAO representatives considered that the addition of more infrastructure would result in an ongoing accumulation of impact to the cultural landscape, albeit to a landscape that is already highly modified.

11.4.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage First Nations heritage impacts, that are applicable to the Project as a whole.

11.5 Hydrology, flooding, water quality, and groundwater

This section provides an assessment of the potential hydrology, flooding, water quality, and groundwater risks associated with the construction and operation of the Project, as well as the potential risks of hydrology, flooding, water quality, and groundwater on the Project. Further detail on the hydrology, flooding and water quality impact assessment is provided in Technical Report 4 – Hydrology, flooding and water quality.

The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 4 – Hydrology, flooding and water quality.

11.5.1 Existing environment

Topography and land use

Canberra covers an area of about 815 km². The city has an elevation of about 580 m Australian Height Datum (mAHD) (refer to Figure 11-53) and occupies a series of small plains between the Brindabella Ranges to the west, and the Queanbeyan Fault Scarp and Tullaganda National Park to the east. These

relatively flat plains include the Ginninderra Plain on the north-western fringe of the city, Tuggeranong Plain in the eastern suburbs and the Molonglo Plain that forms part of the Molonglo River floodplain, and Lake Burley Griffin.

Before colonisation and development, the land was predominantly natural eucalypt forest. These natural forests were gradually cleared by logging activities that eventually ceased during the 1960s due to concerns around water quality and runoff in the receiving waterways.

Canberra today is largely urbanised with medium density residential land that covers over 35 km between the suburbs of Bonner and Banks in the respective outer northern and southern limits of the city.

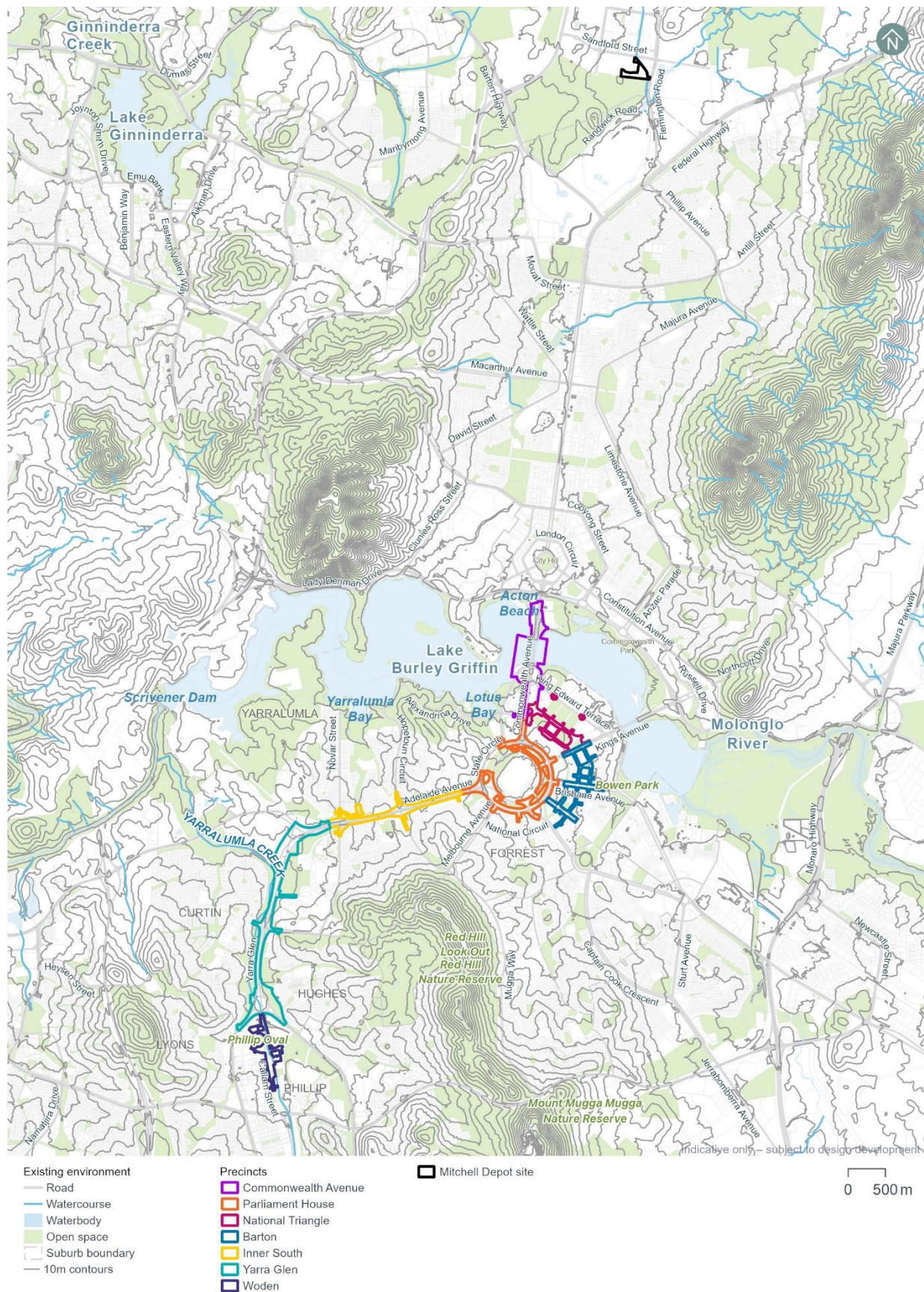


Figure 11-53 Regional topographical context of the Project

Climate

According to the Koppen climate classification, the climate for Canberra is temperate (oceanic) which is characterised by a mild and moderate climate.

The warmest months of the year occur between December and February. January is the warmest month with mean daily maximum temperatures of around 28.5 C. The coldest months of the year occur between June and August, with the lowest mean daily maximum temperature of 11.5 C occurring in July.

During winter, the mean daily minimum temperatures are around 1°C during June and August, and close to zero during July.

Mean annual rainfall totals for Canberra are typically around 650 mm to 700 mm per year. Rain gauge records show that rainfall totals are typically higher during late spring and summer, and lower during autumn and early winter.

Hydrology

The following sections describe the Project's existing hydrological environment regionally and locally. The regional hydrological context of the Project involves the Murrumbidgee River, Molonglo River, Queanbeyan River, and Lake Burley Griffin (artificial waterbody) (refer to Table 11-28 and Figure 11-54). Further, within the Project area there are five catchments, Acton, Capital Hill, Adelaide Avenue, Yarralumla Creek, and Sullivans Creek (refer to Table 11-29 and Figure 11-55). The Mitchell Depot site is located within the Sullivans Creek catchment. It is anticipated that water would be managed within the Mitchell Depot site and that the Project would not discharge to the Sullivans Creek catchment. As such, the entirety of the Sullivans Creek catchment has not been considered in the assessment.

Refer to Section 3.6 in Technical Report 4 – Hydrology, flooding and water quality for further detail including monthly stream flow information.

Table 11-28 Characteristics of regional water bodies around the Project

Characteristic	Murrumbidgee River	Molonglo River	Queanbeyan River	Lake Burley Griffin
Area	84,920 km ² (catchment)	1,870 km ² (catchment)	870 km ² (catchment)	6.6 km ² (lake surface area)
Length	1,500 km	115 km	100 km	10 km
Location	Canberra lies in the upper reaches of the Murrumbidgee River catchment	Originates in New South Wales (NSW) on the western side of the Great Dividing Range and passes through Lake Burley Griffin and into the Murrumbidgee River	Originates south of the ACT and meanders north to the border of the ACT before connecting with the Molonglo River	Lies in the centre of Canberra, from east of Barton to Scrivener Dam
Features	Connects with Molonglo River near Strathnairn, downstream of Lake Burley Griffin	Connects with Queanbeyan River, just north of Queanbeyan and the NSW border	Includes two water storage structures upstream of Lake Burley Griffin that provide flood management	Artificially created by constructing Scrivener Dam on Molonglo River

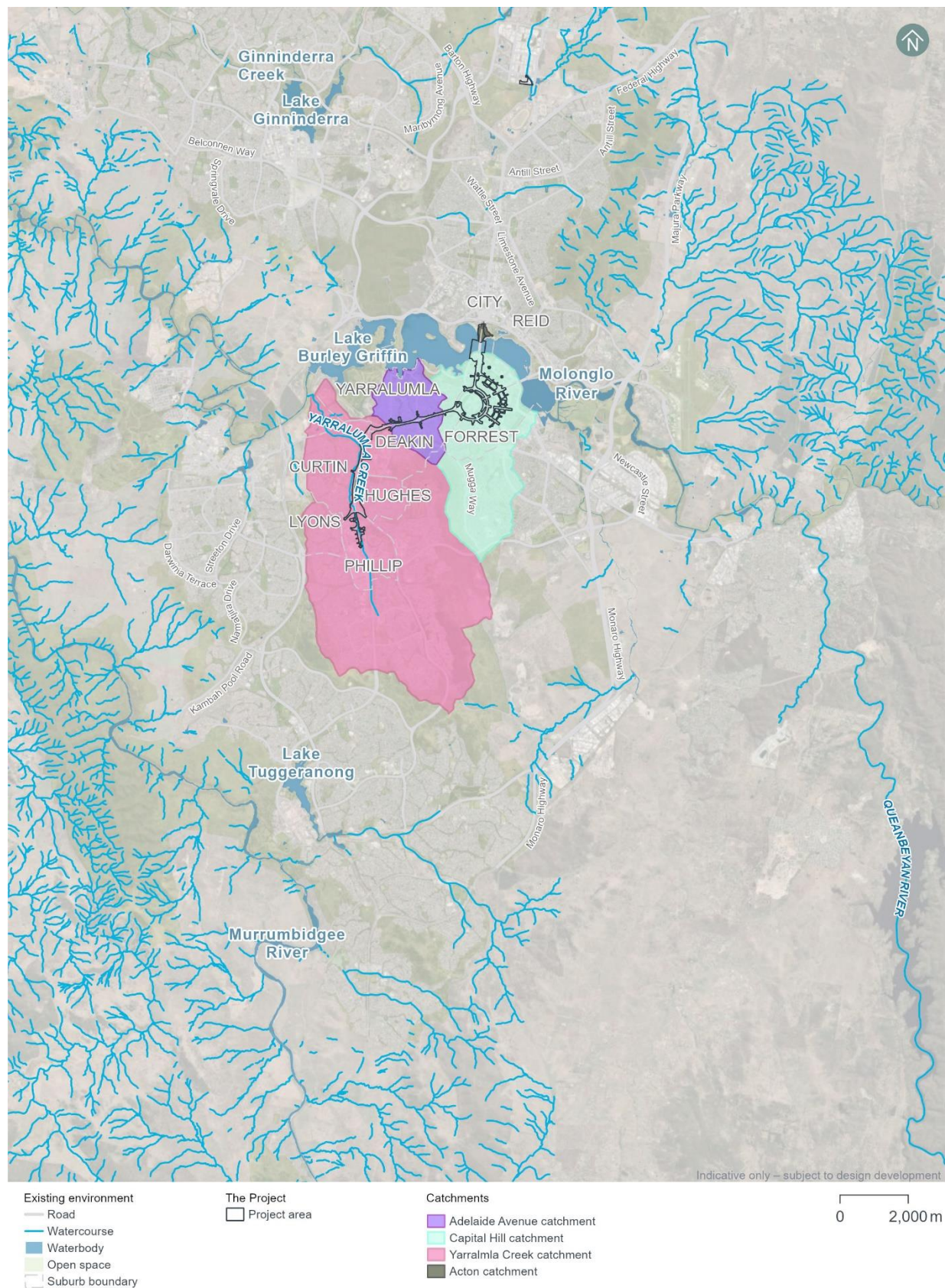


Figure 11-54 Regional hydrological context of the Project

Table 11-29 Project catchment characteristics

Characteristic	Acton catchment	Capital Hill catchment	Adelaide Avenue catchment	Yarralumla Creek catchment	The Mitchell Depot site (Sullivans Creek catchment)
Relevant Project precinct	Commonwealth Avenue	<ul style="list-style-type: none"> Commonwealth Avenue Parliament House National Triangle Barton Inner South 	Inner South	<ul style="list-style-type: none"> Inner South Yarra Glen Woden 	The Mitchell Depot site
Total catchment area	0.12 km ²	12 km ²	4 km ²	34 km ²	36 km ²
Location	City Hill to Barrine Drive, north of Lake Burley Griffin.	Mount Mugga Mugga Nature Reserve to Stirling Park, north of Adelaide Avenue.	Red Hill Lookout to the majority of Adelaide Avenue between National Circuit and Kent Street.	Wanniassa Hills Nature Reserve to Molonglo River, 750 m downstream of Scrivener Dam and Lake Burley Griffin.	Goorooyaroo Nature Reserve to where Sullivans Creek enters Lake Burley Griffin.
Land use	Developed urban environment with a mix of paved roads, car parks, buildings, and parkland.	Natural, dense vegetation through the Red Hill Nature Reserve, to high density urban areas.	Mainly urbanised, with open, landscaped areas closer to National Circuit. Naturally vegetated open spaces around Red Hill Lookout.	Fully developed urban environment with natural dense vegetation and pine forest in the upper part of the catchment.	Mix of urban and rural land uses.
Drainage infrastructure	A 'pit and pipe' stormwater drainage network.	A 'pit and pipe' stormwater drainage network and two open stormwater drainage channels.	A 'pit and pipe' stormwater drainage network conveys stormwater runoff into three open channels.	Stormwater runoff drains into two open channels, Yarralumla Creek and Long Gully, by a 'pit and pipe' stormwater drainage network. Long Gully drains into Yarralumla Creek.	A 'pit and pipe' stormwater drainage network and retarding basins which form part of the Inner North Reticulation Network.

Characteristic	Acton catchment	Capital Hill catchment	Adelaide Avenue catchment	Yarralumla Creek catchment	The Mitchell Depot site (Sullivans Creek catchment)
Drainage discharge point	Lake Burley Griffin at Acton Beach.	Lake Burley Griffin at <ul style="list-style-type: none"> • Lotus Bay in the west • Between Commonwealth Avenue and Kings Avenue to the north • Bowen Park via an open concrete channel that runs along Brisbane Avenue. 	Lake Burley Griffin at Yarralumla Bay.	Molonglo River, 750 m downstream of the Scrivener Dam and Lake Burley Griffin.	Sullivans Creek at the junction of Randwick Road and Flemington Road.
Existing land permeability within Project area	<ul style="list-style-type: none"> • 3 ha pervious • 5 ha impervious* 	<ul style="list-style-type: none"> • 42 ha pervious • 39 ha impervious* 	<ul style="list-style-type: none"> • 9 ha pervious • 8 ha impervious* 	<ul style="list-style-type: none"> • 41 ha pervious • 22 ha impervious* 	<ul style="list-style-type: none"> • 1.4 ha pervious • 2.2 ha impervious*

* impervious surfaces include roads, footpaths, and building roofs.

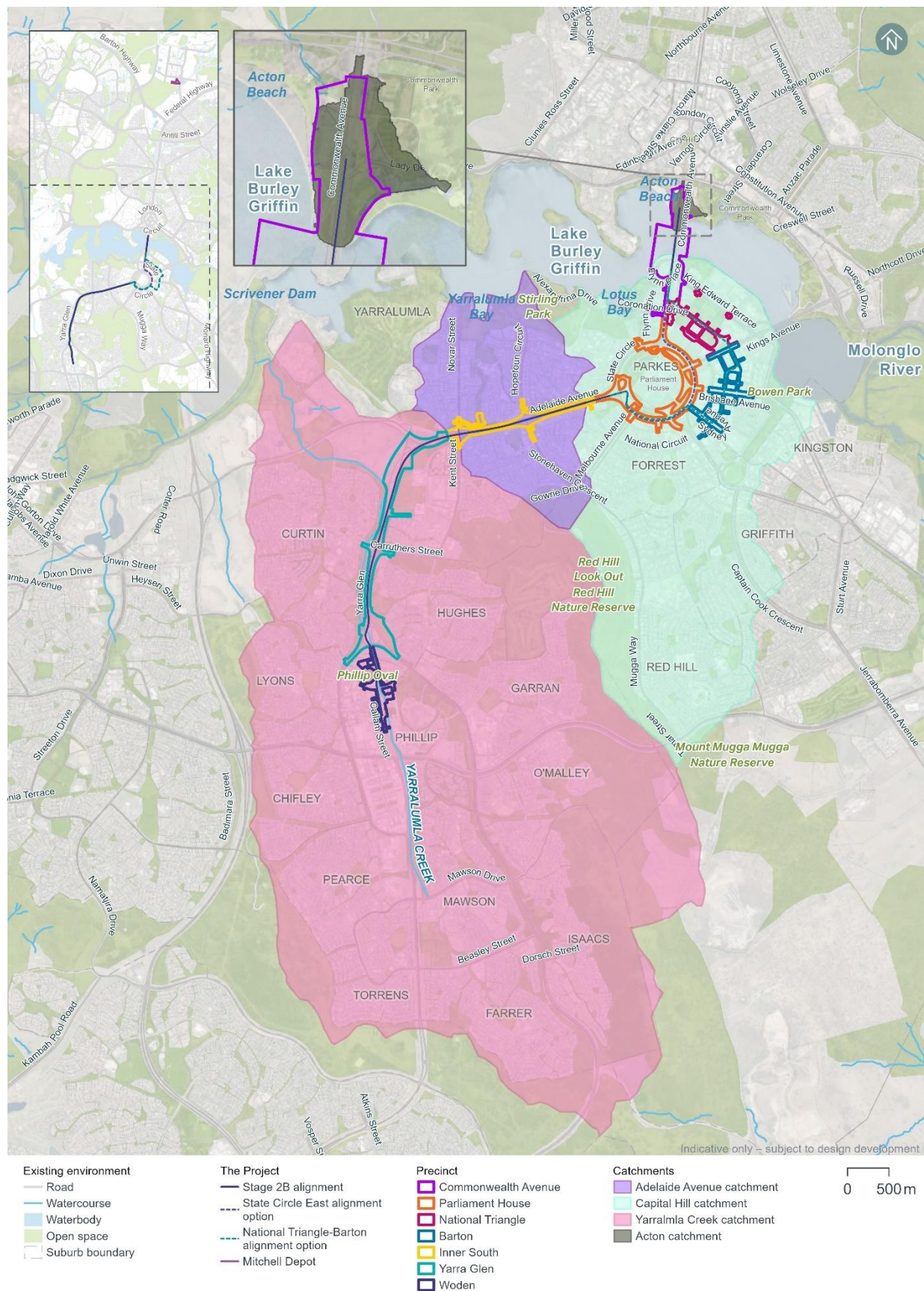


Figure 11-55 Local catchment overview

Water quality

Urban land use in the Project area is managed by a stormwater drainage network to prevent flooding and improve safety, but this network also connects potential contaminants to the aquatic environment. Contaminants, including sediments, nutrients, litter, heavy metals, hydrocarbons, micro-organisms, detergents, and toxic substances, originate from various sources like erosion, sewer spills, vehicle leaks, decaying organic materials, and chemical spraying. These pollutants can accumulate on impervious surfaces and wash into the drainage system during rainfall events, causing downstream environmental impacts.

Refer to Section 11.6 (Soils and contamination) for further detail on potential impacts of the Project on soils and contamination.

Publicly available water quality data has been reviewed for Long Gully Creek and Yarralumla Creek from the Yarralumla catchment. For Long Gully Creek, electrical conductivity data is available. Electrical conductivity is the ability of water to pass an electrical current and indicates the presence of dissolved, charged chemicals. The data revealed that over time Long Gully Creek has consistently recorded electrical conductivity levels above the guideline values, meaning there may be more pollution or contamination from chemicals than guideline values.

For Yarralumla Creek, the Catchment Health Indicator Program (Upper Murrumbidgee Waterwatch, 2023) water quality reporting suggests that the overall water quality of the creek is good, meaning it is generally healthy but may show some minor signs of stress. Water quality parameters such as turbidity, pH, phosphorous, and nitrate levels are rated as excellent indicating they are within acceptable ranges. However, the rating for electrical conductivity and dissolved oxygen parameters is poor, indicating high levels of dissolved chemicals and low levels of dissolved oxygen.

The baseline water quality levels for each catchment in the Project area were modelled using Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version X (MUSICX), a model specified by the Waterways Water Sensitive Urban Design General Code (WSUD General Code) (Department of Environment, Planning and Sustainable Development Directorate, 2020). MUSICX uses catchment characteristics to calculate the annual pollutant loads for the main attributes that influence stormwater quality, which are gross pollutants, total suspended solids, total nitrogen, and total phosphorus. The results of the modelling are shown in Table 11-30.

Table 11-30 Water quality modelling results showing baseline annual pollutant loads in catchments in the Project area

Pollutant	Acton catchment annual pollutant load (kg)	Capital Hill catchment annual pollutant load (kg)	Adelaide Avenue catchment annual pollutant load (kg)	Yarralumla Creek catchment annual pollutant load (kg)	The Mitchell Depot site annual pollutant load (kg)
Gross pollutants	847	7,864	1,718	4,823	434
Total suspended solids	8,546	41,455	9,031	27,374	2,154
Total nitrogen	59	716	156	473	29
Total phosphorus	15	60	13	40	3

The Mitchell Depot site lies close to Sullivans Creek, from which the Inner North Reticulation Network harvests and treats stormwater for purposes of urban irrigation. The scheme benefits Lake Burley Griffin by removing nutrients at its source (EPSDD, 2024).

The Mitchell Depot site consists of largely impervious surfaces, and an existing detention basin assists with pollutant removal before discharging runoff from site.

Flooding

This section provides an overview of baseline flood conditions in each catchment for the 1% and 5% annual exceedance probability (AEP) flood events, and flood hazard for the 1% AEP events. Sensitivity analysis for climate change was also undertaken to assess the potential impacts on flood behaviour. An increase in rainfall intensity of 20% was adopted in the modelling for the major storm event to account for the effects of climate change.

Flood hazard is the relationship between flood velocity and flood depth and is categorised into six classifications in the Australian Disaster Resilience Handbook (Australian Institute of Disaster Resilience, 2017), as shown on Figure 11-56. Flood hazard limits within Stormwater Municipal Infrastructure Standards 08 (Transport Canberra and City Services, 2021) consider the major storm event (1% AEP event).

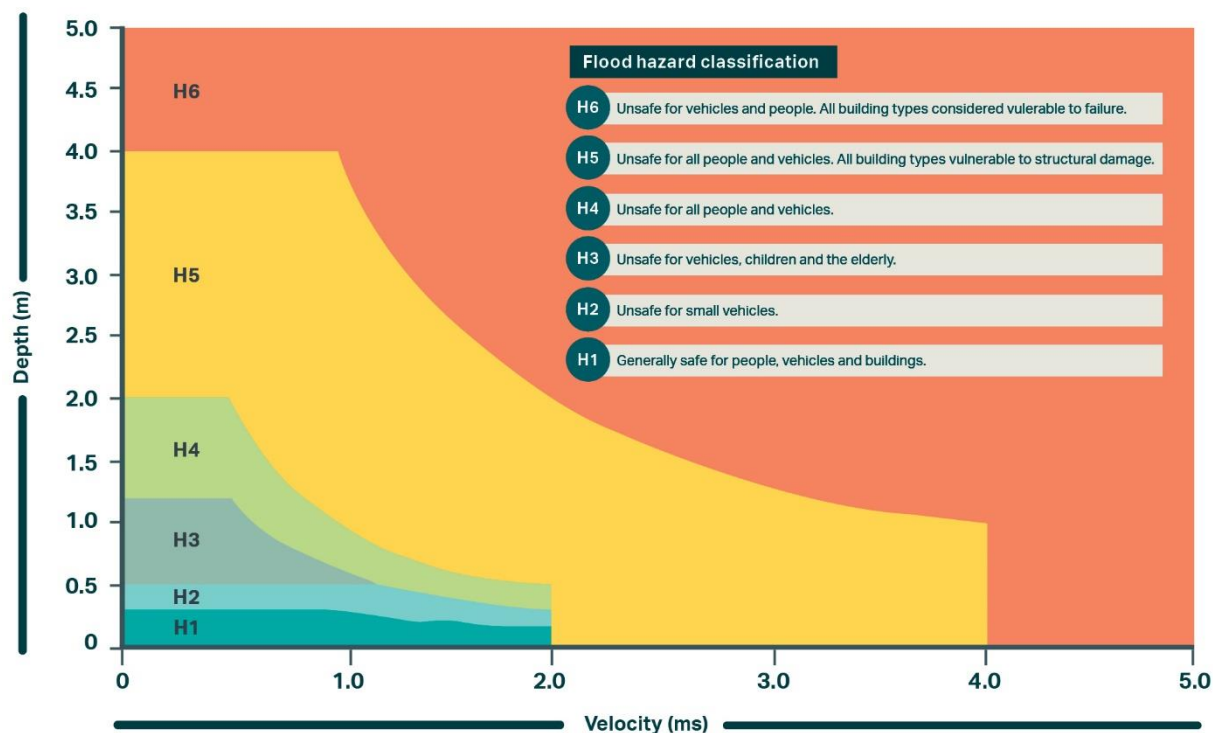


Figure 11-56 General flood hazard vulnerability curve

Canberra infrastructure has been located away from major river systems to reduce riverine flooding. The largest river that interfaces with the Project area is the Molonglo River. However, this river has its flows regulated by utilising Lake Burley Griffin and Googong Dam on the Queanbeyan River as water storages.

Instead of riverine flooding, the greatest risk of flooding across the catchments within the Project area is likely to be from surface water or flash flooding. This occurs when local waterways and stormwater drainage assets are overwhelmed by the volume of rainwater. This is typically created by storms with a high rainfall intensity and can also be geographically concentrated on a specific area of the catchment. Baseline flooding conditions for each catchment are outlined below.

Acton catchment

The key findings of the baseline flooding assessment for the Acton catchment summarised in Table 11-31. Figure 11-57, Figure 11-58, and Figure 11-59 presents the modelled extent and depth of flooding for the Acton catchment for a 1% AEP, 5% AEP, and 1% AEP with 20% climate change event respectively. A sensitivity analysis for climate change and flood hazard rating has also been outlined.

Table 11-31 Acton catchment existing flood conditions

Location	Existing flood conditions
Commonwealth Avenue precinct	
Parkland between Commonwealth Avenue and Regatta Place	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> • Peak depths are up to 0.13 m. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> • Minimal ponding near the Project area. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> • Peak depths are up to 0.20 m.
Flood hazard classification	For the 1% AEP event the flood hazard is classified as H1 - Generally safe for people, vehicles, and buildings.

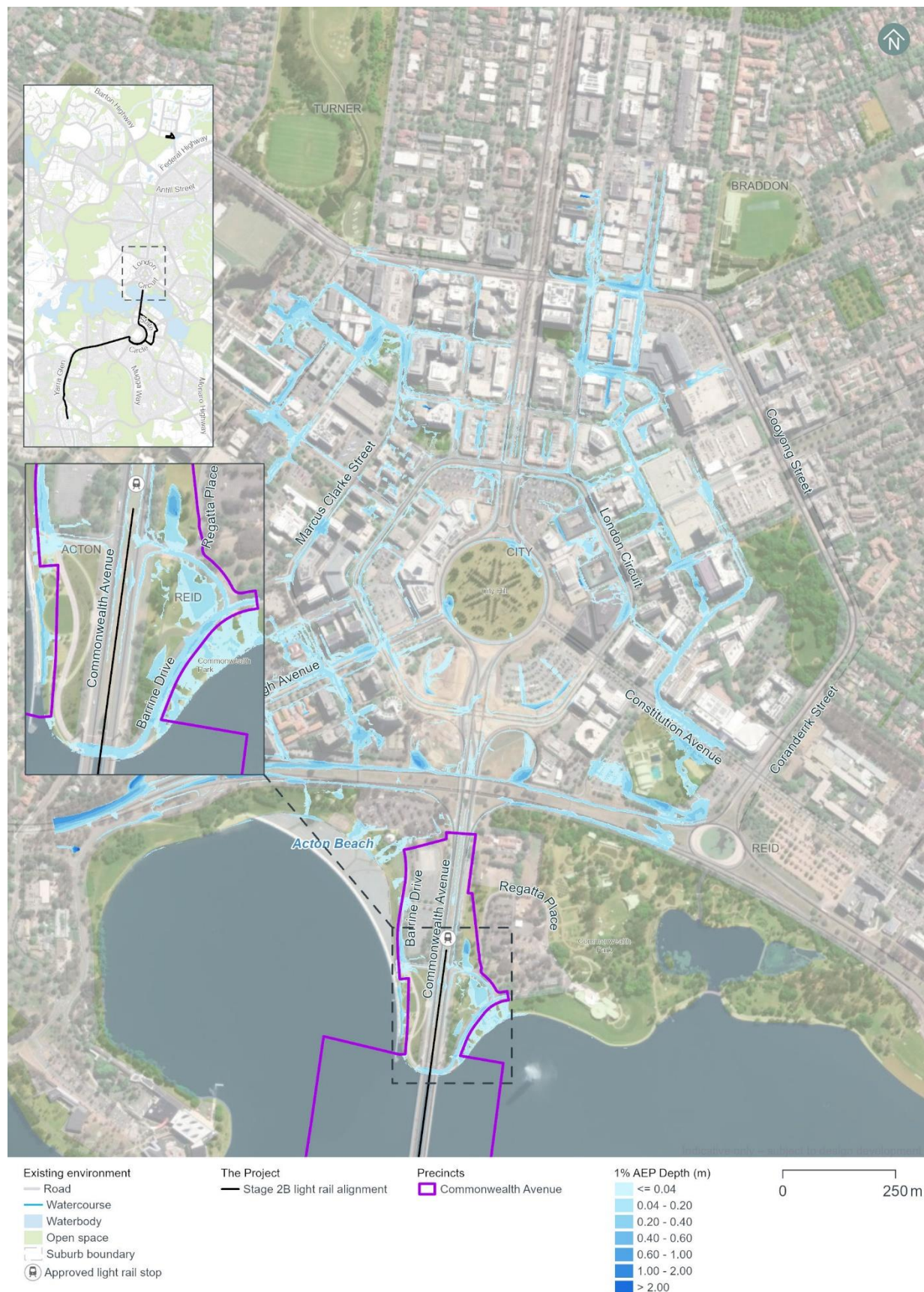


Figure 11-57 Existing Acton catchment 1% AEP flood depth

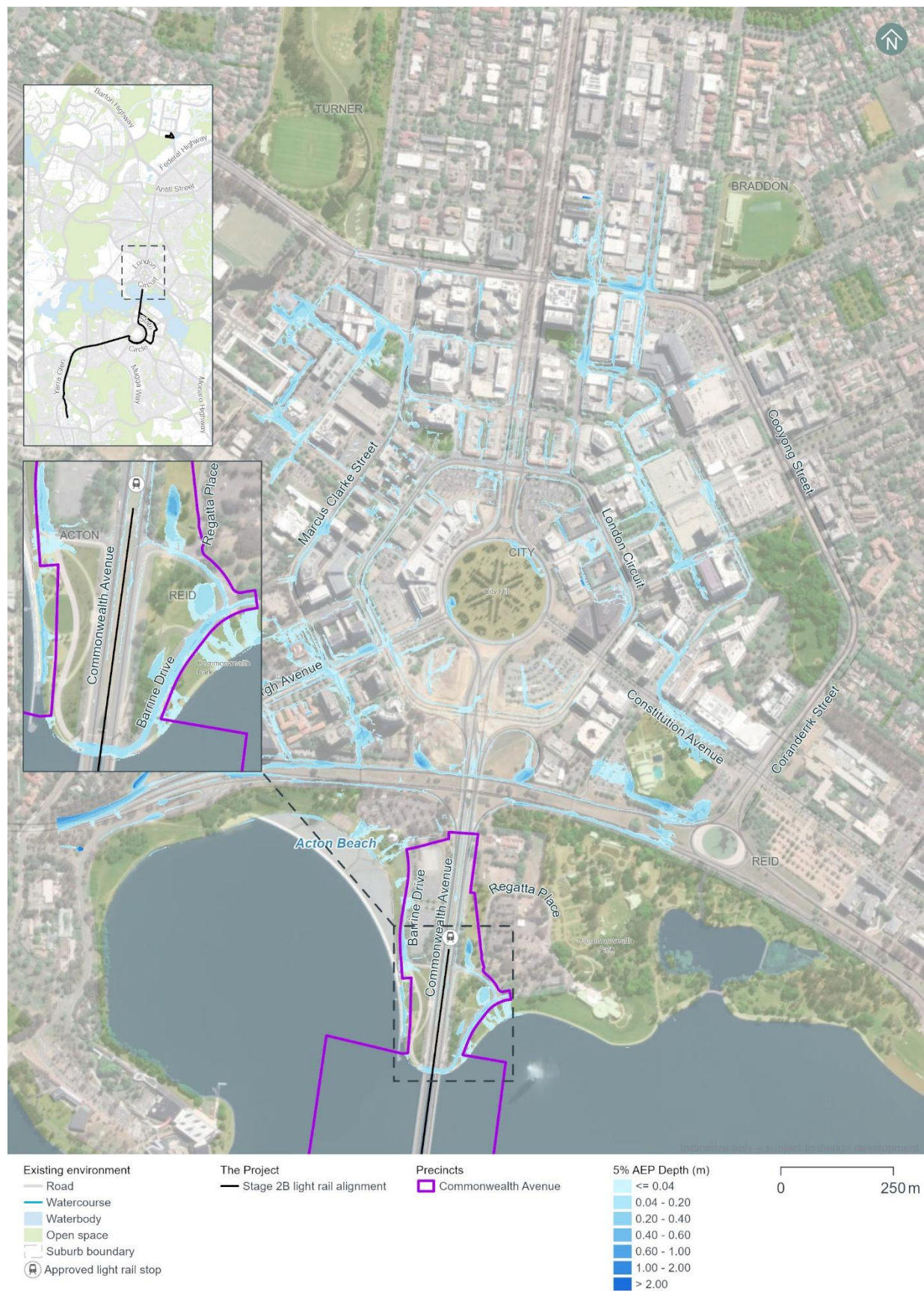


Figure 11-58 Existing Acton catchment 5% AEP flood depth

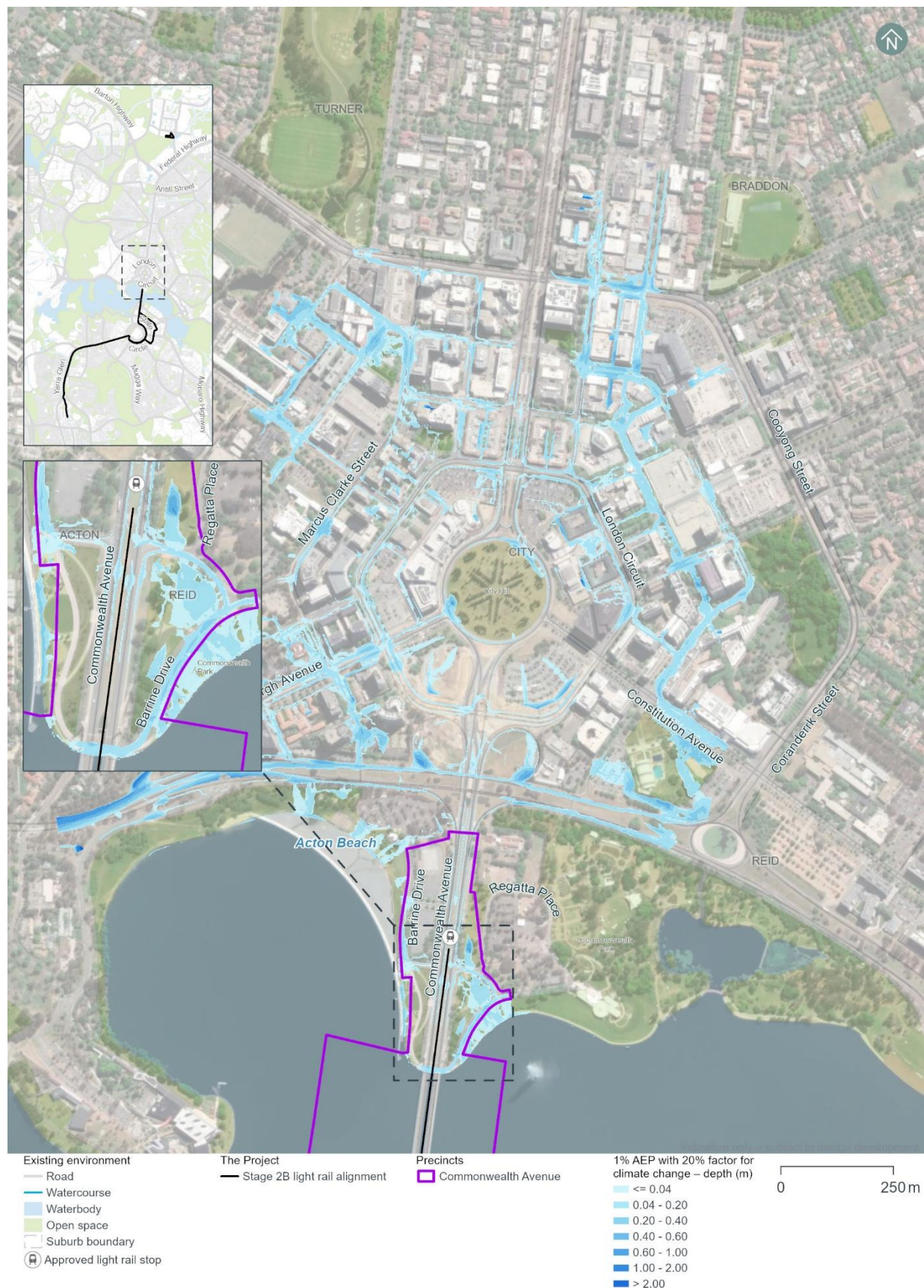


Figure 11-59 Existing Acton catchment 1% AEP with 20% factor for climate change flood depth

Capital Hill catchment

The key findings of the baseline flooding assessment for the Capital Hill catchment are summarised in Table 11-32. Figure 11-60, Figure 11-61, and Figure 11-62 presents the modelled extent and depth of flooding for the Capital Hill catchment for a 1% AEP, 5% AEP, and 1% AEP with 20% factor for climate change event respectively. A sensitivity analysis for climate change and flood hazard rating has also been outlined.

Table 11-32 Capital Hill catchment existing flood conditions

Location	Existing flood conditions
Commonwealth Avenue precinct	
Commonwealth Avenue	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> Two shallow overland flow paths cross the median of Commonwealth Avenue, with depths up to 0.06 m. <p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> Two main flow paths run northwards on both sides of the road toward Lake Burley Griffin Peak depths are up to 0.1 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There are minimal increases in flood depth and extents. Two areas on the Commonwealth Avenue median that previously had shallow flooding, reach peak depths of 0.08 m.
Flood hazard classification	For the 1% AEP event the flood hazard is classified as H1 - Generally safe for people, vehicles, and buildings.
Parliament House precinct	
State Circle under the Commonwealth Avenue road bridges	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> Between Perth Avenue and Kings Avenue overland flow flows north toward the low point on State Circle under the Commonwealth Avenue road bridges Flood depths reach 1 m in the 1% AEP event and 0.7 m in the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths in the low point reach 1.3 m.
State Circle under the Adelaide Avenue road bridges	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> Flows between Canberra Avenue and Perth Avenue head south-west toward the low point under the Adelaide Avenue road bridges Flood depths reach 1.5 m in the 1% AEP event and 0.5 m in the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths in the low point reach 2.5 m.
Flood hazard classification	<ul style="list-style-type: none"> For the 1% AEP event the flood hazard in the precinct outside of the two locations outlined above, the hazard is classified as H1 - Generally safe for people, vehicles, and buildings In the two low points on State Circle the flood hazard is classified as H4 - Unsafe for all people and vehicles.

Location	Existing flood conditions
National Triangle precinct	
King George Terrace	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> There are minor flow paths running toward Commonwealth Avenue and Kings Avenue Flood Depths reach a maximum of 0.1 m in the 1% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There is minimal change compared to the 1% AEP event.
The intersection of King George Terrace and Kings Avenue	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> Ponding occurs due to an overland flow path and a low point at the intersection Flood depths reach 0.32 m for the 1% AEP and 0.3 m for the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths in the low point reach 0.4 m.
Flood hazard classification	For the 1% AEP event the flood hazard is classified as H1 - Generally safe for people, vehicles, and buildings
Barton precinct	
Precinct wide	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> Six private properties within the flood extent. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> Five private properties within the flood extent. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Six private properties within the flood extent.
Brisbane Avenue	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> A main overland flow path runs either side of the road towards the open channel that starts near the intersection with National Circuit At the National Circuit intersection, ponding occurs as the flow paths converge, with peak depths of 0.28 m for the 1% AEP event and 0.24 m for the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths at the intersection reached 0.33 m.
Sydney Avenue	<p>For both 1% and 5% AEP events:</p> <ul style="list-style-type: none"> There is a low point on the south side of Sydney Avenue between the Sydney Avenue median and Game Court Flood depths in the low point reach 0.62 m in the 1% AEP event and 0.17 m in the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flow overtops the Sydney Avenue median and continues down John McEwen Crescent. This connects with the flow path on Darling Street before discharging into the open channel on Brisbane Avenue Flood depths reach 0.74 m.
Flood hazard classification	For the 1% AEP event the flood hazard is classified as H1 - Generally safe for people, vehicles, and buildings.

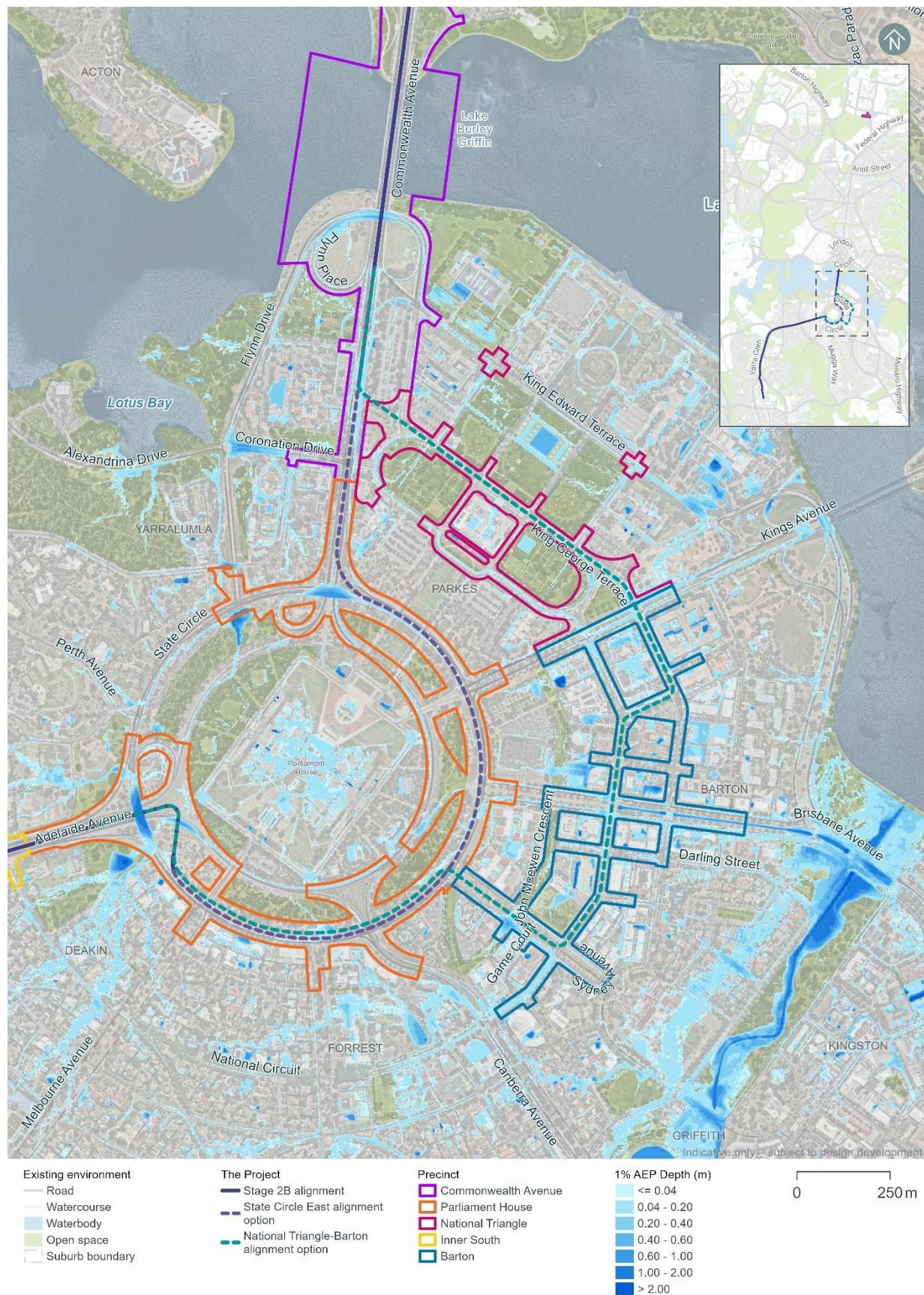


Figure 11-60 Existing Capital Hill catchment 1% AEP flood depth

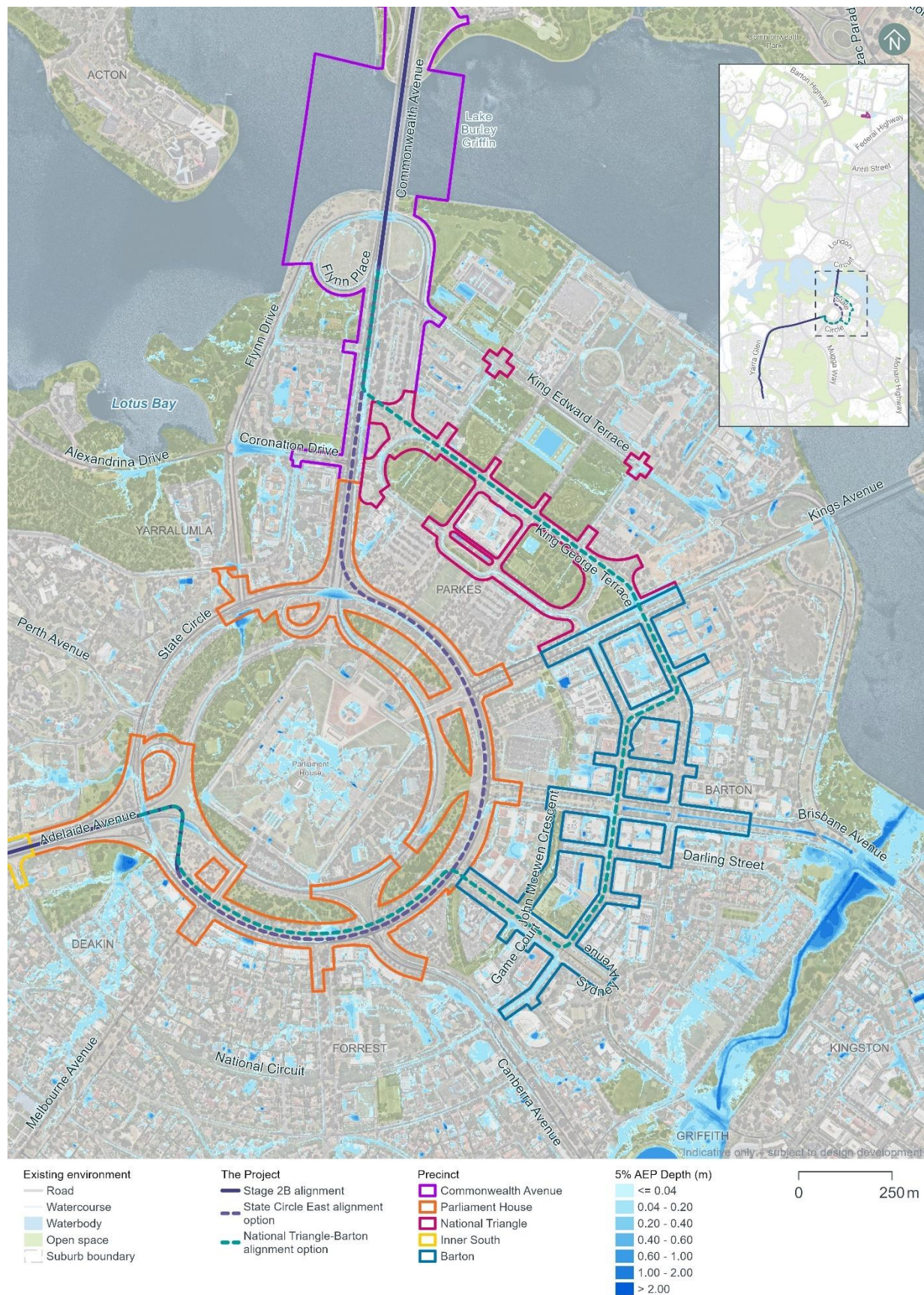


Figure 11-61 Existing Capital Hill catchment 5% AEP flood depth

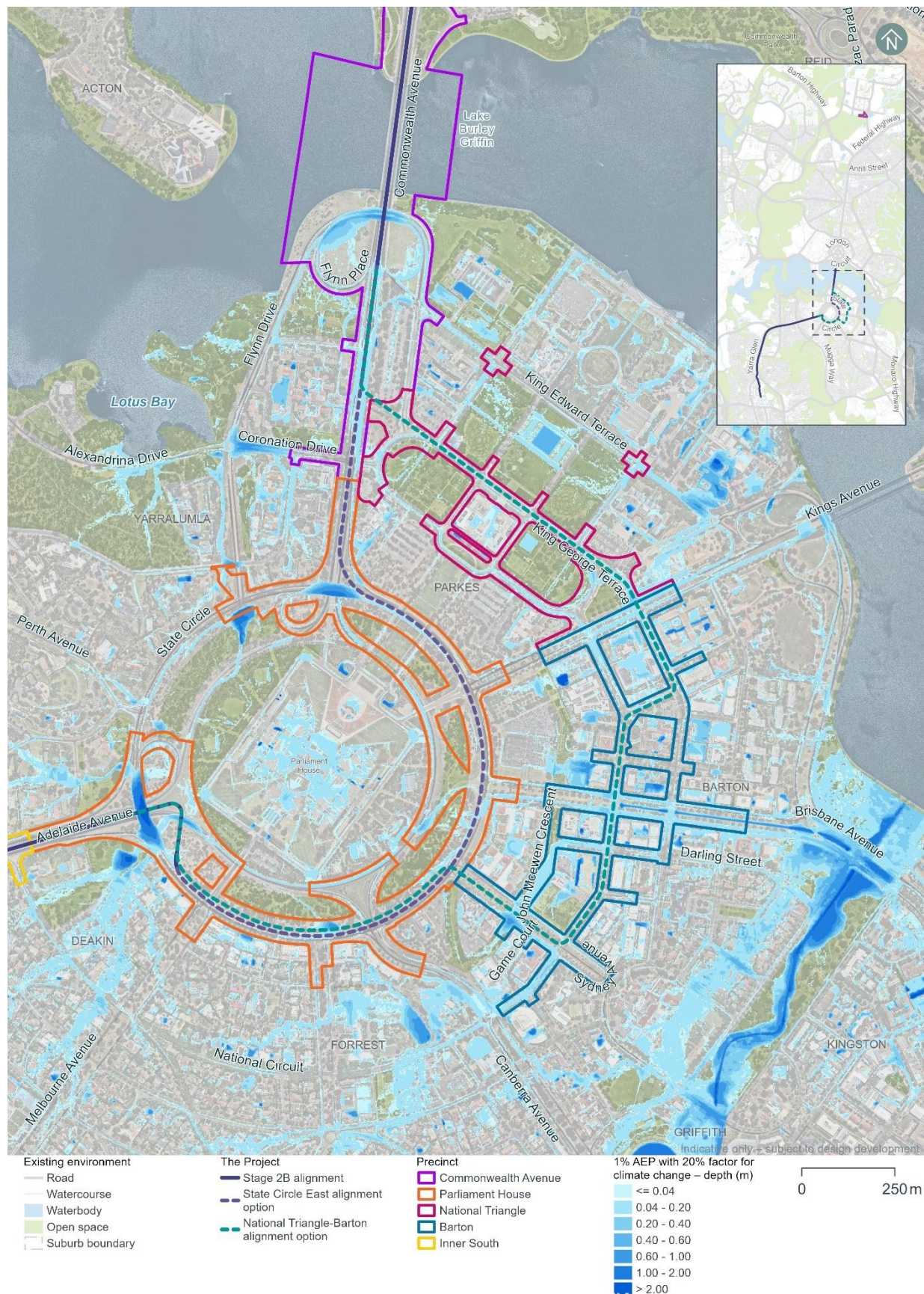


Figure 11-62 Existing Capital Hill catchment 1% AEP with 20% factor for climate change flood depth

Adelaide Avenue catchment

The key findings of the baseline flooding assessment for the Adelaide Avenue catchment are summarised in Table 11-33 for the Inner South precinct. Figure 11-63, Figure 11-64, and Figure 11-65 presents the modelled extent and depth of flooding for the Adelaide Avenue catchment for a 1% AEP, 5% AEP, and 1% AEP with 20% factor for climate change event respectively. A sensitivity analysis for climate change and flood hazard rating has also been outlined.

Table 11-33 Adelaide Avenue catchment existing flood conditions

Location	Existing flood conditions
Inner South precinct	
Precinct wide	For the 1%, 5%, and 1% AEP with 20% factor for climate change events: <ul style="list-style-type: none"> Three private properties within the flood extent.
Adelaide Avenue carriageways	For the 1% AEP event: <ul style="list-style-type: none"> The minor ponding is limited to the outside edges of the Adelaide Avenue carriageways and a small area of the median between Hopetoun Circuit and Kent Street Flood depths reach a maximum of 0.1 m. For the 5% AEP event: <ul style="list-style-type: none"> Flooding is negligible during the 5% AEP event. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There is minimal flood depth change compared to the 1% AEP event.
Hopetoun Circuit, under the Adelaide Avenue northbound and southbound carriageways	For the 1% AEP event and 5% AEP event: <ul style="list-style-type: none"> There is an overland flow path from south to north For the 1% AEP event there is a maximum depth of 0.18 m north of the carriageways and 0.3 m south of the carriageways For the 5% AEP event there is a maximum depth of 0.13 m north of the carriageways and 0.25 m south of the carriageways. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> Flood depths on Hopetoun Circuit reach 0.6 m.
Drainage network between Nathan Street and Guilfoyle Street	For the 1% AEP event and 5% AEP event: <ul style="list-style-type: none"> There is localised flooding at the upstream end of the network in this area and an overland flow path drains towards the surcharge pit off Nathan Street Flood depths at the surcharge pit reach a peak of 0.85 m during a 1% AEP event. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> Flood depths at the surcharge pit reach a peak of 1.0 m.
Flood hazard classification	<ul style="list-style-type: none"> For the 1% AEP event the flood hazard in on Adelaide Avenue is classified as H1 - Generally safe for people, vehicles, and buildings For the 1% AEP event the flood hazard on Hopetoun Circuit is classified as H5 - Unsafe for all people and vehicles. All building types vulnerable to structural damage.



Figure 11-63 Existing Adelaide Avenue catchment 1% AEP flood depth

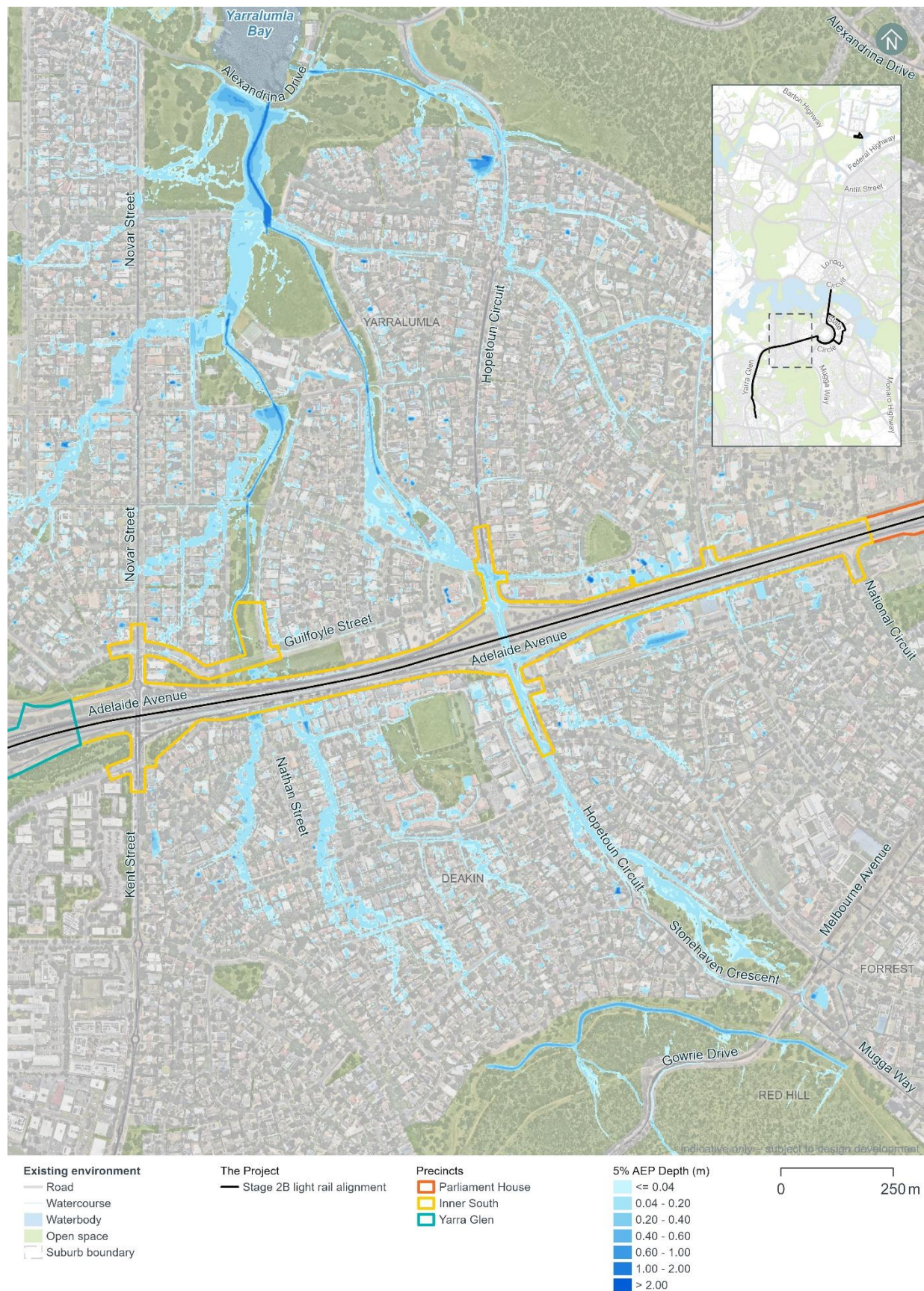


Figure 11-64 Existing Adelaide Avenue catchment 5% AEP flood depth

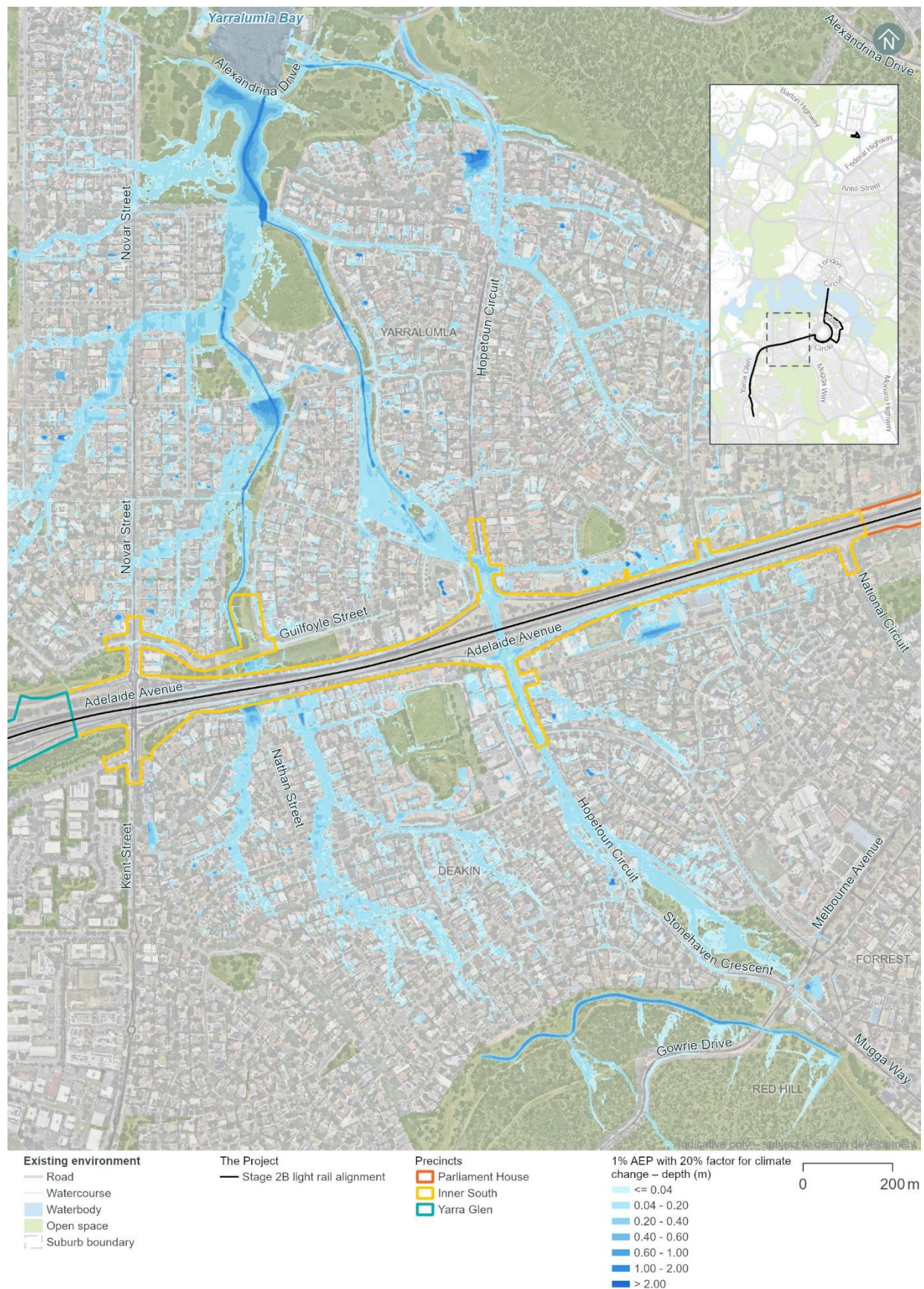


Figure 11-65 Existing Adelaide Avenue catchment 1% AEP with 20% factor for climate change flood depth

Yarralumla Creek catchment

The key findings of the baseline flooding assessment for the Yarralumla Creek catchment are summarised in Table 11-34 for the Yarra Glen and Woden precincts. Figure 11-66, Figure 11-67, and Figure 11-68 presents the modelled extent and depth of flooding for the Yarralumla catchment for a 1% AEP, 5% AEP, and 1% AEP with 20% factor for climate change event respectively. A sensitivity analysis for climate change and flood hazard rating has also been outlined.

Table 11-34 Yarralumla Creek catchment existing flood conditions

Location	Existing flood conditions
Yarra Glen precinct	
Yarra Glen	<p>For the 1% and 5% AEP events:</p> <ul style="list-style-type: none"> There is flooding over Yarra Glen towards Yamba Drive and the median from an overland flow path to the east from King Street and Makin Place. These two flow paths converge in a channel parallel to Yarra Glen Flood depths in the channel reach 1.2 m and 1 m in the 1% AEP event and 5% AEP event respectively There is an overland flow path from North Woden Tennis Club towards the low point in the Yarra Glen median near the Carruthers Street Bridge Flood depths reach 0.1 m on the southbound carriageway for the 1% AEP event The road has minimal flooding in the 5% AEP event. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There is an increase in the size of both the flow paths towards Yarra Glen Flood depths reach 0.3 m on the road near King Street Flood depths near the Carruthers Street Bridge on the southbound carriageway reach 0.4 m.
Yamba Drive – Melrose Drive interchange	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> At the interchange, there is overtopping from the right hand bank of the channel impacting the central area of the roundabout. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> Flooding is confined to the channel. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> The extent of overtopping increases notably.
Flood hazard classification	<ul style="list-style-type: none"> For the 1% AEP event the flood hazard is generally classified as H1 - Generally safe for people, vehicles, and buildings There are areas within the Yarra Glen median and parallel to the southbound carriageway classified as H3 - Unsafe for vehicles, children, and the elderly.

Location	Existing flood conditions
Woden precinct	
Between the Yamba Drive – Melrose Drive interchange and Launceston Street and Irving Street	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> The main channel of Yarralumla Creek is out of bank resulting in flooding of both banks. The flood extent is greatest near the confluence of the two channels and Irving Street In the 1% AEP event there is an overland flow path along Irving Street towards Yarralumla Creek. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> The out of bank flow in the 5% AEP event is notably smaller than the 1% AEP event <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Substantial increase in flood extent with the Irving Street area and around the channel confluence.
Callam Street	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There is out of bank flow caused by the Wilbow Street culvert which results in flood depths on Callam Street of up to 0.16 m. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> Minimal flooding occurs. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths increase substantially and reach up to 0.4 m.
Flood hazard classification	<ul style="list-style-type: none"> The areas adjacent to the Yarralumla Creek channel are classified as H5 - Unsafe for all peoples and vehicles. All building types vulnerable to structural damage In the 1% AEP event Callam Street and other areas are generally classified as H1- Generally safe for vehicles, people and buildings.



Figure 11-66 Existing Yarralumla Creek catchment 1% AEP flood depth



Figure 11-67 Existing Yarralumla Creek catchment 5% AEP flood depth

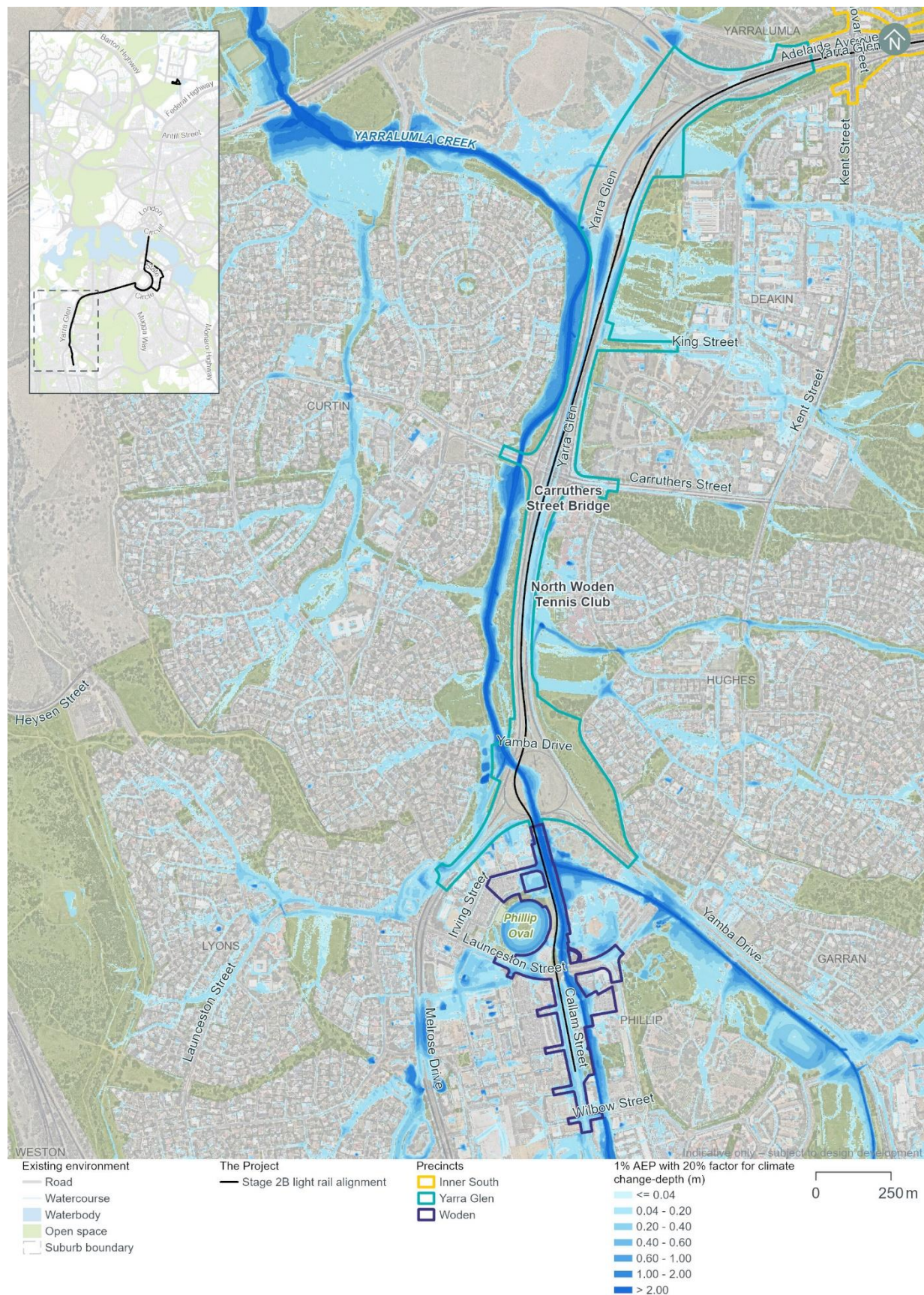


Figure 11-68 Existing Yarralumla Creek catchment 1% AEP with 20% factor for climate change flood depth

Mitchell Depot

The Mitchell Depot is located on Flemington Road and was constructed as part of LRS1. It is located in a separate hydrological catchment than the remainder of the Project area.

Previous flood modelling completed in 2017 demonstrated that the level of the Mitchell Depot was above the flood level of the 0.05% AEP event, and this and any lesser events are contained within the drainage channels.

Hydrogeology

There are two hydrogeological landscapes (HGL) across the Project area: the South Canberra HGL and the Sullivans Creek HGL.

The South Canberra HGL encompasses the towns of Tuggeranong and extends north to the southern shoreline of Lake Burley Griffin. It has an area of 146 km² and is characterised by highly urbanised catchments with constructed stormwater drainage networks, lined creek channels, and modified water bodies. This HGL indicates a baseline fresh groundwater salinity level.

The smaller Sullivans Creek HGL covers an area of 72 km² and extends north from Lake Burley Griffin towards Mitchell. The HGL covers a broad, bowl-shaped valley that is bound by the steep hills to the east and west. The sub-catchments of the HGL are mostly urbanised and include the large areas of new development to the north of Gungahlin. This HGL indicates a baseline fresh to marginal groundwater salinity level.

Both HGLs indicate fresh groundwater and a gentle gradient of the groundwater table with varying degrees of permeability and water movement through the Project area.

Groundwater

Groundwater table depth is dependent on location and hydrogeological conditions. Based on publicly available information, the groundwater table level within the Project area is estimated to range between 2 m and 8 m below ground level (ACTmapi, 2016) with varying degrees of permeability and water movement through the Project area.

11.5.2 Potential impacts – construction

The following sections define the potential hydrology, flooding, water quality, and groundwater impacts that could occur as a result of the proposed construction works.

Surface water quality

The Project spans five catchments that feature discharge points with direct connections into Lake Burley Griffin and the Molonglo River. Without the implementation of mitigation measures, construction activities could increase the risk of stormwater pollution within these sensitive receiving environments and lead to long term changes in aquatic habitat.

Changes in water quality can occur through a range of mechanisms as outlined below.

Runoff from construction areas

Runoff from construction areas is typically caused when ground disturbance exposes soils and other materials such as litter to wind and rain.

Construction activities and locations within the Project area that risk surface water pollution include:

- Utilities work, including protection and relocation
- Earthworks, including the stripping of topsoil
- Excavations for drainage and conduits
- Construction of the light rail bridge over Lake Burley Griffin and associated infrastructure such as temporary jetties
- Construction of the pedestrian and cyclist bridges in the Inner South, Yarra Glen, and Woden precincts

- Construction compounds located adjacent to key stormwater drainage assets or waterways (e.g., construction compound A1 and A2 north of Lake Burley Griffin on Commonwealth Avenue, construction compound B south of Lake Burley Griffin on Commonwealth Avenue, construction compound G located east of Yarra Glen/Yamba Drive roundabout, and construction compound H at Easty Street car park in Woden. Refer to Chapter 6 (Construction) for further detail regarding construction compounds
- Any works within and/or adjacent to the main channel of Yarralumla Creek (i.e. works in the Yarra Glen and Woden precincts)
- Vegetation removal and ground clearing during site establishment.

The impacts of contaminated runoff can vary greatly depending on pollutant type and concentrations. Fine sediments and soluble materials are particularly difficult to manage once they have entered the stormwater pathway and can cause long term environmental changes. For example, high sediment concentrations can cover fish spawning habitat or cause damage to fish gills. Turbid water can also reduce plant photosynthesis and lead to changes in water chemistry.

Spills of fuels or chemicals

Construction activities may increase the risk of pollution incidents caused by spills of fuels or chemicals. There is a higher risk of occurrence in areas where fuels or chemicals are loaded or unloaded onto vehicles, or where fuel is decanted into plant and equipment, either at their point of use, or in secure compounds.

Soluble chemicals and hydrocarbons can severely impact aquatic environments, causing immediate harm to fish and invertebrates. Chemical spills are challenging to remediate and can take years for the environment to recover. Hydrocarbon spills, while more visible, spread quickly, affecting vegetation and fauna. If not recovered, hydrocarbons emulsify and sink, contaminating the waterway bed, with recovery potentially taking months or years.

Dewatering and groundwater

Groundwater may be impacted where construction excavation activities intersect groundwater and/or where construction activities impact on the surface water regimes hydraulically connected to shallow groundwater, including the following:

- Deep excavation activities required to construct the covered section between Commonwealth Avenue and State Circle
- Piling works for new bridges and at Phillip Oval Stop
- Trenching for new or realigned stormwater drainage and utilities
- Cuttings that intersect groundwater table
- Dewatering of temporary excavations.

Particularly deep excavations would be required for the construction of the covered section between Commonwealth Avenue and State Circle, to a depth of around 6 m below the existing ground surface level. This excavated ground may fill with rainwater or groundwater and contain high concentrations of suspended soils, hydrocarbons from plant, and other contaminants such as metals (e.g. iron, copper) and salts from groundwater. If not managed appropriately, dewatering of excavations may cause impacts to downstream receptors.

Perched water (i.e. transient water level established due to rain / surface water percolating the ground and perching above low permeability underground layers) may be encountered during excavations. Depending on bedrock depth, the seasonal perched water may typically be encountered at around 1.5 m to 3 m in depth. A conservative approach has therefore been adopted, and the potential for groundwater table interception has been considered in this assessment.

Temporary dewatering of excavations may be required during construction to provide safe working conditions, and would be discharged in compliance with water quality objectives outlined in the region's water quality management framework (e.g. Environment Protection Guidelines for Construction and

Land Development in the ACT (Environment Protection Authority, 2022), Lake Burley Griffin Water Quality Management Plan (National Capital Authority, 2011)).

Potential impacts to groundwater are likely to be temporary, localised, and relatively small given the limited areas and depth of excavation proposed compared to the scale of the groundwater flow systems.

Mitigation measures (such as measures HF2 and HF3) would be implemented to manage the potential impacts of dewatering and deep excavations, and are presented in Chapter 21 (Environmental management and mitigation measures).

Works on or over Lake Burley Griffin

To construct the light rail bridges between the existing Commonwealth Avenue road bridges, construction works directly on or above Lake Burley Griffin would occur. This direct interface with the waterbody elevates the risk of potential water quality changes and impacts to Lake Burley Griffin and Molonglo River downstream of Scrivener Dam.

One of the key construction impacts would be sedimentation caused by lake bed disturbance during sheet piling works required to create the cofferdams (refer to Chapter 6 (Construction) for further detail). Increased sediment load and turbidity can reduce light penetration and adversely impact the local aquatic ecosystem.

Other impacts may also be caused by construction materials, debris, fuel, oil, and other hazardous substances being released directly into the lake from the active work areas (e.g. bridge segments) or the construction barges.

The combined effect of these pollutants may lead to a temporary decline in water quality, which could have immediate impacts for the ecosystem and also affect recreational activities associated with Lake Burley Griffin.

A key mitigation measure to manage these potential impacts would be the deployment of a silt or turbidity curtain, which would remain in place for the duration of the works, as noted in mitigation measure HF4 in Chapter 21 (Environmental management and mitigation measures).

Hydrology and flooding

Construction activities may change the existing hydrological conditions and drainage pathways. This can occur when temporary works obstruct or divert existing stormwater flow pathways that lead to changes in the flow rate or volume of stormwater discharge at specific locations in the catchment. These changes can exacerbate problems in the existing drainage network, and impact aquatic habitats that have formed based on the existing hydrological conditions.

Baseline flood modelling identified existing widespread flooding across the catchments, except for the Mitchell Depot site. Construction activities occurring in areas impacted by flooding present a risk to the Project and construction workers. The potential impacts of flooding within and surrounding the proposed construction areas would vary in severity and could range from construction program delays, site damage, and compromises to the safety of workers and members of the public. Flooding through work sites may also mobilise contaminants, leading to a detrimental effect on water quality in the receiving waterways.

Flooding can occur at any time of the year and can be caused by overland flows of surface water runoff, or by saturated floodplains through creek corridors. Construction works and locations that are most at risk of flooding have been identified by assessing the baseline 5% AEP event results. These include:

- The area of excavation for the covered section between Commonwealth Avenue and State Circle, due to baseline flooding in this area and potential for disruptions to construction activities as a result
- Plant and vehicle traffic around the Adelaide Avenue light rail bridge over State Circle between the existing Adelaide Avenue northbound and southbound carriageways, due to baseline flooding at the low point on State Circle under the Adelaide Avenue road bridges
- Construction activities around the twin light rail bridges over Hopetoun Circuit and Hopetoun Circuit Stop infrastructure due to a flow path from south to north on Hopetoun Circuit

- All construction works within the Yamba Drive, Melrose Drive, and Yarra Glen interchange
- All works adjacent to and in Yarralumla Creek between Launceston Street and Melrose Drive
- Plant and vehicle traffic around the construction compound E on King George Terrace (refer to Chapter 6 (Construction)).

Temporary land use changes and modifications to floodplain surfaces caused by construction works can also alter flood characteristics. This includes changes to flood depth, flood extent, the velocity of floodwater, overland flow paths, and the duration of flood events.

Structures, such as construction compounds, site buildings, elevated hardstands, and material storage can occupy areas of the floodplain and use up flood storage. Similarly, temporary structures such as fencing, hoarding, and material storage can create blockages or diversions to the existing flood flow paths and drainage infrastructure that results in changes in flow characteristics.

Areas that are potentially at risk include construction compound C on Commonwealth Avenue, and construction compound E at the intersection of King George Terrace and Kings Avenue (refer to Figure 6-1). In these locations, the proposed compounds are located adjacent to identified flow pathways and known areas of ponding. Works in around these areas may change the existing drainage pathways and flow regime. This can occur through the placement of fences, compounds, stockpiles, and storage facilities on existing drainage flow paths and drainage infrastructure.

Blocking or diverting existing stormwater flow pathways can reduce the volume of water or flow rate at certain discharge points and the receiving waterways, which in turn may increase the flood risk upstream of the blockage or diversion. Blocking or diverting stormwater flows can also push water into spaces or drainage assets that do not have the capacity to manage the additional volume of water. While this may not necessarily cause flooding, it can lead to a number of detrimental impacts. These include changes to flow conditions at discharge points, such as increased scour and erosion, reduced headroom in the existing stormwater drainage network, and extended waterlogging in public spaces due to increased volume of runoff.

In accordance with mitigation measure HF5, measures to minimise the risks and impacts of flooding, during construction would be detailed in a Surface Water and Groundwater Plan as part of the CEMP(s) for the Project (refer further to Chapter 21 (Environmental management and mitigation measures)).

11.5.3 Potential impacts – operation

The following sections define the potential hydrology, flooding, water quality, and groundwater impacts that could occur as a result of the operation of the Project.

Surface water quality

The Project would result in net increases to impervious area in each of the five catchments as outlined in Table 11-35. These impervious areas include trackform, light rail stops, additional pavement, and structures such as active travel pathways and light rail bridges.

Table 11-35 Changes to the impervious area within the Project areas

Catchment	Existing (ha)		Post-development (ha)		Impervious Increase
	Pervious	Impervious	Pervious	Impervious	(%)
Acton	3.12	5.03	2.81	5.34	6
Capital Hill (State Circle East alignment option)	29.76	30.63	27.41	32.98	8
Capital Hill (National Triangle-Barton alignment option)	20.46	35.90	18.55	37.81	5
Adelaide Avenue	8.60	7.82	8.18	8.24	5
Yarralumla Creek	40.76	22.68	39.78	23.66	4
Mitchell Depot site	1.42	2.41	1.10	2.73	13

These additional impervious areas may result in the following impacts if not managed appropriately:

- Increased gross pollutants, which can reduce visual amenity and harm wildlife
- Increased total suspended solids, which can cover fish spawning habitat or cause damage to fish gills
- Increased total nitrogen and total phosphorus, which can promote algal blooms.

The MUSICX model determined the potential percentage increase in pollutant loadings from untreated stormwater runoff within Acton, Capital Hill, Adelaide Avenue, and Yarralumla Creek catchments, and the Mitchell Depot site. The results are summarised in Table 11-36 and Table 11-37 for the State Circle East alignment option and National Triangle-Barton alignment option respectively. These potential increases would be treated to meet the water quality objectives as presented in the WSUD General Code.

The MUSICX model demonstrates that the National Triangle-Barton alignment option would mostly follow existing roads, and limit replacing currently pervious areas with impervious surfaces, which reduces the potential increases in stormwater runoff as a result of the Project.

Table 11-36 Potential pollutant loading increase (%) from untreated stormwater runoff from the State Circle East alignment option

Pollutant	Catchment					Total (%)
	Acton (%)	Capital Hill (%)	Adelaide Avenue (%)	Yarralumla Creek (%)	Mitchell Depot site (%)	
Gross Pollutants (GPs)	6	8	5	4	4	5
Total Suspended Solids (TSS)	10	6	4	3	5	4
Total Nitrogen (TN)	9	6	4	3	4	5
Total Phosphorous (TP)	1	6	4	3	6	6

Table 11-37 Potential pollutant loading increase (%) from untreated stormwater runoff from the Project across the National Triangle-Barton alignment option

Pollutant	Catchment					Total (%)
	Acton (%)	Capital Hill (%)	Adelaide Avenue (%)	Yarralumla Creek (%)	Mitchell Depot site (%)	
Gross Pollutants (GPs)	6	5	5	4	4	4
Total Suspended Solids (TSS)	10	4	4	3	5	3
Total Nitrogen (TN)	9	4	4	3	4	4
Total Phosphorous (TP)	1	4	4	3	6	5

Dewatering and groundwater

The covered section between Commonwealth Avenue and State Circle may require intermittent dewatering due to potential seasonal groundwater rise and / or perched water ingress.

The potential impacts of dewatering into the stormwater network and receiving environment can lead to a change in water chemistry and potentially impact aquatic species in receiving waters. Treatment or management prior to discharge may be required.

It is likely that the covered section invert would be above the local groundwater level, and the risk of groundwater ingress would therefore be low. However, as further site investigations would be required to confirm groundwater levels, a conservative assessment of groundwater ingress has been adopted for the Project.

Subject to detailed design, infrastructure to manage potential surface water and groundwater ingress would include a wet-well, in-built subsoil drainage, recessed pumps, a valve pit, and rising main.

To manage discharge of water, it is proposed that water collected would be disposed into the sewer network under a trade waste agreement with Icon Water.

Where groundwater ingress is not considered suitable for discharge into the sewer network, water would be treated through a water treatment plant, which would be built into the wall of the covered section at a low point. The requirement of this water treatment plan would be subject to further investigations during detailed design.

Further detail of water quality mitigation measures is outlined in Chapter 21 (Environmental management and mitigation measures).

Hydrology and flooding

Land use changes and modifications to ground surfaces as a result of the Project have the potential to impact flood characteristics once operation begins. These changes can include alteration of flood depths and extents, the velocity of runoff, flood duration, and flood locations. These changes may also increase the volume and flow characteristics within the existing stormwater drainage network, causing flooding at pit inlets when the pit and pipe network reaches its capacity.

Potential impacts of altered flood characteristics could include a reduction in public safety, damage to buildings, infrastructure, and public spaces. Flooding mechanisms include fluvial (river) and pluvial (stormwater).

An assessment of potential flooding impacts to the Project has been assessed for 1% AEP (the major flood) and 5% AEP events (the minor flood). A sensitivity analysis for climate change and flood hazard rating has also been outlined.

In accordance with mitigation measure HF7, the Project would be designed and operated to minimise flood risk. Further detail on measures to reduce the potential risks of flood damage and disruption is included in Chapter 21 (Environmental management and mitigation measures).

Commonwealth Avenue, Parliament House, National Triangle, and Barton precincts

Potential flood impacts in the Commonwealth Avenue, Parliament House, National Triangle, and Barton precincts for both State Circle East and National Triangle-Barton alignment options are summarised in Table 11-38.

The flood depths for the 1% AEP, 5% AEP, and climate change sensitivity analysis events throughout the precincts as part of the Acton catchment and Capital Hill catchment are shown on Figure 11-69 to Figure 11-75.

Table 11-38 Summary of key flood impacts during Project operation at Commonwealth Avenue, Parliament House, National Triangle, and Barton precincts

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Commonwealth Avenue precinct		
Precinct wide	For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change events: <ul style="list-style-type: none"> There would be no private properties within the flood extents within the Project area. 	
Commonwealth Avenue, between Flynn Drive and Queen Victoria Terrace	For the 1% AEP event: <ul style="list-style-type: none"> Flood depths would generally be reduced. For the 5% AEP event: <ul style="list-style-type: none"> Flood depths would generally be reduced. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths on Flynn Place by up to 0.025 m with maximum depths of around 0.14 m There would be nominal increases in flood depths on Commonwealth Avenue by up to 0.025 m with maximum depths of around 0.15 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings. 	
North of Queen Victoria Terrace, where the alignment bends into King George Terrace across Langton Crescent	Not applicable	For the 1% AEP event: <ul style="list-style-type: none"> Flood depths would generally be reduced For the 5% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths to the south and west of the alignment by up to 0.05 m with a maximum flood depth of around 0.09 m. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> Flood depths would generally be reduced There would be nominal increases in flood depths to the south and west of the alignment by up to 0.05 m with a maximum flood depth of around 0.12 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Parliament House precinct		
Precinct wide	For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change events: <ul style="list-style-type: none"> There would be no private properties within the flood extents within the Project area. 	
State Circle opposite Flynn Drive	For the 1% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths in open land by up to 0.015 m with a maximum flood depth of around 2.2 m. For the 5% AEP event: <ul style="list-style-type: none"> There would be negligible impacts. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths in open land by up to 0.05 m with a maximum flood depth of around 2.55 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H4 - Unsafe for all people and vehicles. 	Not applicable.
State Circle, Wyman Street and opposite Brisbane Avenue	For the 1% AEP event: <ul style="list-style-type: none"> There would be negligible impacts. For the 5% AEP event: <ul style="list-style-type: none"> There would be negligible impacts. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths with a maximum flood depth of around 0.33 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings. 	For the 1% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.04 m with a maximum flood depth of around 0.44 m. For the 5% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.06 m with a maximum flood depth of around 0.38 m. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.013 m with a maximum flood depth of around 0.5 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
State Circle opposite Hobart Avenue	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.25 m with a maximum flood depth of around 0.8 m This is not considered an adverse impact as the receptor is open parkland. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H2 - Unsafe for small vehicles. 	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.5 m with a maximum flood depth of around 0.95 m This is not considered an adverse impact as the receptor is open parkland. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.5 m with a maximum flood depth of around 0.79 m This is not considered an adverse impact as the receptor is open parkland. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.2 m with a maximum flood depth of around 1.0 m. This is not considered an adverse impact as the receptor is open parkland. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H2 - Unsafe for small vehicles.

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
State Circle to Capital Circle, low point under the Adelaide Avenue road bridges	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> Flood depths would generally be reduced. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.13 m with a maximum flood depth of around 0.54 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths would generally be reduced. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard in the low point would remain as H4 - Unsafe for all people and vehicles. 	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.09 m with a maximum flood depth of 0.5 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths would generally be reduced. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard in the low point would remain as H4 - Unsafe for all people and vehicles.
National Triangle precinct		
Precinct wide	<p>For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change events:</p> <ul style="list-style-type: none"> There would be no private properties within the flood extents within the Project area. 	
Walpole Crescent, King George Terrace, and Kings Avenue	Not applicable	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.025 m with a maximum flood depth of around 0.29 m <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.015 m with a maximum flood depth of around 0.25 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.05 m with a maximum flood depth of around 0.33 m. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Barton precinct		
Precinct wide	<p>For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change events:</p> <ul style="list-style-type: none"> There would be six private properties within the flood extents within the Project area Flood levels at three properties would decrease and there would be negligible impacts at the remaining three properties. 	
National Circuit and Brisbane Avenue	Not applicable	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depth by up to 0.012 m with a maximum flood depth of around 0.04 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.1 m with a maximum flood depth of around 0.16 m.
		<p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.
Brisbane Avenue and Macquarie Street intersection	Not applicable	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.06 m with a maximum flood depth of around 0.18 m. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.07 m with a maximum flood depth of around 0.13 m. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> Flood depths would generally be reduced. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Sydney Avenue/John McEwen Crescent	<p>For the 1% AEP event:</p> <ul style="list-style-type: none"> The intersection of Sydney Avenue and John McEwen Crescent would not drain as quickly as the 5% AEP event There would be nominal increases in flood depths by up to 0.02 m with a maximum depth of around 0.25 m. <p>For the 5% AEP event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none"> There would be negligible impacts. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings. 	Not applicable.

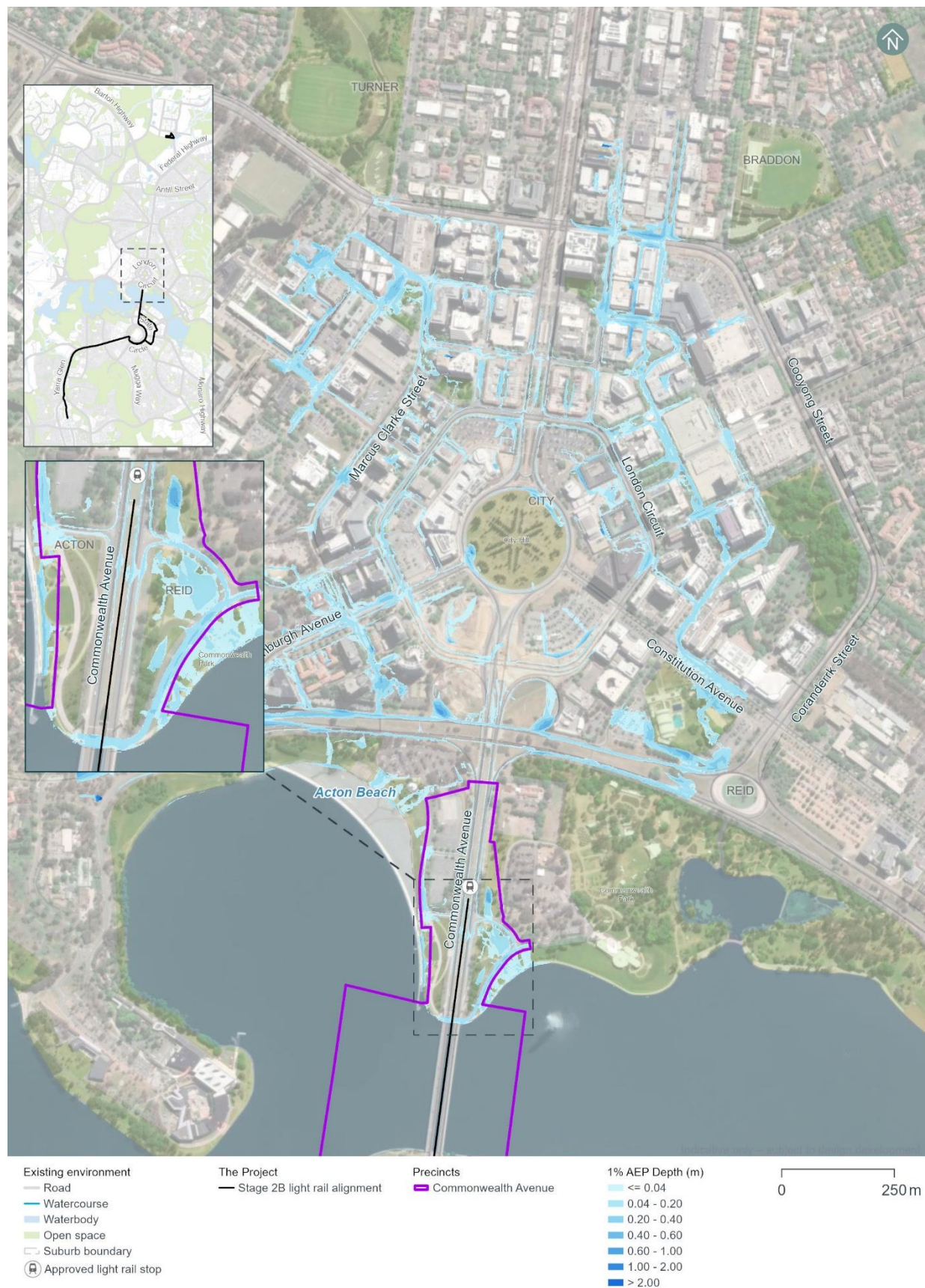


Figure 11-69 Acton catchment 1% AEP event during operation

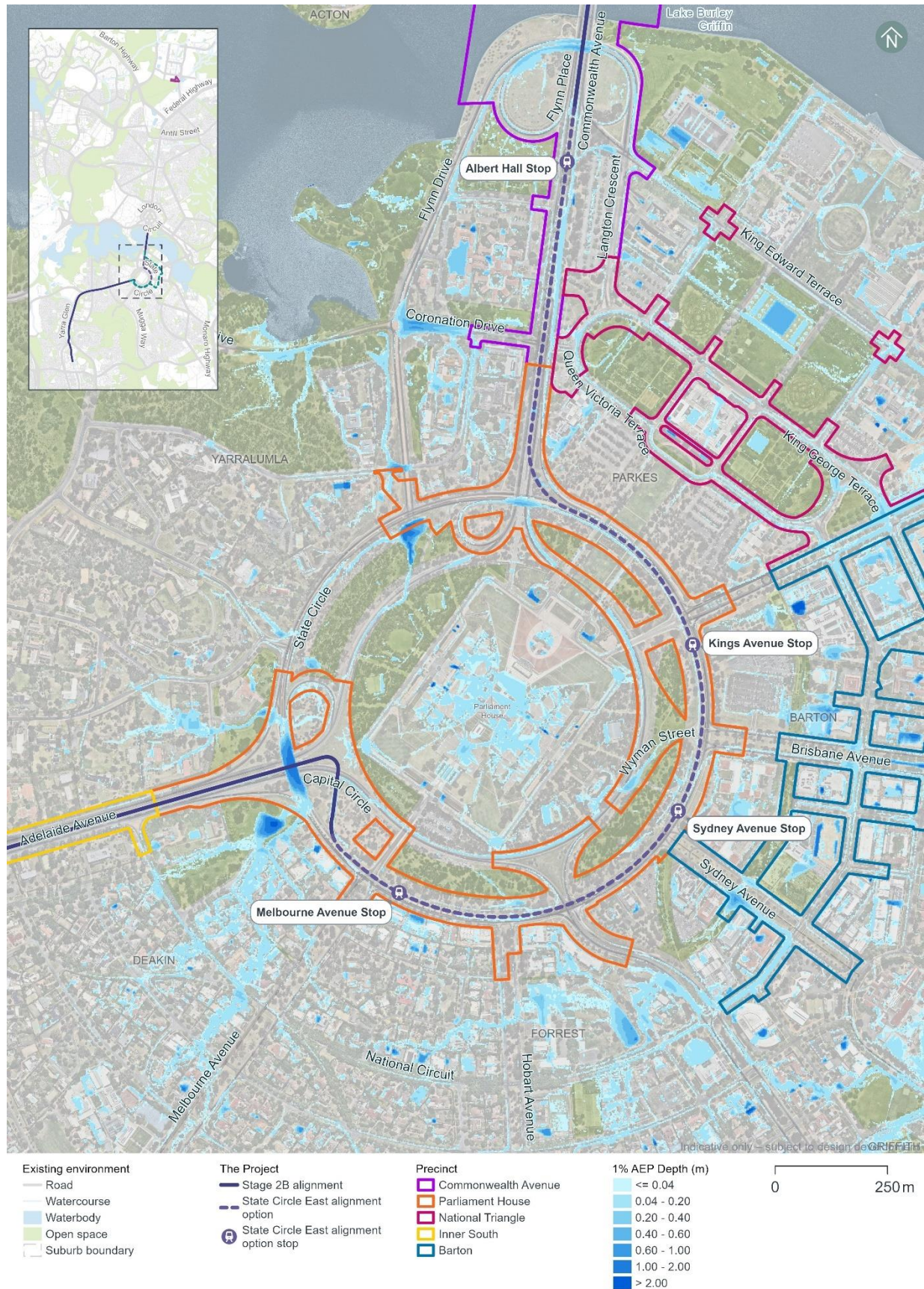


Figure 11-70 State Circle East alignment option 1% AEP event during operation

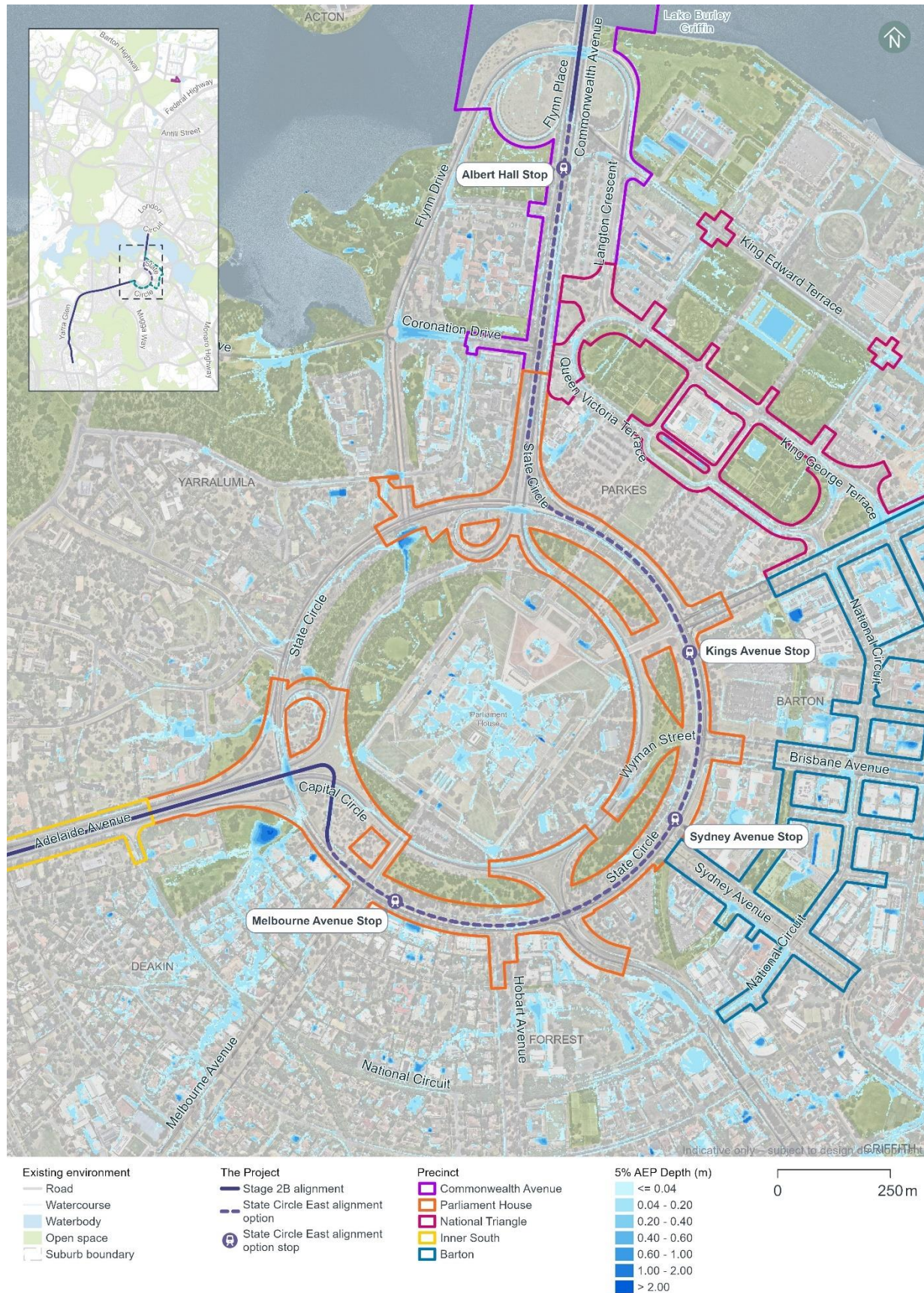


Figure 11-71 State Circle East alignment option 5% AEP event during operation

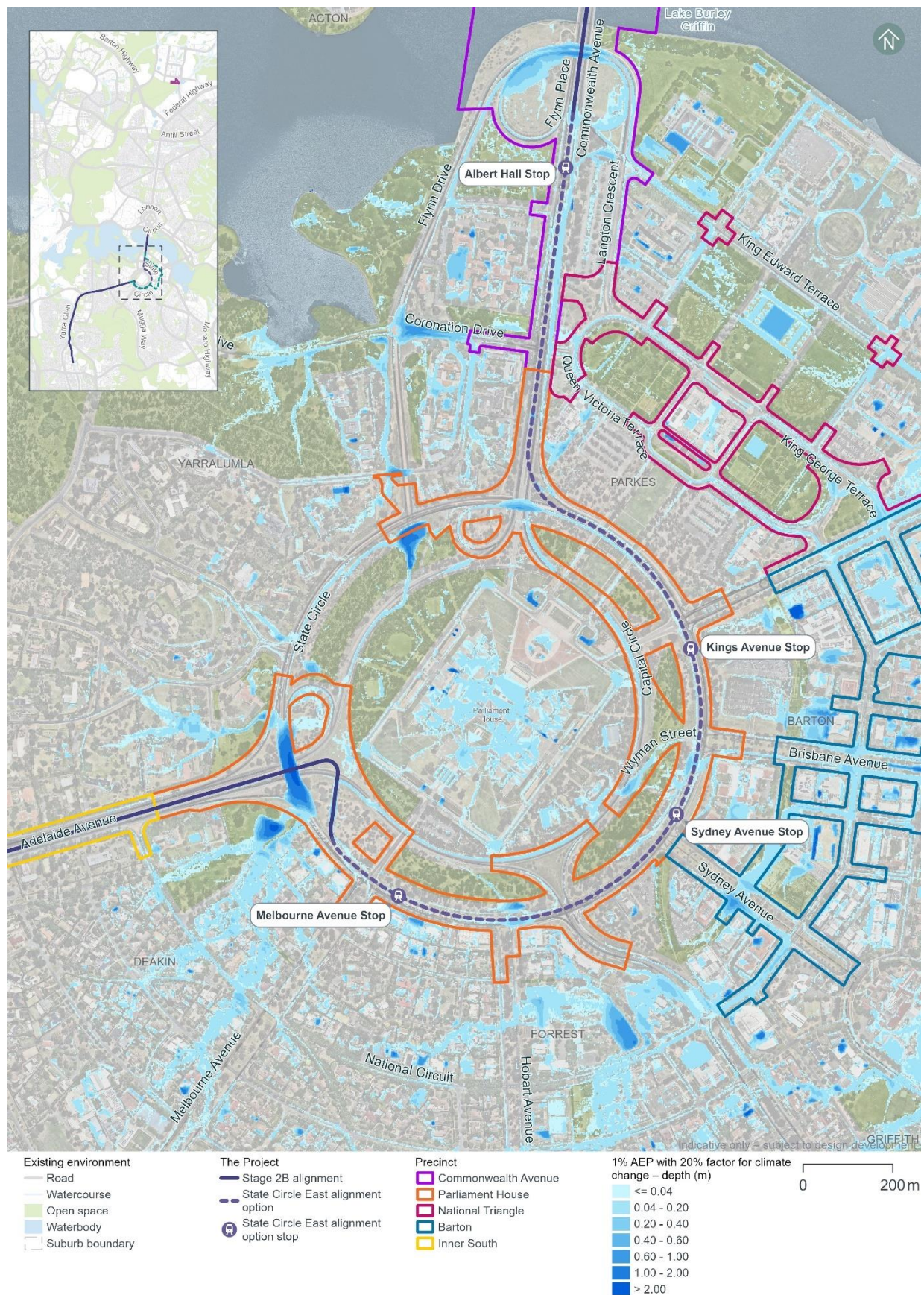


Figure 11-72 State Circle East alignment option 1% AEP with 20% factor for climate change event during operation

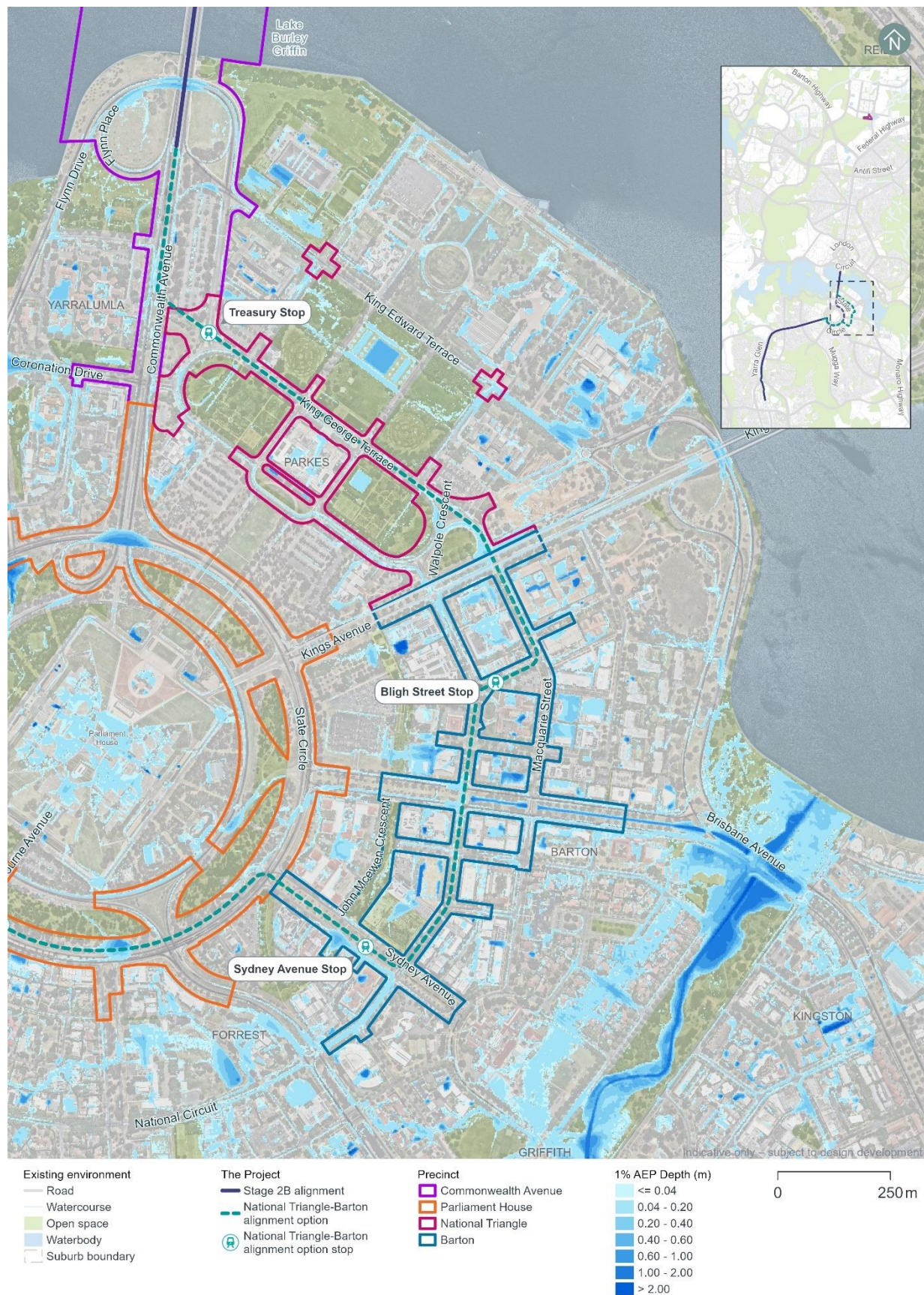


Figure 11-73 National Triangle-Barton alignment option 1% AEP event during operation

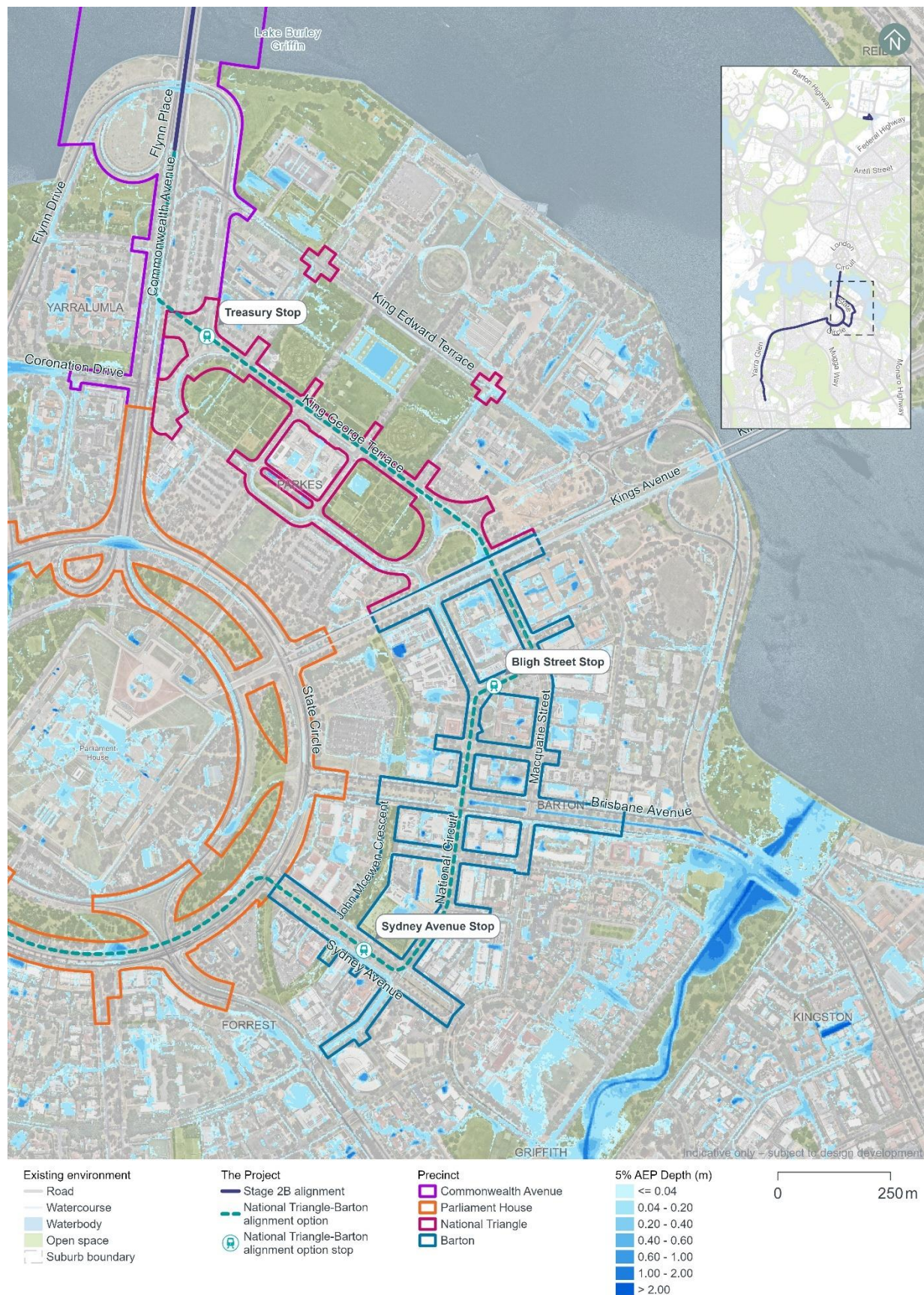


Figure 11-74 National Triangle-Barton alignment option 5% AEP event during operation

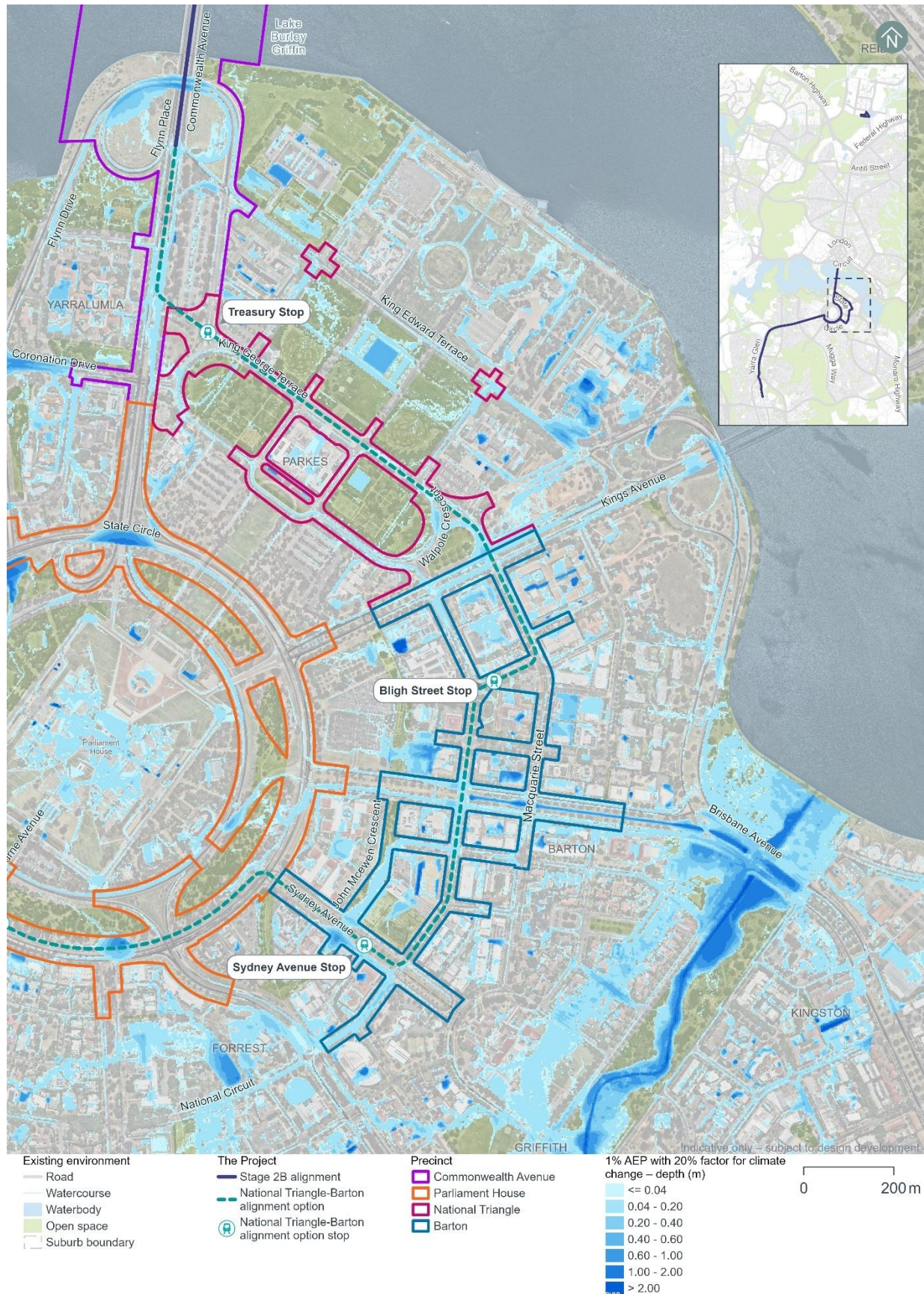


Figure 11-75 National Triangle-Barton alignment option 1% AEP with 20% factor for climate change event during operation

Inner South precinct

Potential flood impacts in the Inner South precinct are summarised in Table 11-39.

The flood depths for the 1% AEP, 5% AEP, and climate change sensitivity analysis events throughout the precinct as part of the Adelaide Avenue catchment are shown on Figure 11-76 to Figure 11-78.

Table 11-39 Summary of key flood impacts during Project operation at Inner South precinct

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Inner South precinct		
Precinct wide	For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change events: <ul style="list-style-type: none"> There would be one private property within the flood extents within the Project area. There would be negligible impacts at this property. 	
Hopetoun Circuit	For the 1% AEP event: <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.24 m with a maximum flood depth of around 0.3 m The increase in flood depths would have no impact beyond the road. For the 5% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.025 m with a maximum flood depth of 0.18 m The increase in flood depths would have no impact beyond the road. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.24 m, and the flood extent would be slightly larger. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H5 - Unsafe for all people and vehicles. 	
Grassed area near Guilfoyle Street	For the 1% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.01 m with a maximum flood depth of around 0.46 m. For the 5% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.015 m with a maximum flood depth of around 0.22 m. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths by up to 0.015 m with a maximum flood depth of around 0.52 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H2 - Unsafe for small vehicles. 	



Figure 11-76 Adelaide Avenue catchment 1% AEP event during operation



Figure 11-77 Adelaide Avenue catchment 5% AEP event during operation



Figure 11-78 Adelaide Avenue catchment 1% AEP with 20% factor for climate change event during operation

Yarra Glen precinct, Woden precinct, and the Mitchell Depot site

Potential flood impacts in the Yarra Glen and Woden precincts and the Mitchell Depot site are summarised in Table 11-40.

The flood depths for the 1% AEP, 5% AEP and climate change sensitivity analysis events in the Yarra Glen and Woden precincts as part of the Yarralumla Creek catchment are shown on Figure 11-79 to Figure 11-81. Figures for the Mitchell Depot site have not been included as negligible flood impacts are identified.

Table 11-40 Summary of key flood impacts during Project operation at Yarra Glen precinct and Woden precinct

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Yarra Glen precinct		
Precinct wide	For the 1% AEP, 5% AEP, and the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be no private properties within the flood extents within the Project area. 	
Yarra Glen near King Street and Makin Place.	For the 1% AEP event: <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.14 m in a channel parallel to Yarra Glen Flood flows would be blocked by the light rail alignment and increase depths on the southbound carriageway There would be increases in flood depths on the road by up to 0.15 m with a maximum flood depth of around 0.4 m. For the 5% AEP event: <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.08 m in a channel parallel to Yarra Glen Flood depths on the road would generally be reduced. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be increases in flood depths by up to 0.14 m in a channel parallel to Yarra Glen There would be increases in flood depths on the road by up to 0.28 m with a maximum flood depth of 0.47 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> On the southbound carriageway the flood hazard would remain as H2 - Unsafe for small vehicles In the ditch parallel to the road the flood hazard would remain as H3 - Unsafe for vehicles, children, and the elderly. 	
Yarra Glen near to the Carruthers Street Stop	For the 1% AEP event: <ul style="list-style-type: none"> There would be nominal increases in flood depths on the southbound carriageway by up to 0.04 m with a maximum flood depth of around 0.14 m For the 5% AEP event: <ul style="list-style-type: none"> Flood depths would generally be reduced. For the 1% AEP with 20% factor for climate change event: <ul style="list-style-type: none"> There would be nominal increases in flood depths on the southbound carriageway by up to 0.05 m. The flood hazard for the 1% AEP event: <ul style="list-style-type: none"> The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings. 	

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Melrose Drive	<p>For the 1% AEP event:</p> <ul style="list-style-type: none">There would be increases in flood depths by up to 0.024 m with a maximum flood depth of around 0.08 m. <p>For the 5% AEP event:</p> <ul style="list-style-type: none">Flood depths would generally be reduced. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none">There would be increases in flood depths of up to 0.02 m on the open land between Melrose Drive and Yarralumla Creek. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none">The flood hazard would remain as H3 - Unsafe for vehicles, children, and the elderly.	
Woden precinct		
Precinct wide	<p>For the 1% AEP, 5% AEP and the 1% AEP with 20% factor for climate change events:</p> <ul style="list-style-type: none">There would be three private properties within the flood extents within the project boundaryThere would be negligible impacts at the properties for the 5% AEP eventFlood depths would be reduced at all three properties for the 1% AEP and the 1% AEP with 20% factor for climate change event.	
Between the Yamba Drive – Melrose Drive interchange and Launceston Street and Irving Street	<p>For the 1% AEP event:</p> <ul style="list-style-type: none">Flood depths would generally be reducedThere would be nominal increases in flood depths around the Phillip Oval Stop. <p>For the 5% AEP event:</p> <ul style="list-style-type: none">Flood depths would generally be reduced. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none">Flood depths would generally be reduced. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none">The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.	
Callam Street	<p>For the 1% AEP event:</p> <ul style="list-style-type: none">There would be negligible impacts. <p>For the 5% AEP event:</p> <ul style="list-style-type: none">There would be negligible impacts. <p>For the 1% AEP with 20% factor for climate change event:</p> <ul style="list-style-type: none">Flood depths on the western side of the alignment would generally be reducedThere would be nominal increases in flood depths by up to 0.03 m on the eastern sideOverall, there would be negligible impacts. <p>The flood hazard for the 1% AEP event:</p> <ul style="list-style-type: none">The flood hazard would remain as H1 - Generally safe for people, vehicles, and buildings.	

Location	Operational flood impacts (compared to baseline)	
	State Circle East alignment option impacts	National Triangle-Barton alignment option impacts
Mitchell Depot site		
Site wide	There would be negligible flood impacts to the Mitchell Depot site as previous modelling indicated that the 0.05% AEP event was contained within the existing channels and basin.	

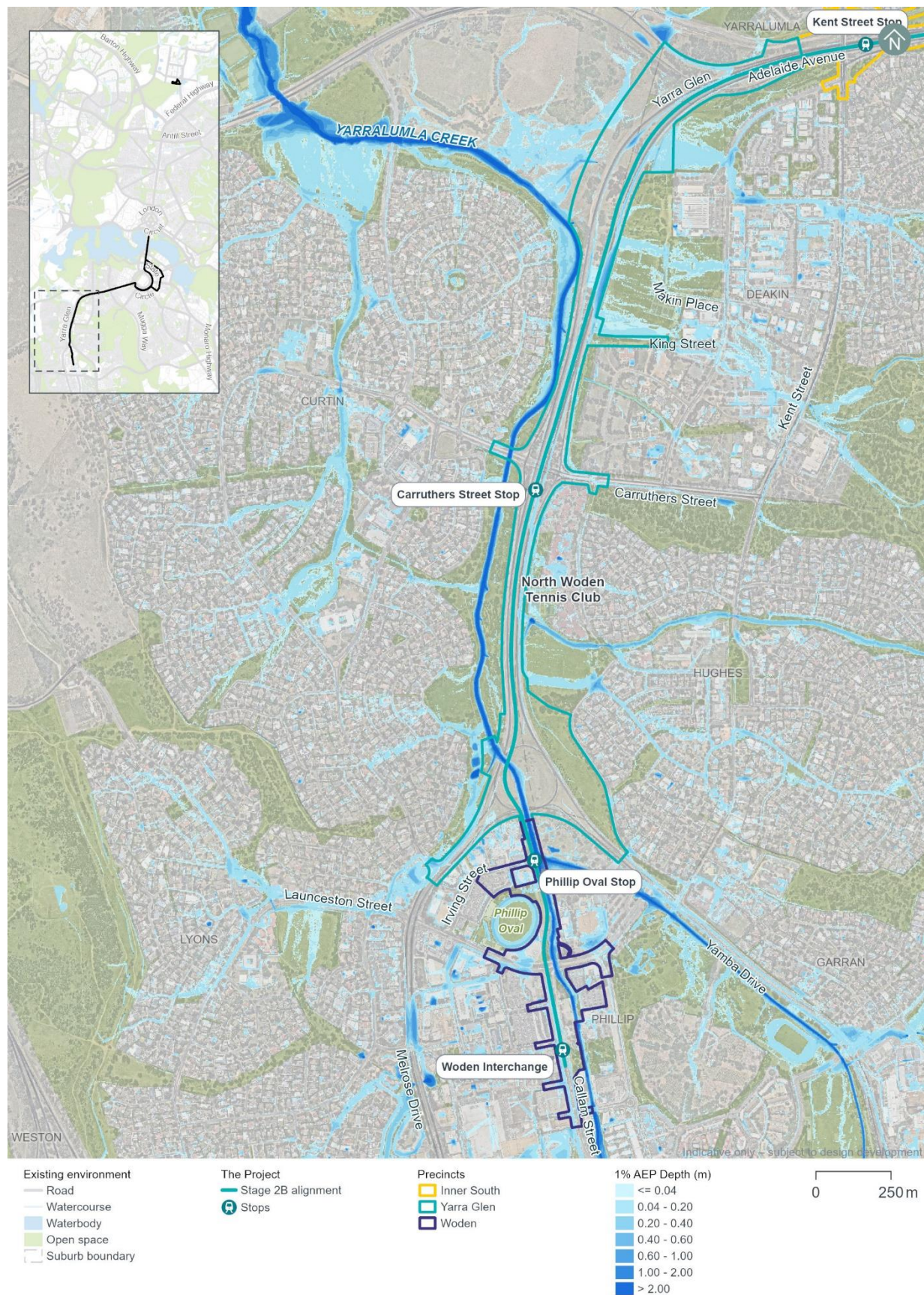


Figure 11-79 Yarralumla Creek catchment 1% AEP event during operation

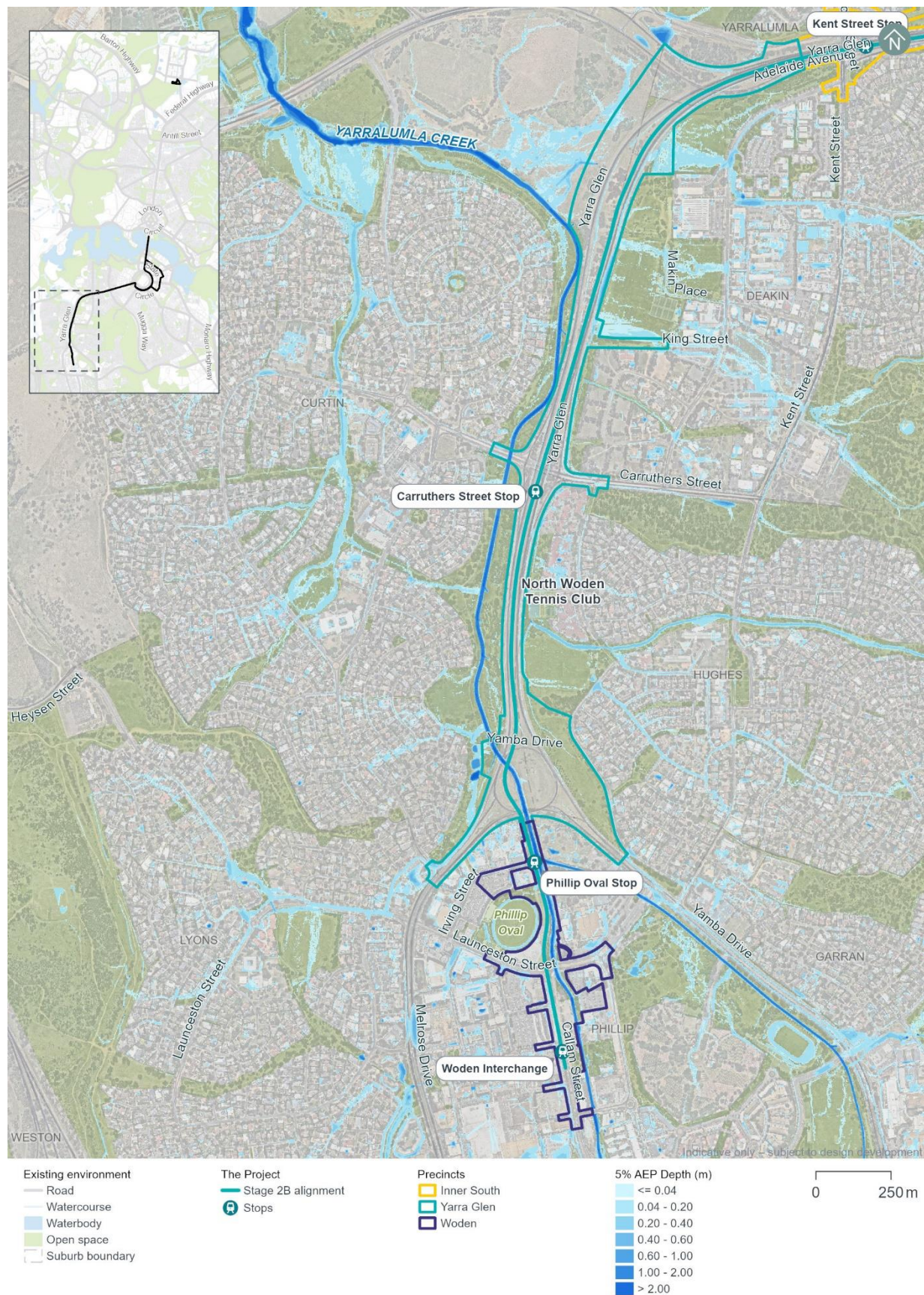


Figure 11-80 Yarralumla Creek catchment 5% AEP event during operation

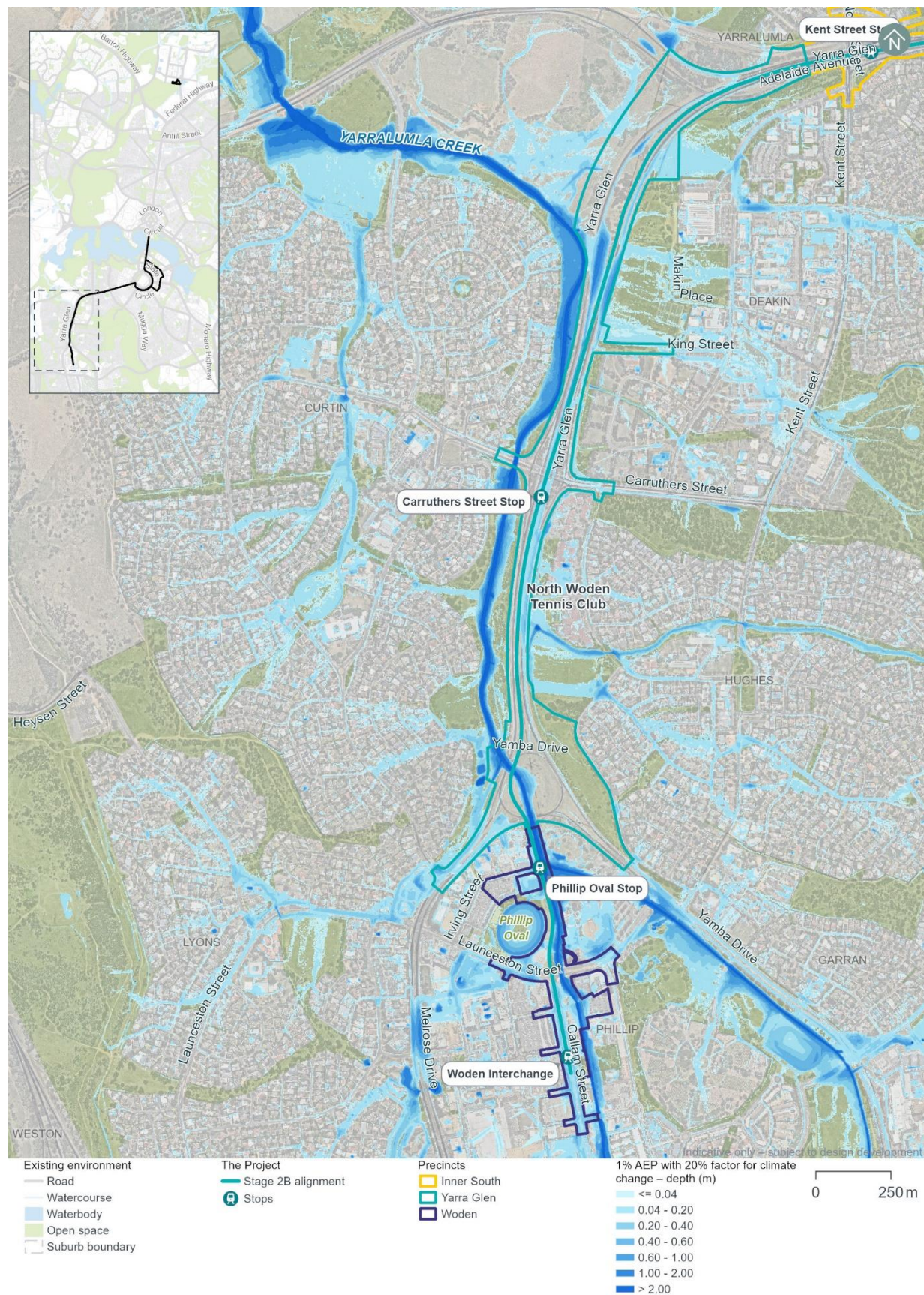


Figure 11-81 Yarralumla Creek catchment 1% AEP with 20% factor for climate change event during operation

11.5.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage hydrological, flooding, water quality and groundwater impacts, that are applicable to the Project as a whole.

11.6 Soils and contamination

This section describes the potential soils and contamination risks associated with the construction and operation of the Project, as well as the potential risks of soils and contamination on the Project. Further detail on the soils and contamination assessment is provided in Technical Report 5 – Contamination.

The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 5 – Contamination.

11.6.1 Existing environment

Study area

To assess potential impacts to soils and contamination, a total of 13 sites were identified within the Project area, which closely align with each precinct and the Mitchell Depot site.

These 13 sites are listed below:

- Commonwealth Avenue precinct – Site 10
- Parliament House precinct western portion – Site 7
- Parliament House precinct eastern portion – Site 8a
- Parliament House precinct northern portion – Site 9a
- National Triangle precinct – Site 9b
- Barton precinct – Site 8b
- Inner South precinct western half – Site 5
- Inner South precinct eastern half – Site 6
- Yarra Glen precinct southern part – Site 2
- Yarra Glen precinct central part – Site 3
- Yarra Glen precinct northern part – Site 4
- Woden precinct – Site 1
- Mitchell Depot site – Site 11.

Current land use

Current land use within the Project area primarily consists of roadways, pavements, public open spaces, and grassed parks. Site 10 (Commonwealth Avenue precinct) also includes Lake Burley Griffin under the existing Commonwealth Avenue road bridges. Site 11 (the Mitchell Depot site) is currently operational as a light rail depot.

The surrounding land use is primarily commercial and civic uses within Commonwealth Avenue, Parliament House, National Triangle, Barton, the southern extent of Yarra Glen, and Woden precincts, and north and west of the Mitchell Depot site. Parkland and agricultural land is present to the south and east of the Mitchell Depot site. The surrounding land use of the remaining Project area is primarily residential.

The key sources of contamination within the Project area are anthropogenic (caused by human activities, as opposed to naturally occurring), such as earthworks at transport hubs in the Woden precinct and the Mitchell Depot site, chemicals from businesses, pesticides, pollution from vehicles and road materials, and operation of petrol stations throughout the Project area.

Topography

Populous areas of Canberra are generally flat, bordered by hills and mountains, with the nearest mountains to the Project area about 1 km away in a north-western direction. The elevation throughout the Project area ranges between about 560 m to 600 m Australian Height Datum (AHD). The highest elevation in the Project area is nearby to Capital Hill at 590 m to 595 m AHD, from which the elevation gradually declines to Lake Burley Griffin at around 560 m AHD, and increasing slightly to the Woden precinct at around 585 m AHD.

Geology

The geology gradually changes from the northern to southern extent of the Project area, as described in Table 11-41.

Table 11-41 Geology across the Project area

Precinct/site	Geology
Commonwealth Avenue (Site 10)	<ul style="list-style-type: none"> Canberra Formation comprising mudstone, siltstone, minor sandstone, limestone, hornfels, volcanic rock and lithic tuff to the north and south of Lake Burley Griffin Anthropogenic material across the Lake Burley Griffin footprint, which is described as thinly laminated muds and silts with organic debris Residual deposits comprising of iron rich sediment, and quartz pebble conglomerate in a small area in the southern extent
Parliament House (Sites 7, 8a, and 9a)	<ul style="list-style-type: none"> Narrabundah Ashstone Member comprising massive tuffaceous sandstone, fine to medium-grained tuff with sandstone as the dominant lithology Black Mountain Sandstone comprising grey, thick-bedded, massive medium-grained arenite with siltstone and shale interbeds with sandstone as the dominant lithology Abercrombie Formation comprising brown and buff to grey, thin to thick bedded, fine to coarse grained mica-quartz sandstone, interbedded with laminated siltstone, and mudstone with sandstone as the dominant lithology State Circle Shale comprising shale, mudstone, siltstone, and minor sandstone across the northern portion Canberra Formation across the eastern portion Mount Painter Volcanics comprising tuff and ashstone with pyroclastic rock as the dominant lithology along the south-western portion
National Triangle (Site 9b)	<ul style="list-style-type: none"> Canberra Formation across the northern extent State Circle Shale comprising shale, mudstone, siltstone, and minor sandstone across majority of the north-western extent Residual deposits comprising of iron rich sediment, and quartz pebble conglomerate in a small area of the south-eastern extent
Barton (Site 8b)	<ul style="list-style-type: none"> Canberra Formation across majority of precinct Residual deposits comprising of iron rich sediment, and quartz pebble conglomerate in a small area along the eastern boundary of the precinct
Inner South (Sites 5 and 6)	<ul style="list-style-type: none"> Yarralumla Formation comprising of calcareous and tuffaceous mudstone and siltstone with minor limestone, calc-silicate hornfels and quartz sandstone across the western portion Mount Painter Volcanics across the eastern portion
Yarra Glen (Sites 2 to 4)	<ul style="list-style-type: none"> Yarralumla Formation across majority of precinct Mount Painter Volcanics along a small portion of the western boundary

Precinct/site	Geology
Woden (Site 1)	<ul style="list-style-type: none"> Yarralumla Formation in the northern portion Mugga Mugga Porphyry Member comprising blue and mauve-grey porphyritic rhyodacite and other igneous rock within a small portion of the eastern boundary Deakin Volcanics comprising tuff and lapilli tuff, sandstone, and shale in the southern portion
The Mitchell Depot site (Site 11)	<ul style="list-style-type: none"> Alluvium comprising unconsolidated grey to brown to beige humic micaceous silty clay, quartz lithic silt, fine to medium grained quartz-rich to quartz-lithic sand, polymictic pebble to cobble gravel across the eastern portion Canberra Formation across the western portion

Soil landscapes

The Project area comprises Williamsdale, Pialligo, and Ginninderra Creek soil landscapes. This includes transferral (generally older and more weathered rocks that have eroded into soils and moved downslope) and alluvial (generally younger deposits of unweathered soils, formed by flowing water) soils, and is detailed in Table 11-42.

Table 11-42 Soil landscapes within the Project area

Precinct/site	Description
Commonwealth Avenue (Site 10)	<ul style="list-style-type: none"> Williamsdale (transferral) comprising of extensively cleared savanna woodland with highly modified grasslands, across majority of the precinct to the north and south of Lake Burley Griffin. Can be described as moderately deep well-drained Red and some Brown Chromosols and Red and Brown Kandosols, shallow Leptic Tenosols Pialligo (alluvial) comprising of extensively cleared savanna woodland, along the southern extent. Can be described as deep, moderately well-drained Red Kandosols, Brown Kandosols, and imperfectly drained Stratic Rudusols
Parliament House (Sites 7, 8a, and 9a)	<ul style="list-style-type: none"> Williamsdale (transferral) throughout precinct Pialligo (alluvial) across the north-eastern area
National Triangle (Site 9b)	<ul style="list-style-type: none"> Williamsdale (transferral) across majority of precinct Pialligo (alluvial) across the north-eastern area
Barton (Site 8b)	<ul style="list-style-type: none"> Williamsdale (transferral) across majority of precinct Pialligo (alluvial) across the north-eastern area
Inner South (Sites 5 and 6)	<ul style="list-style-type: none"> Williamsdale (transferral) throughout precinct
Yarra Glen (Sites 2 to 4)	<ul style="list-style-type: none"> Williamsdale (transferral) across northern portion and eastern boundary Ginninderra Creek (alluvial) comprising of extensively cleared riparian woodland, across southern portion. Can be described as deep, poorly drained Stratic Rudusols on floodplains with deep Sodic Brown Chromosols on margins
Woden (Site 1)	<ul style="list-style-type: none"> Williamsdale (transferral) across the western portion Ginninderra Creek (alluvial) across majority of precinct
The Mitchell Depot site (Site 11)	<ul style="list-style-type: none"> Williamsdale (transferral) across the western portion Ginninderra Creek (alluvial) across eastern precinct

Acid sulfate soils

Acid sulfate soils and potential acid sulfate soils are naturally occurring soils containing iron sulfide. If exposed to oxygen the iron sulfides react with oxygen to form sulfuric acids, which can cause metals in the soil such as iron to mobilise, potentially causing adverse impacts on surface and groundwater quality, and flora and fauna.

According to the Atlas of Australian Acid Sulfate Soils, there is a high (over 70%) probability of occurrence of acid sulfate soils underlying Lake Burley Griffin in the Commonwealth Avenue precinct. The soils underlying the Project area between Kaye Street in the Commonwealth Avenue precinct and Melrose Drive in the Yarra Glen precinct are mapped as having an extremely low probability of occurrence (1% to 5%). The soils underlying the Project area at Mitchell Depot site, and between Melrose Drive (Yarra Glen precinct) and the Woden interchange (Woden precinct), are mapped as having a low probability of occurrence (6% to 70%) of acid sulfate soils.

Soil salinity

Salinity refers to the salt content of soil or water and is caused by the build-up of salt in surface soil or water. The risk of salinity impacts can be increased by clearing vegetation, irrigation, or other activities that can lead to a temporary rise in the groundwater table, which then leaves salt behind as it recedes. According to the eSPADE spatial viewer, there is a very low probability of salinity occurring in the Project area (NSW DCCEEW, 2024).

Historical aerial photography

A review of historical aerial photographs between 1944 and 2018 was undertaken of the Project area and surroundings. The review indicates that development in the northern portion (around Commonwealth Avenue, Parliament House, National Triangle, and Barton precinct) occurred earlier than the southern portion of the Project area (refer to Table 11-43 below and Appendix B of Technical Report 5 – Contamination).

Table 11-43 Historical aerial photograph review

Photograph date	Description
1944	<p>The majority of the main road network had been constructed in the northern portion of the Project area, including the Commonwealth Avenue road bridges, State Circle (except the south-west section), Adelaide Avenue, and Brisbane Avenue.</p> <p>Residential areas were pictured as early as 1944 south-east of Barton precinct, south-west of Parliament House precinct, and south-east of Inner South precinct.</p> <p>Commercial / industrial buildings were also pictured as early as 1944 near the northern and eastern portions of Parliament House precinct.</p>
1961	The south-west section of State Circle was constructed.
1967-1973	<p>Construction of Hopetoun Circuit, Yarra Glen, and Callam Street had commenced in 1967 and was completed by 1973.</p> <p>By 1967, low-density residential housing had been developed, particularly around the southern portion of the Project area.</p> <p>West of Woden precinct, commercial / industrial buildings were built by 1967.</p>
1973	<p>Yarralumla Creek was pictured running north to south along the western side of Yarra Glen precinct and the centre of Woden precinct. By 1973, Yarralumla Creek was diverted into an engineered waterway broadly following the creek's natural alignment.</p> <p>Development of commercial / industrial properties commenced along the south of the Inner South precinct and east of Yarra Glen in 1973, and on Callam Street in the Woden precinct.</p>
1978	Near the Mitchell Depot site, Flemington Road and Sandford Street are pictured to be fully sealed

Photograph date	Description
1992-1997	Commercial / industrial properties south of the Inner South precinct and east of Yarra Glen precinct were fully developed by 1992 and 1997, respectively.
1997-2004	<p>Sydney Avenue and John McEwen Crescent in the Barton precinct were first pictured.</p> <p>By 2004, the southern section of the Mitchell Depot site appears to include a construction laydown pad, with several containers, trucks, and temporary fencing.</p> <p>West of the Woden precinct, minor changes to commercial / industrial buildings were progressively observed, with most buildings similar to their current (2024) appearance by 2004.</p>
2009	Man-made reservoirs are pictured to the east and south of the Mitchell Depot site, which are present today (2024).
2018	By 2018, the Mitchell Depot site has been developed as a stabling and maintenance facility for LRVs, including tracks occupying the southern section, and buildings occupying the northern section.

Historical business activities

A summary of historical business within the Project area with the potential to cause contamination are outlined in Table 11-44.

Table 11-44 Summary of relevant historical business records within the Project area

Precinct/site	Historical business record
Commonwealth Avenue (Site 10)	Motor Garages, Service Stations, Motor Car Laundries, and Welding from 1950 to 1991
Parliament House (Sites 7, 8a, and 9a)	Motor Garages and Motor Service Stations from 1961 to 1991
National Triangle (Site 9b)	None identified
Barton (Site 8b)	Motor Garages and Motor Service Stations from 1961 to 1991
Inner South (Sites 5 and 6)	<ul style="list-style-type: none"> Motor Garages, Motor Service Stations from 1961 Motor Garages, Motor Service Stations, and Welders from 1970 to 1991
Yarra Glen (Sites 2 to 4)	<ul style="list-style-type: none"> Swimming pool in the northern portion from 1970 to 1991 Swimming pool in the southern portion from 1982 Battery Sales and / or Service, Motor Garages and Service Stations from 1991
Woden (Site 1)	None identified
The Mitchell Depot site (Site 11)	None identified

Contaminated land registers

A search of the ACT Environment Protection Authority (EPA) Register of Contaminated Sites was undertaken with a 1 km buffer. Records of both current and former records are presented in Table 11-45 below.

In addition to contaminated land register searches, a desktop search within a 1 km radius of the study area for soils and contamination was conducted to identify current or historical land uses that may be a potential off site source of per- and polyfluoroalkyl substances (PFAS), such as facilities that would utilise aqueous film foaming foams or other PFAS products in their industrial processes. The desktop search did not identify significant sources of PFAS.

Table 11-45 Records of contaminated sites

Precinct/site	Currently on EPA Register	Formerly on EPA Register
Commonwealth Avenue (Site 10)	None identified	<ul style="list-style-type: none"> None identified
Parliament House (Sites 7, 8a, and 9a)	None identified	<ul style="list-style-type: none"> None identified
National Triangle (Site 9a)	None identified	<ul style="list-style-type: none"> None identified
Barton (Site 8b)	None identified	<ul style="list-style-type: none"> None identified
Inner South (Sites 5 and 6)	None identified	<ul style="list-style-type: none"> None identified
Yarra Glen (Sites 2 to 4)	None identified	<ul style="list-style-type: none"> Yamba Club
Woden (Site 1)	Canberra Institute of Technology Campus	<ul style="list-style-type: none"> Phillip Oval Bus Layover Callam Street Bus Interchange and Woden Interchange (light rail) Easty Street Bus Layover Yamba Club
The Mitchell Depot site (Site 11)	Capital Metro Alignment and former Total Care Facility	<ul style="list-style-type: none"> None identified

Areas of environmental concern

The areas of environmental concern (AECs) and potentially associated contaminants are summarised in Table 11-46 and shown on Figure 11-82 to Figure 11-85. Some AECs could result in contamination across multiple precincts/sites, and have therefore been shown as relevant to more than one precinct/site.

Table 11-46 Areas of environmental concern near the Project

Precinct/site	Areas of environmental concern	Discussion	Contaminants of potential concern
Commonwealth Avenue (Site 10)	Capital Metro Audit Area (AEC 10-2)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land No information available regarding the nature of contamination. 	<ul style="list-style-type: none"> Asbestos Total recoverable hydrocarbons (TRH) Benzene, toluene, ethylbenzene, and xylene (BTEX)
	Former Dry Cleaners (AEC 10-1)	<ul style="list-style-type: none"> Potential use of solvents. 	<ul style="list-style-type: none"> Semi-volatile and volatile organic compounds (SVOCs and VOCs) Heavy metals

Precinct/site	Areas of environmental concern	Discussion	Contaminants of potential concern
			<ul style="list-style-type: none"> Polycyclic aromatic hydrocarbons (PAHs) Phenols Organochlorine pesticides (OCP) / Organophosphorus Pesticides (OPP) Chlorinated solvents Nutrients (sediments) Tributyltin (sediments) Microbial contaminants (sediments).
Commonwealth Avenue (Site 10) Parliament House (Sites 7, 8a, and 9a) National Triangle (Site 9b)	Former Motor Garages and Service Stations (AEC 9-3)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP.
	Former Motor Garages and Service Stations (AEC 9-2)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	
	Former Dry Cleaners (AEC 9-1 and 9-2)	<ul style="list-style-type: none"> Potential use of solvents. 	
Parliament House (Sites 7, 8a and 9a) Barton (Site 8b) National Triangle (Site 9b)	Former Motor Garages and Service Stations (AEC 7-1 and 9-3)	<ul style="list-style-type: none"> Potentially contaminated fill, ash, soil and groundwater, potential asbestos impacts. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP.
	Kingston Foreshore Development Area (AEC 8-1)	<ul style="list-style-type: none"> ACT EPA Authorisation for the development area listed the nature of contamination to include potentially contaminated fill, ash, soil and groundwater, and potential asbestos impacts Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	
Inner South (Sites 5 and 6)	Former Motor Garages and Service Stations (AEC 5-2)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP.
	Shell Coles Express Service Station (AEC 5-1)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land Storage of petroleum products. 	

Precinct/site	Areas of environmental concern	Discussion	Contaminants of potential concern
Inner South (Sites 5 and 6) Yarra Glen (Sites 2 to 4)	Former Motor Garages and Service Stations (AEC 4-2)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP.
Yarra Glen (Sites 2 to 4)	Former Brickworks Dump Area (AEC 4-1)	<ul style="list-style-type: none"> Uncontrolled fill. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP Acids and alkalis.
	Caltex Service Station (AEC 2-2)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land Storage of petroleum products. 	
Yarra Glen (Sites 2 to 4) Woden (Site 1)	Former Motor Garages and Service Stations (AEC 1-4 and 2-1)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP.
	Approved Phillip Oval Bus Layover (AEC 1-3)	<ul style="list-style-type: none"> Earthworks and stockpiling material onsite (observed from aerial imagery). 	
Woden (Site 1)	Shell Coles Express Service Station (AEC 1-6)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land Storage of petroleum products. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals Polycyclic aromatic hydrocarbons PAHs Phenols OCP / OPP Chlorinated solvents.
	Former Dry Cleaners (AEC 1-5)	<ul style="list-style-type: none"> Potential use of solvents. 	
	Approved Callam Street Bus Interchange and Woden Interchange (light rail) (AEC 1-2)	<ul style="list-style-type: none"> Earthworks and stockpiling of material on Callam Street (observed from aerial imagery). 	
	Approved Canberra Institute of Technology (CIT) Woden Campus (AEC 1-1)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land Given the age of construction of the demolished building, it is likely that the building contained hazardous 	

Precinct/site	Areas of environmental concern	Discussion	Contaminants of potential concern
		building materials (asbestos, etc.) <ul style="list-style-type: none"> Earthworks and stockpiling material on Callam Street (observed from aerial imagery). 	
The Mitchell Depot site (Site 11)	Former Motor Garages and Service Stations (AEC 11-4 to 11-8)	<ul style="list-style-type: none"> Potential use / storage of petroleum products and a range of lubricants, hydraulic oils, etc. 	<ul style="list-style-type: none"> Asbestos TRH BTEX SVOCs VOCs Heavy metals PAHs Phenols OCP / OPP Nutrients.
	Cleanaway Daniels Pty Ltd (AEC 11-3)	<ul style="list-style-type: none"> Authorised to sterilise clinical waste, perform incineration, and reprocess waste Potential chemicals associated with onsite activities of medical waste disposal and reprocessing. 	
	Use of the southern section of the Mitchell Depot site as suspected laydown area (AEC 11-2)	<ul style="list-style-type: none"> Storage of materials on unsealed ground. Leaks or spills from trucks to unsealed ground. 	
	Capital Metro Alignment (AEC 11-1)	<ul style="list-style-type: none"> Currently on the ACT EPA Register of Contaminated Land Earthworks, stockpiling and onsite storage of water during construction of the metro based on aerial imagery. 	

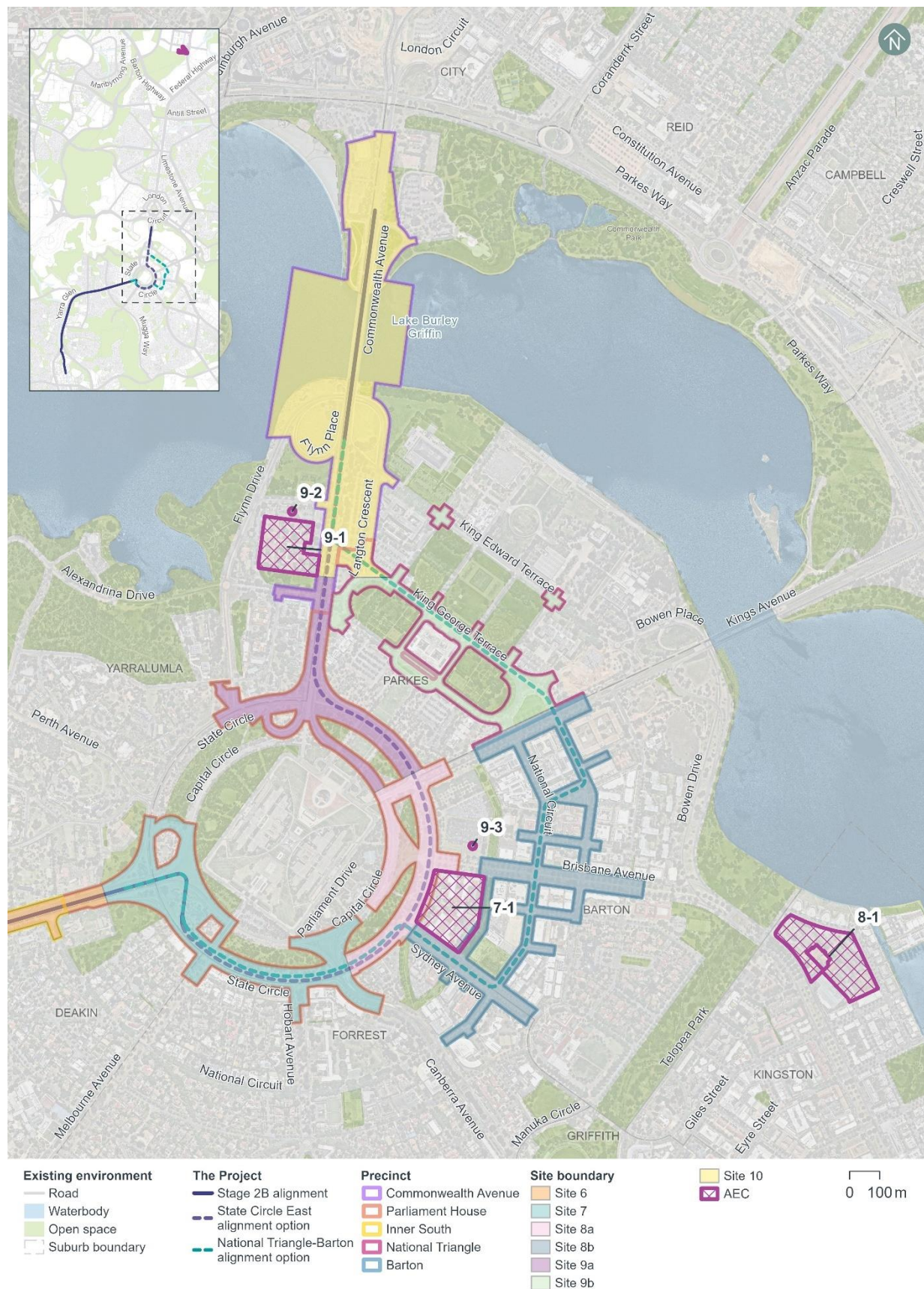


Figure 11-82 Areas of environmental concern (AECs) near the Project (1 of 4)

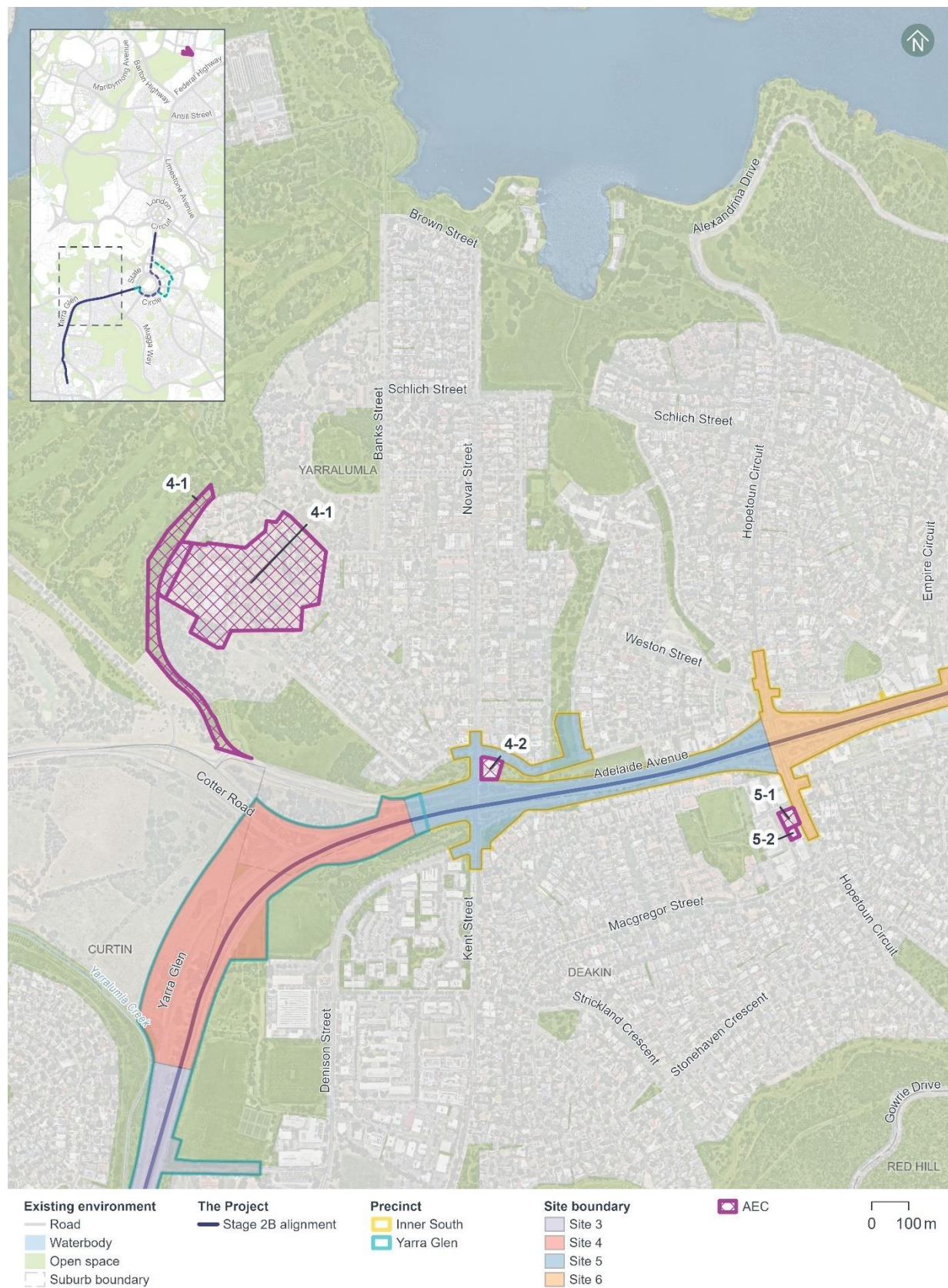


Figure 11-83 Areas of environmental concern (AECs) near the Project (2 of 4)

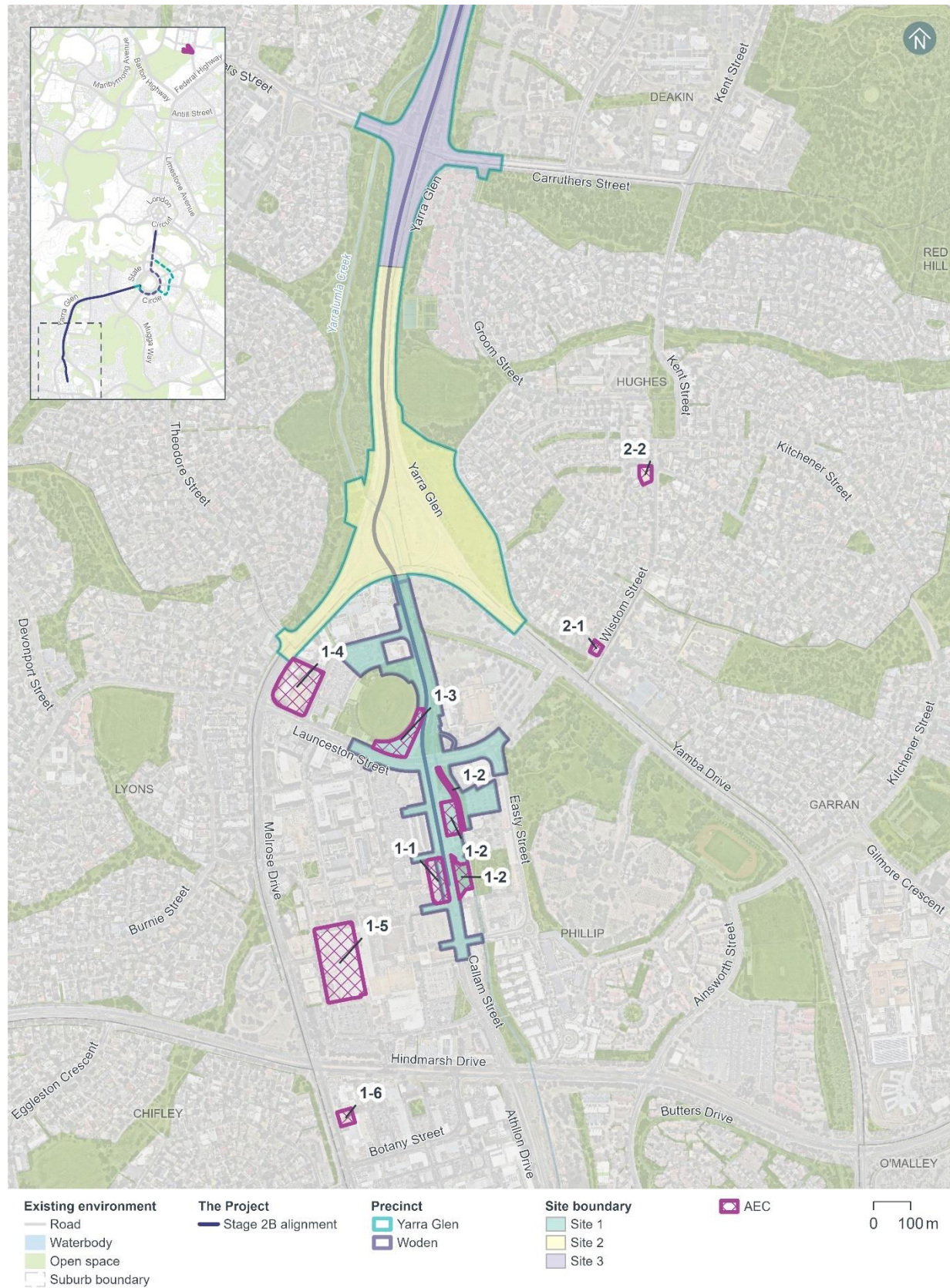


Figure 11-84 Areas of environmental concern (AECs) near the Project (3 of 4)

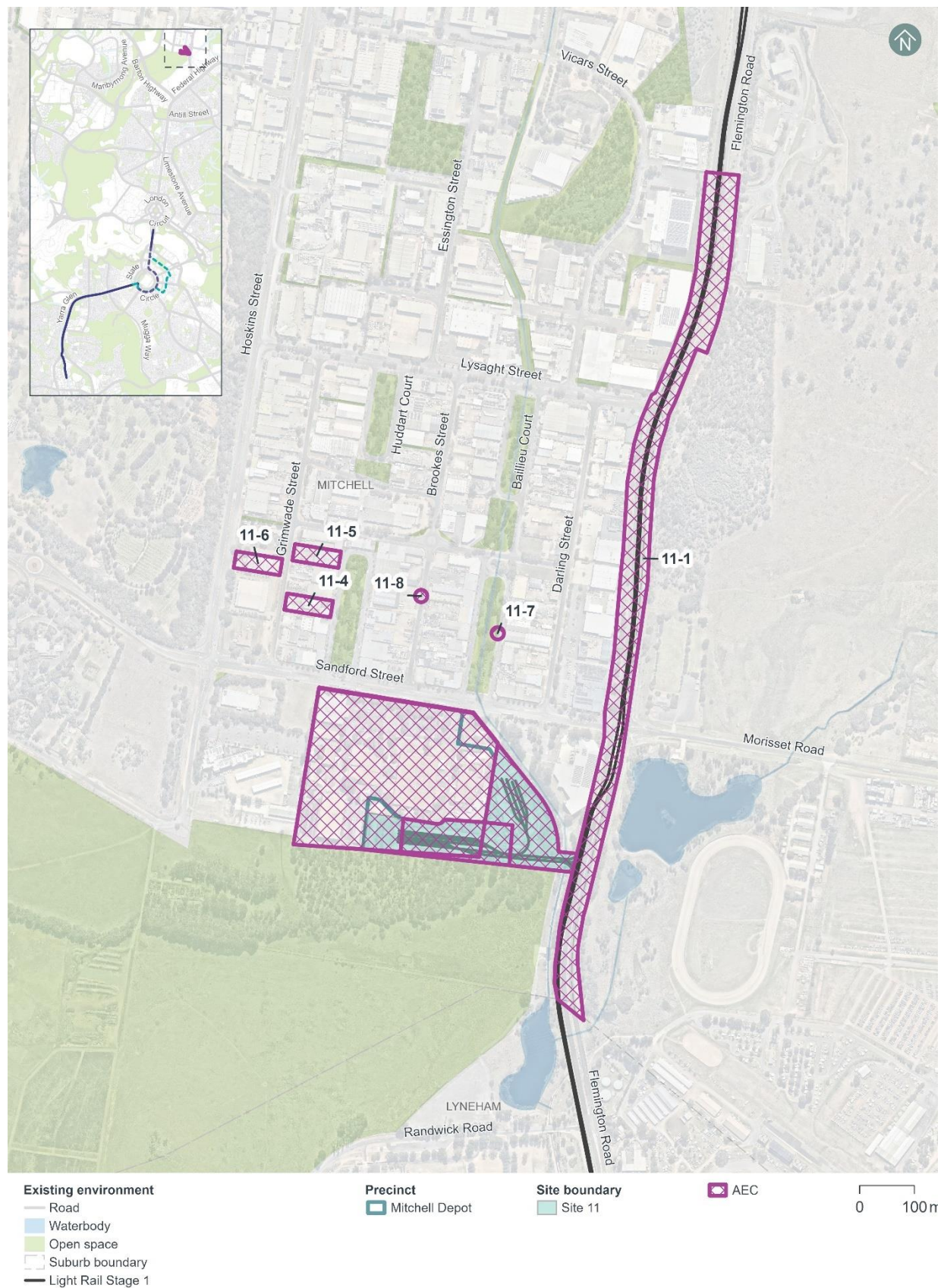


Figure 11-85 Areas of environmental concern (AECs) near the Project (4 of 4)

11.6.2 Potential impacts – construction

Soils

Construction of the Project would temporarily expose the natural ground surface and subsurface through the removal of vegetation and excavation of topsoil. The temporary exposure and stockpiling of soil to water runoff and wind could increase soil erosion potential. There is the potential that exposed soils and other unconsolidated materials (such as spoil, sand, and other aggregates) could be transported from the Project area into surrounding areas and waterways via stormwater runoff. Erosion controls would be implemented and managed in accordance with relevant guidelines to manage this risk.

As discussed in Section 6.3.2 of Chapter 6 (Construction), earthworks required for construction of the Project would result in an excess of fill material. Excavated material would be classified in accordance with the Environmental Standards: Assessment and Classification of Liquid and Non-Liquid Wastes (EPSDD, 2021) and reused on the Project where possible. Chapter 21 (Environmental management and mitigation measures) and Section 2.12.6 of Appendix L (Environmental Management Plan outline) outlines further management measures for managing and classifying excess fill materials from earthworks.

For all precincts apart from the Commonwealth Avenue precinct, it is unlikely that saline or acid sulfate soils would be encountered during construction. For the Commonwealth Avenue precinct, there is a high probability of encountering acid sulfate soils and a moderate probability of encountering in-stream salinity within Lake Burley Griffin.

Disturbance of acid sulfate soils may occur, as piling works required to construct the new Commonwealth Avenue light rail bridge may expose acid sulfate soils to oxygen on the lakebed.

Potential impacts may include:

- Damage to the aquatic environment due to the release of sulfuric acid generated from oxidised acid sulfate soils
- Mobilisation of heavy metals from soils as a result of increased acidity.

Potential impacts from in-stream salinity are discussed in Section 11.5.

Measures to manage known acid sulfate soils would be defined as part of the Construction Environmental Management Plan (refer to Appendix L (Environmental Management Plan outline)). Unexpected saline or acid sulfate soils encountered would be managed under the unexpected finds procedure that would be developed and implemented as part of the Project (refer further to mitigation measure SC3 in Chapter 21 (Environmental management and mitigation measures)).

Contamination

Construction activities could potentially result in soil or surface water contamination from the following activities if unmitigated:

- Spills of oils, fuels or chemicals from plant and equipment in the Project area
- Importing or backfilling of excavations with potentially contaminated fill material
- Stockpiling of potentially contaminated fill material
- Erosion of exposed contaminated soil and stockpiled materials, causing sediment loads to enter nearby watercourses
- Sedimentation caused by lake bed disturbance during works for the light rail bridge over Lake Burley Griffin (refer to Section 11.5.2 for further detail).

As noted in Section 11.5, based on available data and the estimated depths of excavation works, the groundwater table is unlikely to be intercepted during most construction works. However, the following construction activities could potentially result in the contamination of perched groundwater aquifers at depths of between 3 to 10 mbgl:

- Deep excavation activities required to construct the covered section between Commonwealth Avenue and State Circle

- Piling works for new bridges and at Phillip Oval Stop
- Trenching for new or realigned stormwater drainage and utilities
- Cuttings that intersect the groundwater table
- Dewatering of temporary excavations.

These impacts are likely to be relatively minor given the depth of the groundwater table and any bores are likely to be greater than 100 mbgl, and migration of any contamination is considered unlikely.

A Conceptual Site Model (CSM) was developed to identify the mechanisms by which potential and/or complete exposure pathways may exist between known or potential sources of Project impacts, and human or ecological receptors.

Potential contamination pathways could be through:

- Inhalation of contaminated dust (including asbestos fibres)
- Direct contact with or incidental ingestion of soil, groundwater or surface water
- Uptake by aquatic or terrestrial ecosystems/organisms
- Leaching of soil contaminants into groundwater/surface water
- Discharge of groundwater to offsite drainage networks and surface water bodies
- Lateral migration of dissolved contaminants in groundwater.

Based on the outcomes of the CSM, potentially complete source-pathway-receptor linkages were identified for current on-site intrusive works (contaminated dust, asbestos, soil vapour) and on-site ecological receptors. Potential sources of contamination include:

- Historically imported fill materials for construction purposes
- Potential asbestos within operational conduits / service pits
- Potentially damaged asbestos within non-operational conduits / service pits
- Leaks and spills from onsite vehicle servicing
- Leaks and spills from onsite historical and current commercial / industrial land use
- Leaks and spills from offsite historical and current commercial / industrial land use (i.e., dry cleaners, service station / motor garages, current or former UPSS, brickworks dump area, clinical waste processing and incineration)
- Wastewater storage and treatment
- Potential impacts from Yarralumla Creek or the non-perennial tributary of Sullivans Creek
- Potentially impacted sediments and surface water of unknown quality at Yarralumla Creek and Lake Burley Griffin
- Potential overflow impacts to Lake Burley Griffin from Project area and offsite areas (wastewater, stormwater).

PFAS was not considered as a contaminant of potential concern for the study area as the desktop review did not identify significant sources of PFAS on-site or within the surrounding land uses. However, where waste is required to be classified for offsite disposal, it would be undertaken in accordance with the Assessment and Classification of Liquid and Non-Liquid Wastes guidelines (EPSDD, 2021). Location specific waste classifications would be undertaken, and PFAS would be considered if appropriate.

A full list of contamination sources by precinct/site is provided in Technical Report 5 – Contamination.

11.6.3 Potential impacts – operation

Operational impacts are anticipated to be restricted to those arising from accidental spills or leakage, primarily from stabling and maintenance activities at the Mitchell Depot, or from LRVs travelling along the alignment.

Unless carefully managed, the soils in these areas could become contaminated with hazardous materials (such as fuels, lubricants, and hydraulic oils) during maintenance activities. However, with the implementation of mitigation measures, the risk of contamination from operation of the Project is anticipated to be negligible.

11.6.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage soils and contamination impacts, that are applicable to the Project as a whole.

11.7 Socioeconomic

This section describes the potential socioeconomic impacts of the Project across the Project area and broader region. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic.

More localised impacts are discussed separately in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site).

The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and detailed in Section 4 of Technical Report 6 – Socioeconomic.

11.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown on Figure 11-86.

The assessment has considered the following in defining the social area of influence for the Project:

- Precincts: this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur
- Corridor: this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including
 - South Canberra SA3
 - Woden Valley SA3
- ACT: in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).



The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor and the ACT.

A summary of community capitals for the corridor (South Canberra SA3 and Woden Valley SA3) and the ACT is provided in Table 11-47, based on Australian Bureau of Statistics (ABS) 2021 Census data.

Table 11-47 Community capitals summary – corridor and the ACT

Capital	Summary
Human capital	<p>ACT (region)</p> <p>In 2021, the region had a total resident population of 454,499, with a nearly balanced gender distribution of 49.4% male and 50.6% female. Almost 2% of the region's population identifies as Aboriginal and Torres Strait Islander.</p> <p>Compared to Australia as a whole, the region had a relatively younger population in 2021, with a median age of 35 compared to 38.</p> <p>Educational attainment in the region shows that higher education levels are higher than the national population, with 42.9% holding a bachelor's degree level and above and 9.3% having completed an advanced diploma or diploma. This educational data reflects a well-educated population with a range of qualifications.</p> <p>Health data indicates that almost 20% of all people have at least one long term health condition.</p> <p>Corridor</p> <p>The corridor has a combined population of 70,871, with a similar gender distribution to the region (48.6% male and 51.4% female). The median age is notably higher than both the region and the national average, at 39.5 years.</p> <p>The corridor has a slightly lower proportion of Aboriginal and Torres Strait Islander residents (1.4%) than the region (2%).</p> <p>Educational attainment shows the corridor also includes a higher percentage of individuals with postgraduate degrees (50.4% compared to 42.9% in the region).</p> <p>Health data is similar to those of the region.</p>
Social capital	<p>ACT (region)</p> <p>The region has a diverse population. The predominant language spoken at home in the region is English, used by 71.3% of the population. Other commonly spoken languages include Indo-Aryan languages (3.1%) and Mandarin (3.2%).</p> <p>Regarding ancestry, the most common backgrounds are Australian (31.5%) and English (31.9%). Other ancestries identified include Irish (11.7%) and Scottish (10%). Chinese ancestry is reported by 5.7% of residents, while Indian (4.5%) and German (4.2%) ancestries are also notable.</p> <p>Housing data indicates that 46.8% of residents are in registered marriages, while 12.5% are in de facto relationships.</p> <p>Housing mobility is evident, with 15.2% of residents having lived at a different address one year ago and 33.8% having moved in the past five years, indicating a dynamic residential landscape.</p> <p>Community involvement is reflected in the 15.1% of residents who have volunteered through organisations or groups in the past year. The need for assistance with core activities affects 4.6% of the population, while 91.2% do not require such assistance.</p>

Capital	Summary
	<p>Corridor</p> <p>The corridor exhibits a slightly higher percentage of people speaking only English at home (72.5%) compared to the region (71.3%). Regarding ancestry, the corridor has notable percentages of Irish (13.5%) and Scottish (11.18%), whereas the region shows similar or higher proportions of Australian and Chinese ancestries.</p> <p>Household composition in the corridor shows a higher proportion of people in registered marriages (45.6%) compared to the region (34.8%). The corridor also has a higher percentage of single person households (33.23%) than the region (25.7%).</p> <p>Household mobility is notably higher in the corridor compared to the region. In the past year, 20.4% of people in the corridor have moved. Over five years, mobility in the corridor (50.44%) exceeds that of the region (33.8%).</p> <p>The corridor demonstrates higher volunteering rates (21.2%) than the region (15.1%), indicating a more active community engagement. The percentage of people needing assistance is 4.8%, similar to the region (4.6%).</p>
Economic capital	<p>ACT (region)</p> <p>The median weekly personal income in the region is \$1,204 per week, while the median total household income stands at \$2,373 per week. This reflects a moderate-income level, significantly higher than the national average (\$805 median weekly personal and \$1,746 median weekly household), indicative of the ACT's economic status.</p> <p>Median mortgage repayments are \$2,080 per month and weekly median rent is \$450. Financial stress from mortgages (owners with mortgage repayments greater than 30% of household income; 9.4%) is moderate, while rent stress is high (renter households with rent payments greater than 30% of household income; 23%), indicating financial pressure related to housing.</p> <p>The region shows a solid labour force participation rate (69.6%) and a moderate unemployment rate (3.8%). Key industries include Central Government Administration (17.1%) and Defence (5.8%). Major occupations are Professional (31.5%) and Managers (17.9%).</p> <p>Corridor</p> <p>The corridor has a median total personal income of \$1,432.50 per week, which is high when compared to the region. The corridor also has a higher median household income of \$2,543 per week, further reflecting its higher economic capital.</p> <p>Those living in the corridor have median mortgage repayments of \$2,221 per month and median rent of \$470 per week. These figures are higher compared to the region. Financial stress relating to housing is moderate in the corridor, with 9.2% of the population experiencing stress from mortgages and 19.8% from rent.</p> <p>Employment in corridor features a labour force participation rate of 66.8% and an unemployment rate of 3.3%. Key industries include Central Government Administration (20.5%) and Defence (6.6%). The top occupations are Professional (38.7%) and Managers (21.4%).</p> <p>Economic characteristics are discussed further in the following section.</p>

Capital	Summary
Physical capital	<p>ACT (region)</p> <p>In the region, home ownership is divided with 26.6% owning a home outright, 40.2% owning with a mortgage and 30.7% renting. Public housing accounts for 7% of all dwellings in the region. A total of 93.4% of the total housing stock is occupied, and 63.2% of dwellings are separate houses. The average household size in the region is 2.5 persons per household, reflecting a moderately sized household structure.</p> <p>A significant proportion of the population drives a car or is a passenger in a car to travel to work (65.6%), with relatively low walking and bus usage.</p> <p>Corridor</p> <p>The corridor has more outright-owned properties (30.9%) than the region (26.6%). The share of properties owned with a mortgage in the corridor (32%) is notably lower than the region's (40.2%). The percentage of rented properties in the corridor is also slightly higher when compared to the region (34% and 30.7% respectively).</p> <p>Regarding dwelling structure, 49.5% of dwellings in the corridor are separate houses, lower than that of the region. Flats or apartments account for a third of dwelling structures in the corridor (34.5%) compared to 19.4% in the region.</p> <p>The average household size in the corridor is 2.3, reflective of the variance in the dwelling structures. Like the region, a significant proportion of the population that commutes to work in cars, either as the driver or passenger (61.6%)</p>
Natural capital	<p>ACT (region)</p> <p>The region has a well-established network of reserves and natural areas. Approximately 50% of the region's land is dedicated to nature reserves and conservation areas.</p> <p>Corridor</p> <p>The corridor is enriched by natural assets such as Lake Burley Griffin and Black Mountain Nature Reserve, contributing to community well-being and recreational opportunities.</p>

Key economic characteristics

To inform the assessment of economic impacts of the Project to businesses, an analysis of the economic baseline of the precincts, corridor and regions has been carried out and is summarised in the following sections. SA2s attributed to each precinct have been grouped together as follows to provide a summary of the economic environment relevant to each alignment option:

- State Circle East alignment option: Commonwealth Avenue, Parliament House, Inner South, Yarra Glen, Woden
- National Triangle-Barton alignment option: Commonwealth Avenue, Parliament House, National Triangle, Barton Inner South, Yarra Glen, Woden.

The Mitchell Depot site has not been included in the economic analysis. The Project involves expansion to existing depot uses at the Mitchell Depot and has limited potential to result in substantial economic impacts.

Employment profiles developed for each alignment option based on ABS 2021 Census data, which indicated the following:

- There were around 24,630 workers within the study area for the State Circle East alignment option and around 33,380 workers within the National Triangle-Barton alignment option

- The top five industry sectors were consistent across both alignment options and the ACT as a region, with the largest sectors: Public Administration and Safety; Professional, Scientific, and Technical Services; Retail Trade; Accommodation and Food Services; and Health Care and Social Assistance
- The employment profiles for alignment options were also similar to the employment profile for the wider ACT region, with the exception of a larger representation of Public Administration and Safety sector employment and a commensurate reduced level of employment across other industry sectors.

An estimate of the existing economic value represented by each alignment option was also carried out. This economic value represents the estimated contribution to the ACT Gross State Product (GSP), based on the respective study areas for each alignment option (in 2023 dollars). This is based on the scale of employment by industry and the average factor income by industry sector for the ACT.

The estimate of economic value indicated the following:

- The GSP of the ACT in 2023 was recorded as \$51.21 billion. The economic value of business activities within the study area for the State Circle East alignment option corridor is estimated as \$4.08 billion, which represents around 8.0% of the GSP.
- The economic value of business activities within the study area for the National Triangle-Barton alignment option area is estimated as \$5.73 billion, which represents around 11.2% of the GSP.

Further detail on the economic assessment methodology and economic characteristics is provided in Section 7 of Technical Report 6 – Socioeconomic.

Business survey

Engagement carried out for the Project as a whole is summarised in Chapter 4 (Stakeholder and community consultation) which informed the socioeconomic assessment. Further business engagement was carried out specifically to inform the socioeconomic assessment.

During a four-week period (19 June to Friday 12 July 2024) engagement with business operators adjacent to the alignment was undertaken to identify the potential concerns and impacts to different business and sectors operating near the Project. This included one on one discussions between the Project team (iCBR and Social Atlas representatives) and businesses, as well as completion of a business survey of around 14% of identified business. Businesses representing a range of industries were surveyed, including construction, retail trade, accommodation and food services, art and recreation services, education and training, healthcare and social assistance, and others.

Feedback received from the adjacent businesses provided insights into their operating profile (trading hours, weekly or yearly peak operating times) as well as perceived impacts to their business operations during construction and operation of the Project. From the feedback received adjacent businesses perceived the positive and negative impacts of the Project to be:

- During construction – negative impacts including:
 - Changes to access and traffic
 - Loss of parking
 - Noise and vibration
 - Decrease in foot traffic near businesses
 - Access and ability to attend major events and exhibitions (typically reported by businesses in the National Triangle)
- During operation – positive impacts including:
 - Potential for improved access and transport options for staff and visitors
 - Support for an alternative to car/private vehicle use to access the business.
 - Better access and connection to services, facilities, and major events

- Opportunity for increased foot traffic or passing trade, supporting greater visitation and stimulating economic activity.

Further analysis of the survey results indicates that:

- The adjacent retail trade sector identified the highest potential impacts during construction of the Project (perceived potential for substantial turnover decrease)
- Moderate impacts during construction (perceived potential for some turnover decrease) were also identified by adjacent accommodation and food services, arts and recreation services and other services
- Sectors identified as the most benefitted during operation of the Project (perceived potential for substantial business growth) included adjacent retail trade; information, media and telecommunications; and rental hiring and real estate services sectors
- Moderate potential benefit during operation (perceived potential for some business growth) was also identified by adjacent financial and insurance services, and arts and recreation sectors.

Further information on the business survey methodology and results analysis is provided in Technical Report 6 – Socioeconomic.

11.7.2 Potential impacts – construction

Socioeconomic impacts

Some socioeconomic impacts relating to the construction of the Project would be experienced at a broader level, by the whole corridor and regional locality. This includes a range of stakeholders from a regional spatial extent including workers, visitors to the area and commuters.

A summary of the potential Project-wide socioeconomic impacts of construction of the Project is provided in Table 11-48. These impacts would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. Where an impact is beneficial in nature, this has been noted in Table 11-48. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Project-wide impacts during construction relate to increased demand on labour to facilitate construction of the Project. Impacts would be temporary and would be minimised through the implementation of the mitigation measures identified in Table 11-48 and Chapter 21 (Environmental management and mitigation measures).

Table 11-48 Socioeconomic impacts during construction – Project-wide

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Pre-mitigation impact (likelihood/magnitude)
<p>Resource strain and increased demand on labour</p> <p>The Project would support an estimated peak construction workforce of around 900 to 1,000 people (as identified in Section 6.6.2 of Chapter 6 (Construction), as well as additional jobs during the pre-construction period (such as advisory and professional services roles). Studies carried out (described further in Section 8 of Technical Report 6 – Socioeconomic) by the University of Canberra (2022) have identified existing construction and building workforce shortages in the ACT.</p> <p>The increased labour demand has the potential to lead to shortages in the local workforce. This could result in increased competition for skilled workers among various sectors, affecting the availability of resources for essential community services and municipal projects.</p>	<p>Medium (possible/moderate)</p>	<ul style="list-style-type: none"> Implementation of the Business and Labour Strategy (as part of a Community Engagement and Social Management Plan), which would include initiatives would be implemented to address potential labour market resource strain, for example: investment in training programs; investigation of partnerships with local businesses and industries; and incentives for apprentice employment. The Business and Labour Strategy is described further in Appendix L (Environmental Management Plan outline) 	<p>Very low (unlikely/minor)</p>
<p>Employment and training opportunities</p> <p>Delivery of the Project would offer substantial employment and training opportunities. Drawing on the example of LRS1, which generated approximately 4,750 direct construction-related jobs at its peak (Transport Canberra and City Services, 2024), this Project is likely to lead to substantial job creation and increased business expenditure within Canberra. In addition to direct employment, indirect jobs may be generated through the Project's supply chain and the economic activity of workers spending within local communities</p>	<p>Beneficial (possible/positive)</p>	<ul style="list-style-type: none"> Implementation of the Business and Labour Strategy (as part of a Community Engagement and Social Management Plan), which would include strategies to help enhance this potential benefit such as support for training programs and working with local businesses. The Business and Labour Strategy is described further in Appendix L (Environmental Management Plan outline) 	<p>Beneficial (likely/positive)</p>

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Pre-mitigation impact (likelihood/magnitude)
<p>Community concern</p> <p>Community members may experience a lack of trust in decision making, including the perceived lack of positive benefit / need for the project. However, people in the corridor are likely to have experience of the potential benefits and impacts of light rail through the realisation and operation of LRS1. Several community members engaged with for the Project (refer to Chapter 4 (Stakeholder and community consultation)) noted the benefits of light rail for how they live, work or play in Canberra. As such this impact would likely be low at a Project-wide level.</p> <p>Community concern during construction is assessed further for specific precincts in Chapter 12 (Commonwealth Avenue precinct) to Chapter 18 (Woden precinct).</p>	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of a Community Engagement and Social Management Plan, which would include engagement procedures to minimise impact on the community during construction. The strategy is described further in Appendix L (Environmental Management Plan outline) Implementation of a process to manage public grievances, including 24-hour telephone support, postal and email addresses for complaints. Identified incidents would be dealt with through investigation and implementation of corrective treatments where necessary (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Very low (unlikely/minor)

Economic impacts to adjacent businesses

Potential impacts to adjacent industries were developed based on survey responses from businesses identified in each precinct, as detailed in Technical Report 6 – Socioeconomic, and validated via comparison with similar projects. The perceived level of business impacts was determined for the alignment corridors based on a weighted adjustment, informed by the employment profiles for the respective areas. This was scored on a scale from +3 to -3, with a score of 0 indicating no expected impact, and a score of + or -3 indicating a substantial adverse or positive expected impact to business revenue, respectively.

The overall level of perceived business impact was the same for each alignment option (each scoring -1.2), with adjacent businesses likely to experience minor adverse impacts from construction related noise, vibration, and reduced accessibility. It is expected that this level of impact would be temporary in nature (for the duration of construction in each area), causing inconvenience to employees and/or clients, though not necessarily have a direct impact on business turnover.

The greatest level of expected impacts is anticipated by businesses within the retail trade sector, with feedback noting the concern over the potential for reduced turnover. Some of this feedback has been informed by past instances where road works and street closures had negatively impacted business turnover. Based on the expectations of those businesses within the corridor, no adjacent businesses are expected to be positively impacted during the construction phase of the Project.

Implementation of the Community Engagement and Social Management Plan, Construction Environmental Management Plan (CEMP), Traffic Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) would contribute to managing impacts to businesses.

11.7.3 Potential impacts – operation

Socioeconomic impacts

A summary of the potential socioeconomic impacts (both beneficial and negative) of the operation of the Project at the broader corridor and regional level is provided in Table 11-49. These socioeconomic impacts would be common to both alignment options.

Table 11-49 Socioeconomic impacts during operation – Project-wide

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Pre-mitigation impact (likelihood/magnitude)
Health and wellbeing Potential impacts to community safety due to the presence of new light rail stops and ancillary facilities, which may increase opportunities for antisocial behaviour, if this is not managed through design and mitigation strategies.	Medium (possible/moderate)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan (Appendix I), would contribute to creating good public spaces and a high-quality experience for light rail users 	Low (unlikely/minor)
Health and wellbeing Enhanced community safety through the implementation of safety features and Gender Sensitive Urban Design (GSUD) initiatives in the design of the Project – including stops, public domain areas and ancillary facilities.	Beneficial (possible/positive)	<ul style="list-style-type: none"> Continued incorporation of crime prevention through environmental design principles and GSUD initiatives in the Project design, including improved lighting, clear wayfinding, and enhanced visibility at facilities and stops to reduce opportunities for antisocial behaviour (refer further to Section 5.2 (Urban design approach)) 	Beneficial (likely/ positive)
Urban revitalisation The transport connectivity delivered by the Project would facilitate urban development, and enable key government projects aimed at improving infrastructure, accessibility, and economic growth. The Project is needed as part of a coordinated and holistic delivery of a series of major projects in Canberra City and surrounds, to realise the strategic planning and development for Canberra City (refer further to Chapter 2 (Need for the Project)). Strategic plans for Canberra indicate a need for more sustainable transport options to support population and employment growth in Canberra. By facilitating more sustainable transport choices, improving the convenience of connectivity, and supporting affordable transportation for all, the operation of the Project would increase use of public transport. This would potentially contribute toward a broader goal of preventing traffic congestion and improving how people move around the city.	Beneficial (possible/positive)	<ul style="list-style-type: none"> The potential benefit of more people using public transport over the road network would be enhanced by the implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)). 	Beneficial (likely/ positive)

Description of impact	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Pre-mitigation impact (likelihood/ magnitude)
<p>Access to and use of social infrastructure, jobs, businesses, educational facilities and services</p> <p>The Project would facilitate an expansion of Canberra's public transport network by completing a north-south connection across the city, linking Gungahlin, the City Centre, and Woden. This would enable increased access to jobs, businesses, education, services and social facilities along the alignment by providing a convenient and accessible public transport connection.</p> <p>This would benefit the broader community including businesses, customers, students, and vulnerable transport users such as the elderly, and people with mobility constraints or disabilities.</p>	<p>Beneficial (possible/ positive)</p>	<ul style="list-style-type: none"> The potential benefit of more people using public transport over the road network would be enhanced by the implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)). 	<p>Beneficial (likely/ positive)</p>
<p>Intergenerational equity</p> <p>Intergenerational equity involves ensuring that each generation inherits similar or improved access to natural, cultural, health, and economic resources as previous generations. This concept extends to the equitable access and benefits provided by infrastructure projects. The Project has and would continue to be designed and planned to incorporate sustainability initiatives which would contribute to improved intergenerational equity.</p> <p>Chapter 7 (Sustainability) documents the Project approach to sustainability management via an ESG Framework and provides key sustainability targets and initiatives for the Project.</p> <p>Greenhouse gas (GHG) emissions are assessed in Section 11.11 (Greenhouse gas generation). Due to ACT's electricity grid being 100% renewable, the indirect GHG emissions generated from electricity are considered to be zero. Some GHG generation would be associated with maintenance activities.</p>	<p>Beneficial (likely/ positive)</p>	<ul style="list-style-type: none"> Implementation of climate change risk adaptations and greenhouse gas related mitigation measures, including an operational Carbon and Energy Management Plan (refer to Appendix L (Environmental Management Plan outline)). 	<p>Beneficial (likely/ positive)</p>

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Pre-mitigation impact (likelihood/magnitude)
Climate resilience of the Project is assessed in Section 11.10, and climate change risk adaptations identified for the Project are included in Technical Report 7 – Climate change risk.			
<p>Transport network changes</p> <p>The Project has the potential to encourage mode shift from cars to light rail and active travel. Potential benefits of this mode shift to shift could include improvements in the accessibility, reliability, and convenience of the public transport network, and could provide help manage road network congestion.</p> <p>The integration of light rail stops at key intersections and local centres, would improve access to public transport for people.</p> <p>Currently, while buses serve key intersections, they do not provide direct routes between locations like Woden and Curtin or Curtin and Deakin, often requiring longer travel times. This shift towards public transport and active travel would also support a healthier, more sustainable lifestyle, contributing to better mobility and overall urban wellbeing.</p> <p>More localised road and transport network changes (both adverse and positive) are assessed further for specific precincts in Chapter 12 (Commonwealth Avenue precinct) to Chapter 18 (Woden precinct).</p>	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, including investigation of opportunities to optimise the interface between the Project and other transport modes, optimise road network performance, and measures to maintain accessible parking (refer to mitigation measure TT9 in Chapter 21 (Environmental management and mitigation measures)) The potential benefit of more people using public transport over the road network would be enhanced by the implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)). 	Beneficial (likely/ positive)

Economic impacts to adjacent businesses

Potential economic impacts to adjacent businesses during operation were developed based on survey responses from businesses identified in each precinct, as detailed in Technical Report 6 – Socioeconomic. The perceived level of business impacts was determined for the alignment corridors based on a weighted adjustment, informed by the employment profiles for the respective areas. This was scored on a scale from +3 to -3, with a score of 0 indicating no expected impact, and a score of + or -3 indicating a substantial adverse or positive expected impact to business revenue, respectively.

Both alignment options are expected to benefit adjacent businesses with scores of +1.2 and +1.1 for the State Circle East and National Triangle-Barton alignment options, respectively. It is noted that while there is expected to be a positive level of impact based on both alignment options, the overall value of impact for each alignment option is influenced by the total number of businesses and the economic value they each contribute.

The perceived business impacts demonstrate that on average, the economic activity and value throughout both alignment option corridors is expected to be positively impacted by the extension of the light rail to Woden (i.e. the Project), with the increased public transport amenity expected to contribute to operational improvement and some level of turnover growth for many businesses throughout the corridor.

While not necessarily represented in responses received through the business survey, based on similar projects there is likely to be some increases in operational efficiencies delivered by the Project, particularly business-to-business activity and interaction due to the increase in public transport connectivity. This would build upon the benefit of previous stages of Canberra's Light Rail network whereby connections between areas of economic activity are increased or enhanced.

The highest positive impacts are expected to be generated within the retail trade, information, media and telecommunications, and rental, hiring and real estate services. These positive impacts are expected based on the assumed increase in accessibility and convenience which has the potential to result in new customers and an increase in turnover. The increase in accessibility was also stated as expected to result in an increase in commercial occupancy rates, which would positively impact the rental, hiring, and real estate services sector.

11.7.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage socioeconomic impacts, that are applicable to the Project as a whole.

11.8 Land use and property

This section provides a summary of the existing land uses and property along the Project alignment and provides an overview of the potential construction and operational impacts of the Project on these land uses and properties. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies).

Further supporting information to this section is included in Appendix K (Property and land use planning).

11.8.1 Existing environment

This section describes the existing environment as relevant to land use and property for the Project area and adjacent land, including:

- Planning context
- Existing land uses
- Key recreational uses
- Planning and development status.

Commonwealth planning context

Strategic planning direction and planning controls for land under the jurisdiction of the Commonwealth in the Project area is governed by the National Capital Plan (NCP). This plan's applicability to the Project is described further in Chapter 8 (Legislation and policy).

The NCP sets out:

- Specific areas of land which are designated as special areas
- General standards and aesthetic principles for development
- Policies of land use and planning of national and arterial road systems
- Conditions of planning, design, and development
- Special requirements for the development of areas of interest to the National Capital.

The NCP contains Precinct Codes, General Codes, policies, and guidelines for development in Designated Areas. NCP Precinct Codes applicable to the Project are shown on Figure 11-87 and include:

- West Basin Precinct Code
- Parliamentary Zone Precinct Code
- Lake Burley Griffin and Foreshores Precinct Code
- Diplomatic Precinct (Yarralumla, Deakin, O'Malley, and Curtin) Precinct Code
- Main Avenues and Approach Route Precinct Code.

The Mitchell Depot site is not subject to an NCP Precinct Code.

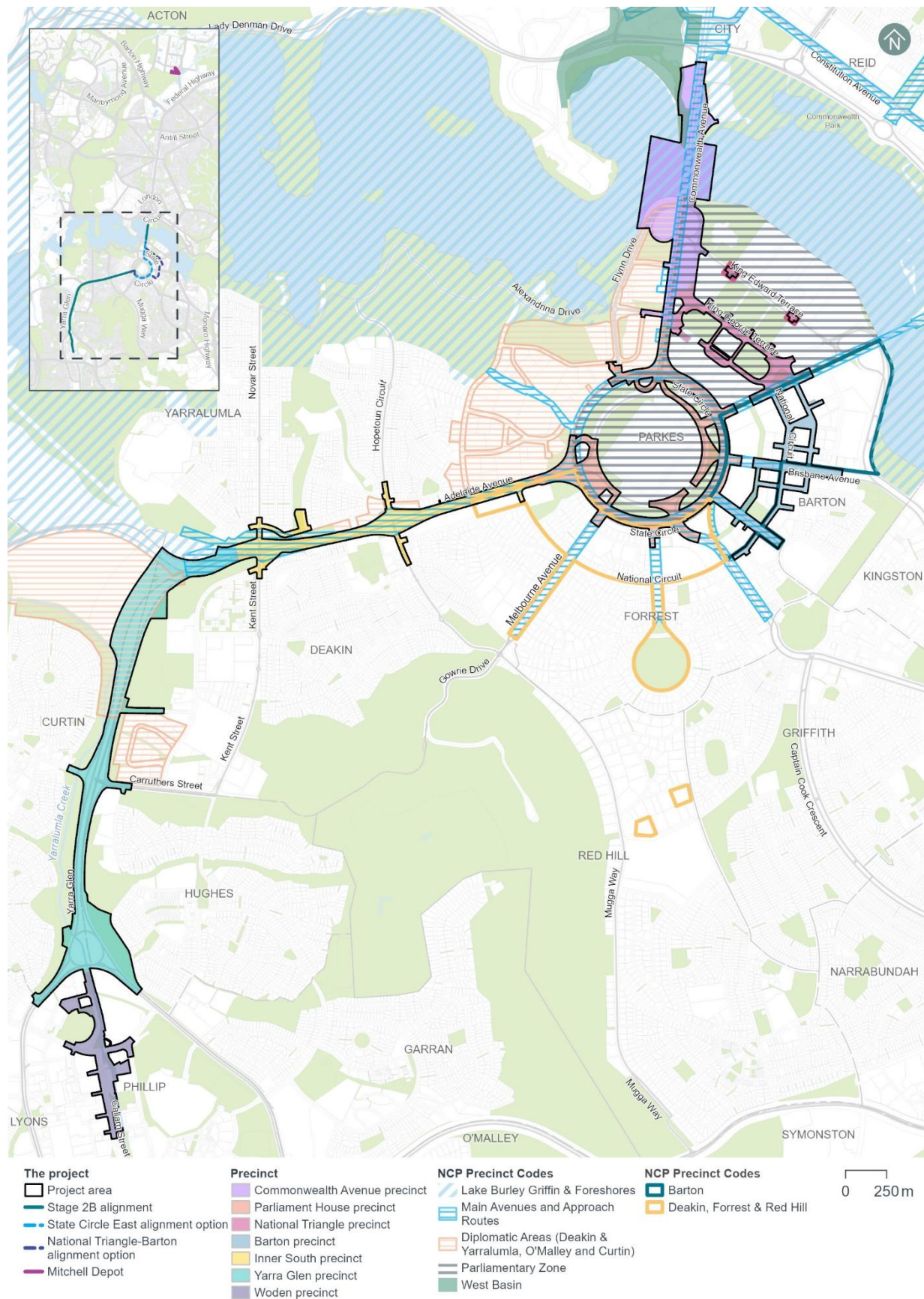


Figure 11-87 NCP Precinct Codes applicable to Project area

Territory planning context

Strategic planning direction and planning controls for land under the jurisdiction of the Territory in the Project area is subject to the *Territory Plan 2023* (Territory Plan), which is a Notifiable Instrument under the *Planning Act 2023*. These policies' applicability to the Project is described further in Chapter 8 (Legislation and policy).

Part C of the Territory Plan provides planning principles and strategic links that aim to ensure the development of the ACT is undertaken in a manner not inconsistent with the NCP, and to promote positive planning outcomes. The principles and strategic links relate to the following themes:

- Activation and liveability
- Cultural heritage conservation
- High-quality design
- Housing affordability
- Integrated delivery
- Investment facilitation
- Long term focus
- Natural environmental conservation
- Sustainability and resilience
- Urban regeneration.

The Territory Plan also gives effect to district strategies, which state the long-term planning policy and goals for districts. Such strategies applicable to the Project include the Inner South District Strategy and the Woden District Strategy.

The consistency of the Project with the principles and strategic links, as well as district strategies, is detailed in Appendix K (Property and land use planning). The Project would generally support the principles and strategic links, as it would encourage use of public transport, would reflect high quality design that responds to environmental sensitivities (such as heritage and biodiversity), and would support sustainable growth in the ACT.

Within the framework set by the Territory Plan (a document created under the *Planning Act 2023* (ACT)) and district strategies, there are more specific documents called a Plan of Management. These plans provide detailed management practices and guidelines for particular areas or types of land, such as parks or heritage sites.

Inner Canberra's and Tuggeranong's Urban Parks and Sportsgrounds (Canberra Urban Parks and Places and Bureau of Sport and Recreation, 2000) has a Plan of Management that relates to public space parkland and sportsgrounds. The Plan of Management includes the West Deakin District Sportsground and pedestrian parkland being adjacent to the Project along Yarra Glen. Works within areas subject to the Plan of Management would be planned with regard to the objectives and character applicable to parkland and sportsgrounds.

Existing land uses

The Project would be located within an urbanised environment, generally within existing road corridors surrounded by a range of commercial, civic, and residential land uses. The nature and character of land use, and land use zoning, are provided for each precinct and the Mitchell Depot site in Table 11-50. The Project would be consistent with the permitted land uses under the relevant policy zones, with further detail in Appendix K (Property and land use planning).

Land use zones are also presented on Figure 11-88 for the NCP, and Figure 11-89, Figure 11-90, and Figure 11-91 for the Territory Plan.

Table 11-50 Land uses along the Project area

Precinct or Site	Description of land use
Commonwealth Avenue	<p>North of Lake Burley Griffin, land uses within the Commonwealth Avenue precinct primarily comprise open space and parkland, including the Henry Rolland Park. South of Lake Burley Griffin, the precinct includes open space areas, with the Hyatt Hotel Canberra and Canberra Croquet Club to the west of the precinct. Other land uses to the east and west of the precinct include civic, government, and diplomatic land uses, such as Albert Hall, Treasury, embassies, and high commissions.</p> <p>Land uses within the Commonwealth Avenue precinct are governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> West Basin Precinct Code– in which the Project would be located is an Open Space land use policy area (west of Commonwealth Avenue, south of Albert Street) Diplomatic Precinct Code, Lake Burley Griffin and Foreshores Precinct Code, and Main Avenues and Approach Routes Precinct Code – in which the Project would be located is a Road land use policy area.
Parliament House	<p>The Parliament House precinct is generally centred on the road corridor along State Circle. The predominant land use feature within this precinct is Parliament House on Capital Hill which is encircled by the precinct. Civic, government, and diplomatic land uses (such as Department of Foreign Affairs and Trade (DFAT), Presbyterian Church of St Andrew, embassies, and high commissions) surround the precinct, outside of State Circle.</p> <p>To the south in the suburb of Forrest there are several residential apartments and houses. To the east in Barton, land use is mixed including low to high density residential, commercial, hotels, childcare centres and schools, and parks.</p> <p>Land uses within the Parliament House precinct are governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> Parliamentary Zone Precinct Code – in which the Project would be located is a combination of Road, National Capital Use, and Parliamentary Use land use policy areas Diplomatic Precinct Code, Main Avenues and Approach Routes Precinct Code, and Deakin/Forrest Residential Area Precinct Code – in which the Project would be located is a Road land use policy area.
National Triangle	<p>Land uses within the National Triangle precinct are predominantly open spaces, parklands, and gardens of government and civic buildings. Land uses immediately surrounding the National Triangle precinct include government and civic buildings such as, Old Parliament House, National Library of Australia, High Court of Australia, the Treasury, The National Science and Technology Centre, The National Gallery, and The National Archives. The Aboriginal Tent Embassy also lies adjacent to the precinct.</p> <p>Land uses within the National Triangle precinct are governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> Parliamentary Zone Precinct Code – in which the Project would be located is a combination of Road, National Capital, and Parliamentary Use land use policy areas Main Avenues and Approach Routes Precinct Code – in which the Project would be located is a Road land use policy area.
Barton	<p>Within the Barton precinct, land uses include government buildings, childcare centres, hotels, and medical centres. Surrounding land uses to the east of National Circuit and south of Brisbane Avenue include a mix of suburban and high density residential, commercial mixed use, community facilities, and urban parks and recreational areas. This includes Forrest residential areas to the south of Barton precinct.</p>

Precinct or Site	Description of land use
	<p>Land uses within the Barton precinct are primarily governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> • Barton Precinct Code, and Main Avenues and Approach Routes Precinct Code – in which the Project would be located is a Road land use policy area. <p>Discrete areas of the precinct at its western extent are governed by controls in the Territory Plan. Land use zones in these areas include:</p> <ul style="list-style-type: none"> • RZ1 – Suburban zone • RZ4 – Medium Density Residential zone • CZ5 – Mixed Use zone • CF – Community Facilities • TSZ1 – Transport zone.
Inner South	<p>Land uses surrounding the Inner South precinct largely comprise suburban residential development to the north and south of Adelaide Avenue. Other land uses include business, commercial, and mixed use land uses, community facilities and open spaces, parks, and recreation, as well as Canberra Girls Grammar School.</p> <p>There are also several government buildings including The Lodge, international embassies, and high commissions, generally adjacent the precinct at its eastern extent, where it adjoins State Circle.</p> <p>The majority of land uses within the Inner South precinct are governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> • Diplomatic Precinct Code, Deakin/Forrest Residential Area Precinct Code, and Main Avenues and Approach Routes Precinct Code – in which the Project would be located is a Road land use policy area <p>Land uses within the western extent of the Inner South precinct are governed by the Territory Plan, and include:</p> <ul style="list-style-type: none"> • PRZ1 – Urban Open Space zone (including an area in which TPS 8 would be located) • RZ1 – Suburban zone • TSZ1 – Transport zone • CZ2 – Business zone.
Yarra Glen	<p>Land use immediately surrounding the Yarra Glen precinct largely includes a mix of urban parks and recreational areas such as playing fields. Suburban residential areas surround the precinct, primarily to the west. To the east of the precinct are diplomatic land uses (including embassies and high commissions), schools, the Cavalry John James Hospital, and the residential area of Hughes.</p> <p>The majority of the Yarra Glen precinct is subject to the Territory Plan, and would be located within the following land use zones:</p> <ul style="list-style-type: none"> • TSZ1 – Transport zone • PRZ1 – Urban Open Space zone • CZ2 – Business zone. <p>Land uses within the northern extent of the Yarra Glen precinct are governed by the NCP. The Precinct Codes and policy areas (as defined by the NCP) that apply include:</p> <ul style="list-style-type: none"> • Diplomatic Precinct Code, and Main Avenues and Approach Routes Precinct Code – in which the Project would be located is a Road land use policy area

Precinct or Site	Description of land use
Woden	<p>Land use within the Woden precinct is primarily a mix of commercial properties of varying scale and high density residential in the Woden Town Centre immediately to the west of the precinct and low density residential further afield, west of Melrose Drive. Westfield Woden is located at the south-western extent of the precinct. The sporting venue, Phillip Oval also lies to the west of the precinct.</p> <p>Land use to the east of Woden precinct is a wide mix of commercial, community, open space, and parks, and medium to high density residential land use. Canberra College is also immediately east of the precinct. Other nearby land uses also include Edison Park and Woden Cemetery.</p> <p>The Woden precinct is subject to the Territory Plan, and would be located within the following land use zones:</p> <ul style="list-style-type: none"> • TSZ1 – Transport zone • PRZ2 – Restricted Access Recreation zone • CZ1 – Core zone • CZ2 – Business zone • CF – Community facilities.
Mitchell Depot site	<p>The Mitchell Depot site comprises an existing light rail stabling and maintenance depot. Land uses to the north and west of the site are industrial in nature. The Australian archives lie to the east of the site. Further east and to the south are vegetated and open space areas, including the Crace Grasslands Nature Reserve to the south.</p> <p>The Mitchell Depot site is subject to the Territory Plan, and is located within a General Industry zone.</p>

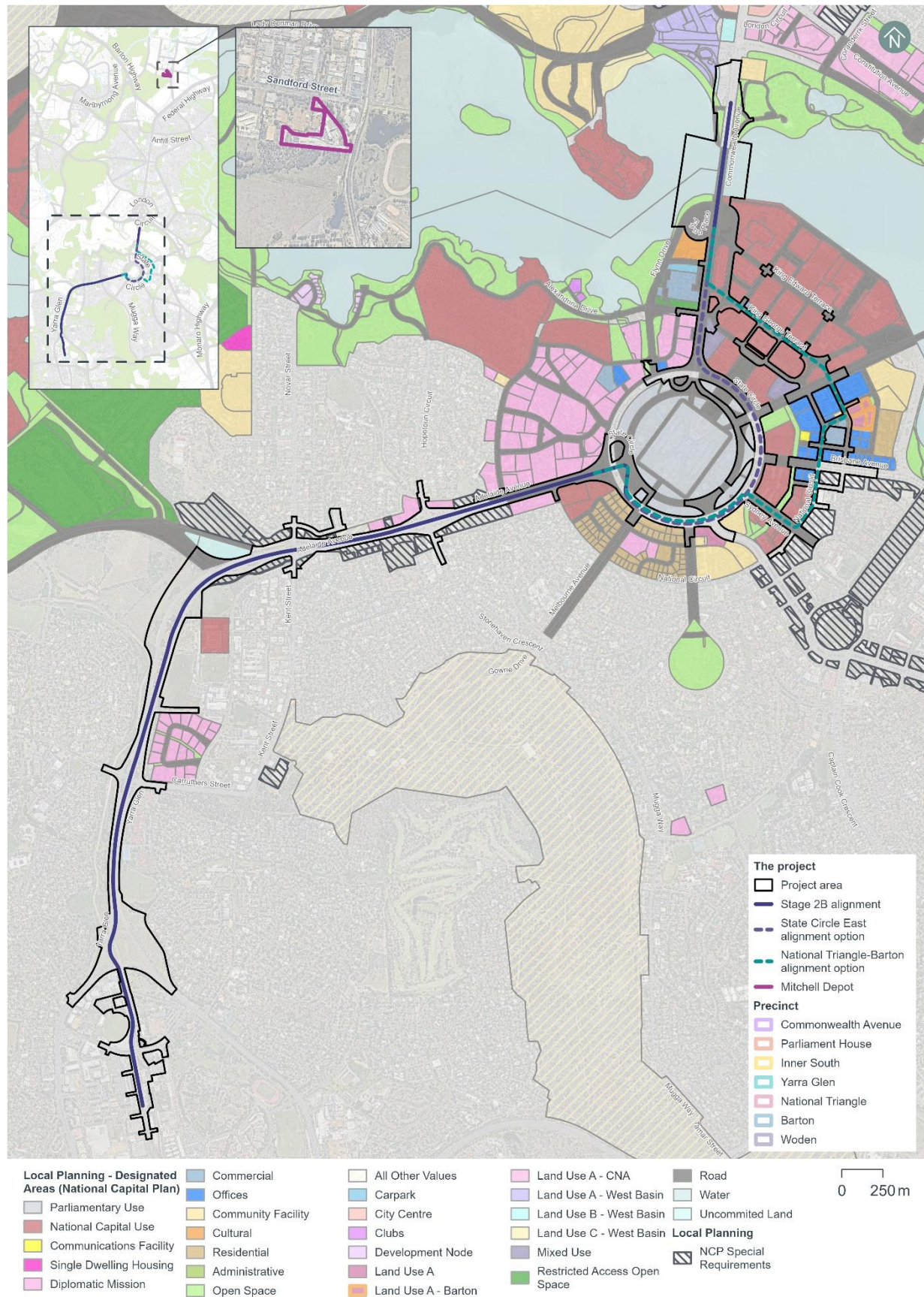


Figure 11-88 Land use policy areas in and around the Project area – NCP



Figure 11-89 Land use zoning in and around the Project area – Territory Plan 2023 (1/3)

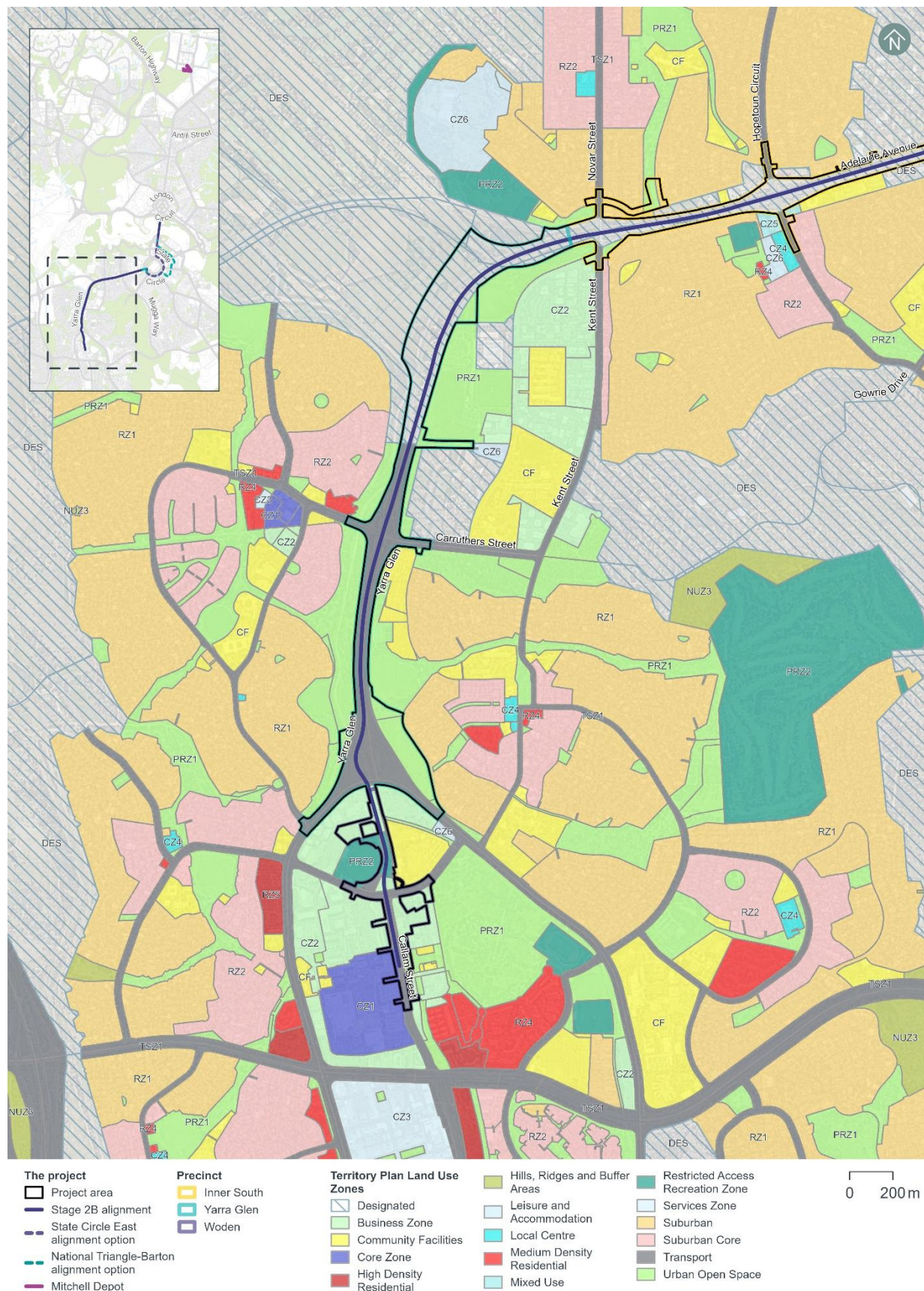


Figure 11-90 Land use zoning in and around the Project area – Territory Plan 2023 (2/3)

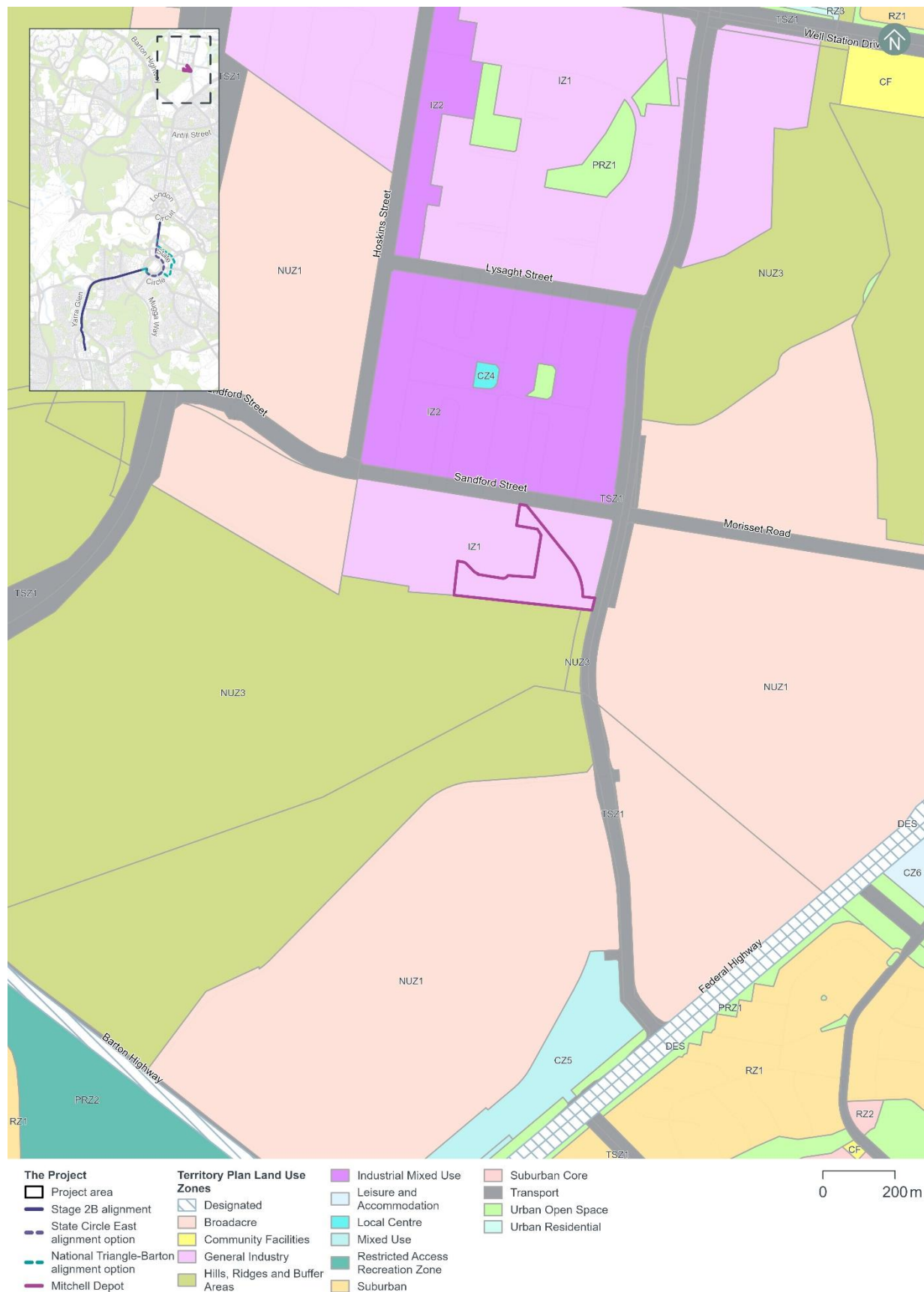


Figure 11-91 Land use zoning in and around the Project area – Territory Plan 2023 (3/3)

Recreational areas and facilities

Formal and informal recreation facilities currently exist along or within close proximity to the Project area. These facilities are identified for each precinct and the Mitchell Depot site in Table 11-51. In addition to these facilities, several open space areas are zoned for recreational land uses along the length of the Project (refer to Figure 11-88). Several memorials and unnamed urban open space areas are also present within proximity to the Project area.

The list below focuses on recreational areas such as sporting facilities, playgrounds, publicly accessible gardens, and open space areas. A complete list of social infrastructure surrounding the Project area is included in Technical Report 6 – Socioeconomic.

Table 11-51 Recreational facilities adjacent to the Project area

Precinct or site	Recreational facilities
Commonwealth Avenue	<ul style="list-style-type: none"> Henry Rolland Park and surrounding open space areas – adjacent to and partially within the Project area Lake Burley Griffin – adjacent to and partially within the Project area Canberra Croquet Club – adjacent to the Project area Open space and parkland areas on the southern foreshore of Lake Burley Griffin – adjacent to and partially within the Project area.
Parliament House	<ul style="list-style-type: none"> York Park – adjacent to the Project area Ian Bull Park – adjacent to the Project area Seguna Community Park – adjacent to the Project area Bert and Peg Piggott Memorial Rose Garden – adjacent to the Project area.
National Triangle	<p>The National Triangle precinct generally includes or is adjacent to several gardens and open space areas surrounding Old Parliament House:</p> <ul style="list-style-type: none"> Magna Carta Place – adjacent to and partially within the Project area The Rex Hazlewood Garden – adjacent to the Project area Senate Gardens/Old Parliament House Rose Gardens – adjacent to the Project area The Broinowski Rose Gardens – adjacent to the Project area Constitution Place Gardens – adjacent to and partially within the Project area Tennis Canberra outdoor tennis courts – adjacent to the Project area The Ladies Rose Garden – adjacent to the Project area The Macarthur Rose Garden – adjacent to the Project area National Rose Gardens – adjacent to the Project area.
Barton	<ul style="list-style-type: none"> York Park, identified above in relation to the Parliament House precinct, is about 30 m from the Barton precinct boundary.
Inner South	<ul style="list-style-type: none"> Irwin Street Park – about 60 m from the Project area Deakin Stadium – about 50 m from the Project area Deakin Oval Playground – about 80 m from the Project area.
Yarra Glen	<ul style="list-style-type: none"> Mint Oval and Deakin playing fields – adjacent to the Project area Hughes Oval – adjacent to the Project area North Woden Tennis Club – adjacent to the Project area.
Woden	<ul style="list-style-type: none"> Woden Town Park – within the Project area Phillip Oval – adjacent to the Project area Arabadoo Park – adjacent to the Project area.
Mitchell Depot site	<ul style="list-style-type: none"> Crace Grasslands Nature Reserve – adjacent to the Project area.

Potential future land uses within the vicinity of the Project

Current and proposed urban developments within and in the vicinity of the Project area are identified in existing ACT Government strategies and available master plans. With respect to potential future land use developments along the Project area, a review of the ACT Government's current Development Application (DA) and Environmental Impact Statement (EIS) registers was undertaken (October 2024). This identified the following:

- **Commonwealth Avenue precinct:** Acton Waterfront project future estate – proposed for residential and mixed use development, construction expected to commence after 2025
- **National Triangle precinct:** John Gorton Campus Carpark Building – approved, under construction
- **Barton precinct:**
 - Australian Tax Office Building (Block 3, Section 22, Division of Barton) – approved, under construction expected completion in May 2025
 - National Security Office Precinct (Block 5, Section 1, Division of Barton) – proposed, construction expected to commence in early 2025
- **Inner South precinct:** Brickworks Precinct Yarralumla (Block 1, Section 102, Yarralumla) – approved for mixed use development, construction expected to commence in 2025
- **Yarra Glen precinct:** North Curtin Residential Area and Diplomatic Estate (Block 4, Section 106 and Block 5, Section 121, Division of Curtin) – proposed for future residential development of 1,300 dwellings
- **Woden precinct:**
 - CIT Woden (Block 4, Section 35, Division of Phillip) – approved for educational establishment, construction commenced in 2023, planned for completion in 2025
 - Woden Bus Interchange – approved, construction underway
 - Matilda Street car park (Block 1, Section 7, Division of Phillip) – proposed for future mixed use development
 - Hellenic Club (Block 21, Section 6, Division of Phillip) – proposed for future mixed use redevelopment
 - Southern Cross Club build to rent (old Pitch n Putt site; Block 4, Section 79, Phillip) – proposed for future residential development.

The interaction of the Project with existing ACT Government strategies is also discussed in Chapter 2 (Need for the Project).

11.8.2 Potential impacts – construction

Property impacts

The majority of the Project area would be located on land owned and managed by the ACT or Australian Government. Operational Project infrastructure would primarily be located along existing transport corridors along the following roads:

- For the State Circle East alignment option: Commonwealth Avenue, State Circle, Adelaide Avenue, Yarra Glen, Callam Street
- For the National Triangle-Barton alignment option: Commonwealth Avenue, King George Terrace, across Kings Avenue, Macquarie Street, Bligh Street, National Circuit, Sydney Avenue, State Circle, Adelaide Avenue, Yarra Glen, Callam Street.

A complete list of roadways within or partially within the Project area is included in Section 1.2 of Appendix K (Property and land use planning).

Some parcels of privately leased land would be partially affected by the Project area, which are located within the Barton, Parliament House, and Woden precincts, and the Mitchell Depot site. Ongoing consultation with relevant lease holders and land custodians would occur, and consent will be sought prior to carrying out works within the applicable blocks. Privately leased blocks within the Project area are listed below.

Barton precinct:

- Blocks 1 and 2, Section 8, Division of Barton
 - Minor encroachment into the southern boundary of the blocks (adjoining Bligh Street) would be required for road and footpath adjustments to allow for the light rail corridor on Bligh Street, associated with the National Triangle-Barton alignment option
- Blocks 2, 3, 4, 5 and 6, Section 10, Division of Barton
 - Works within these blocks would be required for the National Triangle-Barton alignment option, due to the proposed relocation of the Hotel Kurrajong car park access from Bligh Street to Macquarie Street. Consequently, a small number of spaces within the car park would be temporarily unavailable while works are undertaken to relocate the access. One parking space would be permanently removed. Traffic related impacts of the work are assessed in Section 15.2 of Chapter 15 (Barton precinct)

Parliament House precinct:

- Block 1, Section 28, Division of Forrest
 - Minor encroachment into the north-western corner of the block would be required for changes to the road layout and footpaths, required to allow for the light rail corridor on State Circle (for State Circle East alignment option)

Woden precinct:

- Block 4, Section 79, Division of Phillip
 - Minor encroachment into the western boundary of the block would be required to facilitate delivery of active travel arrangements
- Blocks 9 and 10, Section 79, Division of Phillip
 - The light rail corridor would be located within these blocks, which adjoin Yarralumla Creek
- Block 16, Section 79, Division of Phillip
 - Temporary works associated with utilities are proposed along the western boundary of the block currently occupied by Canberra College. Minor permanent encroachment into the western boundary of the block would be required for active travel and associated infrastructure. Existing buildings or infrastructure on the block would not be directly affected

The Mitchell Depot site:

- Block 2, Section 16, Division of Mitchell
 - Portions of this block would be used to accommodate the expansion of the Depot and construction activities.

A complete list of blocks within the Project area is provided in Appendix K (Property and land use planning).

Temporary changes to land use

The Project area comprises both permanent and temporary works required to deliver the Project (refer to Figure 6-1 to Figure 6-4 in Chapter 6 (Construction)). Construction compounds would also be established within the Project area for the duration of construction. All indicative construction compound locations would be required regardless of which alignment option is selected.

During construction, land uses within the Project area would temporarily change from their existing land use to construction works areas or compounds. Public access to this land (where it is currently available) would be restricted for the duration of its use as a construction work area or compound.

Temporary changes to land use associated with the establishment of each construction compound are discussed in Table 11-52.

In addition to the compounds, both temporary and permanent work areas within the Project area would also change from their existing land use to construction work areas for transport infrastructure. However, the change in land use would be shorter in duration (relative to the compounds) as works progress in different parts of the Project area and works/crews move within different construction zones.

Temporary work areas and compounds would be restored and returned to public use (where it is presently available) as far as practicable when works are complete.

Permanent operational impacts on land use (in terms of land use change) are considered in Section 11.8.3.

Table 11-52 Indicative construction compounds and land use change during construction

Precinct	Reference (refer to Figure 6-1 to Figure 6-4)	Location	Land use change impacts during construction
Commonwealth Avenue	A1	Acton Waterfront car park at Corkhill Street (consistent with the compound location used for LRS2A)	Construction of the Project would result in temporary change in land use from a car park to a construction compound for transport infrastructure. This would result in a temporary loss of parking which may discourage users from accessing attractions in the area including Commonwealth Park and Acton Park. Impacts to parking availability are considered further in Section 12.2.2 of Chapter 12 (Commonwealth Avenue precinct).
	A2	Acton Waterfront car park at Albert Street (consistent with the compound location used for LRS2A)	
	B	Yarralumla Parkland, Commonwealth Avenue south-west cloverleaf on the southern side of Lake Burley Griffin and adjacent to the existing bridges	Construction of the Project would require temporary occupation of a section of open space and parkland areas on the southern foreshore of Lake Burley Griffin. This would result in a change in the land use of the area to a construction compound for transport infrastructure. The compound represents a relatively small portion of the available open space in this area and as such impacts associated with temporary land use change are expected to be limited. Impacts on recreational areas are discussed further in the following section.
	C	Langton car park opposite Treasury Building, Parkes	Construction of the Project would result in temporary change in land use from a car park to a construction compound for transport infrastructure. Impacts to parking availability are considered further in Section 12.2.2 of Chapter 12 (Commonwealth Avenue precinct).
Parliament House	F	Capital Hill West	Construction of the Project would require temporary occupation of an area of unoccupied

Precinct	Reference (refer to Figure 6-1 to Figure 6-4)	Location	Land use change impacts during construction
			open space at Capital Hill. This would result in a change in the land use of the area to a construction compound for transport infrastructure. The impact of the temporary land use change would be limited considering the area of open space is an unoccupied, grassed area which would likely attract few users.
National Triangle	D	21 Queen Victoria Terrace Parking	Construction of the Project would result in temporary change in land use from a car park to a construction compound for transport infrastructure. Impacts to parking availability are considered further in Section 14.2.2 of Chapter 14 (National Triangle precinct).
	E	King George Terrace and Kings Avenue	Construction of the Project would require temporary occupation of a section of open space and parkland areas associated with Constitution place. This would result in a change in the land use of the area to a construction compound. Impacts of the land use change would be limited given the availability of similar open spaces which would continue to be publicly accessible throughout construction.
Yarra Glen	G	Parkland east of Yarra Glen/Yamba Drive roundabout, Hughes	Construction of the Project would require temporary occupation of a section of open space and parkland areas east of Yarra Glen/Yamba Drive roundabout. This would result in a change in the land use of the area to a construction compound for transport infrastructure. The area where the construction footprint is proposed comprises open, grassed areas, and recreational facilities to the north of the compound would continue to be available for use. Impacts of the land use change would be limited given the availability of similar open spaces which would continue to be publicly accessible throughout construction.
Woden	H	Easty Street car park in Woden	Construction of the Project would result in temporary change in land use from a car park to a construction compound for transport infrastructure. Impacts to parking availability are considered further in Section 18.2.2 of Chapter 18 (Woden precinct).
Mitchell Depot site	I1	Sandford Street	Construction of the Project would require occupation of a section of leased unoccupied / open space on the southern side of Sandford Street. Once operational this area would be used as part of the expanded Mitchell Depot. This would result in a change in the land use of the area to a construction compound, and longer term change to transport-related infrastructure. Impacts of the land use change would be limited

Precinct	Reference (refer to Figure 6-1 to Figure 6-4)	Location	Land use change impacts during construction
			given the low number of people accessing the site, which is located in an industrial area.
	I2	Adjoining the existing Mitchell Depot site	Construction of the Project would introduce a compound in a section of leased, vacant space which adjoins the existing Mitchell Depot site. Once operational this area would be used as part of the expanded Mitchell Depot. This would have limited impact noting the area adjoins the existing Depot.

Impacts on recreational facilities

Construction of the Project has the potential to result in impacts to recreational facilities and their use due to the following:

- Direct impacts such as temporary occupation of part of a recreational facility for the purposes of establishing a construction work area, resulting in part of the facility being temporarily unavailable for use
- Indirect amenity impacts from works within the vicinity of a facility, for example construction noise, air quality or visual impacts, which may detract from the use of and enjoyment of the facility.

Impacts of the use of recreational facilities that would be directly impacted due to the construction of the Project (i.e. the Project area would affect part of the facility) are outlined in Table 11-53.

Indirect impacts are discussed throughout the EIS including in assessment sections relating to noise and vibration, air quality (dust), traffic, and visual amenity. The majority of impacts would be transient and temporary in nature as work is progressively completed in these areas.

Landowners and operators of recreational facilities would be consulted with as part of detailed design and construction planning, to ensure they are informed of the potential impacts and to identify potential measures to reduce the impact of the Project on the use and enjoyment of the facilities.

Table 11-53 Directly impacted recreational facilities

Precinct	Directly impacted recreational facilities	Impact overview
Commonwealth Avenue	<ul style="list-style-type: none"> • Henry Rolland Park and surrounding open space areas on the northern foreshore of Lake Burley Griffin • Open space and parkland areas on the southern foreshore of Lake Burley Griffin 	Construction of the Project would require temporary occupation of parts of Henry Rolland Park and surrounding open space areas (including footpaths within these areas) on the northern foreshore of Lake Burley Griffin, where these areas lie within the Project area. Access to and use of these areas would be restricted while works occur there. This would affect the majority of Henry Rolland Park, however some areas adjacent to the foreshore (including open space and footpaths along the foreshore) would continue to remain available for use. Construction compounds A1 and A2 would also occupy parking facilities used by visitors of the area (refer to Table 11-52). The area that would be affected during construction only would be restored and returned to public use as works are completed in this location.

Precinct	Directly impacted recreational facilities	Impact overview
	<ul style="list-style-type: none"> Waterway on Lake Burley Griffin surrounding Commonwealth Avenue road bridges 	<p>Construction of the Project would require temporary occupation of open space areas (including footpaths) on the southern foreshore of Lake Burley Griffin, where these areas lie within the Project area. Access to and use of these areas would be restricted while works occur there. Construction compound B would be established within this area (refer to Table 11-52).</p> <p>Open space areas that form part of these facilities would be affected during construction only would be restored and returned to public use as works are completed in this location.</p> <p>Amenity impacts (mainly noise and visual) may affect the outdoor enjoyment for areas along the foreshore that are not directly occupied by construction work areas; however, these impacts are not expected to restrict the use or function of these areas.</p> <p>Construction works associated with the light rail bridge between the Commonwealth Avenue road bridges over Lake Burley Griffin would require access to boat ramps and jetties. The public thoroughfare/ open navigation channel beneath the bridges would also be affected (moved locations for public access under the bridge depending on where construction barges are positioned). These activities would likely result in temporary restrictions to public access in these areas for safety reasons, with access maintained as far as practicable. These restrictions would be temporary, and access reinstated once the relevant construction activities are completed. Waterway users, including boaters, rowing and yacht clubs, and recreational users, may experience disruptions due to temporary restrictions during construction activities within Lake Burley Griffin. Section 12.7 (Socioeconomic) of Chapter 12 (Commonwealth Avenue precinct) includes further detail regarding construction impacts on Lake Burley Griffin recreational users.</p>

Precinct	Directly impacted recreational facilities	Impact overview
National Triangle	<ul style="list-style-type: none"> Magna Carta Place Constitution Place Gardens 	<p>Construction of the Project would require temporary occupation of parts of gardens and recreational areas surrounding Old Parliament House, including Magna Carta Place and Constitution Place Gardens. These areas represent a relatively small portion of the gardens and recreational areas surrounding Old Parliament House, which would continue to be available for public use throughout the construction period.</p> <p>Affected areas would be occupied during construction only and would be restored and returned to public use as works are completed in this location.</p> <p>Amenity impacts (mainly noise and visual) may affect the outdoor enjoyment for other garden and recreational areas that are not directly occupied by construction work areas; however, these impacts are not expected to restrict the use or function of these areas.</p>
Woden	<ul style="list-style-type: none"> Woden Town Park 	<p>Woden Town Park is a relatively small urban park. Construction of the Project would require temporary occupation of the entire park. Access would be restricted to this area while works occur there. The park would be affected during construction only and would be restored and returned to public use as works are completed in this location. Given the availability of other similar parks and recreational areas in the vicinity, including Arabanoo Park immediately to the west, the temporary occupation of Woden Town Park would have a minor impact on the overall availability of recreational space in the Woden Town Centre.</p>

Property amenity

Demolition and construction activities for the Project may adversely affect the amenity of some adjoining land uses due to impacts such as:

- Noise and vibration generated by construction activities (refer to noise and vibration assessment sections in Chapter 12 (Commonwealth Avenue precinct) to Chapter 20 (Cumulative impacts))
- Dust generated by construction activities (refer to Section 11.9)
- Traffic disruption associated with construction traffic and potential temporary road closures (refer to traffic and transport assessment sections in Section 11.1 and Chapter 12 (Commonwealth Avenue precinct) to Chapter 20 (Cumulative impacts))
- Visual impacts associated with tree removal, stockpiles, and construction vehicles/equipment (refer to heritage views and vistas section in Section 11.3 and landscape character and visual amenity assessment sections in Chapter 12 (Commonwealth Avenue precinct) to Chapter 20 (Cumulative impacts)).

Amenity-related impacts on adjacent properties would be most noticeable in areas where residential properties or other sensitive land uses (such as educational receivers) are either located directly adjacent to construction activities (predominantly within the vicinity of the light rail stops) or where receivers have an unscreened view of the construction areas.

These amenity impacts would be managed in accordance with mitigation measures for the Project that have been identified to respond to the specific impacts listed above (refer to Chapter 21 (Environmental management and mitigation measures)).

Should there be delays to the completion of construction, there is potential for amenity impacts to increase in duration. Reasonable efforts would be made to complete construction in accordance with the planned construction program, to avoid the potential for this to occur.

11.8.3 Potential impacts – operation

Property impacts

As identified in Section 11.8.2, the majority of the Project area and operational infrastructure would be located on land owned and managed by the ACT and Australian Government. Permanent impacts to privately leased blocks are identified in Section 11.8.2.

A complete list of properties within the Project area is provided in Appendix K (Property and land use planning).

A positive land use benefit may arise from the Project leading to opportunities for increased urban density along the route. The benefits of Light Rail Stage 1 have been highlighted recently with the release of Light Rail Five Years On: Benefits Realisation Report 2024 (Transport Canberra and City Services, 2024). In the roughly five years since operations between Gungahlin and the City commenced, some of the land use benefits identified include:

- Stimulation of residential development and re-development along the light rail corridor
- More efficient and available access to public infrastructure and services
- Increased business/commercial engagement along the light rail corridor
- Increases in land value
- Public realm and urban amenity improvements.

Property amenity

Properties close to the light rail alignment and associated infrastructure may experience changes in amenity as a result of the project. Operation may result in the following impacts on amenity:

- Increase in noise levels as a result of the operation of LRVs, stop activities, and maintenance activities, however noise levels from these activities are anticipated to be relatively low (refer further to noise and vibration assessment sections in Part B (Environmental impact assessment))
- Increased commuter traffic (primarily pedestrian) within the local area resulting from the operation of the Project (refer further to traffic and transport assessment sections in Part B (Environmental impact assessment))
- Visual impacts where properties have direct views to operational infrastructure required for the Project, such as tracks, stops or TPSs (refer to landscape character and visual amenity assessment sections in Part B (Environmental impact assessment)).

These amenity impacts would be managed in accordance with mitigation measures for the Project that have been identified to respond to the specific impacts listed above (refer to Chapter 21 (Environmental management and mitigation measures)).

The operation of the Project is also anticipated to result in positive amenity impacts for some adjoining land uses through the encouragement of a shift away from private vehicle to public and active transport options (light rail, walking, cycling etc.) thereby reducing traffic impacts on the existing local and arterial network.

Impacts on recreational facilities

The permanent footprint of the Project would be largely within existing transport corridors, and is not anticipated to result in permanent changes to recreational facilities. Access to all existing recreation facilities would be maintained during the operation of the Project.

Consistency with land use planning

Territory Plan 2023

The majority of operational light rail alignment and associated infrastructure would be contained within existing transport corridors (including road reserves and areas zoned for transport uses).

In all instances, the Project is considered to fall within the permitted use nominated for each land use zone (as the Project would constitute works for the purposes of a light rail, or a minor use). Further detail on the consistency of the Project with permitted land uses under the relevant Territory Plan zones is further detailed in Appendix K (Property and land use planning).

In some instances, small sections of the Project area would also extend into areas zoned for other uses (such as suburban, residential, mixed use, community facility, open space, and business zones). These areas are described in detail in Section 1.3 of Appendix K (Property and land use planning). Notwithstanding the land use zoning, the Project alignment is primarily located within existing road corridors in these locations and would not limit the use of surrounding areas for their intended use as per the land use zones.

National Capital Plan

Section 3.1.4 of the NCP sets out the general location of Inter-town public transport system within the Territory. These corridors are identified on Figure 2 'General Policy Plan – Metropolitan Canberra' of the NCP. This section of the NCP provides for a public transport route that traverses Commonwealth Avenue, State Circle, and Adelaide Avenue and does not provide for a public transport route through the National Triangle.

Therefore, an amendment to the NCP would be required if the National Triangle-Barton alignment option is identified as the preferred alignment option for the Project. Refer to Chapter 8 (Legislation and policy) for further detail on the NCP.

Potential future land uses within the vicinity of the Project

Land use along the Project alignment comprises several areas identified for future development and growth as identified in Section 11.8.1. The Project would provide a benefit for future land uses by providing improved public transport connectivity to service existing land uses together with the planned development and growth.

The Project has been, and would continue to be, designed to integrate with existing and future land uses and planned development. The Project would be an important part of the transport network allowing more efficient and safer access for residents, workers and businesses along the alignment, as well as the wider region.

Planned developments and smaller scale redevelopments could be proposed (by others) near the light rail alignment to take advantage of the improved transport network and connectivity the Project would provide, such as residential, commercial, or mixed use development. Should there be delays to the completion of construction and the subsequent opening of the Project, there is potential that these prospective developments are delayed or become less feasible. Reasonable efforts would be made to progress approvals and complete construction in an efficient manner, to avoid the potential for this to occur.

11.8.4 Management and mitigation measures

Management and mitigation measures that will be implemented to manage property and land use impacts are listed in Chapter 21 (Environmental management and mitigation measures).

While construction impacts to properties adjacent to the Project would be temporary in nature, management measures would be required to manage the potential adverse impacts on the amenity of these areas. A number of management measures have been identified to reduce amenity-related impacts on adjacent land uses in relation to noise and vibration, visual amenity, traffic and air quality (refer to Chapter 21 (Environmental management and mitigation measures)).

The Project has been designed to minimise the overall impact on adjoining land uses. Community and stakeholder consultation is ongoing for the Project, and would be required during the construction to mitigate potential land use and amenity issues, particularly for sensitive land uses within the immediate

vicinity of the Project. Further detail on ongoing consultation is provided in Chapter 4 (Stakeholder and community consultation).

11.9 Air quality

This section provides an assessment of the potential air quality impacts associated with the construction and operation of the Project. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies).

11.9.1 Existing environment

Meteorological conditions

Data from CSIRO's The Air Pollution Model (TAPM) and surface operational data from Bureau of Meteorology (BoM) stations at Canberra Airport (about 6.6 km from the Project area) and Tuggeranong (about 8.9 km from the Project area) have been used to provide an indication of meteorological conditions for the Project, with 2018 adopted as a reference year for consistency with the LRS2A Project's environmental assessment (AECOM, 2023). The data has been reviewed against more recent data for 2021 and 2022 to confirm that the modelled year (2018) is still considered representative of local meteorological conditions.

Meteorological data for the Project area is summarised as follows:

- On an annual basis, the predicted dominant wind direction is from the north-west for the Project area. Distinctions between precincts include:
 - Wind distribution patterns for the Commonwealth Avenue, Parliament House and Inner South precincts are similar, showing a higher frequency of winds from the east and south-east
 - Yarra Glen and Woden precincts share a similar distribution pattern with a high frequency of north westerly and south westerly winds but lower frequency of winds from other sectors
 - Both National Triangle and Barton precincts show a lower occurrence of north easterly winds compared to Commonwealth Avenue and Parliament House precincts. South easterly and southerly winds are also common for National Triangle and Barton precincts respectively
- Predicted annual average wind speeds for each precinct are best characterised as a light to moderate breeze ranging from between 2.8 m/s and 3.4 m/s. Higher wind speeds were generally observed for the Commonwealth Avenue, Parliament House, National Triangle and Barton precincts, with lower winds observed for precincts in the south-west portion of the Project area
- The highest wind speeds are predicted to occur within the National Triangle and Barton precincts. Higher wind speeds can result in more favourable dispersal conditions for air pollutants but also pose a higher risk of windblown dust generation from exposed surfaces and stockpile areas
- Calm conditions (defined as wind speeds less than 0.5 m/s) are predicted to occur between 7.3% and 14.5% of the year. Higher frequencies of calms are expected to occur within the Yarra Glen and Woden precincts. Calm conditions generally result in poor dispersal of air pollutants but can also reduce the potential for windblown dust from exposed surfaces and stockpile areas.

Existing air quality

Table 11-54 summarises the measured PM₁₀ and PM_{2.5} concentrations from the Civic monitoring station from the last three full calendar years (2021 to 2023) together with recorded CO and NO₂ data collected from the Florey and Monash stations. Of the data in Table 11-54:

- Particulate matter concentrations recorded at the Civic monitoring station, situated approximately 600 m to the north-east of the Commonwealth Avenue precinct, are considered representative for the entire Project area. As the Civic station only monitors PM₁₀ and particulate matter less than 2.5 micrometres in diameter (PM_{2.5}), data from the Florey and Monash monitoring stations (both recording carbon monoxide (CO) and nitrogen dioxide (NO₂) concentrations) was also reviewed
- The Florey station (located approximately 11 km to the north-west of the Commonwealth Avenue precinct at its closest point) is considered representative of the Commonwealth Avenue, Parliament House, Inner South, National Triangle, and Barton precincts

- The Monash station (located approximately 8 km to the south of the Woden precinct at its closest point) is considered representative of the Woden and Yarra Glen precincts.

Table 11-54 Air quality monitoring data summary for 2021 to 2023 at Civic, Florey and Monash

Pollutant	Station	Averaging Period	Concentration (µg/m³)			Criteria (µg/m³)
			2021	2022	2023	
PM ₁₀	Civic	24 hour maximum	28.6	22.0	40.0	50
		24 hour criteria exceedances	0	0	0	0
		Annual average	8.8	6.7	9.9	20
PM _{2.5}		24 hour maximum	21.8	12.1	17.9	25 (20)
		24 hour criteria exceedances	0 (1)	0	0	0
		Annual average	5.0	4.1	5.5	8 (7)
CO	Florey	8 hour maximum	1,800	1,800	1,400	11,250
		8 hour criteria exceedances	0	0	0	0
	Monash	8 hour maximum	1,625	1,688	1,525	11,250
		8 hour criteria exceedances	0	0	0	0
NO ₂	Florey	1 hour maximum	69.7	53.3	61.5	164
		1 hour criteria exceedances	0	0	0	0
		Annual average	7.4	7.3	7.5	31
	Monash	1 hour maximum	73.8	61.5	63.6	164
		1 hour criteria exceedances	0	0	0	0
		Annual average	6.5	6.0	7.7	31
Note: Criteria in parentheses refers to NEPM proposed ambient air quality goals for PM _{2.5} from 2025.						

The background air quality concentrations shown in Table 11-54 have been reviewed against the existing National Environment Protection (Ambient Air Quality) Measure (NEPM) (2021) standards, with exception to the annual average criterion for particulate matter less than 10 micrometres in diameter (PM₁₀). This is because the ACT Government's policy position is to assess the annual average for PM₁₀ against a lower standard of 20 $\mu\text{g}/\text{m}^3$ rather than the NEPM standard of 25 $\mu\text{g}/\text{m}^3$ (ACT Government, 2023). In addition to this, background air quality concentrations for particulate matter less than 2.5 micrometres in diameter (PM_{2.5}) have been assessed against the NEPM 24-hour maximum and annual average goals of 20 $\mu\text{g}/\text{m}^3$ and 7 $\mu\text{g}/\text{m}^3$ respectively proposed for 2025.

Overall, air quality monitoring data shown in Table 11-54 indicates that air pollutant concentrations for PM₁₀ and PM_{2.5} at Civic and for CO and NO₂ at Florey and Monash stations are compliant with the ambient air quality criteria across all averaging periods between 2021 and 2023. Only one exceedance was recorded at occurred at Civic on the 30 April 2021, which was found likely to have occurred due to hazard reduction burns occurring in NSW (ACT Government, 2023).

11.9.2 Potential impacts – construction

To assess potential construction impacts of the Project, a four-step risk based assessment was undertaken with reference to the UK Institute of Air Quality Management (IAQM) Guidance (IAQM, 2024). These four steps are as follows:

- Step 1 – A screening assessment to identify the presence of human and ecological receptors

- Step 2 – A dust assessment to define:
 - Define the dust emissions magnitude and sensitivity of surrounding area to dust
 - Evaluate these two factors in a risk matrix to determine a potential risk rating for dust impacts on surrounding receptors (both alignment options have been assessed and where the magnitude rating alignment options differ, a separate sensitivity rating has been given)
 - Based on the outcomes of the two previous steps, determine the management and mitigation approach required for dust impacts to remain acceptable
- Step 3 – Determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level (refer to mitigation measures AQ1, AQ2 and AQ3 in Chapter 21 (Environmental management and mitigation measures))
- Step 4 – determine whether there are significant residual impacts, post mitigation, arising from the Project (refer to Appendix J (Environmental risk assessment)).

The assessment methodology is described further in Chapter 10 (Assessment methodologies).

Step 1 – Screening assessment

An initial screening assessment was undertaken for the construction footprint to identify whether there were any:

- Human receptors within a 250 m of the Project area
- Ecological receptors within 50 m of the Project area
- Human or ecological receptors within 50 m of the route used by construction vehicles on public roads up to 250 m from the Project area.

To identify and assess receptors within proximity to the Project area, buffer zones of 20 m, 50 m, 100 m, and 250 m were applied to the Project area and are shown on Figure 11-92. Figure 11-92 shows there are several human receptors within 250 m including:

- Low to high density residential and hotels
- Office and commercial buildings
- Government buildings and international embassies
- Sensitive land uses including schools, childcares, aged care facilities, and medical centres
- Transient receptors including parks, playing fields, footpaths, carparks, and open spaces.

Given the presence of receptors within the buffer zones, a Step 2 assessment was conducted for the Project.

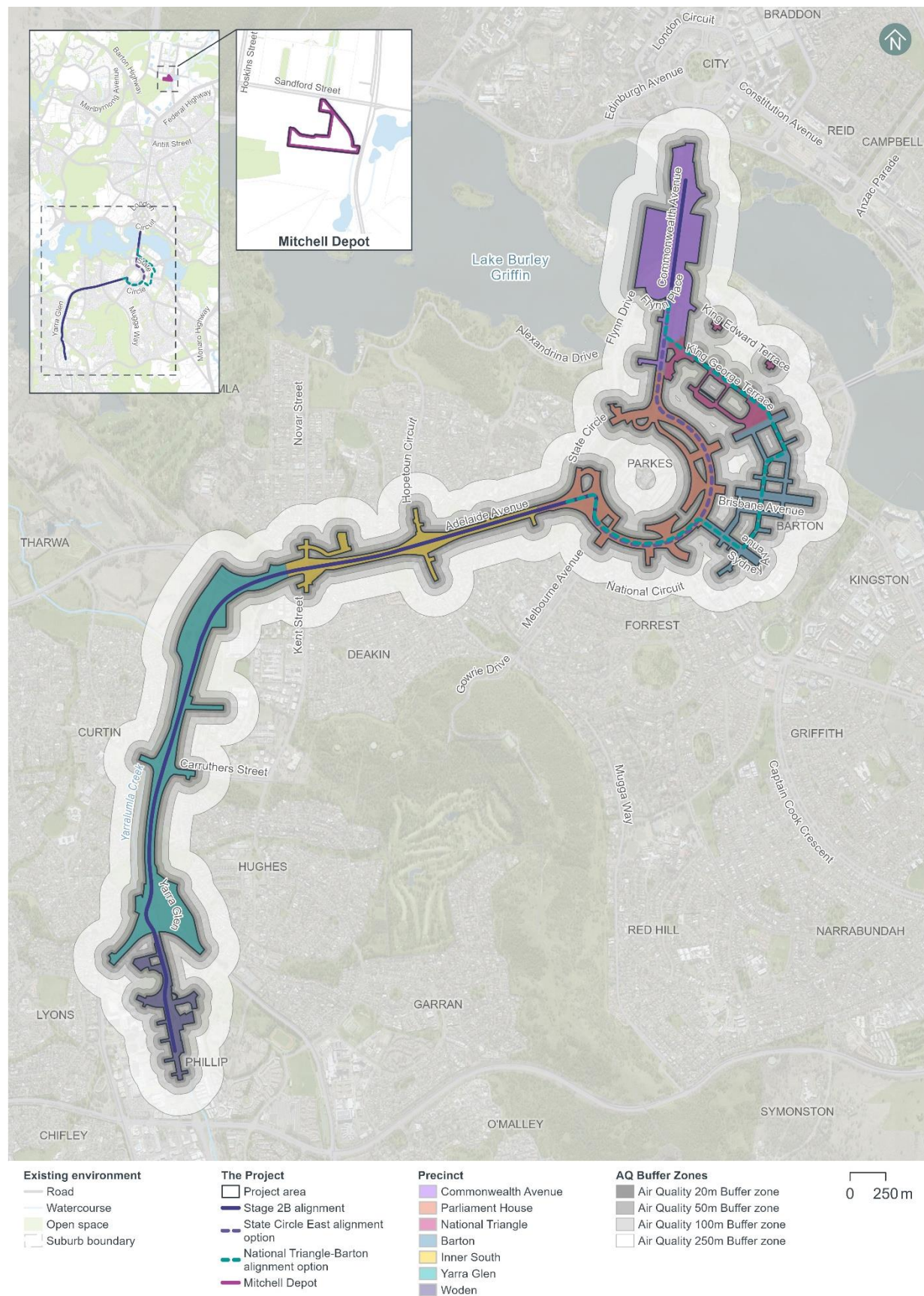


Figure 11-92 Buffer distances for Project area

Step 2 – Dust assessment

The dust assessment was conducted for each precinct and is outlined in the following sections. In addition to each precinct, construction works associated with the proposed adjustments at the existing Mitchell Depot site have been assessed qualitatively, given the limited extent of works proposed at the site.

Construction activity magnitudes

Construction activity magnitudes for each precinct are summarised in Table 11-55. Magnitudes ratings have been estimated based on IAQM (2024) guidance as described in the Chapter 10 (Assessment methodologies), and construction activities discussed in Chapter 6 (Construction).

Table 11-55 Construction activity magnitudes for each precinct

Precinct	Demolition	Earthworks	Construction	Track-out
Commonwealth Avenue	Medium	Large	Large	Medium
Parliament House	Medium	Large	Large	Large
National Triangle (State Circle East alignment option)	Small	Small	Small	Medium
National Triangle (National Triangle-Barton alignment option)	Medium	Large	Large	Medium
Barton (State Circle East alignment option)	Small	Small	Small	Small
Barton (National Triangle-Barton alignment option)	Medium	Large	Large	Medium
Inner South	Medium	Large	Large	Large
Yarra Glen	Medium	Large	Large	Large
Woden	Large	Medium	Large	Large

Sensitivity to dust soiling

Due to the size of the Project area, sensitivity to dust soiling risks have been examined for each of the construction buffer zones identified above and are outlined in Table 11-56. Dust risk ratings are determined by the highest risk rating attributed to a construction buffer zone and have been estimated based on IAQM (2024) guidance and surrounding land use as described in Chapter 10 (Assessment methodologies).

The overall sensitivity rating for all precincts listed in Table 11-56 was determined to be **high** based on the number of highly sensitive receptors within 20 m and 50 m of the Project area boundary.

Table 11-56 Assessment of sensitivity to dust soiling for precincts

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
Commonwealth Avenue	High	<ul style="list-style-type: none"> Highly sensitive receptors include: <ul style="list-style-type: none"> - Hyatt Hotel Canberra - Corporations and Markets Advisory Committee - British High Commission - Katie Bendor Memorial - Archbishops House Acton Waterfront park and future estate (described in Section 11.8.1) There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive receptors (in addition to those within closer buffer zones) include the National Library of Australia There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive (in addition to those within closer buffer zones) include: <ul style="list-style-type: none"> - Embassy of Peoples of China - Lennox Gardens' District Park - New Zealand High Commission There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive receptors (in addition to those within closer buffer zones) include: <ul style="list-style-type: none"> - Treasury - Australian Public Service Commission - National Capital Authority - National Capital Exhibition - National Rose Gardens - Commonwealth Park - Bureau of Meteorology - High Commission of Canada There are no residential dwellings within this buffer zone
	Medium	<ul style="list-style-type: none"> Government places of business and parks within the area are of national importance where the appearance or aesthetics of the property and have been classified highly sensitive (refer to high receptor sensitivity category above for examples) < 100 m includes West Block offices 			
	Low	<ul style="list-style-type: none"> Short term car parking on Langton Crescent, King Edward Terrace and Kaye Street Nearby transient receptors including roads and public footpaths 			

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
Parliament House	High	<ul style="list-style-type: none"> Receptors of national importance including Capital Hill, Parliament House and parts of The Lodge property (noting the main building is within 30 m) Residential dwellings to south of State Circle State Circle East alignment option is within 20 m of York Park 	<ul style="list-style-type: none"> Residential properties to the south of State Circle (in addition to those within closer buffer zones) Receptors of national or international importance including state government departments, international embassies, high commissions and the Presbyterian Church of St Andrew National Triangle-Barton alignment option is within 50 m of York Park 	<ul style="list-style-type: none"> Residential properties to the south of State Circle (in addition to those within closer buffer zones) State government departments, international embassies, high commissions National Archives within 100 m of State Circle East alignment option 	<ul style="list-style-type: none"> Residential properties to south of State Circle (in addition to those within closer buffer zones) Highly sensitive receptors (in addition to those within closer buffer zones) include: <ul style="list-style-type: none"> Old Parliament House (State Circle East alignment option) South African High Commission High Commission for the Islamic Republic of Pakistan Hotels including the Hyatt Hotel Canberra and Little National Hotel Canberra. The Commonwealth Club Casey House and Gardens (State Circle East alignment option)
	Medium	<ul style="list-style-type: none"> Government places of business and parks within the area are considered of national importance where the appearance or aesthetics of the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples) 	<ul style="list-style-type: none"> Government places of business and parks within the area are considered of national importance where the appearance or aesthetics of the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples) 	<ul style="list-style-type: none"> As per receptors within 20 m to 50 m 	

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
National Triangle (National Triangle-Barton alignment option)		<ul style="list-style-type: none"> Bert and Peg Piggott Memorial Rose Garden 			
	Low	<ul style="list-style-type: none"> Adjacent short term carparking near Capital Hill Transient receptors including roads a pedestrian walkway 	<ul style="list-style-type: none"> Short term parking off Brisbane Avenue Transient receptors including roads a pedestrian walkway 	<ul style="list-style-type: none"> As per receptors within 20 m to 50 m 	
	High	<ul style="list-style-type: none"> Highly sensitive receptors including: <ul style="list-style-type: none"> The Treasury Old Parliament House Aboriginal Tent Embassy Gardens surrounding old Parliament House including the senate gardens and the rose gardens Eddie Koiki Mabo Memorial Park. Tennis courts situated immediately east and west of Old Parliament House There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive receptors (in addition to those within closer buffer zones) include: <ul style="list-style-type: none"> The National Archives National Capital Authority Australian Federal Police Bureau of Meteorology There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive receptors (in addition to those within closer buffer zones) include: <ul style="list-style-type: none"> The National Library The John Gorton Building and Climate Change Authority Australian Public Service Commission Gardens surrounding old Parliament House including the senate gardens and the rose gardens (State Circle East alignment option). There are no residential dwellings within this buffer zone 	<ul style="list-style-type: none"> Highly sensitive receptors as listed above and also include the Nationally Gallery of Australia and Australian Gardens Terrace (National Triangle – Barton alignment option only). For the State Circle East alignment <ul style="list-style-type: none"> Old Parliament House Tennis courts situated immediately east and west of Old Parliament House John Gorton Building and Climate Change Authority Bureau of Meteorology National Capital Authority
	Medium	<ul style="list-style-type: none"> Government places of business and parks within the area are considered of national importance where the appearance or aesthetics 	<ul style="list-style-type: none"> As per receptors within 20 m 		

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
		of the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples)			
	Low	<ul style="list-style-type: none"> • Adjacent to short term carparking including at the Treasury and National Library, National Archives and Old Parliament House • Transient receptors including roads and pedestrian walkways • Adjacent to the John Gorton Campus Carpark Building (currently under construction) 	<ul style="list-style-type: none"> • Other nearby transient receptors within 50 m including roads a pedestrian walkway 	<ul style="list-style-type: none"> • As per receptors within 20 m to 50 m 	
Barton	High	<ul style="list-style-type: none"> • Medium density residential dwellings and hotels including: <ul style="list-style-type: none"> - Hotel Kurrajong - Little National Hotel Canberra - Hotel Realm - Burbury Hotel Canberra - Rydges Canberra • Receptors of national or international importance including state government departments, international embassies. Receptors for both alignment options include the Australian 	<ul style="list-style-type: none"> • Medium density residential dwellings and hotels (in addition to those within closer buffer zones) • Receptors of national or international importance including state government departments, international embassies (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> • Suburban residential dwellings • Ridges Hotel and Brassy Hotel 	<ul style="list-style-type: none"> • Suburban residential dwellings (in addition to those within closer buffer zones) • Bently Suites and Brassy Hotel • The State Circle East alignment option is within 250 m of the following hotels: <ul style="list-style-type: none"> - Burbury Hotel Canberra - Hotel Realm - Little National Hotel Canberra - Rydges Canberra

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
		<ul style="list-style-type: none"> National Audit Office, Office of Parliamentary Council, Department of Foreign Affairs and Trade and the Australian Tax Office York Park 			
	Medium	<ul style="list-style-type: none"> Government places of business and parks within the area are considered of national importance where the appearance or aesthetics of the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples) < 250 m also includes Belmore Gardens and Barton Tennis Club 			
	Low	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) Short term parking
Inner South	High	<ul style="list-style-type: none"> A large number of residential dwellings Highly sensitive receptors include government buildings, including international embassies to north and south of Adelaide Avenue, and The Lodge 	<ul style="list-style-type: none"> A large number of additional residential dwellings (in addition to those within closer buffer zones) Highly sensitive receptors include: <ul style="list-style-type: none"> Nigerian High Commission Embassy of Italy Embassy of Saudi Arabia 	<ul style="list-style-type: none"> Residential dwellings (in addition to those within closer buffer zones) Highly sensitive receptors include: <ul style="list-style-type: none"> Embassy of the Philippines The Embassy of Belarus 	<ul style="list-style-type: none"> Residential dwellings (in addition to those within closer buffer zones)
	Medium	<ul style="list-style-type: none"> Government places of business including international embassies are considered of national importance where the appearance or aesthetics of 	<ul style="list-style-type: none"> Government places of business including international embassies are considered of national importance where the appearance or 	<ul style="list-style-type: none"> Businesses and commercial properties on Hopetown Circuit Parklands including Deakin Oval and America Park USA and Deakin Stadium 	<ul style="list-style-type: none"> Businesses and commercial properties on Hopetown Circuit (in addition to those within closer buffer zones)

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
		the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples)	aesthetics of the property and have been classified highly sensitive <ul style="list-style-type: none"> Business and commercial properties on Hopetown Circuit 		<ul style="list-style-type: none"> Parklands including Deakin Oval and America Park USA and Deakin Stadium
	Low	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Short term parking off Grouse Street Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones)
Yarra Glen	High	<ul style="list-style-type: none"> Residential dwellings: <ul style="list-style-type: none"> Multistorey apartment building complexes located of Melrose Drive Suburban residential dwellings west of service street and east of Webster Street Warrigal Hughes aged care facility Royal Bhutanese Embassy 	<ul style="list-style-type: none"> Residential dwellings to the east and west of the precinct (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Residential dwellings to the east and west of the precinct (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Residential dwellings to the east and west of the precinct (in addition to those within closer buffer zones) Highly sensitive receptors including: <ul style="list-style-type: none"> Royal Australian Mint Embassy of Bosnia Solomon Islands High Commission Embassy of Hungary Botswana High Commission The Statesmen Hotel Embassy of the Democratic Republic of Timor-Leste
	Medium	<ul style="list-style-type: none"> Parklands and playing fields including Hughes Oval 	<ul style="list-style-type: none"> Parklands, playing fields and open space including the North Woden Tennis 	<ul style="list-style-type: none"> Parklands, playing fields and open space including the Deakin Cricket Nets 	<ul style="list-style-type: none"> Parklands and open space including Magyar Playground

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
			Club and Woden Floods Memorial		<ul style="list-style-type: none"> Government places of business within the area are considered of national importance where the appearance or aesthetics of the property and have been classified highly sensitive (refer to high receptor sensitivity above for examples)
	Low	<ul style="list-style-type: none"> Transient receptors would generally be limited to roads 	<ul style="list-style-type: none"> As per receptors within 20 m 	<ul style="list-style-type: none"> As per receptors within 20 m 	<ul style="list-style-type: none"> Transient receptors would generally be limited to roads and short term parking facilities
Woden	High	<ul style="list-style-type: none"> Medium and high density residential dwellings Canberra Institute of Technology Woden campus (currently under construction) 	<ul style="list-style-type: none"> Medium and high density residential dwellings (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Medium and high density residential dwellings (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Medium and high density residential dwellings, including the Wilara Apartments and the Bellerive Retirement Village (in addition to those within closer buffer zones)
	Medium	<ul style="list-style-type: none"> Business and commercial properties including the Hellenic Club of Canberra and the Australian Slovenian-Australian Association. Community facilities including Canberra College Woden Park, Arabanoo Park and Phillip Oval are also adjacent to Project 	<ul style="list-style-type: none"> Business and commercial properties to the east and west (both existing and future approved development) < 250 m includes the Woden Cemetery and Edison Park 		

Precinct	Receptor sensitivity	Distance from Project area boundary			
		< 20 m	< 50 m	< 100 m	< 250 m
		<ul style="list-style-type: none"> Several other future developments in Woden, described in Section 11.8.1 			
	Low	<ul style="list-style-type: none"> Short term carparking on Irving Street, Spoering Street, Bowes Street, Easty Street and Neptune Street Transient receptors include roads and pedestrian walkways 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones) 	<ul style="list-style-type: none"> Short term parking on Corinna Street Transient receptors including roads and pedestrian walkways (in addition to those within closer buffer zones)

Sensitivity to exposure to dust for human receptors

The sensitivity to health risk from PM₁₀ emissions has been assessed for each precinct based on IAQM (2024) guidance, taking into account the existing PM₁₀ background concentrations and presence of human receivers within the construction buffer zones considered in the assessment.

The overall sensitivity to human health risk for each precinct is summarised as follows:

- Commonwealth Avenue – **medium** for both alignment options due to low PM₁₀ background concentrations and the proximity of the Hyatt Hotel Canberra within 20 m of the precinct (which would be assumed to have an occupancy rate greater than 100 people at any given time)
- Parliament House – **medium** due to low PM₁₀ background concentrations and the presence of low density sensitive residential receptors within 20 m of the precinct. The risk rating of medium applies to both alignment options, however a higher number of medium to low sensitive receptors are present within the buffer zone area for the State Circle East alignment option
- National Triangle – **medium** for the National Triangle-Barton alignment option due to the low PM₁₀ background concentrations and presence of a highly sensitive receptor (the Aboriginal Tent Embassy) within 20 m of the Project Area. For the State Circle East alignment option, the nearest highly sensitive receptors are within 100 m of the Project Area and therefore the health risk from PM₁₀ emissions would be considered low.
- Barton – **medium** due to the low PM₁₀ background concentrations and the proximity of sensitive receptors (including medium density residences, childcare centres and healthcare facilities) within 20 m of the precinct. The risk rating of high applies to both alignment options, however a higher number of highly sensitive receptors are present within the buffer zone area for the National Triangle-Barton alignment option
- Inner South – **medium** due to the low PM₁₀ background concentrations and the proximity of the residential receptors and the Canberra Girls Junior School within 20 m of the precinct
- Yarra Glen – **medium** due to the low PM₁₀ background concentrations and the proximity of residential and aged care sensitive receptors within 20 m to 50 m of the precinct
- Woden – **high** due to the low PM₁₀ background concentrations and the proximity of medium and high density residences within 20 m of the precinct.

Sensitivity to exposure to dust for ecological receptors

Ecological risks are linked to the presence of sensitive ecological receptors that may be affected by dust deposition. Ecological receptors are defined as habitats that may be sensitive to dust. A preliminary ecological assessment took place at each precinct and a description of the sensitivity of ecological receptors is included in Table 11-57.

The Project area is generally not located within the vicinity of any areas of critical ecological habitat, Ramsar wetlands, or key ecological areas that may be affected by dust soiling. For the purposes of the air quality assessment, it has been conservatively assumed that habitat for any threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth, EPBC ACT) or the ACT *Natural Conservation Act 2014* (ACT) would be susceptible to dust soiling.

Further detail on the ecological environment of each precinct is included in Technical Report 2 – Biodiversity.

Table 11-57 Sensitivity to exposure to dust for ecological receptors

Precinct	Sensitivity assessment
Commonwealth Avenue	<p>The Project area within this precinct is located within 20 to 50 m of urban street trees situated along Commonwealth Avenue. The presence of the endangered Golden Sun Moth (GSM) habitat and Gang-gang Cockatoo foraging habitat has been noted and there may be temporary impacts but would be unlikely to result in ongoing disturbance to GSM habitat. Therefore, the ecological sensitivity of the precinct is considered low.</p> <p>Refer to Section 12.4 of Chapter 12 (Commonwealth Avenue precinct) for a summary of the biodiversity assessment.</p>
Parliament House	<p>The Project area within this precinct contains land that is adjacent to vegetated land between Capital Circle/Adelaide Avenue and State Circle, and is nearby to highly sensitive receptors. GSM sightings and habitat is noted, and indirect disturbance of habitat may occur as a result of dust emissions from construction however these impacts would be temporary and unlikely to result in ongoing disturbance to GSM habitat. Due to this and the presence of mature trees which hold high aesthetic value and foraging and breeding resources for the Gang-gang Cockatoo, the ecological sensitivity of the Project area is considered medium.</p> <p>Refer to Section 13.4 of Chapter 13 (Parliament House precinct) for a summary of the biodiversity assessment.</p>
National Triangle	<p>Several gardens of nationally importance are located within 50 m of the Project area within this precinct, surrounding Old Parliament house. This includes the national Rose Garden, The Senate Gardens, and Old Parliament House Gardens. These gardens are considered as ecological receptors for the purposes of the air quality assessment. As such the ecological sensitivity of the Project area is considered high. Potential foraging habitat for Gang-Gang Cockatoo within Project area however exotic vegetation in urban environments it is not critical habitat to the survival of the species. The presence of GSM habitat has also been noted and there may be temporary impacts but would be unlikely to result in ongoing disturbance to GSM and Gang-gang Cockatoo habitat.</p> <p>Refer to Section 14.4 of Chapter 14 (National Triangle precinct) for a summary of the biodiversity assessment.</p>

Precinct	Sensitivity assessment
Barton	<p>The Project area within this precinct is near land located between Capital Circle/Adelaide Avenue and State Circle (within the Parliament House precinct). The presence of Gang-gang Cockatoo foraging habitat and GSM habitat has been noted and there may be temporary impacts but would be unlikely to result in ongoing disturbance to Gang-gang Cockatoo and GSM habitat. Given that the precinct includes the Commonwealth Heritage Listed York Park North Oak Tree Plantation and the land is considered to be of national importance with intrinsic value, the ecological sensitivity of the Project area is considered high.</p> <p>Refer to Section 15.4 of Chapter 15 (Barton precinct) for a summary of the biodiversity assessment.</p>
Inner South	<p>The Project area within this precinct is located within 20 to 50 m of a large number of urban streets trees situated along Adelaide Avenue. GSM sightings and habitat is noted, and indirect disturbance of habitat may occur as a result of dust emissions from construction however these impacts would be temporary and unlikely to result in ongoing disturbance to GSM habitat. Due to this and the presence of mature trees which hold high aesthetic value and foraging and breeding resources for the Gang-gang Cockatoo, the ecological sensitivity of the Project area is considered medium.</p> <p>Refer to Section 16.4 of Chapter 16 (Inner South precinct) for a summary of the biodiversity assessment.</p>
Yarra Glen	<p>The Project area within this precinct is located within 20 to 50 m of remnant vegetation along the Yarra Glen. The area includes foraging habitat for the Gang-Gang Cockatoo as well as observations of both the Gang-Gang Cockatoo and threatened Superb Parrot. The presence of GSM habitat has been noted and there may be temporary impacts but would be unlikely to result in ongoing disturbance to these species habitat. Therefore, the ecological sensitivity of the precinct is considered low.</p> <p>Refer to Section 17.4 of Chapter 17 (Yarra Glen precinct) for a summary of the biodiversity assessment.</p>
Woden	<p>Land use surrounding the Project area in this precinct is highly urbanised. Ecological receptors are generally limited to urban street trees along Yarralumla Creek, Callam Street, Woden Town Park and Arabanoo Park. The area includes foraging habitat for the Gang-Gang Cockatoo as well as observations of both the Gang-Gang Cockatoo and threatened Superb Parrot. The presence of GSM habitat has been noted and there may be temporary impacts but would be unlikely to result in ongoing disturbance to GSM habitat or threatened bird species. Therefore, the ecological sensitivity of the precinct is considered low.</p> <p>Refer to Section 18.4 of Chapter 18 (Woden precinct) for a summary of the biodiversity assessment.</p>

Overall dust IAQM risk ratings

The potential unmitigated risks identified through the IAQM assessment approach associated with the construction of the Project within Commonwealth Avenue, Parliament House, National Triangle, Barton, Inner South, Yarra Glen, and Woden precincts were found to range from low to high, as summarised in

The potential unmitigated risks identified through the IAQM assessment approach associated with the construction of the Project within Commonwealth Avenue, Parliament House, National Triangle, Barton, Inner South, Yarra Glen, and Woden precincts were found to range from low to high, as summarised in Table 11-58.

Table 11-58 Summary of unmitigated risk assessment for the Project activities within each precinct

Precinct	Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of unmitigated dust impacts		
			Dust soiling	Human health	Ecological Impact	Dust soiling	Human health	Ecological Impact
Commonwealth Avenue	Demolition	Medium	High	Medium	Low	Medium	Medium	Low
	Earthworks	Large	High	Medium	Low	High	Medium	Low
	Construction	Large	High	Medium	Low	High	Medium	Low
	Track-out	Medium	High	Medium	Low	Medium	Low	Low
Parliament House	Demolition	Medium	High	Medium	Medium	Medium	Medium	Medium
	Earthworks	Large	High	Medium	Medium	High	Medium	Medium
	Construction	Large	High	Medium	Medium	High	Medium	Medium
	Track-out	Large	High	Medium	Medium	High	Medium	Medium
National Triangle (State Circle East alignment option)	Demolition	Small	High	Low	Low	Medium	Negligible	Negligible
	Earthworks	Small	High	Low	Low	Low	Negligible	Negligible
	Construction	Small	High	Low	Low	Low	Negligible	Negligible
	Track-out	Medium	High	Low	Low	Medium	Low	Low
National Triangle (National Triangle-Barton alignment option)	Demolition	Medium	High	Medium	High	Medium	Medium	Medium
	Earthworks	Large	High	Medium	High	High	Medium	High
	Construction	High	High	Medium	High	High	Medium	High
	Track-out	Medium	High	Medium	High	Medium	Medium	Medium
Barton (State Circle East alignment option)	Demolition	Small	High	Medium	High	Medium	Low	Medium
	Earthworks	Small	High	Medium	High	Low	Low	Low
	Construction	Small	High	Medium	High	Low	Low	Low
	Track-out	Small	High	Medium	High	Low	Low	Low

Precinct	Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of unmitigated dust impacts		
			Dust soiling	Human health	Ecological Impact	Dust soiling	Human health	Ecological Impact
Barton (National Triangle-Barton alignment option)	Demolition	Medium	High	Medium	High	Medium	Medium	Medium
	Earthworks	High	High	Medium	High	High	Medium	High
	Construction	High	High	Medium	High	High	Medium	High
	Track-out	Medium	High	Medium	High	Medium	Low	Medium
Inner South	Demolition	Medium	High	Medium	Medium	Medium	Medium	Medium
	Earthworks	High	High	Medium	Medium	High	Medium	Medium
	Construction	High	High	Medium	Medium	High	Medium	Medium
	Track-out	High	High	Medium	Medium	High	Medium	Medium
Yarra Glen	Demolition	Medium	High	Medium	Low	Medium	Medium	Low
	Earthworks	Large	High	Medium	Low	High	Medium	Low
	Construction	Large	High	Medium	Low	High	Medium	Low
	Track-out	Large	High	Medium	Low	High	Medium	Low
Woden	Demolition	Large	High	Medium	Low	High	High	Medium
	Earthworks	Medium	High	Medium	Low	Medium	Medium	Low
	Construction	Large	High	Medium	Low	High	Medium	Low
	Track-out	Medium	High	Medium	Low	Medium	Low	Low

Mitchell Depot site

In addition to the assessment of individual precincts, construction works associated with the proposed adjustments at the Mitchell Depot site have been assessed qualitatively, given the limited extent of works proposed and location in an industrial area with fewer sensitive receivers. Construction work associated with the Mitchell Depot is described in Section 6.3.8 of Chapter 6 (Construction).

Potential air quality impacts associated with construction works would largely be associated with dust generation from earthworks, which would include the excavation of up to around 21,000 m³ spoil. Dust mitigation measures would be implemented to minimise the potential dust soiling and risks to human health. Provided these standard dust mitigation measures are implemented, potential dust impacts to nearby sensitive receptors would be of low to negligible risk.

Other potential air quality impacts associated with the modifications to the Mitchell Depot would include dust generated from construction works and track out, and combustion emissions from mobile and stationary plant, equipment, and construction vehicles.

Combustion emissions assessment

Combustion emissions would occur from the Project due to the combustion of petrol and diesel fuel by light and heavy vehicles traveling to and from site as well as onsite, mobile construction equipment, and stationary equipment including generators. Emissions are expected to depend on the nature of the emissions source i.e., size of the equipment, usage rates, duration of operation etc. Pollutants emitted by construction vehicles include CO, particulate matter (PM₁₀ and PM_{2.5}), NO₂, SO₂, VOCs, and PAHs.

Heavy vehicle movements would include deliveries of construction plant, supplies, and infrastructure, and to transport spoil and waste materials. The scheduling of construction heavy vehicle movements would occur outside peak periods whenever feasible. The transportation of oversized loads would also be arranged to take place outside peak traffic times. The location of haulage routes is described in Section 6.7.1 of Chapter 6 (Construction), and construction traffic volumes are estimated in Section 6.7.2 of Chapter 6 (Construction).

Given that the haulage routes are primarily proposed on arterial roads with existing high volumes of traffic, construction traffic from the Project is unlikely to result in a notable reduction in ambient air quality at nearby sensitive receptors. Potential road detours or use of local roads due to construction works would be expected to result in some minor localised changes to ground level pollutant concentration distribution patterns, however these would be temporary in nature.

Combustion emissions from diesel operated mobile equipment identified in Section 6.6.3 of Chapter 6 (Construction) would also result in air pollutant emissions, as well as use of diesel generators to provide onsite power to construction compounds and equipment where access to the electrical grid may not be readily available. Standard mitigation and maintenance measures for operating construction vehicles and plant equipment are presented in mitigation measure AQ2 of Chapter 21 (Environmental management and mitigation measures). With these measures in place, adverse air quality impacts from construction traffic emissions, as well as use of mobile and stationary plant equipment exhaust and equipment, would be limited.

11.9.3 Potential impacts – operation

Potential air quality impacts during operation of the Project would be similar across the Project area, and have therefore been assessed at a Project-wide level.

Operational vehicle emissions

Minor vehicle emissions are expected from the operation and maintenance of the Project. These emissions would be associated with the operational workforce travelling to and from work by light vehicles, and combustion emissions from maintenance vehicles and equipment. The operational workforce would generally travel to and from the Mitchell Depot. Estimated maintenance and staff vehicles during operation would include Utes, heavy vehicles and other construction and maintenance vehicles. Potential air quality emissions attributed to the operation of the Project from general operation and routine maintenance work would be negligible and would be unlikely to have any adverse air quality impacts.

The Project would aim to improve active and public transport uptake, and in turn reduce vehicle movements in Canberra, which may, in turn, have beneficial impacts to the local airshed by reducing potential air emissions from the local traffic network.

Dust from light rail vehicles

Minor fine dust emissions are anticipated from operation of the light rail where ballast track is used on the Project and the operation of sandboxes on LRVs containing silicate sand. LRV sandboxes are typically placed near the wheels, with the discharge nozzle aimed at the rail just ahead of the wheel-rail contact point to limit dispersal. The rate of sand dispersal rate is variable and may be adjusted to meet braking and traction requirements. Application of sand would occur both automatically and manually.

Substantial accumulation of sand in the light rail line and surrounding area associated with braking is not anticipated as rail lines would be regularly maintained using a modified street sweeper designed to extract residual sand from the rail lines.

Sections of the light rail alignment would also operate on 'green track' which has an increased surface roughness. The increased surface roughness would promote deposition of dust. The potential dust impacts and risks associated with respirable crystalline silica are considered very low.

11.9.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage air quality impacts, that are applicable to the Project as a whole.

11.10 Climate change risk

This section provides an assessment of the potential climate change risks associated with the construction and operation of the Project, as well as the potential risks of climate change on the Project. Further detail on the climate change risk assessment is provided in Technical Report 7 – Climate change risk.

The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 7 – Climate change risk.

11.10.1 Existing environment

Overview

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (Intergovernmental Panel on Climate Change, 2023) states with a high confidence that Australia is already experiencing impacts from climate change. This includes a greater frequency and severity of extreme weather events, an increase in the number of extreme heat days, a decrease in the number of extreme cold days, and increases in global GHG concentrations.

The Project would be increasingly exposed to numerous climate hazards as a result of climate change. Transport infrastructure in Canberra is currently the most vulnerable to bushfires compared to other natural hazards such as flooding, extreme heat, and extreme storms (AECOM, 2022). In addition to bushfires, by 2090, flooding, drought, extratropical storms, and extreme temperatures are all recognised as high concern hazards with respect to infrastructure and the built environment. The ACT Climate Change Risk Assessment (AECOM, 2022) also identifies key risks within the built environment domain for hazards of higher average temperatures, more extreme heat days, a decrease in average rainfall, an increase in extreme rainfall and flooding and more severe bushfires.

Local climate context

Canberra's climate is variable due to its diverse topography and inland location. The northern areas are relatively dry and warm, while the southern regions are cooler due to higher elevations. The average annual temperature is 16°C, with summer temperatures ranging from 20 to 22°C and winter temperatures from 12 to 14°C. The region currently experiences fewer than 10 days per year exceeding 35°C. Since 1950, temperatures have been rising, particularly in the last 20 years. Notably, the hottest days on record have occurred since 2019, indicating more frequent heatwaves (Australian Government Bureau of Meteorology, 2024).

Rainfall is relatively consistent during the year, averaging 400 to 800 mm annually. However, the early 2000s saw lower rainfall due to the millennium drought. Recent years have alternated between La Niña (characterised by heavy rainfall and flooding) and El Niño conditions (characterised by hotter, drier conditions) (Australian Government Bureau of Meteorology, 2024).

Bushfire risk in Canberra is influenced by fuel availability, dryness, weather conditions, and ignition sources. The Forest Fire Danger Index (FFDI) indicates low to moderate fire weather on average, with Canberra experiencing approximately 1.1 severe fire weather days annually (ACT Government, 2014).

Historically (since 2017), Canberra has experienced numerous extreme weather events including: extreme rainfall, droughts, extreme storms, bushfires, and extreme heat.

Bushfire prone land, flood prone areas (for 1 in 100 year flood events), and areas where there is a greater level of urban heat relative to surrounding areas reside within and nearby to the Project area.

Bushfire prone lane is identified in Section 11.13. Some sections of the light rail alignment would carry a direct risk from bushfire flames, particularly between the Inner South and Yarra Glen precincts, based on mapping sourced in March 2024 from ACTmapi. The Mitchell Depot is also adjacent to and partially within land mapped as bushfire prone, and may be vulnerable to risk from bushfire flames.

Flood assessments have been carried out (refer to Section 11.5) to describe and detail baseline flood risks for four catchments crossing the Project area – Acton, Capital Hill, Adelaide Avenue and Yarralumla Creek catchments as well as the Mitchell Depot site.

In regard to urban heat, the Project area would experience a relatively low variation in temperature between day and night-time.

Climate hazards

The key climate hazards that are identified in Canberra, which have the potential to impact the Project are:

- Average annual temperatures – projected to continue to increase, which could result in degradation of structures, pavements and track
- Extreme heat events – projected to increase in intensity and frequency, which could result in impacts to track, pavements and surfaces, as well as health and safety risks to both customers and staff
- Bushfires – projected to increase in intensity and frequency, which could result in interruptions to the light rail operations and damage to pavement, structures, surfaces and landscaping either directly through fire or indirectly through smoke
- Average annual rainfall and drought – projected to decrease the volume of average annual rainfall and to increase the length of droughts, which could result in increasing dust concentrations in the air, or soil subsidence, causing damage to pavement and structures
- Extreme rainfall and flooding – projected to increase in frequency and intensity, which could result in blockage of stormwater system, inundation of alignment, local roadways or evacuation routes, damage to nearby property, or interruptions to power supply
- Extreme storms – projected to increase in frequency and intensity, which could result in damage to bridges, structures, alignment, electrical infrastructure, and landscaping.

More details on how these hazards were identified, and their corresponding variables is included in Section 2 of Technical Report 7 – Climate change risk.

11.10.2 Potential impacts – construction

Risks to the Project during construction due to climate change are likely, based on observed events and projected trends. The potential impacts caused by climate change on construction of the Project could include delays to the construction schedule, delivery of supplies, and potential health and safety incidents of construction contractors.

Climate change risks related to Project construction that were rated as high or very high risk (prior to mitigation), are outlined in Table 11-59. These risks have only been considered at the 2045 time horizon, and not 2090, as construction works are anticipated to be complete by 2045.

Table 11-59 Summary of construction risks rated as high or very high for 2045

Hazard	Risk
Extreme rainfall and flooding	Extreme rainfall (including wind and hail) and flooding resulting in delays to construction schedules and cost impacts.
Extreme heat events	Extreme heat (days over 35°C) resulting in increased incidence of tools down and heat-related stress delays to construction, increasing schedules and cost impacts.

11.10.3 Potential impacts – operation

Based on previously observed climatic events and projected trends, operational risks to the Project have the potential to occur. These risks could include damage to associated infrastructure, the environment, as well as human health and safety concerns. The consequences of these risks may include physical damage, increased discharge of water, and the accelerated deterioration of assets. The increased frequency of extreme heat days, bushfire events and extreme rainfall events have already impacted infrastructure, and will continue to do so, in and around Canberra.

The climate change risk assessment identified 39 direct and indirect climate change risk statements that relate to the operation and maintenance of the Project. Each risk has been assigned a consequence criterion, and categorised as either an environmental, economic, or social risk. Consequence criteria were selected based on the highest potential consequence posed by the risk.

A profile of the risk ratings of the identified operational risks across 2045 and 2090 prior to the implementation of adaptation measures is presented on Figure 11-93. As demonstrated by Figure 11-93, the rating of risks tends to increase over time, with 2090 having more risks in the higher rating categories, compared with 2045.

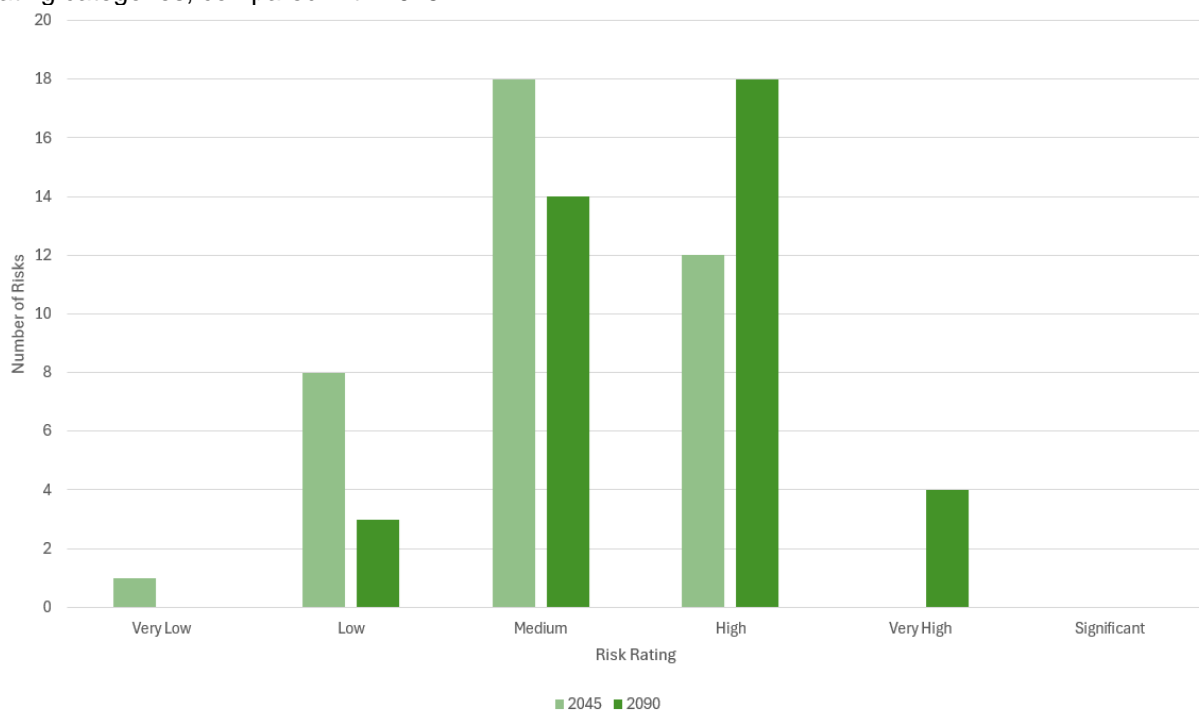


Figure 11-93 Risks ratings of operational risks across 2045 and 2090

Risks that were rated as high or very high prior to the implementation of adaptation measures are summarised in Table 11-60. The greatest number of high and very high risks are those associated with extreme flooding and rainfall, extreme storms, and average annual temperature increase.

During the early stages of Project operation, tree removal carried out during construction would result in some reduction in canopy cover, which has the potential to exacerbate urban heat island effect and further impact the local microclimate. As trees and landscaping delivered by the Project establish and mature, canopy cover would increase along the alignment, lowering the impact of urban heat island effect.

While the majority of the Project alignment would be within existing transport corridors, the Project would result in some increased areas of hardstand during both construction and operation, where grassed areas are replaced with concreted or hardstand areas. The incorporation of green track in the design has the potential to reduce the overall hardstand and as a result reduce the impact of urban heat island effect. Locations where embedded track (or potential ballast track) is proposed, such as sections of the alignment in the Inner South, Yarra Glen and Woden precincts, pose the highest potential increase to urban heat island effect. Further detail on the trackform proposed along different sections of the alignment is provided in Section 5.3 of Chapter 5 (Project description). Risks associated with heat events are also considered in Table 11-60.

Table 11-60 Summary of operation risks rated as high or very high across climate projection scenarios (2045 and 2090)

Hazard	Risk
Extreme rainfall and flooding	Exceeding the capacity of drainage infrastructure due to blockage from debris such as mulch or due to high volumes of water, leading to inundation and nuisance flooding of the track or light rail stop infrastructure and inundation of surrounding roads or buildings
	Disruption to standard evacuation procedures during an extreme rainfall event for people with mobility challenges or other disabilities (e.g. blind, deaf)
	Increased load on stormwater treatment and erosion and sediment control affecting water quality treatment levels leading to pollutant load impacts on biodiversity
	An increase in volume of runoff from catchment areas, increasing loads for Project drainage
	Inundation of the surrounding road and Light Rail network (e.g. Light Rail Stage 1) resulting in reduced access to the light rail corridor and stops (e.g. emergency services, maintenance workers)
Extreme storms	Damage to rail-critical communications (e.g. traffic signals) and other electrical systems due to high winds, lightning, debris, fallen branches/ trees, etc. resulting in service disruptions and increased operational costs
	Damage to light rail bridges, track and other connections (e.g. cycleway, pedestrian, road) resulting in service delay, limited access to light rail stops and potential safety impacts (e.g. transit users and staff)
	Health and safety risks for customers and staff (such as maintenance workers) and during extreme storm and wind events (e.g. risk of slips, trips and falls; risk of being stuck by hail/debris; risks posed by damaged infrastructure such as stop furniture/roofing)
	Disruption to standard evacuation procedures during a storm event for people with mobility challenges or other disabilities (e.g. blind, deaf)
	Damage to the surrounding road and rail network due to debris, fallen branches, etc. resulting in reduced access to light rail corridor and stops
Extreme heat events	Potential for track buckling, and subsequent reduced operating speeds and service disruptions (e.g. potential derailment)
	Health and safety risks for customers and staff during periods of extreme heat (e.g. heat stress, dehydration, hospitalisation)
	Disruption to the local electricity network (blackout/brownout due to heat and/or increased demand for electricity) resulting in loss of power to project infrastructure and subsequent service delays

Hazard	Risk
Average annual temperature increase	Reduced efficiency and/or heat related damage resulting in failure of project electrical infrastructure (e.g. signalling, telecommunications as well as the LRVs) and subsequent disruption to service, increased maintenance costs and safety risk
	Adverse impacts to plant species (e.g. wilting of plants), resulting in increased landscaping costs and exacerbate erosional issues
	Increased risk of chemical, fuel or other flammable liquid (e.g. battery, maintenance materials) combusting due to high heat damaging infrastructure/LRVs or safety risks to customers and staff
	Deterioration and failure of the green track proposed along sections of the light rail corridor due to lack of water availability and limited irrigation, resulting in a failure of the plant material
	An increased power load to bring LRVs to a comfortable temperature on start-up, potentially damaging electrical infrastructure (or resulting in reduced operating efficiency)
Bushfires	Damage to LRV HVAC units due to bushfire smoke or dust necessitating more frequent maintenance and repairs
	Damage to trackside infrastructure (e.g. signals, telecommunications, stops) from fire, ash, embers or smoke requiring increased operational/ maintenance costs and resulting in service delays
	Damage to power supply infrastructure or need to cut supply, leading to power interruptions with increased frequency and duration – limiting the ability of the LRVs to operate
	Pedestrians, cyclists and other individuals using the light rail corridor as an evacuation route and/or running across at non-safe locations (e.g. mid-block) during a bushfire, increasing the risk of LRV strikes
Average annual rainfall changes	Decreased availability of water during periods of drought negatively impacting on landscaped areas (particularly in areas where green track is proposed) and vulnerable species

11.10.4 Climate change adaptation actions

Key to managing climate change risk is the identification and implementation of adaptation actions to address highly probable and consequential natural disaster risks through design, construction, and operation (including maintenance). Climate change adaptation actions are identified in Section 6.2 of Technical Report 7 – Climate change risk.

A residual risk assessment was prepared to re-evaluate climate change risks to estimate the residual risk levels after adaptation actions are implemented. A residual risk rating was provided, which assumes all identified adaptation actions are implemented at the relevant Project period.

At the 2045 time horizon, the application of identified adaptation actions within design, construction and operation would result in the following residual risks:

- No very high or high risks
- 26 medium risks
- One low risk
- One very low risk.

At the 2090 time horizon, these residual risks represent:

- No very high risks
- 11 high risks
- 24 medium risks

- Four low risks.

Ongoing design development of the Project would involve continuing to review the adaptation measures, and consideration of additional treatment options to improve the response of the Project to climate change risk.

11.10.5 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures for climate change risk and potential greenhouse gas impacts, that are applicable to the Project as a whole.

11.11 Greenhouse gas generation

This section provides an assessment of the potential greenhouse gas (GHG) impacts associated with the construction and operation (including maintenance) of the Project. Further detail on the GHG assessment is provided in Technical Report 8 – Greenhouse gas.

The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 8 – Greenhouse gas.

The Project would have both direct and indirect GHG emissions. Direct emissions would be produced from activities controlled by the Project, such as construction activities. Indirect emissions would be generated in the wider economy as a result of the Project, such as goods and services required to facilitate the Project, and electricity consumption from the grid. However, due to ACT's electricity grid being 100% renewable, the indirect GHG emissions generated from electricity consumption would be zero.

GHG emissions are categorised into three scopes based on the source of the emissions. Figure 11-94 provides an overview of the scopes used to estimate GHG emissions for the Project.

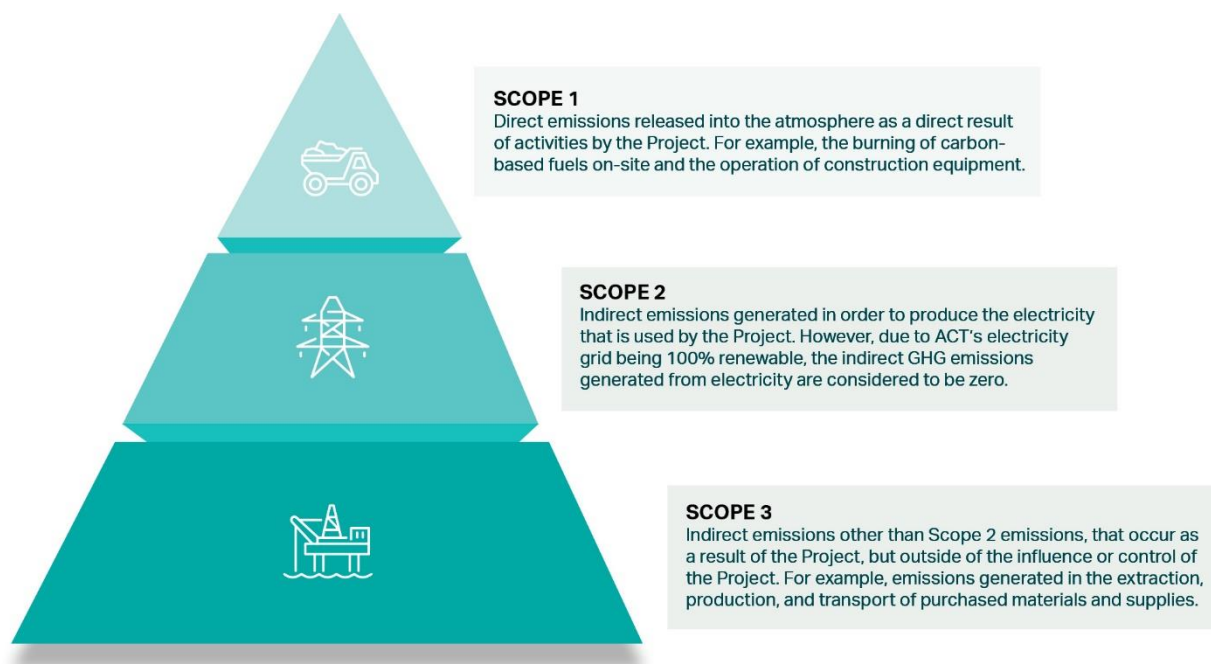


Figure 11-94 Summary of Scope 1, 2, and 3 greenhouse gas emissions

11.11.1 Potential impacts – construction

This section details the estimated quantities of GHG emissions for the Project during construction. The potential sources of GHG emissions during construction of the Project are provided in Table 11-61.

Table 11-61 Construction sources included in the GHG emissions inventory

Source	Sub parameter	Details
Fuel Combustion	Stationary plant equipment	Scope 1 emissions from diesel fuel combustion during use of diesel generators, air compressors, and light-emitting diode (LED) lighting towers.
	Mobile plant and equipment	Scope 1 emissions from operation of mobile plant and equipment within the Project area. The mobile plant and equipment list has been based on draft construction program estimates.
	Workforce vehicles	Scope 1 and Scope 3 emissions from fuel combustion from light vehicles traveling to and from, and within the Project area based on monthly day and night-time averages. The vehicle fleet mix has been assumed to include light commercial vehicles, diesel, petrol, and hybrid cars.
	Construction vehicles	Scope 1 emissions for diesel emissions associated with onsite construction vehicle movements within the Project area.
	Traffic control	Scope 1 emissions for diesel emissions associated with onsite construction vehicles within the Project area.
	Domestic deliveries	Scope 1 and Scope 3 emissions from fuel combustion associated with domestic deliveries travelling to and from, and within the Project area. Deliveries have been based on: <ul style="list-style-type: none"> Construction material volumes for ready mix concrete, culverts and drainage, steel, copper, aluminium, aggregate, timber, glass, granite pavement, cobble, soil, and asphalt. Deliveries for precast concrete transported by Jinker trucks Deliveries required for cranes and associated other construction equipment.
	International deliveries	Scope 3 emissions associated with international shipping and road transport activities associated with assumed import of LRVs from Spain and rail steel from Austria.
	Waste transport	Scope 1 and Scope 3 emissions associated with waste transport activities travelling to and from, and within the Project area including transport of: <ul style="list-style-type: none"> Construction waste including from earthworks, and construction and demolition waste Waste generated at construction compound sites and within individual precincts Vacuum trucks used for utility services and civil works.
Land use changes	Vegetation clearing	Scope 1 emissions from loss of a carbon sink associated with vegetation removal (including tree removal and clearing of grassed areas).
	Replanting vegetation	Scope 1 new carbon sink provision associated with replanting of street trees and installation of green track.
Power consumption	Electrical consumption	Scope 2 emissions from electricity used to power construction compounds, including from compound buildings, flood and security lighting, and closed circuit television (CCTV) operation.
Waste	Construction and demolition waste	Scope 3 emissions from earthworks spoil volumes and total estimates of construction and demolition waste including inert construction material, timber and other green waste, and solid general waste.

Source	Sub parameter	Details
Embodied energy	Construction materials	Scope 3 emissions from construction materials have been estimated for core building components for the Project such as trackform, rails and over-head wires, stops, bridges, retaining walls, road pavement and kerbing, drainage, substations, and construction compounds. Key construction materials would include concrete, culverts and drainage, steel, copper, aluminium, aggregate, timber, glass, granite pavement, cobble, and asphalt.
	LRVs and batteries	Scope 3 emissions have been estimated for new LRVs. Embodied energy estimates have included steel quantities required for each vehicle and lithium ferro-phosphate batteries

Table 11-62 summarises the estimated GHG emissions from construction of each alignment option for the Project. Estimated GHG emissions have been based on construction activities as described in Chapter 6 (Construction). GHG emission estimates are representative of the current stage of Project design development and would be subject to refinement through ongoing design development and construction planning. Due to data limitations, it is not feasible to accurately quantify all potential sources of GHG emissions, and as such the data provided in Table 11-62 has been rounded up.

Table 11-62 Summary of indicative construction GHG emissions for the Project

Scope	Parameter	State Circle East alignment option		National Triangle-Barton alignment option	
		Total (t CO ₂ -e)	Contribution (%)	Total (t CO ₂ -e)	Contribution (%)
Scope 1 emissions	Fuel combustion	17,550	17.1	21,500	21.9
	Trees and vegetation removed	4,800	4.7	4,650	4.8
	Trees and vegetation planted	-2,350	-2.3	-2,650	-2.7
Scope 2 emissions	Electricity	0	0	0	0
Scope 3 emissions	Fuel combustion	13,850	13.5	16,200	16.5
	Waste	15,600	15.2	15,600	15.7
	Embodied energy	53,150	51.8	43,100	43.3
Total emissions		102,600	100	98,400	100

Most Scope 1 emissions would be attributed to fuel combustion. The highest contribution to Scope 3 emissions would be the embodied energy from construction materials.

In 2023 Australia's total GHG emissions were 467 mega tonnes (Mt) CO₂^e (Climate change Authority, 2023) with ACT contributing 1.6 Mt CO₂^e (ACT Government, 2023). GHG emissions that would be generated by the Project in a single construction year would be around 0.005% of Australia's total annual emissions for each alignment option. When compared to the ACT's contribution this would equate to 1.6% of the ACT's total annual emissions for the State Circle East alignment option and 1.5% of the ACT's total annual emissions for the National Triangle-Barton alignment option.

11.11.2 Potential impacts – operation

This section details the estimated quantities of GHG generated from operational activities (including maintenance) for the Project. The sources of GHG emissions during operation and maintenance of the Project are provided in Table 11-63.

Table 11-63 Operational sources included in the GHG emissions inventory

Source	Sub parameter	Details
Fuel Combustion	Street sweeping	Scope 1 emissions from diesel fuel combustion associated with street sweeping for maintenance of track.
	Mitchell Depot operations	Scope 1 emissions from diesel fuel combustion from operation of additional vehicles required for the Project at the Mitchell Depot. This would include additional utility vehicles and a mower.
	Major maintenance replacement works	Scope 1 emissions from diesel fuel combustion from construction activities associated with major preventative and reparative works including full and/or partial replacement of asphalt at traction power substations, culverts and drainage, pavement and partial concrete replacement of retailing walls, stop platforms, track slabs, over-head wire foundations, and bridge and deck approaches.
	Domestic deliveries	Scope 3 emissions from diesel fuel combustion associated with delivery of construction materials required for major maintenance reparative works including for asphalt, stone pavements, concrete replacement and associated steel reinforcement, and reinforced concrete pipes.
	International deliveries	Scope 3 emissions associated with international shipping and port transfers associated with assumed import of LRVs from Spain. A single replacement of the entire new LRV fleet has been assumed.
Power consumption	Signalling	Scope 2 emissions from signalling has been estimated for traffic, pedestrian, and light rail signals.
	Stop lighting	Scope 2 emissions for lighting at stops for both side and island platforms including statutory and accent lighting.
	Street lighting	Scope 2 emissions for street lighting using a combination of 150W and 100W LED lighting.
	LRVs	Scope 2 emissions from energy use for charging LRV batteries, based on energy reduction rates from the onboard energy storage system both north and southbound between Commonwealth Avenue and Hopetoun Circuit. Energy usage from LRVs using over-head wiring has also been estimated.
Embodied energy	Major maintenance replacement works	Scope 3 emissions have been estimated for embodied energy in construction materials required for major maintenance reparative works including for asphalt, stone pavements, concrete replacement and associated steel reinforcement, track and reinforced concrete pipes.
	LRV vehicle and battery replacement	Scope 3 emissions have been estimated based on the quantity of steel required to replace the entire new fleet of LRVs once over the design life of the Project and replacement of lithium ferro-phosphate batteries within the new fleet every seven years equating to seven replacements over the asset life.

Table 11-64 summarises the estimated GHG emissions from operational activities for each alignment option. Estimated quantities of GHG emissions for operational activities have been calculated and reported based on an assumed Project design life of 50 years. Operational GHG emissions would include Scope 1 and Scope 2 emissions. Scope 1 emissions would include fuel combustion from operational and maintenance vehicles at and deployed from the Mitchell Depot and street sweeping. Scope 2 emissions would include those from energy consumption associated with street and stop lighting, signalling, as well as operation of the light rail including both charging of lithium ferro-phosphate batteries and from over-head wires.

Table 11-64 Summary of indicative operational GHG emissions for the Project

Scope	Parameter	State Circle East alignment option		National Triangle-Barton alignment option	
		Annual (t CO ₂ -e)	Design life (t CO ₂ -e)	Annual (t CO ₂ -e)	Design life (t CO ₂ -e)
Scope 1 emissions	Fuel combustion	22	1,100	23	1,150
Scope 2 emissions	Mains electricity consumption	0	0	0	0
Total emissions		22	1,100	23	1,150

Table 11-65 provides an estimate of Scope 1 and Scope 3 greenhouse gas emissions for major preventative maintenance activities and reparative works estimated over the design life for the Project, including estimates of embodied emissions from materials. For the purposes of the greenhouse gas assessment a design life of 50 years has been assumed, although some components of the Project (such as bridges) would have a longer design life, as described in Section 6.1 of Chapter 6 (Construction).

Major preventative maintenance activities have been limited to key materials identified for construction works based on preliminary design estimates including for concrete and asphalt, as well as replacement of LRVs and LRV lithium ferro-phosphate batteries.

Due to ACT's electricity grid being 100% renewable, the indirect GHG emissions generated from electricity would be zero.

Scope 1 and 3 emissions estimates for the alignment options are comparatively similar and would be approximately 0.1% of the ACT's emissions for the 2022-2023 reporting year (Environment, Planning and Sustainable Development Directorate, 2023).

Table 11-65 Summary of indicative major maintenance and replacement works GHG emissions for the Project

Scope	Parameter	State Circle East alignment option	National Triangle-Barton alignment option
		Design life (t CO ₂ -e)	Design life (t CO ₂ -e)
Scope 1 emissions	Fuel combustion	550	350
Scope 3 emissions	Fuel combustion	150	150
	Embodied energy	5,250	5,300
Total emissions		5,950	5,800

The Project has the potential to encourage a modal transport shift, decreasing the number of more carbon intensive road vehicles trips and increasing the uptake in lower emission public transport trips. The beneficial impacts associated with increased public transport patronage could potentially include a reduction in road vehicle emissions on the surrounding road network, with an estimated reduction in GHG emissions of between 2,900 and 5,300 tonnes annually as a result of the Project. The Project would also support longer term priorities established by the *ACT Climate Strategy 2019-2025* by improving public transport, providing a more extensive Light Rail network and through adaptive use of existing roads to better support more sustainable transport modes.

11.11.3 Management and mitigation measures

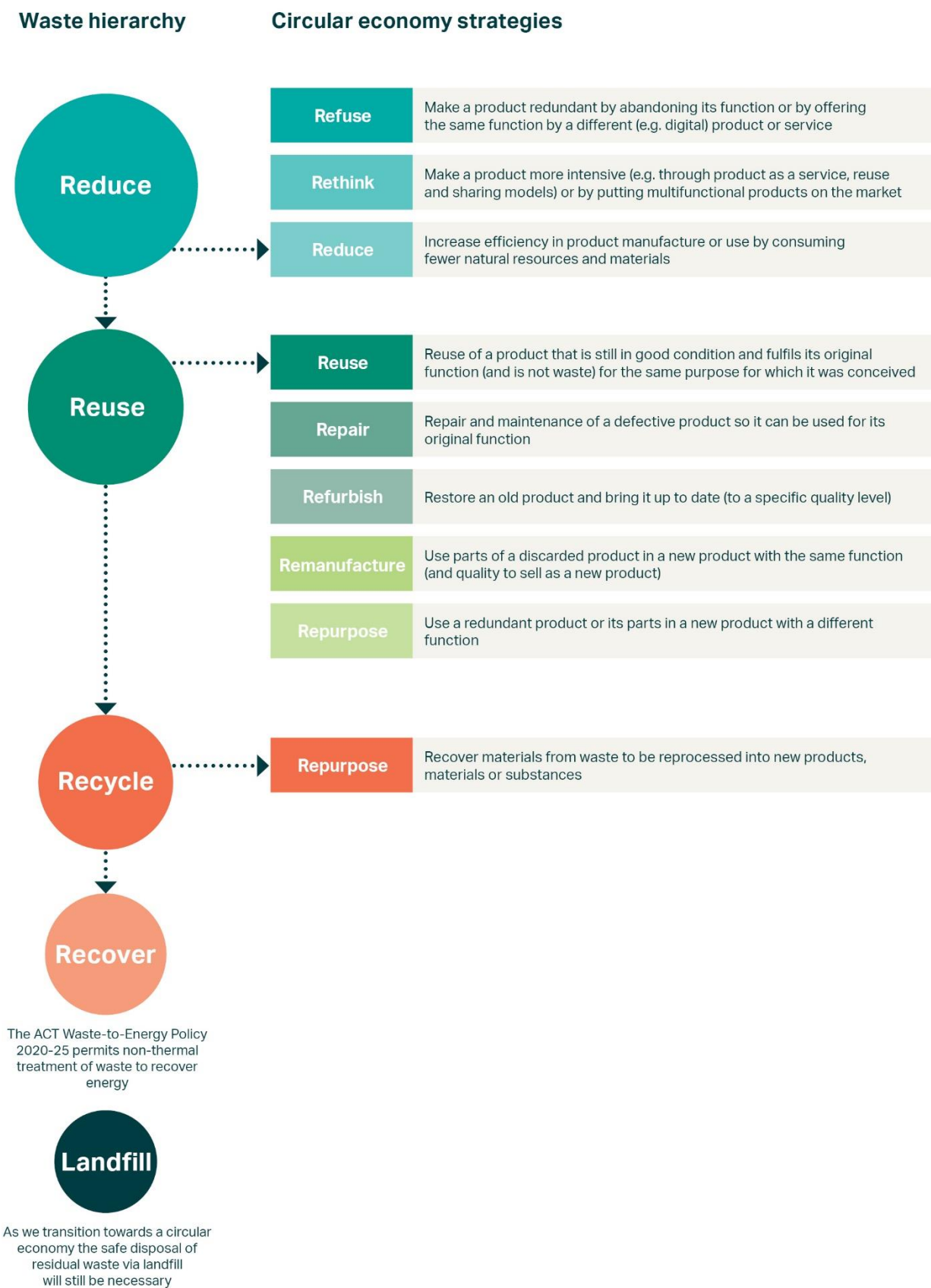
Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage greenhouse gas related impacts, that are applicable to the Project as a whole.

11.12 Materials, waste, and resources

This section provides an overview and assessment of the potential waste and resource use impacts associated with the construction and operation of the Project. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies).

The resourcing of labour (including a construction workforce) for the Project is discussed in Chapter 6 (Construction) and socioeconomic implications of resourcing construction labour are considered in Section 11.7. Labour as a resource is therefore not considered further in this section.

To support effective planning for waste avoidance and reduction, and to enable responsible management of unavoidable waste, it is important to identify various types of waste and materials early in the Project development phase. Proper management of wastes and materials is necessary to prevent soil and water contamination, as well as the generation of leachate, odours, and dust. This would be managed by both the circular economy hierarchy and waste hierarchy's approach of avoidance, reuse then disposal (refer to Figure 11-95). Appropriate waste management would also help reduce the long term costs associated with contamination and waste disposal. Additionally, the management of resources is necessary to ensure efficient and sustainable utilisation and waste minimisation.



The Project commits to addressing waste management in accordance with the *ACT Waste Management Strategy 2011-2025* (Environment, Planning and Sustainable Development Directorate, 2011), through the identification of opportunities to:

- Reduce pressure on raw materials supply through the reuse and recycling of material
- Provide waste facilities, regular cleaning, and maintenance services during operation of the Project to assist in the cleanliness of stops, LRVs and other Project infrastructure
- Ensure Canberra remains a clean, safe place to live and enjoy by reducing litter, managing hazardous waste in accordance with current regulatory requirements and disposal to a licenced waste management facility as a last resort only. This includes identification of options for avoiding, mitigating, and managing major waste streams in accordance with the waste hierarchy outlined in the *ACT Waste Management Strategy*, which is as follows:
 1. Reduce waste generation
 2. Reuse goods and materials
 3. Recycle material into new products
 4. Recover energy from suitable sorted materials
 5. Landfill – residual waste to protect human health and the environment.

The three circular economy principles presented in the *ACT Circular Economy Strategy 2023-2025* (Transport Canberra and City Services, 2023) have also been considered by the Project, including designing to avoid waste and pollution where possible, keeping products and materials in use, and avoiding negative impacts to the environment and regenerating natural systems.

11.12.1 Potential impacts – construction

Potential impacts during construction would relate to:

- Construction resource use, including construction materials, water, and energy
- Construction waste generation and management, including:
 - Generation of waste requiring offsite disposal to landfill
 - Generation of excess spoil requiring offsite disposal, including to landfill
 - Uncontrolled waste leaving the Project area, including litter.

These potential impacts and the approach to managing them are considered in the following sections.

Construction resource use

Construction materials

Based on Project design development to date, it is expected that the greatest quantities of construction materials would include:

- Concrete (such as premix concrete and precast concrete pipes and conduits): indicatively, up to around 115,000 tonnes
- Aggregates and asphalt (such as quarried materials, road sub-base and structural fill): indicatively, up to around 185,000 tonnes
- Metals (such as steel rails, structural steel, steel reinforcement, over-head wiring, prefabricated steel furniture and signage): indicatively, up to around 11,000 tonnes.

Other materials that are likely to be required for construction of the Project would include:

- Timber/plywood
- Structural fill
- Paving pavement finishes
- Polyvinyl chloride (PVC) conduit

- High density polyethylene materials
- Diesel
- Lubricating oil
- Prefabricated items such as railings, stop infrastructure, LRV components.

Current estimated quantities of construction materials are indicative for the purposes of identifying appropriate management strategies, based on the level of Project design at the time of preparing this EIS. Construction material requirements and more precise quantities would be confirmed during design development and construction planning. The management and mitigation measures in Chapter 21 (Environmental management and mitigation measures) have been identified considering this early stage of design, and are adaptable and scalable.

The Project would prioritise reuse of onsite materials, and avoid the need to access quarry materials where possible, however specific resource requirements (including the need to access quarry materials) would be confirmed through detailed design development and construction planning.

The scale of the Project could apply pressure on the availability and supply of construction materials within the region if resource use is not appropriately planned and managed. This pressure may be compounded by other concurrent developments in the region, which may also require general construction materials such as concrete, asphalt, and steel. Construction materials that would be sourced internationally, such as LRV components, are not expected to experience the same pressures, given the scale of the international market and the bespoke nature of procuring those materials for the Project.

Ongoing design development and construction planning for the Project is proceeding with the aim of minimising resource consumption, particularly the need for new materials, and avoiding the generation of waste and pollution as far as practicable. Subject to design development, this could include the use of glass fibre reinforced polymer where possible as a replacement for traditional steel reinforcement, and through the use of geofabrics with recycled material content. Products and materials would be reused and recycled where appropriate and practical (e.g., from demolition, clearing and grubbing, road resurfacing works and excavation). Examples of proposed waste reduction, reuse, and recycling measures are provided in following sections (refer to Table 11-66).

Overall, while construction could increase short to medium term demands on locally and regionally sourced materials, these demands could be adequately managed through careful construction planning, procurement, and resource management. Commitments to minimising resource consumption and optimising reuse and recycling opportunities within the Project would further reduce the Project's impacts on construction material supplies and availability.

Other resources used in construction

In addition to the materials described above, other key resources that would be used for construction activities include water and energy.

The use of water during construction would be required for (but not limited to) dust suppression, road pavement works, including compaction of pavement, site office and amenities, concrete construction, cutting equipment such as concrete cutters, and the establishment of landscaping during construction.

Water supply sources and efficiencies in water use and management would continue to be investigated during design development and construction planning. Specific measures to avoid and minimise water consumption, particularly of potable water, would be investigated and included in construction planning.

The construction of the Project would require the use of energy for a number of construction activities. Fuel would be used for plant (such as cranes and excavators), vehicles (such as trucks and staff vehicles), equipment and generators. Electricity would be required at the construction compounds and worksites. Electricity used during construction of the Project would be from the ACT's 100% renewable energy network. Section 11.11 (Greenhouse gas generation) provides further detail on anticipated energy consumption during construction and measures to manage this.

Construction waste generation and management

The construction of the Project would generate various waste streams that are described in Table 11-66. The approach to managing these waste streams, including measures to facilitate segregation of wastes to prevent cross contamination are described in Table 11-66.

All waste generated during construction would be managed in accordance with the *ACT Waste Management Strategy 2011-2025* (Environment, Planning and Sustainable Development Directorate, 2011) and the nine circular economy principles presented in the *ACT Circular Economy Strategy 2023-2025* (Transport Canberra and City Services, 2023).

Table 11-66 Waste anticipated to be generated during construction and associated management

Waste type	Description	Management
Demolition and general construction waste	Concrete, steel, asphalt, copper, liquid waste, bricks, pavers, timber and gravel plastic and cardboard packaging, and excess construction material (such as concrete, timber, plastic and steel/metal).	<p>Construction waste would be classified in accordance with the Assessment and Classification of Liquid and Non-Liquid wastes guideline (EPSDD, 2021) and directed to a waste management facility that is lawfully permitted to accept that type of waste.</p> <p>General construction waste would be managed in accordance with the waste hierarchy, as described in the ACT Circular Economy Strategy (Transport Canberra and City Services, 2023).</p> <p>Where practicable, waste would be segregated and stockpiled on site, with materials such as concrete, metals and asphalt separated and sent to a recycling facility. Other recyclable materials would be sent for recycling as a mixed waste stream.</p> <p>Opportunities for take back agreements in procurement would be identified (e.g. packaging and pallets etc).</p>
Green waste	Organic waste from grubbing and vegetation removal.	<p>As far as practicable, weed-free green waste would be chipped, mulched and reused on site, transferred to another site where it is lawfully permitted to be accepted, or collected by an authorised contractor and recycled off site.</p> <p>Otherwise, green waste would be collected by an authorised contractor, and composted off site at an appropriately licensed facility.</p> <p>Weeds would be handled in accordance with relevant guidelines/requirements.</p>
Liquid waste	Wastewater being generated from water used in earthworks, groundwater ingress, rainfall runoff and machinery washdown runoff.	Wastewater, sewage and grey water would be disposed to sewer or transported to an appropriately licensed liquid waste treatment facility. Temporary dewatering of excavations may be required during construction to provide safe working conditions, and would be discharged in compliance with relevant water quality objectives (refer further to Chapter 21 (Environmental management and mitigation measures)).
Dangerous goods and hazardous substances	Waste oils and lubricants, excess corrosive substances (e.g., paints, chemicals and cement washout), asbestos containing material (from demolition), and contaminated soil material (e.g., in the event of an accidental spill).	All handling and disposal of dangerous goods and hazardous substances would be carried out by appropriately qualified and licensed contractors in accordance with the <i>Environment Protection Regulation 2005</i> and other relevant guidelines and disposed of at an appropriately licensed facility.

Waste type	Description	Management
Domestic and office waste	Food scraps, glass and plastic bottles, cardboard/paper and plastic containers from site personnel. Paper, e-waste, plastics, food-waste, printing products and office equipment.	<p>Recyclable materials such as paper, cardboard, plastics, glass, ferrous and nonferrous containers would be stored at recycling bins for collection by an authorised contractor, and recycled off site, where feasible.</p> <p>Food organics would be stored in food or food and garden organics bins for collection by an authorised contractor, and composted off site at an appropriately licensed facility, where feasible.</p> <p>Where recycling is not feasible, waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for disposal off site at a licenced waste facility</p>
Spoil	<p>Excavated material and excess fill material including topsoil, contaminated spoil, and clean spoil.</p> <p>The indicative quantity of spoil required and how this would be managed by the Project is described further in the following sections.</p>	<p>In-situ testing of soils in areas of potential contamination concern would be undertaken to determine the appropriate waste classification, refer to Section 11.6 for further information. Where possible spoil would be reused within the Project area, if determined suitable. Subject to quality testing, excess spoil that is not used by the Project could also be directed for use in other projects requiring fill.</p> <p>Should spoil be found unsuitable for reuse or recycling, it would be disposed of, in accordance with ACT Environment Protection Authority (EPA) guidelines. Spoil generated from the construction of the Project would be transported to an appropriately licensed waste disposal or transfer facility. Potential environmental impacts related to stockpiling of materials is discussed further below.</p>

Potential impacts associated with the management, transport, and disposal of waste include:

- Waste being directed to landfill (rather than reused or recycled) due to the inadequate collection, classification, and disposal of materials
- Contamination of soil, surface, and/or groundwater from the inappropriate storage, transport, and disposal of liquid and solid wastes
- An increase in vermin from the incorrect storage, handling, and disposal of putrescible waste from construction sites
- Incorrect classification and/or disposal of waste, including the incorrect storage, handling, and disposal of contaminated spoil and other hazardous materials (for example, asbestos from building demolition)
- Excessive amounts of materials being ordered, resulting in a large amount of unused resources
- Lack of identification of feasible options for recycling or reuse of resources
- Human health risks due to handling of contaminated soils and hazardous materials
- Cross contamination of wastes due to improper segregation
- Waste build up from irregular or disrupted collections.

All waste generated during construction would be managed using circular economy principles and the waste hierarchy approach of avoidance (ACT Government, 2023). It is anticipated that regional waste facilities would have sufficient capacity to manage Project waste. Further detail on the management of spoil (as well as the management of other construction waste) is provided in Table 11-66. For details on estimated volume of cut and fill materials associated with the Project refer to Section 6.3.2 of Chapter 6 (Construction).

The Project would store waste and materials within the Project area in stockpiles. Project stockpiles would be managed to avoid:

- Soil contamination, particularly from hazardous substances, such as asbestos, lead or chemicals, which can leach into soil over time
- Air pollution from stockpiles that are not properly covered, so are disturbed during wind dispersal releasing dust and particulate matter into the air
- Health impacts on the public and construction workers from exposure to hazardous substances. In particular direct contact or inhalation of contaminants, which may contribute to health concerns, such as respiratory issues
- Odour from stagnant materials or water.

Stockpiles would be managed in accordance with standard construction practice and a Spoil and Waste Management Plan, which would include details of the containment, covering, and labelling of materials to prevent contamination and environmental degradation. Appendix L (Environmental Management Plan outline) includes further detail on proposed environmental management plans.

Stockpiles would also be monitored regularly to minimise impacts to the community and the environment. Stockpiles containing waste that cannot be reused would be managed and disposed of in accordance with EPA waste guidelines to minimise storage of waste within the Project area. It is considered unlikely that stockpiled waste and materials would result in impacts as described above.

There is the potential of the spread of waste (including litter) to adjoining areas, including open spaces, residential areas, and other sensitive receivers, such as waterways during demolition and construction should waste not be appropriately managed. The spread of waste can result in land and water contamination, as unmanaged waste can release chemicals and toxins. This can lead to the degradation of soil quality, local ecosystems, and water quality. There is also the potential for unmanaged waste to detract from the visual amenity of adjoining areas.

However, the spread of waste into adjoining areas is unlikely, as the Project would adhere to the waste management and mitigation measures. Waste would be stockpiled within construction compounds, and would be managed to prevent waste from moving offsite. Waste would be handled and transported to waste management facilities in accordance with the Spoil and Waste Management Plan to mitigate the spread of waste.

11.12.2 Potential impacts – operation

Operation resource use

The operation of the Project would involve the ongoing consumption of materials as part of maintenance and stabling activities, and ongoing refurbishment of infrastructure throughout the Project lifecycle. This would include replacement of LRVs and stop furniture, LRV maintenance materials (cleaning chemicals, oils, lubricants, and degreasers), traction sanding devices in LRVs, and asphalt and concrete for track maintenance. Efforts would be made to source recycled materials where possible.

An integrated approach to water management for the Project would be implemented to minimise the use of potable water for operation, maintenance and LRV cleaning activities at the Mitchell Depot. Measures to reduce potable water use include passive irrigation of landscaping that would reduce the amount of water “wasted” as stormwater, instead using this water to irrigate the Project landscape, and adopting Water Sensitive Urban Design (WSUD) features and principles into the design. With the addition of the green track in parts of the Project, irrigation would be a key source of water demand during operations. Opportunities would be explored to minimise the use of potable water for irrigation purposes.

The operation of the Project would require electricity for LRVs, stops, the stabling yard, maintenance hall and administration building at the Depot, lighting, and the operation of signalling equipment. While in the ACT, electricity is 100% renewable, efforts would be made to reduce energy usage where possible, to minimise demand on the grid.

Operational waste generation and management

The operation of the Project would generate various waste streams, which are described in Table 11-67. The proposed handling and management approach for each waste stream is also described in Table 11-67. It is anticipated that a relatively small quantity of waste would be generated by the Project once it is operational.

Table 11-67 Waste anticipated to be generated during operation

Waste generating activity	Description	Management approach
Maintenance and repair	Repairs and maintenance would require resources and materials such as fuel, oils, lubricants, paints, electrical components, plastics, steel, etc. Waste associated with the cleaning would occur daily, while repair and maintenance of light rail stops, LRVs, the alignment, ancillary infrastructure, and street furniture would be conducted as required.	Waste from maintenance activities would be collected and stored in designated waste storage areas, for collection by an authorised contractor for off-site disposal. Where feasible, any potentially hazardous waste would be stored separately in clearly labelled receptacles and disposed of in accordance with its waste classification. Existing waste management measures in place at the Mitchell Depot would continue to be applied as relevant.
Waste generated by staff and passengers	Food scraps, glass and plastic bottles, cardboard/paper and plastic containers from passengers and staff. Sewage from onsite staff toilets. It would also generate paper (ticketing).	Waste and recycle bins at light rail stops would be provided for use by the public. The LRVs and stops would be cleaned daily, with any litter collected either recycled or disposed at an appropriately licensed facility.

Waste generating activity	Description	Management approach
Landscaping	Green waste from vegetation and green track maintenance.	As far as practicable, weed-free green waste would be chipped, mulched, and reused on site, or collected by an authorised contractor and recycled off site. Weeds would be disposed of in accordance with relevant guidelines/requirements.
Liquid waste	The covered section between Commonwealth Avenue and State Circle may require intermittent dewatering due to potential seasonal groundwater rise and / or perched water ingress.	To manage discharge of water, it is proposed that water collected would be disposed into the sewer network under a trade waste agreement with Icon Water. Where groundwater ingress is not considered suitable for discharge into the sewer network, water would be treated through a water treatment plant, which would be built into the wall of the covered section at a low point. The requirement of this water treatment plan would be subject to further investigations during detailed design.

There is the potential of the spread of waste to adjoining areas, including open spaces, residential areas and other sensitive receivers, such as waterways during operation. As described above, the spread of waste can result in soil and water contamination as well as human health impacts from exposure. However, the spread of waste into adjoining areas is considered unlikely, as the Project would adhere to waste management and mitigation measures, and the operational Project is anticipated to create relatively minimal amounts of waste.

11.12.3 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage material, waste and resource-related impacts, that are applicable to the Project as a whole.

11.13 Hazards and risk

This section provides an assessment of the potential hazards and risks associated with the construction and operation of the Project. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies).

Constructing and operating major transport projects carries the inherent possibility of causing hazards and risks to public safety, worker health and safety, as well as the environment. Given the Project's urban context, the implementation of appropriate management measures would reduce the likelihood and severity of these hazards and risks to the local community and workers. Ongoing planning for safety during construction and operation would be carried out as part of design development, with this process to include analysis of potential construction and operational hazards. Safety planning would be carried out in accordance with the *Rail Safety National Law Act 2014* (ACT).

11.13.1 Existing environment

The existing environment of the Project encompasses roads, urban areas, recreational areas, and Lake Burley Griffin. There are inherent risks in the existing environment including:

- Potential for road accidents
- Potential for pedestrian/cyclist accidents
- Extreme weather

- Proximity to electricity services (such as high voltage power lines).

The Project has the potential to cause or be impacted by a range of hazards and risks during both construction and operation (including maintenance) due to changes to the current road conditions and introduction of new activity in the existing environment (for example construction activity or operational light rail infrastructure) along the Project alignment.

The implementation of appropriate management measures (described in Chapter 21 (Environmental management and mitigation measures)) would reduce the potential for these hazards to occur, or their severity.

11.13.2 Potential impacts – construction

Key potential hazards and risks during construction of the Project would be associated with:

- Worker health and safety, such as risk associated with heavy machinery and equipment use
- Environmental hazards, including the following:
 - On-site storage, use, and transport of dangerous goods and hazardous or contaminated materials, including chemicals and fuels
 - On-site handling and transport of contaminated soil and hazardous waste
- Risks to public safety and security, including unauthorised access to construction compounds, and risk to vulnerable road users (including pedestrians, cyclists, scooters, vehicles, and other road users) associated with use of heavy vehicles in urban environments
- Risks to utilities, including potential disruption or disconnection
- Bushfire risks to the Project, including hazards associated with demolition and construction activities that may pose a risk of starting and magnifying a bushfire.

These hazards and risks are typical of a major infrastructure project within an urban environment and would not affect the suitability of the Project area for construction of the Project. The identified hazards and risks would be readily managed through the implementation of the mitigation measures outlined in Chapter 21 (Environmental management and mitigation measures).

Worker health and safety

Worker health and safety hazards could arise during construction where inadequate hazard/risk identification, reporting and monitoring systems are not implemented and/or maintained. Hazards and risks to human health and safety that could occur during the construction include:

- Working near or over water, for example, over Lake Burley Griffin on Commonwealth Avenue creates a risk of drowning
- Using and storing heavy machinery and associated risk with vehicle-to-vehicle collisions, accidents with vehicles and people/equipment
- Working in confined spaces, such as the construction of the covered section between Commonwealth Avenue and State Circle
- Undertaking construction works close to pedestrian footpaths and sensitive community facilities (e.g. schools, childcare centres, age care facilities, and hospitals/medical centres)
- Undertaking construction works within or adjacent to major arterial and regional roads (such as, Adelaide Avenue, Commonwealth Avenue, Yarra Glen, and State Circle)
- Undertaking construction works in the vicinity of existing services and utilities (e.g. high voltage power lines and gas mains)
- Failure to shut down/isolate services and utilities proposed to be relocated as part of the Project (e.g. electricity cables and gas mains)
- Undertaking construction works close to existing buildings and vibration sensitive structures

- Encountering asbestos, contaminated land, and other potentially hazardous materials during construction (e.g. demolition of existing structures) and associated risks associated with the handling, stockpiling, storage, transporting, and disposal of such material
- Slips and trips from walking around site
- Fire hazards caused by explosions or electrocution
- Personnel struck by dropped or swinging loads or other objects
- Manual handling injuries and mobile plant interactions.

Risk to the environment

Risks to the environment have the potential to arise during construction and demolition from incidents involving the following:

- On-site storage, use, and transport of dangerous goods and hazardous materials, including chemicals and fuels
- On-site handling and transport of contaminated soil and hazardous waste.

Potentially dangerous goods and hazardous substances would be temporarily used, stored and transported during construction and demolition activities for the Project. These may include:

- Flammable gases (class 2 dangerous goods), such as liquefied petroleum gas (LPG), acetylene gas for welding and cutting, and pressurised aerosol paints
- Flammable and combustible liquids (class 3 dangerous goods and class C combustible liquids), such as petrol and diesel fuels, epoxy and resin based adhesives, oils, lubricants, grease, degreasers, and coolants
- Oxidising materials (class 5 dangerous goods) such as oxygen gas for welding and cutting
- Corrosive materials (class 8 dangerous goods) such as cleaning products, and pH-correction chemicals for water treatment and management
- Other environmentally hazardous materials (class 9 dangerous goods), such as bitumen
- Materials such as concrete, cement, and grout that may pose a risk to the environment if released.

Accidental leaks and spills during storage and handling of dangerous goods and other hazardous materials have the potential to impact the surrounding community and environment, resulting in an environmental incident (such as land or water contamination, or risks to human health). Some materials, particularly flammable and combustible materials, pose a risk of accidental fires and explosions if not appropriately managed, or providing additional fuel in the event of a fire starting outside the Project. The method of storage would vary depending on the materials but would include drums of various sizes, small and intermediate bulk containers, cylinders in racks, bags/pallets, and banded areas where appropriate.

The risk of an environmental incident associated with the on-site storage, use, and transport of chemicals, fuels, and materials would be managed through standard mitigation measures to be developed for the Project. These measures would include the storage and management of dangerous goods and other hazardous materials in accordance with the *Dangerous Substances Act 2004* (ACT) and relevant Australian Standards. Dangerous goods would be transported to and from construction compounds using the routes identified in Part B (Environmental impact assessment) of this EIS.

Areas of contamination may be encountered during construction where ground disturbance is required in the Project area. As described in Section 11.6, areas of environmental concerns within the Project area are identified in Parliament House and Woden precincts, as well as the Mitchell Depot site. Further areas of environmental concerns adjacent to the Project area are identified next to Commonwealth Avenue, Barton, Inner South, and Yarra Glen precincts. Hazardous materials (such as asbestos) may also be encountered when undertaking earthworks or demolition during construction. Exposure to these contaminants could cause potential incidents, including health and safety impacts on the community and workers through inhalation, incidental ingestion, direct contact, and or/impacts on the environment due to contamination of land. If exposure to hazardous materials occurs, the construction environmental

management plan will detail processes, responsibilities, and measures to manage potential environmental incidents.

Contaminated waste (such as asbestos containing material) would be removed and disposed of in accordance with the construction environmental management plan, relevant legislation, codes of practice and Australian Standards. Environmental, health, and safety impacts associated with potential exposure to contaminated and hazardous materials would be minimised through the measures outlined in HR1 of Chapter 21 (Environmental management and mitigation measures). Further information on contamination is provided in Section 11.6.

Risks to public safety and security

The Project would introduce elements such as construction equipment, machinery, and vehicles within the Project area. Unauthorised access to construction areas has the potential to result in serious injury or fatality. To manage this risk, live construction areas would be fenced off, and existing pedestrian arrangements would be re-arranged to avoid interactions between pedestrians and areas used for construction. All construction work would be isolated from the general public. The construction contractor would ensure that construction sites are secure at all times and would take actions to prevent entry by unauthorised persons.

The construction activities would generate additional heavy vehicle activity within the Project area and along the adjoining road network. This could increase the risk of collisions involving a heavy vehicle, given the urban environment and the high level of road users in the area. Risks to road user safety are assessed in Section 11.1 and would be minimised as far as practicable through full road closures, barriers between traffic and adjacent work, 40 km/h traffic environments, and the implementation of mitigation measures outlined in Chapter 21 (Environmental management and mitigation measures).

Additionally, some construction activities would occur close to highly secure buildings that may have inherent access restrictions, such as government buildings and embassies, particularly within the Parliament House, Barton, National Triangle, and Inner South precincts. The location of construction activities in proximity to these buildings may be inconsistent with existing access and security arrangements or may contribute to an increased need for security or access controls. iCBR has commenced engagement with the owners and occupiers of potentially high security locations and would continue this engagement during design development and construction planning to identify specific security requirements relevant to the Project, such that the security of these buildings is appropriately maintained. This may include workforce planning, inductions, training, selection of construction compound locations and construction vehicle parking, to avoid potential conflicts with security requirements of these secure facilities.

Risks to utilities

Utilities within the Project area may be affected as a result of the Project. This will be managed through the following approaches:

- Identifying utilities in the Project area (such as with dial before you dig searches, non-destructive digging and consultation with utility owners)
- Protecting the asset while works take place
- Minor modification or realignment
- Relocation
- Disconnection, or replacement if required.

The key utilities with potential to be impacted, and indicative proposed treatments, are outlined in Section 5.13 of Chapter 5 (Project description). All works affecting utilities would be carried out in consultation with the relevant utility provider. Suitable treatments would be verified in the process of design evolution and construction preparation in collaboration with the utility provider/asset owner, aligning with pertinent standards and criteria.

Construction activities have the potential to accidentally disrupt or disconnect utilities if not appropriately managed. This may include during utility protection, modification, and relocation activities themselves, through direct or indirect impacts during excavation or as a result of collision with plant and equipment in the case of aboveground services. Unintentional disruption or disconnection of utilities may affect

users who rely on those services, and in proximity to the utilities, may pose a risk to public and worker safety. These risks may include, localised flooding, biohazards associated with sewage, electrocution, and fires or explosions around gas and electricity infrastructure.

A utilities management plan would be prepared as part of the Construction Environmental Management Plan as outlined in Appendix L (Environmental Management Plan outline).

Construction planning would include utility identification, incident and contingency planning, and exclusion of the public from active construction sites. Potential impacts to utilities would be carefully planned and managed in consultation with the relevant utility providers to minimise the risk of unplanned disruptions or disconnections at each location.

Bushfire risks

Several factors can influence the spread of bushfire, including fuel or fuel load (i.e. living or dead vegetation that can sustain and spread fire), topography (including slope and aspect), vegetation, urbanisation, and weather conditions. The areas where the Project would overlap with land mapped as bushfire prone (including on Adelaide Avenue near Kent Street and the Mitchell Depot site) are generally urbanised. While there are some vegetated and grassed areas within the area, there are limited contiguous areas of dense vegetation that would be likely to sustain a major bushfire. The Project and supporting construction areas would also predominantly be located within existing road corridors, or paved areas.

A review of the ACTmapi (ACT Government, 2023d) identified that the following areas of the alignment are located within or near bushfire prone land, as shown on Figure 11-96 to Figure 11-99:

- Within the Project area in Mitchell (Figure 11-96)
- North-east of Capital Hill in Yarralumla (Figure 11-97)
- Within the Project area on Adelaide Avenue near Kent Street (Figure 11-98)
- The suburbs of Red Hill, Deakin, and Yarralumla (Figure 11-98)
- The eastern area of the intersection of Yarra Glen and Carruthers Street (Figure 11-99).

Impact of bushfires on the Project

Bushfires have the potential to pose the following risks to the Project, including:

- Reduced access to the Project during construction
- Safety risks for construction workers, related to heat stress, and smoke inhalation
- Stoppage of works during bushfire events, which would impact the construction program
- The potential for fires to damage construction elements, which would incur additional Project costs, as well as lengthen the construction program to replace lost materials.
- Storage of flammable materials onsite exacerbating or increasing spread of bushfires.

While the risk of a bushfire is low, a Bushfire Assessment Report will be prepared for the Project that will consider the bushfire attack level and identify protection measures and management responses to ensure safety of construction works, and to minimise potential impact to the Project. Further mitigation measures are outlined in Chapter 21 (Environmental management and mitigation measures).



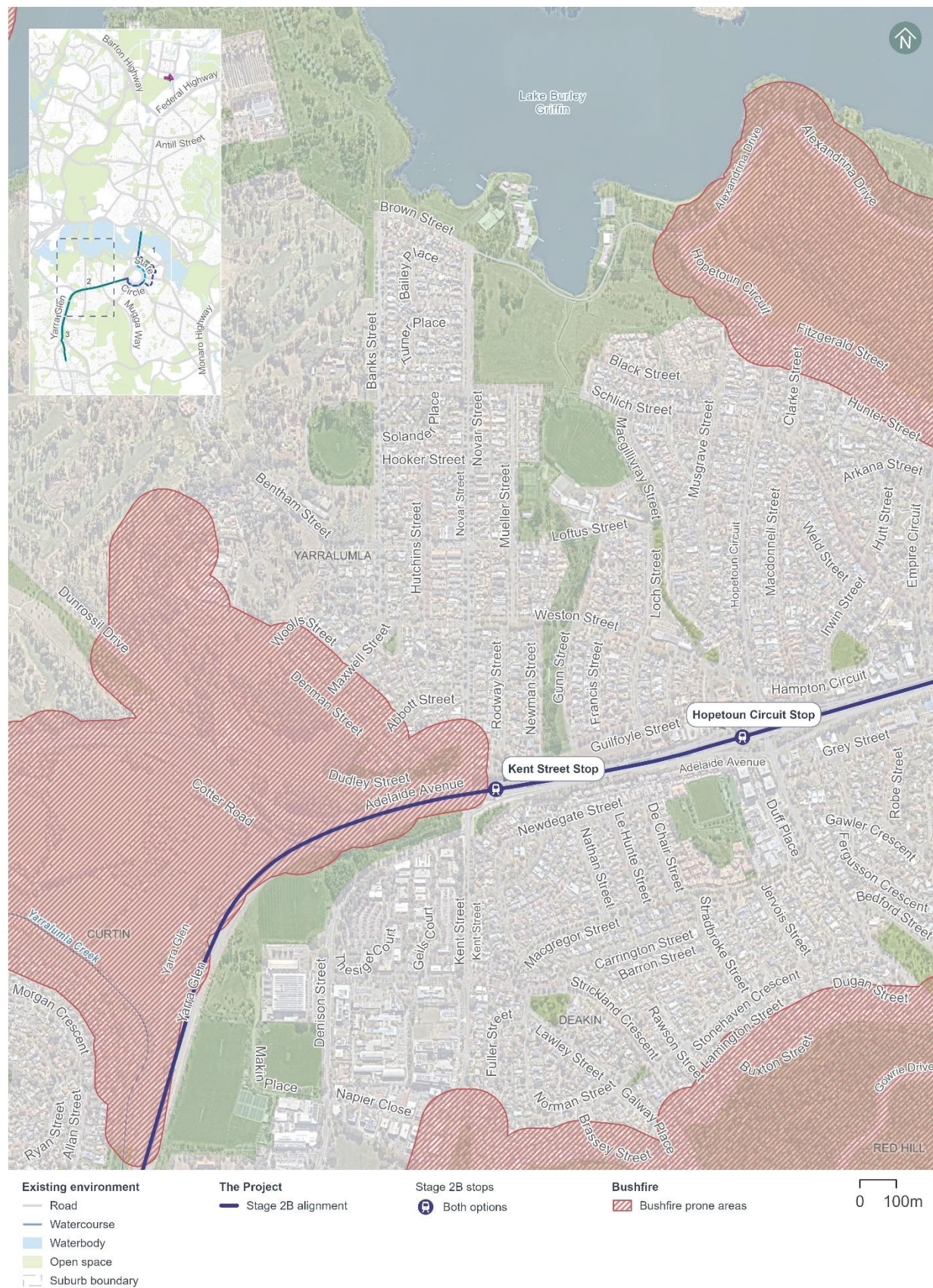


Figure 11-97 Bushfire prone land (2/4)



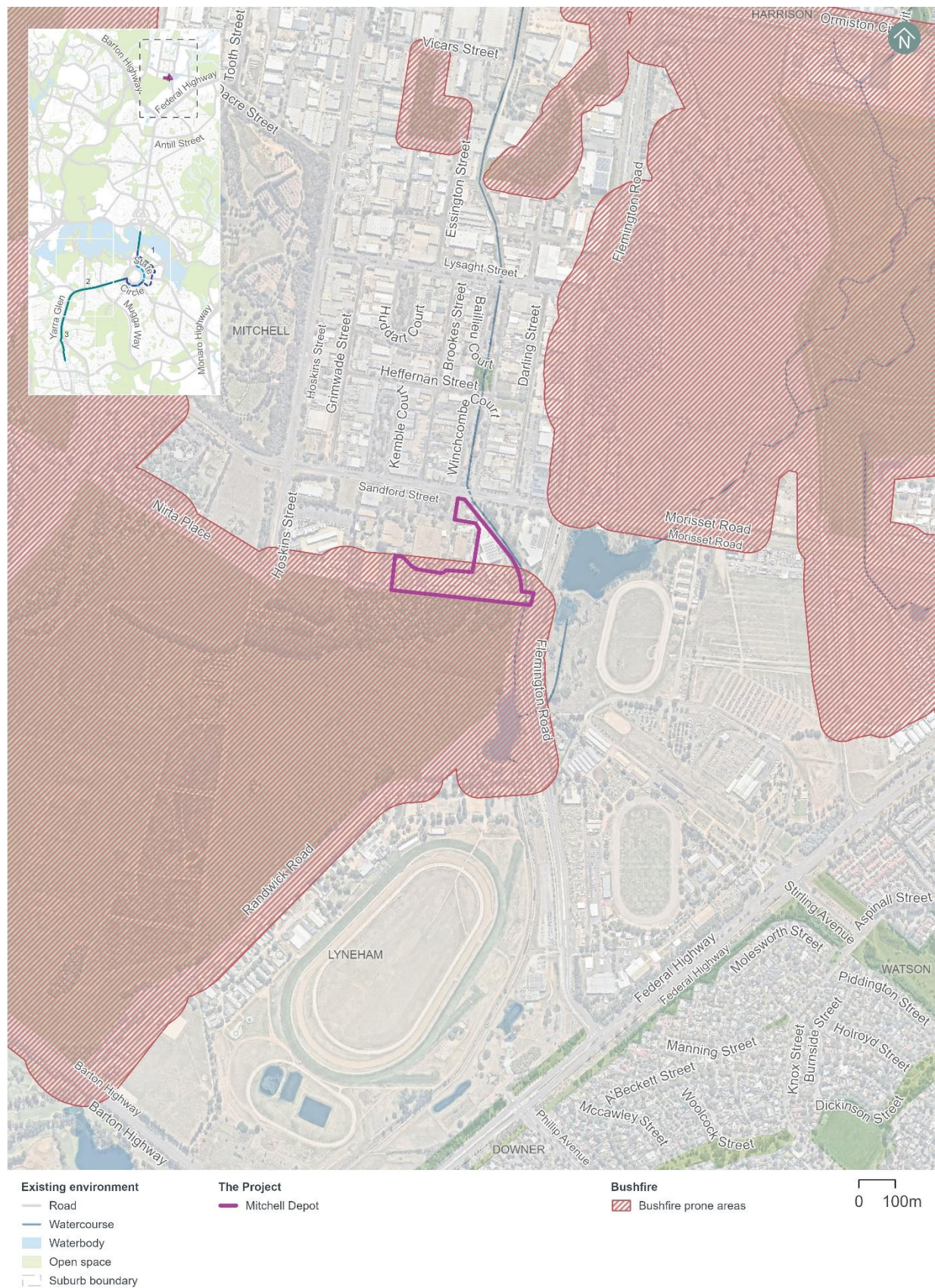


Figure 11-99 Bushfire prone land (4/4)

Impact of the Project on bushfire risks

Procedures would be in place for the Project to reduce the risk of construction works causing a bushfire. Prior to commencing works, all construction personnel would be inducted in bushfire protection measures and requirements, including the restriction of all hot works during Total Fire Ban Days, and days where a catastrophic fire danger has been declared. All construction vehicles and mobile plant would be fitted with fire extinguishers. Project works that may cause or worsen a bushfire during construction are listed below:

- Storage of landscaping materials (such as mulch)
- Hot works
- Chemical storage
- Use of heavy and light vehicles.

Overall, it is unlikely that the construction of the Project would cause a bushfire, given its location predominantly within paved areas and the bushfire management procedures that would be implemented during construction (refer to mitigation measure HR3 of Chapter 21 (Environmental management and mitigation measures)).

The Project's response to the climate change bushfire risks is discussed in Section 11.10.

11.13.3 Potential impacts – operation

Key potential hazards and risks during operation of the Project would be associated with:

- Risks to public safety and security, including unexpected operation (malfunction) of Project infrastructure
- Risks associated with electric and magnetic fields (EMF)
- Unexpected malfunctioning of the system
- Bushfire risks.

Risks to public safety and security

Operating LRVs would result in the potential for public safety and security risks, including the potential for accidental damage associated with the collision of LRVs with pedestrians, motor vehicles (including cars, trucks, and buses), or cyclists. These risks are inherent in the operation of a road network shared by different users, and the interface between the shared network and active transport infrastructure used by pedestrians and cyclists. Risks to public safety and security already exist on the shared road network, without the presence LRVs.

For most of the alignment, LRVs would operate within road medians and inner verges, separate from traffic lanes. At intersections, the movement of road vehicles, pedestrians, cyclists, and LRVs would be directed by traffic light signals.

To manage the risk of accidental damage and potential collisions with LRVs with road users, the operator's management system would include a comprehensive risk and safety management strategy, unexpected finds protocol, and incident and emergency response plans. LRV drivers would be trained to give due consideration to traffic flow, pedestrian movements, assessing LRV speeds and braking requirements against their perceptions of actual or potential hazards.

Hazards associated with the movement of LRVs through the existing road network areas with high pedestrian activities have been successfully managed on the existing Light Rail network in Canberra. Further to this, ongoing design development would be subject to detailed safety reviews to identify requirements for mitigation to manage and reduce the risk of incidents arising from collisions.

The Project proposes over-head wiring within the Inner South, Yarra Glen, and Woden precincts. Poles would be erected along the light rail corridor and the wire would be connected from pole to pole. The LRVs passing through these precincts would run on electricity transmitted through the over-head wires. The wires would be live and have the potential to cause serious injury or fatality in the unlikely event that a person were to come into contact with the over-head wiring. It is extremely unlikely however, that

the over-head wiring would pose a risk to the public, as the wiring would be at a height of about 6 m, which is above the Australian Standard of 5.64 m.

As the national capital, Canberra is populated with many sensitive and high security buildings, including those associated with Government, national security, and foreign embassies. The Project would be located in proximity to many such buildings, and its design has been developed to be responsive to the security and access requirements of those buildings. iCBR would continue to engage with the owners and occupiers of sensitive and high security buildings during ongoing Project design development to ensure that the Project does not conflict with or increase security and access risks.

Unexpected malfunctioning of the light rail system (such as outages at traffic lights or electrical faults) has the potential to lead to operational service disruptions and risk to safety, if not appropriately managed. Detailed design would include consideration of redundancy, including options to operate the light rail in the event of equipment failures. The Project would also be subject to detailed safety reviews to identify requirements for mitigation to manage and reduce the risk associated with unexpected disruptions.

Risks associated with electric and magnetic fields

Electrical systems and appliances (such as power lines and substations, household appliances, lighting, mobile phones, and computers) generate electric and magnetic fields around them when in use (i.e. energised and carrying an electrical current). The scientific evidence does not establish that exposure to the electric and magnetic fields found around the home, the office or near powerlines causes health effects (Australian Radiation Protection and Nuclear Safety Agency, n.d.).

Sources of EMF for the Project would include over-head contact wires, buried cables, traction power stations, and LRVs. Over-head wiring would be located in the Inner South, Yarra Glen, and Woden precincts however, undergrounding of some high voltage electrical cables may be required. The arrangement of underground cables in a 'triplex form' would help negate potential impacts of magnetic fields, while wire shield and insulation would contribute to a reduction in electric fields.

EMF compliance testing was conducted across 13 stop locations on the existing LRS1 network. All stops recorded either low or within normal power frequency magnetic field levels (Ji, 2019). Electric and magnetic field strengths on the Project are generally expected to be comparable to the LRS1 alignment, or other similar light rail systems. As with other existing electricity lines and substations, power supply infrastructure supporting the Project would generate electric and magnetic fields around it during operation.

The design and operation of the Project power supply would be carried out in accordance with standard industry guidelines and codes of practice, such that conductive and semi-conductive materials would effectively shield electrical fields. The Project would also be designed to comply with the limits of exposure set out in the International Commission for Non-Ionising Radiation Protection Guidelines for Limiting Exposure to Time Varying Electric and Magnetic Fields (International Commission on Non-Ionizing Radiation Protection, 2010). This would reduce the risk associated with electric and magnetic field exposure.

The design of the over-head wiring would also be in accordance with Australian Standard (AS)/New Zealand Standard (NZS) 7000:2016 Over-head Line Design, which states that the "over-head line shall be designed to be capable of transferring a prescribed electrical power, at a selected maximum operating temperature, and with acceptable levels of electrical effects of corona, radio and television interference and electric and magnetic fields. It shall also be capable of safe operation at the serviceability limit states." Electric and magnetic fields are therefore not expected to pose a significant risk to public safety.

Stray leakage currents from the running rails in the Light Rail network have the potential to migrate into surrounding earth, posing a risk of electrolysis corrosion to nearby buried metalwork. This corrosion risk arises due to electrochemical reactions between metallic infrastructure and stray currents, which may accelerate the degradation of buried metallic structures. The Project would be designed to minimise leakage current, such as optimising rail insulation and grounding methods.

Risks to utilities

Operation of the light rail would require some additional draw of power to run the LRVs and electrical equipment (such as lighting and emergency help points at each stop). The Project would include the installation of three traction power stations as well as over-head wiring and battery technology. Refer to Section 5.10 of Chapter 5 (Project description) for further detail on proposed power supply arrangements.

Impacts to other utilities during operation are anticipated to be minimal. Refer to Section 11.12 for further detail on increased demand on services. Access to all existing utilities, for routine maintenance and inspection would be maintained during operation.

Bushfire risks

As identified in Section 11.13.2, some areas near or within the Project area have been identified as bushfire prone land on the ACTmap database (ACT Government, 2023d). This includes a section of bushfire prone land which overlaps the light rail alignment on Adelaide Avenue near Kent Street and at the Mitchell Depot site (refer to Figure 11-96 and Figure 11-98). However, some of the mapped areas in and around the Mitchell Depot site are existing hardstand or operational areas that are not vegetated. The light rail alignment would be located around 250 m from bushfire prone land on Commonwealth Avenue near Coronation Drive, and around 100 m on Yarra Glen near Carruthers Street is (refer to Figure 11-97 and Figure 11-99).

In accordance with mitigation measure HR3 (refer to Chapter 21 (Environmental management and mitigation measures), a Bushfire Assessment Report will be prepared for the Project to consider the bushfire attack level and identify protection measures or management responses to be considered in proximity to Project infrastructure, including asset protection zones, fuel load management strategies during operation of the Project.

The Bushfire Assessment Report will inform preparation of a Bushfire Management Plan as part of the CEMP. The Bushfire Management Plan will be prepared in accordance with the requirements specified in Section 2.12 of Appendix L (Environmental Management Plan outline).

Bushfire risk during operation

Extreme heat and subsequent bushfires has the potential to pose a risk to the Project, including:

- Safety risks for users of the Project, related to heat stress and smoke inhalation
- Reduced access to the Project during operation, impacting on emergency response during extreme events
- The potential for fires to damage operational elements, which would incur additional Project costs.

While the risk of a bushfire event is low given the location of the Project away from densely vegetated areas capable of sustaining a major bushfire (refer further to Section 11.13.2), an emergency response management plan would be incorporated into operational management procedures for the Project, to minimise potential risk of bushfire.

The Project would be designed to avoid or reduce potential sources of ignition through landscaping management and adherence to bushfire management standards. Tree replacement/replanting and other landscaping will be compliant with ACT Bushfire Management Standards 2023. The bushfire management standards will also be applied to maintenance activities at the Mitchell Depot site.

However, some elements of the Project such as batteries in LRVs and electrical equipment may still present a limited level of fire risk in the unlikely event of a fault. Relevant fire and life safety requirements would be incorporated into all aspects of the design to limit the potential risk of this occurring. The design of the Project would also allow for efficient access by emergency services in the event of a fire. An emergency response management plan would be also implemented for the Project.

11.13.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage hazards and risk, that are applicable to the Project as a whole.

12.0 Commonwealth Avenue precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Commonwealth Avenue precinct, and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 12.1.4)
- Noise and vibration (Section 12.3)
- Biodiversity (Section 12.4)
- Historic heritage (Section 12.5)
- Landscape character and visual amenity (Section 12.6)
- Socioeconomic impacts (Section 12.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

12.1 Overview

The Commonwealth Avenue precinct comprises Commonwealth Avenue, extending from the Archbishop's House/Parkes Way in the north and ending just south of Coronation Drive in the south. This precinct includes Lake Burley Griffin and the existing Commonwealth Avenue road bridges. Commonwealth Avenue itself is characterised as a key transport connection between north and south Canberra and provides sweeping views of Lake Burley Griffin, several of Canberra's most iconic landmarks, and the surrounding mountains in the middle and far distance.

The Project would extend the light rail alignment south from the approved LRS2A Commonwealth Park Stop, across Lake Burley Griffin and Flynn Drive via new light rail bridges. Within the Commonwealth Avenue precinct, light rail would be wire-free.

12.1.1 State Circle East alignment option

The light rail alignment would be located within the Commonwealth Avenue median within this precinct. It would include one light rail stop near Albert Hall (Albert Hall Stop), where a signalised pedestrian crossing would provide access to the stop from the verges.

Key Project features within this precinct for the State Circle East alignment option are shown on Figure 12-1.

12.1.2 National Triangle-Barton alignment option

The light rail alignment would transition from the median of Commonwealth Avenue to King George Terrace near the entrance to the Hyatt Hotel.

No light rail stops are proposed within this precinct for the National Triangle-Barton alignment option.

Key Project features within this precinct for the National Triangle-Barton alignment option are shown on Figure 12-2.

Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

12.1.3 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Key construction activities within the Commonwealth Avenue precinct would include construction of the light rail bridges between the existing Commonwealth Avenue road bridges over Lake Burley Griffin, and Flynn Drive (refer to Section 6.3.4 of Chapter 6 (Construction)). Construction works over Lake

Burley Griffin would involve the use of cofferdams, barges, and a temporary jetty on the southern side of Lake Burley Griffin, to the west of Commonwealth Avenue.

Construction compounds within Commonwealth Avenue precinct include:

- Compound A1: Acton Waterfront car park at Corkhill Street (consistent with the compound location used for LRS2A)
- Compound A2: Acton Waterfront car park at Albert Street (consistent with the compound location used for LRS2A)
- Compound B: Yarralumla Parkland, Commonwealth Avenue south-west cloverleaf on the southern side of Lake Burley Griffin and the areas adjacent to the existing bridges
- Compound C: Langton car park opposite Treasury building, Parkes.

The location of these compounds is shown on Figure 6-1 in Chapter 6 (Construction).



Figure 12-1 Commonwealth Avenue precinct overview – State Circle East alignment option

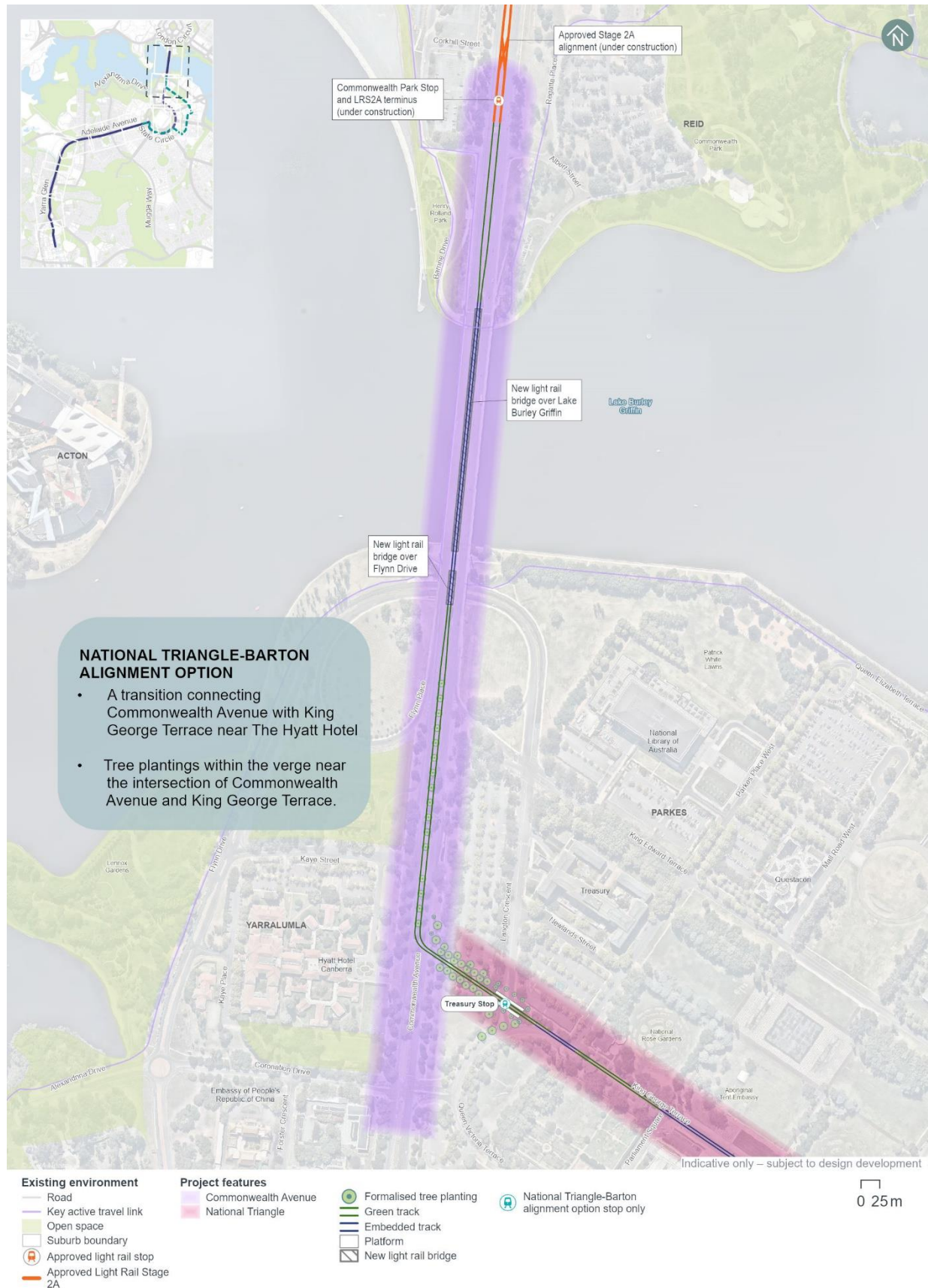


Figure 12-2 Commonwealth Avenue precinct overview – National Triangle-Barton alignment option

12.1.4 Environmental impact overview – construction

Key impacts within the Commonwealth Avenue precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Two potential alignment options are being considered within the Commonwealth Avenue precinct – the State Circle East alignment option and the National Triangle-Barton alignment option. The potential impacts of each alignment option have been assessed in this chapter. Unless specifically noted, impacts in this overview are discussed for both alignment options. Through further design development and the selection of a single, final alignment option, environmental impacts are expected to be further minimised.

Traffic and transport

Construction of the Project would be undertaken within and adjacent to the road reserve, and as such would result in traffic impacts including changes to turning movements and the introduction of heavy vehicle traffic, which would disrupt the road network and parking availability. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Within this precinct, specific impacts associated with the State Circle East alignment option would include restricted right turns at key intersections, such as the Commonwealth Avenue/Coronation Drive intersection, which may result in a slight increase in travel times for motorists. Construction of the National Triangle-Barton alignment option would not change local area access arrangements within the Commonwealth Avenue precinct.

The construction activities for the State Circle East alignment option and the National Triangle-Barton alignment option would also lead to a temporary, staged loss of five or 15 on-street parking spaces, respectively across the precinct as construction works progress. Both alignment options would temporarily reduce off-street car parking by around 766 spaces.

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction-related traffic and site access, parking availability, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some limited clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 2014* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 2.09 hectares of vegetation within the Commonwealth Avenue precinct, 0.01 hectares of which is characterised as native. Removal of this vegetation would impact foraging habitat for the Gang-gang Cockatoo (endangered under the EPBC Act and NC Act), Superb Parrot (vulnerable under the EPBC Act and NC Act), and the Diamond Firetail (vulnerable under the EPBC Act and NC Act). Only one hollow-bearing and one mature native tree, which provide suitable breeding and/or foraging habitat for woodland birds, have been identified within the proposed clearance footprint in the Commonwealth Avenue precinct.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Historic heritage

Several places listed on Commonwealth and ACT Heritage registers are present in the Commonwealth Avenue precinct, including Lake Burley Griffin and adjacent lands (including the Commonwealth Avenue Bridge), Albert Hall, Hotel Canberra, and the Canberra Croquet Clubhouse and Lawn. During

construction, moderate to significant impacts are predicted at Albert Hall (listed on the ACT Heritage register), primarily associated with alterations to its visual setting from the removal of historical trees on the median of Commonwealth Avenue. Moderate impacts are also predicted to the Lake Burley Griffin and adjacent lands (including Commonwealth Avenue Bridge), and Commonwealth Avenue Bridge (not a listed heritage item) associated visual impacts and access restrictions from temporary infrastructure on land and the water.

Heritage places also have the potential to be indirectly affected by the Project during construction through vibration caused by construction activities. However, these impacts would be avoided through appropriate equipment selection, and determination and monitoring of safe vibration levels. A Conservation Management Plan would be implemented as part of the Construction Environmental Management Plan(s) for the Project, with controls to protect heritage values during construction.

Some additional heritage places in this precinct (such as the Parliament House vista) span across multiple precincts and have therefore been assessed in Chapter 11 (Project-wide issues).

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter include:

- **Noise and vibration:** Construction activities in the precinct, including earthworks, road works, and the decommissioning of utilities are expected to generate noise. In the majority of scenarios, no residential buildings have been identified as moderately or highly noise affected. However, in some scenarios a small number of residential and non-residential buildings that are closest to the works (although outside of the precinct) may experience moderate or high noise impacts during the day and night (without the application of mitigation measures), particularly during 'peak' construction scenarios (which represent the noisiest works which would require the use of noise intensive equipment such as concrete saws and rock breakers). Mitigation measures that would be implemented to manage these impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis
- **Landscape character and visual amenity:** Construction activities, such as the establishment of construction compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area, particularly from key locations such as Commonwealth Avenue and Coronation Drive. Night-time construction work, where required, would also involve lighting that would contrast the low levels of existing lighting in this precinct and would be seen from buildings such as Treasury, Hotel Canberra, Albert Hall, Diplomatic Missions, as well as Lake Burley Griffin and parklands such as Commonwealth Park, Henry Rolland Park, and Magna Carta Place of Parliament House. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill, and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the visual integrity of the area
- **Socioeconomic:** Potential impacts include disruptions to local amenity and the road network due to temporary parking loss, increased travel time, and visual impacts, which may particularly affect workers, visitors, and businesses in the Commonwealth Avenue precinct. Mitigation measures, such as the implementation of a Construction Environmental Management Plan (CEMP), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). For construction related impacts, a Construction Environmental Management Plan (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP and sub plans, and is included as Appendix L (Environmental Management Plan outline).

12.1.5 Environmental impact overview – operation

Key impacts within the Commonwealth Avenue precinct during the operational stage of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Commonwealth Avenue precinct would require several changes to the road network, including speed limit adjustments, lane modifications, and new intersection arrangements to accommodate the light rail infrastructure. Within the Commonwealth Avenue precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

Additionally, there would be a loss of around 20 parking spaces within the Langton car park for the National Triangle-Barton alignment option, however, analysis of parking utilisation indicates that this car park typically has spare capacity to cater for some of these lost spaces.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles, and pedestrians with light rail during operation, and review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Landscape character and visual amenity

The introduction of light rail infrastructure, such as light rail tracks and the Albert Hall Stop (proposed for the State Circle East alignment option only), would result in permanent changes to the landscape character and visual amenity of the Commonwealth Avenue precinct. High to moderate adverse visual impacts are predicted for both alignment options, due to the scale of change the Project would introduce within this precinct.

Landscape features such as the use of green track along sections of the alignment within this precinct would contribute to preserving visual amenity. The Public Domain Master Plan (Appendix I) also identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Historic heritage

During operation, significant heritage impacts would occur to Lake Burley Griffin and adjacent lands (listed on the Commonwealth Heritage List) including the Commonwealth Avenue Bridge. Lake Burley Griffin and adjacent lands would experience alteration of large scale vistas of Lake Burley Griffin including Commonwealth Avenue where the light rail travels over the lake. Views to and from Commonwealth Avenue Bridge specifically would also be altered by the addition of the central light rail bridge span and the running light rail vehicles (LRVs).

For the National Triangle-Barton alignment only, moderate indirect impacts may be experienced at the Treasury Building (nominated for the Commonwealth Heritage List) as plantings in previously open spaces would diminish the expression of the significant historical views from the south-west.

Albert Hall (listed on the ACT Heritage Register) would experience moderate to significant impacts (for the State Circle East alignment option) or moderate impacts (for the National Triangle-Barton alignment option), as the light rail corridor and replacement tree planting would alter its historic setting. Impacts would be higher for the State Circle East alignment option as the Albert Hall Stop would alter historic views from Albert Hall to Commonwealth Avenue and obscure the historical significance of Albert Hall as an early landmark building of Canberra.

Key mitigation measures to address potential impacts would include mapping of heritage values and use of specialist advice to avoid/mitigate impacts to heritage values, to develop design responses that integrate the Project into the surrounding heritage landscape, and to implement heritage interpretation in design.

Additional heritage places that are partially located within this precinct (such as the Parliament House vista) have been assessed in Chapter 11 (Project-wide issues) as they span across multiple precincts.

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter include:

- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 12.1.4), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from operation. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops, or potential risk of fauna strike from light rail vehicles (LRVs). Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Socioeconomic:** Benefits of the Project within the Commonwealth Avenue precinct include providing an alternative to private vehicle use, which can enhance accessibility and over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, such as changes to the local visual landscape and community character due to the introduction of light rail infrastructure, which could potentially affect the experience and connection people have with the area, and disruptions to the road network and parking. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support design of a high quality and manage these potential impacts
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the Commonwealth Avenue precinct, with noise and vibration levels predicted to comply with relevant criteria at all receivers. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures, and operational maintenance planning. These measures would enable residual impacts to be limited.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

12.2 Traffic and transport

This section provides an assessment of the potential multimodal traffic and transport impacts associated with the construction and operation phases of the Project within the Commonwealth Avenue precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

12.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Commonwealth Avenue precinct and the respective precinct study area are indicatively shown on Figure 12-3.

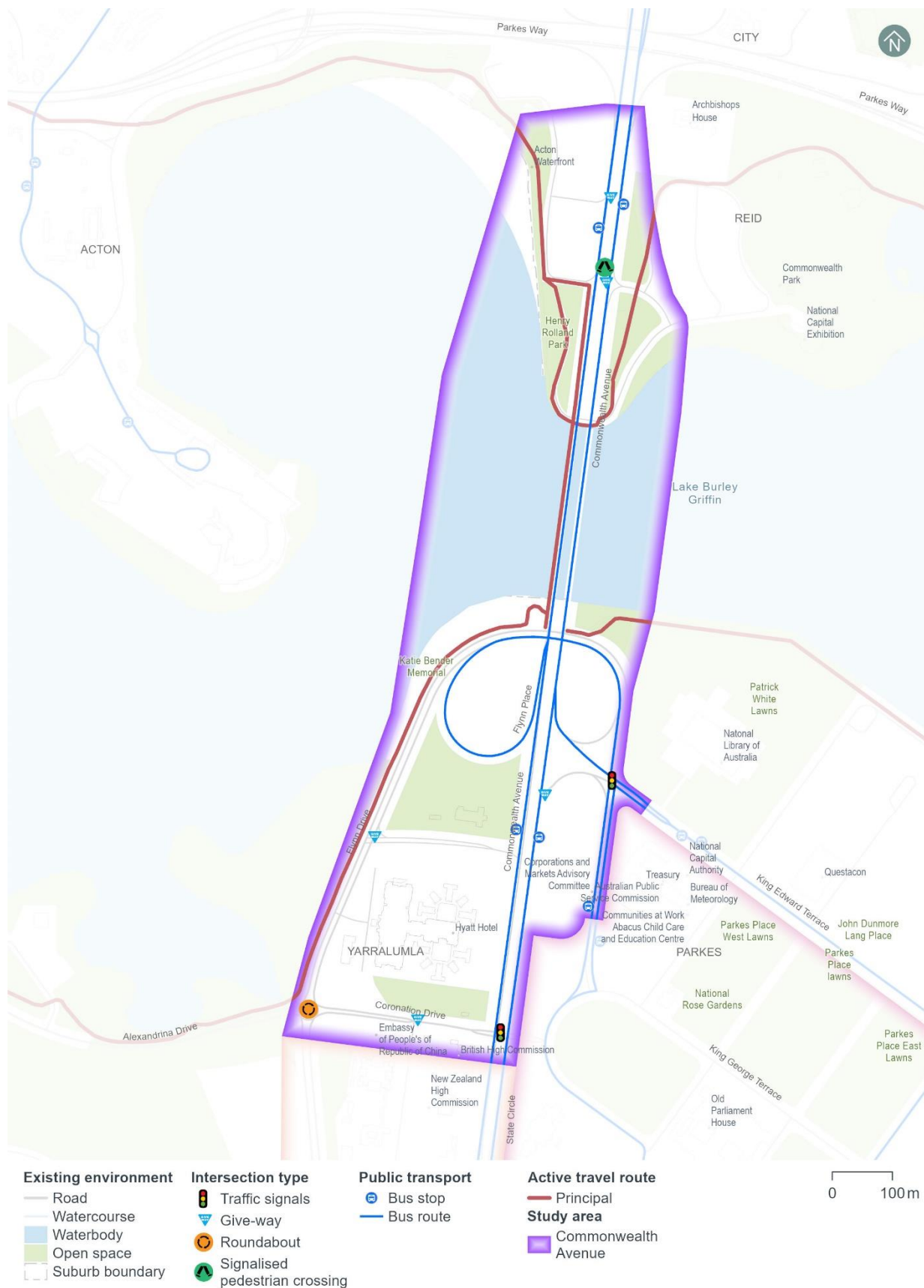


Figure 12-3 Overview of the existing transport network for the Commonwealth Avenue precinct study area

Road network

The characteristics and features of key roads within the Commonwealth Avenue precinct are summarised in Table 12-1.

Table 12-1 Overview of key roads within the Commonwealth Avenue precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Commonwealth Avenue	Arterial	Two-way	Three lanes in each direction, separated by a 13 m wide median	70 km/h
Barrine Drive	Local access	Two-way	One lane in each direction	50 km/h
Corkhill Street		One-way	One lane eastbound from Barrine Drive to Corkhill Street	50 km/h
Albert Street		Two-way	One lane in each direction	50 km/h
Flynn Drive	Major collector	Two-way	Two westbound lanes, one eastbound lane. One lane on and off ramps to connect Commonwealth Avenue with Flynn Place	60 km/h
Coronation Drive		Two-way	One westbound lane, two eastbound lanes	60 km/h
Kaye Street	Minor collector	Two-way	One lane in each direction. Westbound access only from Commonwealth Avenue	50 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00 am to 9:00 am) and PM (5:00 pm to 6:00 pm) peak hour traffic counts for various mid-block locations within the Commonwealth Avenue precinct are summarised on Figure 12-4. As shown, the 2024 data indicates there has generally been a reduction in traffic during the AM and PM peak hours along Commonwealth Avenue since 2017.

This reduction in traffic could be due to several reasons including a higher uptake in flexible working and more people working from home in 2024, and ongoing construction works in the area (e.g. Raising London Circuit (RLC)) which may have resulted in some people travelling via alternative routes.



Figure 12-4 2017 and 2024 peak hourly traffic volumes within the Commonwealth Avenue precinct study area

Historical average weekday traffic volume, heavy vehicle composition, and 85th percentile speed data have also been analysed for key roads within the Commonwealth Avenue precinct, with a summary provided in Table 12-2. The data indicates that heavy vehicles account for around 9% of traffic on Commonwealth Avenue, with lower proportions on Flynn Drive and Coronation Drive. The 85th percentile speed data indicates that most vehicles generally travel below these roads' applicable posted speed limit.

Table 12-2 Average weekday traffic volume characteristics on key roads within the Commonwealth Avenue precinct

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
Commonwealth Avenue	Between Coronation Drive and Kaye Street	2024	36,550	9%	66 km/h
Flynn Drive	Between Commonwealth Avenue overpass and Coronation Drive	2022	790	7%	54 km/h
Coronation Drive	Between Forster Crescent and Flynn Drive	2022	5,230	3%	55 km/h

Figure 12-5 shows the weekday average daily traffic volume profile for Commonwealth Avenue, indicating a clear AM peak hour between 8:00 am and 9:00 am and the PM peak hour between 5:00 pm and 6:00 pm. Traffic volumes on Commonwealth Avenue are typically much lower adjacent to the peak hours.

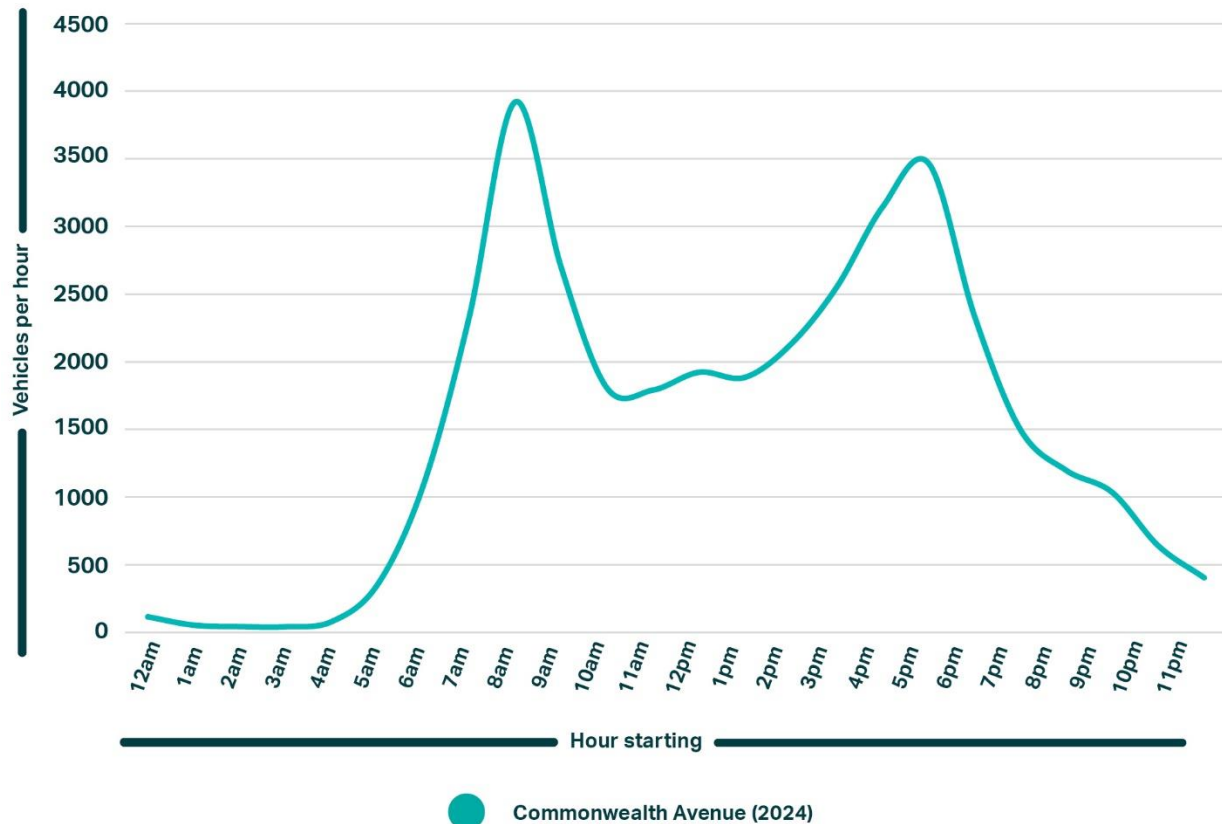


Figure 12-5 Weekday average daily traffic volume profile on Commonwealth Avenue

Intersection performance

The operation of the key intersections within the Commonwealth Avenue precinct have been assessed using the microsimulation model which has been calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct existing performance of the assessed intersections is shown on Figure 12-6.

All the assessed intersections within the Commonwealth Avenue precinct generally operated satisfactorily in 2017 at a level of service D or better during the weekday peak hours. The exception was the Queen Victoria Terrace/ Langton Crescent intersection which operated at a level of service E during the PM peak hour. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. The high vehicle delays at this intersection were due to minimal storage capacity for vehicles to queue on Queen Victoria Terrace between Commonwealth Avenue and Langton Crescent, which has flow-on impacts for westbound vehicles turning right from Langton Crescent onto Queen Victoria Terrace.

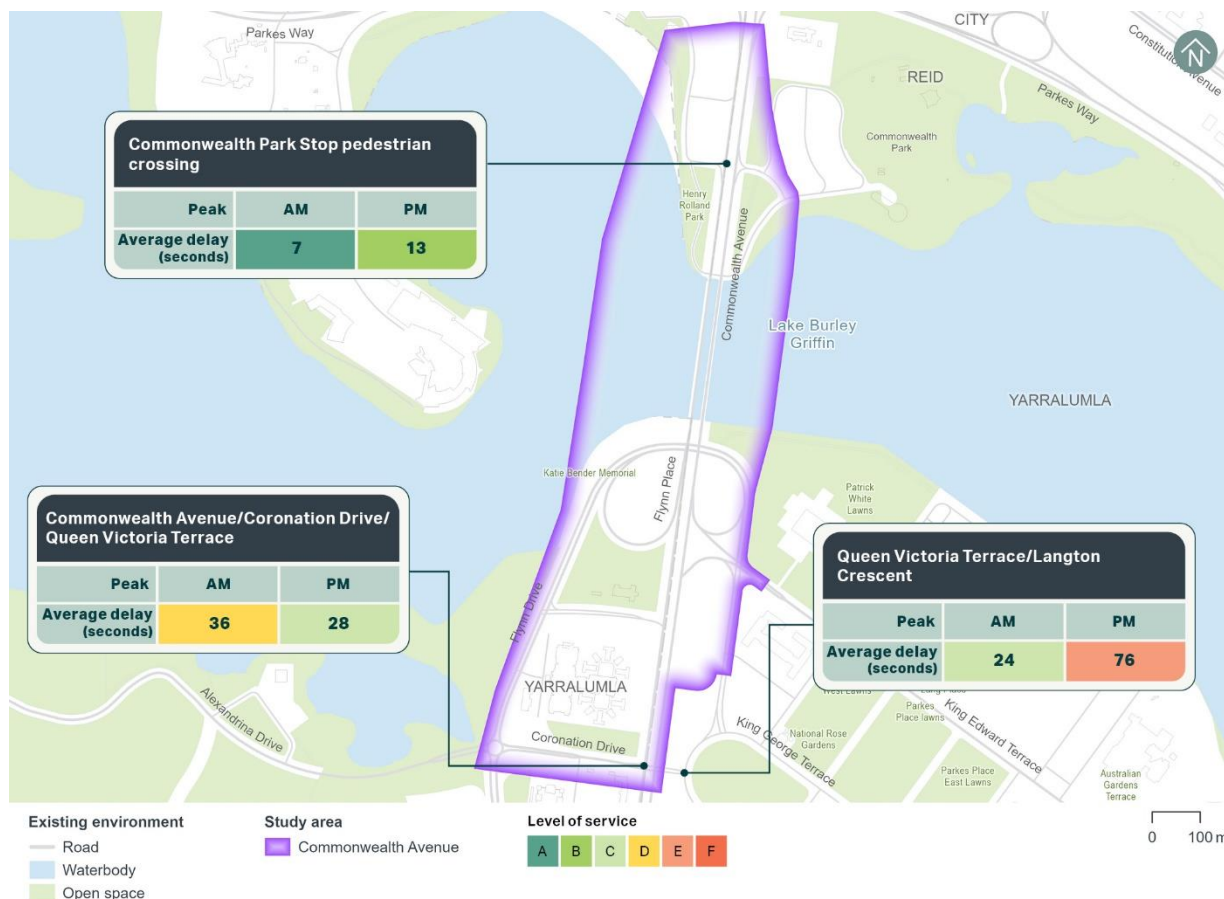


Figure 12-6 2017 AM and PM peak hour intersection performance within the Commonwealth Avenue precinct study area

Public transport

There are four existing bus stops (two for northbound travel and two for southbound travel) located along Commonwealth Avenue, north of Kaye Street. Bus routes that service these bus stops generally provide connection to Woden, Tuggeranong, Denman Prospect, Australian National University (ANU), and the city centre. The bus routes that operate within the Commonwealth Avenue precinct are: R4, R5, R6, R7, R10, 180, and 181.

Active transport

Footpaths are available on both sides of most roads within the Commonwealth Avenue precinct. Signalised pedestrian crossings are provided on all main approaches to the Commonwealth Avenue/Coronation Drive intersection, with zebra crossings provided on the slip lanes. Commonwealth Avenue is further serviced by a signalised pedestrian crossing north of Lake Burley Griffin at Albert Street.

Shared paths are provided on both sides of the Commonwealth Avenue road bridges over Lake Burley Griffin transitioning to on-road cycling lanes to the south. Shared paths are provided on connecting roads, including Flynn Drive and Lake Burley Griffin's southern side. On-road cycle lanes are provided on both sides of the road between the south end of the Commonwealth Avenue road bridges and the Commonwealth Avenue/Coronation Drive intersection.

A pedestrian underpass beneath Commonwealth Avenue, north of Kaye Street, facilitates connectivity between bus stops on each side of the road. The City to Tuggeranong via Woden principal community route traverses the precinct along the Commonwealth Avenue road bridges over Lake Burley Griffin.

Pedestrian and cyclist count data from 2024 has been used to understand current active travel demand within the precinct. The AM and PM peak hour counts at key locations within the precinct are summarised on Figure 12-7. Pedestrian volumes at the recorded locations are low and equate to

around 35 pedestrians during the weekday peak hours. Slightly higher pedestrian numbers have been recorded on Commonwealth Avenue near Albert Street during the PM peak hour, which may relate to higher levels of recreational activity in the afternoon on the northern side of Lake Burley Griffin. The on-road cycle lanes on Commonwealth Avenue near Albert Street carried around 70 to 80 cyclists during the peak hours. Cycling activity on Commonwealth Avenue to the south of Lake Burley Griffin was lower, with around 40 to 60 cyclists recorded during the peak hours.

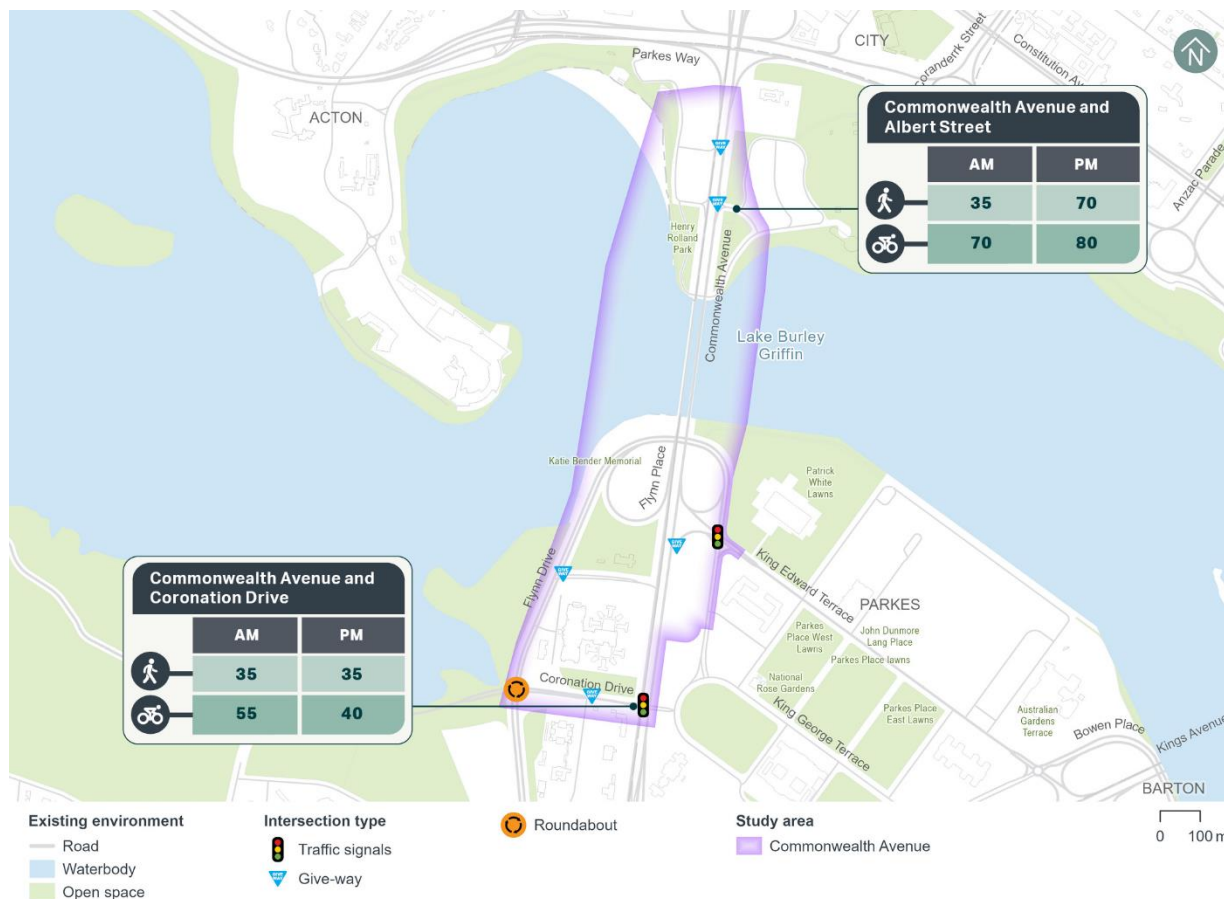


Figure 12-7 2024 peak hour active travel volumes within the Commonwealth Avenue precinct study area

Car parking, kerbside uses, and access

Kerbside uses

The existing kerbside uses including on-street parking within the Commonwealth Avenue precinct are summarised in Table 12-3.

Table 12-3 Commonwealth Avenue precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
On alignment	Commonwealth Avenue	Flynn Drive on/off ramps	East	Bus zone (public)	N/A
			West	Bus zone (public)	N/A
Off alignment	Flynn Drive	Kaye Street and Commonwealth Avenue	West	Unlimited time paid parking (8:30 am – 5:30 pm Monday to Friday)	42
	Kaye Street	Flynn Drive and Commonwealth Avenue	North	4P (8:30 am - 5:30 pm Monday to Friday)	18
			South	4P (8:30 am - 5:30 pm Monday to Friday)	20
	Langton Crescent	King Edward Terrace and Newlands Street	East	1P	8
			West	1P	11
	Total				

Off-street parking

Most buildings within the Commonwealth Avenue precinct have dedicated on-site car parks generally accessed via local roads. Key off-street public car parks located within the Commonwealth Avenue precinct include:

- Acton Waterfront central car park: at-grade car park with around 80 spaces
- Acton Waterfront southern car park: at-grade car park with around 170 spaces
- Commonwealth Park car park: at-grade car park with around 255 spaces
- Barrine Drive car park: at-grade car park with around 13 spaces
- Langton car park: at-grade car park with around 503 spaces
- Kaye Street car park: at-grade car park with around 217 spaces.

These car parks accommodate around 1,250 car parking spaces, as shown on Figure 12-8.

Aerial imagery indicates that the other car parks typically have some spare capacity on a weekday. Based on historical parking counts from 2023, the Kaye Street car park reached a peak occupancy of around 45%.

As part of construction for the Light Rail Stage 2A (LRS2A) project, the Acton Waterfront car parks have been approved for temporary use for construction compounds.



Figure 12-8 Off-street car parking within the Commonwealth Avenue precinct study area

Property access

The existing property accesses along the Project's alignment within the Commonwealth Avenue precinct are summarised in Table 12-4.

Table 12-4 Existing property access within the Commonwealth Avenue precinct

Road	Site address	Site access arrangement
Commonwealth Avenue	Hyatt Hotel Canberra	Two separate left-in left-out entry and exit points on Commonwealth Avenue
	Albert Hall	One exit point on Commonwealth Avenue

Crash history

Figure 12-9 shows the five year crash history (1 January 2018 to 31 December 2022) within the Commonwealth Avenue precinct.

A total of 193 crashes have been recorded within the Commonwealth Avenue precinct during the five year period, including:

- One crash that resulted in a fatality which occurred on Commonwealth Avenue to the north of the Commonwealth Avenue road bridge
- Two crashes that resulted in a serious injury (around 1%)
- 12 crashes that resulted in a minor injury (around 6%)
- 178 crashes that resulted in property damage only (around 92%).

The following common crash types occurred:

- Around 70% of crashes involved a rear end collision
- Around 10% of crashes involved a same direction side swipe.

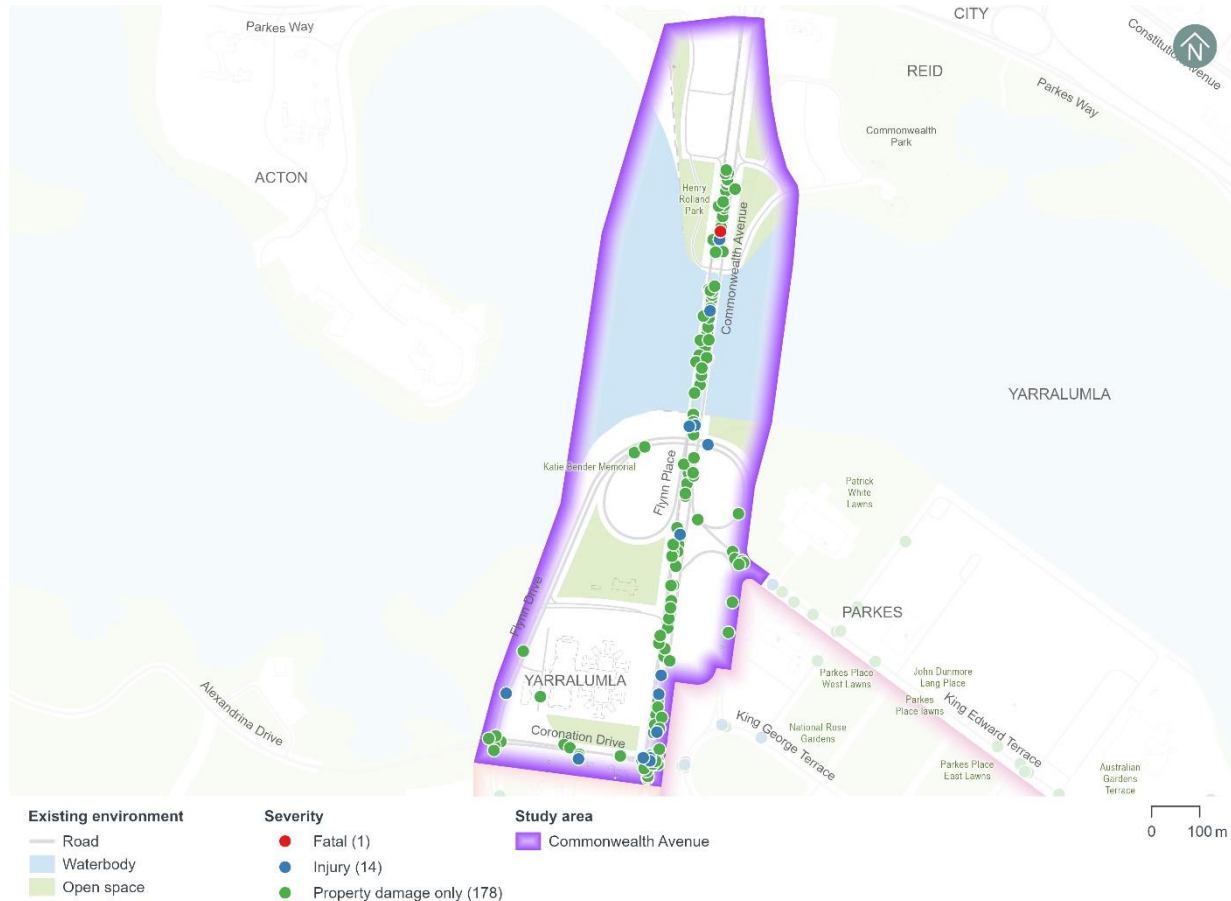


Figure 12-9 Crash data between 2018 and 2022 within the Commonwealth Avenue precinct study area

Modelling approach

The transport modelling assumptions have adopted the 'committed and funded expenditure approach' as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The 'committed and funded expenditure approach' requires that only transport projects identified as 'committed and funded' are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as 'committed and funded' are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

12.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside use

State Circle East alignment option

It is estimated that up to five on-street kerbside spaces on Flynn Drive (off-alignment) would be temporarily lost within the Project area in the Commonwealth Avenue precinct. This represents around 5% of the total 99 on-street kerbside spaces identified within the Commonwealth Avenue precinct. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

National Triangle-Barton alignment option

It is estimated that up to 15 on-street kerbside spaces would be temporarily lost within the Project area in the Commonwealth Avenue precinct for the National Triangle-Barton alignment option, including:

- Five spaces on Flynn Drive (off-alignment)
- 10 spaces on Langton Crescent (off-alignment).

This represents around 15% of the total 99 on-street kerbside spaces identified within the Commonwealth Avenue precinct. Construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

Off-street parking

The Project's construction compounds within the Commonwealth Avenue precinct would temporarily reduce off-street car parking by around 766 spaces at the following locations (refer to Chapter 6 (Construction)):

- Site compound A1 – Acton Waterfront central car park at Corkhill Street: loss of around 80 parking spaces
- Site compound A2 – Acton Waterfront southern car park at Albert Street: loss of around 170 parking spaces
- Site compound C – Langton car park: loss of around 503 parking spaces
- Barrine Drive car park: Loss of around 13 parking spaces.

Site compounds A1 and A2 have been approved for use as construction compounds for the LRS2A project. Therefore, these off-street car parking impacts would continue during the construction of the Project. Although, there would be a gap between completion of construction of LRS2A and construction of the Project commencing when they would not be occupied by construction compounds.

The new John Gorton multi-storey car park, which is currently under construction, would offset some of the parking temporarily lost during the closure of the Langton car park. However, walking distances to/from the new John Gorton multi-storey car park may be longer depending on the origin and destination. There are also several other off-street public car parks located throughout the National Triangle precinct which may be able to cater for some of the parking demand associated with the displaced parking particularly from the Langton car park.

Local area access

State Circle East alignment option

The construction traffic staging arrangement along Commonwealth Avenue would temporarily restrict right turns from the northern, western and southern approaches to the Commonwealth Avenue/Coronation Drive intersection.

Vehicles that currently turn right into Coronation Drive (west) from Commonwealth Avenue (north) would need to use available alternative routes, such as the Flynn Drive off-ramp from Commonwealth

Drive, to circulate to the other end of Coronation Drive. Vehicles that currently turn right into Queen Victoria Terrace (east) from Commonwealth Avenue (south) would need to enter the National Triangle precinct via alternative roads including Flynn Drive or Kings Avenue. Similarly, vehicles that currently turn right onto Commonwealth Avenue (south) from Coronation Drive would need to use Flynn Drive to access State Circle.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

National Triangle-Barton alignment option

Construction of the National Triangle-Barton alignment option would not change local area access arrangements within the Commonwealth Avenue precinct.

Property access

The Project's construction would not change any property accesses within the Commonwealth Avenue precinct.

12.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Commonwealth Avenue precinct to accommodate the Project would include speed limit adjustments, adjustments to existing lanes, key intersection adjustments, new intersection arrangements, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further information on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Commonwealth Avenue precinct, particularly on Commonwealth Avenue, Flynn Drive, and Coronation Drive.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

Traffic volume changes associated with the State Circle East alignment option are summarised in Table 12-5 and Table 12-6, and those associated by the National Triangle-Barton alignment option are summarised in Table 12-7 and Table 12-8. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance
- Changes in mode choice due to the introduction of light rail.

*State Circle East alignment option***Table 12-5 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Commonwealth Avenue precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Commonwealth Avenue	North of Kaye Street	Northbound	2,160	2,600	440	20%	1,810	2,270	460	25%
		Southbound	3,140	2,290	-850	-27%	3,270	2,130	-1,140	-35%
Flynn Drive	Below Commonwealth Avenue	Eastbound	60	70	10	17%	60	70	10	17%
		Westbound	750	1,130	380	51%	720	1,150	430	60%
Coronation Drive	West of Commonwealth Avenue	Eastbound	400	490	90	23%	320	470	150	47%
		Westbound	150	220	70	47%	130	220	90	69%

Table 12-6 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Commonwealth Avenue precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Commonwealth Avenue	North of Kaye Street	Northbound	2,620	1,940	-680	-26%	2,720	2,110	-610	-22%
		Southbound	2,990	2,210	-780	-26%	2,750	2,460	-290	-11%
Flynn Drive	Below Commonwealth Avenue	Eastbound	20	30	10	50%	20	20	0	0%
		Westbound	780	890	110	14%	700	850	150	21%
Coronation Drive	West of Commonwealth Avenue	Eastbound	400	440	40	10%	520	540	20	4%
		Westbound	100	100	0	0%	110	150	40	36%

*National Triangle-Barton alignment option***Table 12-7 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Commonwealth Avenue precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Commonwealth Avenue	North of Kaye Street	Northbound	2,160	2,710	550	25%	1,810	2,390	580	32%
		Southbound	3,140	2,260	-880	-28%	3,270	2,320	-950	-29%
Flynn Drive	Below Commonwealth Avenue	Eastbound	60	70	10	17%	60	50	-10	-17%
		Westbound	750	980	230	31%	720	850	130	18%
Coronation Drive	West of Commonwealth Avenue	Eastbound	400	520	120	30%	320	500	180	56%
		Westbound	150	150	0	0%	130	150	20	15%

Table 12-8 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Commonwealth Avenue precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Commonwealth Avenue	North of Kaye Street	Northbound	2,620	2,590	-30	-1%	2,720	3,180	460	17%
		Southbound	2,990	2,480	-510	-17%	2,750	2,360	-390	-14%
Flynn Drive	Below Commonwealth Avenue	Eastbound	20	10	-10	-50%	20	110	90	450%
		Westbound	780	910	130	17%	700	880	180	26%
Coronation Drive	West of Commonwealth Avenue	Eastbound	400	430	30	8%	520	540	20	4%
		Westbound	100	40	-60	-60%	110	80	-30	-27%

Road network performance

State Circle East alignment option

A comparison of vehicle delay across the Commonwealth Avenue precinct's road network with and without the Project in the 2031 scenario has been conducted for the AM and PM peak hours.

For most of the road network in this precinct, there would be little to no congestion in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041 scenarios. However, there would be localised areas where higher congestion levels would occur, such as on the approaches to intersections.

The Project's changes to the road network and associated traffic reassignment and signal operation changes would cause the following changes to congestion and vehicle delay when compared to the without Project scenario in the 2031 scenario:

- Increased congestion and delay on the southbound carriageway of Commonwealth Avenue and propagating back over Lake Burley Griffin during the AM peak hour
- Decreased congestion and delay on Commonwealth Avenue northbound downstream of the Flynn Drive on-ramp and back up the ramp and to Coronation Drive during the AM peak hour
- Increased congestion and delay on Commonwealth Avenue northbound over Lake Burley Griffin during the PM peak hour
- Increased congestion and delay on Flynn Drive upstream of the on-ramp to Commonwealth Avenue during the PM peak hour
- Decreased congestion and delay on Commonwealth Avenue northbound between Coronation Drive and the Flynn Drive on-ramp during the PM peak hour.

With the Project, traffic flows in the AM peak hour on Commonwealth Avenue would increase in the northbound direction however congestion would decrease. Conversely, traffic flows in the PM peak hour on Commonwealth Avenue would decrease in the northbound direction however congestion would increase. These changes in congestion are both related to changes in signal operations resulting from altered traffic flows across the road network.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041. However, the extent of longer delays is anticipated to propagate further than in 2031.

National Triangle-Barton alignment option

Within the Commonwealth Avenue precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

A comparison of vehicle delay across the Commonwealth Avenue precinct's road network with and without the Project in the 2031 scenario have been conducted for the AM and PM peak hours, respectively.

The Project's changes to the road network and associated traffic reassignment and signal operation changes would cause the following changes to congestion and vehicle delay when compared to the without Project scenario in 2031:

- Increased congestion and delay on the southbound carriageway of Commonwealth Avenue and queuing back over Lake Burley Griffin during the AM peak hour
- Decreased delay and congestion on Commonwealth Avenue northbound downstream of the Flynn Drive on-ramp and extending back up the ramp and to Coronation Drive during the AM peak hour
- Similar levels of congestion and delay on Commonwealth Avenue in both directions over Lake Burley Griffin during the PM peak hour
- Decreased congestion and delay on Commonwealth Avenue northbound between the Coronation Drive and the Flynn Drive on-ramp during the PM peak hour.

With the Project, traffic flows on Commonwealth Avenue would increase in the northbound direction during the AM peak hour. However, congestion on Commonwealth Avenue would decrease due to changes in signal operations resulting from the altered traffic flows. Similar traffic flows are expected on Commonwealth Avenue with and without the Project during the PM peak hour. Congestion on Flynn Drive and Commonwealth Avenue near Coronation Drive would decrease due to changes in signal operations.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041. However, the extent of longer delays is anticipated to propagate further than in 2031.

Intersection performance

State Circle East alignment option

The performance of the key intersections within the Commonwealth Avenue precinct with and without the Project for the State Circle East alignment option is provided in Table 12-9 and Table 12-10. Intersection performance has been evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. Key findings relating to intersection performance are as follows:

- The Commonwealth Park Stop pedestrian crossing and the new Albert Hall Stop pedestrian crossing would both operate satisfactorily at a level of service C or better with the Project during the weekday peak hours in 2031 and 2041 scenarios
- The Commonwealth Drive/ Coronation Drive intersection would change from a level of service E (AM) or C (PM) without the Project to a level of service F with the Project during the weekday peak hours in the 2031 scenario. Similarly, reductions in level of service are expected during the PM peak hour in the 2041 scenario, noting that the intersection would already be operating at a level of service F during the AM peak hour without the Project. The change in level of service with the Project is due to the introduction of the Project alignment and associated signal phasing changes, along with the removal of the slip lanes resulting in left turning vehicles being controlled by traffic signals.
- The Queen Victoria Terrace/ Langton Crescent intersection would operate at a level of service F with and without the Project due to its constrained existing configuration and limited offset from the Commonwealth Drive/ Coronation Drive intersection.

Table 12-9 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Commonwealth Avenue precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Commonwealth Park Stop pedestrian crossing	7	A	13	B	7	A	12	B
Albert Hall Stop pedestrian crossing	-	-	28	C	-	-	13	B
Commonwealth Avenue/Coronation Drive/Queen Victoria Terrace	56	E	102	F	94	F	94	F
Queen Victoria Terrace/Langton Crescent	>150	F	>150	F	>150	F	>150	F

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 12-10 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Commonwealth Avenue precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Commonwealth Park Stop pedestrian crossing	6	A	17	B	12	B	22	C
Albert Hall Stop pedestrian crossing	-	-	23	C	-	-	39	D
Commonwealth Avenue/Coronation Drive/Queen Victoria Terrace	31	C	88	F	24	C	123	F
Queen Victoria Terrace/Langton Crescent	>150	F	>150	F	>150	F	>150	F

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

National Triangle-Barton alignment option

The performance of the key intersections within the Commonwealth Avenue precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 12-11 and Table 12-12. Key findings relating to intersection performance are as follows:

- The Commonwealth Park Stop pedestrian crossing and Commonwealth Avenue/ Coronation Drive/ Queen Victoria Terrace intersections would both operate satisfactorily at a level of service D or better with the Project during the weekday peak hours in 2031 and 2041 scenarios
- The Queen Victoria Terrace/ Langton Crescent intersection would operate satisfactorily at a level of service A with the Project during the AM peak hour in 2031 and 2041 scenarios, however at a level of service E or F during the PM peak hour in 2031 and 2041 scenarios. The performance of this intersection would be better with the Project compared to without the Project. This improvement in performance would be due to the change in travel patterns and traffic distributions primarily at the adjacent Commonwealth Avenue/ Coronation Drive/Queen Victoria Terrace intersection because of the Project, which has flow-on benefits at the Queen Victoria Terrace/Langton Crescent intersection.

Table 12-11 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Commonwealth Avenue precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Commonwealth Park Stop pedestrian crossing	6	A	11	B	8	A	10	A
Commonwealth Avenue/Coronation Drive/Queen Victoria Terrace	56	E	34	C	66	E	45	D
Queen Victoria Terrace/Langton Crescent	>150	F	10	A	>150	F	11	B

Table 12-12 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Commonwealth Avenue precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Commonwealth Park Stop pedestrian crossing	8	A	31	C	8	A	50	D
Commonwealth Avenue/Coronation Drive/Queen Victoria Terrace	27	C	33	C	24	C	28	C
Queen Victoria Terrace/Langton Crescent	>150	F	>150	F	>150	F	58	E

Active travel

State Circle East alignment option

The key active travel provisions that would be provided within the Commonwealth Avenue precinct as part of the Project for the State Circle East alignment option and their benefits or impacts are summarised in Table 12-13.

Table 12-13 Active travel provisions within the Commonwealth Avenue precinct and associated impacts and benefits (State Circle East alignment option)

Proposed treatment	Impact or benefit
The signalised pedestrian crossing at the southern end of the approved Commonwealth Park Stop would be reconfigured as a staggered pedestrian crossing.	Staggering the pedestrian crossings within the median would provide more area for pedestrians to store within the median, however could result in higher delays for pedestrians waiting to cross the road.
New traffic signals on Commonwealth Avenue near King Edward Terrace/Flynn Drive would be provided to allow pedestrian access to the Albert Hall Stop in the median.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility across Commonwealth Avenue to the Albert Hall Stop.
Kerb adjustments and signalised pedestrian crossings would be provided on all legs of the Commonwealth Avenue/Coronation Drive intersection.	Removal of slip lanes would reduce the crossing distance for pedestrians on Coronation Drive. Signalised pedestrian crossings on all legs of the intersection would provide a safer crossing facility for pedestrians.

National Triangle-Barton alignment option

The key active travel provisions that would be provided within the Commonwealth Avenue precinct as part of the Project for the National Triangle-Barton alignment option and their benefits or impacts are summarised in Table 12-14.

Table 12-14 Active travel provisions within the Commonwealth Avenue precinct and associated impacts and benefits (National Triangle-Barton alignment option)

Proposed treatment	Impact or benefit
The signalised pedestrian crossing at the southern end of the approved Commonwealth Park Stop would be reconfigured as a staggered pedestrian crossing.	Staggering the pedestrian crossings within the median would provide more area for pedestrians to store within the median, however could result in higher delays for pedestrians waiting to cross the road.
The on-road cycle lane on Commonwealth Avenue southbound carriageway would be augmented to facilitate a safer crossing angle of the track.	Physical separation would be provided between traffic lanes and on-road cycle lanes for a short distance for improved safety.

Kerbside use

The Project would not change any kerbside uses within the Commonwealth Avenue precinct.

Off-street parking

State Circle East alignment option

The State Circle East alignment option would not change any off-street car parking within the Commonwealth Avenue precinct.

National Triangle-Barton alignment option

It is estimated that around 20 off-street car parking spaces (less than 5%) would be removed in the Langton car park for the National Triangle-Barton alignment option.

Historical aerial imagery and site observations on 11 June 2024 indicate this car park typically has some spare capacity on weekdays to cater for some of the 20 spaces lost for the National Triangle-Barton alignment option.

Local area access

The Project would not change any local area access arrangements within the Commonwealth Avenue precinct.

Property access

The Project would not change any local area access arrangements within the Commonwealth Avenue precinct.

12.2.4 Precinct specific management and mitigation measures

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the Commonwealth Avenue precinct.

12.3 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts associated with the construction and operation of the Project within the Commonwealth Avenue precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

12.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas were determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Area 1 was identified for the noise assessment of the Commonwealth Avenue precinct. Noise Catchment Area 1 and associated sensitive receivers are shown on Figure 12-10.

Noise Catchment Area 1 is primarily urban and includes noise sensitive receivers surrounding Commonwealth Avenue, both north and south of Lake Burley Griffin. North of Lake Burley Griffin, land uses within the catchment primarily comprise open spaces and parkland for passive recreation. There are some residential uses in the area north of Lake Burley Griffin, including the Archbishop's House.

South of Lake Burley Griffin, there are active recreation, commercial and public building land uses in the catchment area. These include Hyatt Hotel Canberra and Canberra Croquet Clubhouse and Lawns which are also heritage-listed places on the ACT Heritage Register. Other heritage places have also been identified as being potentially susceptible to noise and vibration impacts from works in Commonwealth Avenue precinct, including Albert Hall (listed on the ACT Heritage Register) and the Treasury Building (nominated for the Commonwealth Heritage List). Further detail on heritage places in the precinct is included in Section 12.5.

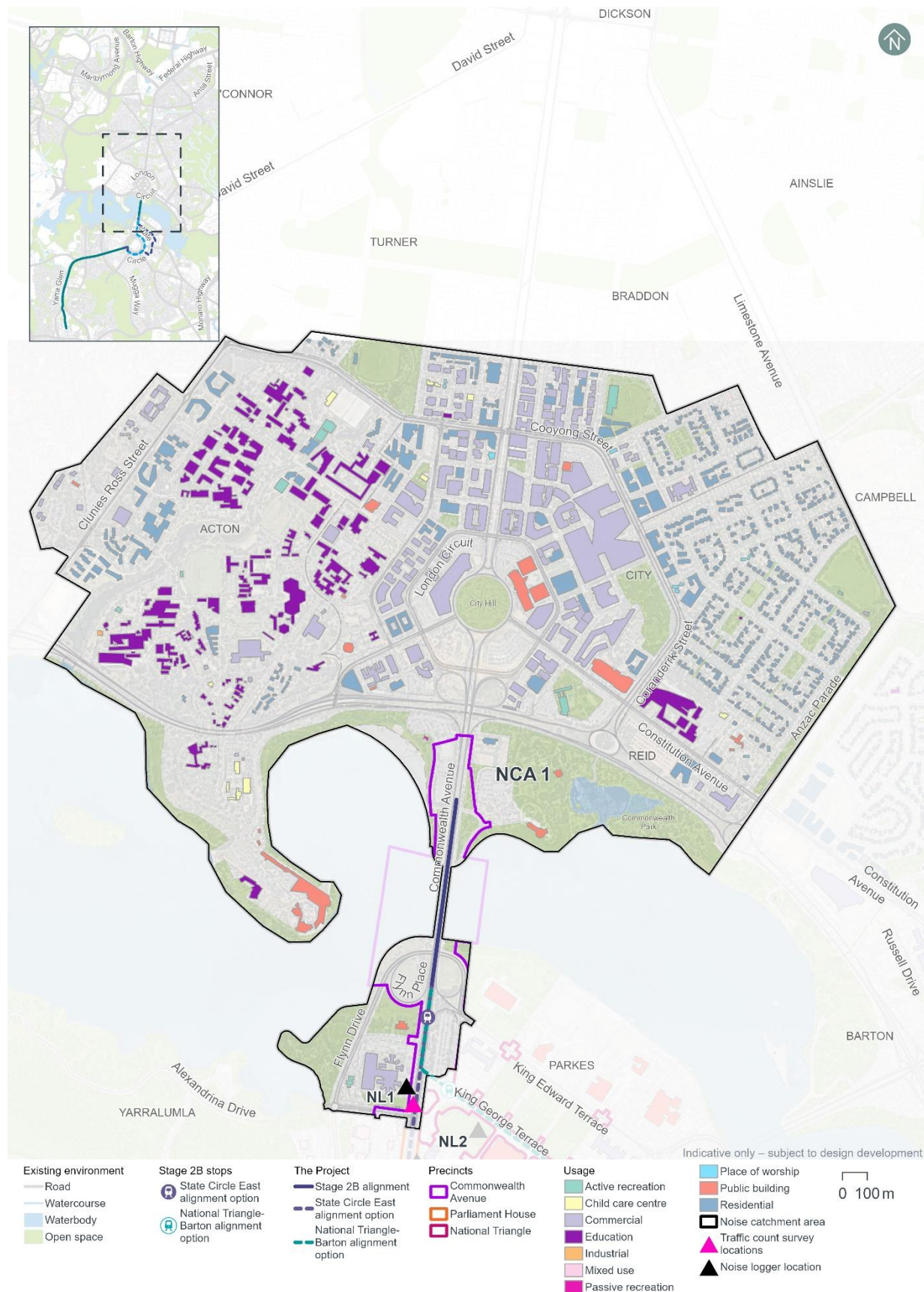


Figure 12-10 Noise catchment area and sensitive receivers – Commonwealth Avenue precinct

Existing noise levels

Unattended noise monitoring was carried out at one location in the Commonwealth Avenue precinct (at noise logger 1 (NL1)) between 2 and 13 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 12-15.

The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 12-15 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL1	Hyatt Hotel Canberra 120 Commonwealth Avenue, Yarralumla	52	35	60	52

Notes:

- $dB(A)$ represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
- In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 12-16.

Table 12-16 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL1	58	53	Noise recorded mostly reflected constant traffic, including trucks and cars. Distant traffic was audible during lulls in traffic.

Road traffic noise monitoring was also carried out at NL1, with data used to validate a road traffic noise model for the Project. The results of this monitoring are summarised in Section 2.5 of Technical Report 9 – Noise and vibration.

12.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this

assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Commonwealth Avenue precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (which includes construction of the covered section between Commonwealth Avenue and State Circle using equipment such as hammers and excavators)
- Construction of stops
- Construction of Commonwealth Avenue light rail bridges
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project, therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures).

All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls

identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Where relevant, construction scenarios have been assessed separately for each alignment option to reflect the different locations of proposed work.

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 12-17, which assumes no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 12-18.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Table 12-17 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place) – Commonwealth Avenue precinct

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 1				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	1	3	1
	Typical	-	1	-
Earthworks, road works, and construction of light rail (State Circle East alignment option)	Peak	-	1	-
	Typical	-	-	-
Earthworks, road works, and construction of light rail (National Triangle-Barton alignment option)	Peak	-	1	-
	Typical	-	-	-
Construction of stops (State Circle East alignment option)	Typical/peak	-	-	-
Construction of stops (National Triangle-Barton alignment option)	Typical/peak	-	-	-
Construction of Commonwealth Avenue light rail bridges	Peak	-	-	-
	Typical	-	-	-
Construction of bridges on land	Peak	-	-	-
	Typical	-	-	-

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

**Table 12-18 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) –
Commonwealth Avenue precinct**

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 1		
Mobilisation and establishment of construction compound sites - peak	Passive recreation	1
	Public buildings	1
Protection, relocation, treatment and/or decommissioning of utilities - peak	Active recreation	1
	Passive recreation	1
	Public buildings	1
Protection, relocation, treatment and/or decommissioning of utilities - typical	Active recreation	1
Earthworks, road works, and construction of light rail infrastructure – peak (State Circle East alignment option)	Active recreation	1
	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – typical (State Circle East alignment option)	Active recreation	1
	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – peak (National Triangle-Barton alignment option)	Active recreation	1
	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – typical (National Triangle-Barton alignment option)	Active recreation	1
	Public buildings	1
Construction of bridges on land - peak	Public buildings	1

Notes:

1. Where a construction scenario did not result in any non-residential receiver being moderately noise affected, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the Commonwealth Avenue precinct during the daytime indicate:

- In the majority of scenarios, no residential buildings have been identified as moderately noise affected
- The 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario is predicted to result in one residential building being moderately noise affected, north of Lake Burley Griffin
- The 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario would result in the highest number of instances where non-residential buildings are predicted to be moderately noise affected. Three non-residential buildings are predicted to be moderately noise affected, including Albert Hall (listed on the Commonwealth Heritage List), Canberra Croquet Clubhouse and Lawns (listed on the ACT Heritage Register) and Acton Park pavilion. For each building usage identified in Table 12-18, the moderately noise affected non-residential receiver is the same across the construction scenarios.

The findings of the unmitigated peak and typical construction noise impact assessments for the Commonwealth Avenue precinct during night-time period indicate:

- During out of hours, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in the highest number of residential buildings where receivers may be moderately noise affected. Three residential buildings are expected to be moderately noise affected, and one residential building – the Archbishop's House (located north of Lake Burley Griffin) – is predicted to be highly noise affected
- During out of hours, 'typical' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in one residential receiver, north of Lake Burley Griffin, being moderately noise affected. No residential receivers are expected to be highly noise affected
- Hotel (commercial) buildings have also been assessed for the night-time period, however no receivers were predicted to be moderately noise affected. Construction impacts at hotels within the Commonwealth Avenue precinct are discussed further in Section 5.1 of Technical Report 9 – Noise and vibration.

Construction of the covered section between Commonwealth Avenue and State Circle (required for the State Circle East alignment option only) would be carried out in the Parliament House precinct, in the vicinity of the Commonwealth Avenue precinct. Covered section construction is assessed in the earthworks, road works and construction of light rail infrastructure scenario. If piling activities are carried out around the covered section construction area, noise levels could increase by up to 1 dB(A) for 'peak' works, and up to 3 dB(A) for 'typical' works. Where this occurs, potential increase in noise levels of up to 3 dB(A) may impact receivers in the neighbouring Commonwealth Avenue precinct.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical' works case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 12-19 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Area 1, in the absence of mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently, and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is

considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 12-19 Number of residential buildings where noise levels may exceed sleep awakening reaction levels for night work (assuming no mitigation measures are in place)

Construction scenario (typical works)	Number of residential buildings where unmitigated noise levels may exceed the sleep awakening reaction level
Protection, relocation, treatment and/or decommissioning of utilities	1
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	1
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	1
Construction of stops (State Circle East alignment option)	-
Construction of stops (National Triangle-Barton alignment option)	-
Construction of Commonwealth Avenue light rail bridges	-
Construction of bridges on land	-

Noting the awakening reaction level is only exceeded by one residential building north of Lake Burley Griffin with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (for both alignment options).

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. No residential buildings are located within the human response minimum working distance for a large hydraulic hammer (within 73m of the Project area boundary), and therefore exceedances of human response criteria are not predicted.

Cosmetic damage

No light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures).

Several heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage and other sensitive structures).

Heritage structures that may potentially be affected by vibration from large hydraulic hammers and other proposed vibratory plant and equipment are listed in Table 12-20. Potential impacts to heritage are further discussed in Section 12.5.

Table 12-20 Heritage items within 60 m (minimum working distance for a large hydraulic hammer) of the Project area

Heritage place name	Distance between Project area and heritage structure (m)
Albert Hall (ACT Heritage Register Registered Place)	25
Hotel Canberra (ACT Heritage Register Registered Place)	40
Canberra Croquet Clubhouse and Lawns (ACT Heritage Register Registered Place)	5
Treasury Building (Commonwealth Heritage List Nominated Place)	14

This presents a worst-case unmitigated assessment which has assumed that vibration-intensive equipment could be used at the boundary of the Project area. In reality, vibration intensive equipment is not likely to be used throughout the entire Project area. Instead, this equipment would typically be limited to areas of the footprint away from the boundary of the Project area, where it could be used to construct the light rail alignment, for example, in road medians and verges.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring, and consultation with the sensitive receivers would be undertaken. Further detail on the approach to managing potential vibration impacts is included in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network, with Commonwealth Avenue serving as the key route for construction traffic within this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (assessed for AM peak period (8am to 9am) and night-time (assessed for 10pm to 7am) and are presented in Table 12-21. The year 2031 was selected as representative of the peak year of construction.

No increases in road traffic noise greater than 2 dB(A) have been identified along the proposed haulage routes within the Commonwealth Avenue precinct. Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener.

Table 12-21 Construction road traffic noise peak hourly traffic counts

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Commonwealth Avenue between Flynn Drive and Coronation Drive	Northbound	1,132	85	2	2	0.0
	Southbound	1,646	124	2	2	0.0
Night-time assessment						
Commonwealth Avenue between Flynn Drive and Coronation Drive	Northbound	172	13	14	1	0.3
	Southbound	196	15	14	1	0.3

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

12.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Commonwealth Avenue precinct. Both the State Circle East and National Triangle-Barton alignment options travel through the Commonwealth Avenue precinct, and have been assessed in the following sections.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of each alignment option. This involved assessment of noise levels at a total of 15 receivers in the Commonwealth Avenue precinct, including residential receivers, public buildings, active recreation receivers, and passive recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

For each alignment option, the results of the operational rail noise assessment indicated compliance with both daytime and night-time airborne noise trigger levels. No exceedances of the trigger levels were predicted. Rail noise impacts would be intermittent and last for a relatively short duration as the LRV passes the receiver, would not represent a constant noise source.

Operational rail noise contours for the Project are presented in Appendix F of Technical Report 9 – Noise and vibration.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Commonwealth Avenue precinct at the most affected (closest) receiver – the British High Commission Canberra at 130 Commonwealth Avenue, Yarralumla – for the State Circle East alignment option are presented in Table 12-22. For the National Triangle-Barton alignment option, potentially affected receivers are over 50 m away and ground-borne noise levels are predicted to be below relevant criteria.

No sensitive receivers are expected to experience ground-borne noise levels over the trigger levels, for either alignment option.

Table 12-22 Commonwealth Avenue precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted Ground-borne noise, dB(A) L_{ASmax}
State Circle East alignment option					
British High Commission Canberra (130 Commonwealth Avenue, Yarralumla)	Public Building	37	45	40	31

Rail vibration assessment

The predicted vibration levels for Commonwealth Avenue precinct at the most affected (closest) receivers for each alignment option are presented in Table 12-23. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria, for either alignment option.

Table 12-23 Commonwealth Avenue precinct – vibration assessment results (human comfort; assuming no mitigation measures are in place)

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), $m/s^{1.75}$	Predicted equivalent vibration dose value (Daytime), $m/s^{1.75}$	Vibration Criteria (Night), $m/s^{1.75}$	Predicted equivalent vibration dose value (Night), $m/s^{1.75}$
State Circle East alignment option					
The Clubhouse Fitness Centre (120 Commonwealth Avenue, Yarralumla) <i>Commercial</i>	66	0.4	0.003	0.4	0.002
British High Commission Canberra (130 Commonwealth Avenue, Yarralumla) <i>Public building</i>	37	0.4	0.005	0.4	0.003
National Triangle-Barton alignment option					
The Clubhouse Fitness Centre (120 Commonwealth Avenue, Yarralumla) <i>Commercial</i>	66	0.4	0.003	0.4	0.002

The Commonwealth Avenue precinct lies in proximity to Albert Hall, Hotel Canberra, and the Canberra Croquet Clubhouse and Lawns which are heritage items listed on the ACT Heritage Register, the Treasury Building, nominated for the Commonwealth Heritage List, and the National Library of Australia and Surrounds listed under the Commonwealth Heritage List. None of these heritage receivers are expected to be adversely affected by operational rail vibration due to the distance to the track centreline.

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is presented in Table 12-24.

Table 12-24 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected as the most representative dataset for the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth, and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Commonwealth Avenue precinct, existing road traffic noise levels are between 55-60 dB(A). Future predicted road traffic noise levels would not exceed 60 dB(A), and are therefore considered acceptable.

The results of the road traffic noise assessment for each alignment option are presented in Table 12-25 to Table 12-28, for 2031 and 2041 scenarios respectively.

Table 12-25 Road traffic noise assessment, 2031 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Commonwealth Avenue	Hyatt Hotel Canberra	Northbound	20,679	2,045	4,742	469	0	Yes, no increase in traffic noise level
		Southbound	34,759	3,438	-6,370	-630		

Table 12-26 Road traffic noise assessment, 2031 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Commonwealth Avenue	Hyatt Hotel Canberra	Northbound	20,679	2,045	4,285	424	0	Yes, no increase in traffic noise level
		Southbound	34,759	3,438	-7,969	-788		

Table 12-27 Road traffic noise assessment, 2041 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Commonwealth Avenue	Hyatt Hotel Canberra	Northbound	16,744	1,656	5,099	504	0	Yes, no increase in traffic noise level
		Southbound	36,152	3,575	-8,448	-836		

Table 12-28 Road traffic noise assessment, 2041 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Commonwealth Avenue	Hyatt Hotel Canberra	Northbound	16,744	1,656	5,480	542	0	Yes, no increase in traffic noise level
		Southbound	36,152	3,575	-9,057	-896		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the $L_{A10, 15 \text{ minute}}$ assessment noise level at any location.

Within the Commonwealth Avenue precinct, the Albert Hall Stop is proposed for the State Circle East alignment option only. The closest receiver with potential sensitivity to PA system announcements is the Hyatt Hotel Canberra at 120 Commonwealth Avenue. The subjective impacts are likely to be minimal, given the relative infrequency of announcements, and existing background noise levels.

No other fixed operational facilities are proposed in the Commonwealth Avenue precinct.

12.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage noise and vibration impacts that are specific to the Commonwealth Avenue precinct are shown in Table 12-29.

Table 12-29 Noise and vibration mitigation measures – Commonwealth Avenue precinct

ID	Objective	Management and mitigation measure	Timing
NV8	Minimising night-time construction road traffic noise	Where night-time road traffic noise levels at sensitive receivers are predicted to increase by more than 2 dB(A), alternative construction vehicle haulage routes will be investigated. Where there are no alternative haulage routes available early consultation with the affected sensitive receivers will be undertaken.	Construction

12.4 Biodiversity

This section provides an assessment of the potential biodiversity impacts associated with the construction and operation of the Project for the Commonwealth Avenue precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 3 of Technical Report 2 – Biodiversity.

12.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Commonwealth Avenue precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 13.75 ha of vegetation is present in the Commonwealth Avenue precinct. Vegetation within the precinct is comprised of four vegetation communities. Table 12-30 and Figure 12-11 depict the area and distribution of each vegetation community within the Commonwealth Avenue precinct.

Table 12-30 Extent of vegetation communities within Project area in the Commonwealth Avenue precinct

Vegetation community	Area (ha)
Non-local native ground cover	0.07
Landscape plantings – Native	1.38
Landscape plantings – Exotic	5.63
Exotic grassland	6.67
Total vegetation	13.75



Figure 12-11 Vegetation communities, hollow-bearing and mature trees in the Commonwealth Avenue precinct

Hollow-bearing trees and mature trees

A total of 35 hollow-bearing trees and 64 mature trees have been recorded in the Commonwealth Avenue precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 12-31 summarises the number of hollow-bearing and mature trees within the Commonwealth Avenue precinct and is shown on Figure 12-11.

Field surveys carried out between 2022 and 2024 have identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 12-31 Summary of hollow-bearing and mature trees within the Project area in the Commonwealth Avenue precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Commonwealth Avenue	35	0	30	9	9	4	64

- Notes:
1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat

The Golden Sun Moth (*Synemon plana*) is listed as vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 2014* (ACT) (NC Act). A total area of 0.86 ha of potential Golden Sun Moth habitat was recorded within the Commonwealth Avenue precinct. This habitat was identified as high-density Chilean needlegrass habitat (refer to Figure 12-12).



Figure 12-12 Golden Sun Moth potential habitat and sightings in the Commonwealth Avenue precinct

One Golden Sun Moth population has been identified in the Commonwealth Avenue precinct, through previous biodiversity assessments reviewed for this Environmental Impact Statement (EIS) (ARUP, 2021). The location of the population is shown on Figure 12-12. Other Golden Sun Moth individuals, populations and habitat across the Project area are identified in Section 11.2 of Chapter 11 (Project-wide issues).

Other potential threatened fauna habitat identified within the Commonwealth Avenue precinct includes:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (listed as endangered under both the EPBC Act and the NC Act) – the Commonwealth Avenue precinct supports 1.38 ha of foraging habitat and 13 breeding trees for the species (refer to Figure 12-13)
- Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable under both the EPBC Act and the NC Act) – the Commonwealth Avenue precinct supports 1.38 ha of foraging habitat for this species (refer to Figure 12-13)
- Diamond Firetail (*Stagonopleura guttata*) (listed as vulnerable under both the EPBC Act and the NC Act.) – 1.38 ha Landscape Planting – Native community has been identified within the Commonwealth Avenue precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 12-13).

No habitat has been identified in the Commonwealth Avenue precinct for the Swift Parrot (*Lathamus discolor*), Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberra*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).

Grey-headed Flying-fox (*Pteropus poliocephalus*) (listed as vulnerable under both the EPBC Act and the NC Act) – a colony of Grey-headed Flying -inhabits Commonwealth Park, outside the Project area and adjacent to the northern shoreline of Central Basin (around 350 m east of Commonwealth Avenue precinct).

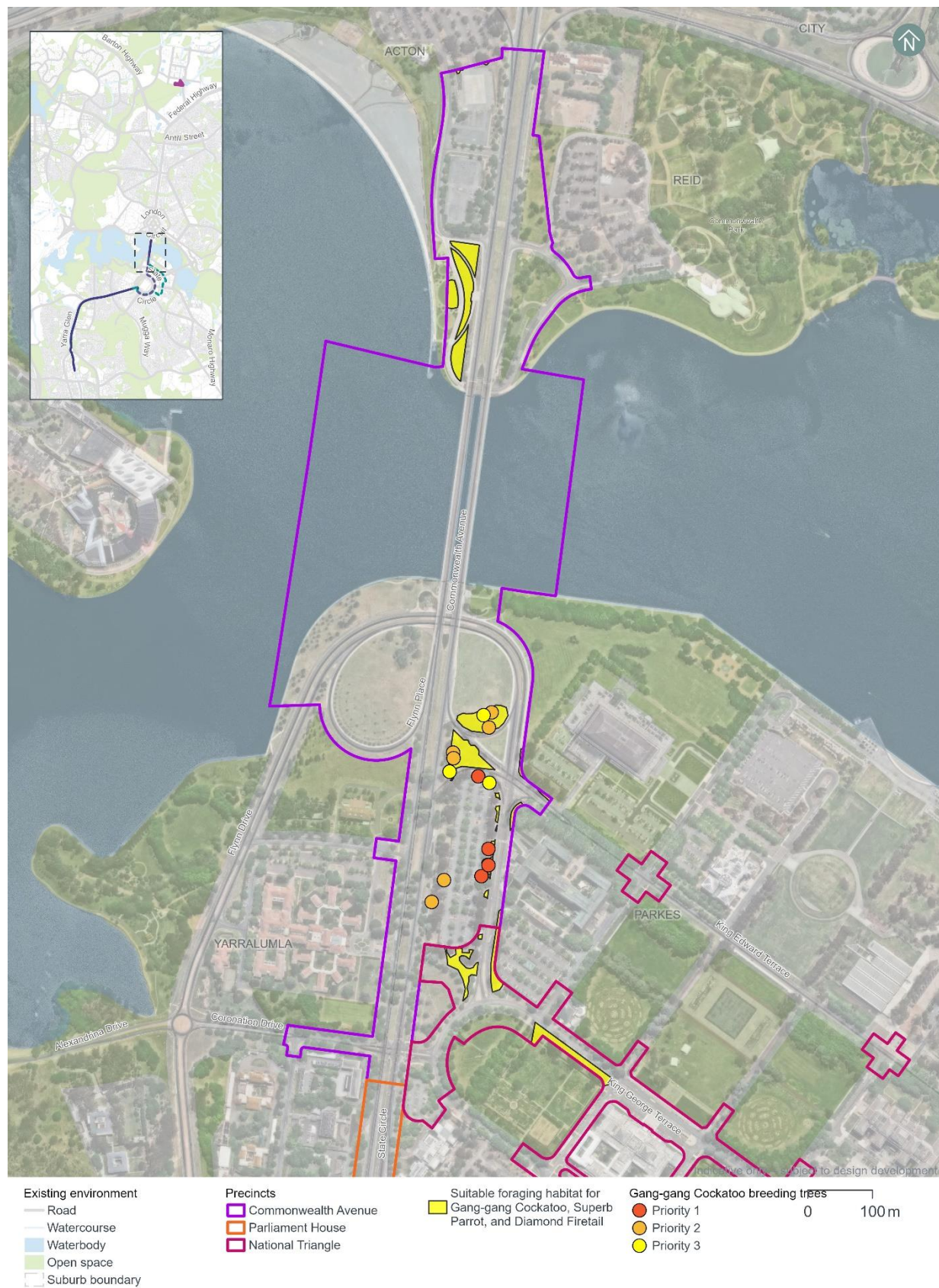


Figure 12-13 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Commonwealth Avenue precinct

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Commonwealth Avenue precinct. Impacts to threatened or rare flora species are therefore not anticipated.

One pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) has been recorded in the Commonwealth Avenue precinct. The pest species, the Chilean needlegrass (*Nassella neesiana*), is also a Weed of National Significance.

12.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Commonwealth Avenue precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown on Figure 12-14. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of three vegetation communities as summarised in Table 12-32. Only 0.01 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 12-32 **Extent of vegetation communities within the clearance footprint in the Commonwealth Avenue precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	0.01
Landscape plantings – Exotic	0.95
Exotic grassland	1.13
Total vegetation	2.09

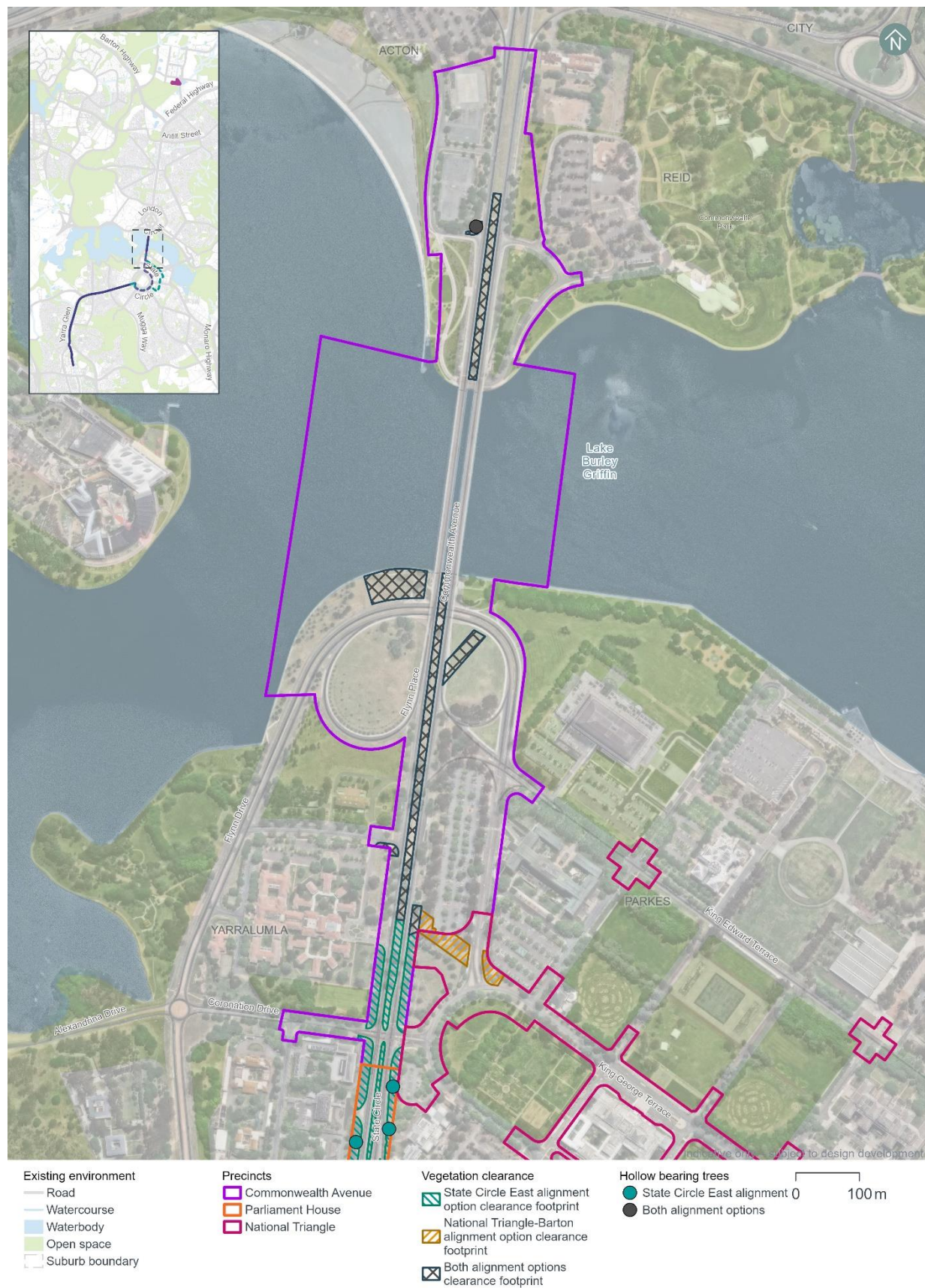


Figure 12-14 Clearance footprint in the Commonwealth Avenue precinct

Only one hollow-bearing tree and one mature native tree have been recorded within the clearance footprint in the Commonwealth Avenue precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence. Table 12-33 summarises the number of hollow-bearing and mature native trees within the Commonwealth Avenue precinct and is shown on Figure 12-14.

Table 12-33 Hollow-bearing and mature native trees within the clearance footprint in the Commonwealth Avenue precinct

Precinct	Number of hollow-bearing trees	Hollows					Number of mature native trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Commonwealth Avenue	1	0	1	0	0	0	1

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Commonwealth Avenue precinct would include impacts on the following through habitat removal:

- Gang-gang Cockatoo – 0.01 ha of foraging habitat, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 0.01 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 0.01 ha of Landscape Planting – Native within the precinct which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the whole clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Commonwealth Avenue precinct clearance footprint for the Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint, may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works (for example, potentially impacting the Grey-headed Flying-fox camp north-east of the precinct)
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Section 11.2.2 of Chapter 11 (Project-wide issues).

12.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike.

There would be no over-head wiring installed in this precinct as part of the Project and therefore there would be no risk of fauna strike with over-head wires. Further detail on these indirect impacts for operational activities is discussed in Section 11.2.3 of Chapter 11 (Project-wide issues).

12.4.4 Precinct specific management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, including through the development of a minimised clearance footprint within the Project area (refer to Figure 12-14).

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Commonwealth Avenue precinct.

12.5 Historic heritage

This section provides an assessment of the potential historic heritage impacts associated with the construction and operation of the Project within the Commonwealth Avenue precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

12.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Commonwealth Avenue precinct. This section also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The Commonwealth Avenue precinct's heritage character arises from its importance in defining the National Triangle and Parliamentary Zone, as an original element of the Griffin Plan for Canberra (Griffin Plan).

The Commonwealth Avenue precinct provides a formal axis in the landscape, and frames key views to and within the Central National Area. The character is underlined by its function of serving as a gateway to Canberra, a civic and national avenue for ceremonial and public purpose; and its position as one side of the National Triangle.

Commonwealth Avenue's layout, its width as a boulevard, with wide green verges and medians, with uniformly planted historic trees plantings are significant. Charles Weston, Director of City Planning and Superintendent of Parks and Gardens from 1921, was one key figure who designed and planted the National Triangle with avenues, formal plantings, 'outdoor rooms', and architecturally designed buildings.

Within the precinct, the following historical characteristics are represented:

- The 1920s era – distinct along the southern portion of Commonwealth Avenue, demonstrated by the extant Weston-planted evergreens and their uniformity, the road geometry, generous verges and setting of nearby historic places
- The 1960s era – distinct along the northern portion of the precinct and Commonwealth Avenue Bridge, as designed by the National Capital Development Commission.

The historic heritage assessment identified nine heritage places (five listed, one nominated, and 3 unlisted) heritage places within and surrounding the Commonwealth Avenue precinct, as noted below in Table 12-34 and shown on Figure 12-15.

Table 12-34 Heritage places within and surrounding the Commonwealth Avenue precinct

Heritage places	Description
Commonwealth Heritage List	
Lake Burley Griffin and Adjacent Lands (including Commonwealth Avenue Bridge) (refer to Figure 12-16)	<p>This landscape is a significant part of the Griffin Plan, and the layout of Canberra as Lake Burley Griffin is used to arrange city elements and connect surrounding natural features. There are multiple vistas along the Water Axis (a view line running through Lake Burley Griffin perpendicular to the Land Axis) and between the Commonwealth Avenue Bridge. It is valued by Australians and the Canberran community as a landmark of Canberra, the focus of the Central National Area designed landscape, and as an aesthetically pleasing feature of the city.</p> <p>Lake Burley Griffin is significant as forming part of the Water Axis which Griffin used to arrange city elements and connect surrounding natural features. The grand scale of lake vistas along the Water Axis and in other areas gifts the National Triangle and city a sense of grandeur and beauty.</p>
Parliament House Vista	<p>The Parliament House Vista along the Land Axis (formed by the view line between Capital Hill and Mount Ainslie) is the most iconic of the intentional vistas created in the Griffin Plan. The open sweeping vista along the Land Axis is experienced in two directions and creates a dramatic view terminating in Capital Hill at one end and Mount Ainslie at the other.</p> <p>The Aboriginal Tent Embassy is included in the Commonwealth Heritage List citation for the Parliament House Vista and is generally understood to be of high cultural significance to both the Aboriginal community and the wider population. This is due to it being significant as a place of political protest and action. The establishment of the embassy was a defining event which brought Aboriginal rights to an international arena. It represents the ongoing political struggle of Aboriginal people and is part of Australia's political heritage.</p> <p>Given this vista spans across multiple precincts, it is assessed further in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>

Heritage places	Description
Treasury Building (nominated)	<p>The Treasury Building, located on the southern side of King Edward Terrace, is a significant heritage place on Commonwealth Land. Though it is not included in the Commonwealth Heritage List it has been nominated to the list and its heritage values assessed through its heritage management plan.</p> <p>The Treasury Building has significant historic and aesthetic heritage values that are derived from its connection with the Griffin Plan, its strong expression of the Late Twentieth Century Stripped Classical style of architecture and its visual and physical relationship with the John Gorton Building in the context of the Parliament House Vista.</p>
ACT Heritage Register	
Albert Hall	<p>Albert Hall, its historical site boundary, the adjacent landscape, and its historical setting, including views and vistas to the former Hotel Canberra, Lake Burley Griffin, and Commonwealth Avenue, hold aesthetic heritage values embodied in its architecture, landscape, and interior design.</p> <p>Albert Hall is significant as an example of the architecture of Canberra's Federal Capital era of the early 19th century, when the city was first being established and a distinctive architectural character was being sought that was equal to the city's status as the national capital.</p>
Hotel Canberra (refer to Figure 12-18)	<p>Hotel Canberra exemplifies the design attributes of the Federal Capital era at that time. Attributes which express these values include the building, its pavilions and courtyards, and its garden setting.</p> <p>It is historically important for the role it played in providing accommodation for early Members of Parliament and public servants.</p>
Canberra Croquet Clubhouse and Lawns	<p>Canberra Croquet Clubhouse and Lawns is historically significant as one of the few early social focal points for women associated with Parliamentarians and Government offices.</p> <p>It contributes to the historic streetscape along Commonwealth Avenue, which also includes the Hotel Canberra and Albert Hall (the croquet lawn was once part of the facilities for guests at Hotel Canberra).</p>
Unlisted significant heritage places	
Commonwealth Avenue Bridge (refer to Figure 12-17)	<p>Commonwealth Avenue Bridge is historically significant as an important part of Lake Burley Griffin and represents a significant part of Canberra's planning history, landscape design, and development.</p> <p>It is highly valued by the Canberra community for its aesthetic and social significance; its architectural design which complements its setting, its elegance and simplicity, and views to and from the bridge. Under the northern end of Commonwealth Avenue Bridge is the Waterloo Bridge Memorial. Two large granite blocks were presented to Australia from the demolished Waterloo Bridge in London as a historic link to the United Kingdom and sit between the spans just above shore level.</p>

Heritage places	Description
Parliament House and surrounds	<p>Parliament House and surrounds is culturally significant as a creative and technical achievement in the way the architecture integrates with the landscape to symbolise the area as the centre of Canberra, and the focal point of the Parliamentary Triangle, expressing the Griffin Plan's concept for a capital that symbolises democracy.</p> <p>Given this heritage place spans multiple precincts, this is assessed further in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, this is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 12-15 and is not considered further in this precinct assessment.</p>

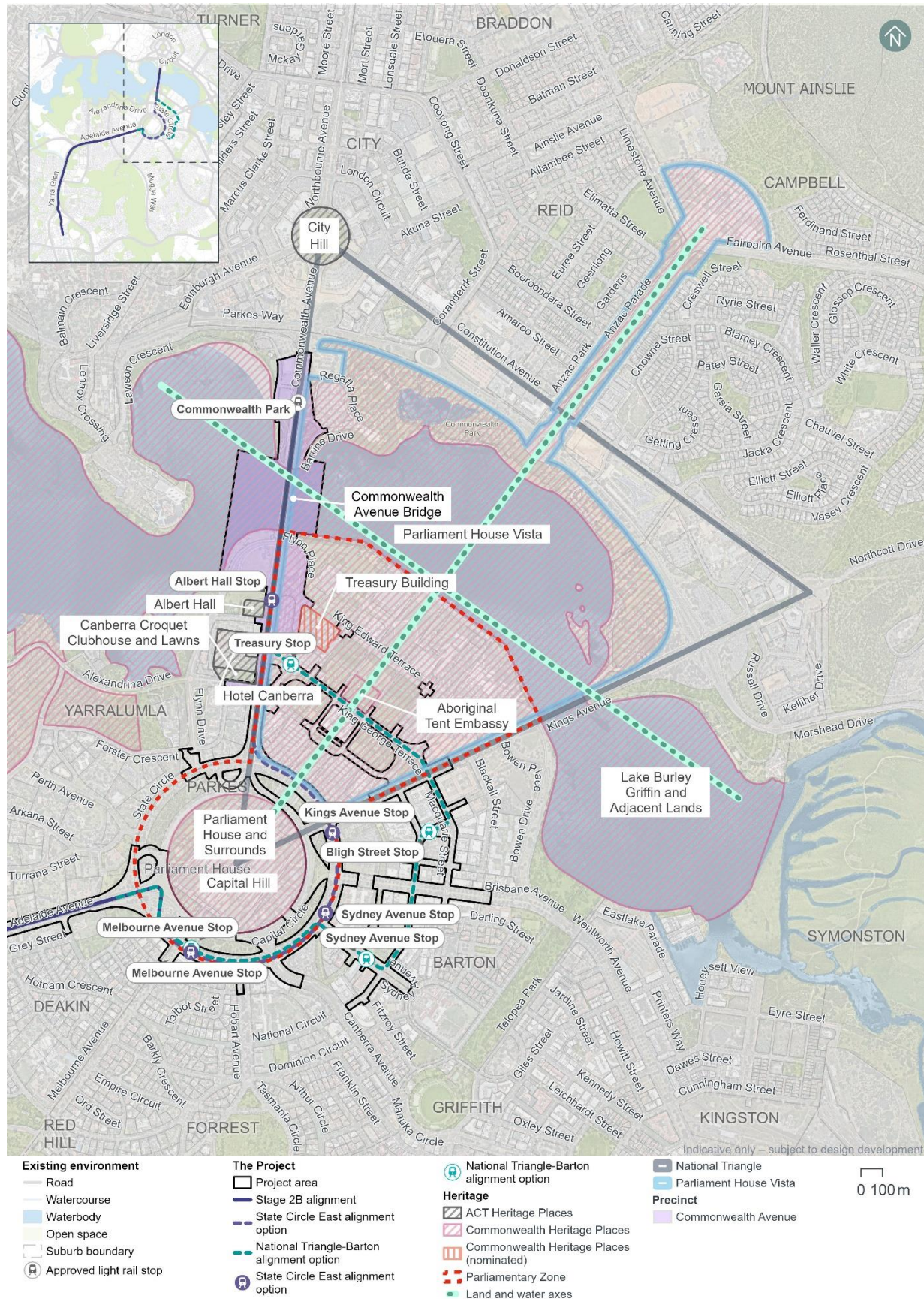


Figure 12-15 Heritage places relevant to the Commonwealth Avenue precinct



Figure 12-16 Lake Burley Griffin and Commonwealth Avenue Bridge viewed from the north side of Lake Burley Griffin



Figure 12-17 Commonwealth Avenue Bridge looking south along Commonwealth Avenue



Figure 12-18 Hotel Canberra on the west side of Commonwealth Avenue

Condition, integrity, and sensitivity to change

The existing heritage condition within the Commonwealth Avenue precinct is good. Some avenue trees are in poorer health but most have been identified as in fair to good condition. The historical structures associated with the precinct (Parliament House, Albert Hall, and Hotel Canberra) are in use and well maintained.

The integrity of the heritage values is good. The original design character of the Griffin Plan and the historical layers of the landscape are generally intact and legible. While some alterations have been made over time, for example the removal of some Weston era trees by the National Capital Development Commission associated with the construction of Parliament House, and alterations to the original Griffin Plan road geometry on the eastern side of Commonwealth Avenue, the status, symbolism and importance of the precinct is well-expressed.

The Commonwealth Avenue precinct is highly sensitive to change based on the precinct's significance, condition, and integrity. As a landscape of outstanding national importance, with a strong, formal character, alterations to this precinct are highly likely to impact on its heritage significance.

The integrity of its original features, heritage significance, and good condition mean that changes could have consequential impacts on not only the heritage character of the precinct, but the broader heritage significance of Canberra's Central National Area (as assessed in Section 11.3 of Chapter 11 (Project-wide issues)).

12.5.2 Potential impacts – construction

Table 12-35 summarises the potential construction impacts of the Project on heritage places in the Commonwealth Avenue precinct. Table 12-35 considers the impact of both alignment options noting that the two alignment options only diverge in the southern part of the precinct (refer to Figure 12-15).

Table 12-35 Construction impacts on heritage places within the Commonwealth Avenue precinct

Heritage place	Construction impact State Circle East alignment option	Construction impact National Triangle-Barton alignment option
Commonwealth Heritage List		
Lake Burley Griffin and adjacent lands (including Commonwealth Avenue Bridge)	Moderate <ul style="list-style-type: none">Minor visual impacts from temporary infrastructure on land and the waterTemporarily restricting full access to parts of Lake Burley Griffin due to temporary infrastructure.	
Treasury Building (nominated)	Minor <ul style="list-style-type: none">No direct impacts to heritage placeTemporary impacts to the visual setting of this heritage placeTechnical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near Treasury Building within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures	
ACT Heritage Register		
Albert Hall	Moderate to significant <ul style="list-style-type: none">Alterations to the immediate setting of Albert Hall from the removal of historical trees on the median of Commonwealth Avenue would diminish the expression of its historical landscape setting and connection with the broader design principles for Canberra.Minor visual impacts from temporary infrastructureTechnical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near Albert Hall within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).	
Hotel Canberra	Nil <ul style="list-style-type: none">No direct impacts to heritage placeTemporary impacts to the visual setting of this heritage placeTechnical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near Hotel Canberra within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).	

Heritage place	Construction impact State Circle East alignment option	Construction impact National Triangle-Barton alignment option
Canberra Croquet Clubhouse and Lawns	Minor to moderate <ul style="list-style-type: none"> Alterations to the landscape setting of the Canberra Croquet Clubhouse and Lawns from the removal of a historic tree on the eastern side of Commonwealth Avenue within the heritage place boundary would diminish the significant connection with the historic streetscape along Commonwealth Avenue Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near Croquet Clubhouse within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures). 	Nil <ul style="list-style-type: none"> No direct impacts to heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near Croquet Clubhouse within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Unlisted significant heritage places		
Commonwealth Avenue Bridge	Moderate <ul style="list-style-type: none"> Potential accidental physical impacts from construction works Minor visual impacts from temporary infrastructure on land and the water Relocating the Waterloo Bridge Memorial to a nearby location (final location has not yet been selected) As part of construction of the light rail bridge, there is the potential for vibration-intensive equipment to be operated near Commonwealth Avenue Bridge within a minimum working distance for cosmetic (or potentially structural) damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures). 	

Construction impacts on Parliament House Vista, Parliament House and surrounds, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

12.5.3 Potential impacts – operation

Table 12-36 summarises the potential operation impacts of the Project on heritage places in the Commonwealth Avenue precinct.

Table 12-36 Operation impacts on heritage places within the Commonwealth Avenue precinct

Heritage place	Operation impact State Circle East alignment option	Operation impact National Triangle-Barton alignment option
Commonwealth Heritage List		
Lake Burley Griffin and adjacent lands (including Commonwealth Avenue Bridge)	Significant <ul style="list-style-type: none"> The light rail bridge would alter large scale vistas of Lake Burley Griffin including Commonwealth Avenue where it travels over the lake The visual impact on Lake Burley Griffin and adjacent lands would be minimised by the use of wire-free running over the bridge and the design of the new bridge integrating with the height and form of the existing Commonwealth Avenue Bridge Impacts on other attributes of the heritage place, such as the lake as a whole, its edge treatments, function as part of the water axis, public places, and community uses would be minimal. 	
Treasury Building (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No vibration impacts to heritage place. 	Moderate <ul style="list-style-type: none"> No direct impacts to this heritage place The Treasury Stop platform near the intersection of King George Terrace and Langton Terrace and plantings in previously open spaces would diminish the expression of the significant historical view to the Treasury Building's south-western façade No vibration impacts to heritage place.
ACT Heritage Register		
Albert Hall	Moderate to significant <ul style="list-style-type: none"> No direct impacts to this heritage place Albert Hall Stop would alter historic views from Albert Hall to Commonwealth Avenue and obscure the historical significance of Albert Hall as an early landmark building of Canberra Tree replacement with a different species would be visually inconsistent with the historic plantings No vibration impacts to heritage place. 	Moderate <ul style="list-style-type: none"> No direct impacts to this heritage place Light rail corridor would alter the historic setting Tree replacement with a different species would be visually inconsistent with the historic plantings No vibration impacts to heritage place.

Heritage place	Operation impact State Circle East alignment option	Operation impact National Triangle-Barton alignment option
Hotel Canberra	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No vibration impacts to heritage place. 	
Canberra Croquet Clubhouse and Lawns	Nil <ul style="list-style-type: none"> The same species would be planted to replace the removed tree. It would be planted in a slightly different position from the original tree, but would not notably impact heritage values of the place No vibration impacts to heritage place. 	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No vibration impacts to heritage place.
Unlisted significant heritage places		
Commonwealth Avenue Bridge	Significant <ul style="list-style-type: none"> The light rail bridge would alter large scale vistas of Lake Burley Griffin including the view through the current void between the two spans of the Commonwealth Avenue Bridge looking towards Capital Hill and City Hill Weathered steel used on the light rail bridge could detract from the original bridge Views to and from Commonwealth Avenue Bridge specifically (separate but related to broader views of Lake Burley Griffin) would be altered by the addition of the central light rail bridge span and the running LRVs The visual impact would be minimised by the use of wire-free running, the narrow form of the light rail bridge, its consistent height with the existing bridge, and ensuring spacing and form of the new supporting pillars matches the existing road bridges Relocating the Waterloo Bridge Memorial to a nearby location that allows for the historical connection to be interpreted (final location has not yet been selected) No vibration impacts to heritage place. 	

Operation impacts on Parliament House Vista, Parliament House and surrounds, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

12.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage historic heritage impacts that are specific to the Commonwealth Avenue precinct are shown in Table 12-37.

Table 12-37 Historic heritage management and mitigation measures – Commonwealth Avenue precinct

ID	Objective	Management and mitigation measure	Timing
NH9	Relocation of Waterloo Bridge memorial	The Waterloo Bridge Memorial stones will be relocated close to its existing location to enable the continued interpretation of the historical connection between the memorial stones and Commonwealth Avenue Bridge, in consultation with the NCA and other stakeholders as relevant.	Construction

12.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Commonwealth Avenue precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural, and heritage attributes of the landscape, planning designations, and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown on Figure 12-19.

12.6.1 Existing environment

The Commonwealth Avenue precinct lies within the National Triangle, connecting Capital Hill and City Hill. The precinct also lies within the Parliamentary Zone, connecting with the National Triangle and Yarralumla Diplomatic Precinct.

City Hill and Capital Hill are landmark points at the northern and southern ends of Commonwealth Avenue. North of the existing Commonwealth Avenue road bridges, the precinct is characterised by roadway infrastructure, while south of Lake Burley Griffin, it features a formal, planted avenue with mature trees, characteristic of the Griffin Plan. This formal landscape frames the Parliament House vista, defining its historic character. Existing planting along Commonwealth Avenue includes deciduous English Elms and coniferous *Cedrus* and *Cupressus* species.

The existing Commonwealth Avenue road bridges, crossing over Lake Burley Griffin, add to the precinct's landscape and visual values. Nearby heritage-listed items include Albert Hall, Hotel Canberra, and Canberra Croquet Clubhouse and Lawns. Section 12.5 provides further information on historic heritage items and characteristics of the Commonwealth Avenue precinct.

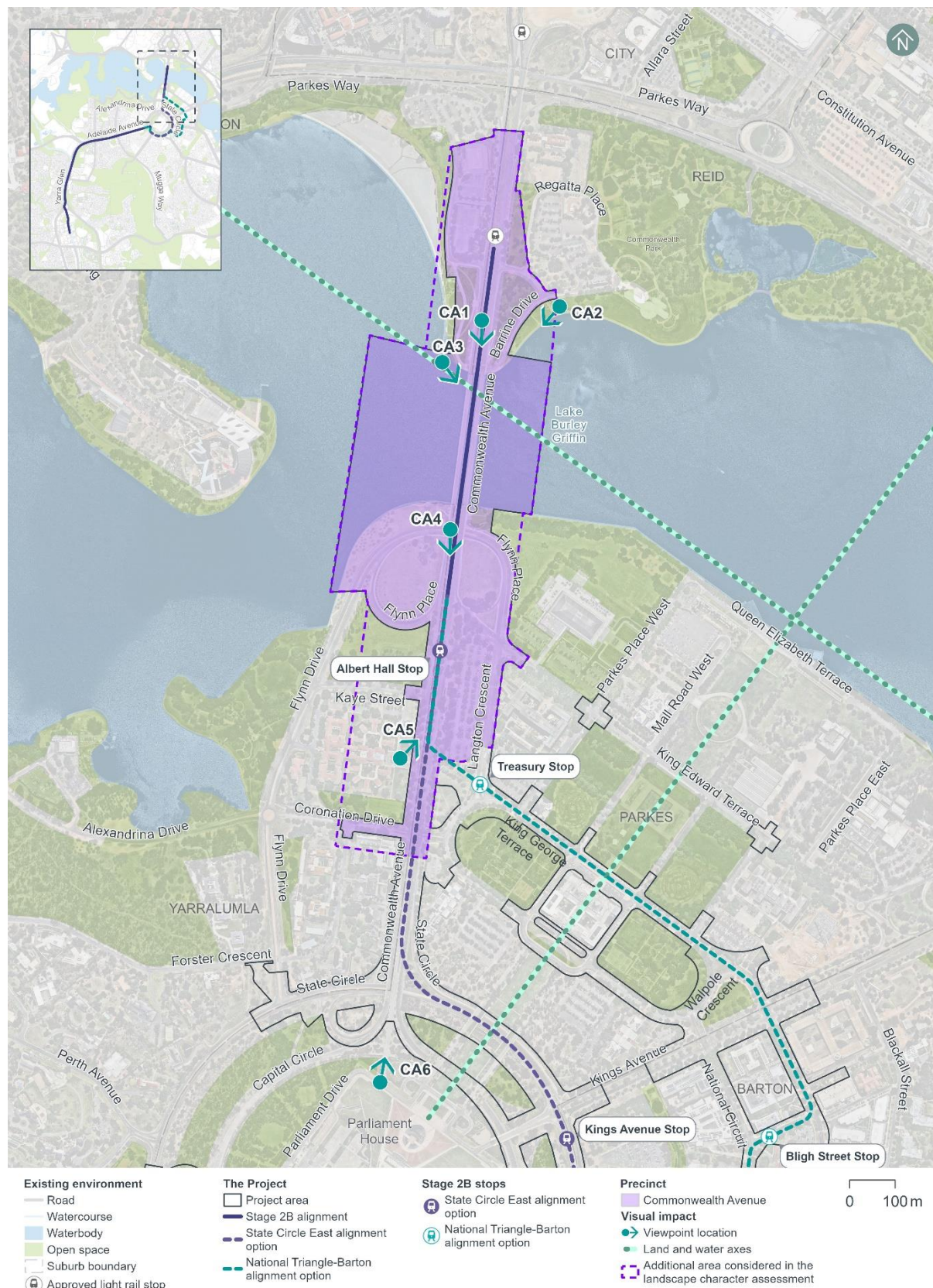


Figure 12-19 Landscape character zone and viewpoints in the Commonwealth Avenue precinct

Landscape character

Commonwealth Avenue transitions from an urban ‘motorway’ setting north of the existing Commonwealth Avenue road bridges (which includes the southern-most extent of the approved Light Rail Stage 2A (LRS2A) in the median) to a formal, planted avenue to the south of Lake Burley Griffin, with mature street-trees within both the verges and median, characteristic of the Griffin Plan. Key images showing the landscape character in the Commonwealth Avenue precinct can be seen on Figure 12-20 to Figure 12-22.



Figure 12-20 View looking north along Commonwealth Avenue from north of Lake Burley Griffin



Figure 12-21 View looking south along Commonwealth Avenue from south of Lake Burley Griffin

Lake Burley Griffin is one of the key landscape features within Canberra and a landmark within this precinct. Its values include its aesthetic qualities, its presence, and importance in the Land and Water Axes, as an iconic cultural landscape and symbol of identity, as a recreational and tourist destination, as a key component of the Griffin Plan, and its association with the creation of the National Capital.

Within the central Lake Burley Griffin area, the lake edges are connected by a wide recreational shared path, with a parkland landscape beyond featuring native and exotic trees. The newly constructed Henry Rolland Park (refer to Figure 12-22), exhibits the continuing value placed on green space surrounding the lake with the conversion of carparking to public open space.

South of Lake Burley Griffin, the Commonwealth Avenue precinct is flanked by the suburb of Yarralumla to the west, characterised by diplomatic missions, including both **embassies** and **high** commissions. The National Triangle is positioned to the east and Parliament House to the south.



Figure 12-22 Henry Rolland Park, with the Commonwealth Avenue road bridges visible in the background

The precinct contains several listed heritage items contributing to its heritage values including the Parliament House Vista (Commonwealth Heritage List (CHL)), Hotel Canberra (ACT Heritage Register (ACTHR)), Albert Hall (ACTHR), and Canberra Croquet Clubhouse Lawns (CHL and ACTHR). Further information on the heritage items listed above can be found in Section 12.5.

Viewpoints

Representative viewpoints that have been identified to assess visual impacts within the Commonwealth Avenue precinct are shown in Figure 12-19 and described in Table 12-38. Images of all viewpoints can be found in Technical Report 10 – Landscape character and visual amenity.

Table 12-38 Commonwealth Avenue precinct viewpoints, description and sensitivity rating

Viewpoint	Description	Sensitivity rating
Viewpoint CA1: Commonwealth Avenue North	<p>This viewpoint is located on Commonwealth Avenue, north of the Commonwealth Avenue road bridges, looking south towards Parliament House (refer to Figure 12-23). The view covers the south and northbound carriageways, turf median, and western footpath of Commonwealth Avenue extending south across Lake Burley Griffin on the Commonwealth Avenue road bridges.</p> <p>Visual receptors seeing this view would primarily be those travelling on Commonwealth Avenue in vehicles and on foot and would include both visitors to Canberra and locals.</p> <p>The view sensitivity is high due to the importance of views along Commonwealth Avenue, one of the main avenues in the National Triangle, ending in landmark elements at either end.</p>	High
Viewpoint CA2: Commonwealth Park	<p>This viewpoint is located within Commonwealth Park on the north bank of Lake Burley Griffin, looking south to south-west towards the Project. The view comprises a wide and open view (both fore and middle ground) of Lake Burley Griffin and Commonwealth Park.</p> <p>The view sensitivity is high due to its position within an important area from a heritage and planning perspective. Viewers can appreciate heritage items within a valued parkland setting. This viewpoint is likely to include sensitive visual receptors such as visitors and those using the park for recreational purposes.</p>	High

Viewpoint	Description	Sensitivity rating
Viewpoint CA3: Henry Rolland Park	<p>This viewpoint is located on the jetty lookout in Henry Rolland Park on Lake Burley Griffin looking south-east towards the Project (Figure 12-25). It comprises a wide and open view across Lake Burley Griffin, with the Commonwealth Avenue road bridges being visually prominent features.</p> <p>The view sensitivity is high due to multiple indicators of importance, including views across Lake Burley Griffin near the Griffins' Water Axis. This viewpoint is likely to be a popular tourist spot and has recreational value along the foreshore. This viewpoint is likely to attract visitors and other visual receptors who would be using the park for recreational purposes.</p>	High
Viewpoint CA4: Commonwealth Bridge South	<p>This viewpoint is located on the pedestrian path on the northern verge of Commonwealth Avenue, south of the Commonwealth Avenue road bridges, looking south-west towards Parliament House (Figure 12-27). The view comprises a directional view along a main road with south and northbound carriageways and footpath of Commonwealth Avenue extending south into the distance.</p> <p>The view sensitivity is high due to the importance of views along Commonwealth Avenue, one of the main avenues in the National Triangle, ending in landmark elements on either side. Most of the visual receptors who would see this view would be passers-by.</p>	High
Viewpoint CA5: Hotel Canberra	<p>This viewpoint is located along the pedestrian path of Commonwealth Avenue between driveways to access the heritage listed Hotel Canberra. The view comprises the western footpath, turf verge, and the south and northbound carriageways of Commonwealth Avenue with a wide turf median.</p> <p>The view sensitivity is moderate. Although it is adjacent to an important heritage and planning area and near Hotel Canberra, the views at this location are not specifically noted for their heritage value. Visual receptors would include visitors who would access this location for work, tourism or recreational purposes</p>	Moderate
Viewpoint CA6: Parliament House North	<p>This viewpoint is located on the lawn at the northern corner of Parliament House looking north along Commonwealth Avenue towards City Hill. The foreground of the view is dominated by the manicured green lawn of Parliament House, sloping down to Parliament Drive.</p> <p>The view sensitivity is high as the viewpoint is positioned within an important area from a heritage and planning perspective. Most visitors to this location are likely to pause to experience the view before moving on.</p>	High

Night-time lighting

The Commonwealth Avenue precinct holds several landscape and heritage sensitivities with a key focus on vistas, particularly along Commonwealth Avenue and across the Griffins' Water Axis. Both alignment options sit within the setting of the Commonwealth Avenue and its surrounds. Commonwealth Avenue is also a National Triangle road as assigned within the National Capital Authority's (NCA) Outdoor Lighting Policy. Due to its prominence within the structure of the National Triangle and its urban context, Commonwealth Avenue is an area of A4: High district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023). Existing lighting within the precinct accentuates the Commonwealth Avenue vista with surrounding roads sitting within the A3: Medium district brightness category.

The lighting along the Commonwealth Avenue corridor would minimise light spill and contribute to high quality landscape boulevards to direct views towards the feature lighting of Parliament House and the Capital Hill Flag Pole, reinforcing the integrity of the visual structure of the National Triangle.

Relevant design requirements of strategy 1a of the NCA's Outdoor Lighting Policy for the Commonwealth Avenue precinct include:

- i. Emphasise the three node points of the Griffins' National Triangle by creating and maintaining strong visual 'anchors' at Parliament House, City Hill, and Russell
- ii. Create a unique identity for the roads that form the Griffins' National Triangle, being Commonwealth, Kings, and Constitution Avenues, through careful selection and installation of an integrated suite of street furniture and lighting. Achieve a high degree of uniformity in lighting performance on these three main avenues
- v. Use full cut-off light fittings in all landscape areas, roads, paths, and car parks within the Central National Area
- vi. Use full cut-off street and pedestrian lighting on all main avenues that contributes to their development as high quality landscape boulevards
- vii. Align lighting hardware to strengthen the framing of the National Triangle, main avenues, and formally landscaped open spaces.

Strategy 1b also prioritises a clear hierarchy of built environment illumination in Central Canberra. The integrated lighting design for the Commonwealth Avenue road bridges contribute to the defining elements of the city's urban landscape.

12.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition (of construction activity, equipment, and construction compounds) and loss of elements (most notably to trees) within the Commonwealth Avenue precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops, retaining walls, bridges, and covered sections
- Installation of lighting, signage, and landscaping
- Temporary traffic changes
- Establishment of construction compounds.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years).

As such, the magnitude of change during construction would be high within the Commonwealth Avenue precinct due to the visual clutter of construction and the removal of trees. This would result in a high adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Commonwealth Avenue precinct, in most cases the overall impact at each viewpoint has been assessed as being high due to:

- High sensitivity of most viewpoints to change
- High heritage values of views across this precinct

- High magnitude of works anticipated throughout construction that would be visible in the fore, middle, and background of most viewpoints.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 12-39. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints. These differences have been specified as appropriate in the table below.

Table 12-39 Viewpoints construction impact summary – Commonwealth Avenue precinct

Viewpoint	Impact summary	Impact ratings
Viewpoint CA1: Commonwealth Avenue North	Construction would introduce temporary fencing, hoarding, signage, and traffic equipment, along with earthworks, drainage adjustments, and road improvements across both sides of the road, including the median. The activity would be visually prominent within the foreground and middle ground due to the scale and proximity of equipment, contrasting with the established landscape, although no tree removal would occur. The high sensitivity of this view, part of the National Triangle, and the extensive visual changes—including the construction of a central light rail bridge—would result in a high adverse impact, as construction elements and visual clutter would dominate the view toward landmark features.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint CA2: Commonwealth Park	Construction would be visible within the middle and background of the view, notably the light rail bridge over Lake Burley Griffin and associated temporary structures, including a service jetty and barges. Piling and pier works would contrast strongly with the calm waterscape, introducing visually prominent elements to the central view, approximately 100 m from the viewpoint. Though some northern works may be partially screened by trees, the visual impact remains high due to the view's high sensitivity within the National Triangle and its recreational significance. Overall, the construction would create a high adverse effect on the view, as activity and large structures would disrupt the established landscape setting.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint CA3: Henry Rolland Park	Construction of the light rail bridge over Lake Burley Griffin, including piling and pier works with cofferdams, would be visible within the middle and background, featuring prominently between the existing northbound and southbound bridge carriageways. Temporary structures, such as a service jetty and working barges, would be particularly noticeable, along with a construction compound on the western side of the bridge. While some elements may be screened by retained trees, the high magnitude of change across the open lake landscape would create a strong contrast with the existing, tranquil view. The high sensitivity of this viewpoint, positioned in a recreational area by Lake Burley Griffin, results in a high adverse impact as the temporary construction activity would occupy a moderate but visually prominent portion of the view, introducing visual clutter across the central middle ground.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Viewpoint	Impact summary	Impact ratings
Viewpoint CA4: Commonwealth Bridge South	<p>State Circle East alignment option: Construction within the entire road corridor of Commonwealth Avenue, including the verges, median, and carriageways, would be visually prominent due to the proximity and scale of equipment, as well as the addition of substantial elements like a light rail bridge over Flynn Drive and a light rail stop adjacent to Albert Hall. The view would experience high visual impact from extensive tree removal in the median, fencing, hoarding, signage, and heavy earthworks extending across the fore, middle, and background. The use of Langton Car Park to the east of Commonwealth Avenue as a construction compound would add visible structures and increase vehicle movement, further heightening visual clutter. Given the view's high sensitivity within the National Triangle, the construction activity would result in an adverse effect, temporarily dominating the view and disrupting the established tree-lined avenue toward key landmarks.</p> <p>National Triangle-Barton alignment option: Construction would take place across the entire road corridor, affecting verges, the median, and carriageways, with the addition of a light rail bridge over Flynn Drive visible within the view. Construction would involve fencing, hoarding, removal of trees and furniture, bulk earthworks, and construction of the bridge superstructure and trackform. The retention of some trees in the median would provide a visual backdrop, softening the view of construction equipment to some extent. However, the proximity and scale of the activity, compounded by the establishment of construction compounds such as the one in Langton Car Park, would increase visual clutter and the movement of large vehicles. The changes would predominantly affect the central portion of the view, extending both north and south along Commonwealth Avenue. Although temporary, the high sensitivity of the view, as a key visual corridor within the National Triangle, combined with the extensive visual change, results in a high visual impact rating. The clutter of construction would dominate the view, reducing the visual quality of the tree-lined avenue leading toward Parliament House.</p>	Sensitivity: High
		Magnitude: High (both alignment options)
		Overall impact: High (both alignment options)
		Qualitative rating: Adverse
Viewpoint CA5: Hotel Canberra	<p>State Circle East alignment option: Construction would be prominent within the view from Hotel Canberra, encompassing the entire median and road corridor, with substantial tree removal, fencing, hoarding, and traffic safety equipment. The addition of a light rail stop to the left of the view and a large construction compound partially screened by trees in Langton Car Park would contribute to high visual contrast, disrupting the established landscape of trees and open lawns. These changes would span the middle and background of the view, introducing visually dominant construction elements. Although temporary, the construction would have a high to moderate adverse impact due to the view's moderate sensitivity.</p> <p>National Triangle-Barton alignment option: Construction would extend across the entire width of the road corridor along Commonwealth Avenue, with substantial tree removal, fencing, hoarding, and visible earthworks. A light rail stop and a construction compound in Langton Car Park, made more prominent by tree removal, would be visible in the background.</p>	Sensitivity: Moderate
		Magnitude: High (both alignment options)
		Overall impact: High to moderate (both alignment options)

Viewpoint	Impact summary	Impact ratings
	The high magnitude of change, particularly within the middle and background, contrasts sharply with the established landscape of trees and open lawns. Though temporary, these changes would dominate the view with visually prominent construction activity, resulting in a high to moderate adverse impact due to the moderate sensitivity of the viewpoint.	Qualitative rating: Adverse
Viewpoint CA6: Parliament House North	<p>State Circle East alignment option: Construction on Commonwealth Avenue would introduce moderate changes primarily due to the removal of median trees, large-scale construction activities, and equipment associated with the light rail stop and covered section. These elements would visually shorten the elongated view along the avenue, contrasting with the established landscape. While the high sensitivity of the viewpoint contributes to a high to moderate adverse impact, the majority of the view would remain unchanged, as construction activity would be seen from approximately 300 m away within the middle and background.</p> <p>National Triangle-Barton alignment option: Construction activity would be visible from this viewpoint, although at a distance, limiting the visibility of detail and screening much of the activity due to retained median and verge trees. The primary visual changes would be minor, with only taller construction elements, such as cranes, potentially visible. Tree removal along Commonwealth Avenue would slightly impact the view's continuity, resulting in a low magnitude of change. The overall construction impact would be moderate, affecting a small portion of the view temporarily and mostly screened by vegetation, though introducing adverse visual clutter within the corridor.</p>	Sensitivity: High
		Magnitude: Moderate (State Circle East alignment option) Low (National Triangle-Barton alignment option)
		Overall impact: High to moderate (State Circle East alignment option) Moderate (National Triangle-Barton alignment option)
		Qualitative rating: Adverse (both alignment options)

Night-time visual impact assessment

Night works may be required outside standard construction hours (Monday to Saturday, 7am to 6pm) on occasion throughout this precinct during construction.

Night works would contrast with the lower light levels of this precinct, designed to accentuate vistas and focal points. Temporary lighting would be required within the construction compounds to prioritise safety and security.

The construction of the Commonwealth Avenue light rail bridge would have the most prominent lighting due to its surrounding open area. This would be visible from key locations such as the Acton Peninsula, Black Mountain, Parliament House, and Mount Ainslie.

Lighting associated with night works would be seen from adjacent nationally significant buildings such as Treasury, Hotel Canberra, Albert Hall, Diplomatic Missions, as well as Lake Burley Griffin and parklands such as Commonwealth Park, Henry Rolland Park, and Magna Carta Place. The removal of mature street trees would potentially allow existing road lighting to be seen more clearly from these adjacent properties. Lighting associated with night works may also draw attention away from the feature lighting of Parliament House.

For these reasons, the visual impact during construction at night would be **high adverse**.

12.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project would impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 12-40 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 12-40 Landscape character impact assessment summary in the Commonwealth Avenue precinct – both alignment options

Alignment option	Impact summary	Impact rating
State Circle East alignment option	The Project would introduce light rail infrastructure along Commonwealth Avenue, including a stop at Albert Hall and a light rail bridge between the existing Commonwealth Avenue road bridges, impacting the precinct's established landscape character. The addition of embedded and green track, signage, lighting, and adjustments to road configurations would lead to changes within the median, requiring the replacement of mature trees with juvenile species. The loss of mature trees in this precinct would be partially mitigated by planting trees between the tracks, although it is noted that the existing trees have value as original Weston-planted evergreens and replacement trees would be of a different species and form. Further, although replacement trees would retain some formal planting effects, the density and arrangement would differ. These changes would introduce new elements in a highly sensitive area with heritage and landscape significance. The most substantial changes would include the addition of the light rail bridge and the removal of mature street trees, which would impact the avenue's traditional planting layout and aesthetic. While the Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running, it would result in an adverse change in the precinct's character, especially due to the introduction of large elements and tree replacements within this historically and culturally sensitive area.	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse

Alignment option	Impact summary	Impact rating
National Triangle-Barton alignment option	The Project would introduce addition of light rail infrastructure along Commonwealth Avenue, extending from the interface with LRS2A to the transition into the National Triangle precinct. Positioned within the road corridor, the light rail would consist of gravel and green track with associated elements such as signage, lighting, and passing LRVs, along with adjustments to median widths, intersections, and road configurations. A light rail bridge between the existing Commonwealth Avenue road bridges would be introduced, alongside tree removal and replacement with juvenile species. Although the National Triangle-Barton alignment involves a shorter length of track and no stop within the precinct, the addition of new structures, changes to planting, and increased lighting would maintain a moderate level of visual impact. The loss of mature trees in this precinct would be partially mitigated by planting trees between the tracks, although it is noted that the existing trees have value as original Weston-planted evergreens and replacement trees would be of a different species and form. Further, although replacement trees would retain some formal planting effects, the density and arrangement would differ. While the Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running, it would result in an adverse change in the precinct's character, especially due to the introduction of large elements and tree replacements within this historically and culturally sensitive area. Overall, the Project would result in a high to moderate adverse change to the precinct's character.	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Commonwealth Avenue precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- High sensitivity of most viewpoints to change
- Viewpoints ranging from high to moderate to low magnitude of change, the main impact being views of passing LRVs.

Neutral to beneficial changes to visual amenity would also occur at some viewpoints due to the preservation of turf or trees in the median/verges.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 12-41. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints. These differences have been specified as appropriate in the table below.

Table 12-41 Viewpoints operation impact summary – Commonwealth Avenue precinct

Viewpoint	Impact summary	Impact rating
Viewpoint CA1: Commonwealth Avenue North	<p>The Project would introduce light rail infrastructure, including a light rail bridge between the existing Commonwealth Avenue road bridges. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. While passing LRVs would be visible, akin to buses but within the median, other elements would remain visually consistent with the existing corridor character, resulting in a high to moderate visual impact. The light rail bridge would introduce a new element, yet would be visually recessive, allowing the elongated view toward Parliament House and Capital Hill to remain intact. The overall impact, though adverse, would align with the corridor's designation for public transport, maintaining the aesthetic of the existing turf median.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint CA1 is provided on Figure 12-24.</p>	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint CA2: Commonwealth Park	<p>The Project would introduce a light rail bridge between the existing Commonwealth Avenue road bridges, with additional supporting piers as the most visually prominent change. LRVs would be visible travelling across Lake Burley Griffin, resembling the appearance of passing buses. Tree replacement in the median with deciduous species would also be noticeable but visually recessive, largely blending with existing mature trees. The changes would occupy a narrow strip below the bridge and be visible from approximately 200 m away, resulting in a moderate visual impact due to the sensitivity of the viewpoint on the lake's shores. The additional bridge infrastructure would align with the existing character, retaining the aesthetic of the simple structural form and causing no substantial alteration to the view's quality.</p>	Sensitivity: High
		Magnitude: Low
		Overall impact: Moderate
		Qualitative rating: Neutral
Viewpoint CA3: Henry Rolland Park	<p>The Project would introduce a bridge between the existing Commonwealth Avenue road bridges, with additional supporting piers as the most visually prominent element. LRVs would be visible travelling across Lake Burley Griffin, and some mature trees on the southern side would be replaced with deciduous species along the median, although these changes would likely be visually subtle due to distance and existing screening. Viewed from approximately 60 m away, the Project would result in a moderate adverse visual impact, with the light rail bridge infrastructure aligning with the character of the existing road bridge structure. The wide, expansive view across Lake Burley Griffin and along the Water Axis would remain largely unchanged, preserving key visual elements. Although the addition of piers would introduce a slight reduction in the simplicity of the bridge's streamlined form, the overall visual change would be low and in keeping with the established context.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint CA3 is provided on Figure 12-26.</p>	Sensitivity: High
		Magnitude: Low
		Overall impact: Moderate
		Qualitative rating: Adverse

Viewpoint	Impact summary	Impact rating
Viewpoint CA4: Commonwealth Bridge South	<p>State Circle East alignment option: The Project would position the light rail within the central median, featuring green track that replaces the existing turf median, along with passing LRVs and signage. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. A centrally located light rail stop, traffic infrastructure, and landscaping elements would be introduced, with deciduous street trees planted in a linear arrangement within the median. The proposed deciduous trees, narrower and offering less canopy than the existing mature evergreen trees, would slightly alter the visual composition, reducing the perceived bulk of the current tree cover. Although these changes would be in contrast to the existing condition, the use of green track and the gradual maturation of new trees would help soften the appearance of the light rail infrastructure. While the Project would maintain the wide, open views toward Parliament House and Capital Hill, it would increase the visual presence of transport infrastructure within the avenue. The overall impact would be adverse due to the change in tree form and the introduction of built elements, but the green track and new planting would contribute to unifying the corridor visually.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint CA4 is provided on Figure 12-28.</p> <p>National Triangle-Barton alignment option: The Project would position the light rail within the median, featuring green track that replaces the existing turf median, along with signage, lighting, and passing LRVs. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. The central median would include a single row of deciduous street trees, which would differ in arrangement and canopy cover from the existing coniferous trees. The addition of three traffic lanes and a reinstated cycle lane, along with kerbs, gutters, and lighting, would increase the visible transport infrastructure within the corridor. Although the changes would be visually prominent from close proximity, retained mature trees near Parliament House would help soften the impact and maintain some continuity. While the Project would alter the landscape with narrower deciduous trees and expanded infrastructure, the visual softening from green track and tree plantings would unify the corridor, preserving the wide view to landmark elements like Parliament House.</p>	Sensitivity: High
		Magnitude: High (both alignment options)
		Overall impact: High (both alignment options)
		Qualitative rating: Adverse (State Circle East alignment option) Neutral (National Triangle-Barton alignment option)

Viewpoint	Impact summary	Impact rating
Viewpoint CA5: Hotel Canberra	<p>State Circle East alignment option: During operation, the Project would be visible within the median of Commonwealth Avenue, extending along its length and featuring green track, signage, and passing LRVs. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. A light rail stop (Albert Hall) with a central canopy would be introduced to the left of the view. Juvenile deciduous trees in a single row would replace the existing grouped trees, altering the visual arrangement and canopy cover. The Project would create a high degree of change due to the introduction of LRVs and infrastructure into the previously open median. While the new trees and green track would help integrate the changes within the established transport corridor over time, the visual prominence of the new elements, particularly the juvenile trees and light rail stop, would result in a high to moderate impact. Although the loss of heritage trees is an adverse outcome, the use of green track helps maintain the turf aesthetic, mitigating the overall effect on the view.</p> <p>National Triangle-Barton alignment option: During operation, the Project would be visible within the median of Commonwealth Avenue to the north of the viewpoint, turning to the south-east and extending along King George Terrace with a combination of green track and embedded road pavement. This would include a light rail stop with a canopy structure, new footpaths, and a cycleway in the verge, along with signage and lighting elements. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. Juvenile trees would replace those removed during construction, particularly affecting the landscape along King George Terrace but sparing the southern portion of Commonwealth Avenue from tree removal impacts. The introduction of light rail infrastructure, reduced mature tree cover, and the addition of a light rail stop in an open green space would create a noticeable contrast to the existing conditions. While the changes would be permanent and visually prominent, tree planting along the alignment would help reduce their impact over time. Overall, the changes would result in a high to moderate adverse visual impact, extending transport infrastructure visibly from the north to the south-east, but leaving the southern section of Commonwealth Avenue unchanged.</p>	Sensitivity: Moderate
		Magnitude: High (both alignment options)
		Overall impact: High to moderate (both alignment options)
		Qualitative rating: Adverse (both alignment options)

Viewpoint	Impact summary	Impact rating
Viewpoint CA6: Parliament House North	<p>State Circle East alignment option: At operation, the Project would introduce light rail infrastructure within the median of Commonwealth Avenue, including a light rail stop, LRVs, and juvenile deciduous street trees replacing the existing double row of conifers. The visual prominence of the infrastructure would be softened by green track and wire-free running, preserving the green median and avoiding over-head infrastructure. While changes to the north of the Commonwealth Avenue road bridges would be indiscernible from this viewpoint, the addition of light rail elements and tree plantings south of the Commonwealth Avenue bridges would be visible, altering the tree arrangement and opening up the view corridor between Parliament House and City Hill. Despite the high sensitivity of this viewpoint, the use of green track would help maintain the visual character of the median. The visual impact would be high to moderate due to the loss of heritage trees and additional built structures, but the revised tree planting would soften these changes over time.</p> <p>National Triangle-Barton alignment option: At operation, the light rail infrastructure is unlikely to be visible from this viewpoint due to the distance to these elements (greater than 700 m) and existing, retained trees which would screen the changes.</p> <p>As the Project would be unlikely to be visible from this viewpoint at operation, the magnitude of change would be negligible for this option. This combined with a high sensitivity rating would make the overall impact negligible.</p>	Sensitivity: High
		Magnitude: Moderate (State Circle East alignment option) Negligible (National Triangle-Barton alignment option)
		Overall impact: High to moderate (State Circle East alignment option) Negligible (National Triangle-Barton alignment option)
		Qualitative rating: Adverse (State Circle East alignment option) Neutral (National Triangle-Barton alignment option)



Figure 12-23 Existing view south along Commonwealth Avenue from Viewpoint CA1



Figure 12-24 Indicative visualisation of viewpoint CA1 during operation



Figure 12-25 Existing view south along Commonwealth Avenue from Viewpoint CA3



Figure 12-26 Indicative visualisation of viewpoint CA3 during operation



Figure 12-27 Existing view south along Commonwealth Avenue from Viewpoint CA4



Figure 12-28 Indicative visualisation of viewpoint CA4 during operation for State Circle East alignment option

Night-time visual impact assessment

While the Project would introduce additional lighting, including LRV headlights along the tracks, the light rail corridor would align with the outcomes of the existing A4: High district brightness area.

Additional lighting would include, the upgrade of existing street light poles and luminaires, in line with the approved LRS2A infrastructure along Commonwealth Avenue, with no additional light poles required within the median. Lighting of the light rail bridge across Lake Burley Griffin would be consistent with the existing integrated approach within the bridge railing elements.

State Circle East alignment option

Lighting of the light rail stop would be provided to prioritise passenger safety at night and as a result this would introduce additional lighting. Light spill from the stop may affect adjacent land uses including open spaces and heritage buildings.

The existing lighting along Commonwealth Avenue would become more prominent with the tree removal required as part of the Project. Replacement trees would reduce the prominence of these lighting elements as they mature overtime.

While there would be a noticeable reduction in visual amenity at night due to LRVs and additional lighting along the corridor, this would occur within a high district brightness environment. The night-time visual impact during operation for the State Circle East alignment option would result in a **minor adverse impact** at night.

National Triangle-Barton alignment option

Additional street-level lighting would be seen in the context of the existing lit transport corridor. No additional lighting would be required along the peripheral streets. Additionally, no residential properties would be impacted by additional lighting. Project associated lighting would be designed to limit spill into non-target areas and up-lighting would be capped by structures. Light colour would be designed to complement the adjacent area and public safety cameras would be selected to function without unnecessary lighting.

The existing lighting along Commonwealth Avenue would become more prominent with required tree removal associated with the Project. Replacement trees would reduce the prominence of these lighting elements as they mature.

While there would be a noticeable reduction in visual amenity at night due to LRVs and additional lighting along the corridor, this would occur within a high district brightness environment. The night-time visual impact during operation for the National Triangle-Barton alignment option would result in a **minor adverse impact**.

12.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for landscape character and visual amenity impacts at the Commonwealth Avenue precinct.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

12.7 Socioeconomic

This section provides an assessment of the potential socioeconomic impacts associated with the construction and operation of the Project within the Commonwealth Avenue precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues)

12.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown on Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. The Commonwealth Avenue precinct spans the following SA2s:
 - Parkes North SA2
 - Parkes South SA2
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- **ACT:** in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor, and the ACT. Capital refers to various forms of resources that contribute to the wellbeing, sustainability, and resilience of a community.

The Commonwealth Avenue precinct's main function is to connect important government buildings, landmarks, and commercial areas, rather than providing residential accommodation or community-focused amenities. The precinct does not have a significant residential population. As such, residential populations in SA2s relevant to the precinct were unable to be quantified by the Australian Bureau of Statistics in the 2021 census.

Commonwealth Avenue is surrounded by notable green spaces and natural features that contribute to its natural capital. The Commonwealth Avenue road corridor is bordered by landscaped gardens and open spaces, providing aesthetic appeal and recreational opportunities.

The Commonwealth Avenue road corridor functions as a transport and administrative corridor, supporting the movement of workers and professionals across key areas. Its strategic location connects important government buildings, commercial centres, and landmarks, making it a key route for both daily commuters and visitors.

Section 11.7 of Chapter 11 (Project-wide issues) provides a summary of community capitals for the corridor and the ACT. The South Canberra SA3 has been analysed as part of the corridor, and provides insight into people most likely to be transient to the precinct (e.g. visiting or working in the precinct).

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural, or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Commonwealth Avenue precinct's area of social influence is shown on Figure 12-29.

The precinct includes community infrastructure facilities, cultural institutions, sports clubs, swimming pools, beaches, gardens, community parks, and places of worship.



12.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those working in, visiting, or living in proximity to the Commonwealth Avenue precinct is provided in Table 12-42. Construction-phase socioeconomic impacts within the Commonwealth Avenue precinct would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those people working in the nearby offices, hotel guests and transient visitors to the area such as tourists and people attending events.

Residents, workers, and students provided feedback via online surveys and other consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)), indicating that construction noise and vibration is a key community concern. However, several participants recognised that the construction impacts would be temporary and that the Project would deliver longer term benefits once operational.

Most (over 60 per cent) of consultation participants indicated concern about possible delays and traffic congestion during construction with several highlighting their recent experiences of traffic congestion in this precinct in general. Over a third of participants in this precinct noted the unique and important landscape and visual character of this precinct including the tree lined median, and the view of both the lake and of Parliament House.

Although some construction impacts remain rated as medium or high after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 12-42 and Chapter 21 (Environmental management and mitigation measures).

Table 12-42 Socioeconomic impacts during construction – Commonwealth Avenue precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to local amenity during construction, potentially leading to a decline in health and wellbeing affecting workers, visitors, and accommodation providers. This may particularly affect people with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 12.1.4, Section 12.3, and Section 12.6 (in relation to traffic, noise and visual impacts, respectively).</p>	Both	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Low (possible/minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Disruptions to waterway users</p> <p>As described in Section 6.7.5 of Chapter 6 (Construction), construction works associated with the light rail bridge between the Commonwealth Avenue road bridges over Lake Burley Griffin may necessitate temporary restrictions on public access to boat ramps and jetties to maintain safety by preventing interaction between the public and the construction site. The open navigation channel beneath the bridges would also be affected by construction barges. The light rail bridge would include five spans and would be constructed progressively, resulting in temporary restrictions to public access in these areas for safety reasons, with access maintained as far as practicable.</p> <p>Waterway users, including boaters, rowing and yacht clubs, and recreational users, may experience disruptions due to temporary restrictions during construction activities over Lake Burley Griffin.</p>	Both	Medium (likely/ minor)	<ul style="list-style-type: none"> Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) Implementation of a Waterway User Strategy to inform users of upcoming access restrictions of changes, provide and clearly mark alternative access points to facilitate continued safe access to water based recreational activities, and work with local waterway user groups to address their specific needs and concerns (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) 	Low (possible/ minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Disruptions to the road network and parking – impacts to road users</p> <p>Temporary impact to road users due to temporary traffic changes which may impact travel times, including during major events.</p> <p>This would include temporary restrictions to turning movements (for the State Circle East alignment option), introduction of heavy vehicle traffic associated with construction, and temporary loss of parking for establishment of construction compounds (impacting over 700 spaces) and on-street spaces on Flynn Drive, which would change how people travel through and use the area and result in minor travel time increases.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 12.1.4.</p>	Both	Very high (likely/ major)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) A public awareness campaign of possible disruption to the transport network during construction, and 	Medium (possible/ moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>Decline in accessibility to businesses, services and places of employment due to temporary loss of parking during construction. Temporary parking loss would include impact to carparks at Acton Waterfront and Treasury where construction compounds are proposed as well as some on-street spaces on Flynn Drive.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 12.1.4.</p>	Both	High (likely/moderate)	<p>promote alternative travel arrangements (as part of the Community Engagement Strategy)</p> <ul style="list-style-type: none"> Preparation of event impact assessments for major events, and implementation of tailored mitigation measures in consultation with event organisers. This could include providing temporary facilities or alternative access arrangements for event related activities if construction impacts are unavoidable (refer to measure SE5 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Visual landscape and heritage</p> <p>Changes to aesthetic value and heritage items of significance in the area may affect those people visiting, working, or living in the area by diminishing their connection to place and changing their surroundings, which could impact the overall experience and sense of belonging for people who engage with the precinct. Impact to mature trees along Commonwealth Avenue and the introduction of visual clutter associated with construction works in heritage sensitive areas would contribute to this impact.</p> <p>Further detail on landscape and visual impacts in this precinct is provided in Section 12.6.</p> <p>Further detail on impacts to heritage in this precinct is provided in Section 12.5.</p>	Both	Significant (almost certain/major)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

12.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those working in, visiting, or living in proximity to the Commonwealth Avenue precinct is provided in Table 12-43. Socioeconomic impacts within the Commonwealth Avenue precinct would be common to both alignment options, unless otherwise noted.

Table 12-43 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 12-43. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Table 12-43 Socioeconomic impacts during operation – Commonwealth Avenue precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Landscape and visual changes</p> <p>Changes to community character due to permanent changes to local visual landscape. The extension of light rail infrastructure and removal of trees would result in potential adverse changes along Commonwealth Avenue, although replacement trees would maintain a formal avenue effect. This change may impact people's overall experience and connection to the area (particularly as they adjust to the new changes).</p> <p>Further detail on landscape and visual impacts in this precinct is provided in Section 12.6.</p>	Both	Low (possible/minor)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users (and ultimately result in a benefit) 	Beneficial (possible/positive)
<p>Access and mobility</p> <p>Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. staggered pedestrian crossings).</p> <p>Refer to Section 5.7 of Chapter 5 (Project description) for further detail on active travel arrangements.</p>	Both	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (likely/positive)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking</p> <p>Some decline in accessibility to businesses, places of employment and services due to permanent loss of around 20 parking spaces within the Langton car park opposite the Treasury building (refer to Section 12.1.4). The State Circle East alignment option would not result in parking loss in this precinct.</p> <p>Impacts to road users in the broader corridor resulting from Project-wide transport network impacts are assessed further in Section 11.7.</p>	National Triangle-Barton alignment option	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, measures to minimise accessible parking loss and optimise the interface between the Project and other transport modes (refer to measures TT8, TT9, and TT10 in Chapter 21 (Environmental management and mitigation measures)) Continued engagement with local businesses via the Community Engagement and Social Management Plan (refer to Appendix L (Environmental Management Plan outline)) 	Very low (unlikely/minor)

12.7.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage socioeconomic impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for socioeconomic impacts at the Commonwealth Avenue precinct.

13.0 Parliament House precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Parliament House precinct and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 13.1.4)
- Noise and vibration (Section 13.3)
- Biodiversity (Section 13.4)
- Historic heritage (Section 13.5)
- Landscape character and visual amenity (Section 13.6)
- Socioeconomic (Section 13.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

13.1 Overview

The Parliament House precinct surrounds Capital Hill and Parliament House, forming the southern point of the National Triangle. The northern extent of the precinct begins on Commonwealth Avenue, immediately south of the intersection with Coronation Drive. It extends east around Parliament House along State Circle to Adelaide Avenue near its intersection with National Circuit. Most of the Parliament House precinct is within the Parliamentary Zone, where key national institutions, government buildings and significant landmarks are located, and which serves as the administrative and political hub of the country.

State Circle serves as a key transport connection between north and south Canberra, connecting Commonwealth Avenue with Adelaide Avenue and other main avenues such as Canberra Avenue and Kings Avenue. Views of Parliament House, key Federal Government department offices, and established native trees on the inner verge of State Circle enshrine Canberra as the 'Bush Capital' through this precinct.

For both options, the light rail alignment would pass around the southern side of Capital Hill and Parliament House through this precinct. To the west of Melbourne Avenue, it would transition from State Circle onto Adelaide Avenue via the landscaped annulus between State Circle and Capital Circle leading into a new light rail bridge over State Circle. Within the Parliament House precinct, the light rail would be wire-free.

13.1.1 State Circle East alignment option

Within Parliament House precinct, the State Circle East alignment option would transition from the Commonwealth Avenue road corridor into a covered section about 125 m in length. This covered section would allow the light rail to pass underneath southbound Commonwealth Avenue traffic lanes through to State Circle, both northbound and southbound.

For the State Circle East alignment option, light rail would run within the median (median running) and would include three stops located within the median of State Circle:

- Kings Avenue Stop, located immediately to the south of Kings Avenue
- Sydney Avenue Stop, located immediately to the north of Sydney Avenue
- Melbourne Avenue stop, located immediately to the east of Melbourne Avenue.

The State Circle road corridor would be widened into Capital Hill, generally between Commonwealth Avenue and Adelaide Avenue, by up to around 20 m to accommodate the light rail median running arrangement. Widening into Capital Hill would be greater at intersections along State Circle to accommodate all existing turning movements, by up to around 25 m at Canberra Avenue and 28 m near Melbourne Avenue.

Key Project features within this precinct for the State Circle East alignment option are shown on Figure 13-1.

13.1.2 National Triangle-Barton alignment option

The National Triangle-Barton alignment option would transition into the Parliament House precinct after it traverses the National Triangle and Barton precincts at the State Circle intersection with Sydney Avenue. This alignment option runs on the inner road verge (inner running) of State Circle until its transition onto Adelaide Avenue.

The National Triangle-Barton alignment option would include one stop within this precinct (Melbourne Avenue Stop), located on the inner road verge of State Circle immediately east of its intersection with Melbourne Avenue.

The State Circle road corridor would be widened into Capital Hill, generally between Sydney Avenue and Adelaide Avenue, by up to around 22 m to accommodate the light rail inner running arrangement. Widening into Capital Hill would be greater at intersections along State Circle to accommodate light rail infrastructure, by up to around 35 m at Sydney Avenue, 27 m at Canberra Avenue and 29 m near Melbourne Avenue.

Key Project features within this precinct for the National Triangle-Barton alignment option are shown on Figure 13-2.

Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

13.1.3 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Key construction activities within the Parliament House precinct would include construction of the Adelaide Avenue light rail bridge over State Circle (refer to Section 6.3.4). This would involve ground preparation, piling, installation of key bridge elements, barriers, trackform and rails, and finishings.

For the State Circle East alignment option, construction of the covered section between Commonwealth Avenue and State Circle would be carried out in this precinct. A 'cut and cover' construction method is proposed for construction of this covered section, which is described further in Section 6.3.5. This would generally involve construction of a soil retaining structure (e.g. piles, walls and supports), excavation works, and installation of track, drainage, combined services route, fit-out and finishes.

Both options would require some widening of the road corridor on the inside edge of State Circle, into Capital Hill. This would generally involve relocating utilities, relocating inner kerb lines, reconstruction of drainage, and reconstruction of the inner verge including retaining walls. Following this, excavation for light rail stops and trackform, intersection reconfiguration and construction, and trackform and stop construction would be carried out.

Compound F (Capital Hill West) is the only construction compound within Parliament House precinct. The location of the compound is shown on Figure 6-1 in Chapter 6 (Construction).

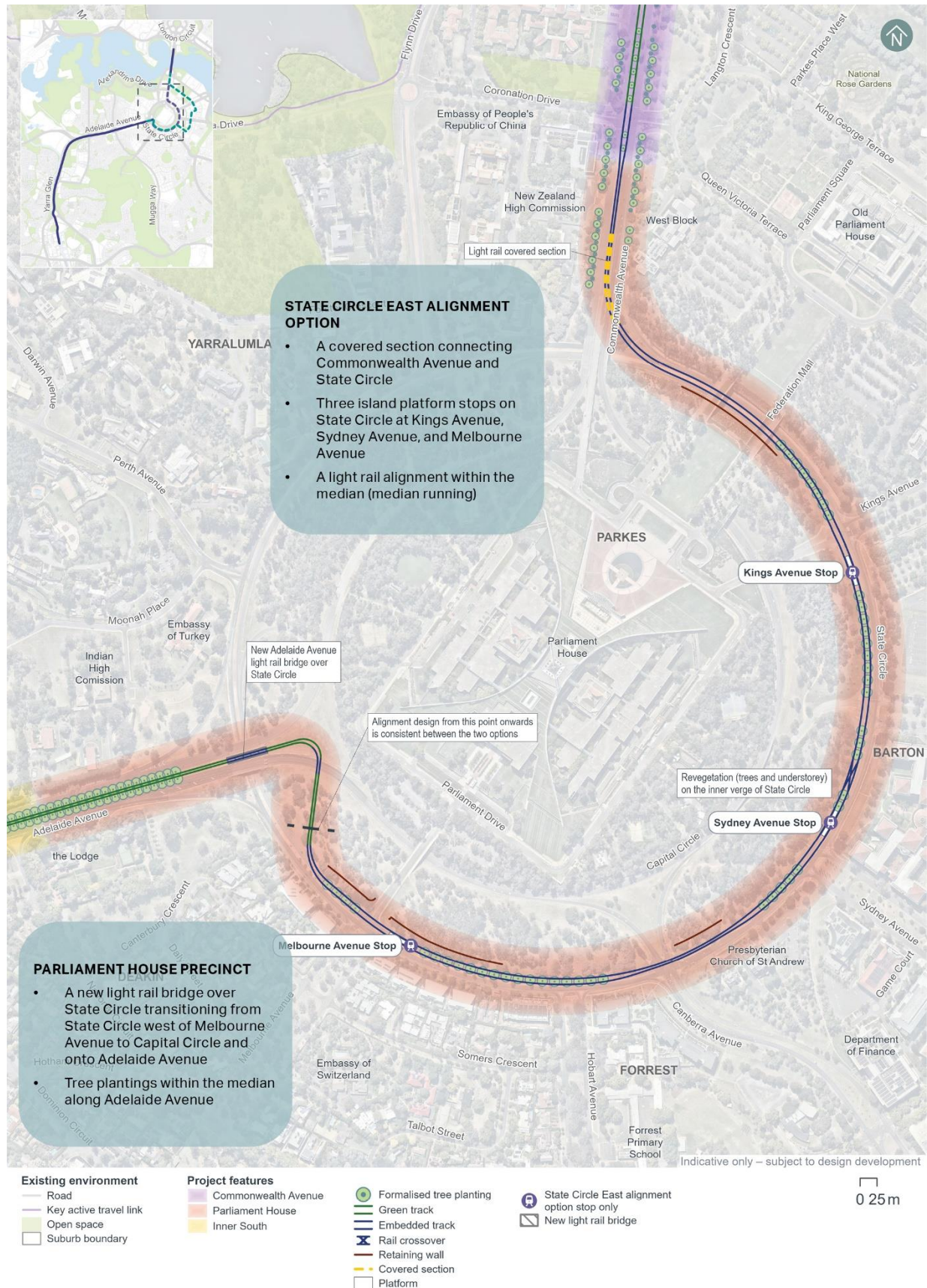


Figure 13-1 Parliament House precinct overview – State Circle East alignment option



13.1.4 Environmental impact overview – construction

Key impacts within the Parliament House precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Two potential alignments for the Project are being considered through the Parliament House precinct – the State Circle East alignment option and the National Triangle-Barton alignment option. The potential impacts of each alignment option has been assessed in this chapter. Unless specifically noted, impacts in this overview are discussed for both alignment options. Through further design development, construction planning and the selection of a single, final alignment option, environmental impacts are expected to be further minimised.

Traffic and transport

Construction of the Project would be undertaken within and adjacent to the road reserve, and as such would result in localised traffic impacts, including temporary road closures, changes to turning movements, and the introduction of heavy vehicle traffic, which would disrupt the road network and parking availability. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Within this precinct, depending on the alignment option selected, specific impacts would include restricted right turns at key intersections, such as State Circle and Kings Avenue, and changes to property access points, which may result in increased travel times for motorists.

The construction activities would also lead to a temporary, staged loss of 46 on-street parking spaces across the precinct as construction works progress.

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction related traffic and site access, parking availability, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, road works, and the establishment of construction compounds, are expected to generate noise that could moderately to highly affect nearby residential and non-residential buildings during the day and night, particularly during ‘peak’ construction scenarios (representing the noisiest works that require the use of noise intensive equipment such as concrete saws and rock breakers).

In the night-time hours, receivers located adjacent to the proposed haulage routes on parts of Flynn Drive and State Circle may be affected by the increases in road traffic noise levels (in instances where night works are required).

Mitigation measures that would be implemented to manage impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised through construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *The Nature Conservation Act 1992* (NC Act) would be required to construct and operate the Project. This would include a total of 7.08 hectares of vegetation within the Parliament House precinct, 2.46 hectares of which is characterised as native.

Removal of this vegetation would impact suitable habitat for the Golden Sun Moth (listed as vulnerable under the EPBC Act and NC Act), breeding and foraging habitat for the Gang-gang Cockatoo (endangered under the EPBC Act and NC Act) and the Diamond Firetail (vulnerable under the EPBC

Act and NC Act), and foraging habitat for the Superb Parrot (vulnerable under the EPBC Act and NC Act) and Swift Parrot (endangered under the EPBC Act and NC Act). Ten hollow-bearing and 60 mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been identified along State Circle in the proposed clearance footprint for the Project.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter include:

- **Heritage:** Several places listed on Commonwealth and ACT Heritage registers are present in the precinct including the State Circle Cutting, West Block and the Dugout, Commencement Column Monument, York Park North Tree Plantation, and The Presbyterian Church of St Andrew. While direct impacts have been avoided, these places have the potential to be indirectly affected by the Project during construction through vibration caused by construction activities. However, these impacts would be avoided through appropriate equipment selection, and determination and monitoring of safe vibration levels. Only West Block and the Dugout would experience moderate impacts due to the removal of historic trees along Commonwealth Avenue, altering and obscuring the aesthetic heritage values of the building and its setting. Some additional heritage places in this precinct (such as the Parliament House vista) span across multiple precincts, and have therefore been assessed in Chapter 11 (Project-wide issues)
- **Landscape character and visual amenity:** Construction activities, such as the establishment of compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area, particularly from key locations such as Adelaide Avenue and State Circle. Night-time construction work would involve lighting that could impact nearby residential, commercial, and heritage properties, drawing attention away from the feature lighting of Parliament House. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Socioeconomic:** Potential socioeconomic impacts include disruptions to local amenity, health, and wellbeing due to noise, vibration, and visual impacts, which may particularly affect workers, visitors, and accommodation providers in the area. Mitigation measures, such as the implementation of Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing both construction and operational aspects) has been developed for the Project to guide the development of the CEMP and sub plans, and is included as Appendix L (Environmental Management Plan outline).

13.1.5 Environmental impact overview – operation

Key impacts within the Parliament House precinct during the operational stage of Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Parliament House precinct would require several changes to the road network, including speed limit adjustments, lane modifications, and new intersection arrangements to accommodate the light rail infrastructure. Within the Parliament House precinct, there would be localised areas where higher congestion levels would occur in both the with and without

Project scenarios (for both alignment options) in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

Additionally, there would be a permanent loss of around 30 kerbside parking spaces along State Circle (for the State Circle East alignment option only), which may affect accessibility for businesses and services in the area.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation, and review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Landscape character and visual amenity

The introduction of light rail infrastructure, including tracks and stops, would result in permanent changes to the landscape character and visual amenity of the area. High adverse visual impacts are predicted for the State Circle East alignment option in particular, due to the scale of change the Project would introduce within this precinct.

Landscape features such as the use of green track along sections of the alignment within this precinct would contribute to preserving visual amenity. The Public Domain Master Plan (Appendix I) also identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter include:

- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 13.1.4), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops, or potential risk of fauna strike from light rail vehicles (LRVs). Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Socioeconomic:** Benefits of the Project within the Parliament House precinct include provision of an alternative to private vehicle use, which can enhance accessibility and overtime and reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, such as changes to the local visual landscape and community character due to the introduction of light rail infrastructure, which could potentially affect the experience and connection people have with the area. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support design of a high quality and manage these potential impacts
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the precinct, with noise and vibration levels predicted to comply with relevant criteria at the majority of receivers. Some minor exceedances of criteria for airborne and ground-borne noise are predicted at receivers closest to the alignment (buildings associated with the Presbyterian Church of St Andrew), assuming no mitigation measures are in place. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures, and operational maintenance planning. These measures would enable residual impacts to be limited

- Historic heritage: No direct impacts to heritage places within this precinct are predicted during operation of the Project. The Presbyterian Church of St Andrew (listed on the ACT Heritage Register) has the potential to experience indirect (e.g. visual) impacts due to changes in the landscape setting and minor kerb adjustments, however these changes would not detract from the place's heritage value and visual prominence. Additional heritage places that are partially located within this precinct (such as the Parliament House vista) have been assessed in Chapter 11 (Project-wide issues) as they span across multiple precincts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

13.2 Traffic and transport

This section provides an assessment of the potential multimodal traffic and transport impacts associated with the construction and operation of the Project within the Parliament House precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

13.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Parliament House precinct and the respective study area is indicatively shown on Figure 13-3.

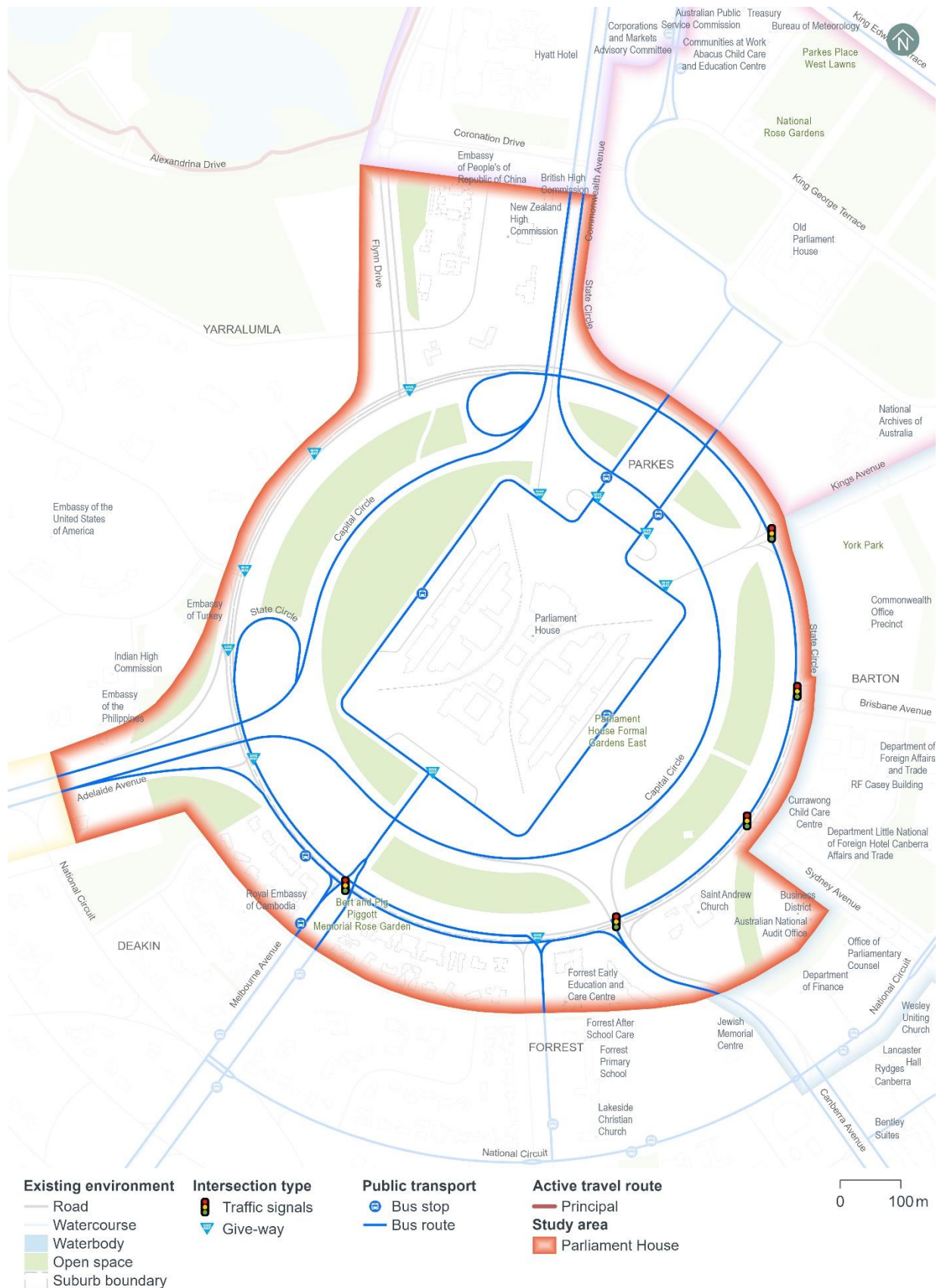


Figure 13-3 Overview of the existing transport network for the Parliament House precinct study area

Road network

The characteristics and features of key roads within the Parliament House precinct are summarised in Table 13-1.

Table 13-1 Overview of key roads within the Parliament House precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Capital Circle	Arterial	One-way in clockwise direction	Two to three lanes including one T2 transit lane	80 km/h
Commonwealth Avenue		Two-way	Three lanes in each direction, separated by a median	70 km/h
State Circle		Two-way	Two lanes in each direction	70 km/h
Kings Avenue		Two-way	Two lanes in each direction, separated by 12 m wide median	60 km/h
Brisbane Avenue		Two-way	Two lanes in each direction, separated by 30 m wide median	60 km/h
Canberra Avenue		Two-way	Two lanes in each direction	60 km/h
Hobart Avenue	Major collector	Two-way	One southbound lane and two northbound lanes, separated by 20 m wide median	60 km/h
Melbourne Avenue		Two-way	Two lanes in each direction, separated by 30 m wide median	60 km/h
Federation Mall	Minor collector	Two-way	One lane in each direction, separated by 90 m	50 km/h
Parliament Drive		One-way in anti-clockwise direction	One to two lanes	50 km/h
Sydney Avenue		Two-way	Two lanes in each direction, separated by 30 m wide median	40 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peak hour traffic counts for various mid-block locations within the Parliament House precinct have been analysed and are summarised on Figure 13-4. As shown, the 2024 data indicates a reduction in traffic during the AM and PM peak hours along State Circle since 2017. The exception is near Canberra Avenue, where there has been an increase in the eastbound direction during both peak hours, and to the north of Adelaide Avenue, where there has been an increase in the northbound direction in the PM peak hour.

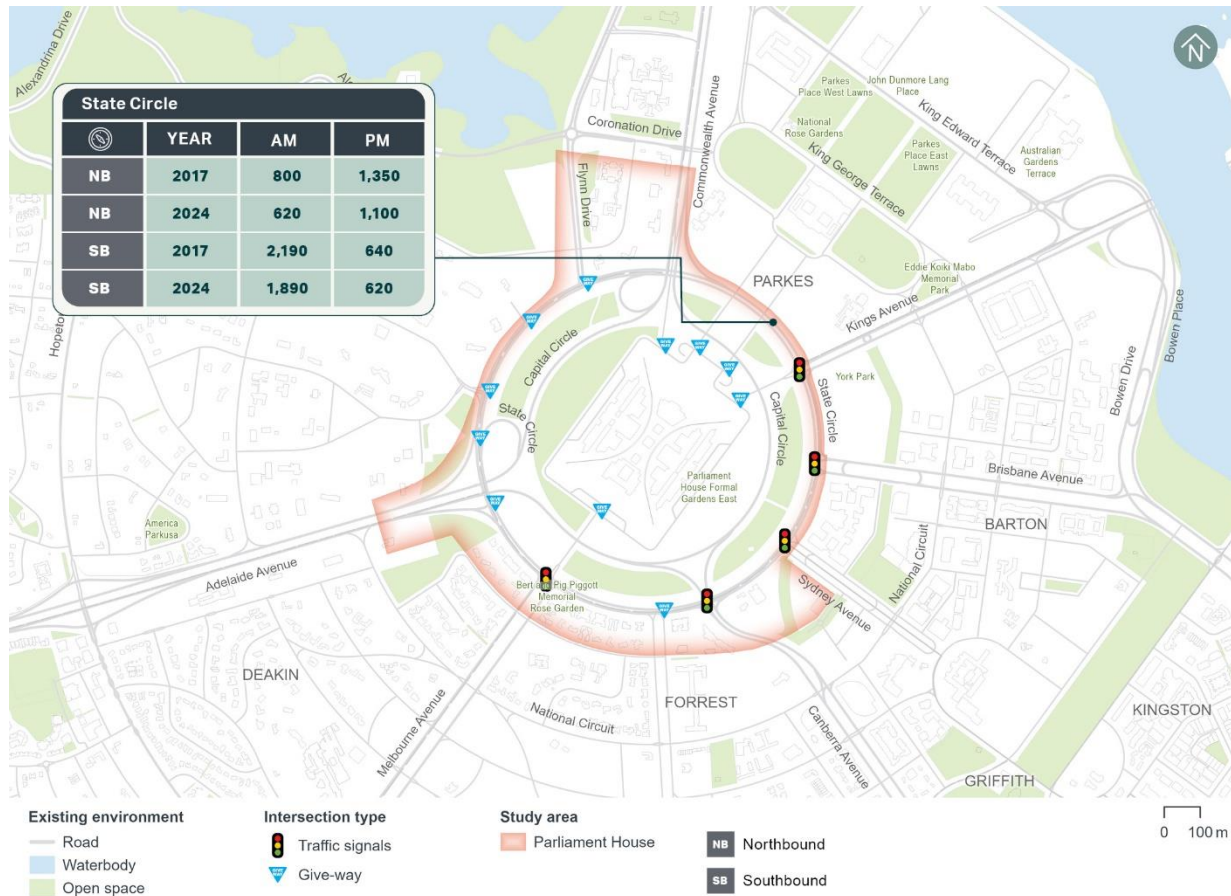


Figure 13-4 2017 and 2024 peak hourly traffic volumes within the Parliament House precinct study area

Historical average weekday traffic volume, heavy vehicle composition, and 85th percentile speed data have also been analysed for key roads within the Parliament House precinct, with a summary provided in Table 13-2. The data indicates heavy vehicles account for around 5% to 6% of the total daily traffic volumes on State Circle, while heavy vehicle proportions are lower on Hobart Avenue and Sydney Avenue. Sydney Avenue's 85th percentile vehicle speed is also higher than the posted speed limit.

Table 13-2 Average weekday traffic volume characteristics on key roads within the Parliament House precinct

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
State Circle	Between Melbourne Avenue and Adelaide Avenue	2024	15,150	5%	66 km/h
State Circle	Between Sydney Avenue and Canberra Avenue	2024	13,030	6%	70 km/h
Hobart Avenue	Between Somers Crescent and National Circuit	2021	3,040	3%	55 km/h
Sydney Avenue	Between State Circle and John McEwan Crescent	2022	5,400	4%	51 km/h

Figure 13-5 shows the weekday average daily traffic volume profile for State Circle, which indicates a clear AM peak hour between 8:00 am and 9:00 am and a PM peak hour between 5:00 pm and 6:00 pm.

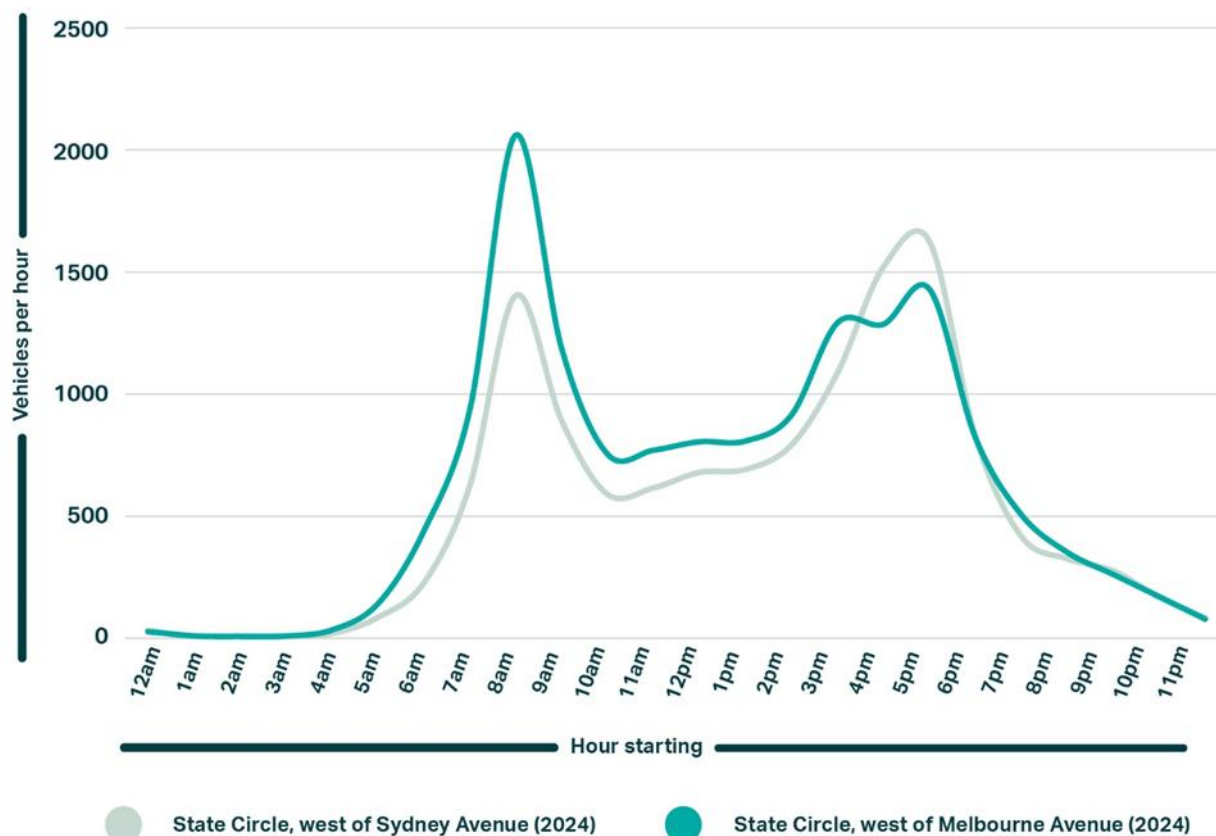


Figure 13-5 Weekday average daily traffic volume profile on State Circle

Intersection performance

The operation of the key intersections within the Parliament House precinct has been assessed using the microsimulation model which has been calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct existing performance of the assessed intersections is shown on Figure 13-6.

All the assessed intersections within the Parliament House precinct operated satisfactorily in 2017 at a level of service D or better during the weekday peak hours. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport.

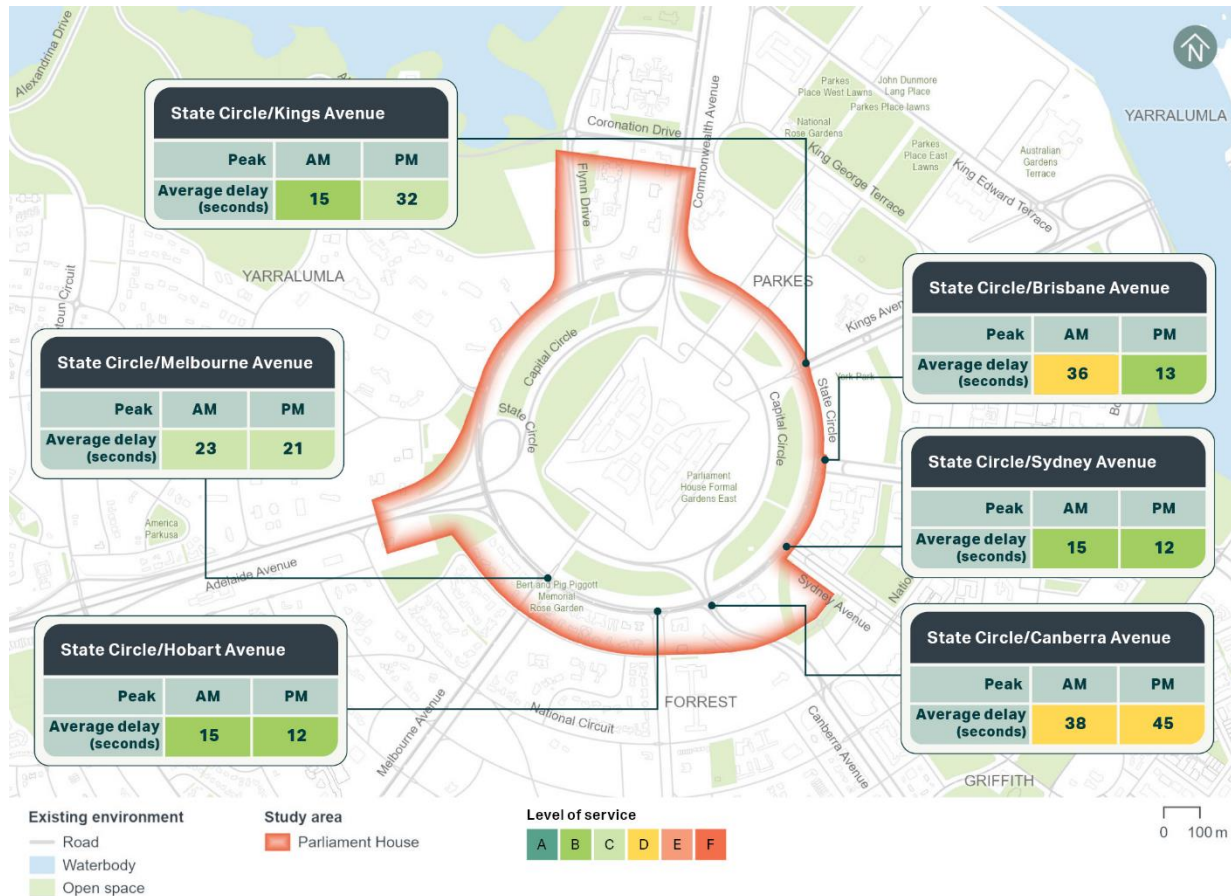


Figure 13-6 2017 AM and PM peak hour intersection performance within the Parliament House precinct study area

Public transport

One existing bus stop is located along State Circle, west of Melbourne Avenue. Only outbound services from the city centre use this bus stop, while inbound services use the bus stop on Melbourne Avenue before turning onto State Circle. In addition, bus stops are located on Parliament Drive adjacent to Parliament House.

Four bus routes service stops within the Parliament House precinct and provide connection to the city centre, Woden Interchange, Barton, Russel Offices, ANU, Canberra Hospital or more regionally to Yass. The bus routes that service stops within the Parliament House study area are routes 57, 58, 59, and 842 (operated by Transport for NSW). In addition, several bus routes also use Capital Circle but do not stop within the Parliament House precinct.

Active travel

Footpaths are provided on both sides of Commonwealth Avenue between Coronation Drive and State Circle and generally along the outer side of State Circle. A network of footpaths is also provided on the inner side of State Circle to provide a connection to Parliament House.

Signalised pedestrian crossings are provided at the following intersections:

- State Circle/Kings Avenue on the north, east and south approaches
- State Circle/Sydney Avenue on the north and east approaches
- State Circle/Canberra Avenue on all approaches
- State Circle/Melbourne Avenue on the west and east approaches.

Zebra crossings are provided on all slip lanes along State Circle's signalised intersections, including the State Circle/Brisbane Avenue intersection, which has no other formal pedestrian crossing facilities.

An on-road cycle lane is provided southbound along Commonwealth Avenue that continues around the eastern side of Capital Circle.

Pedestrian and cyclist count data from 2024 has been used to understand current active travel demand within the Parliament House precinct. The AM and PM peak hour counts at key locations within the precinct are summarised on Figure 13-7. Pedestrian volumes are higher on State Circle East. Cycling demand is higher on State Circle West during the AM peak hour. During the PM peak hour, cycling demand is consistent across all areas of State Circle.

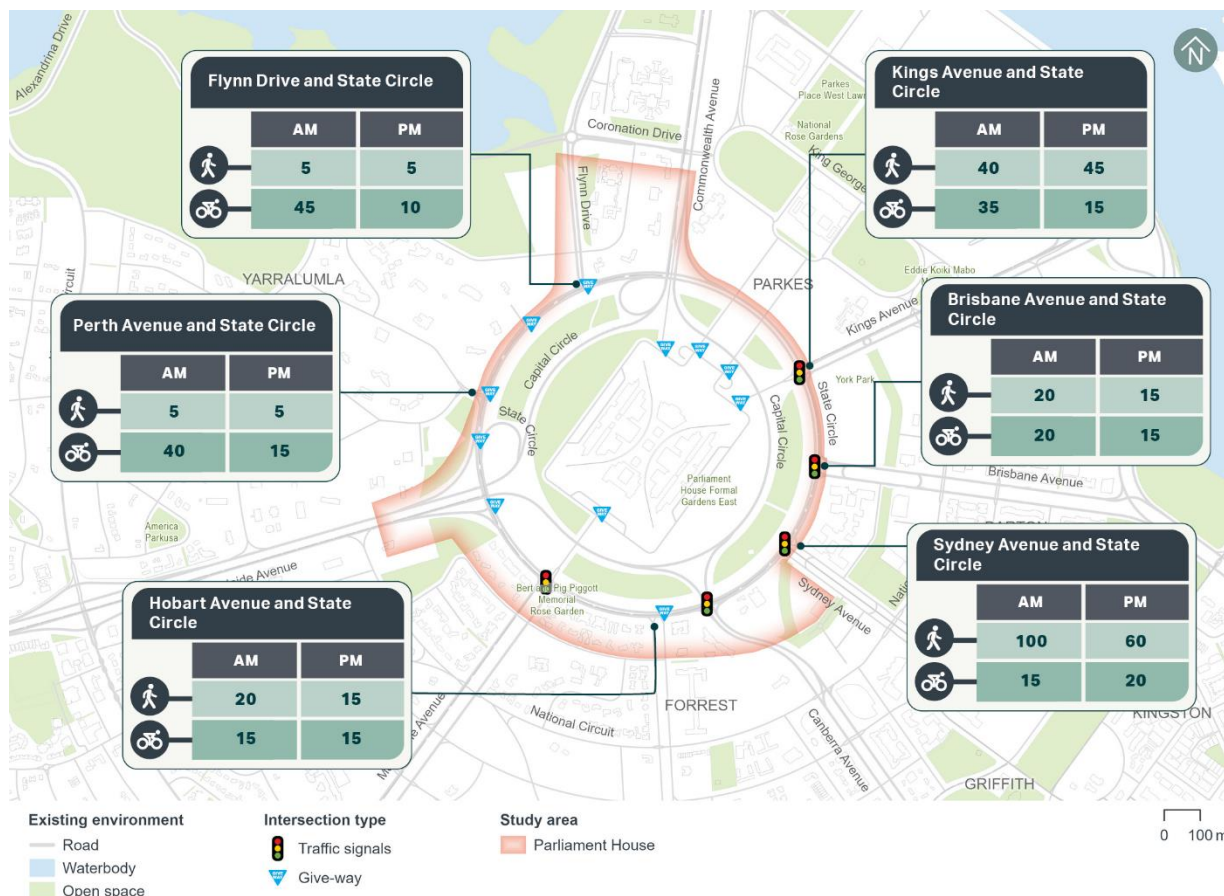


Figure 13-7 2024 peak hour active travel volumes within the Parliament House precinct study area

Car parking, kerbside uses, and access

Kerbside uses

The existing kerbside uses including on-street parking within the Parliament House precinct are summarised in Table 13-3.

Table 13-3 Parliament House precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
On alignment	State Circle	Hobart Avenue and Melbourne Avenue	South	2P	19
				Loading zone (6:00 am - 12:00 pm)	3
		Melbourne Avenue and Adelaide Avenue	South	2P	9
				Bus zone (public)	N/A

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
Off alignment	Hobart Avenue	State Circle and Somers Crescent	West	2P (7:30 am - 6:00 pm Monday to Friday)	11
	Melbourne Avenue	State Circle and Somers Crescent	East	2P (7:30 am - 6:00 pm Monday to Friday)	5
			West	Unrestricted	3
				Bus zone (public)	N/A
				Total	

Off-street parking

Parliament House has dedicated on-site car parking, which is accessed via Parliament Drive and Federation Mall. Additionally, Scriveners Hut, Federation Mall South West, Federation Mall South East and the Ministerial Wing external car parks have a small number of public and time-restricted car parks.

Property access

There are several property accesses located along the Project's alignment within the Parliament House precinct, as summarised in Table 13-4.

Table 13-4 Existing property access arrangements within the Parliament House precinct

Road	Site address	Site access arrangement
Commonwealth Avenue	New Zealand High Commission	Single left in, left out access along Commonwealth Avenue
State Circle	The Presbyterian Church of St Andrew	Two separate access points along State Circle
	15 State Circle	Single left in, left out access along State Circle
	27 State Circle	Single left in, left out access along State Circle
	29 State Circle	Single left in, left out access along State Circle
	33 State Circle	Single left in, left out access along State Circle
	35 State Circle	Single left in, left out access along State Circle

Crash history

Figure 13-8 shows the five year crash history (1 January 2018 to 31 December 2022) within the Parliament House precinct. A total of 209 crashes have been recorded within the Parliament House precinct during the five year period, including:

- Three crashes that resulted in a serious injury (around 1%)
- 22 crashes that resulted in a minor injury (around 11%)
- 184 crashes that resulted in property damage only (around 88%).

The following common crash types occurred:

- Nearly 31% of crashes involved a rear end collision
- Around 24% of crashes involved a same direction side swipe
- Around 19% of crashes involved an off-road struck object.



Figure 13-8 Crash data between 2018 and 2022 within the Parliament House precinct study area

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

13.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside use*State Circle East alignment option*

It is estimated that up to 46 on-street kerbside spaces would be lost within the Project area in the Parliament House precinct, including:

- 31 spaces on State Circle (on-alignment)
- Four spaces on Melbourne Avenue (off-alignment)
- 11 spaces on Hobart Avenue (off-alignment).

This represents around 92% of the total 50 on-street kerbside spaces identified within the Parliament House precinct. Of these kerbside uses, 31 on-street kerbside spaces would be permanently lost as part of the Project's permanent works for the State Circle East alignment option. The remaining spaces would be temporarily lost during construction. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

National Triangle-Barton alignment option

It is estimated that up to 46 on-street kerbside spaces would be temporarily lost within the National Triangle-Barton alignment option Project area in the Parliament House precinct as listed in above in the State Circle East alignment option section. This represents around 92% of the total 50 on-street kerbside spaces identified within the Parliament House precinct.

Construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

Off-street parking

The Project's construction would not change any off-street parking within the Parliament House precinct.

Local area access*State Circle East alignment option*

Construction of the State Circle East alignment option would change the following local area access arrangements within the Parliament House precinct:

- Right turns from State Circle to Kings Avenue would be restricted, with the right turn on the southern approach being a temporary restriction only during construction and the right turn on the northern approach being permanently removed as part of the Project
- Right turns from State Circle to Brisbane Avenue would be temporarily restricted
- Right turn from State Circle (eastern approach) to Canberra Avenue (north approach) would be temporarily restricted
- Right turn movements in and out of Hobart Avenue at State Circle would be restricted, noting this is a permanent change as part of the Project.

Vehicles that currently turn right onto Kings Avenue westbound from State Circle southbound would need to access Parliament Drive from Melbourne Avenue or Commonwealth Avenue, or instead approach Kings Avenue via the east or south. Similarly, vehicles that turn right onto Kings Avenue eastbound from State Circle northbound would need to instead approach Kings Avenue from the north or west.

Vehicles that currently turn right from State Circle southbound onto Canberra Avenue/Capital Circle westbound would need to use available alternative routes, such as stay on State Circle to connect with Adelaide Avenue, or adjust their trip further afield to use the broader arterial road network.

Vehicles that currently turn right in or out of Hobart Avenue at State Circle would need to use either Melbourne Avenue or Canberra Avenue along with the connecting streets.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists including those that may be connecting with Parliament House via Kings Avenue.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

National Triangle-Barton alignment option

Right turns from State Circle to Kings Avenue would be temporarily restricted during construction of the National Triangle-Barton alignment option.

Vehicles that currently turn right onto Kings Avenue westbound from State Circle southbound would need to access Parliament Drive from Melbourne Avenue or Commonwealth Avenue, or instead approach Kings Avenue via the east or south. Similarly, vehicles that turn right onto Kings Avenue eastbound from State Circle northbound would need to instead turn right at Brisbane Avenue, or instead approach Kings Avenue from the north or west.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists including those that may be connecting with Parliament House via Kings Avenue.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

Property access

State Circle East alignment option

The two existing site access points on State Circle to the Presbyterian Church of St Andrew would be restricted to left in, left out during construction of the State Circle East alignment option. Vehicles that currently turn right into this site would need to use State Circle and/or other connecting side roads to approach from the north and turn left into the site. Similarly, vehicles that currently turn right out of this site would need to turn left and circulate clockwise around State Circle and/or use connecting side roads to travel north. Approaching these access points from the north rather than the south could result in a slight increase in travel time depending on where drivers are travelling from and how far afield they adjust their travel route. Similarly, departing to the south instead of the north could also result in a slight increase in travel time.

This property access change forms part of the Project's permanent works for the State Circle East alignment option.

Property access at Parliament House would not be impacted by construction of the State Circle East alignment option.

National Triangle-Barton alignment option

Construction of the National Triangle-Barton alignment option would not change property access within the Parliament House precinct, including access to Parliament House itself.

13.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Parliament House precinct to accommodate the Project would include speed limit adjustments, adjustments to existing lanes, key intersection adjustments, new intersection arrangements, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Parliament House precinct, particularly on Adelaide Avenue, Capital Circle, and State Circle.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

Traffic volume changes associated with the State Circle East alignment option are summarised in Table 13-5 and Table 13-6, and those for the National Triangle-Barton alignment option are summarised in Table 13-7 and Table 13-8. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance
- Changes in mode choice due to the introduction of light rail.

*State Circle East alignment option***Table 13-5 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Parliament House precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
State Circle	Between Sydney Avenue and Canberra Avenue	Eastbound	1,070	970	-100	-9%	1,130	1,010	-120	-11%
		Westbound	1,170	580	-590	-50%	1,070	590	-480	-45%
	West of Flynn Drive	Eastbound	2,280	1,440	-840	-37%	2,110	1,580	-530	-25%
		Westbound	470	760	290	62%	490	750	260	53%
Capital Circle	Between Canberra Avenue and Melbourne Avenue	Westbound	1,670	1,150	-520	-31%	1,880	1,260	-620	-33%
	Between Adelaide Avenue and Commonwealth Avenue	Northbound	1,610	1,920	310	19%	1,370	1,580	210	15%
Canberra Avenue	South of State Circle	Northbound	1,350	1,240	-110	-8%	1,540	1,330	-210	-14%
		Southbound	1,320	1,270	-50	-4%	1,400	1,270	-130	-9%
Hobart Avenue	South of State Circle	Northbound	690	520	-170	-25%	600	440	-160	-27%
		Southbound	310	120	-190	-61%	310	100	-210	-68%

Table 13-6 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Parliament House precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
State Circle	Between Sydney Avenue and Canberra Avenue	Eastbound	650	530	-120	-18%	610	590	-20	-3%
		Westbound	1,580	1,250	-330	-21%	1,810	1,480	-330	-18%
	West of Flynn Drive	Eastbound	1,060	690	-370	-35%	1,170	860	-310	-26%
		Westbound	750	720	-30	-4%	730	750	20	3%
Capital Circle	Between Canberra Avenue and Melbourne Avenue	Westbound	2,570	2,230	-340	-13%	2,480	2,440	-40	-2%
	Between Adelaide Avenue and Commonwealth Avenue	Northbound	950	1,110	160	17%	1,190	1,060	-130	-11%
Canberra Avenue	South of State Circle	Northbound	1,550	1,710	160	10%	1,320	1,600	280	21%
		Southbound	1,310	1,360	50	4%	1,600	1,510	-90	-6%
Hobart Avenue	South of State Circle	Northbound	490	360	-130	-27%	680	580	-100	-15%
		Southbound	500	190	-310	-62%	540	160	-380	-70%

*National Triangle-Barton alignment option***Table 13-7 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Parliament House precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
State Circle	Between Sydney Avenue and Canberra Avenue	Eastbound	1,070	1,020	-50	-5%	1,130	1,120	-10	-1%
		Westbound	1,170	840	-330	-28%	1,070	770	-300	-28%
	West of Flynn Drive	Eastbound	2,280	1,910	-370	-16%	2,110	1,730	-380	-18%
		Westbound	470	670	200	43%	490	660	170	35%
Capital Circle	Between Canberra Avenue and Melbourne Avenue	Westbound	1,670	1,350	-320	-19%	1,880	1,340	-540	-29%
	Between Adelaide Avenue and Commonwealth Avenue	Northbound	1,610	1,870	260	16%	1,370	1,590	220	16%
Canberra Avenue	South of State Circle	Northbound	1,350	1,350	0	0%	1,540	1,280	-260	-17%
		Southbound	1,320	900	-420	-32%	1,400	1,010	-390	-28%
Hobart Avenue	South of State Circle	Northbound	690	850	160	23%	600	730	130	22%
		Southbound	310	320	10	3%	310	380	70	23%

Table 13-8 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Parliament House precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
State Circle	Between Sydney Avenue and Canberra Avenue	Eastbound	650	380	-270	-42%	610	730	120	20%
		Westbound	1,580	1,500	-80	-5%	1,810	1,540	-270	-15%
	West of Flynn Drive	Eastbound	1,060	1,090	30	3%	1,170	1,400	230	20%
		Westbound	750	1,020	270	36%	730	1,030	300	41%
Capital Circle	Between Canberra Avenue and Melbourne Avenue	Westbound	2,570	2,580	10	0%	2,480	2,300	-180	-7%
	Between Adelaide Avenue and Commonwealth Avenue	Northbound	950	900	-50	-5%	1,190	890	-300	-25%
Canberra Avenue	South of State Circle	Northbound	1,550	1,620	70	5%	1,320	1,750	430	33%
		Southbound	1,310	1,560	250	19%	1,600	1,330	-270	-17%
Hobart Avenue	South of State Circle	Northbound	490	420	-70	-14%	680	580	-100	-15%
		Southbound	500	390	-110	-22%	540	600	60	11%

Road network performance

State Circle East alignment option

A comparison of vehicle delay across the Parliament House precinct's road network with and without the Project in the 2031 scenario has been conducted for the AM and PM peak hours.

Within the Parliament House precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

The Project's changes to the road network and associated traffic reassignment and signal operation changes would cause the following changes to congestion and vehicle delay when compared to the without Project scenario in 2031:

- Increased congestion and delay on State Circle (clockwise direction) and, particularly on approach to Kings Avenue and propagating back to Adelaide Avenue, as well as Brisbane Avenue and Melbourne Avenue during the AM peak hour
- Increased congestion and delay on State Circle (clockwise direction) on approach to Melbourne Avenue during the PM peak hour and decreased congestion and delay on approach to Canberra Avenue and Kings Avenue during the PM peak hour
- Increased congestion and delay on State Circle (anti-clockwise direction) on approach to Canberra Avenue during the AM peak hour and on approach to Brisbane Avenue during the PM peak hour
- Decreased congestion and delay on State Circle (anti-clockwise direction) on approach to Perth Avenue during the PM peak hour
- Increased congestion and delay on Melbourne Avenue at the northern approach to State Circle during the PM peak hour
- Decreased congestion and delay on Adelaide Avenue westbound on-ramp near State Circle during the PM peak hour
- Increased congestion and delay on Capital Circle between Adelaide Avenue and Commonwealth Avenue during the AM and PM peak hours
- Decreased congestion and delay on Flynn Drive on the approach to State Circle during the AM peak hour, which could be due to more gaps in the traffic stream on State Circle due to reduced vehicle speeds because of a more congested network
- Decreased congestion and delay on the Capital Circle off-ramp to Canberra Avenue during the AM peak hour and increased congestion and delay on Capital Circle off-ramp to Canberra Avenue during the PM peak hour.

With the Project, traffic flows on some sections of State Circle in the clockwise direction and the Capital Circle off-ramp to Canberra Avenue would reduce during the AM and PM peak hours, respectively. However, congestion on these sections would increase due to changes in signal operations resulting from the altered traffic flows.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041. However, the extent of longer delays is anticipated to propagate further than in 2031.

National Triangle-Barton alignment option

A comparison of vehicle delay across the Parliament House precinct's road network with and without the Project in the 2031 scenario has been conducted for the AM and PM peak hours.

Within the Parliament House precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

The Project's changes to the road network and associated traffic reassignment and signal operation changes would cause the following changes to congestion and vehicle delay when compared to the without Project scenario in the 2031 scenario:

- Increased congestion and delay on Commonwealth Avenue on the southbound approach to Capital Circle and propagating back to Coronation Drive during the AM peak hour
- Increased congestion and delay on State Circle (clockwise direction) on approach to Kings Avenue and propagating back to Perth Avenue and on approach to Canberra Avenue and propagating back to Brisbane Avenue during the AM peak hour
- Increased congestion and delay on State Circle (anti-clockwise direction) on approach to Brisbane Avenue and propagating back to Melbourne Avenue during the AM peak hour
- Decreased congestion and delay on Perth Avenue on approach to State Circle during the AM peak hour
- Increased congestion and delay on the Capital Circle off-ramp to Canberra Avenue and propagating back to Commonwealth Avenue during the AM peak hour and decreased congestion and delay during the PM peak hour
- Increased congestion and delay on Adelaide Avenue in the westbound direction during the PM peak hour
- Increased congestion and delay on State Circle (clockwise direction) on the approach to Sydney Avenue and decreased congestion and delay on the approach to Canberra Avenue during the PM peak hour
- Decreased congestion and delay on State Circle (anti-clockwise direction) on the approach to Perth Avenue during the PM peak hour
- Decreased congestion and delay on the State Circle off-ramp onto Commonwealth Avenue northbound and on Commonwealth Avenue northbound during the PM peak hour
- Decreased congestion and delay on Flynn Drive on the approach to State Circle during the AM peak hour, which could be due to more gaps in the traffic stream on State Circle due to reduced vehicle speeds because of a more congested network.

With the Project, traffic flows on some sections of State Circle in the clockwise direction would reduce during the AM and PM peak hours, respectively. However, congestion on these sections would increase due to changes in signal operations resulting from the altered traffic flows.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in the 2041 scenario. Although, the extent of longer delays is anticipated to propagate further than in the 2031 scenario.

Intersection performance

State Circle East alignment option

The performance of the key intersections within the Parliament House precinct with and without the Project for the State Circle East alignment option is provided in Table 13-9 and Table 13-10.

Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. Key findings relating to intersection performance are as follows:

AM peak hour:

- The State Circle/Hobart Avenue intersection and new Project alignment crossings across State Circle (south) and Capital Circle would operate satisfactorily at a level of service A with the Project in the 2031 and 2041 scenarios. The improved performance at the State Circle/Hobart Avenue intersection with the Project is due to the intersection arrangement changing to permit left in, and left out movements only

- The performance of other intersections along State Circle would generally reduce with the Project in 2031 and 2041 scenarios. This reduction in intersection performance would be due to the introduction of the Project alignment and associated signal phasing changes, along with the removal of several slip lanes, which would result in left turning vehicles being controlled by traffic signals. In addition, the removal of a right turn at the State Circle/Kings Avenue intersection would result in higher vehicle delays at adjacent intersections where the right turn movement would be retained.

PM peak hour:

- The following intersections would operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - Light rail crossing of State Circle (north)
 - Brisbane Avenue/State Circle
 - Sydney Avenue/State Circle
 - Hobart Avenue/State Circle
 - Light rail crossing of State Circle (south)
 - Light rail crossing of Capital Circle.
- The performance of other intersections along State Circle would generally reduce with the Project in 2031 and 2041 scenarios during the PM peak hour, similar to the AM peak hour.

Table 13-9 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Parliament House precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Light rail crossing of State Circle (north)	-	-	123	F	-	-	108	F
Kings Avenue/State Circle	82	F	104	F	35	C	115	F
Brisbane Avenue/State Circle	24	C	54	D	23	C	86	F
Sydney Avenue/State Circle/	37	D	56	E	32	C	75	E
Canberra Avenue/State Circle	61	E	66	E	87	F	86	F
Hobart Avenue/State Circle	11	B	2	A	71	E	2	A
Melbourne Avenue/State Circle	29	C	65	E	42	D	62	E
Light rail crossing of State Circle (south)	-	-	10	A	-	-	33	C
Light rail crossing of Capital Circle	-	-	7	A	-	-	6	A

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 13-10 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Parliament House precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Light rail crossing of State Circle (north)	-	-	36	D	-	-	37	D
Kings Avenue/State Circle	49	D	74	E	36	D	81	F
Brisbane Avenue/State Circle	26	C	28	C	28	C	33	C
Sydney Avenue/State Circle/	39	D	46	D	61	E	55	D
Canberra Avenue/State Circle	143	F	78	E	134	F	128	F
Hobart Avenue/State Circle	24	C	9	A	110	F	4	A
Melbourne Avenue/State Circle	29	C	65	E	49	D	59	E
Light rail crossing of State Circle (south)	-	-	8	A	-	-	9	A
Light rail crossing of Capital Circle	-	-	6	A	-	-	5	A

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

National Triangle-Barton alignment option

The performance of the key intersections within the Parliament House precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 13-11 and Table 13-12. Key findings relating to intersection performance are as follows:

AM peak hour:

- The following intersections would operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - State Circle/Melbourne Avenue
 - State Circle/Hobart Avenue
 - Light rail crossing of Capital Circle
- There is an improvement in performance at the State Circle/Hobart Avenue intersection in the 2041 scenario with the Project (level of service D versus F without the Project). This is due to the storage capacity for the right turn from State Circle to Hobart Avenue being increased.
- The performance of the State Circle/Sydney Avenue intersection would reduce with the Project in 2031 and 2041 scenarios. This reduction in intersection performance is due to the Project alignment passing through this intersection and associated signal phasing changes. In addition, the removal of a U-turn movement within the central median on Sydney Avenue would shift this demand to the State Circle/Sydney Avenue intersection, where this U-turn movement would be permitted with the Project.
- Similarly, the performance of the State Circle/Canberra Avenue intersection would reduce in the 2031 scenario due to the Project alignment passing through this intersection and associated signal phasing changes. However, the additional short lane on Canberra Avenue (refer to Chapter 5 (Project description) for discussion on road network changes) and the change in travel patterns with the Project results in a slightly lower delay across the intersection in the 2041 scenario compared to without the Project.

PM peak hour:

- The following intersections would operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - State Circle/Hobart Avenue
 - State Circle/Melbourne Avenue
 - Light rail crossing of Capital Circle
- The performance of the State Circle/Sydney Avenue intersection would reduce with the Project in 2031 and 2041 scenarios due to the introduction of the Project alignment and associated signal phasing changes.
- The performance of the State Circle/Canberra Avenue intersection would improve with the Project in 2031 and 2041 scenarios due to the additional lane on Canberra Avenue and change in travel patterns with the Project.

Table 13-11 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Parliament House precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Sydney Avenue/ State Circle/	33	C	77	E	41	D	76	E
Canberra Avenue/ State Circle	54	D	63	E	76	E	64	E
State Circle/ Hobart Avenue	11	B	32	C	>150	F	37	D
State Circle/ Melbourne Avenue	28	C	46	D	49	D	54	D
Light rail crossing of Capital Circle	-	-	7	A	-	-	7	A

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 13-12 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Parliament House precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Sydney Avenue/ State Circle/	51	D	64	E	52	D	65	E
Canberra Avenue/ State Circle	120	F	80	E	113	F	75	E
State Circle/ Hobart Avenue	22	C	12	B	128	F	33	C
State Circle/ Melbourne Avenue	28	C	47	D	50	D	41	D
Light rail crossing of Capital Circle	-	-	5	A	-	-	5	A

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Active travel

State Circle East alignment option

The key active travel provisions that would be provided within the Parliament House precinct as part of the Project for the State Circle East alignment option and their benefits or impacts are summarised in Table 13-13.

Table 13-13 Active travel provisions within the Parliament House precinct and associated impacts and benefits (State Circle East alignment option)

Proposed treatment	Impact or benefit
Slip lanes would be removed at the following intersections to signalise the pedestrian crossing: <ul style="list-style-type: none"> State Circle and Kings Avenue State Circle and Brisbane Avenue State Circle and Sydney Avenue State Circle and Canberra Avenue State Circle and Melbourne Avenue. 	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in increased delays for pedestrians waiting to cross the road.
Signalised pedestrian crossings would be provided across the tracks at the following locations: <ul style="list-style-type: none"> Kings Avenue and State Circle Sydney Avenue and State Circle Canberra Avenue and State Circle Melbourne Avenue and State Circle. 	The signalised pedestrian crossings would be staged crossings which could result in higher delays for pedestrians waiting to cross the road than the current signalised crossings in these locations.
A signalised pedestrian crossing would be provided on the slip lane from Commonwealth Avenue to State Circle.	A signalised pedestrian crossing would provide a controlled and typically safer crossing facility. However, providing a signalised pedestrian crossing could result in higher delays for pedestrians waiting to cross the road.
Pedestrian track connection would be provided between Capital Circle and State Circle west of Melbourne Avenue and would be an unsignalised but formalised crossing of the track.	Existing pedestrian and cyclist connectivity would be maintained across the track.

National Triangle-Barton alignment option

The key active travel provisions that would be provided within the Parliament House precinct as part of the Project for the National Triangle-Barton alignment option and their benefits or impacts are summarised in Table 13-14.

Table 13-14 Active travel provisions within the Parliament House precinct and associated impacts and benefits (National Triangle-Barton alignment option)

Proposed treatment	Impact or benefit
Signalised pedestrian crossings would be provided across the tracks at the following locations: <ul style="list-style-type: none"> Canberra Avenue and State Circle Melbourne Avenue and State Circle. 	The signalised pedestrian crossings would be staged crossings which could result in higher delays for pedestrians waiting to cross the road than the current signalised crossings in these locations.
Pedestrian track connection would be provided between Capital Circle and State Circle west of Melbourne Avenue and would be an unsignalised but formalised crossing of the track.	Existing pedestrian and cyclist connectivity would be maintained across the track.

Kerbside use

State Circle East alignment option

The State Circle East alignment option would remove 31 on-street kerbside spaces along State Circle between Hobart Avenue and Adelaide Avenue within the Parliament House precinct. Historical aerial imagery and site observations from June 2024 indicate that these spaces are currently not well utilised. Kerbside parking demand on adjacent side roads such as Hobart Avenue and Melbourne Avenue is also low. As such, it is likely these side roads could accommodate some of the existing demand for the kerbside uses on State Circle that would be removed as part of the Project.

National Triangle-Barton alignment option

The National Triangle-Barton alignment option would not change any kerbside uses within the Parliament House precinct.

Off-street parking

The Project would not change any off-street parking within the Parliament House precinct.

Local area access

State Circle East alignment option

The State Circle East alignment option would change the following local area access arrangements within the Parliament House precinct:

- Right turn from State Circle southbound to Kings Avenue westbound would be removed
- Right turn movements in and out of Hobart Avenue at State Circle would be removed.

Vehicles that currently turn right onto Kings Avenue westbound from State Circle southbound would need to access Parliament Drive from Melbourne Avenue or Commonwealth Avenue, or instead approach Kings Avenue via the east or south.

Vehicles that currently turn right in or out of Hobart Avenue at State Circle would need to use either Melbourne Avenue or Canberra Avenue along with the connecting streets.

These changes to local area access would likely result in a slight increase in travel time, including to vehicles that may be connecting with Parliament House via Kings Avenue, depending on where drivers are travelling to/from and how far afield they adjust their travel route.

National Triangle-Barton alignment option

U-turns out of Sydney Avenue onto State Circle and returning into Sydney Avenue would be enabled to offset the removal of the existing U-turn movement that uses the central median on Sydney Avenue. The National Triangle-Barton alignment option would not change any other local area access arrangements within the Parliament House precinct.

Property access

State Circle East alignment option

The State Circle East alignment option would realign the kerb of Commonwealth Avenue outside the New Zealand High Commission, resulting in minor adjustments to the existing property access kerbs. However, the kerb realignment would not alter the functionality of existing access.

The two existing site access points on State Circle to the Presbyterian Church of St Andrew would be restricted to left in, left out with the State Circle East alignment option. Vehicles that currently turn right into this site would need to use State Circle and/or other connecting side roads to approach from the north and turn left into the site. Similarly, vehicles that currently turn right out of this site would need to turn left and circulate clockwise around State Circle and/or use connecting side roads to travel north. Approaching these access points from the north rather than the south could result in a slight increase in travel time depending on where drivers are travelling from and how far afield they adjust their travel route. Similarly, departing to the south instead of the north could also result in a slight increase in travel time.

Property access at Parliament House would not be impacted by the Project.

National Triangle-Barton alignment option

The National Triangle-Barton alignment option would not change any property accesses within the Parliament House precinct, including access to Parliament House itself.

13.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the Parliament House precinct.

13.3 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts associated with the construction and operation of the Project within the Parliament House precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

13.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas were determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Areas 3, 5, and 6 were identified for the noise assessment of the Parliament House precinct. Noise Catchment Areas 3, 5 and 6 and associated sensitive receivers are shown on Figure 13-9.

Noise Catchment Area 3 consists mainly of mixed use (embassies and high commissions) and commercial land uses, including federal government offices in the RG Casey Building, located on John McEwen Crescent in Barton. There are two heritage-listed items within Noise Catchment Area 3 – West Block and Dugout and East Block Government Offices, both listed under the Commonwealth Heritage List. The National Archives of Australia is located within East Block, and is considered a receiver that may have potentially vibration-sensitive equipment. Further detail on the West Block and Dugout is included in Section 13.5 and discussion regarding the East Block Government Offices is included in Section 14.5, given its proximity to the National Triangle precinct.

Noise Catchment Area 5 is centred in the suburb of Forrest and includes several residential apartments and houses, particularly in the southern portion of the catchment area. There are a number of commercial and educational land uses, including offices along Sydney Avenue and Forrest Primary School. There are also several places of worship, such as the Presbyterian Church of Saint Andrew, Lakeside Christian Church, and Saint Christopher's Cathedral.

The predominant feature within Noise Catchment Area 6 is the public building land use feature of Parliament House. Within Noise Catchment Area 6, Parliament House is surrounded by mixed use land uses to the west (mostly including embassies and high commissions), and by residential land uses to the south.

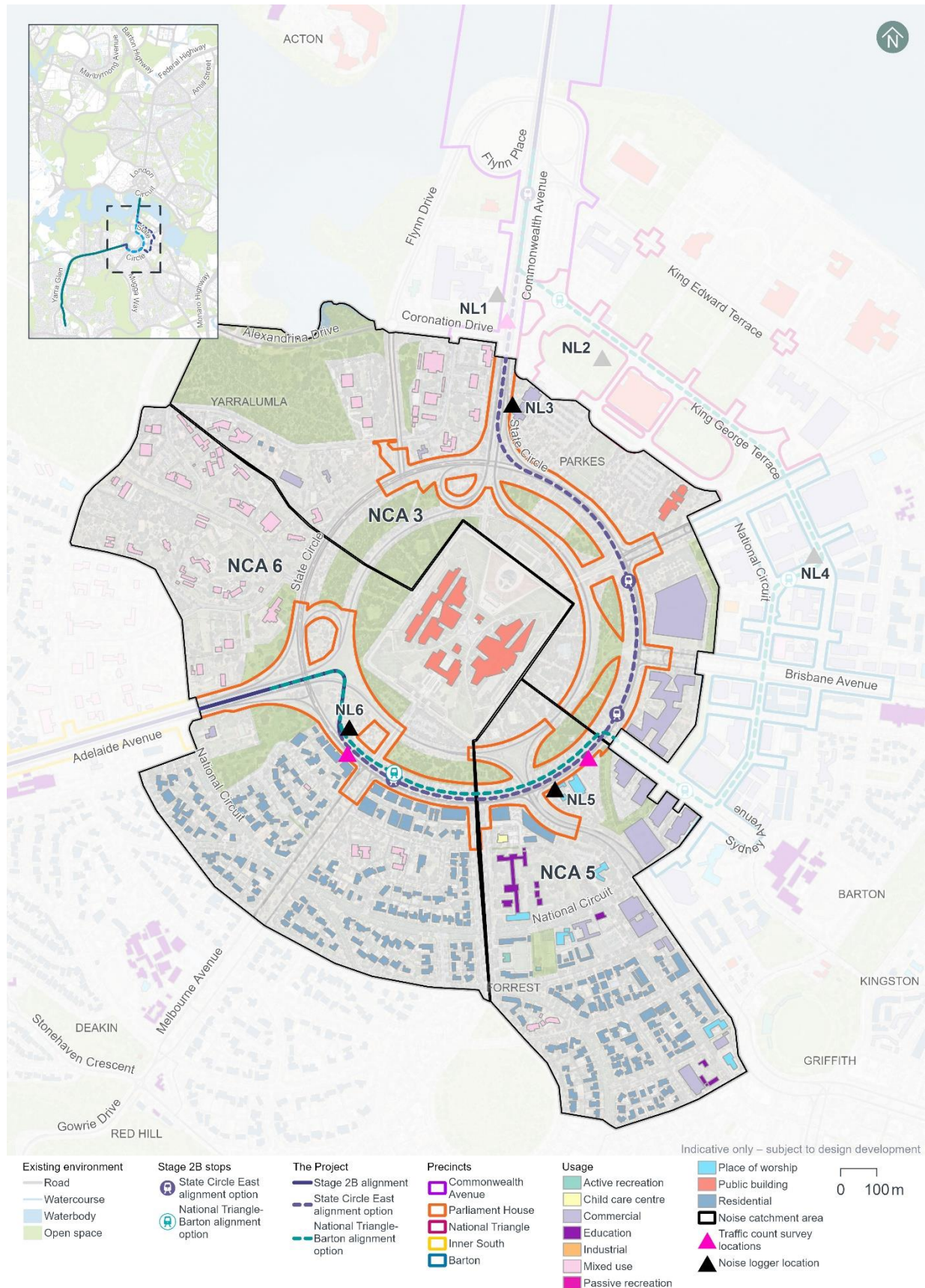


Figure 13-9 Noise catchment area and sensitive receivers – Parliament House precinct

Existing noise levels

Unattended noise monitoring was carried out at three locations in the Parliament House precinct (at noise loggers 3, 5 and 6 (NL3, NL5 and NL6)) between 2 and 15 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 13-15. The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 13-15 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL3	West Block, Queen Victoria Terrace, Parkes	53	30 ³	66	59
NL5	The Presbyterian Church of Saint Andrew, 3 State Circle, Forrest	53	32	64	55
NL6	Opposite 29 State Circle, Deakin	52	30 ³	59	51

Notes:

1. dB(A) represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
2. In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 13-16.

Table 13-16 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL3	64	53	Noise recorded was dominated by traffic, including trucks and cars. Some insect noise was audible during lulls in traffic, and some construction noise from West Block was audible.
NL5	60	53	Noise recorded was dominated by traffic noise from the intersection. Some bird noise was audible during lulls.
NL6	62	51	Noise recorded reflected mostly constant traffic.

Road traffic noise monitoring was also carried out at NL5 and NL6, with data used to validate a road traffic noise model for the Project. The results of this monitoring are summarised in Section 2.5 of Technical Report 9 – Noise and vibration.

13.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Parliament House precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (which includes construction of the covered section on Commonwealth Avenue and State Circle for the State Circle East alignment option using equipment such as hammers and excavators)
- Construction of stops
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project, therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures). All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and

establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise exceedances compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Where relevant, construction scenarios have been assessed separately for each alignment option to reflect the different locations of proposed work.

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 13-17, which assumes no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 13-18.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Table 13-17 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place) – Parliament House precinct

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 3				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	1
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	3	20	8
	Typical	-	14	2
Earthworks, road works, and construction of light rail infrastructure	Peak	4	20	7
	Typical	2	17	5
Earthworks, road works, and construction of light rail infrastructure	Peak	1	14	1
	Typical	1	8	1
Construction of stops (State Circle East alignment option)	Typical/peak	-	-	-
Construction of stops (National Triangle-Barton alignment option)	Typical/peak	-	-	-
Construction of bridges on land	Peak	-	2	-
	Typical	-	-	-
Noise Catchment Area 5				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	2	14	3
	Typical	2	3	2

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Earthworks, road works, and construction of light rail infrastructure	Peak	2	5	3
	Typical	2	3	2
Earthworks, road works, and construction of light rail infrastructure	Peak	2	5	3
	Typical	2	3	2
Construction of stops (State Circle East alignment option)	Typical/peak	-	-	-
Construction of stops (National Triangle-Barton alignment option)	Typical/peak	-	-	-
Construction of bridges on land	Peak	-	-	-
	Typical	-	-	-
Noise Catchment Area 6				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	19	167	39
	Typical	7	57	17
Earthworks, road works, and construction of light rail infrastructure	Peak	18	157	37
	Typical	14	95	24
Earthworks, road works, and construction of light rail infrastructure	Peak	16	156	37
	Typical	14	91	25
Construction of stops (State Circle East alignment option)	Typical/peak	2	13	3

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Construction of stops (National Triangle-Barton alignment option)	Typical/peak	2	13	3
Construction of bridges on land	Peak	3	105	11
	Typical	-	28	3

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

Table 13-18 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) – Parliament House precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Areas 3, 5 and 6		
Mobilisation and establishment of construction compound sites - peak	Public buildings	3
Protection, relocation, treatment and/or decommissioning of utilities - peak	Child care centre	1
	Education	1
	Place of worship	4
	Public buildings	6
Protection, relocation, treatment and/or decommissioning of utilities - typical	Place of worship	2
	Public buildings	2
Earthworks, road works, and construction of light rail infrastructure – peak (State Circle East alignment option)	Child care centre	1
	Education	1
	Place of worship	3
	Public buildings	3
Earthworks, road works, and construction of light rail infrastructure – typical (State Circle East alignment option)	Child care centre	1
	Education	1
	Place of worship	3
	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – peak (National Triangle-Barton alignment option)	Child care centre	1
	Education	1
	Place of worship	3
	Public buildings	4
Earthworks, road works, and construction of light rail infrastructure – typical (National Triangle-Barton alignment option)	Child care centre	1
	Education	1
	Place of worship	3
Construction of bridges on land - peak	Public buildings	3

Notes:

1. Where a construction scenario did not result in an exceedance for a non-residential receiver, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the Parliament House precinct during the daytime indicate:

- The 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario is predicted to result in 24 residential buildings being moderately noise affected, across the three relevant noise catchment areas
- The 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario would result in the highest number of instances where non-residential buildings are predicted to be moderately noise affected. A total of 12 non-residential buildings are predicted to be moderately noise affected, including the National Archives of Australia, Parliament House, and the Presbyterian Church of St Andrew (listed on ACT Heritage Register).

The findings of the unmitigated peak and typical construction noise impact assessments for the Parliament House precinct during the night-time period indicate:

- For Noise Catchment Area 3, 'peak' protection, relocation, treatment and/or decommissioning of utilities and earthworks, road works, and construction of light rail infrastructure is predicted to result in the highest number of noise affected residential buildings, with 20 receivers expected to be moderately noise affected and eight receivers expected to be highly noise affected
- For Noise Catchment Area 5, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in the highest number of noise affected residential buildings, with 14 receivers expected to be moderately noise affected and three receivers expected to be highly noise affected
- For Noise Catchment Area 6, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in the highest number of noise affected residential buildings, with 167 receivers expected to be moderately noise affected and 39 receivers expected to be highly noise affected.

Construction of the covered section between Commonwealth Avenue and State Circle (required for the State Circle East alignment option only) would be carried out in the Parliament House precinct. Covered section construction is assessed in the earthworks, road works and construction of light rail infrastructure scenario. If piling activities are carried out around the covered section construction area, noise levels could increase by up to 1 dB(A) for 'peak' works, and up to 3 dB(A) for 'typical' works. Where this occurs, potential increase in noise levels of up to 3 dB(A) may impact receivers in the Parliament House precinct.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical' works case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 13-19 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Areas 3, 5, and 6, in the absence of any mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently, and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 13-19 Number of residential buildings where noise levels may exceed sleep awakening reaction levels for night work (assuming no mitigation measures are in place)

Scenario (typical works)	Number of residential buildings where unmitigated noise levels may exceed the sleep awakening reaction level
Noise Catchment Area 3	
Protection, relocation, treatment and/or decommissioning of utilities	16
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	18
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	13
Construction of stops (State Circle East alignment option)	-
Construction of stops (National Triangle-Barton alignment option)	-
Construction of bridges on land	-
Noise Catchment Area 5	
Protection, relocation, treatment and/or decommissioning of utilities	3
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	12
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	10
Construction of stops (State Circle East alignment option)	-
Construction of stops (National Triangle-Barton alignment option)	-
Construction of bridges on land	-
Noise Catchment Area 6	
Protection, relocation, treatment and/or decommissioning of utilities	78
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	146
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	145
Construction of stops (State Circle East alignment option)	17
Construction of stops (National Triangle-Barton alignment option)	17
Construction of bridges on land	53

Noting the awakening reaction level is exceeded at residential receivers in each Noise Catchment Area in the Parliament House precinct with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (for both alignment options).

In Noise Catchment Area 6, the awakening reaction level is also exceeded by noise relating to:

- Construction of stops (for both alignment options)
- Construction of bridges on land.

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. A number of residential buildings are located within the human response minimum safe working distance for the large hydraulic hammer (73 m from the Project area boundary). There is potential for exceedances of the human comfort criteria to occur depending on the duration, nature and location of the construction activity within the construction footprint. Any exceedances would be expected to be short in duration due to the intermittent nature of vibration emissions.

Cosmetic damage

A number of light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures), and heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage and other sensitive structures).

Heritage structures that may potentially be affected by vibration from large hydraulic hammers and other proposed vibratory plant and equipment are listed in Table 13-20. Potential impacts to heritage in the Parliament House precinct are further discussed in Section 13.5, and the East Block Government Offices are further discussed in Section 14.5 due to their proximity to the National Triangle precinct.

Table 13-20 Heritage items within 60 m (minimum working distance for a large hydraulic hammer) of the Project area

Heritage place name	Distance between Project area and heritage structures (m)
West Block and the Dugout (Commonwealth Heritage List Listed Place)	4
East Block Government Offices (Commonwealth Heritage List Listed Place)	14
St Andrew's Church Precinct (ACT Heritage Register Registered Place)	4
Commencement Column Monument (Commonwealth Heritage List Listed Place)	48

Heritage place name	Distance between Project area and heritage structures (m)
York Park North Tree Plantation (Commonwealth Heritage List Listed Place)	5

The National Archives of Australia (located within East Block Government Offices) has been identified as a location with potentially vibration sensitive equipment and is located within the minimum working distance to the Project area boundary (60 m for heritage and other sensitive structures). The nature, location and sensitivity of the equipment housed in this building would be confirmed prior to construction works that may impact the receiver.

The Lodge is located near the boundary of the Parliament House and Inner South precincts and has the potential to be affected by works from both precincts. Potential vibration impacts on The Lodge are assessed in Section 16.3 as part of the Inner South precinct.

This presents a worst-case unmitigated assessment which has assumed that vibration-intensive equipment could be used at the boundary of the Project area. In reality, vibration intensive equipment is not likely to be used throughout the entire Project area. Instead, this equipment would typically be limited to areas of the footprint away from the boundary of the Project area, where it could be used to construct the light rail alignment, for example, in road medians and verges.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further detail on the approach to managing potential vibration impacts is included in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds and the Mitchell Depot site would be distributed across the road network, with Commonwealth Avenue and State Circle serving as the key route for construction traffic in this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels for during the daytime (assessed for AM peak period (8am to 9am)) and night-time (assessed for 10pm to 7am) and are presented in Table 13-21. The year 2031 was selected as representative of the peak year of construction.

The majority of haulage routes would receive relative noise level increases of less than 2 dB(A). Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener. However, there are a number of noise sensitive receivers along Flynn Drive (between Coronation Drive and State Circle) that may potentially be impacted by the 2.1 dB(A) noise level increase during daytime (shown in bold in Table 13-21 below) due to additional construction traffic. These receivers comprise embassy/consulate buildings.

In the night-time hours, residential receivers located adjacent to the proposed haulage route sections of Flynn Drive and State Circle would potentially be affected by the increases in road traffic noise levels (shown in bold in Table 13-21). To manage this, an alternative haulage routes to Flynn Drive would be reviewed as part of construction planning and implemented if possible during night-time works (refer further to Section 13.3.4).

Table 13-21 Construction road traffic noise peak hourly traffic counts

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Flynn Drive between Coronation Drive and State Circle	Northbound	95	7	1	11	2.1
	Southbound	125	9	1	11	1.7
Capital Circle between Canberra Avenue and Adelaide Avenue	Westbound	868	65	1	11	0.3
State Circle between Sydney Avenue and Canberra Avenue	Southbound	613	46	1	11	0.4
State Circle between Melbourne Avenue and Adelaide Avenue	Westbound	630	47	1	11	0.4
	Eastbound	430	32	1	11	0.5
Night-time assessment						
Flynn Drive between Coronation Drive and State Circle	Northbound	27	2	9	5	3.4
	Southbound	6	0	9	5	7.8
Capital Circle between Canberra Avenue and Adelaide Avenue	Westbound	179	13	9	5	0.6
State Circle between Sydney Avenue and Canberra Avenue	Southbound	104	8	9	5	1.1
State Circle between Melbourne Avenue and Adelaide Avenue	Westbound	70	5	9	5	1.6
	Eastbound	47	4	9	5	2.1

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

13.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Parliament House precinct. Both the State Circle East and National Triangle-Barton alignment options travel through the Parliament House precinct, and have been assessed in the following sections.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of each alignment option. This involved assessment of noise levels at a total of 290 receivers in the Parliament House precinct, including residential receivers, mixed use receivers, education and childcare centres, places of worship, public buildings, and active recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative light rail vehicle (LRV) design speeds identified along the alignment during the design development process.

For each alignment option, the results of the operational rail noise assessment indicated compliance with both daytime and night-time airborne noise trigger levels at the majority of receivers.

For the State Circle East alignment option, the results of the operational rail noise assessment indicated five exceedances of the $L_{Aeq, 1 \text{ hour}}$ trigger level, across three different buildings associated with the Presbyterian Church of St Andrew. For the National Triangle-Barton alignment option, the assessment indicated two exceedances of the $L_{Aeq, 1 \text{ hour}}$ trigger level, at two buildings associated with the Presbyterian Church of St Andrew, for the National Triangle-Barton alignment option. Noise sensitive receivers that experienced exceedances of the noise trigger level are presented in Table 13-22.

Rail noise impacts would be intermittent and last for a relatively short duration as the LRV passes the receiver and would not represent a constant noise source.

For the State Circle East alignment option only, Table 13-22 indicates that the predicted $L_{Aeq, 1hr}$ noise levels are up to 5 dB(A) above the noise trigger levels at two building associated with the Presbyterian Church of St Andrew. Mitigation measures in Chapter 21 (Environmental management and mitigation measures) of the EIS would be implemented to manage these potential operational noise impacts.

Table 13-22 Parliament House precinct noise sensitive building operational airborne noise exceedances (daytime; assuming no mitigation measures are in place)

ID ¹	Usage	Address	Predicted L _{Aeq,1hr} noise level, dB(A)	L _{Aeq,1hr} noise trigger level, dB (A)	Exceedance dB(A)
State Circle East alignment option					
2444	Place of Worship	The Presbyterian Church of Saint Andrew 3 State Circle, Forrest	58	53	5
2852	Place of Worship		54	53	1
3410	Place of Worship		58	53	5
National Triangle-Barton alignment option					
2444	Place of Worship	The Presbyterian Church of Saint Andrew 3 State Circle, Forrest	54	53	1
3410	Place of Worship		55	53	2

Notes:

1. Refer to Appendix F of Technical Report 9 – Noise and vibration of the location of identified receivers.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Parliament House precinct at the most affected (closest) receivers for each alignment option are presented in Table 13-23.

Ground-borne noise levels at one of the representative receivers (11 State Circle, Forrest) are predicted to exceed the ground-borne noise trigger levels by up to 1dB, when no mitigation measures are in place. Mitigation measures in Chapter 21 (Environmental management and mitigation measures) of the EIS would also be implemented to manage the potential for operational noise, if required.

Table 13-23 Parliament House precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted ground-borne noise level, dB(A) L_{ASmax}
State Circle East alignment option					
11 State Circle, Forrest	Residential	20	40	35	36

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted ground-borne noise level, dB(A) L_{ASmax}
29 State Circle, Deakin	Residential	28	55	35	35
Embassy of the Philippines (1 Moonah Place, Yarralumla)	Public Building	39	70	40	35
National Triangle-Barton alignment option					
11 State Circle, Forrest	Residential	35	40	35	32
29 State Circle, Deakin	Residential	43	55	35	31
Embassy of the Philippines (1 Moonah Place, Yarralumla)	Public Building	39	70	40	35

Targeted mitigation is recommended when ground-borne noise levels are higher than the airborne noise levels. The airborne noise levels for internal spaces with windows open are predicted to be L_{ASmax} 61-62 dB(A) for the most affected receiver on State Circle during the night-time period. These airborne noise levels are higher than the ground-borne noise levels, and therefore no additional treatment is considered necessary for the alignment within the Parliament House precinct to manage this impact.

Rail vibration assessment

The predicted vibration levels for the Parliament House precinct at the most affected (closest) receivers for each alignment option are presented in Table 13-24. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria, for either alignment option.

Table 13-24 Parliament House precinct – vibration assessment results (human comfort; assuming no mitigation measures are in place)

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), $m/s^{1.75}$	Predicted equivalent vibration dose value (Daytime), $m/s^{1.75}$	Vibration Criteria (Night), $m/s^{1.75}$	Predicted equivalent vibration dose value (Night), $m/s^{1.75}$
State Circle East alignment option					
11 State Circle, Forrest <i>Residential</i>	20	0.2	0.009	0.13	0.005
29 State Circle, Deakin <i>Residential</i>	28	0.2	0.009	0.13	0.005
Embassy of the Philippines (1 Moonah Place, Yarralumla) <i>Public Building</i>	39	0.4	0.008	0.4	0.004

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), m/s ^{1.75}	Predicted equivalent vibration dose value (Daytime), m/s ^{1.75}	Vibration Criteria (Night), m/s ^{1.75}	Predicted equivalent vibration dose value (Night), m/s ^{1.75}
National Triangle-Barton alignment option					
11 State Circle, Forrest <i>Residential</i>	35	0.2	0.007	0.13	0.004
29 State Circle, Deakin <i>Residential</i>	43	0.2	0.008	0.13	0.004
Embassy of the Philippines (1 Moonah Place, Yarralumla) <i>Public Building</i>	39	0.4	0.008	0.4	0.004

The Parliament House precinct lies in proximity to St Andrew's Church Precinct (listed on the ACT Heritage Register), and the State Circle Cutting, Commencement Column Monument, West Block and the Dugout, East Block Government Offices, York Park North Tree Plantation and The Lodge (which are listed on the Commonwealth Heritage List). None of these heritage receivers are expected to be adversely affected by operational rail vibration due to the distance to the track centreline.

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is presented in Table 13-25.

Table 13-25 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, L _{Aeq,15hr}	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected as the most representative dataset for the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Parliament House precinct, existing road traffic noise levels are between 55-60 dBA on Melbourne Avenue and future predicted road traffic noise levels would not exceed 60 dBA, and are therefore considered acceptable. At the Presbyterian Church of Saint Andrew on State Circle, predicted road traffic noise levels would not increase above existing levels, and are therefore considered acceptable. The results of the road traffic noise assessment for each alignment option are presented in Table 13-26 to Table 13-29, for 2031 and 2041 scenarios respectively.

Table 13-26 Road traffic noise assessment, 2031 – State Circle East alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
State Circle	The Presbyterian Church of Saint Andrew, 3 State Circle, Forrest	Westbound	7,252	463	-659	-42	-2	Yes, no increase in traffic noise level
		Eastbound	7,946	507	-4,033	-256		
	2 Melbourne Ave, Deakin	Westbound	8,170	521	-1,917	-122	0	Yes, no increase in traffic noise level
		Eastbound	5,580	356	1,556	99		

Table 13-27 Road traffic noise assessment, 2031 – National Triangle-Barton alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
State Circle	The Presbyterian Church of Saint Andrew, 3 State Circle, Forrest	Westbound	7,252	463	--319	-20	-1	Yes, no increase in traffic noise level
		Eastbound	7,946	507	-2,236	-143		
	2 Melbourne Ave, Deakin	Westbound	8,170	521	598	38	0	Yes, no increase in traffic noise level
		Eastbound	5,580	356	-7	0		

Table 13-28 Road traffic noise assessment, 2041 – State Circle East alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
State Circle	The Presbyterian Church of Saint Andrew, 3 State Circle, Forrest	Westbound	7,273	464	-408	-26	-1	Yes, no increase in traffic noise level
		Eastbound	7,681	490	-3,670	-234		
	2 Melbourne Ave, Deakin	Westbound	8,707	556	-2,726	-174	0	Yes, no increase in traffic noise level
		Eastbound	6,566	419	911	58		

Table 13-29 Road traffic noise assessment, 2041 – National Triangle-Barton alignment

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
State Circle	The Presbyterian Church of Saint Andrew, 3 State Circle, Forrest	Westbound	7,273	464	340	22	-1	Yes, no increase in traffic noise level
		Eastbound	7,681	490	-2,447	-156		
	2 Melbourne Ave, Deakin	Westbound	8,707	556	-1,767	-113	0	Yes, no increase in traffic noise level
		Eastbound	6,566	419	2,175	139		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the $L_{A10, 15min}$ assessment noise level at any location.

Within the Parliament House precinct, stops are located on State Circle at:

- Kings Avenue (State Circle East alignment option only)
- Sydney Avenue (State Circle East alignment option only)
- Melbourne Avenue (within the median for the State Circle East alignment option and the inside verge for the National Triangle-Barton alignment option).

No residential receivers are located nearby to the Kings Avenue or Sydney Avenue stops, and it is expected that PA systems could operate without adverse noise impacts at these locations.

The nearest residential receivers to the Melbourne Avenue Stop are located approximately 20-40 m away for each alignment option. Despite this short distance to the stop, there are higher existing ambient noise levels in this area due to traffic on State Circle, Melbourne Avenue, and Adelaide Avenue. Although noise from State Circle is likely to dominate noise levels at these locations, there is potential for annoyance if PA systems are audible at or inside residences. The subjective impacts are however likely to be minimal given the relative infrequency of announcements, and existing background noise levels.

No other fixed operational facilities are proposed in the Parliament House precinct.

13.3.4 Precinct-specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage noise and vibration impacts that are specific to the Parliament House precinct are shown in Table 13-30.

Table 13-30 Noise and vibration mitigation measures – Parliament House precinct

ID	Objective	Management and mitigation measure	Timing
NV8	Minimising night-time construction road traffic noise	Where night-time road traffic noise levels at sensitive receivers are predicted to increase by more than 2 dB(A), alternative construction vehicle haulage routes will be investigated. Where there are no alternative haulage routes available early consultation with the affected sensitive receivers will be undertaken.	Construction

13.4 Biodiversity

This section provides an assessment of the potential impacts on biodiversity associated with the construction and operation of the Project, and provides a summary of the biodiversity assessment for the Parliament House precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues).

Further detail on the biodiversity assessment is provided in Section 3 of Technical Report 2 – Biodiversity.

13.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Parliament House precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including

habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 19.63 ha of vegetation is present in the Parliament House precinct. Vegetation within the Parliament House precinct is comprised of four vegetation communities. Table 13-31 and Figure 13-10 depict the extent and distribution of each vegetation community within the Parliament House precinct.

Table 13-31 **Extent of vegetation communities within the Project area in the Parliament House precinct**

Vegetation community	Area (ha)
Non-local native ground cover	0.51
Landscape plantings – Native	8.17
Landscape plantings – Exotic	1.17
Exotic grassland	9.78
Total vegetation	19.63

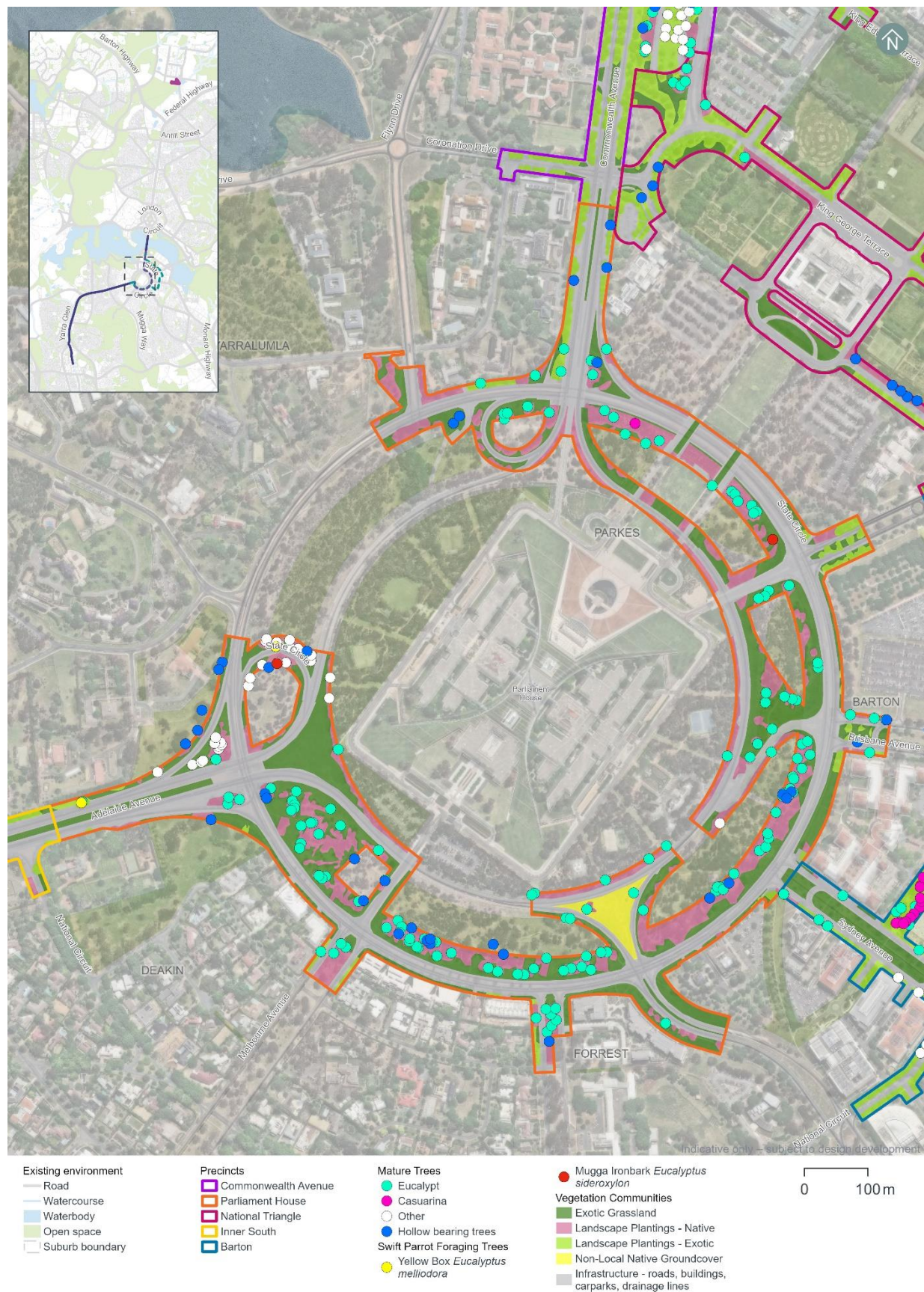


Figure 13-10 Vegetation communities, hollow-bearing and mature trees in the Parliament House precinct

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Hollow-bearing trees and mature trees

A total of 38 hollow-bearing trees and 184 mature trees have been recorded in the Parliament House precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 13-32 summarises the number of hollow-bearing and mature trees within the Parliament House precinct and is shown on Figure 13-10.

Field work carried out between 2022 and 2024 have identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 13-32 Summary of hollow-bearing and mature trees within the Project area in the Parliament House precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Parliament House	38	1	28	25	8	3	184

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat assessment

The Golden Sun Moth (*Synemon plana*) is listed as vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 2014* (ACT) (NC Act). A total area of 5.13 ha of potential Golden Sun Moth habitat has been recorded within the Parliament House precinct. This habitat has been identified as low-density (2.35 ha) and high-density (2.78 ha) Chilean needlegrass habitat (refer to Figure 13-11).



Figure 13-11 Golden Sun Moth habitat and sightings in the Parliament House precinct

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Two Golden Sun Moth populations have been identified in the Parliament House precinct, through previous biodiversity assessments reviewed for this Environmental Impact Statement (EIS) (ARUP, 2021). The locations of the populations are shown on Figure 13-11 and include:

- Population 2 – around State Circle and Barton (Parliament House and Inner South precincts)
- Population 3 – along the western side of State Circle near the Embassy of Türkiye.

Other Golden Sun Moth individuals, populations and habitat across the Project area are identified in Section 11.2 in Chapter 11 (Project-wide issues).

Other potential threatened fauna habitat identified within the Parliament House precinct includes:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (listed as endangered under both the EPBC Act and the NC Act) – the Parliament House precinct supports 8.17 ha of foraging habitat and 23 breeding trees for the species (refer to Figure 13-12)
- Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable under both the EPBC Act and the NC Act) – the Parliament House precinct supports 8.17 ha of foraging habitat for this species (refer to Figure 13-12)
- Swift Parrot (*Lathamus discolor*) (listed as critically endangered under both the EPBC Act and the NC Act) – the Parliament House precinct supports two mature Mugga ironbark trees and two mature yellow box trees which comprise foraging habitat, critical for the survival of the species (refer to Figure 13-12)
- Diamond Firetail (*Stagonopleura guttata*) (listed as vulnerable under both the EPBC Act and the NC Act.) – 8.17 ha of the Landscape Planting – Native community has been identified within the Parliament House precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 13-12).

No habitat was identified in the Parliament House precinct for the Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberrae*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).

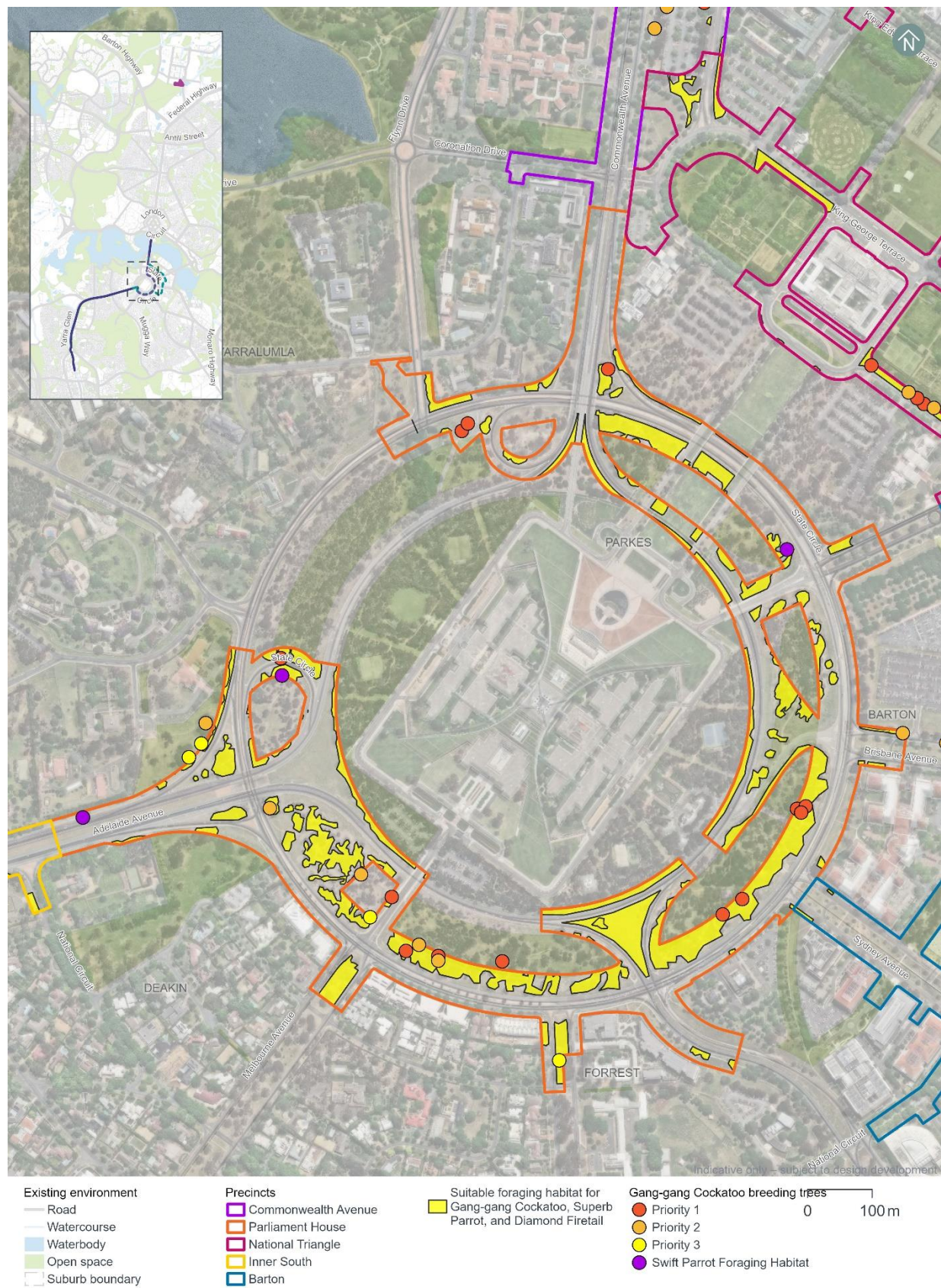


Figure 13-12 Gang-gang Cockatoo, Superb Parrot, Swift Parrot, and Diamond Firetail foraging habitat in the Parliament House precinct

May 2025

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Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Parliament House precinct. Impacts to threatened or rare flora species are therefore not anticipated.

Three pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Parliament House precinct:

- Chilean needlegrass (*Nassella neesiana*) – a Weed of National Significance
- African lovegrass (*Eragrostis curvula*)
- St John's wort (*Hypericum perforatum*).

13.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Parliament House precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown on Figure 13-13. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of four communities as summarised in Table 13-33. Only 2.46 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 13-33 **Extent of vegetation communities within the clearance footprint in the Parliament House precinct**

Vegetation community	Area (ha)
Non-local native ground cover	0.08
Landscape plantings – Native	2.46
Landscape plantings – Exotic	0.31
Exotic grassland	4.23
Total vegetation	7.08

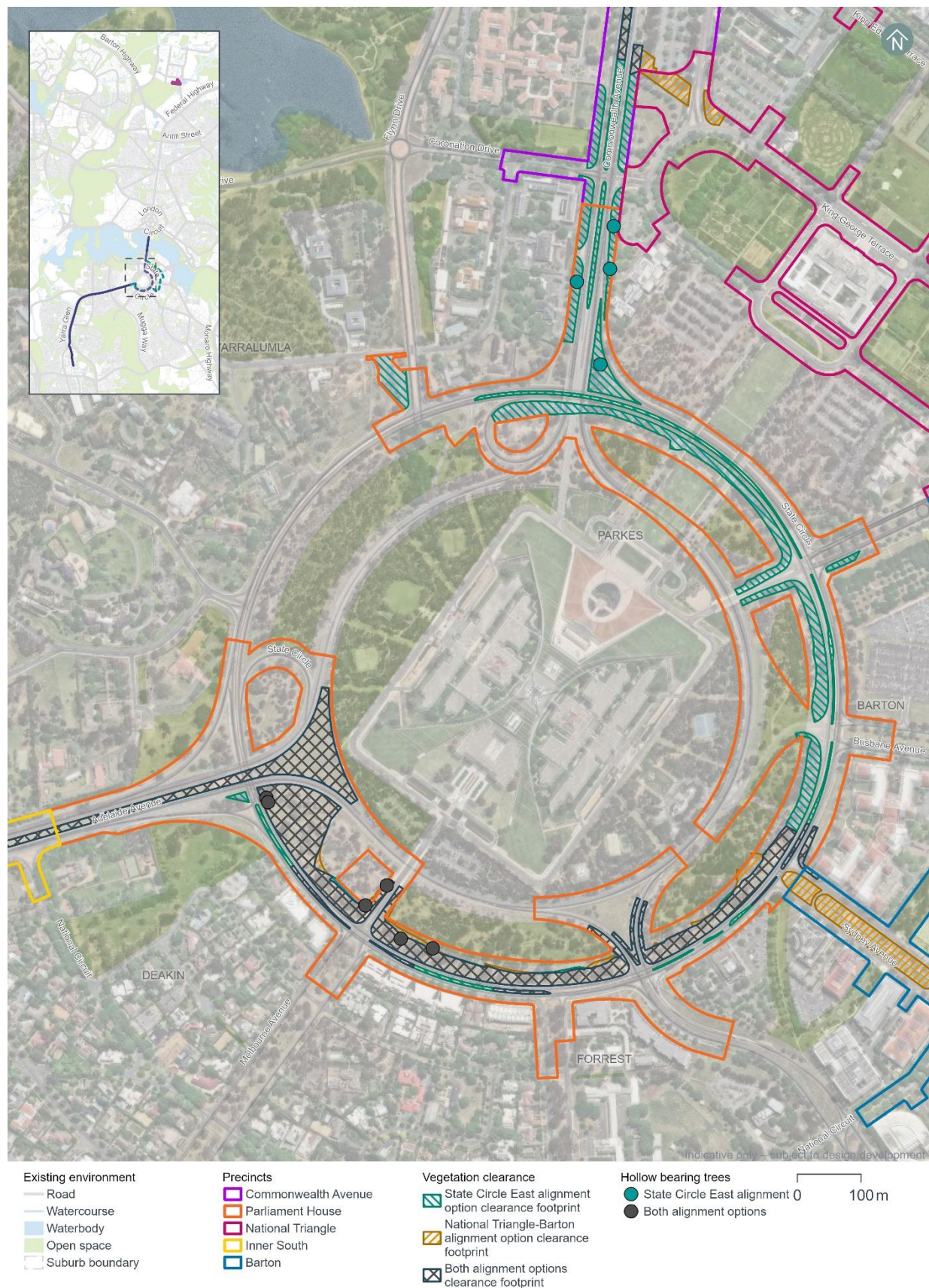


Figure 13-13 Clearance footprint in the Parliament House precinct

A total of 10 hollow-bearing trees and 60 mature native trees have been recorded in the Parliament House precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence. Table 13-34 summarises the number of hollow-bearing and mature native trees within the Parliament House precinct and is shown on Figure 13-13.

Table 13-34 Hollow-bearing and mature native trees within the clearance footprint in the Parliament House precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature native trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Parliament House	10	0	14	6	4	0	60

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Parliament House precinct would include impacts on the following through habitat removal:

- Golden Sun Moth – 2.47 ha of habitat, including habitat associated with Golden Sun Moth populations 2 and 3
- Gang-gang Cockatoo – 2.46 ha of foraging habitat and six or four breeding trees for the State Circle East and National Triangle-Barton alignment options respectively, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 2.46 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Swift Parrot – supports one mature Mugga ironbark tree which provides foraging habitat, critical for the survival of the species
- Diamond Firetail – 2.46 ha of the Landscape Planting – Native community which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Parliament House precinct clearance footprint for the Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works

- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Chapter 11 (Project-wide issues).

13.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike.

There would be no over-head wiring installed in this precinct as part of the Project and therefore there would be no risk of fauna strike with over-head wires. Further detail on these indirect impacts for operational activities is discussed in Chapter 11 (Project-wide issues).

13.4.4 Management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, through the development of a clearance footprint within the Project area (refer to Figure 13-13).

Environmental management for this Project is detailed in Part C (Environmental management and conclusion). This includes construction and operational management and mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Parliament House precinct.

13.5 Historic heritage

This section provides an assessment of the potential historic heritage impacts associated with the construction and operation of the Project within the Parliament House precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

13.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Parliament House precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The heritage character of the Parliament House precinct is defined by the prominence of Parliament House and Capital Hill, its immediate setting, and its connection to the Parliamentary Zone, National Triangle, and Central National Area.

The precinct symbolises Australia's democracy, with different design styles used to illustrate the progress of place-making in the national capital. Within the landscape, Capital Hill is a terminating feature of the National Triangle. It shows how important national design fits into the Australian landscape by aligning with the Land Axis. This adds grandeur to the view of Parliament House and completes the city's layout as planned in the Griffin Plan for Canberra. The way each of the radiating

avenues (Commonwealth, Kings, Brisbane, Sydney, Canberra, Hobart, Melbourne, Adelaide, and Perth) terminate at State Circle emphasises the status of Parliament House.

State Circle marks a difference in character between Parliament House and Capital Hill, and the inner south suburbs. Parliament House is embedded in a planted, naturalistic Australian setting which reflects Canberra's character as the Bush Capital.

The historic heritage assessment identified 12 heritage places (eight listed and four unlisted) within and surrounding the Parliament House precinct, as noted below in Table 13-35 and shown on Figure 13-14.

Table 13-35 Heritage places within and surrounding the Parliament House precinct

Heritage places	Description
Commonwealth Heritage List	
Parliament House Vista	<p>The Parliament House Vista along the Land Axis is the most iconic of the intentional vistas created in the Griffin Plan. The open sweeping vista along the Land Axis is experienced in two directions and creates a dramatic view terminating in Capital Hill at one end and Mount Ainslie at the other.</p> <p>The Aboriginal Tent Embassy is included in the Commonwealth Heritage List citation for the Parliament House Vista and is generally understood to be of high cultural significance to both the Aboriginal community and the wider population.</p> <p>Given this vista spans across multiple precincts it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>
State Circle Cutting (refer to Figure 13-15)	State Circle Cutting has high natural heritage value as it shows sandstone rafts, ripple marks, and a pallid zone assisting in the interpretation of the ancient geological landscape of the Canberra region. However, it has been considerably reduced in scale by the previous excavation of the cutting and is also threatened by vibration damage due to traffic.
West Block and the Dugout (refer to Figure 13-16)	West Block and the Dugout is on the east side of Commonwealth Avenue and is significant as one of the earliest government buildings in Canberra and is an integral component of the National Triangle landscape. It demonstrates architecture suited to sit within a designed landscape of related buildings and spaces.
Commencement Column Monument	The Commencement Column is Canberra's foundation monument for the official announcement of Canberra as Australia's new national capital, at a formal ceremony held on Capital Hill in 1913.
York Park North Tree Plantation (refer to Figure 13-17)	York Park Tree Plantation is located adjacent to the intersection of Kings Avenue and State Circle. There are many trees of the same species (English Oak) in a grid spacing arrangement. The plantation is historically significant for its association with the celebration of the opening of Old Parliament House and the inaugural planting by His Royal Highness the Duke of York in 1927.
The Surveyors Hut	The Surveyors Hut is a remnant of the original surveyor's camp at Capital Hill in 1909. It is significant as one of the earliest existing Commonwealth buildings, predating the design competition for Australia's new national capital and its eventual construction.
ACT Heritage Register	
The Presbyterian Church of St Andrew (refer to Figure 13-18)	The Presbyterian Church of St Andrew is located on State Circle between Sydney Avenue and Canberra Avenue and is significant as an early church built in an inter-war gothic style. The church and its surroundings of mature plantings strengthen its historical value.

Heritage places	Description
Unlisted significant heritage places	
Parliament House and surrounds (refer to Figure 13-19)	<p>Parliament House is culturally significant as a creative and technical achievement in the way the architecture integrates with the landscape to symbolise the area as the centre of Canberra, and the focal point of the Parliamentary Triangle, expressing the Griffin Plan's concept for a capital that symbolises democracy.</p> <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>
Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	<p>Commonwealth and Kings Avenues are two of the three original major avenues for Canberra, and together with Constitution Avenue they form the Parliamentary Triangle. Their symmetry, tree-lined avenues, plantings, landscape setting, and geometry contribute to an understanding of the Griffin Plan. They are significant as individual places and as part of the broader historical urban designed landscape of Canberra.</p> <p>State Circle and Capital Circle encircle Parliament House, framing Capital Hill. The smoothed contours, grassed verge edges, and massed native plantings between State and Capital Circles are significant by creating a 'natural Australian' aesthetic as the appropriate setting for the nation's parliament and reflect the principles of Canberra as a designed city in the landscape.</p> <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>





Figure 13-15 State Circle Cutting below Federation Mall



Figure 13-16 West Block and the Dugout facing the north-western façade



Figure 13-17 York Park North Tree Plantation at the corner of State Circle and Kings Avenue



Figure 13-18 The Presbyterian Church of St Andrew (Presbyterian Church of St Andrew website, 2016)



Figure 13-19 Parliament House and surrounds viewed from Parliament Drive

Condition, integrity, and sensitivity to change

The existing heritage within the Parliament House precinct is generally in good condition. The landscape and structures are well maintained.

The integrity of the heritage values is good. The heritage features of the precinct are effective in expressing its character as part of the broader designed landscape of Canberra's Central National Area. Some changes over time, particularly the removal of original Weston-planted evergreens at the southern end of Commonwealth Avenue, and the excavation of the upper tier of State Circle Cutting, both for the construction of Parliament House, have reduced the ability to interpret its heritage character to some degree.

The precinct has moderate to high sensitivity to change. As a central element of a historic designed landscape of national importance, Capital Hill, Parliament House and its immediate surrounds are sensitive to alterations which could obscure or detract from expression of its symbolic and tangible position in Australian democracy and the Central National Area of Canberra. The reduced integrity of key features such as the State Circle Cutting and trees along Commonwealth Avenue mean these elements are particularly sensitive to future change.

13.5.2 Potential impacts – construction

Table 13-36 summarises the potential construction impacts of the Project on heritage places in the Parliament House precinct for both alignment options. Where an alignment option would not involve light rail construction in the vicinity of a heritage place (based on the proposed location of light rail trackform and stops), no impact has been identified in Table 13-36.

Table 13-36 Construction impacts on heritage places within the Parliament House precinct for both alignment options

Heritage place	Construction impact State Circle East alignment option	Construction impact National Triangle-Barton alignment option
Commonwealth Heritage List		
State Circle Cutting	Nil <ul style="list-style-type: none"> There is potential risk of accidental physical impact to the place during construction works, which would occur close to the State Circle Cutting, for example, from heavy vehicle movement. The impacts of this could range from low to severe, however would be effectively avoided with appropriate management measures in place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the State Circle Cutting within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures). 	No impacts
West Block and the Dugout	Moderate <ul style="list-style-type: none"> No direct impacts to this heritage place Existing trees along Commonwealth Avenue would be removed, which define one of the building's longer elevations along the north-western edge. The removal of these trees would alter and obscure the aesthetic heritage values of the building and its setting Temporary impacts from construction activity to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the West Block and the Dugout within the minimum working distance for cosmetic damage to heritage structures. Further, there may be indirect physical impacts on the place from vibration caused by the construction of the covered section between Commonwealth Avenue and State Circle. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 	No impacts

Heritage place	Construction impact State Circle East alignment option	Construction impact National Triangle-Barton alignment option
	<p>(Environmental management and mitigation measures)</p> <ul style="list-style-type: none"> Construction compound D would be established immediately to the north-east of the West Block and the Dugout but outside the boundary of the heritage place. The construction impacts of this compound are addressed under the heritage place, Parliament House Vista, in Section 11.3 of Chapter 11 (Project-wide issues). 	
Commencement Column Monument	<p>Nil</p> <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place. 	No impacts
York Park North Tree Plantation	<p>Nil</p> <ul style="list-style-type: none"> Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the York Park North Tree Plantation within the minimum working distance for cosmetic damage to heritage structures. However, there are no significant heritage structures at the place that may be impacted. The trees themselves are not anticipated to be affected by vibration impacts. Appropriate management by an arborist would help monitor and manage any unanticipated risks There is potential risk of accidental physical impact to the place or indirect impacts to the health of the trees during construction works, which would occur close to the plantation. The impacts would be effectively avoided with appropriate management measures in place No removal of trees is anticipated in the heritage place Temporary impacts to the visual setting of this heritage place. 	No impacts
The Surveyors Hut	<p>Nil</p> <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place. 	No impacts

Heritage place	Construction impact State Circle East alignment option	Construction impact National Triangle-Barton alignment option
ACT Heritage Register		
The Presbyterian Church of St Andrew	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Presbyterian Church of St Andrew within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures) No removal of trees is anticipated within or immediately adjacent to the heritage place. 	

Construction impacts on Parliament House Vista, Parliament House and surrounds, Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

13.5.3 Potential impacts – operation

Table 13-37 summarises the potential operation impacts of the Project on heritage places in the Parliament House precinct for both alignment options. Where an alignment option would not involve light rail operation in the vicinity of a heritage place (based on the proposed location of light rail trackform and stops), no impact has been identified in Table 13-37.

Table 13-37 Summary of potential operation impacts on heritage places within the Parliament House precinct for both alignment options

Heritage place	Operation impacts State Circle East alignment option	Operation impacts National Triangle-Barton alignment option
Commonwealth Heritage List		
State Circle Cutting	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to heritage place. 	No impacts

Heritage place	Operation impacts State Circle East alignment option	Operation impacts National Triangle-Barton alignment option
West Block and the Dugout	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of this heritage places as a result of light rail infrastructure and operations Replacement trees of a similar species to the original trees on Commonwealth Avenue would eventually mostly mitigate the removal of existing historic trees as the replacement trees grow to maturity The replacement trees would be in a slightly different alignment than the previous planting, but would not notably alter or diminish the heritage values of the place No operational vibration impacts to heritage place. 	No impacts
Commencement Column Monument	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to heritage place. 	No impacts
York Park North Tree Plantation	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to heritage place. 	No impacts
The Surveyors Hut	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to heritage place. 	No impacts
ACT Heritage Register		
The Presbyterian Church of St Andrew	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No operational vibration impacts to heritage place Minor kerb alignment changes are proposed at the intersection of State Circle and Canberra Avenue, but these would not impact the setting of the Church The prominence of the Church on the block would be maintained as the light rail trackform and infrastructure would be at a distance from the Church. 	

Operation impacts on Parliament House Vista, Parliament House and surrounds, Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

13.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for historic heritage impacts at the Parliament House precinct.

13.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Parliament House precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 - Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural, and heritage attributes of the landscape, planning designations, and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown on Figure 13-20.

13.6.1 Existing environment

The Parliament House precinct is located south of Coronation Drive and circles the eastern edge of Capital Hill along State Circle, connecting to Adelaide Avenue. It surrounds the Australian Parliament House, sitting at the top of Capital Hill and overlooking Canberra. State Circle marks the base of Capital Hill, with its southern part lying in the valley between Capital Hill and Red Hill.

State Circle was established as part of the Griffin Plan (NCA, 2007), and forms the geometry of the National Triangle and Capital Hill. This area prioritises traffic over pedestrian access. It continues the character of Commonwealth Avenue, transitioning to a curving road surrounded by woodland on the inner edge of Capital Hill. The precinct is characterised by native woodland on the inner side of State Circle and exotic, deciduous street trees on the outer side.



Figure 13-20 Landscape character zone and viewpoints in the Parliament House precinct

Landscape character

The key aspects of landscape character in the Parliament House precinct can be seen on Figure 13-21 and Figure 13-22. Running adjacent to Parliament House, this precinct surrounds the building comprising the peak of Capital Hill and overlooking Canberra. State Circle presents the base of Capital Hill with the southern portion of the road sitting within the valley between the Capital Hill and the ridgeline of Red Hill.



Figure 13-21 View along State Circle looking north-west towards the heritage listed State Circle Cutting

Capital Hill and Parliament House form the tip of the National Triangle. Canberra has been developed with Capital Hill forming a notable topographical element, with views along the avenues which radiate out from this landmark. The fall across the precinct from the inner edge of Capital Hill to the surrounding avenues is a characteristic element.

This precinct is dominated by the wide corridor of State Circle, Capital Hill and the radiating avenues (Commonwealth Avenue and Kings Avenue) which form part of the National Triangle. The southern portion of Commonwealth Avenue aligns with the Commonwealth Avenue precinct before it transitions to the curving road of State Circle, bordered by a woodland buffer on the inner edge of Capital Hill (refer to Figure 13-22).



Figure 13-22 The view towards the Presbyterian Church of St Andrew looking south along State Circle, with woodland buffer seen at the base of Capital Hill

Vegetation within the precinct comprises the native woodland on the inner edge of State Circle and predominantly exotic, deciduous street trees on the outer edge of the road. The wide, green verges reflect the Griffin Plan, which responds to the topography of the landscape. The woodland buffer on Capital Hill contributes to the Bush Capital character highlighting the intrinsic value of the location and setting of Parliament House.

The precinct is near several listed heritage items contributing to its heritage values including the State Circle Cutting, York Park North Tree Plantation (refer to Figure 13-23), Parliament House Vista, The Lodge, and the Presbyterian Church of St Andrew.

Further information on the heritage items listed above can be found in Section 13.5.



Figure 13-23 Commonwealth Heritage Listed York Park North Tree Plantation

Viewpoints

Representative viewpoints that have been identified to assess visual impacts within the Parliament House precinct are shown on Figure 13-20 and described in Table 13-38. Images of all viewpoints can be found in Technical Report 10 – Landscape character and visual amenity.

Table 13-38 Parliament House precinct viewpoints and descriptions

Viewpoint	Description	Sensitivity rating
Viewpoint PH1: Parliament House North-east	<p>This viewpoint is located on the lawn at the northern corner of Parliament House looking north-east along Kings Avenue towards the Australian-American Memorial. The foreground of the view is dominated by the green lawn of Parliament House, sloping down to Parliament Drive and Kings Avenue. This viewpoint would be a popular tourist destination, where receptors' attention would be focussed on the surrounding landscape. The quality of the view is paramount to the visitor experience. Most visitors are likely to pause to appreciate the view before moving on.</p> <p>The view sensitivity is high due to its position within an important area from a heritage and planning perspective. This viewpoint would be a popular tourist spot and forms part of the National Triangle.</p>	High
Viewpoint PH2: Kings Avenue Bridge	<p>This viewpoint is located centrally on the Kings Avenue Bridge looking south-west towards Parliament House. The view comprises separated east and westbound carriageways and northern footpath of Kings Avenue, extending west. The Kings Avenue road corridor and steel barricading dominates the foreground of the view, with the two-lane carriageways, and the shared path. Receptors seeing this view would include pedestrians, cyclists, and motorists travelling across Kings Avenue bridge.</p> <p>The view sensitivity is negligible as there would be no view to the Project from this viewpoint. As a result of this rating, Viewpoint PH2 has not been assessed further in the visual impact assessment.</p>	Negligible – not assessed further
Viewpoint PH3: Commonwealth Avenue at Coronation Drive	<p>This viewpoint is located within the median of Commonwealth Avenue at the intersection with Coronation Drive, looking south towards Parliament House (refer to Figure 13-24). The view comprises the separated south and northbound carriageways of Commonwealth Avenue extending south towards Parliament House, elevated on Capital Hill in the background. While most of the visual receptors who would see this view would be passers-by, a proportion of these would be visitors who would be travelling along Commonwealth Avenue between landmarks. These receptors would be more focussed on the view, particularly as the view culminates in Parliament House to the south and City Hill to the north.</p> <p>The view sensitivity is high due to the importance of views along main avenues as part of the National Triangle and surrounding landmarks.</p>	High

Viewpoint	Description	Sensitivity rating
Viewpoint PH4: State Circle at Kings Avenue	<p>This viewpoint is located on the pedestrian path of State Circle at the intersection with Kings Avenue, looking south along State Circle with Parliament House to the right of the viewpoint (refer to Figure 13-26). The central view comprises the road corridor of State Circle. The middle and background of the view features tree plantings either side of State Circle, with native woodland on the inner verge and a mix of native and deciduous trees on the outer verge. Receptors largely include pedestrians, cyclists, and motorists travelling along State Circle; however, a proportion of these would be visitors who would be travelling along State Circle to access Parliament House. These receptors would be more focussed on the view.</p> <p>The view sensitivity is high due to its location within an important view corridor and the visibility of important heritage elements.</p>	High
Viewpoint PH5: Parliament House South-west	<p>This viewpoint is located at a lookout point at the south-west corner of the Parliament House grounds, looking south-west along Adelaide Avenue. The foreground of the view comprises a collection of native tree canopies and shrubs planted in the embankment below Parliament Drive. Beyond the vegetation, a large area of lawn extends to between the carriageways of Adelaide Avenue. Visual receptors at this viewpoint would mostly be pedestrians, including visitors and staff of Parliament House. However, it is unlikely that these groups would observe the view unless particularly seeking it out.</p> <p>The view sensitivity is moderate. Despite its location within an important heritage item along a main avenue, the view south-west is mostly screened by native vegetation.</p>	Moderate
Viewpoint PH6: Adelaide Avenue East.	<p>This viewpoint is located on the northern verge of Adelaide Avenue near the connection to State Circle and The Lodge, looking north-east towards Parliament House (refer to Figure 13-28). The view comprises the turf verge, eastbound carriageway, and wide turf median of Adelaide Avenue extending east towards Parliament House. While most visual receptors would be motorists, a proportion of these would be visitors who would be travelling along Adelaide Avenue towards central Canberra due to its value as a destination. These receptors would be more focussed on the view, particularly as the view culminates in Parliament House.</p> <p>The view sensitivity is moderate. Despite its location near two important heritage items (Parliament House and The Lodge) along a main avenue, it is anticipated that most receptors would be local motorists rather than visitors with less overall focus on the landscape as they pass. Additionally, The Lodge is not visible in this view due to vegetation screening both on Capital Hill and at The Lodge.</p>	Moderate

Night-time lighting

Both alignment options sit within the setting of the base of Capital Hill, within an area of A3: Medium district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023). The lighting along these corridors would be cut-off street and pedestrian lighting to contribute to the high quality landscape boulevards and not distract from the feature lighting of Parliament House and other nationally significant buildings or interrupt views to these elements.

Relevant design requirements of strategy 1a of the National Capital Authority's (NCA's) Outdoor Lighting Policy for the Parliament House precinct include:

- i. Create a unique identity for the roads that form the Griffins' National Triangle, being Commonwealth, Kings and Constitution Avenues, through careful selection and installation of an integrated suite of street furniture and lighting. Achieve a high degree of uniformity in lighting performance on these three main avenues
- ii. Illuminate the Griffins' Land Axis by retaining the existing Anzac Parade street lighting and illumination of Federation Mall
- v. Use full cut-off light fittings in all landscape areas, roads, paths, and car parks within the Central National Area
- vi. Use full cut-off street and pedestrian lighting on all main avenues that contributes to their development as high quality landscape boulevards
- vii. Align lighting hardware to strengthen the framing of the National Triangle, main avenues, and formally landscaped open spaces.

13.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition of construction activity, equipment, and construction compounds and loss of elements (most notably trees) within the Parliament House precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops, retaining walls, bridges, and covered sections
- Installation of lighting, signage, and landscaping
- Temporary traffic changes
- Establishment of construction compounds.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary may experienced over the short term as construction activities progress along the alignment.

As such, the magnitude of change during construction is considered to be high within the Parliament House precinct due to the visual clutter of construction and the removal of trees. This would result in a high adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Parliament House precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- High to moderate sensitivity of most viewpoints to change
- High heritage values of views across this precinct

- High magnitude of works anticipated throughout construction that would be visible in the fore, middle, and background of most viewpoints.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 13-39. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints, or impacts would only be seen with one alignment option. These differences have been specified as appropriate in the table below.

Table 13-39 Viewpoints construction impact summary – Parliament House precinct

Viewpoint	Anticipated change in view	Impact summary
Viewpoint PH1: Parliament House North-east	State Circle East alignment option only: The view to the construction activity would be framed by the mature avenue tree planting that focuses the view from this location along Kings Avenue to the American-Australian Memorial. Construction activities would be screened by the dense vegetation along State Circle. Construction would also partially obstruct the distant view down Kings Avenue towards the Australian-American Memorial.	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint PH2: Kings Avenue Bridge	State Circle East alignment option only: The sensitivity of this view to construction of the Project is negligible as State Circle is not visible from the viewpoint due to screening and distance. Therefore, potential impacts at this viewpoint have not been assessed further and are assumed to be negligible.	Sensitivity: Negligible
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral
Viewpoint PH3: Commonwealth Avenue at Coronation Drive	State Circle East alignment option only: Changes during construction would be seen across the fore, middle, and background of this viewpoint and would comprise additional transport infrastructure within the view. The construction activity, while temporary, would be visually prominent, particularly due to the close proximity of the changes to the view and the scale of the construction activities and equipment required. Additionally, the construction of the covered section to State Circle would result in additional infrastructure elements within the view. The visual clutter of construction activity would become the dominant feature within the view, rather than the composition of the extended view along a main avenue towards a landmark feature.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint PH4: State Circle at Kings Avenue	State Circle East alignment option only: Construction activity would be seen along State Circle and a portion of Kings Avenue with the most substantial changes comprising the removal of a small number of mature trees and construction of a light rail stop (Kings Avenue Stop) within a narrow section of the overall road corridor. The change would be in contrast to the existing, established landscape and would be visible in the fore, middle, and background. The visual clutter of construction activity would become the predominant characteristic within the view.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Viewpoint	Anticipated change in view	Impact summary
Viewpoint PH5: Parliament House South-west	Vegetation in the foreground of the view would provide partial screening to the nearby construction compound, which would occupy the large expanse of lawn in the middle ground of the view. Large scale construction activities and equipment would be positioned within the view, especially associated with the bridge construction over State Circle. These construction elements and activities would partially obstruct the distant view of Parliament House along Adelaide Avenue. The low number of receptors likely to experience the view and screening vegetation would reduce the visual impact at this location.	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Adverse
Viewpoint PH6: Adelaide Avenue East	Construction activities and equipment visible from this viewpoint would be in contrast to the existing, established landscape along a main avenue. The construction activity would be visually prominent within the view, particularly due to the close proximity of the changes and the scale of the equipment. The construction of the bridge across State Circle would require construction elements that may include cranes and other tall equipment. The visual clutter of construction activity would become the dominant feature within the view, rather than the composition of the extended view along a main avenue towards a landmark feature.	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse

Night-time visual impact assessment

Works in the Parliament House precinct may need to be undertaken outside standard construction hours (Monday to Saturday, 7am to 6pm). Night works may also be required with most of the works occurring within and directly adjacent to the existing road corridor.

The construction of the covered section and the light rail bridge on Adelaide Avenue above State Circle would require prominent lighting. These works would be more prominent due to the large equipment required to construct these elements. This would be visible from key locations such as the Acton Peninsula, Black Mountain, Parliament House, and Mount Ainslie. Night works may also include the construction of the covered section within the Commonwealth Avenue and State Circle corridors.

Additional lighting from night works within the precinct would be seen from the adjacent commercial, religious, and residential properties whereby residential properties between Canberra Avenue and Adelaide Avenue along State Circle would be most sensitive to the temporary lighting and vehicle movement.

The Capital Hill West construction compound would be established between Adelaide Avenue and Capital Circle. The construction compound would require temporary lighting to prioritise safety and security of the facility. Lighting associated with night works may also draw attention away from the feature lighting of Parliament House, however mature tree planting would provide some visual buffering in this scenario.

For these reasons, the visual impact during construction at night would be **moderate adverse**.

13.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project will impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 13-40 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 13-40 Landscape character impact assessment summary in the Parliament House precinct – both alignment options

Alignment option	Anticipated change	Impact summary
State Circle East alignment option	<p>The Project would introduce light rail infrastructure along Commonwealth Avenue and State Circle, including three stops at Melbourne Avenue, Sydney Avenue, and Kings Avenue, a covered section that would transition between Commonwealth Avenue and State Circle, and a light rail bridge from State Circle to Adelaide Avenue. These changes would impact the precinct's established landscape character. The addition of embedded and green track, signage, lighting, and adjustments to road configurations would lead to changes within the median, requiring the replacement of mature trees with juvenile species. These changes would introduce new elements in a highly sensitive area with heritage and landscape significance, thus impacting the precinct's traditional planting layout and aesthetic. Although replacement trees would retain some formal planting effects, the density and arrangement would differ. While the Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running, it would result in an adverse change in the precinct's character, especially due to the introduction of large elements and tree replacements within this historically and culturally sensitive area.</p> <p>The addition of the covered section and the light rail bridge between State Circle and Adelaide Avenue would constitute some of the largest changes in this precinct. However, these elements would be consistent with the existing character of the precinct, where curving connecting roads between avenues are a common feature, particularly within and around Capital Hill.</p> <p>Other key aesthetic and perceptual elements of the precinct would be retained and protected, including road corridors framed by tree planting as well as strong, linear elements that assist in orientation, highlight landmarks and introduce drama and emphasis to areas and items within the landscape.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Alignment option	Anticipated change	Impact summary
National Triangle-Barton alignment option	The Project would introduce light rail infrastructure along State Circle through to Adelaide Avenue, including one stop near Melbourne Avenue, extending between Barton precinct to the Inner South precinct. Positioned within the inner road verge of State Circle, the light rail would consist of embedded and green track with associated elements such as signage, lighting, and passing LRVs, along with adjustments to median widths, intersections, and road configurations. A light rail bridge from State Circle to Adelaide Avenue would be introduced, alongside tree removal and replacement with juvenile species. The most substantial impact to landscape character would occur where the light rail interfaces with the landscape areas of State Circle's inner verge whereby the topography and vegetation of Capital Hill would be impacted. This would include the removal of mature trees, addition of retaining walls, additional lighting and signage. The removal of existing street trees would create a substantial change to the landscape, with replacement trees retaining the avenue's linear character but differing in species and arrangement. While the Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running, it would result in an adverse change in the precinct's character, especially due to the introduction of large elements and tree replacements within this historically and culturally sensitive area. Overall, the Project would result in a high to moderate adverse change to the precinct's character.	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Parliament House precinct, in most cases the overall impact at each viewpoint has been assessed as being moderate due to:

- High to moderate sensitivity of most viewpoints to change
- Viewpoints ranging from high to moderate to low magnitude of change, the main impact being views of passing LRVs.

Neutral to beneficial changes to visual amenity would also occur at some viewpoints due to the preservation of turf or trees and planting of trees in the median/verges.

A description of the anticipated change in view and associated potential impacts on the Project during operation are discussed in Table 13-41. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints, or impacts would only be seen with one alignment option. These differences have been specified as appropriate in the table below.

Table 13-41 Viewpoints operation impact summary – Parliament House precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint PH1: Parliament House North-east	<p>State Circle East alignment option only: Once construction is complete, the most visually prominent change within the view would be periodically passing LRVs. The addition of light rail infrastructure within the median of State Circle may be visible from this viewpoint, however, would be difficult to discern due to the viewing distance and the small portion of the overall view that this change would effect.</p> <p>While the upgrade of the road pavement and footpaths would be a positive outcome, the ground plane would only just be visible from this viewpoint due to the distance and change in levels. Passing LRVs, while a new element within the view, would be similar in character to other larger vehicles passing along State Circle, and would not alter the quality of the view.</p>	Sensitivity: High
		Magnitude: Low
		Overall impact: Moderate
		Qualitative rating: Neutral
Viewpoint PH2: Kings Avenue Bridge	<p>State Circle East alignment option only: The sensitivity of this view to operation of the Project is negligible as State Circle is not visible from the viewpoint due to screening and distance. Therefore, potential impacts at this viewpoint have not been assessed further and are assumed to be negligible.</p>	Sensitivity: Negligible
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral
Viewpoint PH3: Commonwealth Avenue at Coronation Drive	<p>State Circle East alignment option only: The turf ground plane in the central median of Commonwealth Avenue would be preserved at this viewpoint through the use of green track. The open, wide view along the main avenue would also be preserved, including the view to Parliament House and Capital Hill. However, the addition of the covered section, removal of mature trees, planting of juvenile trees in the median, and the introduction of LRVs within the view would increase the scale and activity within the road corridor.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint PH3 is provided on Figure 13-25.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Viewpoint	Anticipated change in view	Impact rating
Viewpoint PH4: State Circle at Kings Avenue	<p>State Circle East alignment option only: The Project would result in the addition of a light rail stop and associated infrastructure within the road reserve of State Circle, with changes to the traffic conditions across the Kings Avenue intersection. A small number of mature trees on the inner verge of State Circle would be removed, however, a row of trees would be planted within the central median of the light rail and would comprise a new element within the view. These changes would be visually prominent, seen in close proximity of the viewpoint and extending into the background. The most prominent elements would include the addition of tree planting within the median of the road corridor and addition of a light rail stop. The addition of a light rail stop and associated light rail infrastructure within the view would slightly widen the view of the transport corridor and add a built form to the view. Long views along the curving road would be somewhat shortened by the inclusion of the light rail stop. Tree planting within the median may interrupt views to Parliament House from this viewpoint, however, this view is not noted as a key view corridor towards the landmark.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint PH4 is provided on Figure 13-27.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint PH5: Parliament House South- west	<p>At operation, the trackform would extend along Adelaide Avenue within the centre of the view, crossing a light rail bridge over State Circle, between the carriageways. The light rail would extend into the background centrally along Adelaide Avenue, comprising green track, wire-free running and including a double row of trees on either side of the trackform.</p> <p>The most discernible elements of change within this view would comprise the addition of light rail infrastructure, including a light rail bridge, within the median extending the length of Adelaide Avenue within the view. Planted trees within the central median would also comprise a new element within the view, changing the open composition of the view along the road corridor.</p> <p>The changes would be visually recessive due to the foreground screening and the use of green track.</p>	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Neutral
Viewpoint PH6: Adelaide Avenue East	<p>At completion, the most visually prominent elements of the Project visible from this viewpoint would include a light rail bridge over State Circle, between the road corridors transitioning from Adelaide Avenue to Capital Circle. The light rail would be positioned within the median, comprising green track and wire-free running.</p>	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate

Viewpoint	Anticipated change in view	Impact rating
	<p>The turf of the central median would be preserved and the addition of the bridge within the view would be viewed as a continuation of the road corridor. The addition of trees and passing LRVs within the median would result in a contrast to the existing condition, however, passing LRVs would be visually similar to passing buses (albeit within the median, where traffic was previously absent) and temporary within the view as they pass. The addition of trees within the median would compress the width of the viewing corridor towards Parliament House, reducing the visual prominence of the road corridor by splitting the carriageways with a vertical element. Although the addition of light rail tracks within the median would be a new element within the view, the use of green track would preserve the visual aesthetic of the turf median.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint PH6 is provided on Figure 13-29.</p>	<p>Qualitative rating: Neutral</p>



Figure 13-24 Existing view from Viewpoint PH3 looking south along Commonwealth Avenue towards Parliament House



Figure 13-25 Indicative visualisation of viewpoint PH3 during operation for State Circle East alignment option



Figure 13-26 Existing view from Viewpoint PH4 looking south along State Circle



Figure 13-27 Indicative visualisation of viewpoint PH4 during operation for State Circle East alignment option



Figure 13-28 Existing view from Viewpoint PH6 looking north-east along Adelaide Avenue



Figure 13-29 Indicative visualisation of viewpoint PH6 during operation

Night-time visual impact assessment

While the Project would introduce additional lighting, including expanded areas of street lighting and LRV headlights along the tracks, the light rail corridor would have similar light levels to the existing streetscapes of State Circle and Adelaide Avenue which fall within the A3: Medium district brightness zone and Commonwealth Avenue (State Circle East alignment option only) which falls within the A4: High district brightness zone. However, light rail stops would introduce additional lighting to prioritise passenger safety at night. Light spill from these stops would affect adjacent land uses including:

- The Commonwealth heritage listed York Park North Tree Plantation (State Circle East alignment option)
- Commercial properties on State Circle at Sydney Avenue (State Circle East alignment option)
- Residential properties on State Circle at Melbourne Avenue (both alignment options)
- Adjacent woodland buffer planting areas of Capital Hill (both alignment options).

The covered section and light rail bridge over State Circle would introduce lighting elements within the precinct. Sensor activated lighting within the covered section would be part of the lighting strategy to reduce visual impact and discourage unwanted access by pedestrians or vehicles, such that lighting for the track is only activated when a LRV approaches.

Additional street-level lighting would be seen in the context of the existing lit transport corridors. However, due to the frequency of LRVs and additional lighting corridor, there would be a noticeable reduction in visual amenity at night from particularly residential properties facing State Circle.

For these reasons, the visual impact during operation at night would be **minor adverse**.

13.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for landscape character and visual amenity impacts at the Parliament House precinct.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

13.7 Socioeconomic

This section provides an assessment of the potential socioeconomic impacts associated with the construction and operation of the Project within the Parliament House precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

13.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown on Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. The Parliament House precinct spans the following SA2s:
 - Parkes North SA2
 - Parkes South SA2
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- **ACT:** in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor, and the ACT. Capital refers to various forms of resources that contribute to the well-being, sustainability, and resilience of a community.

The Parliament House precinct is primarily a central administrative and ceremonial space. Its primary function is to house significant government buildings, monuments, and open spaces. While there are some nearby dwellings in surrounding precincts, the precinct itself does not have a substantial residential population. As such, residential populations in SA2s relevant to the precinct were unable to be quantified by the Australian Bureau of Statistics in the 2021 census. It is noted that residential properties on State Circle are captured in the relevant Inner South SA2.

The Parliament House precinct is an important site for democratic expression, hosting rallies, protests, and memorials at Federation Mall, which is also an attractor for tourists. On average, there are four rallies, protests, or memorials per year, with peak visitation typically occurring in March.

Parliament House serves as a central hub for government operations and political activity, attracting a wide range of workers, officials, and professionals. Its status as a national symbol and the site of key political events also draws numerous domestic and international tourists.

Section 11.7 of Chapter 11 (Project-wide issues) provides a summary of community capitals for the corridor and the ACT. The South Canberra SA3 has been analysed as part of the corridor and provides insight into people most likely to be transient to the precinct (e.g. visiting or working in the precinct).

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural, or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Parliament House precinct's area of social influence is shown on Figure 13-30.

The precinct includes government institutions, community parks, and gardens.

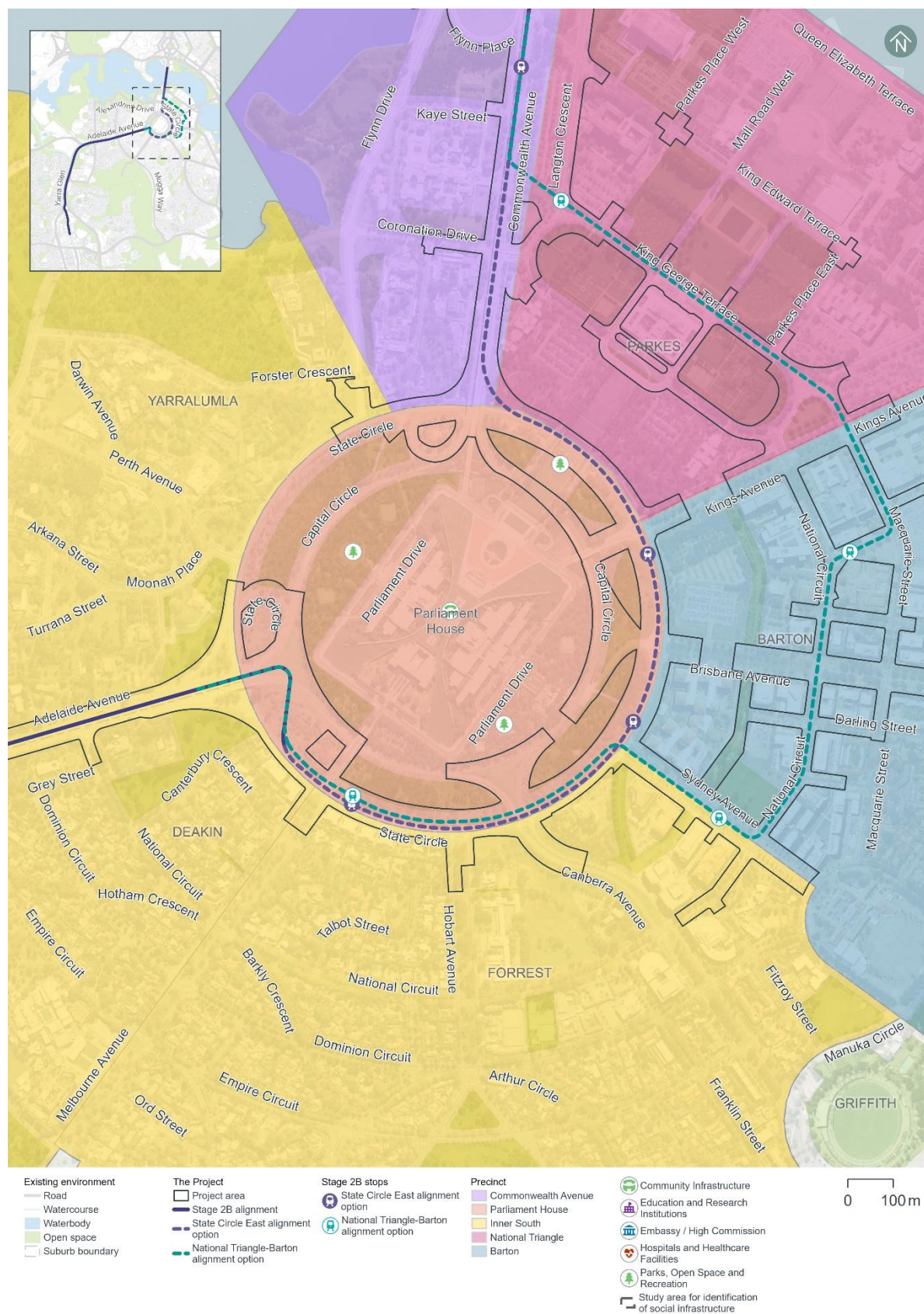


Figure 13-30 Social infrastructure within the Parliament House precinct

13.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those working in, visiting, or living in proximity to the Parliament House precinct is provided in Table 13-42. Construction-phase socioeconomic impacts within the Parliament House precinct would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those living in nearby residential premises, local workers, visitors to Parliament House, and those attending events or cultural activities.

Residents, workers, and students provided feedback via online surveys and other consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)), indicating that construction noise and vibration is a key community concern, as well as potential traffic impacts causing disruptions to their commute. Participants indicated concern over disturbance to workers from construction during business hours, and potential for annoyance to residences outside of business hours.

In terms of landscape and heritage, several participants highlighted the importance of maintaining an attractive landscape during construction given the national significance of the Parliament House area for both workers and tourists.

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 13-42 and Chapter 21 (Environmental management and mitigation measures).

Table 13-42 Socioeconomic impacts during construction – Parliament House precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to local amenity during construction, potentially leading to a decline in health and wellbeing affecting workers, visitors, and accommodation providers. This may particularly affect people with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 13.1.4 Section 13.3, and Section 13.6, (in relation to traffic, noise and vibration, and visual impacts, respectively).</p>	Both	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, facilitating follow up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking – impact to road users</p> <p>Temporary impact to road users due to temporary traffic changes, including during major events.</p> <p>This would include temporary road closures and restrictions of some turning movements, introduction of heavy vehicle traffic associated with construction, and temporary loss of on-street parking spaces, which would change how people travel through and use the area and result in minor travel time increases.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 13.1.4.</p>	Both	Very high (likely/major)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) 	High (likely/moderate)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>Decline in accessibility to business and services due to temporary loss of some on-street parking on State Circle, Melbourne Avenue and Hobart Avenue during construction, affecting visitors, employees and customers.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 13.1.4.</p>	Both	Very high (likely/major)	<ul style="list-style-type: none"> A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) 	High (likely/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
			<ul style="list-style-type: none"> Preparation of event impact assessments for major events, and implementation of tailored mitigation measures in consultation with event organisers. This could include providing temporary facilities or alternative access arrangements for event related activities if construction impacts are unavoidable (refer to measure SE5 in Chapter 21 (Environmental management and mitigation measures)) 	
<p>Visual landscape and heritage</p> <p>Changes to the aesthetic value of the area and impact to heritage items of significance adjacent to the Project area, potentially affecting connection to place, shared histories, and the future of their community, including Parliament House.</p> <p>Further detail on landscape and visual impacts in this precinct is provided in Section 13.6.</p> <p>Further detail on impacts to historic heritage in this precinct is provided in Section 13.5 and impacts to First Nations heritage is provided in Section 11.4 of Chapter 11 (Project-wide issues).</p>	Both	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

13.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in, or visiting the Parliament House precinct is provided in Table 13-43. Socioeconomic impacts within the Parliament House precinct would be common to both alignment options, unless otherwise noted.

Table 13-43 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 13-43. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Participants in the online YourSay survey from this precinct (refer to Chapter 4 (Stakeholder and community consultation)) indicated light rail operational benefits for the precinct including support for providing an alternative to private vehicle use, and for potential visual benefits of light rail compared to cars or buses. Transport-related socioeconomic benefits would apply to people across the light rail corridor and are considered further in Chapter 11 (Project-wide issues).

Table 13-43 Socioeconomic impacts during operation – Parliament House precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Landscape and visual changes Change to community character due to permanent changes to local visual landscape. The addition of light rail infrastructure, including three stops, along State Circle and removal of trees would result in potential adverse changes. This change may impact people's overall experience and connection to the area. Further detail on landscape and visual impacts in this precinct is provided in Section 13.6.	State Circle East alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users (and ultimately result in a benefit) 	Medium (likely/minor)
Landscape and visual changes Change to community character due to permanent changes to local visual landscape. The addition of light rail infrastructure along about a third of State Circle and the northern end of Adelaide Avenue and removal of trees would result in potential adverse changes, although the use of green track would partly mitigate the visual impact. This change may impact people's overall experience and connection to the area. Further detail on landscape and visual impacts in this precinct is provided in Section 13.6.	National Triangle-Barton alignment option	Medium (possible/moderate)		Low (possible/minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>Some decline in accessibility to business and services due to permanent loss of around 30 kerbside spaces and changes to property access.</p> <p>Impacts to the road network and parking associated with each alignment option are detailed in Section 13.1.4.</p>	State Circle East alignment option	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, measures to minimise accessible parking loss and optimise the interface between the Project and other transport modes (refer to measures TT8, TT9, and TT10 in Chapter 21 (Environmental management and mitigation measures)) Continued engagement with local businesses via the Community Engagement and Social Management Plan (refer to Appendix L (Environmental Management Plan outline)) 	Low (possible/minor)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>A decline in accessibility to business and services is unlikely as current parking spaces and property access would be maintained.</p> <p>Impacts to the road network and parking associated with each alignment option are detailed in Section 13.1.4.</p>	National Triangle-Barton alignment option	Very low (unlikely/minor)		Negligible (remote/minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Access and mobility Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. improved crossing facilities). Refer to Section 5.8 of Chapter 6 (Project description) for further detail on active travel arrangements.	Both	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (possible/positive)
Operational noise Potential decline in social amenity and impact on amenity for sensitive receivers e.g. the Presbyterian Church of St Andrew services due to operational rail noise impacts. Refer to Section 13.3 for further detail on operational rail noise impacts in this precinct.	State Circle East alignment option	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of operational noise and vibration mitigation measures identified in Chapter 21 (Environmental management and mitigation measures), to review and minimise potential operational noise impacts 	Medium (possible/moderate)

13.7.4 Precinct-specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for socioeconomic impacts within the Parliament House precinct.

14.0 National Triangle precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the National Triangle precinct, and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 14.1.4)
- Noise and vibration (Section 14.3)
- Biodiversity (Section 14.4)
- Historic heritage (Section 14.5)
- Landscape character and visual amenity (Section 14.6)
- Socioeconomic impacts (Section 14.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

14.1 Overview

The National Triangle precinct encompasses the area generally between Commonwealth Avenue and Kings Avenue. This precinct is within the National Triangle and Parliamentary Zone, and is adjacent to Old Parliament House and the Aboriginal Tent Embassy, with views across the lake to the Australian War Memorial, and Mount Ainslie in the background. Nearby are Australia's most significant cultural and governmental institutions such as the High Court of Australia, National Gallery of Australia, National Library of Australia, and the National Science and Technology Centre (Questacon).

14.1.1 State Circle East alignment option

There would be no operational light rail infrastructure within the National Triangle precinct for the State Circle East alignment option.

14.1.2 National Triangle-Barton alignment option

For this option, the light rail alignment would traverse King George Terrace from Commonwealth Avenue to its intersection with Kings Avenue. Part of King George Terrace would be transformed into a shared space by closing vehicular traffic between Parkes Place East and Parkes Place West, creating a forecourt setting to Old Parliament House. King George Terrace between Parkes Place East and Kings Avenue would also be closed to vehicle traffic. The light rail would be within the road median (median running), with the exception of a section of the alignment between Commonwealth Avenue and Langton Crescent where the alignment would be located away from the road reserve.

Treasury Stop is proposed at the intersection of King George Terrace and Langton Crescent. At this intersection Langton Crescent would be closed to vehicular traffic.

Within the National Triangle precinct, light rail would be wire-free.

Key Project features within this precinct for the National Triangle-Barton alignment option are shown in Figure 14-1.

Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

14.1.3 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Some adjustments to traffic signals would be required on King Edward Terrace at its intersection with Parkes Place East and Parkes Place West. These areas are shown in Figure 6-1 in Chapter 6 (Construction).

Construction compounds within National Triangle precinct include:

- Compound D: 21 Queen Victoria Terrace Parking
- Compound E: King George Terrace and Kings Avenue.

The location of these compounds is shown in Figure 6-1 in Chapter 6 (Construction).

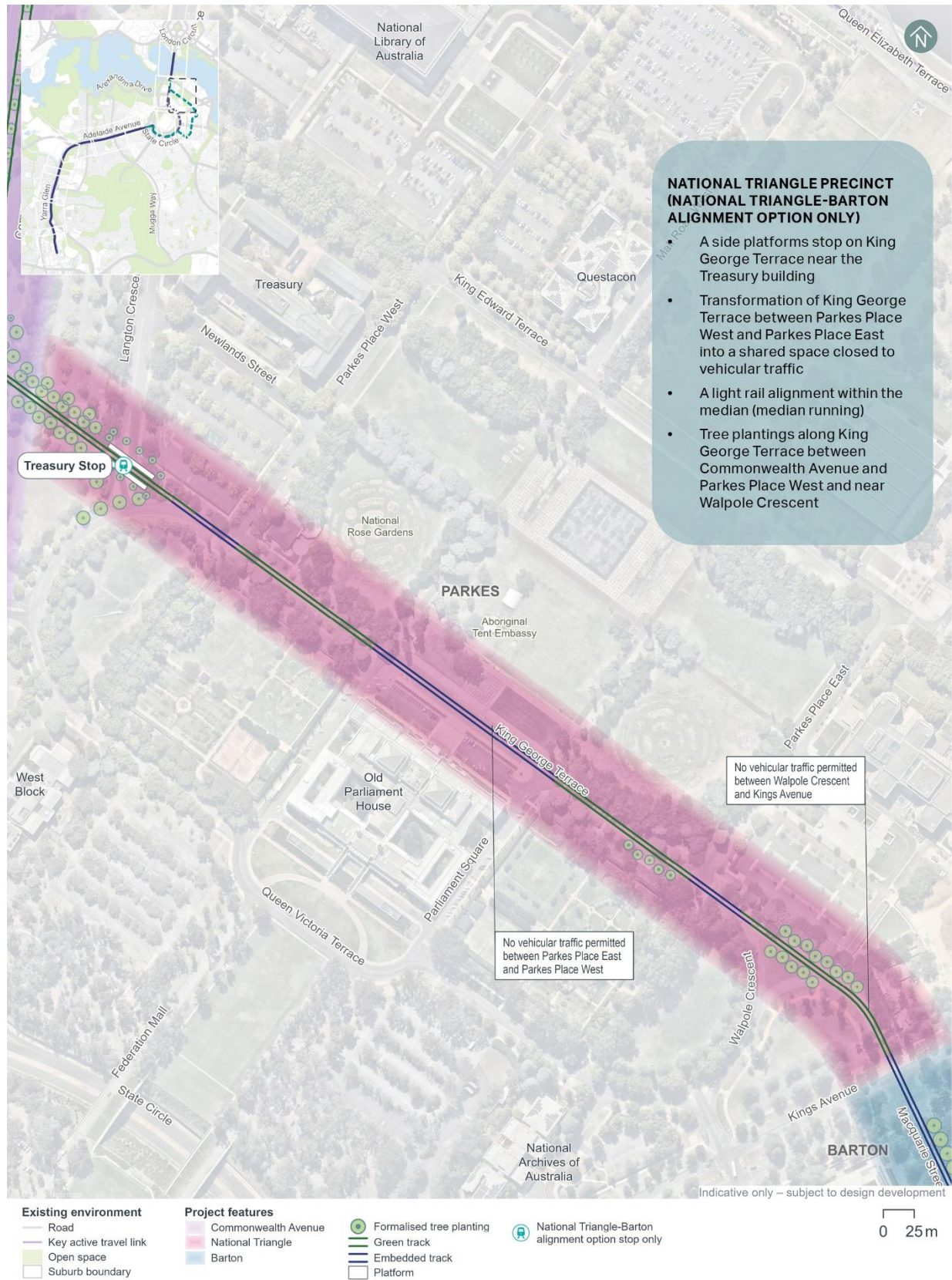


Figure 14-1 National Triangle precinct overview – National Triangle-Barton alignment option

14.1.4 Environmental impact overview – construction

Key impacts within the National Triangle precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Two potential alignments options are being considered for the Project – the State Circle East alignment option and the National Triangle-Barton alignment option. The potential impacts of each alignment option have been assessed in this chapter. While construction activities for the State Circle East alignment option may include works in this precinct, the operational light rail alignment for State Circle East would not extend into this precinct. Through further design development and the selection of a single, final alignment option, environmental impacts are expected to be further minimised.

Traffic and transport

Construction of the Project would be undertaken within and adjacent to the road reserve, and as such would result in traffic impacts, including temporary road closures, changes to turning movements, and the introduction of heavy vehicle traffic, which would disrupt the road network and parking availability. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Within this precinct, specific impacts attributed to the construction of the National Triangle-Barton alignment option would include the closure of King George Terrace between Langton Crescent and Kings Avenue, and local area access diversions, which may result in increased travel times for motorists.

Construction would also lead to a temporary, staged loss of up to 129 on-street parking spaces and five bus zones across the precinct as construction works progress. Construction compound D would result in the temporary loss of all 32 off-street spaces within the 21 Queen Victoria Terrace car park.

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction-related traffic and site access, parking availability, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, the decommissioning of utilities, are expected to generate noise that could moderately affect nearby non-residential buildings, particularly during ‘peak’ construction scenarios, which represent the noisiest works requiring the use of noise-intensive equipment such as concrete saws and rock breakers. Non-residential receivers located adjacent to the proposed haulage routes on parts of King George Terrace and Langton Crescent would be potentially affected by the increases in road traffic noise levels in instances where night works are required.

Mitigation measures that would be implemented to manage impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised through effective construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 1992* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 0.89 hectares of vegetation within the National Triangle precinct, 0.08 hectares of which is characterised as native. Removal of this vegetation would impact foraging habitat for the Gang-gang Cockatoo (*Callocephalon fimbriatum*) (listed as endangered under the EPBC Act and NC Act) and Superb Parrot (*Polytelis swainsonii*) (vulnerable under the EPBC Act and NC Act), and breeding and foraging habitat for the Diamond Firetail (*Stagonopleura guttata*) (vulnerable under the EPBC Act and NC Act). The Project would also require the removal of around

0.23 hectare of high-density Chilean needlegrass that may provide suitable habitat for the Golden Sun Moth (*Synemon plana*) (vulnerable under the EPBC Act and the NC Act). Three mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been identified in the proposed clearance footprint within the National Triangle precinct.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter include:

- **Historic heritage:** Several places listed on Commonwealth, National and ACT Heritage registers are present in the precinct, including the King George V Memorial, John Gorton Building, Old Parliament House Gardens, National Library of Australia and surrounds, East Block Government Offices, National Rose Gardens, Old Parliament House and Curtilage and The High Court and National Gallery Precinct. While direct impacts have been avoided, these places have the potential to be indirectly affected by the Project during construction through vibration caused by construction activities. However, these impacts would be managed through appropriate equipment selection, and determination and monitoring of safe vibration levels. Some additional heritage places in this precinct, such as the Parliament House vista, span across multiple precincts and have therefore been assessed in Chapter 11 (Project-wide issues)
- **Construction activities,** such as the establishment of compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area, particularly from key locations such as King George Terrace and Old Parliament House. Night-time construction work, where necessary, would also involve lighting that could impact nearby non-residential and heritage properties. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill, and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Potential socioeconomic impacts** include disruptions to local amenity, health, and wellbeing due to noise, vibration, and visual impacts, which may particularly affect workers, visitors, and accommodation providers in the area. Mitigation measures, such as the implementation of a Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP and sub plans, and is included as Appendix L (Environmental Management Plan outline).

14.1.5 Environmental impact overview – operation

Key impacts within the National Triangle precinct during the operational stage of the Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the National Triangle precinct would require several changes to the road network, including road closures to vehicles, speed limit adjustments, adjustments to existing lanes, adjustments to intersections, and adjustments to access arrangements.

Within the National Triangle precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

Additionally, there would be a permanent loss of around 30 kerbside parking spaces and three bus zones within the National Triangle-Barton alignment option, which may affect accessibility for businesses and services in the area. Access arrangements would also be altered due to the closure of sections of King George Terrace during the operation of the Project.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles, and pedestrians with light rail during operation, and review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed on a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Landscape character and visual amenity

The introduction of light rail infrastructure, including tracks and stops, would result in permanent changes to the landscape character and visual amenity of the area. High adverse visual impacts are predicted for the National Triangle-Barton alignment option in particular, due to the scale of change the Project would introduce within this precinct.

Landscape features such as the use of green track along sections of the alignment within this precinct would contribute to preserving visual amenity. The Public Domain Master Plan (Appendix I) also identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to the management and mitigation of landscape and visual impacts of the Project during operation.

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter are summarised below:

- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 14.1.4), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops. Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Socioeconomic:** Benefits of the Project within the National Triangle precinct include providing an alternative to private vehicle use, which can enhance accessibility and, over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, such as changes to the local visual landscape and community character due to the introduction of light rail infrastructure, which could potentially affect the experience and connection people have with the area. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support the design of high quality and manage these potential impacts
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the precinct, with noise and vibration levels predicted to comply with relevant criteria at the majority of receivers. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures, and operational maintenance planning. These measures would enable residual impacts to be limited
- **Historic heritage:** No direct impacts to heritage places within this precinct are predicted during operation of the Project. The John Gorton Building (listed on the Commonwealth Heritage List) has the potential to experience indirect (e.g., visual) impacts due to planting of trees partially obscuring the view, however, these changes would not detract from the place's heritage value and visual prominence. Additionally, Old Parliament House and Curtin House has the potential to experience

indirect impacts due to the location of Project infrastructure and LRVs in the direct line of site of the Land Axis, modifying the original historic landscape design. This impact would be mitigated through the use of wire-free running in this precinct and removal of bus parking along King George Terrace. Additional heritage places that are partially located within this precinct (such as the Parliament House vista) have been assessed in Chapter 11 (Project-wide issues) as they span across multiple precincts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

14.2 Traffic and transport

This section provides an assessment of the potential multimodal traffic and transport impacts associated with the construction and operation of the Project within the National Triangle precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

14.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the National Triangle precinct and the respective study area is indicatively shown in Figure 14-2.

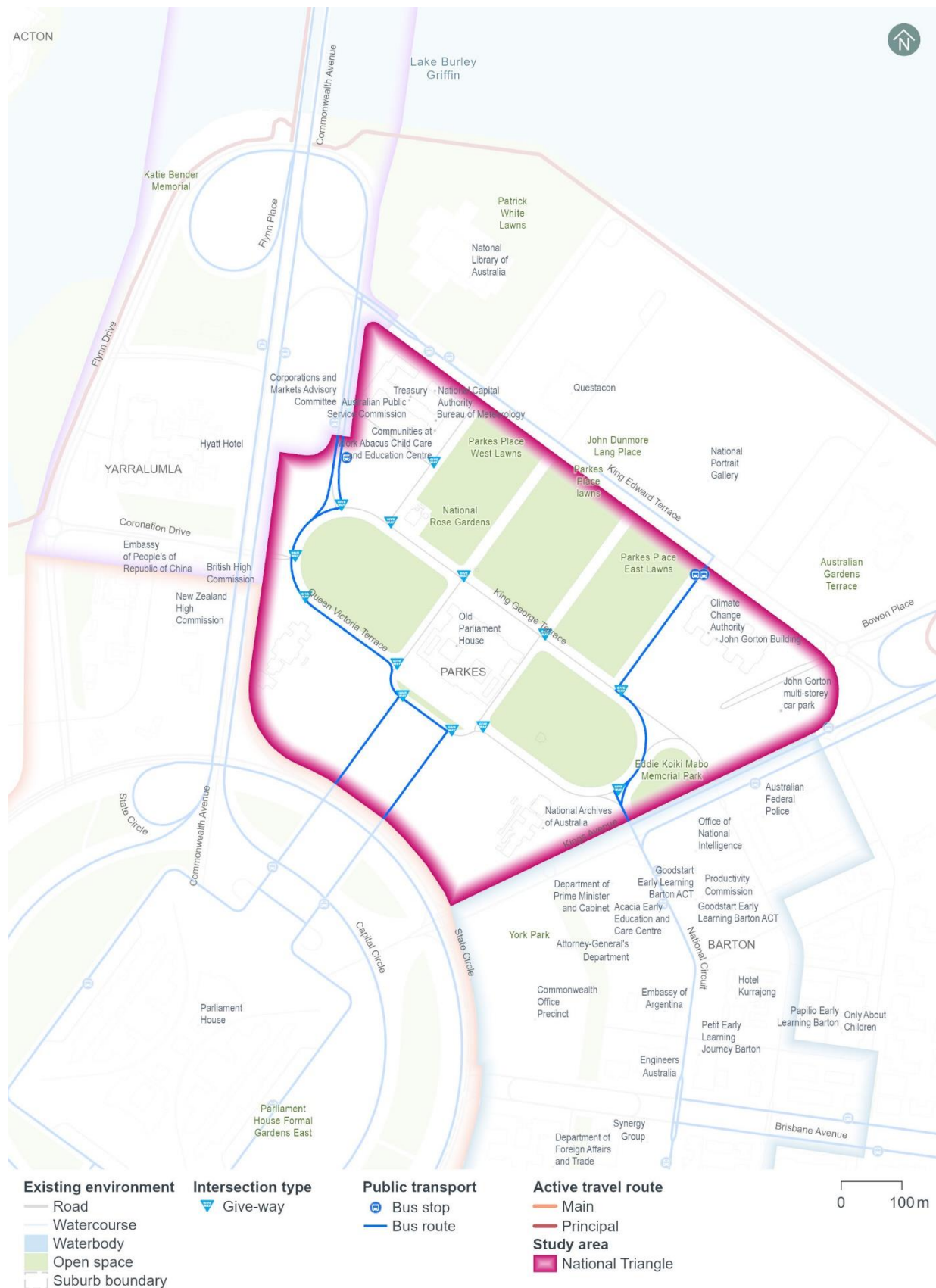


Figure 14-2 Overview of the existing transport network for the National Triangle precinct study area

Road network

The characteristics and features of key roads within the National Triangle precinct are summarised in Table 14-1.

Table 14-1 Overview of key roads within the National Triangle precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Langton Crescent	Major collector	Two-way	Two lanes in each direction	60 km/h
King George Terrace		Two-way	One lane in each direction	60 km/h
Queen Victoria Terrace		Two-way	One lane in each direction	60 km/h
King Edward Terrace		Two-way	One lane in each direction	60 km/h
Walpole Crescent	Local access	Two-way	One lane in each direction	60 km/h
Parkes Place West		Two-way	One lane in each direction	50 km/h
Parkes Place East		Two-way	One lane in each direction	50 km/h
Parliament Square		One-way around Old Parliament House	One lane on all sides of Old Parliament House	50 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peak hour traffic counts for various mid-block locations within the National Triangle precinct have been analysed and are summarised in Figure 14-3. As shown, traffic volumes along King George Terrace are similar in 2017 and 2024 during the AM and PM peak hours.



Figure 14-3 2017 and 2024 peak hourly traffic volumes within the National Triangle precinct study area

Intersection performance

The operation of the key intersections within the National Triangle precinct has been assessed using the microsimulation model which has been calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct existing performance of the assessed intersections is shown in Figure 14-4.

All the assessed intersections within the National Triangle precinct operated satisfactorily in 2017 at a level of service A during the weekday peak hours. Level of service represents the extent of delays experienced by drivers at an intersection.

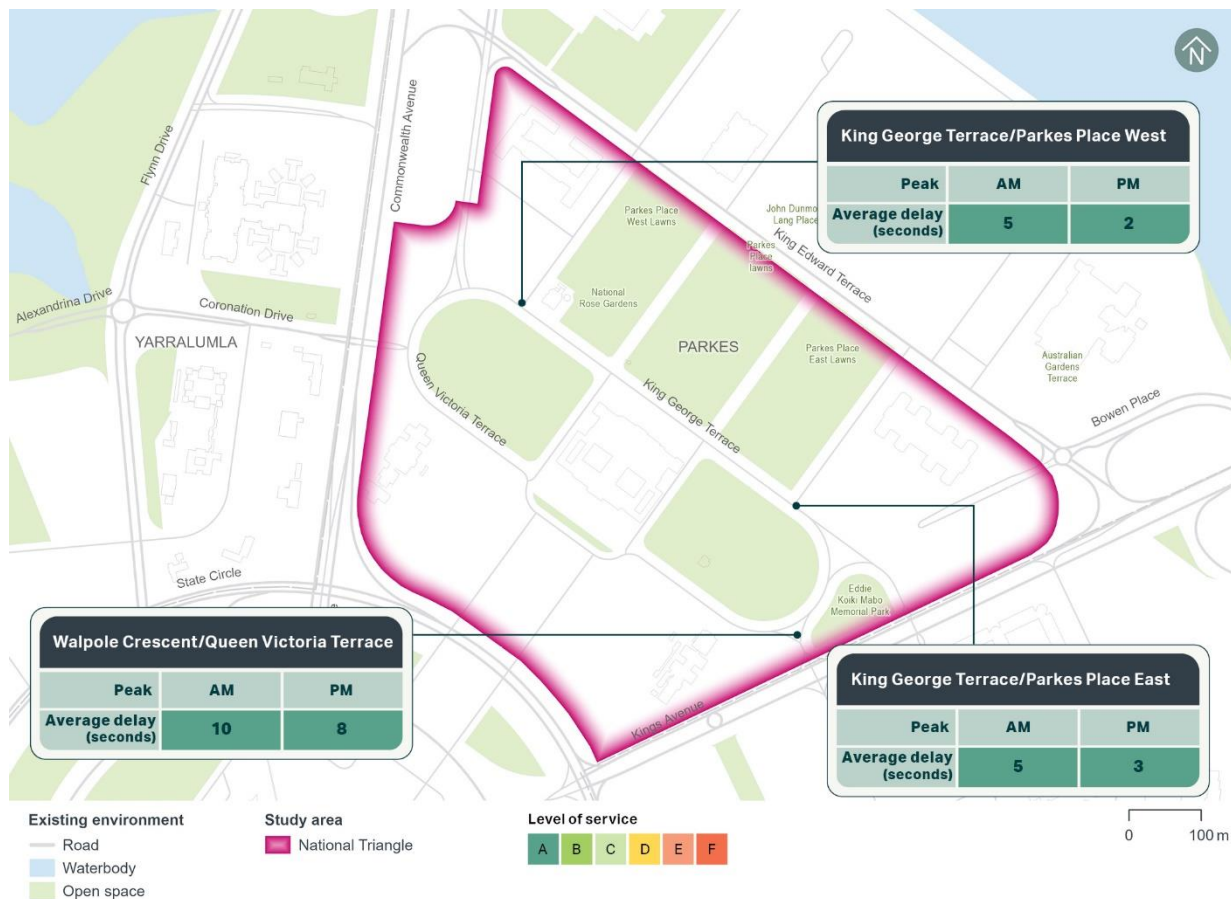


Figure 14-4 2017 AM and PM peak hour intersection performance within the National Triangle precinct study area

Public transport

There are bus stops located on Langton Crescent, King Edward Terrace, and Parkes Place East within the National Triangle precinct. Transport Canberra operates bus routes servicing these bus stops and generally provides connections to Woden and Civic, among other destinations. The bus routes that operate within the National Triangle precinct include the 57, 58, 830, R2, and R6.

In addition, there are bus zones located along King George Terrace and Parliament Square adjacent to Old Parliament House which are commonly used by coaches associated with school groups and tourism operators visiting nearby landmarks and cultural institutions.

Active transport

Footpaths are provided on both sides of most roads within the National Triangle precinct. Signalised pedestrian crossings are provided on all approaches to the Langton Crescent/King Edward Terrace intersection, while zebra crossings are provided in various locations along Langton Crescent, King Edward Terrace, King George Terrace, and Queen Victoria Terrace. Much of the National Triangle precinct has been identified as a central walking area in the 2024-2030 Active Travel Plan (ACT Government, 2023). The City to Queanbeyan and Lake Burley Griffin Circuit cycling routes also run through the precinct.

Pedestrian and cyclist count data from 2024 has been used to understand current active travel demand within the National Triangle precinct. The AM and PM peak hour counts at key locations within the precinct are summarised in Figure 14-5. The highest pedestrian volumes have been recorded at the Queen Victoria Terrace and Parliament Square (west) intersection, with around 60 pedestrians recorded during the weekday peak hours. The highest cyclist volumes have been recorded on King George Terrace near Old Parliament House and Parkes Place West, with around 40 cyclists recorded during the weekday peak hours.

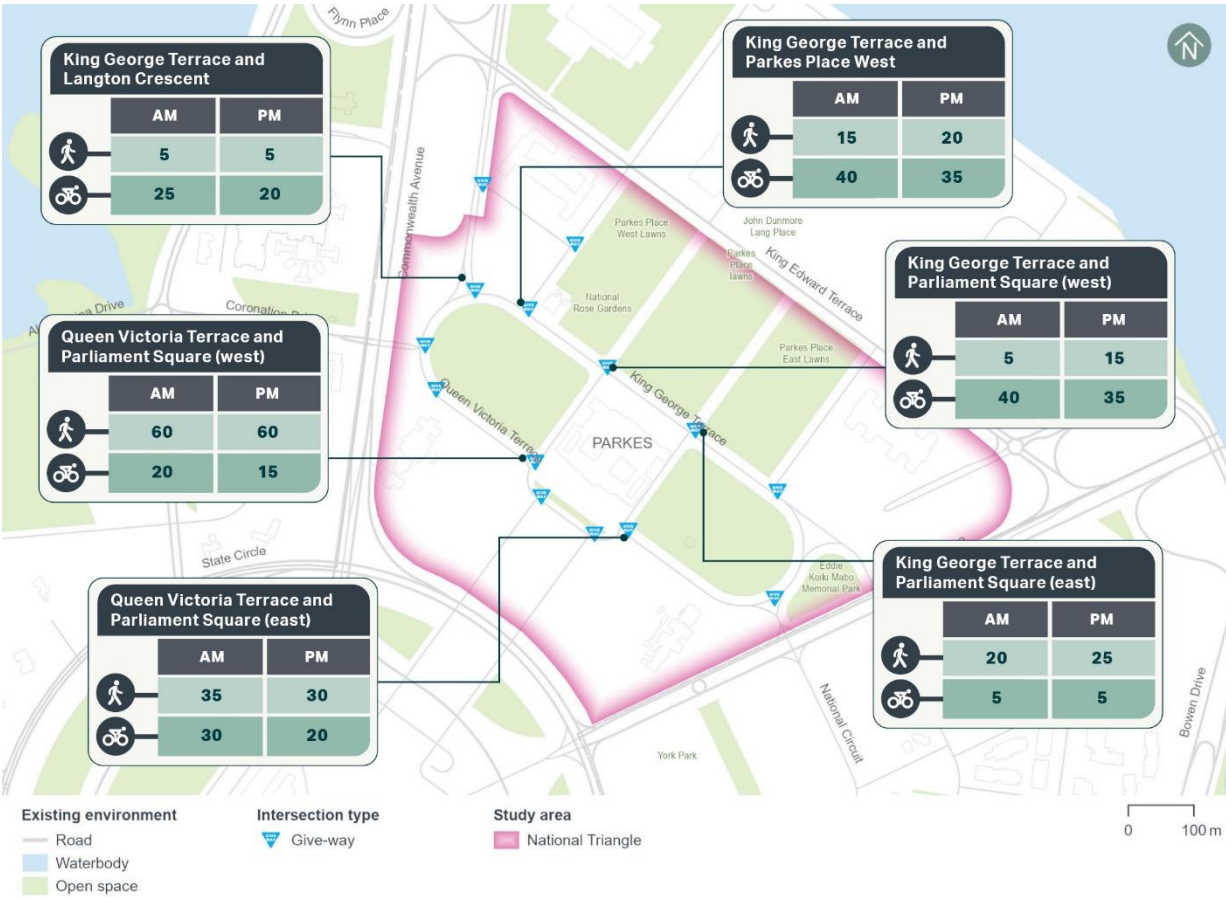


Figure 14-5 2024 peak hour active travel volumes within the National Triangle precinct study area

Car parking, kerbside uses, and access

Kerbside uses

The existing kerbside uses including on-street parking within the National Triangle precinct are summarised in Table 14-2.

Table 14-2 National Triangle precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
On alignment	King George Terrace	Parliament Square (west) and Parliament Square (east)	North	1P	18
			South	Bus zone	N/A
	King George Terrace	Parliament Square (east) and Parkes Place West	North	Bus zone	N/A
			South	Bus zone	N/A

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
Off alignment	Langton Crescent	Newlands Street and King George Terrace	East	Permit zone	4
				Bus zone (public)	N/A
			West	Bus zone (public)	N/A
	Newlands Street	Langton Crescent and Parkes Place West	North	1P	7
				Accessible parking	5
				Permit zone	6
			South	Loading zone (30 min)	5
				1P	9
	Parkes Place West	King Edward Terrace and King George Terrace	East	1P	28
				30 min loading zone	1
			West	Permit zone (8:30 am - 5:30 pm Monday to Friday)	3
				30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	3
				1/4P (7:30 am - 6:00 pm Monday to Friday)	7
				1P	7
	Parliament Square (north)	Parliament Square (west) and Parliament Square (east)	North	4P	34
			South	Accessible parking	6
				1P	5
	Parliament Square (west)	King George Terrace and Queen Victoria Terrace	East	Bus zone	N/A
			West	4P	14
				Permit zone	3
	Parliament Square (east)	King George Terrace and Queen Victoria Terrace	East	4P	17
				Permit zone	10
				Volunteer only	4
			West	Bus zone	N/A

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
	Parkes Place East	King Edward Terrace and King George Terrace	East	Bus zone (public)	N/A
				1/2P (7:30 am - 6:00 pm Monday to Friday)	4
				30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	8
				1P	7
			West	Bus zone (public)	N/A
				1P	20
				Taxi zone	6
	21 Queen Victoria Terrace access road	-	East	Permit zone	7
				Two hour loading zone	3
			West	1P	7
	Queen Victoria Terrace	Coronation Drive and Walpole Crescent	North	1P	16
Total					274 (including 11 accessible spaces)

Off-street parking

There are several existing off-street public car parks located within the National Triangle precinct which accommodate around 1,400 car parking spaces as shown in Figure 14-6 and listed below:

- Treasury South car park: at-grade car park with 270 spaces
- 21 Queen Victoria Terrace car park: at-grade car park with around 32 spaces
- John Gorton Building car park: at-grade car park with around 288 spaces
- West Block car park: at-grade car park with around 369 spaces
- East Block car park: at-grade car park with around 409 spaces
- Federation Mall car park: at-grade car parks with around 28 spaces.

Aerial imagery indicates that the Treasury South, John Gorton Building, and East Block car parks experience high parking demand on weekdays. At the same time, there is typically some spare capacity in the West Block car park.

In addition to the above, the new John Gorton multi-storey car park is currently under construction. This car park replaces the previous 500 space capacity car park in the same location, with the new car park providing a net increase of an additional 570 car parking spaces.



Figure 14-6 Off-street car parking within the National Triangle precinct study area

Property access

There are no direct property accesses along the Project's alignment within the National Triangle precinct. However, car and coach parking associated with Old Parliament House, and other nearby landmarks and cultural institutions is provided along Parliament Square, which connects to King George Terrace along the Project's alignment. It is noted that Parliament Square also has connections to Queen Victoria Terrace to the south of Old Parliament House.

Crash history

The five year crash history (1 January 2018 to 31 December 2022) within the National Triangle precinct can be seen in Figure 14-7. A total of 20 crashes have been recorded during the five year period, including:

- Five crashes that resulted in a minor injury (around 25%)
- 15 crashes that resulted in property damage only (around 75%).

The following common crash types occurred:

- Around 25% of crashes involved a rear end collision
- Around 20% of crashes involved a same direction side swipe.

One of the crashes involved a pedestrian.



Figure 14-7 Crash data between 2018 and 2022 within the National Triangle precinct study area

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

14.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside uses

State Circle East alignment option

It is estimated that up to eight on-street kerbside spaces along the 21 Queen Victoria Terrace access road (off-alignment) would be temporarily lost to support the construction work areas required for the State Circle East alignment option. This represents around 3% of the total 274 on-street kerbside spaces identified within the National Triangle precinct. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

National Triangle-Barton alignment option

It is estimated that up to 129 on-street kerbside spaces and five bus zones would be removed to support the National Triangle-Barton alignment option in the National Triangle precinct, including:

- 18 spaces and three bus zones on King George Terrace (on-alignment)
- Four spaces on Langton Crescent (off-alignment)
- Six spaces on Parkes Place West (off-alignment)
- Six spaces on Parkes Place East (off-alignment)
- 93 spaces and two bus zones on Parliament Square (off-alignment)
- Two spaces on Queen Victoria Terrace (off-alignment).

This represents around 47% of the total 274 on-street kerbside spaces identified within the National Triangle precinct. Of these kerbside uses, 30 on-street kerbside spaces and three bus zones would be permanently lost as part of the Project's permanent works for the National Triangle-Barton alignment option. The remaining spaces would be temporarily lost during construction. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program. Any potential temporary relocation of the bus zones associated with Old Parliament House during construction of the Project would be investigated further as part of detailed construction planning.

There are several off-street public car parks located throughout the National Triangle precinct which may be able to cater for some of the parking demand associated with the displaced kerbside uses. Any accessible spaces impacted by the works would be relocated temporarily as close as possible to their existing location.

Off-street parking

Construction compound D would result in the temporary loss of all 32 off-street spaces within the 21 Queen Victoria Terrace car park.

Local area access

State Circle East alignment option

Construction of the State Circle East alignment option would result in local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) to Kings Avenue. To manage traffic congestion and maintain reasonable vehicle travel times along Kings Avenue, the right turn from King George Terrace to Kings Avenue would be temporarily restricted during construction of the State Circle East alignment option.

Vehicles that currently make this turn would need to use available alternative routes such as turning right onto Kings Avenue via Queen Victoria Terrace, or adjust their trip further afield to use the broader arterial road network.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

National Triangle-Barton alignment option

Construction of the National Triangle-Barton alignment option would require closure of King George Terrace to vehicles from Langton Crescent to Kings Avenue during the construction program. The sections of King George Terrace between Parkes Place West and Parkes Place East, and between Walpole Crescent and Kings Avenue would be closed permanently to vehicles once construction is complete.

Vehicles would need to use alternate routes such as Queen Victoria Terrace or King Edward Terrace. The Parkes Place West and Parkes Place East intersections with King George Terrace would generally remain open, except during construction of the track crossings at these intersections, which would be subject to weekend closures.

The southern end of Langton Crescent and its intersection with King George Terrace would be closed to traffic. This connection would be removed as part of the Project's permanent works for the National Triangle-Barton alignment option, resulting in a permanent change to local area access arrangements at this location. Vehicles would need to use alternative routes such as Newlands Street and Parkes Place West, or the northern end of Langton Crescent to connect with King Edward Terrace.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

Property access*State Circle East alignment option*

Construction of the State Circle East alignment option would not change any property accesses within the National Triangle precinct.

National Triangle-Barton alignment option

The existing property accesses to Parliament Square and Old Parliament House on King George Terrace would not be accessible by vehicles from commencement of construction, and permanently due to the closure of King George Terrace for the National Triangle-Barton alignment option. However, the alternative accesses to Parliament Square and Old Parliament House on Queen Victoria Terrace would be maintained throughout construction. Accessing Parliament Square and Old Parliament House from Queen Victoria Terrace instead of King George Terrace could result in a slight increase in travel time depending on where drivers are travelling from and how far afield they adjust their travel route.

14.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the National Triangle precinct to accommodate the Project would include road closures to vehicles, speed limit adjustments, adjustments to existing lanes, adjustments to intersections, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the National Triangle precinct, particularly on Queen Victoria Terrace, Langton Crescent, and King George Terrace.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

Traffic volume changes are summarised in Table 14-3 and Table 14-4. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance
- Changes in mode choice due to the introduction of light rail.

Adjacent to the National Triangle precinct, traffic volumes along King Edward Terrace would also increase during the AM and PM peak hours as a result of the Project's road network changes and resulting traffic reassignment.

Table 14-3 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the National Triangle precinct in 2031 and 2041 scenarios with and without the Project

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
King George Terrace	Between Parliament Square East and Parliament Square West	Eastbound	410	0	-410	-100%	420	0	-420	-100%
		Westbound	350	0	-350	-100%	230	0	-230	-100%
Queen Victoria Terrace	Between Parliament Square East and Parliament Square West	Eastbound	300	460	160	53%	260	510	250	96%
		Westbound	170	260	90	53%	180	260	80	44%

Table 14-4 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the National Triangle precinct in 2031 and 2041 scenarios with and without the Project

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
King George Terrace	Between Parliament Square East and Parliament Square West	Eastbound	260	0	-260	-100%	180	0	-180	-100%
		Westbound	170	0	-170	-100%	200	0	-200	-100%
Queen Victoria Terrace	Between Parliament Square East and Parliament Square West	Eastbound	40	220	180	450%	120	190	70	58%
		Westbound	360	470	110	31%	310	410	100	32%

Road network performance

Within the National Triangle precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

Changes to the road network due to the Project, including traffic signal operation changes contribute to congestion and vehicle delay when compared to the without Project scenario in the 2031 scenario:

- Increased congestion and delay on Queen Victoria Terrace on approach to Kings Avenue during the AM and PM peak hour and reduced congestion and delay on Queen Victoria Terrace on approach to Langton Crescent and Commonwealth Avenue during the AM and PM peak hours
- Increased congestion and delay on Parkes Place West on approach to King Edward Terrace during the AM peak hour
- Reduced congestion and delay on Langton Crescent on approach to Commonwealth Avenue during the PM peak hour.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in the 2041 scenario.

Intersection performance

The performance of the key intersections within the National Triangle precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 14-5 and Table 14-6. Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. Key findings relating to intersection performance are as follows:

AM peak hour:

- The King George Terrace/Parkes Place West and King George Terrace/Parkes Place East intersections would operate satisfactorily at a level of service C with the Project in 2031 and 2041 scenarios
- The performance of the King George Terrace/Parkes Place West intersection would be better with the Project compared to without the Project, primarily due to the closure of King George Terrace to vehicles between Parkes Place East and West, which results in much lower traffic volumes at this intersection particularly in the 2041 scenario
- The Walpole Crescent/Queen Victoria Terrace intersection would operate at a level of service F with and without the Project in 2031 and 2041 scenarios. This is a constraint of the existing configuration and limited offset from the Kings Avenue/Queen Victoria Terrace intersection, which would result in high delays, particularly to vehicles on Queen Victoria Terrace when queues extend back from the Kings Avenue intersection.

PM peak hour:

- The King George Terrace/Parkes Place West and King George Terrace/Parkes Place East intersections would operate satisfactorily at a level of service C with the Project in 2031 and 2041 scenarios
- Similar to the AM peak hour, the performance of the King George Terrace/Parkes Place West intersection would be better with the Project compared to without the Project in 2031 and 2041 scenarios, primarily due to the closure of King George Terrace to vehicles between Parkes Place East and West which results in much lower traffic volumes at this intersection

- The Walpole Crescent/Queen Victoria Terrace intersection would reduce from a level of service A without the Project to a level of service F with the Project in the 2031 scenario. This is due to a combination of the closure of access to the National Triangle precinct for vehicles from the King George Terrace/Kings Avenue intersection, as well as the closure of King George Terrace to vehicles between Parkes Place East and West. These closures result in higher traffic volumes with the Project at the Walpole Crescent/Queen Victoria Terrace intersection. The limited offset from the Kings Avenue/Queen Victoria Terrace intersection results in high delays for vehicles on Queen Victoria Terrace when queues extend back from the Kings Avenue intersection.
- The Walpole Crescent/Queen Victoria Terrace intersection would operate at a level of service F with and without the Project in the 2041 scenario.

Table 14-5 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the National Triangle precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
King George Terrace/Parkes Place West	6	A	24	C	46	D	25	C
King George Terrace/Parkes Place East	7	A	24	C	7	A	26	C
Walpole Crescent/Queen Victoria Terrace	>150	F	>150	F	>150	F	>150	F

Table 14-6 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the National Triangle precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
King George Terrace/Parkes Place West	>150	F	37	D	>150	F	27	C
King George Terrace/Parkes Place East	13	B	23	C	3	A	23	C
Walpole Crescent/Queen Victoria Terrace	6	A	>150	F	122	F	>150	F

Active travel

The key pedestrian and cyclist provisions that would be provided within the National Triangle precinct as part of the Project for the National Triangle-Barton alignment option and their benefits or impacts are summarised in Table 14-7.

Table 14-7 Active travel provisions within the National Triangle precinct and associated impacts and benefits (National Triangle-Barton alignment)

Proposed treatment	Impact or benefit
A new raised intersection would be provided at the following locations: <ul style="list-style-type: none"> Langton Crescent, King George Terrace, and Parkes Place West Parkes Place East, King George Terrace, and Walpole Crescent. 	The raised intersection treatments would promote safer crossing for pedestrians and cyclists by reducing vehicle speeds.
A shared path would be provided on the northern side of the alignment between Commonwealth Avenue and Parkes Place West running parallel to the Treasury Stop.	The shared path would accommodate pedestrian and cyclist access between Commonwealth Avenue and the Treasury Stop.
Pedestrian footpaths would be augmented in the vicinity of the Treasury Stop and between Parkes Place East and Kings Avenue to facilitate the road closure.	The road closure would remove potential conflicts between vehicles and pedestrians/cyclists improving safety and accessibility.

Kerbside uses

The National Triangle-Barton alignment option would remove around 30 on-street kerbside spaces within the National Triangle precinct, including:

- 18 spaces on King George Terrace (on-alignment)
- Six spaces on Parkes Place West (off-alignment)
- Six spaces on Parkes Place East (off-alignment).

The loss of around 30 on-street kerbside spaces represents 11% of the total on-street parking supply within the National Triangle precinct. If the Old Parliament House bus zones on King George Terrace are relocated, additional kerbside spaces may be removed elsewhere near Old Parliament House. The potential relocation of these bus zones would be investigated further as part of ongoing design development.

Historical aerial imagery as well as site observations in June 2024 indicate the spaces along King George Terrace outside Old Parliament House are generally well utilised on weekdays, however generally have spare capacity on weekends. On-street parking demand is typically much lower on adjacent side roads on both weekdays and weekends, including Parkes Place East and West.

Off-street parking

The Project would not change any off-street parking within the National Triangle precinct.

Local area access

The National Triangle-Barton alignment option would change the following local area access arrangements within the National Triangle precinct:

- The southern end of Langton Crescent connecting into King George Terrace would be closed to traffic
- King George Terrace between Parkes Place West and Parkes Place East would be closed to traffic in both directions
- King George Terrace from Walpole Crescent to Kings Avenue would be closed to traffic in both directions.

Vehicles that currently travel between King George Terrace and Langton Crescent would need to travel via Parkes Place West and Newlands Road instead, or alternatively change their trip further afield and approach/depart via the northern end of Langton Crescent.

Vehicles that currently travel along King George Terrace between Parkes Place West and Parkes Place East would need to travel on alternate roads, including King Edward Terrace or Queen Victoria Terrace.

Lastly, vehicles that currently enter or exit the National Triangle precinct via the Kings Avenue/King George Terrace intersection would need to use the Kings Avenue/Walpole Crescent intersection.

These changes to local area access would likely result in a slight increase in travel time for impacted motorists depending on where drivers are travelling to/from and how far afield they adjust their travel route.

Property access

The existing vehicle property accesses to Parliament Square and Old Parliament House on King George Terrace would be removed in the National Triangle-Barton alignment option. All vehicle access to Parliament Square and Old Parliament House would be via the existing accesses on Queen Victoria Terrace. Accessing Parliament Square and Old Parliament House from Queen Victoria Terrace instead of King George Terrace could result in a slight increase in travel time depending on where drivers are travelling from and how far afield they adjust their travel route.

14.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Part C (Mitigation and residual environmental risks). This includes construction and operational mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the National Triangle precinct.

14.3 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts associated with the construction and operation of the Project within the National Triangle precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

14.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas were determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Area 2 was identified for the noise assessment of the National Triangle precinct. Noise Catchment Area 2 and associated sensitive receivers are shown in Figure 14-8.

Land uses within Noise Catchment Area 2 are predominantly passive and active recreation, commercial and public building land uses.

No residential receivers are located in the National Triangle precinct, however Noise Catchment Area 2 extends north past Lake Burley Griffin into the residential suburb of Campbell.

Heritage-listed items within the Noise Catchment Area include the National Library of Australia and surrounds (listed on the Commonwealth Heritage List), Treasury Building (nominated for the Commonwealth Heritage List), Old Parliament House and Curtilage (listed on the Commonwealth Heritage List) and the John Gorton Building (listed on the Commonwealth Heritage List). The Parliament House Vista (listed on the Commonwealth Heritage List) is also located within this Noise Catchment Area. Further detail on heritage items is included in Section 14.5.

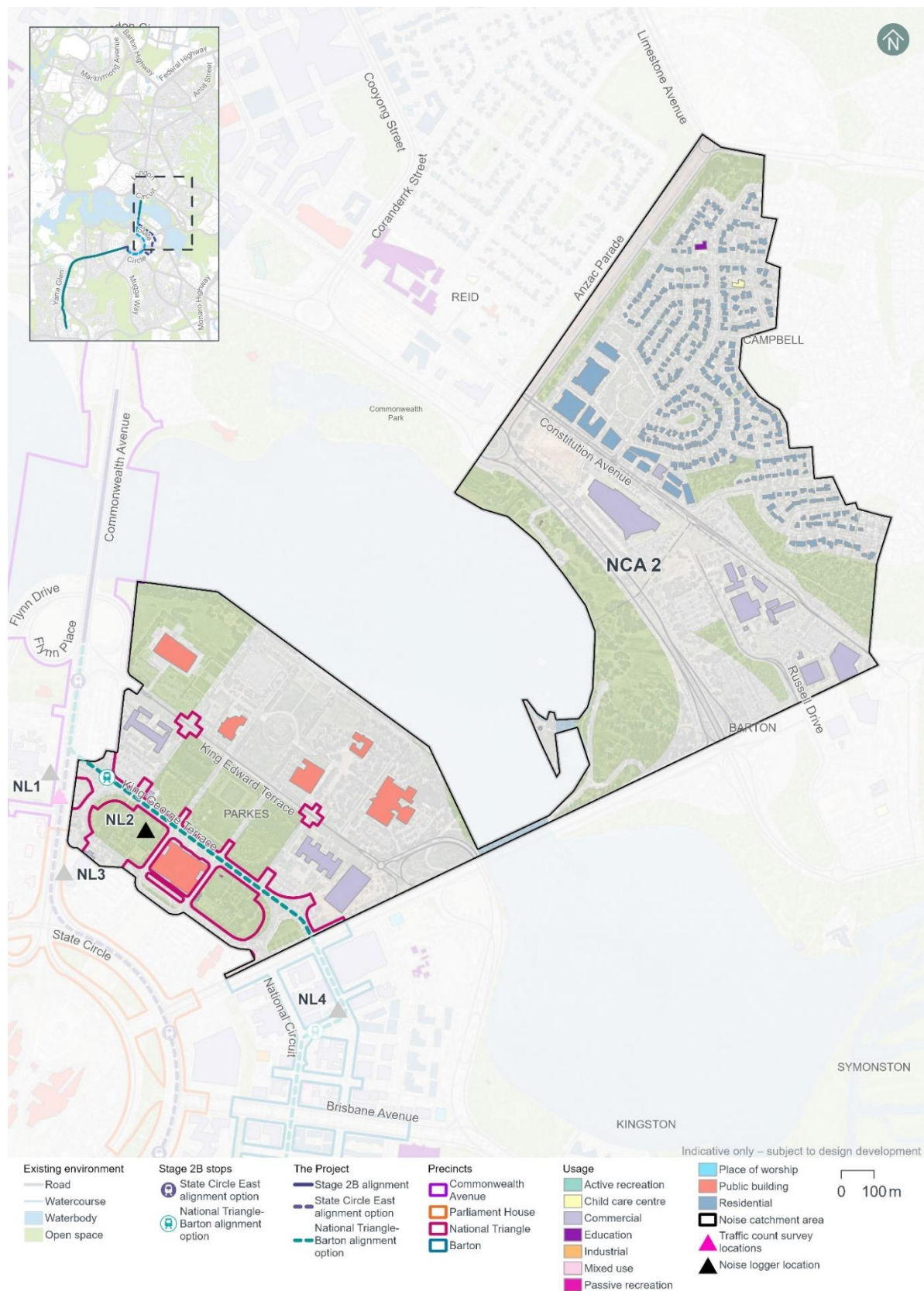


Figure 14-8 Noise catchment area and sensitive receivers

Existing noise levels

Unattended noise monitoring was carried out at one location in the National Triangle precinct (at noise logger 2 (NL2)) between 2 and 15 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 14-8. The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 14-8 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL2	The Broinowski Rose Garden, Parliament Square and King George Terrace, Parkes	44	30	55	41

Notes:

1. dB(A) represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
2. In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 14-9.

Table 14-9 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL2	53	44	Audible noises included distant traffic, reversing alarms, bird noises and distant construction. Reversing alarms were the most dominant noise source.

14.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level. Receivers in Noise Catchment Area 2 (refer to Figure 14-8) have the potential to experience impacts from the construction of either alignment option, which could be generated from works within multiple precincts. Where relevant, construction scenarios have been assessed separately for each alignment option to reflect the different locations of proposed work.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the National Triangle precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (which includes construction of the covered section between Commonwealth Avenue and State Circle for the State Circle East alignment option using equipment such as hammers and excavators)
- Construction of stops
- Construction of Commonwealth Avenue light rail bridges
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project, therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures). All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls

identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Assessment results

During standard construction hours and out of hours, no residential receivers within the Noise Catchment Area assessed for the National Triangle precinct are expected to be moderately noise affected or highly noise affected due to any of the construction scenarios.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 14-10, which assumes no mitigation measures are in place. The assessment results are relevant to both alignment options except where otherwise indicated, for example, for the 'earthworks, road works, and construction of light rail infrastructure' scenarios.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Table 14-10 Moderately noise affected non-residential buildings (assuming no mitigation measures are in place) – National Triangle precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 2		
Protection, relocation, treatment and/or decommissioning of utilities - peak	Active recreation	2
	Passive recreation	1
	Public buildings	4
Protection, relocation, treatment and/or decommissioning of utilities - typical	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – peak (State Circle East alignment option)	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – typical (State Circle East alignment option)	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – peak (National Triangle-Barton alignment option)	Active recreation	2
	Passive recreation	1
	Public buildings	4
Earthworks, road works, and construction of light rail infrastructure – typical (National Triangle-Barton alignment option)	Active recreation	2
	Passive recreation	1
	Public buildings	4
Construction of Commonwealth Avenue light rail bridges - peak	Public buildings	1

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Construction of bridges on land - peak	Public buildings	1

Notes:

1. Where a construction scenario did not result in any non-residential buildings being moderately noise affected, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the National Triangle precinct during the daytime indicate:

- The 'peak' protection, relocation, treatment and/or decommissioning treatment of utilities, and 'peak' and 'typical' earthworks, road works and construction of light rail infrastructure scenarios (for the National Triangle-Barton alignment) are predicted to result five non-residential buildings being moderately noise affected, including the Tennis Canberra tennis courts, National Portrait Gallery, Old Parliament House, and receiver buildings within the Old Parliament House Gardens
- The 'peak' and 'typical' earthworks, road works and construction of light rail infrastructure scenarios for the State Circle East alignment option are predicted to result in one non-residential building – the National Library of Australia – being moderately noise affected
- The Aboriginal Tent Embassy is considered as a mixed-use building and would likely be moderately noise affected due to its location near the Old Parliament House and Gardens.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical' works case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

The assessment for this precinct indicates that the awakening reaction level is not predicted to be exceeded at any residential receiver.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. No residential buildings are located within the human response minimum working distance for a large hydraulic hammer (within 73 m of the Project area boundary), and therefore exceedances of human response criteria are not predicted.

Cosmetic damage

One light-framed structure – The Lawns of the Lobby – is located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures) for cosmetic damage. Several heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage and other sensitive structures) for cosmetic damage.

Heritage structures that may potentially be affected by vibration from large hydraulic hammers and other proposed vibratory plant are listed in Table 14-11. Potential impacts to heritage are discussed further in Section 14.5.

Table 14-11 Heritage items within 60 m (minimum working distance for a large hydraulic hammer) of the Project area

Heritage place name	Distance between Project area and heritage structures (m)
Treasury Building (nominated for the Commonwealth Heritage List)	14
Old Parliament House and Curtilage (listed on the Commonwealth Heritage List)	1
John Gorton Building (listed on the Commonwealth Heritage List)	28
King George V Memorial (listed on the Commonwealth Heritage List)	0
Old Parliament House Gardens (listed on the Commonwealth Heritage List)	0
National Rose Gardens (listed on the Commonwealth Heritage List)	0
Aboriginal Tent Embassy (listed on the Commonwealth Heritage List as a part of the Parliament House Vista)	49
Communications Centre (at John Gorton Building) (listed on the Commonwealth Heritage List)	40

This presents a worst-case unmitigated assessment which has assumed that vibration-intensive equipment could be used at the boundary of the Project area. In reality, vibration intensive equipment is not likely to be used throughout the entire Project area. Instead, this equipment would typically be limited to areas of the footprint away from the boundary of the Project area, where it could be used to construct the light rail alignment, for example, in road medians and verges.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further detail on the approach to managing potential vibration impacts is included in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network with King Edward Terrace serving as a key route for construction traffic in this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (AM peak period, 8am to 9am) and night-time (10pm to 7am) are presented in Table 14-12. The year 2031 was selected as representative of the peak year of construction.

The majority of haulage routes would receive relative noise level increases of less than 2 dB(A). Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener.

Increases in road traffic noise greater than 2 dB(A) has been identified along the proposed haulage route on Walpole Crescent between King George Terrace and Queen Victoria Terrace in the night-time period. However, the proposed haulage route on Walpole Crescent adjoins recreational areas only. Therefore, the increases of 8.7 dB(A) and 2.8 dB(A) in the northbound and southbound direction respectively are not predicted to negatively impact any noise sensitive receivers during the night-time period.

Table 14-12 Construction road traffic noise peak hourly traffic counts – Daytime

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
King Edward Terrace between Bowen Place and Parkes Place	Westbound	211	16	2	2	0.2
	Eastbound	436	33	2	2	0.1
Walpole Crescent between King George Terrace and Queen Victoria Terrace	Northbound	103	8	2	2	0.5
	Southbound	98	7	2	2	0.5
Night-time assessment						
King Edward Terrace between Bowen Place and Parkes Place	Westbound	23	2	10	1	1.7
	Eastbound	40	3	10	1	1.1
Walpole Crescent between King George Terrace and Queen Victoria Terrace	Northbound	2	0	10	1	8.7
	Southbound	12	1	10	1	2.8

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

14.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the National Triangle precinct. Only the National Triangle-Barton alignment travels through the National Triangle precinct, and therefore the noise and vibration sensitive buildings in the precinct are only expected to be potentially impacted by the National Triangle-Barton alignment option.

Exceedances of operational rail noise trigger levels are not anticipated to result from the State Circle East alignment in this precinct.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of the alignment. This involved assessment of noise levels at a total of nine receivers in the National Triangle precinct, including public buildings, active recreation receivers and passive recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

The results of the operational rail noise assessment indicated compliance with both daytime and night-time airborne noise trigger levels. No exceedances of the trigger levels were predicted. Rail noise would be intermittent and last for a relatively short duration as the LRV passes the receiver, and would not represent a constant noise source.

Operational rail noise contours for the Project are presented in Appendix F of Technical Report 9 – Noise and vibration.

Ground-borne rail noise assessment

There are no residential receivers located in proximity to the alignment that have the potential to be impacted by any ground-borne noise. The nearest sensitive receiver is a commercial building use, which does not have ground-borne noise criteria. The Aboriginal Tent Embassy is not predicted to exceed the noise trigger levels at the sovereignty sign, ceremonial fire or demountable. Noise levels throughout the area within the Aboriginal Tent Embassy where temporary structures, such as tents, are usually located are also not predicted to exceed the noise trigger levels.

No sensitive receivers are expected to experience ground-borne noise levels over the trigger levels.

Rail vibration assessment

The predicted vibration levels for the National Triangle precinct at the most affected (closest) receiver are presented in Table 14-13. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria.

Table 14-13 National Triangle precinct – vibration results (human comfort; assuming no mitigation measures are in place)

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Daytime), $\text{m/s}^{1.75}$	Vibration Criteria (Night), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Night), $\text{m/s}^{1.75}$
Old Parliament House (19 King George Terrace, Parkes) <i>Commercial</i>	21	0.4	0.009	0.4	0.005

Heritage items in the National Triangle precinct are not predicted to be adversely impacted by rail vibration. Further information on heritage listed items is provided in Section 14.5.

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the *Noise Management Guideline* (Roads ACT, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is provided in Table 14-14.

Table 14-14 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected to represent the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the National Triangle precinct, existing road traffic noise levels are less than 55 dB(A). Future predicted road traffic noise levels would not increase and are therefore considered acceptable.

The results of the road traffic noise assessment for each alignment option are presented in Table 14-15 to Table 14-18, for 2031 and 2041 scenarios.

Road network changes required as part of the Project would include closures of sections of King George Terrace to general vehicular traffic for the National Triangle-Barton alignment only, as described in Section 5.9 of Chapter 5 (Project description). These closures would result in a reduction in road traffic noise in these areas, as shown below.

Table 14-15 Road traffic noise assessment, 2031 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
King George Terrace	Old Parliament House	Westbound	2,768	208	456	34	0	Yes, no increase in traffic noise level
		Eastbound	3,192	240	-47	-4		

Table 14-16 Road traffic noise assessment, 2031 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
King George Terrace	Old Parliament House	Westbound	2,768	208	-2,768	-208	-27	Yes, no increase in traffic noise level
		Eastbound	3,192	240	-3,192	-240		

Table 14-17 Road traffic noise assessment, 2041 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
King George Terrace	Old Parliament House	Westbound	2,280	172	629	47	-2	Yes, no increase in traffic noise level
		Eastbound	6,919	521	-3,617	-272		

Table 14-18 Road traffic noise assessment, 2041 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
King George Terrace	Old Parliament House	Westbound	2,280	173	-2,280	-173	-29	Yes, no increase in traffic noise level
		Eastbound	6,919	521	-6,919	-521		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the $L_{A10,15min}$ assessment noise level at any location.

Within the National Triangle precinct, the Treasury Stop is not located in proximity to residential receivers, and it is expected that PA systems could operate without adverse noise impacts to residential receivers. The Aboriginal Tent Embassy is located over 200 m away from the Treasury Stop and is unlikely to be adversely affected by the PA systems.

No other fixed operational facilities are proposed in the National Triangle precinct.

14.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Part C (Mitigation and residual environmental risks). This includes construction and operational mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for noise and vibration impacts at the National Triangle precinct.

14.4 Biodiversity

This section provides an assessment of the potential impacts associated with the construction and operation of the Project on biodiversity, and provides a summary of the biodiversity assessment for the National Triangle precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues).

Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity.

14.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the National Triangle precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 6.49 ha of vegetation is present in the National Triangle precinct. Vegetation within the National Triangle precinct is comprised of three vegetation communities. Table 14-19 and Figure 14-9 depict the area and distribution of each vegetation community within the National Triangle precinct.

Table 14-19 Extent of vegetation communities within the Project area in the National Triangle precinct

Vegetation community	Area (ha)
Landscape plantings – Native	1.16
Landscape plantings – Exotic	3.40
Exotic grassland	1.93
Total vegetation	6.49

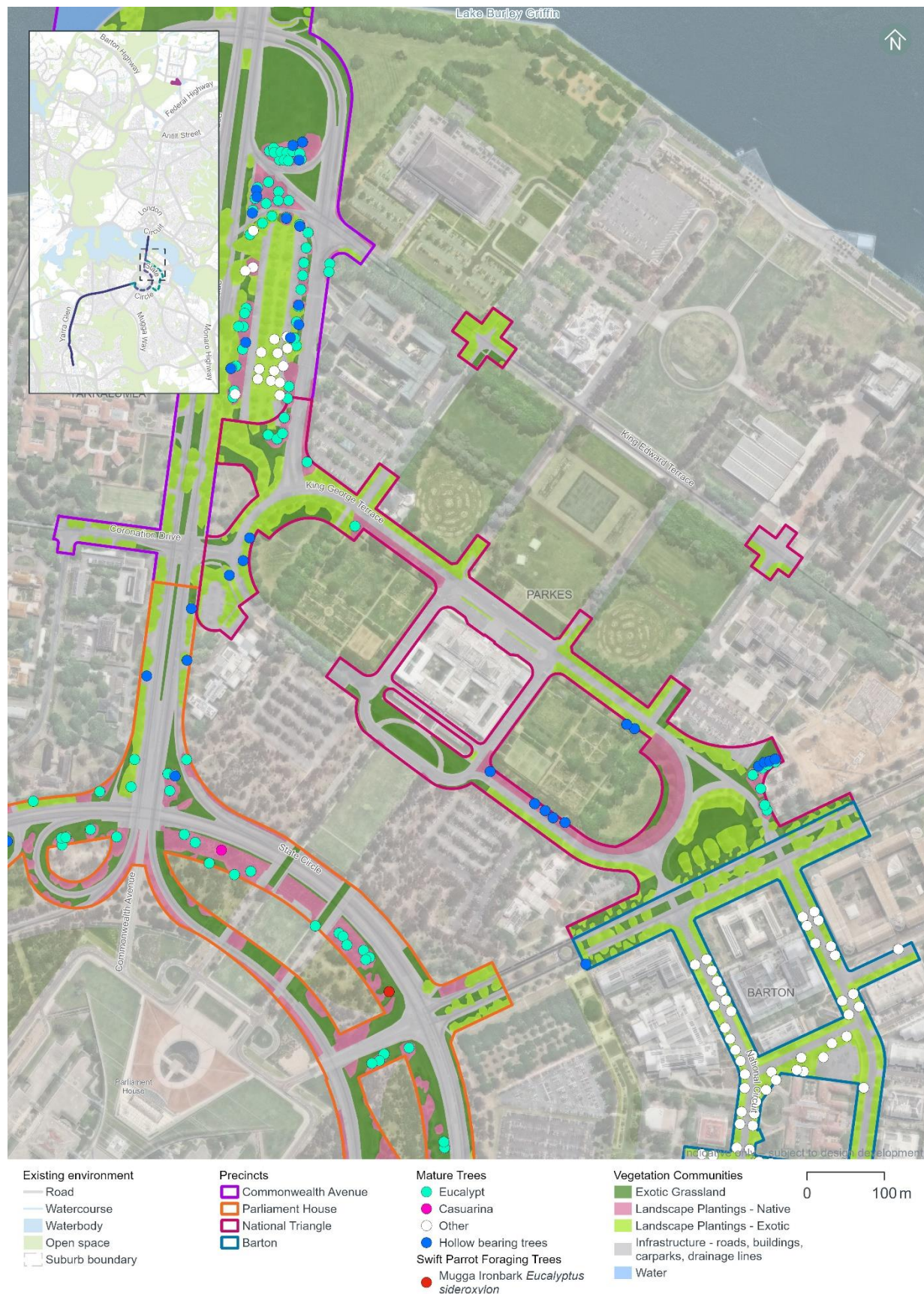


Figure 14-9 Vegetation communities, hollow-bearing, and mature trees in the National Triangle precinct

Hollow-bearing trees and mature trees

A total of 14 hollow-bearing trees and 20 mature trees have been recorded in the National Triangle precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature native tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 14-20 summarises the number of hollow-bearing and mature trees within the National Triangle precinct and is shown in Figure 14-9.

Field surveys carried out between 2022 and 2024 have identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 14-20 Summary of hollow-bearing and mature trees within the Project area in the National Triangle precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
National Triangle	14	2	4	1	5	5	20

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat

The Golden Sun Moth (*Synemon plana*) is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 0.44 ha of potential Golden Sun Moth habitat has been recorded within the National Triangle precinct, which has been identified as high-density Chilean needlegrass habitat (refer to Figure 14-10). However, no Golden Sun Moth individuals have been recorded in National Triangle precinct. Other Golden Sun Moth individuals and populations, and habitat across the Project area are identified in Section 11.2 of Chapter 11 (Project-wide issues).

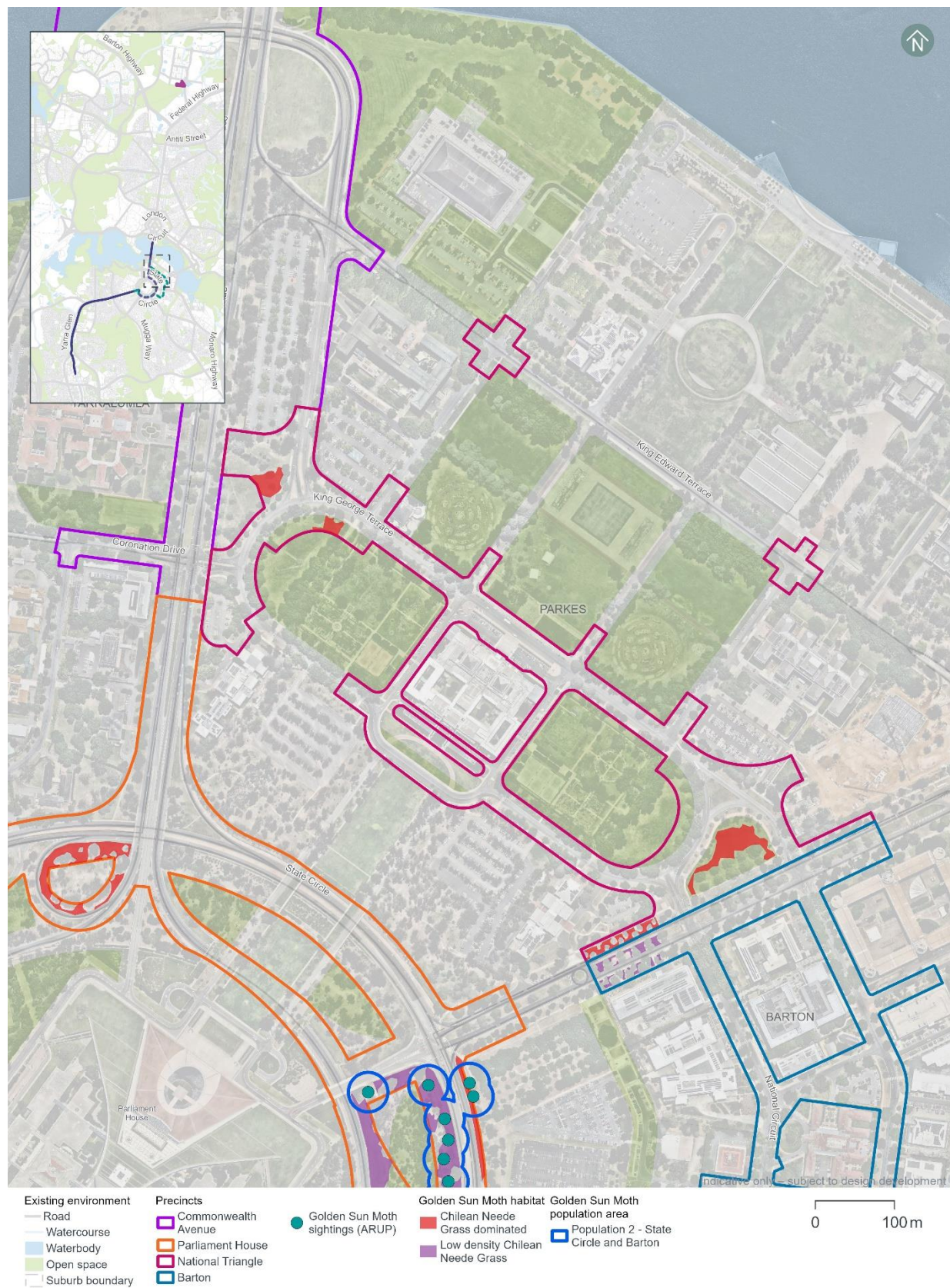


Figure 14-10 Golden Sun Moth habitat in the National Triangle precinct

Other potential threatened fauna habitat identified within the National Triangle precinct includes:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (listed as endangered under both the EPBC Act and the NC Act) – the National Triangle precinct supports 1.16 ha of foraging habitat and seven breeding trees for the species (refer to Figure 14-11)
- Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable under both the EPBC Act and the NC Act) – the National Triangle precinct supports 1.16 ha of foraging habitat for this species (refer to Figure 14-11)
- Diamond Firetail (*Stagonopleura guttata*) (listed as vulnerable under both the EPBC Act and the NC Act.) – 1.16 ha of the Landscape Planting – Native community has been identified within the National Triangle precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 14-11).

No habitat was identified in the National Triangle precinct for the Swift Parrot, Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberrae*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).

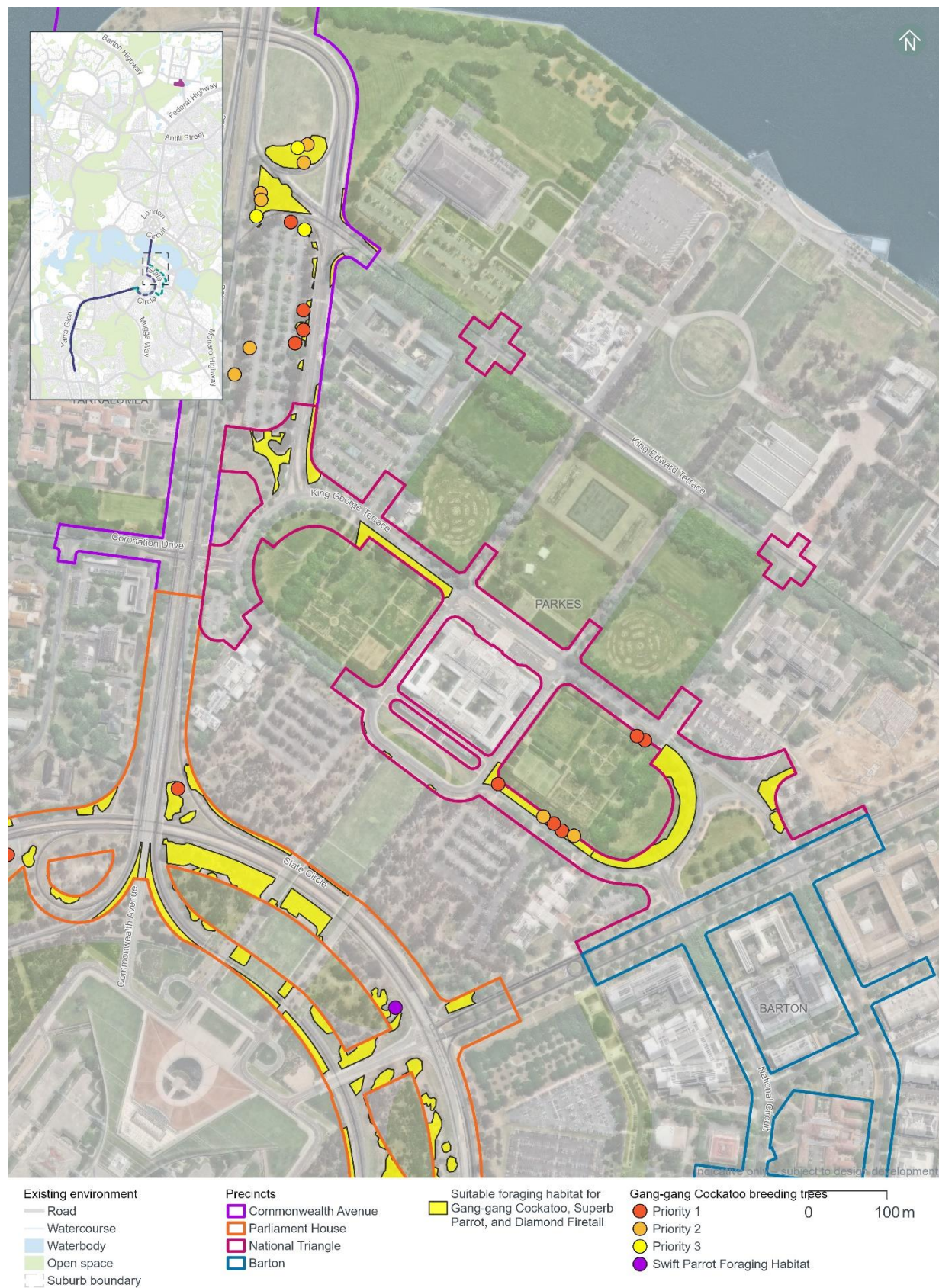


Figure 14-11 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the National Triangle precinct

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Threatened flora and pest plants

No threatened or rare flora species have been recorded in the National Triangle precinct. Impacts to threatened or rare flora species are therefore not anticipated.

One pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) has been recorded in the National Triangle precinct. The pest plant species, the Chilean needlegrass (*Nassella neesiana*), is also a Weed of National Significance.

14.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the National Triangle precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 14-12. Vegetation clearing would not be permitted outside this clearance footprint.

Vegetation clearing in this precinct would be required to construct the National Triangle-Barton alignment option only. No vegetation clearing in this precinct would be required for the State Circle East alignment option.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 14-21. Only 0.08 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 14-21 **Extent of vegetation communities within the clearance footprint in the National Triangle precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	0.08
Landscape plantings – Exotic	0.41
Exotic grassland	0.40
Total vegetation	0.89

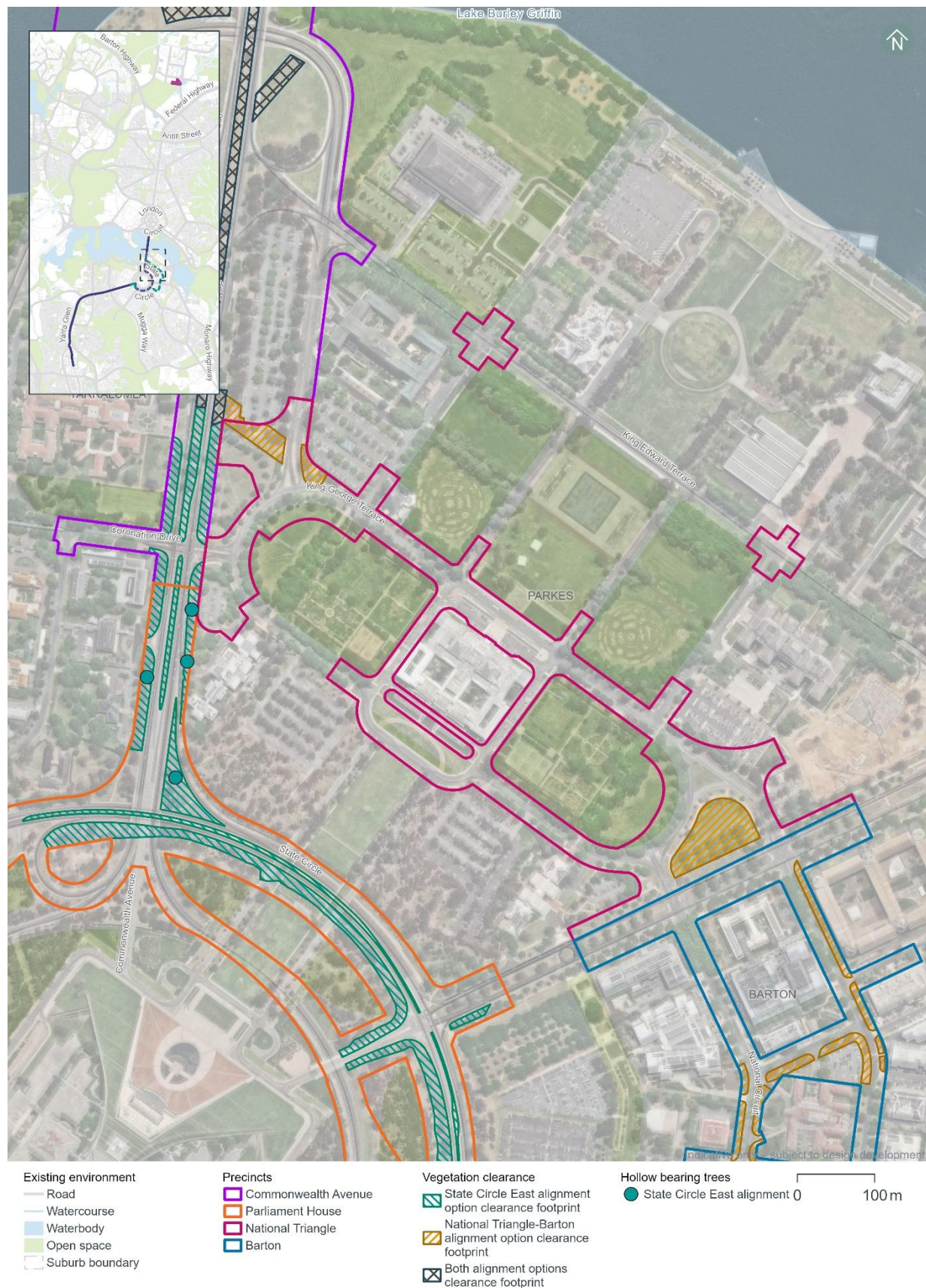


Figure 14-12 Clearance footprint in the National Triangle precinct

Three mature native trees have been recorded in the clearance footprint in the National Triangle precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

No hollow-bearing trees have been recorded within the clearance footprint in the National Triangle precinct.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the National Triangle precinct would include impacts on the following through habitat removal:

- Gang-gang Cockatoo – 0.08 ha of foraging habitat, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 0.08 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 0.08 ha of the Landscape Planting – Native community within the precinct which may provide suitable habitat for the species
- Golden Sun Moth – 0.23 ha of high-density Chilean needlegrass which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the National Triangle precinct clearance footprint for the Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Section 11.2.2 of Chapter 11 (Project-wide issues).

14.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike.

There would be no over-head wiring installed in this precinct as part of the Project and therefore there would be no risk of fauna strike with over-head wires. Further detail on these indirect impacts for operational activities is discussed in Section 11.2.3 of Chapter 11 (Project-wide issues).

14.4.4 Precinct specific management and mitigation measures

The Project has sought to reduce and avoid impacts to MNES and other biodiversity values in the landscape, through the development of a clearance footprint within the Project area (refer to Figure 14-12).

Environmental management for this Project is detailed in Part C (Environmental management and conclusion). This includes construction and operational management and mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the National Triangle precinct.

14.5 Historic heritage

This section provides an assessment of the potential historic heritage impacts associated with the construction and operation of the Project within the National Triangle precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

14.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the National Triangle precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The heritage character of the National Triangle precinct arises from its position at the centre of the National Triangle and the Parliament House Vista along the Land Axis (formed by the view line between Capital Hill and Mount Ainslie). The Parliament House Vista expresses clearly the Griffin Plan for Canberra (Griffin Plan) with the Land Axis serving as the central geometric feature around which the layout of Canberra was constructed. The National Triangle precinct directly intersects the centre of this Axis.

The National Triangle precinct also includes architecture, road geometry, plantings, and open spaces that reflect the status and function of the national capital and symbolises Australian politics and Government.

The historic heritage assessment identified 12 heritage places (nine listed, one nominated, and two unlisted) within and surrounding the National Triangle precinct, as noted below in Table 14-22 and shown in Figure 14-13.

Table 14-22 Heritage places within and surrounding the National Triangle precinct

Heritage places	Description
Commonwealth Heritage List	
Parliament House Vista	<p>The Parliament House Vista along the Land Axis is the most iconic of the intentional vistas created in the Griffin Plan. The open sweeping vista along the Land Axis is experienced in two directions and creates a dramatic view between Capital Hill and Mount Ainslie.</p> <p>The Aboriginal Tent Embassy is included in the Commonwealth Heritage List citation for the Parliament House Vista and is generally understood to be of high cultural significance to both the Aboriginal community and the wider population. This is due to it being significant as a place of political protest and action. The establishment of the embassy was a defining event which brought Aboriginal rights to an international arena. It represents the ongoing political struggle of Aboriginal people and is part of Australia's political heritage.</p> <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not assessed further in this precinct assessment.</p>
King George V Memorial	<p>The King George V Memorial, located on the northern side of King George Terrace, is historically significant as a tangible example of the importance of the Australian Head of State within the Australian system of government. The statue commemorates King George V, Monarch at the time of the opening of the Old Parliament House.</p> <p>The memorial is a significant feature of the Parliament House Vista landscape and provides enframement to the Land Axis space.</p>
John Gorton Building (including the Communications Centre)	<p>The John Gorton Building on Parkes Place East is in an inter-war Stripped Classical style. Key features of this style displayed by the building include: the symmetrical facades; the division of the elevations into vertical bays; the occasional use of correct Classical details; the use of a basic Classical column form; and the expressed portico.</p> <p>The Communications Centre is a rare example of an underground bunker, significant for its associations with the nation's 'cold war' activities.</p>
Old Parliament House Gardens	<p>The Old Parliament House Gardens, located to the north west of Old Parliament House, are historically significant for their contribution to understanding the operations of Old Parliament House, being closely integrated into the daily life of Old Parliament House during its operations as a place of relaxation, recreation and a venue for special events. Beyond the gardens, the trees of King George and Queen Victoria Terraces, and adjacent avenue walks contribute green canopy backdrops to the gardens.</p>
National Library of Australia and surrounds	<p>The National Library of Australia and surrounds is a good example of the Late Twentieth Century Stripped Classical style, and part of the significant cultural landscape of the Parliamentary Triangle. It occupies a prominent and strategic location on the western side of the Triangle, making it one of Canberra's landmark features. The library is valued by the community for its cultural use as a library, for its national collections, and for its exhibitions.</p>

Heritage places	Description
East Block Government Offices	East Block Government Offices is on the west side of Kings Avenue and is significant as one of the earliest government buildings in Canberra and is an integral component of the National Triangle landscape. It demonstrates architecture suited to sit within a designed landscape of related buildings and spaces.
National Rose Gardens	The National Rose Gardens, located on the north side of King George Terrace to the east of Old Parliament House, are historically significant as Australia's first national gardening project. They were planned to represent cooperation between the Commonwealth and the States, and roses were contributed by all states in Australia.
Commonwealth Heritage List and National Heritage List	
Old Parliament House and Curtilage (refer to Figure 14)	Old Parliament House and Curtilage is a nationally significant heritage place, with historical, rarity, research, and characteristic heritage values. It has aesthetic and social heritage value to the Australian community, is an expression of creative and technical achievement, and is associated with many significant people. It is located centrally in the National Triangle, acting as a physical representation of democracy in the nation.
The High Court and National Gallery Precinct (including High Court of Australia and National Gallery of Australia)	The High Court and National Gallery Precinct, located to the north of King Edward Terrace, is significant for demonstrating the development of the National Triangle as a home for national institutions. It is visually prominent in the National Triangle due to the buildings' monumental Brutalist architecture on the eastern side of the Land Axis.
ACT Heritage Register	
Canberra's pre-cast concrete bus shelters (object) (nominated)	<p>Canberra's precast concrete bus shelters are iconic landmarks in Canberra's city and garden suburbs because of their aesthetic distinctiveness, technical innovation, functionality of form and meaning to the community. About 90% are still understood to be in use today. The bus shelters have been moved as needed to locations throughout Canberra.</p> <p>It is understood that there is currently one precast concrete bus shelter in the Project Area, on King George Terrace to the north-west of the intersection with Parkes Place East.</p>
Unlisted significant heritage places	
Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	<p>Commonwealth Avenue and Kings Avenue are two of the three original major avenues for Canberra and together with Constitution Avenue they form the Parliamentary Triangle. Their symmetry, tree-lined avenues, plantings, landscape setting, and geometry contribute to an understanding of the Griffin Plan. They are significant as individual places and as part of the broader historical urban designed landscape of Canberra.</p> <p>State Circle and Capital Circle encircles Parliament House, framing Capital Hill. The smoothed contours, grassed verge edges, and massed native plantings between State and Capital Circles are significant by creating a 'natural Australian' aesthetic as the appropriate setting for the nation's parliament and reflect the principles of Canberra as a designed city in the landscape.</p> <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>

Heritage places	Description
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 14-13 and is not considered further in this precinct assessment.</p>





Figure 14-14 Old Parliament House

Condition, integrity, and sensitivity to change

The existing heritage within the National Triangle precinct is generally in good condition. The features of Parliamentary Zone and National Triangle are generally well maintained. Some trees are in poorer health but most are in fair to good condition. The historical structures associated with the precinct are in use and maintained.

The integrity of the heritage values is good. The original design character of the Griffin Plan and the historical layers of the landscape are generally intact and legible. Some changes have been made over time which have obscured the intended primacy of symbolic public buildings in the landscape and the symmetry of landscape design in the Griffin Plan, for example alterations to the original Griffin road geometry in a way which has obscured the historical layout, and the construction of a multi-storey carpark adjacent to the John Gorton Building.

The precinct is highly sensitivity to change due to the landscape being of outstanding national importance, central expression of the Griffin Plan and through its implementation by subsequent custodians.

14.5.2 Potential impacts – construction

Table 14-23 summarises the potential construction impacts of the Project on heritage places in the National Triangle precinct. Construction of the State Circle East alignment option would not have any impacts on heritage places within the National Triangle precinct.

Table 14-23 Construction impacts on heritage places within the National Triangle precinct

Heritage place	Construction impact National Triangle-Barton alignment option
Commonwealth Heritage List	
King George V Memorial	Minor <ul style="list-style-type: none"> No direct impacts to this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the King George V Memorial within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures) Ability to appreciate the memorial would be limited because of temporary visual impacts due to potential restricted access during construction.
John Gorton Building (including the Communications Centre)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the John Gorton Building within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Old Parliament House Gardens	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.
National Library of Australia and surrounds	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.
East Block Government Offices	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place The National Archives of Australia is located in the building and while its collections are not part of the heritage listing, they are highly significant and may be sensitive to vibrational impacts. Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the East Block within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Heritage place	Construction impact National Triangle-Barton alignment option
National Rose Gardens	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.
Commonwealth Heritage List and National Heritage List	
Old Parliament House and curtilage	Minor <ul style="list-style-type: none"> No direct impacts to this heritage place Minor visual impacts to the view from Federation Mall towards Old Parliament House and from Old Parliament House towards Mount Ainslie from temporary construction works and construction traffic Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Old Parliament House and curtilage within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
The High Court and National Gallery Precinct	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.
ACT Heritage Register	
Canberra's pre-cast concrete bus shelters (object) (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.

Construction impacts on Parliament House Vista, Parliament House and surrounds, Roads on national land – Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

14.5.3 Potential impacts – operation

Table 14-24 summarises the potential operation impacts of the Project on heritage places in the National Triangle precinct. Operation of the State Circle East alignment option would not have any impacts on heritage places within the National Triangle precinct.

Table 14-24 Operation impacts to the heritage places in the National Triangle precinct

Heritage place	Operation impact National Triangle-Barton alignment option
Commonwealth Heritage List	
King George V Memorial	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage place as a result of light rail infrastructure and operations No operational vibration impacts to this heritage place.

Heritage place	Operation impact National Triangle-Barton alignment option
John Gorton Building (including the Communications Centre)	Minor <ul style="list-style-type: none"> No direct impacts to this heritage place The planting of trees on either side of the light rail track on King George Terrace as LRVs pass the south-western side of John Gorton Building would partially obscure to a further degree the significant view south-west from the John Gorton Building entrance towards Walpole Crescent and Kings Avenue No operational vibration impacts to this heritage place.
Old Parliament House Gardens	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage places as a result of light rail infrastructure and operations There would be no tree removal and several additional trees would be planted adjacent to the garden to fill a gap created by the removal of a bus stop No operational vibration impacts to this heritage place.
National Library of Australia and surrounds	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to this heritage place.
East Block Government Offices	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to this heritage place.
National Rose Gardens	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage place No operational vibration impacts to this heritage place.
Commonwealth Heritage List and National Heritage List	
Old Parliament House and curtilage	Moderate to significant <ul style="list-style-type: none"> No direct impacts to this heritage place Project infrastructure and LRVs would be in the direct line of sight of the Land Axis and would pass in front of Old Parliament House. This would modify the expression of the original historic landscape design of this place. Impact to the setting would be mitigated by the use of wire-free running Closure of King George Terrace to traffic, and the resulting alterations to road access to Old Parliament House, are not expected to obscure or diminish its heritage values, as access to the building and its overall landscape setting, including the significant open forecourt, will be maintained Moderate positive outcomes for the heritage values would occur by removing parking bays in front of Old Parliament House as the visual impact of parked vehicles occurs over a longer duration than the passing visual impacts of the LRVs No operational vibration impacts to this heritage place.

Heritage place	Operation impact National Triangle-Barton alignment option
The High Court and National Gallery Precinct	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage places as a result of light rail infrastructure and operations No operational vibration impacts to this heritage place.
ACT Heritage Register	
Canberra's pre-cast concrete bus shelters (object) (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage place as a result of light rail infrastructure and operations No operational vibration impacts to this heritage place.

Operation impacts on Parliament House Vista, Parliament House and surrounds, Roads on national land – Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle, and Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

14.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for historic heritage impacts in the National Triangle precinct.

14.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the National Triangle precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural, and heritage attributes of the landscape, planning designations, and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown in Figure 14-15.

14.6.1 Existing environment

The National Triangle precinct extends along King George Terrace, passing between Old Parliament House and the Aboriginal Tent Embassy, and is bordered by Commonwealth Avenue and Kings Avenue. The precinct features open spaces and iconic buildings such as Old Parliament House, the Australian War Memorial, and the National Library.

Old Parliament House lies directly adjacent to the National Triangle-Barton alignment option and is located centrally to the National Triangle, intersecting the vista along the Griffin's Land Axis (Land Axis) between Parliament House and The Australian War Memorial. The adjacent Aboriginal Tent Embassy is a symbolic site established in 1972 by Aboriginal activists in Canberra. Its significance lies in its role as a focal point for Aboriginal political activism, advocating for land rights and self-determination within the Australian political landscape. The precinct contains many heritage items in close proximity to each other.

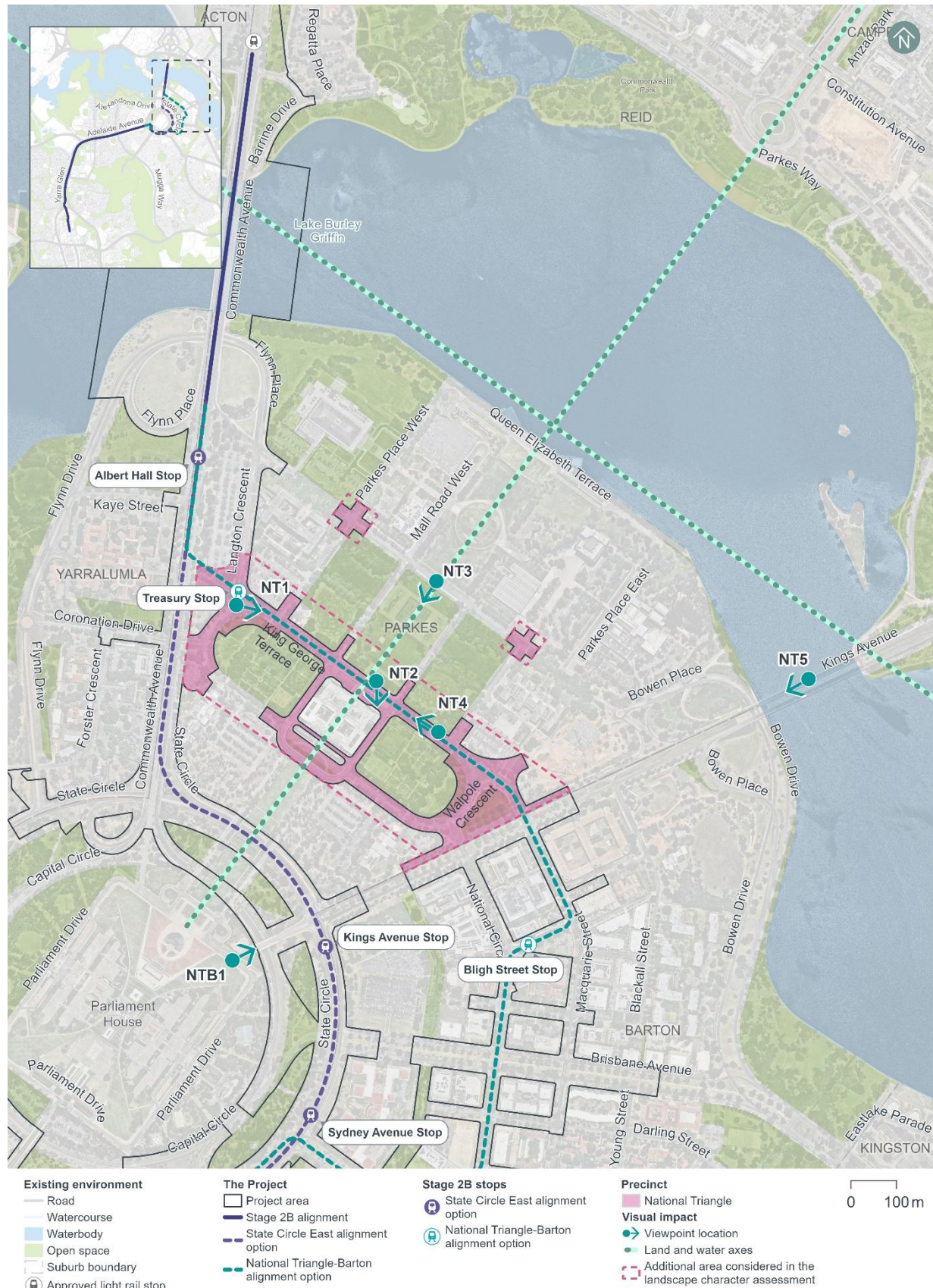


Figure 14-15 Landscape character zone and viewpoints in the National Triangle precinct

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Landscape character

The key aspects of the landscape character in the National Triangle precinct can be seen in Figure 14-16 and Figure 14-17. The National Triangle precinct comprises a formal landscape, with the geometry of the road and block network responding to the triangular shape of the broader land parcel, bisected and bounded by avenues and axes that are integral to the structure of the city. Views and vistas along King George Terrace and the Land Axis are compartmentalised within the landscape by the formal planting along road corridors or along boundaries (refer to Figure 14-16). This results in a framing of Old Parliament House and other buildings. Vegetation includes formal tree planting with large areas of open turf and some smaller gardens, including the National Rose Garden. Land uses within the precinct are predominantly National Capital use, with some commercial (i.e. restaurants and cafés). Surface level car parks within the precinct service substantial campuses and are fringed by vegetation.

The precinct contains many heritage elements, the most notable for this area being the Parliament House Vista, listed on the Commonwealth Heritage List (CHL). This listing includes the entire precinct, however, key attributes focus on the vistas along the Land Axis between Parliament House and Mount Ainslie including other important items such as Old Parliament House.

The symbolic weight of the Land Axis makes this an important space for cultural functions. The Aboriginal Tent Embassy (which is included in the Parliament House Vista listing in the CHL) is located within the Land Axis. The landscape between Old Parliament House (refer to Figure 14-17) and the Australian War Memorial along the Land Axis emphasises the nationally significant architecture.



Figure 14-16 The landscape has been compartmentalised by boundary and avenue planting



Figure 14-17 View along the Griffin's Land Axis, with Old Parliament House and the Australian War Memorial seen against the backdrop of Mount Ainslie

Viewpoints

Representative viewpoints that have been identified to assess visual impacts to the National Triangle precinct and are shown in Figure 14-15 and described in Table 14-25. These viewpoints have been assessed for the National Triangle-Barton alignment option only. Images of all viewpoints can be found in Technical Report 10 – Landscape character and visual amenity.

Table 14-25 National Triangle precinct viewpoints and description

Viewpoint	Description	Sensitivity rating
Viewpoint NT1: Magna Carta Place	<p>This viewpoint is located on King George Terrace, looking south-east along the road corridor towards Old Parliament House. The viewpoint is located adjacent to Magna Carta Place (refer to Figure 14-20). The central view comprises the northern turf verge and road pavement of King George Terrace, which extends from the foreground into the background. Visual receptors are likely to be pedestrians, cyclists, or motorists passing by this viewpoint.</p> <p>The sensitivity to change of this viewpoint is high. The viewpoint is positioned within an important area from a heritage and planning perspective.</p>	High
Viewpoint NT2: Old Parliament House	<p>This viewpoint is located at Parkes Place, looking south towards Old Parliament House and along King George Terrace. The view is situated within the Land Axis, adjacent to the Aboriginal Tent Embassy. The existing view includes the narrow road corridor towards the Old Parliament House building and forecourt. This viewpoint would be a popular tourist destination for visual receptors whereby the attention would be focussed on the architecture at this location. The quality of the view is paramount to the visitor experience. Those at the Aboriginal Tent Embassy would experience more prolonged views of this viewpoint than other visual receptors, however this view is only one of many available to protestors at the Aboriginal Tent Embassy.</p> <p>The sensitivity to change of this viewpoint is high. The viewpoint is positioned within an important area from a heritage and planning perspective.</p>	High

Viewpoint	Description	Sensitivity rating
Viewpoint NT3: Federation Centenary Fountains	<p>This viewpoint is located within Parkes Place, looking south-west towards Old Parliament House and the Aboriginal Tent Embassy from the north-eastern edge of Federation Centenary Fountains (refer to Figure 14-18). The view is dominated by the base of the Federation Centenary Fountains and surrounding patterned pavement. This viewpoint would be a visitor destination for visual receptors whereby the attention would be focussed on the architecture and vistas at this location. The quality of the view is paramount to the visitor experience.</p> <p>The sensitivity to change of this viewpoint is high. The viewpoint is positioned within an important area from a heritage and planning perspective.</p>	High
Viewpoint NT4: King George Terrace East	<p>This viewpoint is located on King George Terrace, looking north-west along the road towards Old Parliament House near the intersection with Parkes Place East (refer to Figure 14-19). The central view comprises the road pavement of King George Terrace extending from the foreground to the background, lined with street trees. Visual receptors are likely to be pedestrians, cyclists, or motorists passing by this viewpoint.</p> <p>The sensitivity to change of this viewpoint is high. The viewpoint is positioned within an important area from a heritage and planning perspective with views towards Old Parliament House and surrounding landmarks.</p>	High
Viewpoint NT5: Kings Avenue Bridge	<p>This viewpoint is located centrally on the Kings Avenue Bridge looking south-west towards Parliament House. The view comprises the separated east and westbound carriageways and northern footpath of Kings Avenue, extending west. While most of the visual receptors who would see this view would be transiting through the area to another destination, a proportion of these would be visitors who would be travelling along Kings Avenue between parks or landmarks due to their value as destinations within Canberra. These receptors would be more focussed on the view, particularly as the view culminates in Parliament House looking in one direction and the Australian-American Memorial looking in the other.</p> <p>The sensitivity of the viewpoint is high due to the importance of views along main avenues, particularly Kings Avenue, as one side of the National Triangle terminating in a landmark element at either side.</p>	High
Viewpoint NTB1: Parliament House North-east	<p>This viewpoint is located on the lawn at the northern corner of Parliament House looking north-east along Kings Avenue towards the Australian-American Memorial. The foreground of the view is dominated by the manicured green lawn of Parliament House, sloping down to Parliament Drive which passes through the middle ground.</p> <p>The sensitivity to change of this viewpoint is negligible as the Project would not be seen from this viewpoint. No further assessment of this alignment option from this viewpoint will be undertaken and are assumed to be negligible.</p>	Negligible – not assessed further



Figure 14-18 Existing view south-west along the Land Axis from Viewpoint NT3



Figure 14-19 Existing view north-west along King George Terrace from Viewpoint NT4

Night-time lighting

The National Triangle precinct holds a number of landscape and heritage sensitivities with a key focus on vistas, particularly along the Land Axis. The National Triangle is an area of A3: Medium district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023), with low level lighting of streetscapes to ensure the prominence of the feature lighting of nationally significant buildings.

Relevant design requirements of strategy 1a of the National Capital Authority's (NCA) Outdoor Lighting Policy for the National Triangle precinct include:

- i. Illuminate the Griffins' Land Axis by retaining the existing Anzac Parade street lighting and illumination of Federation Mall
- ii. Use full cut-off light fittings in all landscape areas, roads, paths, and car parks within the Central National Area
- iii. Align lighting hardware to strengthen the framing of the National Triangle, main avenues, and formally landscaped open spaces.

Due to the removal of private vehicle movement along the King George Terrace corridor, passive surveillance would be lessened within the precinct. Pedestrian lighting would be provided along the corridor to increase safety for the community while framing views along King George Terrace and toward Old Parliament House, reinforcing the integrity of the visual structure throughout the precinct.

14.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition and loss of elements within the National Triangle precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops
- Installation of lighting, signage, and landscaping
- Temporary traffic changes
- Establishment of construction compounds.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years).

As such, the magnitude of change during construction would be high within the National Triangle precinct due to the visual clutter of construction and the removal of trees. This would result in a high adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. These viewpoints have been assessed for the National Triangle-Barton alignment option only. During the construction phase within the National Triangle precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- High sensitivity of most viewpoints to change
- High heritage and aesthetic values of views across this precinct
- High magnitude of works anticipated throughout construction that would be visible in the fore, middle, and background of most viewpoints.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 14-26.

Table 14-26 Viewpoints construction impact summary – National Triangle precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint NT1: Magna Carta Place	This viewpoint would be inaccessible during construction due to the close proximity to construction works. The magnitude of change during construction cannot be assessed as this viewpoint would not be accessible during construction and is therefore deemed negligible. This combined with a high sensitivity rating makes the overall impact negligible.	Sensitivity: High
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral

Viewpoint	Anticipated change in view	Impact rating
Viewpoint NT2: Old Parliament House	During construction, private vehicle access along King George Terrace would be removed. The change would be in contrast to the existing, recessive road corridor and iconic architecture at this location and would be visible in the fore and middle ground of this view. The Project would result in the addition of construction activity and equipment which is likely to at least partially screen views to Old Parliament House and its gardens and is positioned on the Griffins' Land Axis, and in close proximity to the Aboriginal Tent Embassy.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint NT3: Federation Centenary Fountains	<p>During construction, private vehicle access along King George Terrace would be removed. From this viewpoint, which is 200 m away from the proposed changes at its nearest point, the discernible construction activity would include:</p> <ul style="list-style-type: none"> Fencing and hoarding Bulk earthworks and construction of trackform, equipment to facilitate changes to drainage and utilities adjustments, adjustments to kerbs, construction of footpaths, and re-sheeting. <p>The construction would be seen in the background of the view however, the work is likely to be seen in front of Old Parliament House. Changes would be somewhat prominent within the view due to the contrast against the stark white façade of Old Parliament House, but the overall prominence of the works would be diminished by the distance of viewing.</p>	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint NT4: King George Terrace East	During construction, private vehicle access along King George Terrace would be removed. The construction would be seen in the foreground and middle ground of the view and over a large proportion of the view. Construction activity would be in contrast to the existing, established landscape and would result in an adverse effect on the quality of the view. The visual clutter of construction activity would become a dominant feature of the view, with additional large elements and construction activities evident within the view.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint NT5: Kings Avenue Bridge	<p>A glimpse of the construction activity would be seen framed by the mature avenue tree planting that focuses the view from this location along Kings Avenue to the focal point at Parliament House. The viewing distance between the viewpoint and the Project is greater than 650 m but some construction activity would be visible from this location. The construction would result in visual clutter within the Kings Avenue view corridor.</p> <p>While limited construction activity is likely to be seen in detail, the activity is likely to result in a disruption in the continuity of the view of the avenue leading up to Capital Hill.</p>	Sensitivity: High
		Magnitude: Low
		Overall impact: Moderate
		Qualitative rating: Adverse
Viewpoint NTB1: Parliament House North-east	The sensitivity of this view to construction of the Project is negligible. Therefore, potential impacts at this viewpoint have not been assessed further and are assumed to be negligible.	Sensitivity: Negligible
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral

Night-time visual impact assessment

Works in the National Triangle precinct may need to be undertaken outside standard construction hours (Monday to Saturday, 7am to 6pm).

Temporary lighting would be required within the construction compounds to prioritise safety and security of the facility. Construction compounds within the precinct would be located within:

- 21 Queen Victoria Terrace
- The open space adjacent to the intersection of King George Terrace and Kings Avenue.

For these reasons, the visual impact during construction at night would be **high adverse**.

14.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project will impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 14-27 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 14-27 Landscape character impact assessment summary in the National Triangle precinct – National Triangle-Barton alignment option only

Alignment option	Anticipated change	Impact rating
National Triangle-Barton alignment option only	<p>The Project would result in the addition of the light rail infrastructure, including a light rail stop with canopy, along King George Terrace which would comprise a change to a large portion of the precinct. The Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running. The central road within the precinct would shift from cars to light rail, with some portions of the road effectively 'removed' due to the installation of green track, which would characteristically shift these areas to resemble the more open turfed areas on either side of the corridor.</p> <p>While the Project would result in the addition of light rail infrastructure within an existing green space at the north-western end of King George Terrace, linking this road with Commonwealth Avenue, there would be an overall increase in the amount green space (softscape) throughout the precinct due to the removal of hard road surface (replaced with green track), as well as the replacement of part of Walpole Crescent with turf.</p> <p>Changes to the traffic arrangements would result in a positive visual outcome within the Griffins' Land Axis, particularly in front of Old Parliament House and the Aboriginal Tent Embassy, through the removal of visual clutter including parking along King George Terrace and the pedestrianisation of the plaza.</p> <p>While the addition of light rail infrastructure would comprise a new element within this precinct, the low visual prominence of the trackform within key view corridors, particularly along the Griffins' Land Axis, and embedding the design within the surrounding landscape through the use of green track would allow it to characteristically align with the landscape character. The Treasury Stop would be the most substantial new element within the precinct, comprising a new architectural element. The stop would be some 100 m to the north-west of the Commonwealth Heritage Listed Old Parliament House Gardens, inclusive of Magna Carta Place, however, would retain the geometric structure of the Griffin Plan.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Beneficial

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. These viewpoints have been assessed for the National Triangle-Barton alignment option only. During operation within the National Triangle precinct, overall impacts varied greatly between viewpoints, ranging from high to negligible due to:

- Varied visibility of the Project from each viewpoint
- Varied visual blending of the Project with the surrounding view
- Pedestrianisation of the precinct.

Neutral to beneficial changes to visual amenity would also occur at some viewpoints due to the preservation of turf or trees in the median/verges, addition of tree plantings, and installation of sections of green track within the existing road corridor.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 14-28.

Table 14-28 Viewpoints operation impact summary – National Triangle precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint NT1: Magna Carta Place	<p>The Project would result in the addition of light rail infrastructure along King George Terrace. The viewpoint would be positioned at the south-eastern end of Treasury Stop. Tree planting along the alignment would reduce the impact of tree removal over time as the trees mature, although it is noted that a few trees would be removed within the existing view. Wire-free running would reduce any visual clutter associated with the Project at this location.</p> <p>The addition of the light rail corridor extending along the road, with passing LRVs would be visually prominent and would result in a contrast to the existing condition. King George Terrace would be changed from a road where cars could travel along to one with only LRVs. The changes would be permanent, seen from close proximity, within the central portion of the view, extending into the distance. An indicative visualisation of the Project, once operational, from Viewpoint NT1 is provided in Figure 14-21.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint NT2: Old Parliament House	<p>The Project would result in the addition of light rail infrastructure, passing LRVs, and the removal of traffic lanes along King George Terrace. The removal of street parking and vehicle movement would reduce the level of road vehicle activity within the view, with the space catering primarily to pedestrians and LRVs. The changes spread across the entire view are visually unobtrusive, primarily at ground level. Changes to the use of the road corridor and removal of parking would be the most substantial change. The view to Old Parliament House would remain largely unchanged due to the low profile of the infrastructure, which includes wire-free running.</p>	Sensitivity: High
		Magnitude: Low
		Overall impact: Moderate
		Qualitative rating: Beneficial

Viewpoint	Anticipated change in view	Impact rating
Viewpoint NT3: Federation Centenary Fountains	<p>The light rail trackform would not be visible from this viewpoint. The most substantial changes to the view would be the removal of street parking and light vehicles moving along King George Terrace within the view as well as the addition of passing LRVs. Wire-free running would reduce any visual clutter associated with the Project at this location.</p> <p>The magnitude of change experienced at this viewpoint at operation of the Project would be negligible. Passing and parked cars within the view would be replaced with passing LRVs.</p>	Sensitivity: High
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral
Viewpoint NT4: King George Terrace East	<p>The Project would result in the shift in the road corridor usage from vehicular to light rail transport. The green track would visually soften the transport corridor within the view, tying the corridor into the surrounding parkland landscape. The Project would also result in the addition of light rail infrastructure and passing LRVs within the view and the removal of traffic lanes along King George Terrace. The retained avenue trees would delineate the transport corridor within the view.</p> <p>While the Project would result in a change within the corridor, these would be primarily beneficial outcomes to the view. As the road would be closed to traffic, there would be a reduction in vehicle traffic along the route, including the removal of on-street car parking within the view. This would result in a reduction in hardscape within the view, creating a green space that prioritises pedestrian movement as per the Griffin Legacy.</p> <p>The increase in trees would reinforce the avenue aesthetic within the view. Wire-free running would reduce any visual clutter associated with the Project at this location.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Beneficial
Viewpoint NT5: Kings Avenue Bridge	<p>At operation, passing LRVs would be seen crossing the intersection at King George Terrace and Macquarie Street in the background of the view. The remaining light rail infrastructure would not be discernible from this viewpoint due to the distance to these elements (greater than 650 m) as well as median and verge tree planting between the viewpoint and the Project. Passing LRVs would be visually similar to passing busses in the existing view. Wire-free running would reduce any visual clutter associated with the Project at this location.</p>	Sensitivity: High
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral
Viewpoint NTB1: Parliament House North- east	<p>The sensitivity of this view to operation of the Project is negligible. Therefore, potential impacts at this viewpoint have not been assessed further and are assumed to be negligible.</p>	Sensitivity: Negligible
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral



Figure 14-20 Existing view south-east along King George Terrace from Viewpoint NT1



Figure 14-21 Indicative visualisation of viewpoint NT1 during operation for National Triangle-Barton alignment option

Night-time visual impact assessment

The priority within this precinct would be to deliver lighting that would respond to the sensitivities of the local landscape while prioritising the safety outcomes of pedestrians along King George Terrace through passive surveillance in response to the removal of private vehicle movement. The lighting along King George Terrace would be cut-off pedestrian lighting to contribute to the high quality landscape boulevard and not distract from the feature lighting of Old Parliament House and other nationally significant buildings.

While the addition of passing LRV headlights would be a new element within the Land Axis, these are temporary and would comprise an overall reduction of headlight movement within the corridor in response to the removal of private vehicle movement.

Lighting of the Treasury Stop adjacent to Magna Carter Place is vital to prioritise passenger safety at night and as a result this would create a lighting element within the road corridor and its surrounding environment. Existing pedestrian lighting is positioned along the path surrounding Magna Carta Place, however the park itself is not lit. Light spill from the stop is likely to affect the character of the public open space at night. Light spill from the stop may be beneficial to the perceived safety of the car park. While additional lighting would be required within the precinct, changes would not be experienced within the formal gardens of Old Parliament House due to tall hedging and mature tree planting.

Due to the reduction in traffic movement within the precinct at night and opportunities for placemaking within the Land Axis while prioritising the view corridor, there would be a noticeable improvement in visual amenity at night due to the Project.

The visual impact during operation for the National Triangle-Barton alignment option would result in a **moderate beneficial** change at night.

14.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage landscape character and visual amenity impacts that are specific to the National Triangle precinct are shown in Table 14-29.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Table 14-29 Landscape and visual management and mitigation measures – National Triangle precinct

ID	Objective	Management and mitigation measure	Timing
LV11	Recognising the visual significance of the Aboriginal Tent Embassy and Old Parliament House	Opportunities to enhance and celebrate the visual significance of the Aboriginal Tent Embassy and Old Parliament House through signage, landscaping and lighting will be developed in consultation with relevant stakeholders.	Design and operation

14.7 Socioeconomic

This section provides an assessment of the potential socioeconomic impacts associated with the construction and operation of the Project within the National Triangle precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

14.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown in Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. The National Triangle precinct includes the following SA2s:
 - Parkes North SA2
 - Parkes South SA2
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3

- ACT: in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor, and the ACT. Capital refers to various forms of resources that contribute to the well-being, sustainability, and resilience of a community.

The National Triangle precinct is primarily a central administrative and ceremonial space. Its primary function is to house significant government buildings such as Old Parliament House and Treasury, monuments, and open spaces, rather than serving as a residential neighbourhood. The National Triangle precinct serves as a hub for various workers and professionals, given its central role in government and administrative functions.

The precinct does not have a significant residential population. As such, residential populations in SA2s relevant to the precinct were unable to be quantified by the Australian Bureau of Statistics in the 2021 census.

The National Triangle precinct is also a venue for large-scale community events and major exhibitions, and its significant landmarks and events attract both domestic and international tourists.

Section 11.7 of Chapter 11 (Project-wide issues) provides a summary of community capitals for the corridor and the ACT. The South Canberra SA3 has been analysed as part of the corridor and provides insight into people most likely to be transient to the precinct (e.g. visiting or working in the precinct).

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural, or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the National Triangle precinct's area of social influence is shown in Figure 14-22.

The precinct includes cultural institutions, government institutions, memorials, early childhood facilities, libraries, parks and recreational areas, and gardens.

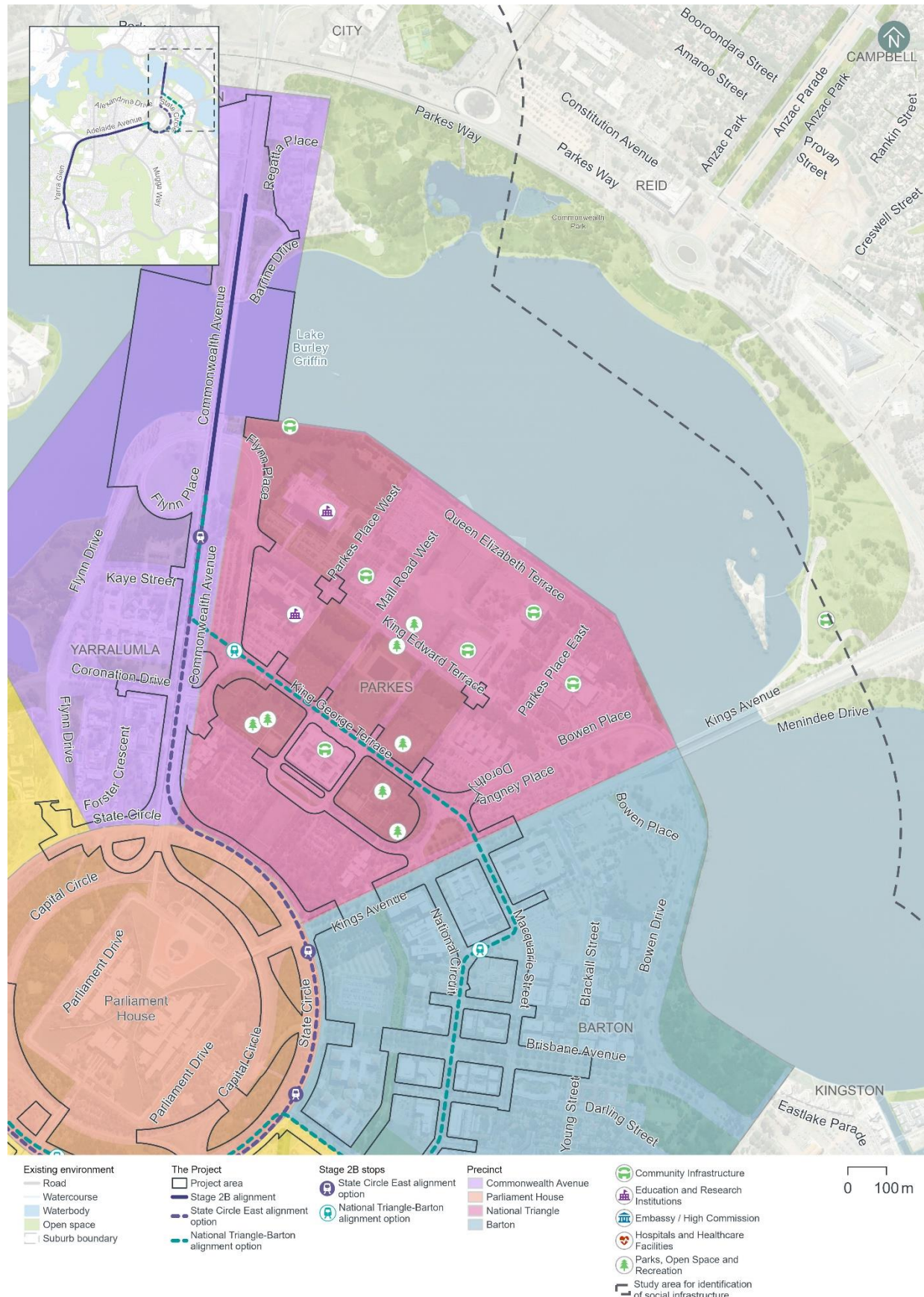


Figure 14-22 Social infrastructure within the National Triangle precinct

May 2025

Prepared for – Infrastructure Canberra – ABN: 66 676 633 401

14.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those working in, visiting, or living in proximity to the National Triangle precinct is provided in Table 14-30.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include workers in the precinct and key sensitive receivers such as occupants of the Aboriginal Tent Embassy.

During consultation activities (described in Chapter 4 (Stakeholder and community consultation)), feedback collected from stakeholders within this precinct indicated concern with potential construction noise and vibration and construction traffic impacting workers, visitors, and events. Stakeholder consultation with cultural institutions and major employers in the precinct indicated availability of parking to be of importance to workers and visitors.

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 14-30 and Chapter 21 (Environmental management and mitigation measures).

Table 14-30 Socioeconomic impacts during construction – National Triangle precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to local amenity during construction, potentially leading to a decline in health and wellbeing affecting visitors to public buildings and recreation areas. This may particularly affect people with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 14.1.4, Section 14.3, and Section 14.6 (in relation to traffic, noise and visual impacts, respectively).</p>	Both	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking – impacts to road users</p> <p>Temporary impact to road users on existing road network during construction due to temporary traffic changes which may impact travel times, including during major events. This would include substantial temporary loss of on-street parking spaces (including on King George Terrace, Langton Crescent, Parkes Place West, Parkes Place East, Parliament Square, and Queen Victoria Terrace), impact to bus zones on King George Terrace and several road closures, which would change how people travel through and use the area.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 14.1.4.</p>	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) 	Medium (possible/moderate)
<p>Disruptions to the road network and parking – impacts to road users</p> <p>Temporary impact to road users on existing road network during construction due to temporary traffic changes which may impact travel times, including during major events. This would include some limited temporary loss of off-street parking spaces in the Queen Victoria Terrace car park and some nearby on-street parking spaces on Queen Victoria Terrace, which would change how people travel through and use the area.</p>	State Circle East alignment option	Medium (possible/moderate)	<ul style="list-style-type: none"> A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) 	Low (possible/minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Further detail on transport and access impacts within this precinct is provided in Section 14.1.4.			<ul style="list-style-type: none"> Preparation of event impact assessments for major events, and implementation of tailored mitigation measures in consultation with event organisers. This could include providing temporary facilities or alternative access arrangements for event related activities if construction impacts are unavoidable (refer to measure SE5 in Chapter 21 (Environmental management and mitigation measures)) 	
Economic impacts and disruption to events and cultural festivals Potential for disruption to festivals, exhibitions, and events due to adjacent construction activities and traffic changes, resulting in convergence for attendees, and potentially lower attendance.	Both	Very high (likely/ major)	<ul style="list-style-type: none"> Implementation of the Construction Traffic Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan Preparation of event impact assessments for major events, and implementation of tailored mitigation measures in consultation with event organisers. This could include providing temporary facilities or alternative access arrangements for event related activities if construction impacts are unavoidable (refer to measure SE5 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Visual landscape and heritage</p> <p>Changes to the aesthetic value of the area and impact to heritage items of significance adjacent to construction activities, affecting connection to place, shared histories, and the future of their community, including the Commonwealth Heritage Listed Aboriginal Tent Embassy.</p> <p>Further detail on impacts to heritage in this precinct is provided in Section 14.5 and Section 11.4 of Chapter 11 (Project-wide issues).</p>	Both	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

14.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in or visiting the National Triangle precinct is provided in Table 14-31.

Table 14-31 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 14-31. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

During engagement activities (refer to Chapter 4 (Stakeholder and community consultation)), some stakeholders emphasised the benefits of light rail operations within the precinct. Stakeholders suggested that enhanced connectivity and transport options could increase visitor numbers for galleries, museums, and events in the area. Transport-related socioeconomic benefits would apply to people across the light rail corridor and are considered further in Chapter 11 (Project-wide issues).

Table 14-31 Socioeconomic impacts during operation – National Triangle precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Landscape and visual changes</p> <p>Changes to community character due to permanent changes to local visual landscape. While there would be the addition of light rail infrastructure, including a light rail stop, and transient LRVs along King George Terrace, there would be an overall increase in the amount of green space resulting in a beneficial impact.</p> <p>Changes to the landscape and visual environment in this precinct are detailed in Section 14.6.</p>	National Triangle-Barton alignment option	Beneficial (possible/ positive)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users (and ultimately result in a benefit) 	Beneficial (likely/ positive)
<p>Heritage and culture</p> <p>The Project is expected to enhance access to significant heritage sites, including the National Heritage Listed Aboriginal Tent Embassy. This improved accessibility could strengthen the connection to place and support the preservation and celebration of shared histories.</p> <p>Further detail on impacts to heritage in this precinct is provided in Section 14.5.</p>	National Triangle-Barton alignment option	Beneficial (possible/ positive)	<ul style="list-style-type: none"> Implementation of heritage mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users (and ultimately result in a benefit) 	Beneficial (likely/ positive)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Access and mobility</p> <p>Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. raised intersections).</p> <p>Refer to Section 5.8 of Chapter 5 (Project description) for further detail on active travel arrangements.</p>	National Triangle-Barton alignment option	Beneficial (possible/ positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (likely/ positive)
<p>Disruptions to the road network and parking</p> <p>Some decline in accessibility to businesses and services due to permanent loss of around 30 on-street parking spaces on King George Terrace, Parkes Place West and Parkes Place East, and changes to pedestrian and motorist access.</p> <p>Impacts to road networks and parking are detailed in Section 14.1.4.</p>	National Triangle-Barton alignment option	Low (possible/ minor)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, measures to minimise accessible parking loss and optimise the interface between the Project and other transport modes (refer to measures TT8, TT9, and TT10 in Chapter 21 (Environmental management and mitigation measures)) Continued engagement with local businesses via the Community Engagement and Social Management Plan (refer to Appendix L (Environmental Management Plan outline)) 	Very low (unlikely/ minor)

14.7.4 Precinct-specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to socioeconomic impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for socioeconomic impacts within the National Triangle precinct.

15.0 Barton precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Barton precinct and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 15.1.4)
- Noise and vibration (Section 15.3)
- Biodiversity (Section 15.4)
- Historic heritage (Section 15.5)
- Landscape character and visual amenity (Section 15.6)
- Socioeconomic impacts (Section 15.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

15.1 Overview

The Barton precinct encompasses the area generally between Kings Avenue and Sydney Avenue, extending along Sydney Avenue to its intersection with State Circle. It is characterised by its canopy of streetside trees along Macquarie Street, Bligh Street, and National Circuit. Several key government agencies are located in Barton, adjoining the Barton precinct, including the Department of Foreign Affairs and Trade, Australian Federal Police, Australian National Audit Office, Department of the Prime Minister and Cabinet, and the Attorney-General's Department. A number of hotels, educational institutions, parks and open spaces, and mixed use/commercial buildings are in this area. The heritage-listed Hotel Kurrajong is adjacent to this precinct.

15.1.1 State Circle East alignment option

There would be no operational light rail infrastructure within the Barton precinct for the State Circle East alignment option.

15.1.2 National Triangle-Barton alignment option

Through this precinct, the light rail alignment would have a median running arrangement along Macquarie Street, Bligh Street, National Circuit, and Sydney Avenue before connecting with State Circle. Asymmetric running (offsetting the light rail track from the centre of the existing roadway) has been adopted for small section of Macquarie Street to allow light rail to safely turn onto Bligh Street from Macquarie Street, and to avoid direct property impacts and land acquisition. It would also allow trees on one side of these roads to be retained.

The National Triangle-Barton alignment option would include two stops in this precinct (Bligh Street Stop and Sydney Avenue Stop).

Within the Barton precinct, light rail would be wire-free.

Key Project features within this precinct for the National Triangle-Barton alignment option are shown in Figure 15-1.

Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

15.1.3 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction). There would be no construction compounds within Barton precinct.

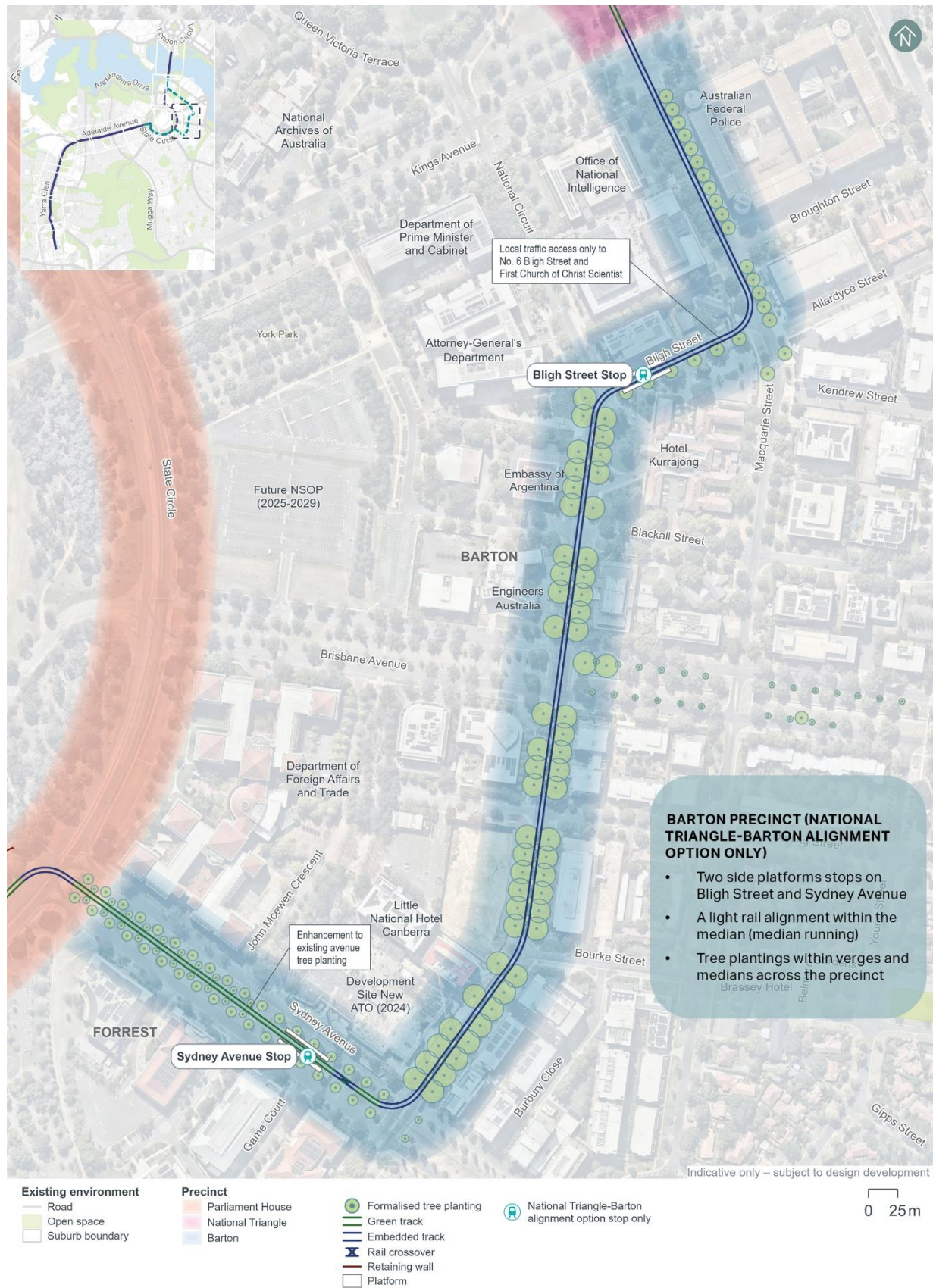


Figure 15-1 Barton precinct overview – National Triangle-Barton alignment option

15.1.4 Environmental impact overview – construction

Key impacts within the Barton precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Two potential alignment options are being considered for the Project – the State Circle East alignment option and the National Triangle-Barton alignment option. The potential impacts of each alignment option have been assessed in this chapter. While some isolated construction activities for the State Circle East alignment option may include works in this precinct, the operational light rail alignment for State Circle East would not extend into this precinct. Through further design development and the selection of a single, final alignment option, environmental impacts are expected to be further minimised.

Traffic and transport

Construction of the Project would be undertaken within and adjacent to the road reserve, and as such would result in localised traffic impacts, including temporary block closures, changes to turning movements, and the introduction of heavy vehicle traffic, which would disrupt the road network and parking availability. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Within this precinct, specific impacts would include block closures at various times in the construction program, at locations such as Macquarie Street, Bligh Street and National Circuit, and changes to property access points, which may result in increased travel times for motorists.

The construction activities would also lead to a temporary, staged loss of up to 291 on-street parking spaces, a small number of off-street parking spaces, seven bus zones and one motorcycle parking area across the precinct as construction works progress.

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction-related traffic and site access, parking availability, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, road works, and the decommissioning of utilities, are expected to generate noise that could moderately to highly affect nearby residential and non-residential buildings during the day and night, particularly during 'peak' construction scenarios, which represent the noisiest works requiring the use of noise-intensive equipment such as concrete saws and rock breakers. There are a number of heritage listed structures within the Barton precinct that may potentially be affected by vibration located within the minimum working distance of 60 m.

Mitigation measures that would be implemented to manage these impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised where possible through construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 1992* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 2.28 hectares of vegetation within the Barton precinct, none of which is characterised as native. Removal of this vegetation would impact suitable habitat for the Golden Sun Moth (*Synemon plana*) (listed as vulnerable under the EPBC Act and NC Act). No hollow-bearing trees or mature native trees have been recorded within the clearance footprint in the Barton precinct.

Opportunities to further avoid or minimise these biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Historic heritage:** Several places listed on Commonwealth and ACT Heritage registers are present in the precinct, including the Edmund Barton Offices, the former Patent Office, Hotel Kurrajong, Barton Housing Precinct, Brassey Hotel, Telopea Park High School, Wesley Uniting Church Complex and Barton Conference Centre. While direct impacts have been avoided to the majority of these sites, these places have the potential to be indirectly affected by the Project during construction through vibration caused by construction activities. However, these impacts would be avoided through appropriate equipment selection, and identification and monitoring of safe vibration levels. Hotel Kurrajong would experience significant impacts, including direct impacts, largely due to the removal of historic mature oak trees along Bligh Street and National Circuit, altering and obscuring the expression of the building's historic landscape setting. Replacement trees of a similar species to the original trees on Bligh Street and National Circuit would help to mitigate the removal of existing historic trees in the longer term. Some additional heritage places in this precinct span across multiple precincts and have therefore been assessed in Chapter 11 (Project-wide issues)
- **Landscape character and visual amenity:** Construction activities, such as the establishment of compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area, particularly from key locations such as Bligh Street, National Circuit and Sydney Avenue. Night-time construction work, where necessary, would also involve lighting that could impact nearby residential, commercial, and heritage properties, notably the Edmund Barton Building, Former Patent Office Building, Hotel Kurrajong and Telopea Park High School. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill, and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Socioeconomic:** Potential impacts would include disruptions to the local road network, changes to the visual landscape and heritage, and health and wellbeing impacts due to noise, vibration, and visual impacts, which may particularly affect workers, visitors, and accommodation providers in the area. Mitigation measures, such as the implementation of Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, and others would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP(s) and sub plans, and is included as Appendix L (Environmental Management Plan outline).

15.1.5 Environmental impact overview – operation

Key impacts within the Barton precinct during the operational stage of the Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Barton precinct would require several changes to the road network, including road closures, speed limit adjustments, adjustments to existing lanes, and adjustments to intersection and access arrangements to accommodate the light rail infrastructure.

Within the Barton precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections. Additionally, there would be a permanent loss of around 115 on-street parking spaces throughout the precinct, which may affect accessibility for businesses and services in the area.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles, and pedestrians with light rail during operation, and review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed on a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Landscape character and visual amenity

The introduction of light rail infrastructure, including tracks and stops, would result in permanent changes to the landscape character and visual amenity of the area. High adverse visual impacts are predicted for the Barton precinct for the National Triangle-Barton alignment option, due to the scale of change the Project would introduce within this precinct.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project going forward. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to the management and mitigation of landscape and visual impacts of the Project during operation.

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 15.1.4), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops, or potential risk of fauna strike from light rail vehicles (LRVs). Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the precinct, with noise and vibration levels predicted to comply with relevant criteria at most receivers. Some minor exceedances of criteria for airborne noise are predicted at buildings associated with the First Church of Christ, Scientist, where no mitigation measures are in place, due to the tight radius curvature of the track alignment onto Bligh Street. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures, flange lubrication and operational maintenance planning. These measures would enable residual impacts to be limited
- **Historic heritage:** No direct impacts are predicted to the majority of heritage places within this precinct during operation of the Project. Hotel Kurrajong (listed on the ACT Heritage Register) has the potential to experience significant impacts due to changes in the kerb alignment, removal and replacement of mature oak trees, and the operation of the Bligh Street Stop, which would be partially within the boundary of the heritage place (given the heritage boundary extends over the existing roads). Mitigations for these impacts include replacement of trees with the same species, and careful consideration of the design form of the Bligh Street Stop to allow for further landscaping. Replacement trees would eventually mitigate the removal of existing historic trees as

the replacement trees grow to maturity. Other heritage places that are partially located within this precinct have been assessed in Chapter 11 (Project-wide issues) as they span across multiple precincts

- **Socioeconomic:** Benefits of the Project within the Barton precinct include provision of an alternative to private vehicle use, which would enhance accessibility and, over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, such as changes to the local visual landscape and community character due to the introduction of light rail infrastructure, which could potentially affect the experience and connection people have with the area. Disruptions to the road network and parking arrangements could also arise, which may impact the local community and businesses. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support the design of a high quality public realm and manage these potential impacts

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

15.2 Traffic and transport

This section provides a summary of the potential multimodal traffic and transport impacts associated with the construction and operation phases of the Project within the Barton precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

15.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Barton precinct and the respective study area is indicatively shown in Figure 15-2.

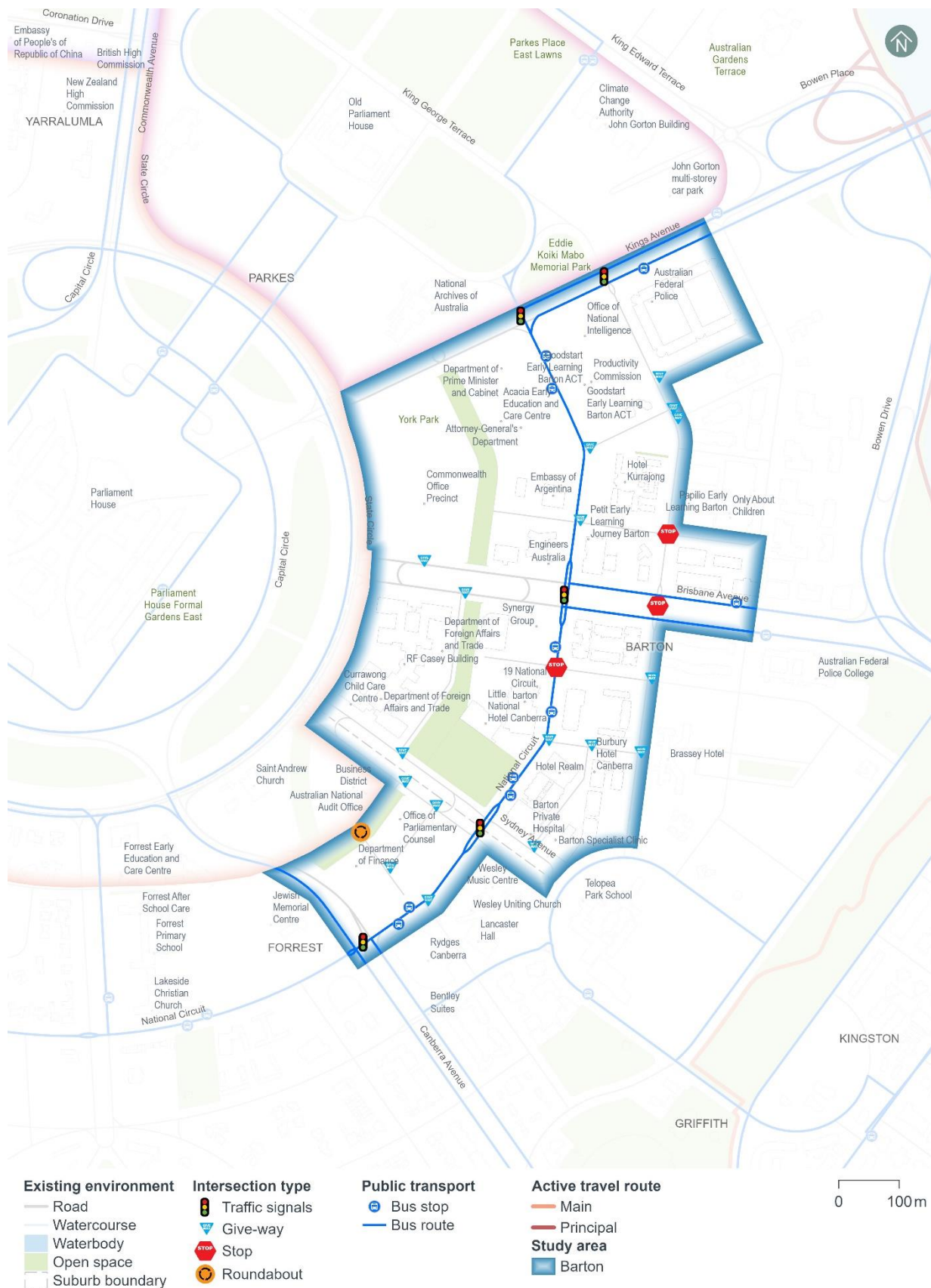


Figure 15-2 Overview of the existing transport network for the Barton precinct study area

Road network

The characteristics and features of key roads within the Barton precinct are summarised in Table 15-1.

Table 15-1 Overview of key roads within the Barton precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Kings Avenue	Arterial	Two-way	Two lanes in each direction, separated by 12 m wide median	60 km/h
Brisbane Avenue			Two lanes in each direction, separated by 30 m wide median	60 km/h
Macquarie Street	Major collector	Two-way	One lane in each direction	50 km/h
National Circuit			One lane in each direction	60 km/h
Blackall Street	Local access	Two-way	One lane in each direction	50 km/h
Broughton Street			One lane in each direction	50 km/h
Bligh Street			One lane in each direction	50 km/h
Darling Street			One lane in each direction	50 km/h
Bourke Street			One lane in each direction	50 km/h
Game Court			One lane in each direction	50 km/h
Burbury Close			One lane in each direction	50 km/h
Sydney Avenue	Minor collector	Two-way	Two lanes in each direction, separated by 30 m wide median	40 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00 am to 9:00 am) and PM (5:00 pm to 6:00 pm) peak hour traffic counts for various mid-block locations within the Barton precinct have been analysed and are summarised in Figure 15-3. The 2024 data indicates a slight increase in traffic during the AM and PM peak hours throughout the precinct since 2017. The exception is along Kings Avenue and Canberra Avenue, where there was a reduction in traffic in at least one direction during the peak hours.



Figure 15-3 2017 and 2024 peak hourly traffic volumes within the Barton precinct study area

Historical average weekday traffic volume, heavy vehicle composition and 85th percentile speed data have also been analysed for key roads within Barton precinct, with a summary provided in Table 15-2. The data indicates that heavy vehicles account for around 4% to 12% of the total daily traffic volumes on the key roads through the precinct. The 85th percentile vehicle speed on Blackall Street and Sydney Avenue is higher than the posted speed limit for these roads.

Table 15-2 Average weekday traffic volume characteristics on key roads within the Barton precinct

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
Blackall Street	Between Allardyce Street and Macquarie Street	2023	2,040	5%	51 km/h
Sydney Avenue	Between State Circle and John McEwan Crescent	2022	5,400	4%	51 km/h
Brisbane Avenue	Between John McEwan Crescent and State Circle	2022	7,120	5%	53 km/h
National Circuit	Between Kings Avenue and Bligh Street	2021	5,820	9%	44 km/h

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
National Circuit	Between Brisbane Avenue and Blackall Street	2021	5,370	12%	47 km/h
National Circuit	Between Bourke Street and Sydney Avenue	2021	5,430	5%	48 km/h
National Circuit	Between Fitzroy Street and Canberra Avenue	2021	5,490	7%	44 km/h

Intersection performance

The operation of the key intersections within the Barton precinct has been assessed using the microsimulation model which was calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct is shown in Figure 15-4.

All the assessed intersections within the Barton precinct operated satisfactorily in 2017 at a level of service D or better. Level of service represents the extent of delays experienced by drivers at an intersection. The exception was the National Circuit/Brisbane Avenue intersection, which operated at a level of service E during the AM peak hour. The high vehicle delay at this intersection was associated with the right turn movements from Brisbane Avenue to National Circuit.

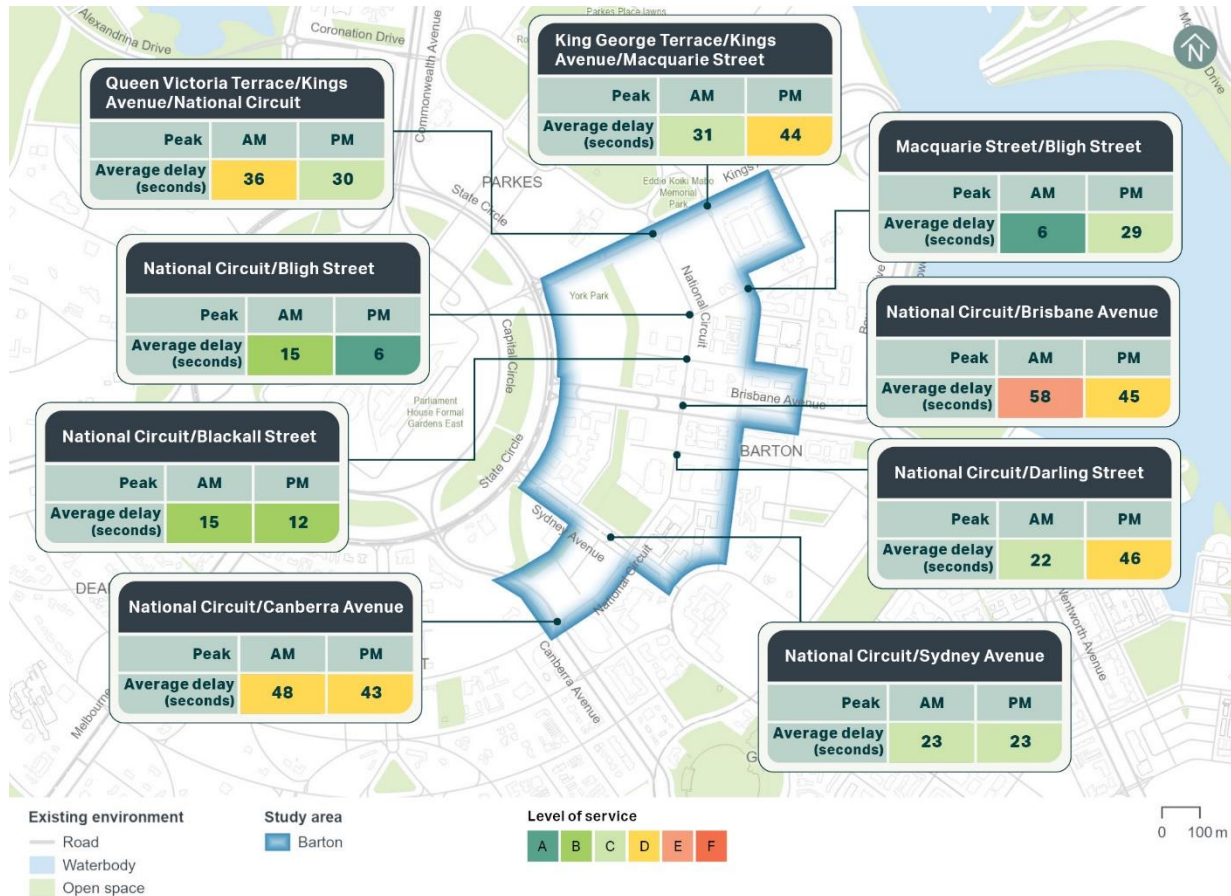


Figure 15-4 2017 AM and PM peak hour intersection performance within the Barton precinct study area

Public transport

Bus stops are located on Kings Avenue, National Circuit, Brisbane Avenue, and Sydney Avenue within the Barton precinct. Transport Canberra operates bus routes that service these bus stops and generally provide connections to Barton, Woden, Queanbeyan, and Civic. The bus routes that service stops within the Barton precinct include 56, 59, 182, 830, 840x, 842, 844x, R2, and R6.

Active travel

Footpaths are on both sides of most roads within the Barton precinct. Signalised pedestrian crossings are on all approaches at the following intersections:

- Kings Avenue/Macquarie Street
- National Circuit/Kings Avenue
- National Circuit/Brisbane Avenue
- National Circuit/Sydney Avenue.

In addition, zebra crossings are at various locations along Macquarie Street and National Circuit and on the slip lanes at the National Circuit/Kings Avenue signalised intersection. Cycling infrastructure within the Barton precinct is limited to the on-road cycling lanes along National Circuit.

Pedestrian and cyclist count data from 2024 was used to understand current active travel demand within the Barton precinct. The AM and PM peak hour counts at key locations within the precinct are summarised in Figure 15-5. Pedestrian volumes during the weekday peak hours are higher along National Circuit between Brisbane Avenue and Canberra Avenue than the other surveyed precinct locations. This is due to the land uses along this section of National Circuit. Cyclist volumes during the peak hours are consistent throughout the precinct, with up to 60 cyclists recorded at any single intersection.

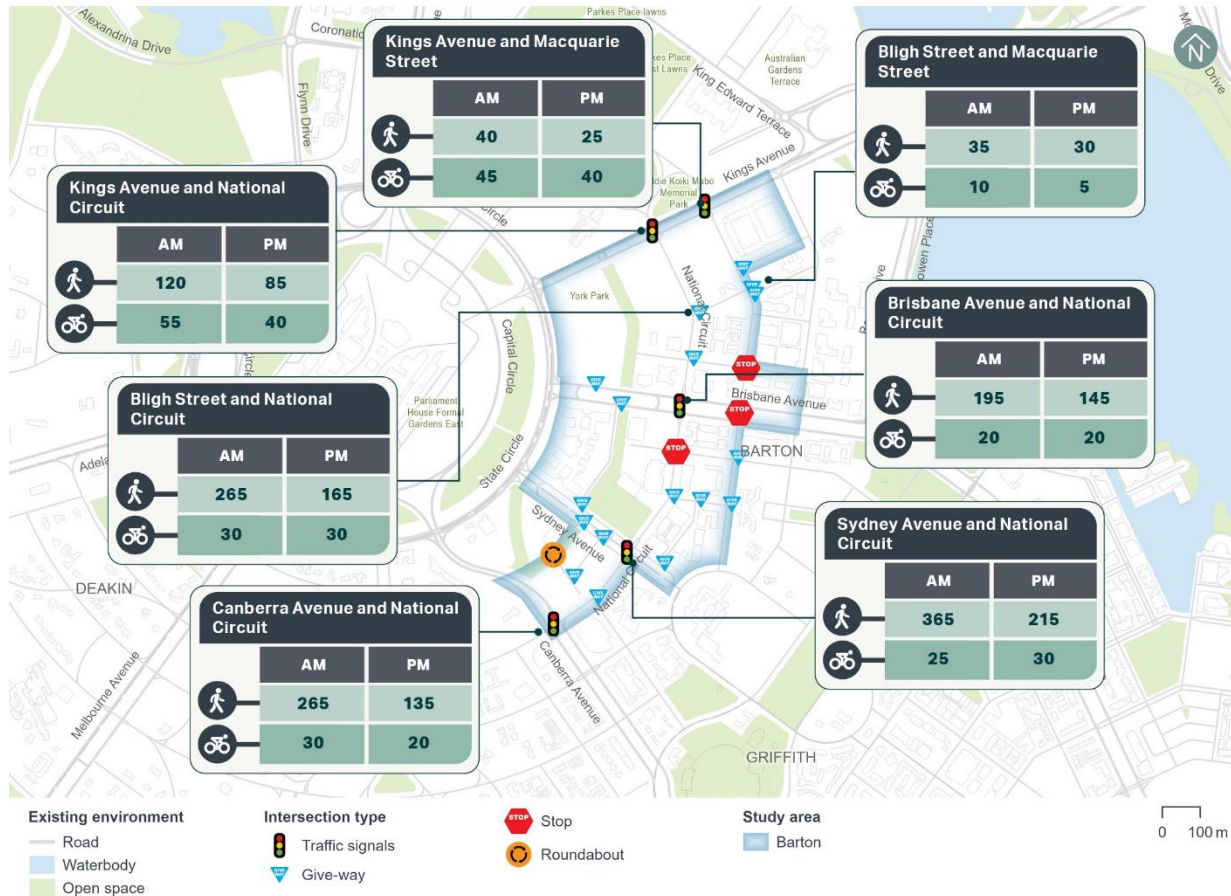


Figure 15-5 2024 peak hour active travel volumes within the Barton precinct study area

Car parking, kerbside uses and access

Kerbside uses

The existing kerbside uses including on-street parking within the Barton precinct are summarised in Table 15-3.

Table 15-3 Barton precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
On alignment	Macquarie Street	Kings Avenue and Bligh Street	East	Emergency vehicles only	2
				30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	3
				Government vehicles only (8:30 am - 5:30 pm Monday to Friday)	2
				Pick up and set down only	2

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
On-alignment			West	2P (7:30 am - 6:00 pm Monday to Friday)	6
				1/4P (7:30 am - 6:00 pm Monday to Friday)	5
				P5min (7:30 am - 6:00 pm Monday to Friday)	4
	Bligh Street	Macquarie Street and National Circuit	North	1/4P (7:30 am - 6:00 pm Monday to Friday)	3
			South	2P	13
	National Circuit	Bligh Street and Sydney Avenue	East	Bus zone (public)	N/A
				30 min loading zone	2
			West	Bus zone (public)	N/A
	Sydney Avenue	State Circle and National Circuit	North	1/4P (7:30 am - 6:00 pm Monday to Friday)	5
				Bus zone (public)	N/A
				1/2P (8:30 am - 5:30 pm Monday to Friday)	6
				2P (8:30 am - 5:30 pm Monday to Friday)	7
				Taxi zone	2
			South	Bus zone (public)	N/A
				1/4P (7:30 am - 6:00 pm Monday to Friday)	1
				30 min loading zone (7:30 am - 5:30 pm Monday to Friday)	3
				Taxi zone	1
				30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	2
				1/2P	2
				2P	4

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
Off alignment	Macquarie Street	Bligh Street and New South Wales Crescent	East	30 min loading zone	3
				2P	3
				1/2P	2
				1P	2
			West	2P (7:30 am - 6:00 pm Monday to Friday)	20
				30 min loading zone	2
				2P	10
	National Circuit	Kings Avenue and Bligh Street	East	Bus zone (public)	N/A
			West	Bus zone (public)	N/A
		Sydney Avenue and Canberra Avenue	East	Bus zone (public)	N/A
			West	Bus zone (public)	N/A
	Broughton Street	Macquarie Street and Blackall Street	South	2P (7:30 am - 6:00 pm Monday to Friday)	16
				Motorcycle parking zone	N/A
	Blackall Street	4 Blackall Street and 51 Blackall Street	North	1/2P (7:30 am - 6:00 pm Monday to Friday)	6
				1P (7:30 am - 6:00 pm Monday to Friday)	27
			South	2P	4
				30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	4
				P5min (7:30 am - 6:00 pm Monday to Friday)	7
				1P (7:30 am - 6:00 pm Monday to Friday)	10
	Brisbane Avenue	State Circle and National Circuit	North	2P (7:30 am - 6:00 pm Monday to Friday)	20
				30 min loading zone	2
				Bus zone	N/A

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
			South	2P (7:30 am - 6:00 pm Monday to Friday)	5
				3P (7:30 am - 6:00 pm Monday to Friday)	4
				1/4P (7:30 am - 6:00 pm Monday to Friday)	1
				1P (7:30 am - 6:00 pm Monday to Friday)	5
				Bus zone	N/A
		National Circuit and Macquarie Street	North	2P (7:30 am - 6:00 pm Monday to Friday)	5
				1P (7:30 am - 6:00 pm Monday to Friday)	4
			South	1/4P	1
				1/2P	5
				1P (7:30 am - 6:00 pm Monday to Friday)	7
		Macquarie Street and Young Street	North	30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	2
				2P (7:30 am - 6:00 pm Monday to Friday)	7
				Bus zone (public)	N/A
			South	2P (7:30 am - 6:00 pm Monday to Friday)	17
	Darling Street	John McEwan Crescent and Macquarie Street	North	2P	12
				1P	8
				Two hour loading zone (7:30 am - 6:00 pm Monday to Friday, 7:30 am - 12:00 pm Saturday)	2
			South	2P	15
				Accessible parking	2
	Bourke Street		North	2P (7:30 am - 6:00 pm Monday to Friday)	12

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
		National Circuit and Macquarie Street	South	2P (8:30 am - 5:30 pm Monday to Friday)	13
		Burbury Close	East	P5min	4
			West	Car share	1
				2P (8:30 am - 5:30 pm Monday to Friday)	15
				Accessible parking	2
	Sydney Avenue	East of National Circuit	North	2P	4
				30 min loading zone	2
				Emergency vehicles only	4
				Pick up and set down only	1
				1P (7:30 am - 6:00 pm Monday to Friday)	4
			South	Bus zone	N/A
				Motorcycle parking zone	N/A
				1P (7:30 am - 3:30 pm Monday to Friday)	9
	Game Court (west)	South of Sydney Avenue	East	Accessible parking	1
				2P (9:00 am - 3:00 pm Monday to Friday), 1/4P (7:00 am - 9:00 am and 3:00 pm - 6:00 pm Monday to Friday)	13
			West	30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	2
				Motorcycle parking zone	N/A
				Accessible parking	2
	Game Court (east)	Sydney Avenue and Game Court (south)	East	2P	5
			West	2P	6

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
	Game Court (south)	Game Court (west) and Game Court (east)	North	2P	4
			South	2P	3
				Pick up and set down only	2
				30 min loading zone	2
				Permit zone (8:30 am - 5:00 pm Monday to Friday)	2
Total					430 (including 7 accessible spaces)

Off-street parking

Most buildings within the Barton precinct have dedicated on-site car parks accessed via local roads. Key off-street car parks located within the Barton precinct include:

- Windsor Walk car park: at-grade car park with 132 spaces
- York Park at-grade car park: at-grade car park with 276 spaces
- Brisbane Avenue car park: at-grade car park with 440 spaces
- Little National car parks: at-grade and multi-storey car parks with around 580 spaces
- Realm Quarters car park: covered car park with unknown parking supply
- Hotel Realm car park: covered car park with unknown parking supply
- One Sydney Avenue: covered car park with unknown parking supply.

The Windsor Walk, York Park, Brisbane Avenue and Little National car parks accommodate around 1,430 public car parking spaces. It is noted that the Brisbane Avenue car park is planned to be redeveloped as part of the National Security Office Precinct development.

In addition, Hotel Kurrajong has a private 53 space car park located along the Project's alignment on Bligh Street for the National Triangle-Barton alignment option.

Aerial imagery indicates there is typically some spare capacity in the public car parks on weekdays. These public and private car parks are shown in Figure 15-6.



Figure 15-6 Off-street car parking within the Barton precinct study area

Property access

There are several property accesses located along the Project's alignment within the Barton precinct, as described in Table 15-4.

Table 15-4 Existing property access arrangements within the Barton precinct

Road	Site address	Site access arrangement
Macquarie Street	Edmund Barton Building – Australian Federal Police	Two separate entry and exit driveways on Macquarie Street
	Robert Garran Building – Office of National Intelligence	One two-way driveway on Macquarie Street
	54 Macquarie Street – Fujitsu	One two-way driveway on Macquarie Street
Bligh Street	4 Bligh Street	Two two-way driveways on Bligh Street
	6 National Circuit	One consolidated driveway on Bligh Street providing access to a garage and separate circulation aisle along the eastern side of the building
	Hotel Kurrajong	A two-way access road connecting Bligh Street with the Hotel Kurrajong car park

Road	Site address	Site access arrangement
National Circuit	Robert Garran Offices – 3-5 National Circuit	One two-way driveway on National Circuit
	John McEwan House – 7 National Circuit	Two separate entry and exit driveways on National Circuit
	Hotel Kurrajong – 8 National Circuit	Two separate entry and exit access roads on National Circuit
	Engineering House – 11 National Circuit	Two separate entry and exit driveways on National Circuit
	Pharmacy Guild House - 15 National Circuit	Single entry driveway on National Circuit
	National Press Club – 16 National Circuit	Two separate entry and exit driveways on National Circuit
	Hotel Realm – 18 National Circuit	Two separate entry and exit driveways on National Circuit
	19 National Circuit	Site is currently vacant, with proposed development involving two separate entry and exit driveways on National Circuit
	Little National Hotel – 21 National Circuit	One two-way driveway on National Circuit
Sydney Avenue	15 Sydney Avenue	Site is currently under construction, with new development to have one two-way driveway on National Circuit
	41 Sydney Avenue	Two separate entry and exit driveways on Sydney Avenue

Crash history

Figure 15-7 shows the five year crash history (1 January 2018 to 31 December 2022) within the Barton precinct.

A total of 173 crashes have been recorded in the Barton precinct during the five year period, including:

- 18 crashes that resulted in a minor injury (around 10%)
- Three crashes that resulted in a serious injury (around 2%)
- 152 crashes that resulted in property damage only (around 88%).

The following common crash types occurred:

- Around 21% of crashes involved a right angle collision
- Around 21% of crashes involved a rear end collision.

Seven of the crashes involved pedestrians.



Figure 15-7 Crash data between 2018 and 2022 within the Barton precinct study area

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

15.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside uses

It is estimated that up to 291 on-street kerbside spaces, seven bus zones, and one motorcycle parking area would be temporarily lost within the National Triangle-Barton alignment option Project area in the Barton precinct, including:

- 24 spaces on Macquarie Street (on-alignment)
- 16 spaces on Bligh Street (on-alignment)
- Two spaces and four bus zones on National Circuit (on-alignment)
- 33 spaces on Sydney Avenue (on-alignment)
- 17 spaces on Macquarie Street (off-alignment)
- 12 spaces on Broughton Street (off-alignment)
- 33 spaces on Blackall Street (off-alignment)
- 72 spaces and two bus zones on Brisbane Avenue (off-alignment)
- 39 spaces on Darling Street (off-alignment)
- 12 spaces on Bourke Street (off-alignment)
- 24 spaces, one bus zone and one motorcycle parking zone on Sydney Avenue (off-alignment)
- Seven spaces on Game Court (off-alignment).

This represents around 68% of the total 430 on-street kerbside spaces identified within the precinct. Of these kerbside uses, 115 on-street kerbside spaces would be lost permanently as part of the Project's permanent works for the National Triangle-Barton alignment option as discussed in Section 15.2.3. The remaining spaces would only be temporarily lost during construction. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

There are several off-street public car parks located throughout the Barton precinct which may be able to cater for some of the parking demand associated with the displaced kerbside uses. Any accessible spaces impacted by the works would be relocated temporarily as close as possible to their existing location.

Off-street parking

The National Triangle-Barton alignment option would require the relocation of the Hotel Kurrajong car park access from Bligh Street to Macquarie Street. Consequently, a small number of spaces within the car park would be temporarily unavailable while civil works are undertaken to relocate the access.

Local area access

Construction of the National Triangle-Barton alignment option would require block closures along the following sections of road at varying times throughout the construction program:

- Macquarie Street between Kings Avenue and Bligh Street
- Bligh Street between Macquarie Street and National Circuit
- National Circuit between Bligh Street and Sydney Avenue.

During the block closures, vehicles passing through the area would need to use alternative routes such as State Circle, Blackall Street and/or the unaffected section of Macquarie Street.

The following intersections would generally remain open during the block closures, except during the construction of the trackform at intersections, which would be subject to 56 hour long weekend closures:

- King George Terrace/Kings Avenue/Macquarie Street
- Macquarie Street/Bligh Street

- National Circuit/Bligh Street
- National Circuit/Blackall Street
- National Circuit/Brisbane Avenue
- National Circuit/Darling Street
- National Circuit/Bourke Street
- National Circuit/Sydney Avenue.

In addition, the existing U-turn movements within the central median on Sydney Avenue would be restricted during construction of the National Triangle-Barton alignment option. These U-turns would be removed as part of the Project's permanent works for the National Triangle-Barton alignment option, resulting in a permanent change to local area access arrangements within the National Triangle precinct. Eastbound traffic seeking to perform a U-turn would be able to turn around at the eastern end of Sydney Avenue. Westbound traffic seeking to perform a U-turn would be required to turn onto State Circle and use connecting roads to turn around, or alternatively alter their trip further afield.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

Property access

Property access would generally be maintained throughout the Barton precinct during the construction of the National Triangle-Barton alignment option, including along the block closures. The Project contractor would use vehicle escorts to maintain property access during these closures.

Although property access would generally be maintained during construction, some turning movements may be impacted at times particularly to properties along the Project alignment whereby vehicles may be restricted to left in and left out movements only for example. Vehicles accessing these properties would generally be able to use the immediate surroundings roads to travel around the block when approaching or departing the property. This may result in a slight increase in travel time depending on where drivers are travelling to/from.

Management measures would be investigated to minimise disruption to the Hotel Kurrajong car park while relocating the vehicle access from Bligh Street to Macquarie Street. This may include constructing the new access on Macquarie Street before decommissioning the existing access on Bligh Street. Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures).

15.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Barton precinct would include road closures, speed limit adjustments, adjustments to existing lanes, adjustments to intersections, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Barton precinct, particularly on Kings Avenue, Brisbane Avenue, and Sydney Avenue.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

Traffic volume changes associated with the National Triangle-Barton alignment option are summarised in Table 15-5 and Table 15-6. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance
- Changes in mode choice due to the introduction of light rail.

Adjacent to the Barton precinct, traffic volumes along Bowen Drive, Canberra Avenue, and Blackall Street would also increase during the AM and PM peak hours due to the Project's road network changes and resulting traffic reassignment.

Table 15-5 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Barton precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Kings Avenue	West of National Circuit	Eastbound	1,700	1,830	130	8%	1,520	1,560	40	3%
		Westbound	530	640	110	21%	540	600	60	11%
Macquarie Street	Between Kings Avenue and Broughton Street	Northbound	370	220	-150	-41%	370	190	-180	-49%
		Southbound	350	630	280	80%	390	540	150	38%
National Circuit	Between Kings Avenue and Bligh Street	Northbound	370	310	-60	-16%	390	230	-160	-41%
		Southbound	1,000	640	-360	-36%	860	490	-370	-43%
	Between Bourke Street and Sydney Avenue	Northbound	700	490	-210	-30%	630	420	-210	-33%
		Southbound	640	690	50	8%	510	780	270	53%
Brisbane Avenue	West of National Circuit	Eastbound	1,140	1,090	-50	-4%	1,060	1,400	340	32%
		Westbound	730	830	100	14%	880	980	100	11%
Sydney Avenue	West of National Circuit	Eastbound	480	630	150	31%	500	590	90	18%
		Westbound	850	1,010	160	19%	840	970	130	15%

Table 15-6 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Barton precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Kings Avenue	West of National Circuit	Eastbound	850	900	50	6%	830	980	150	18%
		Westbound	1,300	1,330	30	2%	1,150	1,240	90	8%
Macquarie Street	Between Kings Avenue and Broughton Street	Northbound	550	330	-220	-40%	450	330	-120	-27%
		Southbound	560	540	-20	-4%	380	460	80	21%
National Circuit	Between Kings Avenue and Bligh Street	Northbound	710	500	-210	-30%	770	470	-300	-39%
		Southbound	480	260	-220	-46%	500	300	-200	-40%
	Between Sydney Avenue and Bourke Street	Northbound	750	620	-130	-17%	710	590	-120	-17%
		Southbound	550	630	80	15%	490	680	190	39%
Brisbane Avenue	West of National Circuit	Eastbound	900	820	-80	-9%	890	880	-10	-1%
		Westbound	910	820	-90	-10%	850	930	80	9%
Sydney Avenue	West of National Circuit	Eastbound	560	610	50	9%	510	630	120	24%
		Westbound	380	500	120	32%	460	560	100	22%

Road network performance

Within the Barton precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM peak hour in both 2031 and 2041, such as on the approaches to intersections. Higher congestion levels would occur in the PM peak hour without the Project, with some slight improvements expected with the Project.

The Project's changes to the road network and associated traffic reassignment and signal operation would cause the following changes to congestion and vehicle delay within the Barton precinct when compared to the without Project scenario in 2031:

- Increased congestion and delay on Kings Avenue on approach to National Circuit during the AM peak hour
- Increased congestion and delay on Brisbane Avenue on both approaches to Macquarie Street and reduced congestion and delay on Brisbane Avenue on approach to National Circuit during the AM and PM peak hours
- Increased congestion and delay on Sydney Avenue on both approaches to National Circuit during the AM and PM peak hours
- Increased congestion and delay on National Circuit on approach to Sydney Avenue and Canberra Avenue, particularly in the northbound direction during the AM and PM peak hours and reduced congestion and delay on National Circuit on approach to Kings Avenue during the AM peak hour
- Increased congestion and delay on most local access streets that intersect with National Circuit, including Blackall Street, Darling Street, Bourke Street, and Fitzroy Street, particularly during the AM peak hour.

The local and regional traffic reassignment caused by the Project's road network changes and associated signal operation changes would also increase the congestion and delays along the following corridors located adjacent to the Barton precinct when compared to the without Project scenario:

- Bowen Drive on the southbound approach to Brisbane Avenue during the AM peak hour and on the northbound approach to the Kings Avenue underpass and downstream on-ramp during the PM peak hour
- Canberra Avenue on its southbound approach to National Circuit in the AM peak hour
- Blackall Street on its northbound approach to Kings Avenue during the PM peak hour.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041.

Intersection performance

The performance of the key intersections within the Barton precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 15-7 and Table 15-8. Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. Key findings relating to intersection performance are as follows:

AM peak hour:

- The following intersections would operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - Queen Victoria Terrace/Kings Avenue/National Circuit
 - King George Terrace/Kings Avenue/Macquarie Street
 - Macquarie Street/Bligh Street
 - National Circuit/Bligh Street
 - National Circuit/Blackall Street

- National Circuit/Darling Street.

Most of these intersections would operate better with the Project compared to without. This is primarily due to certain movements being restricted at the intersection or adjacent intersections, or certain intersections being upgraded from priority-controlled intersections to signalised intersections.

- The following intersections would operate at a level of service E or F with the Project in 2031 and 2041 scenarios:
 - National Circuit/Brisbane Avenue
 - National Circuit/Sydney Avenue
 - National Circuit/Canberra Avenue.

It is noted that the National Circuit/Brisbane Avenue and National Circuit/Canberra Avenue intersections would be operating at a level of service E or F in 2031 and 2041 scenarios without the Project.

The reduction in level of service at the National Circuit/Sydney Avenue with the Project in 2031 and 2041 scenarios is due to the introduction of the Project alignment and associated signal phasing changes. This would have flow-on impact on the operation of the National Circuit/Canberra Avenue intersection, particularly in 2031.

PM peak hour:

- The following intersections would operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - Queen Victoria Terrace/Kings Avenue/National Circuit
 - Macquarie Street/Bligh Street
 - National Circuit/Bligh Street
 - National Circuit/Darling Street.

Most of these intersections would operate better with the Project compared to without. This is primarily due to certain movements being restricted at the intersection, or adjacent intersections or certain intersections being upgraded from priority-controlled intersections to signalised intersections.

- The National Circuit/Blackall Street and National Circuit/Brisbane Avenue intersections would operate satisfactorily at a level of service D with the Project in 2031. However, these intersections would operate at a level of service E with the Project in 2041. This would be an improvement from without the Project scenario where the intersections would experience higher vehicle delays in 2041. The improvement in performance with the Project is primarily due to the National Circuit/Blackall Street intersection being upgraded to traffic signals and right turns being restricted from National Circuit onto Brisbane Avenue
- The following intersections would operate at a level of service E or F with the Project in 2031 and 2041 scenarios:
 - King George Terrace/Kings Avenue/Macquarie Street
 - National Circuit/Sydney Avenue
 - National Circuit/Canberra Avenue.

The King George Terrace/Kings Avenue/Macquarie Street and National Circuit/Canberra Avenue intersections would be operating at a level of service E or F in 2031 and 2041 scenarios without the Project at both AM and PM peak hours.

The reduction in level of service at the National Circuit/Sydney Avenue with the Project in 2031 and 2041 scenarios is due to the introduction of the Project alignment and associated signal phasing changes. This would have flow-on impact on the operation of the National Circuit/Canberra Avenue intersection, particularly in 2041.

Table 15-7 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Barton precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Queen Victoria Terrace/Kings Avenue/National Circuit	46	D	53	D	47	D	44	D
King George Terrace/Kings Avenue/Macquarie Street	56	E	44	D	54	D	38	D
Macquarie Street/Bligh Street	27	C	19	B	20	B	18	B
National Circuit/Bligh Street	23	C	20	B	7	A	16	B
National Circuit/Blackall Street	116	F	36	D	66	E	47	D
National Circuit/Brisbane Avenue	94	F	67	E	88	F	88	F
National Circuit/Darling Street	>150	F	53	D	>150	F	49	D
National Circuit/Sydney Avenue	52	D	108	F	28	C	105	F
National Circuit/Canberra Avenue	72	E	141	F	80	E	72	E

Table 15-8 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Barton precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Queen Victoria Terrace/Kings Avenue/National Circuit	40	D	33	C	45	D	43	D
King George Terrace/Kings Avenue/Macquarie Street	79	E	71	E	66	E	76	E
Macquarie Street/Bligh Street	15	B	14	B	36	D	15	B
National Circuit/Bligh Street	86	F	12	B	80	E	22	C
National Circuit/Blackall Street	78	E	53	D	>150	F	60	E
National Circuit/Brisbane Avenue	79	E	50	D	77	E	66	E
National Circuit/Darling Street	>150	F	47	D	135	F	51	D
National Circuit/Sydney Avenue	29	C	>150	F	21	C	>150	F
National Circuit/Canberra Avenue	76	E	75	E	60	E	79	E

Active travel

For much of the Project, existing active travel arrangements would be retained and complemented by new active travel arrangements or treatments. The key pedestrian and cyclist provisions that would be provided within the Barton precinct as part of the Project for the National Triangle-Barton alignment option and their benefits or impacts are summarised in Table 15-9.

Table 15-9 Active travel provisions within the Barton precinct and associated impacts and benefits (National Triangle-Barton alignment)

Proposed treatment	Impact or benefit
Pedestrian crossings would be formalised and signalised at the following intersections: <ul style="list-style-type: none"> • Macquarie Street and Bligh Street • National Circuit and Bligh Street • National Circuit and Blackall Street • National Circuit and Darling Street. 	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
The existing zebra crossing on Macquarie Street to the north of Bligh Street would be removed and replaced by a signalised raised crossing at Bligh Street.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road. Additionally, the relocated crossing may not align with all pedestrian desire lines and could therefore increase the walking distances for some pedestrians, depending on their origins and destinations.
A shared path would be provided between Kings Avenue and Bligh Street on the eastern verge of Macquarie Street and the existing on-road dedicated cycle lanes on National Circuit would be replaced with a shared path between Bligh Street and Sydney Avenue on the western verge of National Circuit.	The shared path would accommodate pedestrian and cyclist access between Kings Avenue, Sydney Avenue and the Bligh Street Stop.

Kerbside use

The National Triangle-Barton alignment option would remove around 115 on-street kerbside spaces in the Barton precinct, including:

- 31 spaces on Macquarie Street (24 on-alignment and seven off-alignment)
- 16 spaces on Bligh Street (on-alignment)
- 48 spaces on Brisbane Avenue (on-alignment)
- Six spaces on National Circuit (on-alignment)
- Seven spaces on Sydney Avenue around the pedestrian crossings (on-alignment)
- Eight spaces on Blackall Street due to the signalised intersection at National Circuit
- Three spaces on Darling Street due to the signalised intersection at National Circuit.

The permanent loss of around 115 on-street kerbside spaces represents 27% of the total on-street parking supply within the Barton precinct. Historical aerial imagery and site observations from 11 June 2024 indicate that on-street parking demand in the Barton precinct is generally well utilised despite most properties having designated off-street car parks.

Off-street parking

The National Triangle-Barton alignment option would remove one parking space from the Hotel Kurrajong car park due to the relocation of the car park access from Bligh Street to Macquarie Street.

Local area access

The National Triangle-Barton alignment option would change the following local area access arrangements within the Barton precinct:

- Vehicle access to Bligh Street would only be permitted for local vehicles accessing 6 National Circuit and 4 Bligh Street. Access to Bligh Street would only be via a left turn from Macquarie Street northbound
- The following intersections would be restricted to left in, left out:
 - Macquarie Street and Broughton Street
 - Macquarie Street and Bligh Street
 - Macquarie Street and Allardyce Street
 - Bourke Street and National Circuit
- Right turns would not be permitted from National Circuit to Darling Street, and from Brisbane Avenue to National Circuit
- The existing U-turns on Sydney Avenue within the median would be removed, and an alternative U-turn movement would be provided at the intersection with State Circle.

Vehicles currently travelling between National Circuit and Macquarie Street via Bligh Street would need to use Blackall Street or other alternative side roads after Bligh Street is closed to through traffic.

Vehicles that currently turn right in or out of Broughton Street and Allardyce Street at Macquarie Street would likely enter or exit these roads from the eastern end at Blackall Street after the Macquarie Street intersections are restricted to left in, left out. Similarly, vehicles that currently turn right into Bourke Street from National Circuit would likely use Sydney Avenue and Burbury Close, while vehicles that currently turn right out of Bourke Street onto National Circuit would likely travel north via Macquarie Street and other alternative side roads.

With the restriction on right turns from National Circuit to both Darling Street and Brisbane Avenue, vehicles currently performing these turns would likely connect with Darling Street and Brisbane Avenue via Macquarie Street instead.

These changes to local area access would likely result in a slight increase in travel time for impacted motorists depending on where drivers are travelling to/from and how far afield they adjust their travel route.

Property access

The National Triangle-Barton alignment option would change the following property accesses within the Barton precinct:

- Access to 4 Bligh Street and 6 National Circuit would be restricted to right in and left out movements only
- Access to the Hotel Kurrajong car park and rear courtyard would be relocated from Bligh Street to Macquarie Street
- Driveway access would be modified to left in and left out access only to the following locations:
 - 60 Macquarie Street
 - 61 Macquarie Street
 - 54 Macquarie Street
 - 3-5 National Circuit
 - 7 National Circuit
 - 8 National Circuit
 - 10 National Circuit

- 11 National Circuit
- 15 National Circuit
- 16 National Circuit
- 18 National Circuit
- 21 National Circuit
- 15 Sydney Avenue.

Vehicles accessing these properties would generally be able to use the immediate surroundings roads to travel around the block when approaching or departing the property. This may result in a slight increase in travel time depending on where drivers are travelling to/from. As such, the impact of these changes is considered minor.

15.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the Barton precinct.

15.3 Noise and vibration

This section provides an assessment of the potential noise and vibration risks associated with the Project within the Barton precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

15.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas were determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Area 4 was identified for the noise assessment of the Barton precinct. Noise Catchment Area 4 and associated sensitive receivers are shown in Figure 15-8.

Land uses within Noise Catchment Area 4 are predominantly commercial (government offices and hotels) and residential. There are also a number of places of worship and educational buildings, including Telopea Park School, which is heritage-listed on the ACT Heritage Register.

Several other listed and nominated heritage items are located within Noise Catchment Area 4, including:

- Edmund Barton Offices (listed on the Commonwealth Heritage List)
- Patent Office (former) (listed on the Commonwealth Heritage List)
- Hotel Kurrajong (listed on the ACT Heritage Register)
- Barton Conference Centre (nominated on the ACT Heritage Register)
- Brassey Hotel (listed on the ACT Heritage Register)
- Barton Housing Precinct (listed on the ACT Heritage Register)
- Wesley Uniting Church Complex (nominated on the ACT Heritage Register).

Further detail on heritage places in the precinct is included in Section 15.5.

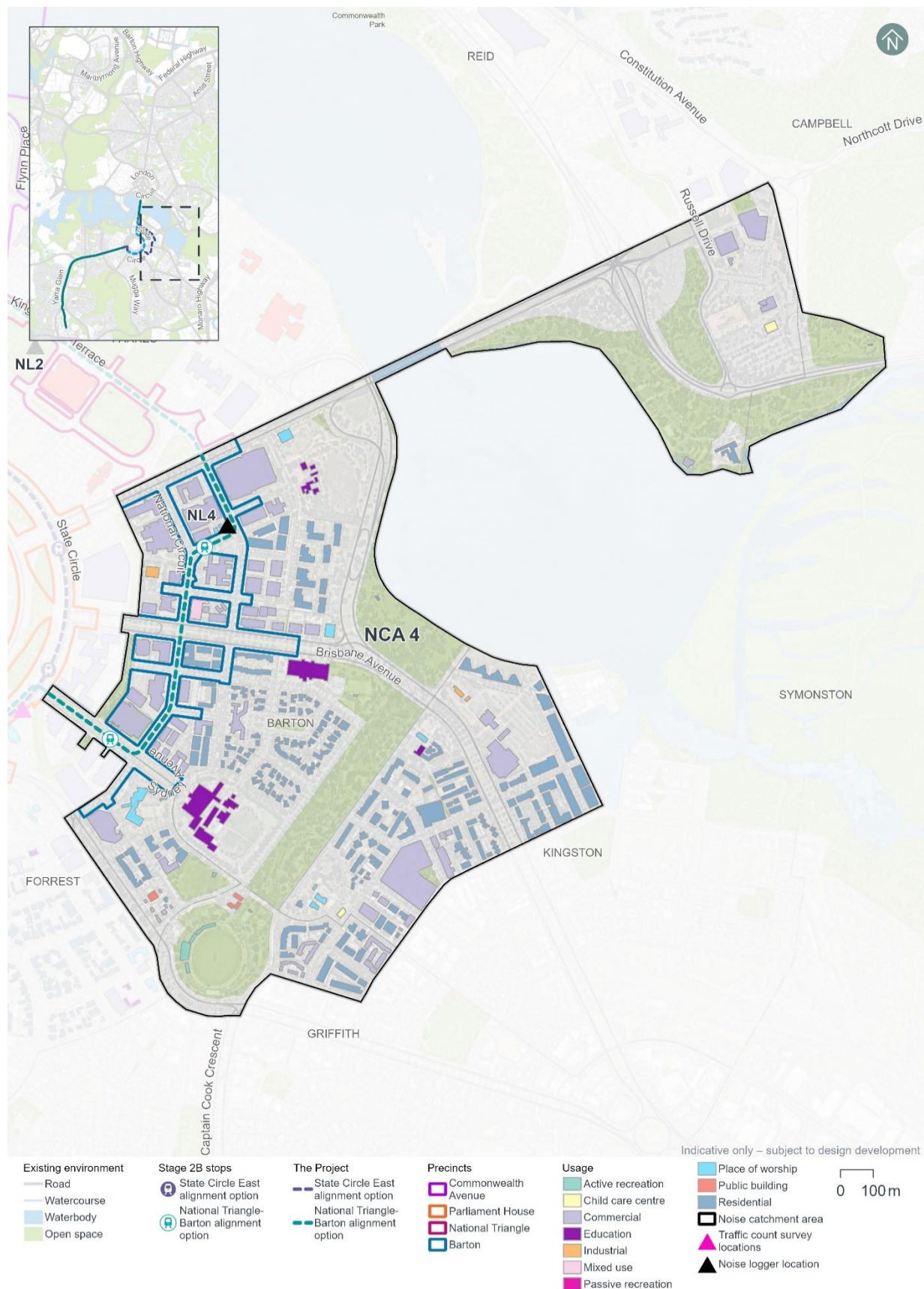


Figure 15-8 Noise catchment area and sensitive receivers – Barton precinct

Existing noise levels

Unattended noise monitoring was carried out at one location in the Barton precinct (at noise logger (NL4)) between 2 and 15 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 15-10.

The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 15-10 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL4	First Church of Christ, Scientist (4 Bligh Street, Barton)	49	37	57	49

Notes:

- $dB(A)$ represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
- In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 15-11.

Table 15-11 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL4	54	49	Local traffic noise on Macquarie Street and Bligh Street and general pedestrian noise were dominant.

15.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level. Receivers in Noise Catchment Area 4 (refer to Figure 15-8) have the potential to experience impacts from the construction of either alignment option, which could be generated from works within multiple precincts. Where relevant, construction scenarios have been assessed separately for each alignment option to reflect the different locations of proposed work.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Barton precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project, therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures). All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 15-12, which assumes no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 15-13. The assessment results are relevant to both alignment options except where otherwise indicated, for example, for the 'earthworks, road works, and construction of light rail infrastructure' and 'construction of stops' scenarios.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Table 15-12 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place) – Barton precinct

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 4				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	19	54	24
	Typical	7	20	14
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	Peak	-	-	-
	Typical	-	-	-
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	Peak	17	38	24
	Typical	12	29	17
Construction of stops (State Circle East alignment option)	Typical/peak	-	-	-
Construction of stops (National Triangle-Barton alignment option)	Typical/peak	-	-	-
Construction of bridges on land	Peak	-	-	-
	Typical	-	-	-

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

Table 15-13 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) – Barton precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 4		
Protection, relocation, treatment and/or decommissioning of utilities - peak	Education	1
	Hotel (commercial)	5
	Place of worship	3
Protection, relocation, treatment and/or decommissioning of utilities - typical	Education	1
	Hotel (commercial)	1
	Place of worship	2
Earthworks, road works, and construction of light rail infrastructure – peak (National Triangle-Barton alignment option)	Education	1
	Hotel (commercial)	2
	Place of worship	3
Earthworks, road works, and construction of light rail infrastructure – typical (National Triangle-Barton alignment option)	Education	1
	Hotel (commercial)	2
	Place of worship	3
Construction of stops – typical (National Triangle-Barton alignment option)	Place of worship	2

Notes:

1. Where a construction scenario did not result in any non-residential buildings being moderately noise affected, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the Barton precinct during the daytime indicate:

- In the majority of scenarios, no residential buildings have been identified as moderately noise affected
- The 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in 19 residential buildings being moderately noise affected
- The 'peak' decommissioning and treatment of utilities scenario for the National Triangle-Barton alignment option is predicted to result in nine non-residential buildings being moderately noise affected, including Rydges Canberra, Hotel Kurrajong Canberra, Little National Hotel Canberra, the First Church of Christ, Scientist, and the Australian Federal Police College.

The findings of the unmitigated peak and typical construction noise impact assessments for the Barton precinct during the night-time period indicate:

- During out of hours 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in the highest number of residential buildings being moderate noise affected. 54 residential buildings are expected to be moderately noise affected, and a total of 24 receivers are predicted to be highly noise affected

- During out of hours, 'typical' earthworks, road works and construction of light rail infrastructure is predicted to result in the highest number of receivers being moderately or highly noise affected. For the National Triangle-Barton alignment option, 29 receivers are predicted to be moderately noise affected, and a total of 17 receivers are predicted to be highly noise affected. For the State Circle East alignment option, no receivers are predicted to be highly noise affected
- Hotel buildings have been assessed both during the daytime (Table 15-13) and during the night-time. During the night-time, the 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario and the 'peak' Earthworks, road works, and construction of light rail infrastructure scenario (National Triangle-Barton alignment option) are predicted to result in two hotel buildings being moderately noise affected, and the 'typical' protection, relocation, treatment and/or decommissioning of utilities scenario is predicted to result one hotel building being moderately noise affected. These hotel buildings include Hotel Kurrajong Canberra and Rydges Canberra.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the typical works case for each scenario, except for the mobilisation and establishment of construction compound sites which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 15-14 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Area 4, in the absence of any mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently, and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 15-14 Number of residential buildings where noise levels may exceed sleep awakening reaction levels for night work (assuming no mitigation measures are in place)

Construction scenario (typical works)	Number of residential buildings where unmitigated noise levels may exceed the sleep awakening reaction level
Protection, relocation, treatment and/or decommissioning of utilities	51
Earthworks, road works, and construction of light rail infrastructure (State Circle East alignment option)	3
Earthworks, road works, and construction of light rail infrastructure (National Triangle-Barton alignment option)	79
Construction of stops (State Circle East alignment option)	-
Construction of stops (National Triangle-Barton alignment option)	3
Construction of bridges on land	-

Noting the awakening reaction level is exceeded with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure (for both alignment options).
- Construction of stops (National Triangle-Barton alignment option only).

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. Some residential buildings are located within the human response minimum working distance for a large hydraulic hammer (73 m from the Project area boundary). There is potential for exceedances of the human comfort criteria to occur depending on the duration, nature and location of the construction activity within the construction footprint. Any exceedances would be expected to be relatively short in duration due to the intermittent nature of vibration emissions.

Cosmetic damage

A number of light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures), and heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage and other sensitive structures).

Heritage structures that may potentially be affected by vibration from large hydraulic hammers and other proposed vibratory plant and equipment are listed in Table 15-15. Potential impacts to heritage are further discussed in Section 15.5.

Table 15-15 Heritage items within 60 m (minimum working distance for a large hydraulic hammer) of the Project area

Heritage place name	Distance between Project area and heritage structures (m)
Edmund Barton Offices (listed on the Commonwealth Heritage List)	4
Patent Office (former) (listed on the Commonwealth Heritage List)	12
Hotel Kurrajong (registered on the ACT Heritage Register)	3
Barton Conference Centre (nominated for the ACT Heritage Register)	4
Brassey Hotel (registered on the ACT Heritage Register)	58
Barton Housing Precinct (registered on the ACT Heritage Register)	8

Heritage place name	Distance between Project area and heritage structures (m)
Telopea Park School (registered on the ACT Heritage Register)	46
Wesley Uniting Church Complex (nominated for the ACT Heritage Register)	10

This presents a worst-case unmitigated assessment which has assumed that vibration-intensive equipment could be used at the boundary of the Project area. In reality, vibration intensive equipment is not likely to be used throughout the entire Project area. Instead, this equipment would typically be limited to areas of the footprint away from the boundary of the Project area, where it could be used to construct the light rail alignment, for example, in road medians and verges.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further detail on the approach to managing potential vibration impacts is included in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network, with Kings Avenue, National Circuit, Brisbane Avenue, and Bowen Drive being construction traffic routes within this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (8am to 9am) and night-time (10pm to 7am) are presented in Table 15-16.

The year 2031 was selected as representative of the peak year of construction.

No increases in road traffic noise greater than 2 dB(A) have been identified along the proposed haulage routes within the Barton precinct. Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener.

Table 15-16 Construction road traffic noise assessment

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Kings Avenue between National Circuit and Bowen Drive	Westbound	702	53	2	1	0.0
	Eastbound	444	33	2	1	0.1
National Circuit between Kings Avenue and Brisbane Avenue	Southbound	196	15	2	1	0.2
Brisbane Avenue between National Circuit and Bowen Drive	Eastbound	453	34	2	1	0.1
Canberra Avenue between National Circuit and Manuka Circle	Northbound	567	43	2	1	0.1
	Southbound	861	65	2	1	0.0

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Night-time assessment						
Kings Avenue between National Circuit and Bowen Drive	Westbound	85	6	8	1	0.4
	Eastbound	60	4	8	1	0.5
National Circuit between Kings Avenue and Brisbane Avenue	Southbound	31	2	8	1	0.9
Brisbane Avenue between National Circuit and Bowen Drive	Eastbound	45	3	8	1	0.7
Canberra Avenue between National Circuit and Manuka Circle	Northbound	74	6	8	1	0.4
	Southbound	89	7	8	1	0.3

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

15.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Barton precinct. Only the National Triangle-Barton alignment travels through the Barton precinct, and therefore the noise and vibration sensitive buildings in the precinct are only expected to be potentially impacted by the National Triangle-Barton alignment option.

Exceedances of operational rail noise trigger levels are not anticipated to result from the State Circle East alignment in this precinct.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of the alignment. This included a total of 130 receivers in the Barton precinct, including residential receivers, mixed use receivers, educational receivers, places of worship, public buildings and active recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

The majority of receivers assessed are not predicted to experience exceedances of the noise trigger levels.

The results of the operational rail noise assessment indicated two exceedances of the $L_{Aeq,1hr}$ trigger level, both at buildings associated with the First Church of Christ, Scientist. The noise sensitive receivers that experienced exceedances of the noise trigger level are presented in Table 15-17. Predicted noise impacts would be intermittent and last for a relatively short duration as the LRV passes the receiver and would not represent a constant noise source.

At one receiver, the predicted $L_{Aeq,1hr}$ noise levels are up to 8 dB(A) in excess of the trigger levels. At this location it is likely the exceedance is due to curve squeal associated with tight radius curvature of the track alignment. The LRV fleet would incorporate flange lubrication to minimise flanging and wheel squeal noise generated by tight curves in accordance with the mitigation measures presented in Chapter 21 (Environmental management and mitigation measures).

Table 15-17 Barton precinct noise sensitive receiver $L_{Aeq,1hr}$ exceedances (daytime; assuming no mitigation measures are in place)

ID	Usage	Address	Predicted $L_{Aeq,1hr}$ noise level, dB(A)	$L_{Aeq,1hr}$ noise trigger level, dB(A) ¹	Exceedance dB(A)
1296	Place of Worship	First Church of Christ, Scientist (4 Bligh Street, Barton)	57	53	4
2858	Place of Worship	First Church of Christ, Scientist (4 Bligh Street, Barton)	61	53	8

Notes:

1. Refer to Appendix F of Technical Report 9 – Noise and vibration for the location of identified receivers.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Barton precinct at the most affected (closest) receiver are presented in Table 15-18. No sensitive receivers are expected to experience ground-borne noise levels over the project trigger levels.

Table 15-18 Barton precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted ground-borne noise level, dB(A) L_{ASmax}
First Church of Christ, Scientist (4 Bligh Street, Barton)	Place of Worship	15	15	45	39

Mitigation measures in Chapter 21 (Environmental management and mitigation measures) of the EIS would also be implemented to manage the potential for operational noise impacts during the design development and operations planning process.

Rail vibration assessment

The predicted vibration levels for the Barton precinct at the most affected (closest) receivers are presented in Table 15-19. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria.

Table 15-19 Barton precinct – vibration assessment results (human comfort; assuming no mitigation measures are in place)

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Daytime), $\text{m/s}^{1.75}$	Vibration Criteria (Night), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Night), $\text{m/s}^{1.75}$
18 National Circuit, Barton <i>Commercial</i>	13	0.4	0.004	0.4	0.002
First Church of Christ, Scientist (4 Bligh Street, Barton) <i>Place of Worship</i>	15	0.4	0.005	0.4	0.002
7 National Circuit, Barton <i>Commercial</i>	16	0.4	0.011	0.4	0.006
19 National Circuit, Barton <i>Commercial</i>	21	0.4	0.009	0.4	0.005

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is provided in Table 15-20.

Table 15-20 Traffic noise levels resulting from upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected as the most representative dataset for the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Barton precinct, existing road traffic noise levels are between 55-60 dB(A) and future predicted road traffic noise levels for Kings Avenue, Brisbane Avenue and Sydney Avenue, and National Circuit would not exceed 60 dB(A), and are therefore acceptable.

The results of the road traffic noise assessment for each alignment are presented in Table 15-21 to Table 15-24, for 2031 and 2041.

Table 15-21 Road traffic noise assessment, 2031 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Macquarie Street	First Church of Christ, Scientist, Bligh Street, Barton	Westbound	2,021	152	1,518	114	0	Yes, no increase in traffic noise level
		Eastbound	3,538	266	-1,966	-148		

Table 15-22 Road traffic noise assessment, 2031 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Macquarie Street	First Church of Christ, Scientist, Bligh Street, Barton	Westbound	2,021	152	1,046	79	2	An increase of 2 dB is predicted, however existing levels during the assessed year are expected to remain around $L_{Aeq,15hr}$ 56 dB, therefore overall levels would be below $L_{Aeq,15hr}$ 60 dB. Therefore the increase is compliant.
		Eastbound	3,538	266	1,415	107		

Table 15-23 Road traffic noise assessment, 2041 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Macquarie Street	First Church of Christ, Scientist, Bligh Street, Barton	Westbound	3,145	237	1,573	118	1	An increase of 2 dB is predicted, however existing levels during the assessed year are expected to remain around $L_{Aeq,15hr}$ 56 dB, therefore overall levels would be below $L_{Aeq,15hr}$ 60 dB. Therefore the increase is compliant.
		Eastbound	3,224	243	865	65		

Table 15-24 Road traffic noise assessment, 2041 - National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Macquarie Street	First Church of Christ, Scientist, Bligh Street, Barton	Westbound	3,145	237	723	54	1	An increase of 2 dB is predicted, however existing levels during the assessed year are expected to remain around $L_{Aeq,15hr}$ 56 dB, therefore overall levels would be below $L_{Aeq,15hr}$ 60 dB. Therefore the increase is compliant.
		Eastbound	3,224	243	1,030	78		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the LA10, 15min assessment noise level at any location.

Within the Barton precinct, the nearest sensitive receiver to the Bligh Street Stop is Hotel Kurrajong at 8 National Circuit. There is potential for annoyance if PA systems are audible at or inside the hotel. The subjective impacts are however likely to be minimal given the relative infrequency of announcements.

At the Sydney Avenue Stop, residential receivers are located greater than 100 m from the stop and it is expected that PA systems could operate without adverse noise impacts to residences.

No other fixed operational facilities are proposed in the Barton precinct.

15.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for noise and vibration impacts at the Barton precinct.

15.4 Biodiversity

This section describes the potential impacts of the Project on biodiversity and provides a summary of the biodiversity assessment for the Barton precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). Further detail on the biodiversity assessment is provided in Technical Report 3 – Biodiversity.

15.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Barton precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 10.59 ha of vegetation is present in the Barton precinct. Vegetation within the Barton precinct is comprised of three vegetation communities. Table 15-25 and Figure 15-9 depict the extent and distribution of each vegetation community within the Barton precinct.

Table 15-25 **Extent of vegetation communities within the Project area in the Barton precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	0.29
Landscape plantings – Exotic	8.07
Exotic grassland	2.23
Total vegetation	10.59

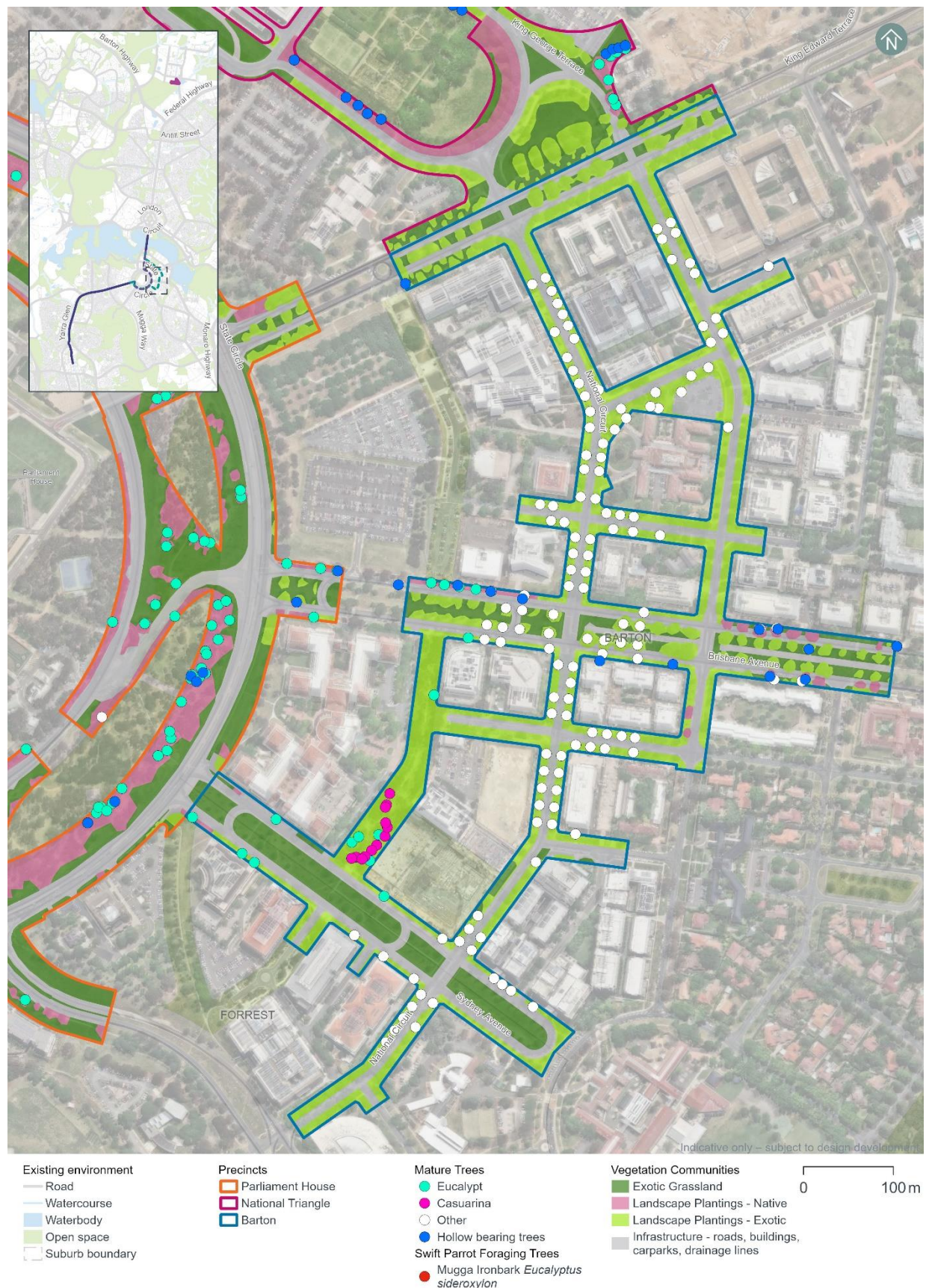


Figure 15-9 Vegetation communities, hollow-bearing and mature trees in the Barton precinct

Hollow-bearing trees and mature trees

A total of 13 hollow-bearing trees and 163 mature trees have been recorded in the Barton precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 15-26 summarises the number of hollow-bearing and mature trees within the Barton precinct and is shown in Figure 15-9.

Field work carried out between 2022 and 2024, and July 2024 has identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 15-26 Summary of hollow-bearing and mature trees within the Project area in the Barton precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Barton	13	0	2	3	7	0	163

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat assessment

The Golden Sun Moth is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 0.23 ha of potential Golden Sun Moth habitat has been recorded within the Barton precinct. This habitat has been identified as low-density (0.06 ha) and high-density (0.17 ha) Chilean needlegrass habitat (refer to Figure 15-10). However, no Golden Sun Moth individuals have been recorded in the Barton precinct. Other Golden Sun Moth individuals, populations and habitat across the Project area are identified in Section 11.2 in Chapter 11 (Project-wide issues).

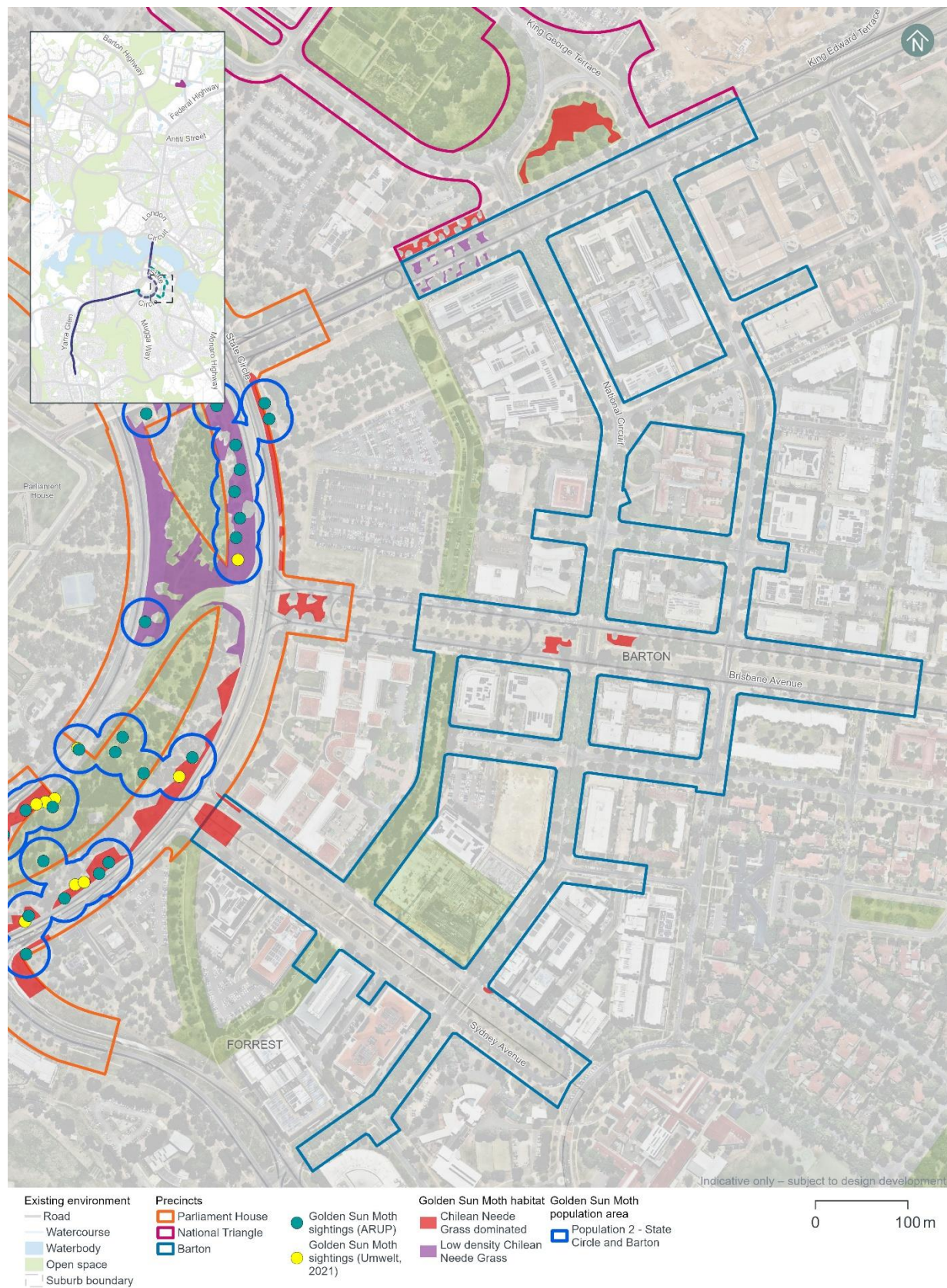


Figure 15-10 Golden Sun Moth habitat and sightings in the Barton precinct

Other potential threatened fauna habitat identified within the Barton precinct includes:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*) (listed as endangered under both the EPBC Act and the NC Act) – the Barton precinct supports 0.29 ha of foraging habitat and nine breeding trees for the species (refer to Figure 15-11)
- Superb Parrot (*Polytelis swainsonii*) (listed as vulnerable under both the EPBC Act and the NC Act) – the Barton precinct supports 0.29 ha of foraging habitat for this species (refer to Figure 15-11)
- Diamond Firetail (*Stagonopleura guttata*) (listed as vulnerable under both the EPBC Act and the NC Act.) – 0.29 ha of the Landscape Planting – Native community has been identified within the Barton precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 15-11).

No habitat was identified in the precinct for the Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberraee*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).

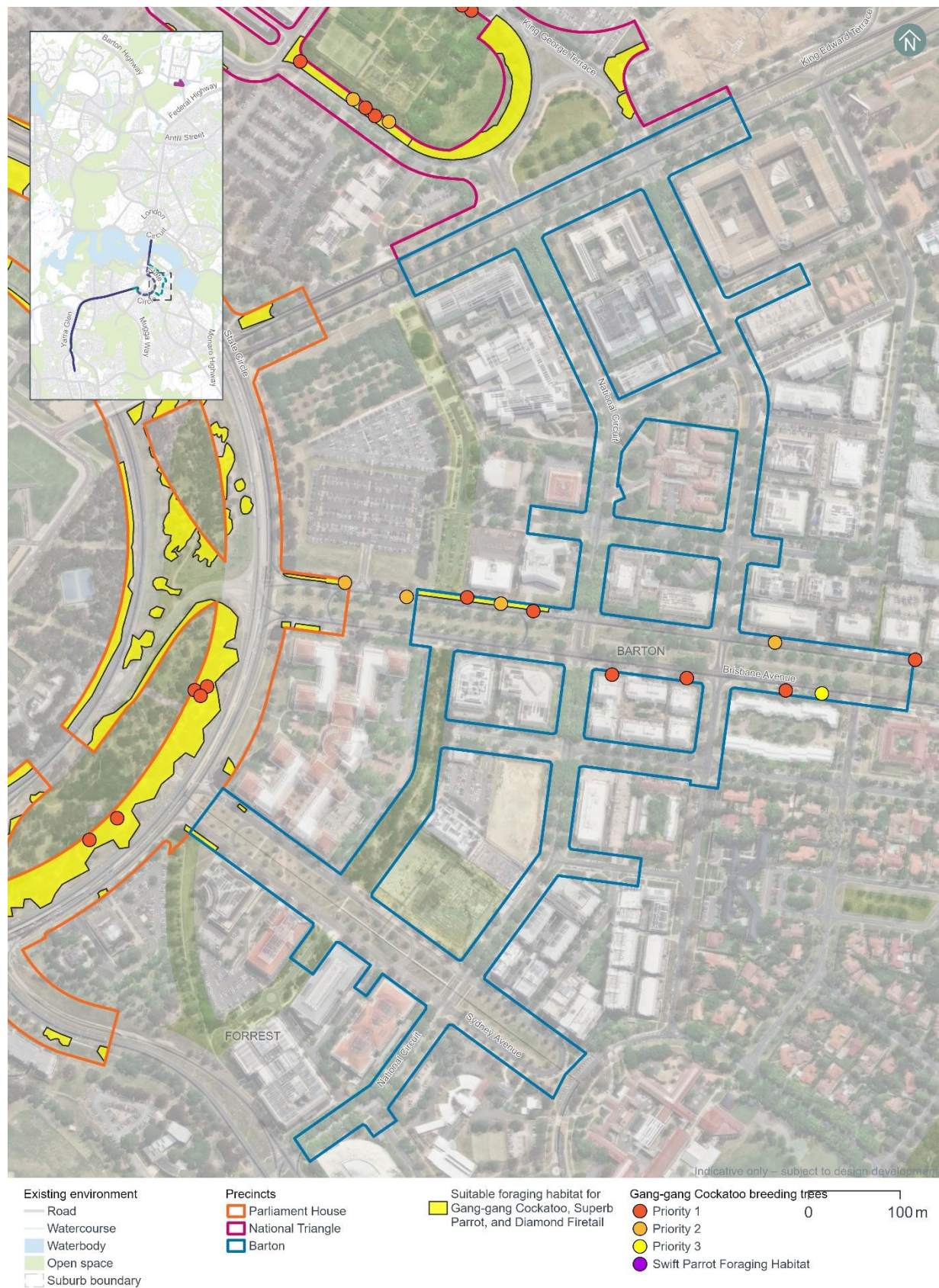


Figure 15-11 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Barton precinct

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Barton precinct. Impacts to threatened or rare flora species are therefore not anticipated.

One pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) has been recorded in the Barton precinct. The pest species, the Chilean needlegrass (*Nassella neesiana*), is also a Weed of National Significance.

15.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Barton precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 15-12. Vegetation clearing would not be permitted outside this clearance footprint.

The majority of vegetation clearing in this precinct would be required to construct the National Triangle-Barton alignment option only. A small portion of vegetation along Sydney Avenue would require removal for both alignment options, as shown in Figure 15-12.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 15-27. None of this vegetation is characterised as native.

Table 15-27 **Extent of vegetation communities within the clearance footprint in the Barton precinct**

Vegetation community	Area (ha)
Landscape plantings – Exotic	1.34
Exotic grassland	0.94
Total vegetation	2.28

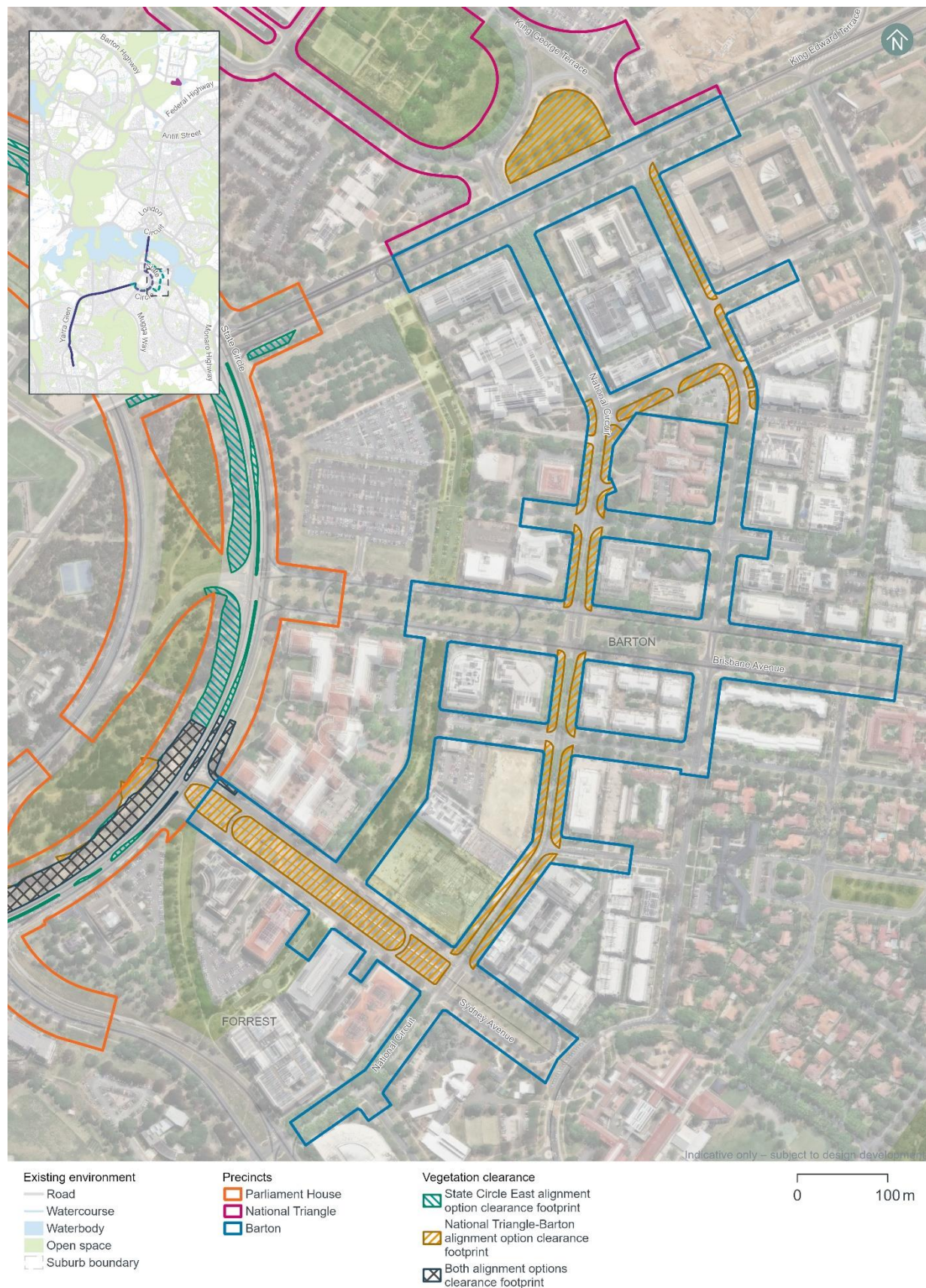


Figure 15-12 Clearance footprint in the Barton precinct

No hollow-bearing trees or mature native trees have been recorded within the clearance footprint in the Barton precinct.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Barton precinct include removal of 0.11 ha of habitat for the Golden Sun Moth.

Potential impacts on threatened fauna habitat across the clearance footprint are discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Barton precinct clearance footprint for the Gang-gang Cockatoo, Superb Parrot, Diamond Firetail, Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Chapter 11 (Project-wide issues).

15.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike.

There would be no over-head wiring installed in this precinct as part of the Project and therefore there would be no risk of fauna strike with over-head wires. Further detail on these indirect impacts for operational activities is discussed in Chapter 11 (Project-wide issues).

15.4.4 Precinct specific management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, including through the development of a minimised clearance footprint within the Project area (refer to Figure 15-12).

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Barton precinct.

15.5 Historic heritage

This section provides a summary assessment of the potential historic heritage impacts associated with the construction and operation phases of the Project within the Barton precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

15.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Barton precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The Barton precinct's heritage character arises from the expression of the 'Garden City' urban design philosophy which partly inspired the Griffin Plan for Canberra and the historic buildings within the precinct associated with Canberra's development as the national capital.

Its historical urban planning and landscape character are demonstrated by the geometry of the street arrangements, road widths and avenue plantings, where the mature oak trees create tunnel-like avenue effects, with distinct aesthetics through seasonal changes.

The historic heritage assessment identified 10 heritage places (six listed, two nominated, and two unlisted) within and surrounding the Barton precinct, as noted below in Table 15-28 and shown in Figure 15-13.

Table 15-28 Heritage places within and surrounding the Barton precinct

Heritage places	Description
Commonwealth Heritage List	
Patent Office (Former)	<p>The former Patent Office at the intersection of Kings Avenue and National Circuit, is historically significant as it expresses the decision to build monumental, permanent structures in Canberra. Its construction demonstrated Parliament's commitment to secure Canberra as the national capital.</p> <p>The building's aesthetic qualities, along with other significant features and architecturally significant buildings in the area, contribute to the monumental character of the streetscape of Kings Avenue, one of the boundaries of the National Triangle.</p>
Edmund Barton Offices (refer to Figure 15-14)	<p>The Edmund Barton Offices on the east side of Macquarie Street, demonstrate Late Twentieth-Century International Style of architecture in Australia. The building has important aesthetic value, creating a strong, elegant presence on Kings Avenue, with strong horizontal patterns of the concrete 'I' beams and windows contributing to the view along Kings Avenue. The Edmund Barton Offices are recognised for their technical innovation and the use of post-tensioned concrete and 'T' and 'I' beams now rare in Australia. The low scale of the building was a design feature to ensure the building would not detract from Parliament House.</p>

Heritage places	Description
ACT Heritage Register	
Hotel Kurrajong (refer to Figure 15-15)	<p>The Hotel Kurrajong located on the east side of National Circuit, has historical, social, and architectural significance relating to the early years of Canberra's development.</p> <p>It is notable for its scale and position of the building, the avenues of trees lining paths along the place boundaries, mature trees on the National Circuit frontage, the hedges and shrubs which define the edges of the building, and the formal landscaping at the front of the hotel.</p>
Barton Housing Precinct	<p>The Barton Housing Precinct located south of Brisbane Avenue and east of Macquarie Street, is an early twentieth century residential subdivision in Canberra, constructed primarily in the 1920s.</p> <p>The influences of early planning philosophy, including social segregation, and the urgent need for large public housing estates are reflected in the highly-ordered layout and aesthetic unity of the precinct.</p> <p>The composition of architectural and landscape elements form a cohesive streetscape that the community values, including:</p> <ul style="list-style-type: none"> • Symmetrical and hierarchical road patterns • Generous landscape verges • Public utility services located underground • Unified landscape treatments and street furniture • A mature public and private treescape.
Brassey Hotel	<p>The Brassey Hotel located on the east side of Macquarie Street, is significant for its architectural design, which exhibits influences of American Colonial architecture.</p> <p>It is historically significant as it was the only Federal Capital Commission hostel of this style in Canberra.</p> <p>It contributes to the urban environment of the Barton residential area with its garden setting and axial placement at the end of Belmore Gardens.</p>
Telopea Park High School	<p>Telopea Park High School located at the eastern end of Sydney Avenue, is significant as one of the first public buildings undertaken by the Federal Capital Advisory Committee and is the first public school completed by the Commonwealth for Canberra.</p> <p>It is notable for its 1920s buildings, the symmetry of the 1920s buildings centred on the Griffin axis along Sydney Avenue, and the landscape setting with ovals and tree plantings, within the broader Barton landscape.</p>
Wesley Uniting Church Complex (nominated)	<p>The Wesley Uniting Church Complex located south of Sydney Avenue, is significant for its strong religious, cultural, and historical associations. The complex was built as a national memorial and centre of Methodism in Australia prior to the advent of the Uniting Church.</p>
Barton Conference Centre (nominated)	<p>Barton Conference Centre (now a café and gym) located on the corner of National Circuit and Brisbane Avenue, is significant as it expresses an innovative design solution to the site, where most of the conference centre was constructed below-ground. The portion above ground appears as a sculptural form, and a pond and fountain were used for cooling and insulation.</p> <p>The building has been considerably altered, but key indicators of its architectural style remain such as its asymmetrical massing and retention of the natural setting.</p>

Heritage places	Description
Unlisted significant heritage places	
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 15-13 and is not considered further in this precinct assessment.</p>
Roads on national land – Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle	<p>Commonwealth Avenue and Kings Avenue are two of the three original major avenues for Canberra, and together with Constitution Avenue they form the Parliamentary Triangle. Their symmetry, tree-lined avenues, plantings, landscape setting, and geometry contribute to an understanding of the Griffin Plan. They are significant as individual places and as part of the broader historical urban designed landscape of Canberra.</p> <p>State Circle and Capital Circle encircles Parliament House, framing Capital Hill. The smoothed contours, grassed verge edges, and massed native plantings between State and Capital Circles are significant by creating a 'natural Australian' aesthetic as the appropriate setting for the nation's parliament and reflect the principles of Canberra as a designed city in the landscape.</p> <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues) and is not considered further in this precinct assessment.</p>

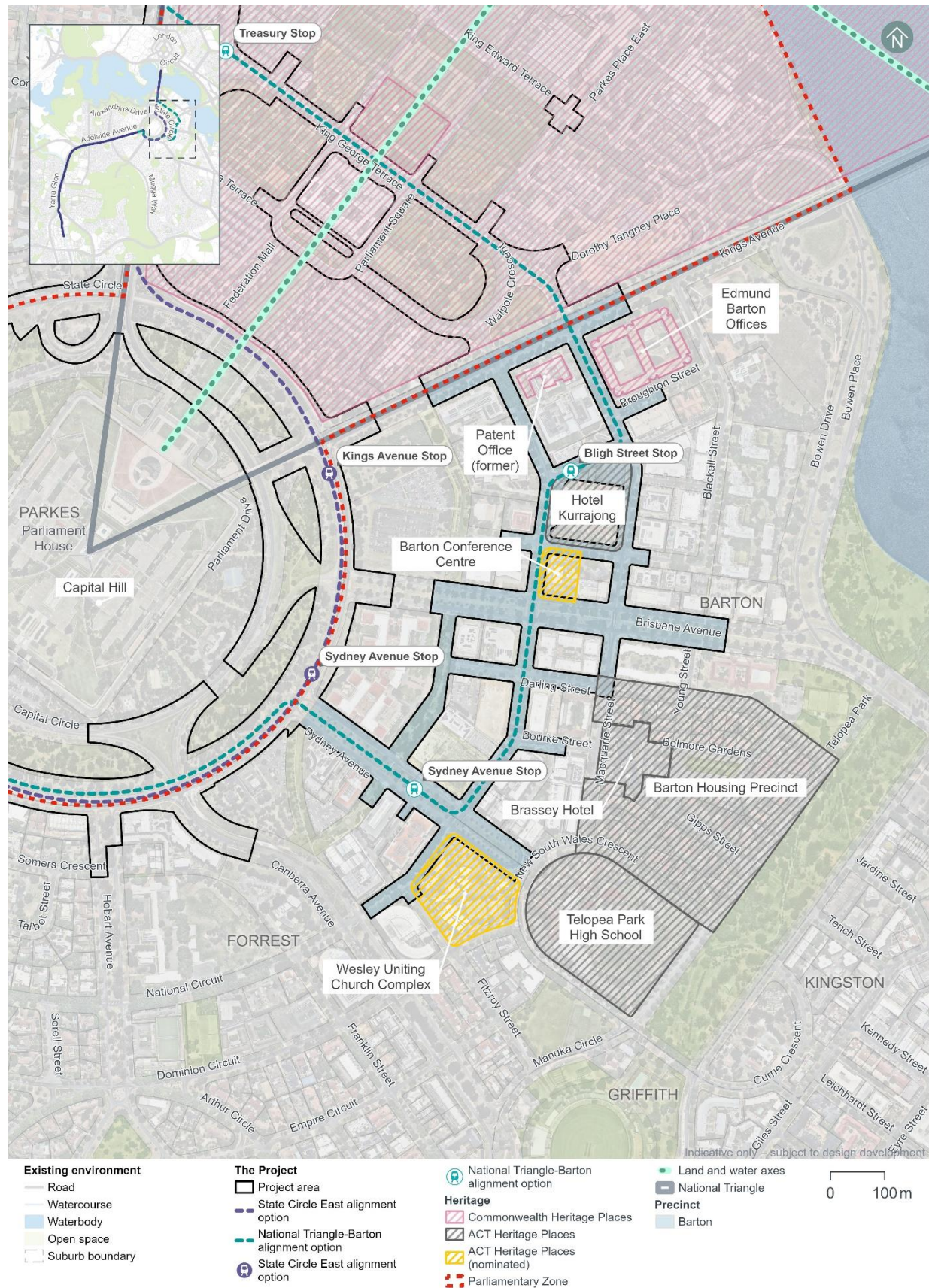


Figure 15-13 Heritage places relevant to the Barton precinct



Figure 15-14 Edmund Barton Offices looking from intersection of Kings Avenue (left) and Macquarie Street (right)



Figure 15-15 National Circuit looking south-east towards Hotel Kurrajong

Condition, integrity, and sensitivity to change

The existing heritage within the Barton precinct is generally in good condition. Some avenue trees are in poorer health, but most have been identified as in fair to good condition. The historical structures associated with the precinct (Hotel Kurrajong, Patent Office, and Edmund Barton Building) are in use and maintained.

The integrity of the heritage values is moderate. The original 19th century urban design character is generally intact and legible via the road geometry, landscape, and original street planting, despite some changes over time, such as increasing development of modern office and residential buildings. Individual heritage places such as the Hotel Kurrajong and Patent Office retain high integrity, particularly in both the Hotel Kurrajong's landscape setting and physical fabric.

The precinct has moderate to high sensitivity to change. The road geometry, widths, landscape setting of 20th century buildings and avenue plantings (refer to Figure 15-16) are original and highly significant features which are sensitive to alterations. Areas within the precinct, such as Sydney Avenue (refer to Figure 15-17), are a combination of historical urban design and more modern plantings or structures, and have a greater tolerance for change.



Figure 15-16 Avenue plantings looking north along National Circuit from Brisbane Avenue



Figure 15-17 Sydney Avenue looking north-west to Parliament House

15.5.2 Potential impacts – construction

Table 15-29 summarises the potential construction impacts of the Project on heritage places in the Barton precinct. No construction impacts are anticipated for the State Circle East alignment option (except Telopea Park High School) as the Project would avoid impacts to the heritage places in this precinct.

Table 15-29 Construction impacts to the heritage places within the Barton precinct

Heritage place	Construction impact National Triangle-Barton alignment option
Commonwealth Heritage List	
Patent Office (Former)	<p>Nil</p> <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Former Patent Office within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Heritage place	Construction impact National Triangle-Barton alignment option
Edmund Barton Offices	Moderate <ul style="list-style-type: none"> No direct impacts to this heritage place Existing trees along Macquarie Street would be removed, which define the south-western edge of the building. The removal of these trees would alter and obscure the aesthetic heritage values of the building and its setting Temporary impacts from construction activity to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Edmund Barton Offices within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
ACT Heritage Register	
Hotel Kurrajong	Significant <ul style="list-style-type: none"> No direct impacts to this heritage place Historic mature oak trees along Bligh Street and National Circuit would be removed, which define the northern and western edges of the Hotel Kurrajong Garden City block. The removal of these trees would alter and obscure the expression of the building's historic landscape setting Temporary impacts from construction activity to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Hotel Kurrajong within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Barton Housing Precinct	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Barton Housing Precinct within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Brassey Hotel	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.

Heritage place	Construction impact National Triangle-Barton alignment option
Telopea Park High School	Minor <ul style="list-style-type: none"> No direct impacts to this heritage place Minor visual impacts from temporary infrastructure. It is noted that the temporary infrastructure is also proposed for the State Circle East alignment option, and would have similar impacts Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Telopea Park High School within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Wesley Uniting Church Complex (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Wesley Uniting Church Complex within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).
Barton Conference Centre (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Barton Conference Centre within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction impacts on Canberra: the Planned National Capital and Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

15.5.3 Potential impacts – operation

Table 15-30 summarises the potential operation impacts of the Project on heritage places in the Barton precinct. No operation impacts are anticipated for the State Circle East alignment option as the Project would avoid impacts to the heritage in this precinct.

Table 15-30 Operation impacts to the heritage places within the Barton precinct

Heritage place	Operation impact National Triangle-Barton alignment option
Commonwealth Heritage List	
Patent Office (Former)	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.
Edmund Barton Offices	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations Replacement trees on Macquarie Street like-for-like with the original species would eventually mostly mitigate the removal of existing historic trees as the replacement trees grow to maturity No operational vibration impacts to heritage place.
ACT Heritage Register	
Hotel Kurrajong	Significant <ul style="list-style-type: none"> Kerb alignment along Bligh Street and National Circuit would be altered, changing the historical road geometry and grassed settings Replacement trees of a similar species to the original trees on Bligh Street and National Circuit would partly mitigate the removal of existing historic trees The Bligh Street Stop would be partially within the boundary of the heritage place, within the verge area to be converted to hard surface, which would degrade the expression of the heritage values of the Hotel Kurrajong as demonstrated via its landscaped garden setting The Bligh Street Stop would partly mitigate the impact of the change to the streetscape by using a separated canopy on the stop which would allow for a replacement tree to be planted close to the road kerb Replacement trees on Bligh Street and National Circuit like-for-like with an oak species would eventually mostly mitigate the removal of existing historic trees as the replacement trees grow to maturity.
Barton Housing Precinct	Nil <ul style="list-style-type: none"> No direct impacts to heritage place Changes to the kerb alignment are proposed on Macquarie Street between Brisbane Street and Darling Street to facilitate traffic arrangements, immediately adjacent to the boundary of the Barton Housing Precinct. However, kerb alignment changes are not proposed to extend into the boundary of the Barton Housing Precinct itself No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.
Brassey Hotel	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.

Heritage place	Operation impact National Triangle-Barton alignment option
Telopea Park High School	Nil <ul style="list-style-type: none"> No direct impacts to heritage place The introduction of light rail and the Sydney Avenue Stop in the median of Sydney Avenue between National Circuit and State Circle would partially impact the ability to interpret the symmetrical connection between the High School and the avenue axis However, the symmetry of the light rail tracks, use of wire-free running, and construction of stop platforms on either side of the central median would minimise this impact No operational vibration impacts to heritage place
Wesley Uniting Church Complex (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.
Barton Conference Centre (nominated)	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.

Operation impacts on Canberra: the Planned National Capital and Roads on national land - Commonwealth Avenue, Kings Avenue, State Circle, and Capital Circle have been assessed in Section 11.3 of Chapter 11 (Project-wide issues). Operation impacts on avenue views in Barton framed by trees are discussed further in Section 11.3 of Chapter 11 (Project-wide issues) and Section 6.3 of Technical Report 3 – Heritage.

15.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for historic heritage impacts at the Barton precinct.

15.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Barton precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape

The landscape character assessment describes the physical, cultural, and heritage attributes of the landscape, planning designations, and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown in Figure 15-18.

15.6.1 Existing environment

The Barton precinct is known for its prestigious office buildings that host major national functions related to the Parliament. Situated between Lake Burley Griffin and Parliament House, it features a generous 'Garden City' setting with a clear street layout, celebrating its connection to Parliament through strong geometry and established views.

The Barton precinct includes the section of the Project passing through Macquarie Street, Bligh Street, National Circuit, and Sydney Avenue, and is home to several government offices, education facilities, and embassies.

The generous, tree-lined streets surrounding the precinct is characterised by Victorian and Federation-era architecture contrasted with modern developments featuring a mix of low and mid-rise modern commercial buildings.

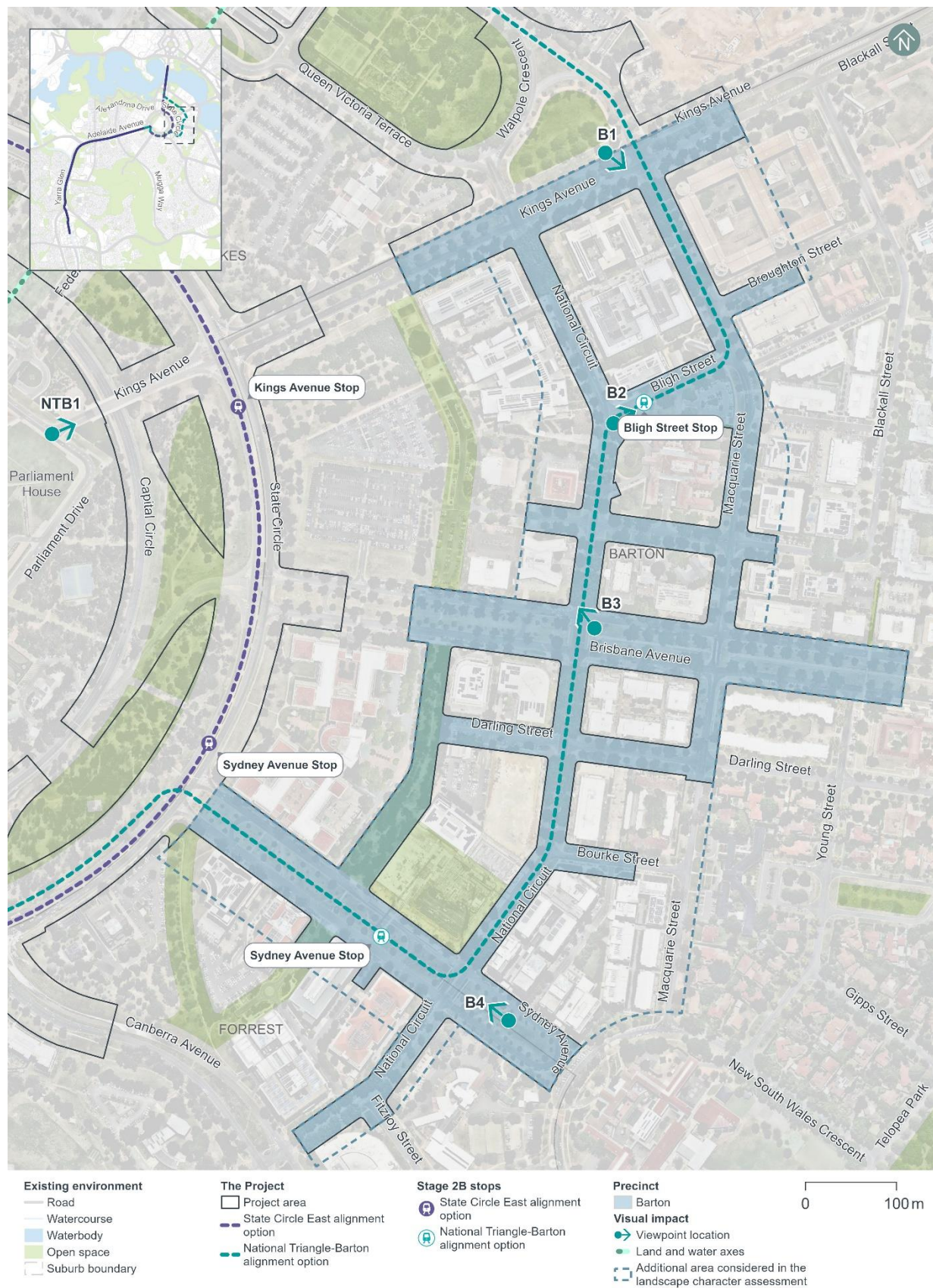


Figure 15-18 Landscape character zone and viewpoints in the Barton precinct

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Landscape character

The key aspects of the landscape character in the Barton precinct can be seen in Figure 15-19 and Figure 15-20. The tree-lined streets within the precinct are positioned in an even, radial grid, characterised by Victorian and Federation-era architecture along with a mix of low and mid-rise modern commercial buildings. Streetscapes typically feature wide streets with formally spaced mature tree planting (refer to Figure 15-19). Mature tree planting also extends between buildings, extending throughout public and private land.



Figure 15-19 Kings Avenue, with rows of formal street tree planting.

Main avenues passing through the precinct include Kings, Brisbane, and Sydney Avenues. These avenues form major design components of the Griffin Plan for Canberra. The formal planting along these corridors focus views on Parliament House (refer to Figure 15-20) as well as the Australian-American Memorial at the north-east extent of Kings Avenue. The main avenues are subject to a Precinct Code within the NCP as Designated Areas. Notable heritage items within this precinct include the Parliament House Vista, Edmund Barton Building, Hotel Kurrajong, and the Presbyterian Church of St Andrew.

Very small patches of natural heritage including Golden Sun Moth and Gang-gang Cockatoo habitat occur within the precinct, with more substantial patches of Superb Parrot habitat spread across the precinct. Hollow bearing trees have been identified along Brisbane Avenue, raising the ecological value of these areas.

Further information on the Parliament House Vista and natural heritage can be found in Section 11.3 (Historic heritage) of Chapter 11 (Project-wide issues). Further information on the other heritage items listed above can be found in Section 15.5.



Figure 15-20 View along Sydney Avenue, terminating in the iconic structure of Parliament House

Viewpoints

Representative viewpoints that have been identified to assess changes to the Barton precinct which are and shown in Figure 15-18 and described in Table 15-31. These viewpoints have been assessed for the National Triangle-Barton alignment option only.

Table 15-31 Barton precinct viewpoints and description

Viewpoint	Description	Sensitivity rating
Viewpoint B1: Edmund Barton Building	<p>This viewpoint is located at the intersection of King George Terrace, Macquarie Street, and Kings Avenue, looking east towards the Edmund Barton Building (refer to Figure 15-22). The view comprises the road pavement with line marking of the intersection of Kings Avenue and King George Terrace which transitions into Macquarie Street on the far side of the road within the view. Visual receptors at this viewpoint would predominantly comprise workers as well as visitors to the National Triangle, in particular Parliament House or Lake Burley Griffin, travelling on the footpath or on the road. While there are interesting buildings within the view, most visual receptors would be passing by.</p> <p>The sensitivity to change of the viewpoint is moderate. The viewpoint is positioned within an important area and in view of the heritage listed Edmund Barton Building; however, views are not specifically noted at this location for their heritage value and visual receptors likely to be passing by are therefore unlikely to be focussed on the view at this location.</p>	Moderate
Viewpoint B2: National Circuit at Bligh Street	<p>This viewpoint is located along the pedestrian path of National Circuit at the intersection with Bligh Street, looking north-east along Bligh Street. The view comprises the western verge, road pavement of National Circuit and Bligh Street, with adjacent buildings. Visual receptors at this viewpoint would mostly be pedestrians, cyclists and motorists passing by.</p> <p>The sensitivity to change of this viewpoint would be high. Technical Report 3 – Heritage lists views within Barton framed by trees as views of secondary importance. This viewpoint includes the ACT heritage listed Hotel Kurrajong where trees within the streetscape are listed as an important heritage attribute as part of the setting of the building.</p>	High

Viewpoint	Description	Sensitivity rating
Viewpoint B3: National Circuit at Brisbane Avenue	<p>This viewpoint is located on National Circuit at the intersection with Brisbane Avenue, looking north to north-west towards the Engineering House Building (refer to Figure 15-21). The view includes a direct line-of-sight along National Circuit to the north and Brisbane Avenue to the west, extending towards Parliament House. Visual receptors at this viewpoint would mostly be pedestrians, cyclists and motorists passing by.</p> <p>The sensitivity of the view is high due to the importance of views along main avenues to Parliament House. The Project would affect a large proportion of the view from this location.</p>	High
Viewpoint B4: Sydney Avenue	<p>This viewpoint is located on National Circuit at the intersection with Sydney Avenue, looking north-west towards Parliament House (refer to Figure 15-24). The view primarily comprises the National Circuit corridor with the view corridor along the broad median of Sydney Avenue extending towards Parliament House. Visual receptors at this viewpoint would mostly be pedestrians, cyclists and motorists passing by.</p> <p>The sensitivity of the view is high due to the importance of views along main avenues to Parliament House, further emphasised by the park-like nature of the median. The Project would affect a large proportion of the view from this location.</p>	High



Figure 15-21 Existing view from Viewpoint B3 looking north-west along Brisbane Avenue and National Circuit

Night-time lighting

The Barton precinct holds a number of landscape and heritage sensitivities with a key focus on vistas, particularly along the main avenues. The proposed National Triangle-Barton alignment option would travel along Sydney Avenue from National Circuit to State Circle, also intersecting Kings Avenue and Brisbane Avenue. Kings Avenue is also a National Triangle Road as assigned within the National Capital Authority's (NCA) Outdoor Lighting Policy. Overall, the Barton precinct is an area of A3: Medium district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023), with low level lighting of streetscapes to highlight the prominence of the view corridors of the main avenues. Kings Avenue would be A4: High district brightness in line with Commonwealth Avenue.

Relevant design requirements of strategy 1a of the NCA's Outdoor Lighting Policy for the Barton precinct include:

- i. Emphasise the three node points of the Griffins' National Triangle by creating and maintaining strong visual 'anchors' at Parliament House, City Hill, and Russell

- ii. Create a unique identity for the roads that form the Griffins' National Triangle, being Commonwealth, Kings, and Constitution Avenues, through careful selection and installation of an integrated suite of street furniture and lighting. Achieve a high degree of uniformity in lighting performance on these three main avenues
- v. Use full cut-off light fittings in all landscape areas, roads, paths, and car parks within the Central National Area
- vi. Use full cut-off street and pedestrian lighting on all main avenues that contributes to their development as high quality landscape boulevards
- vii. Align lighting hardware to strengthen the framing of the National Triangle, main avenues, and formally landscaped open spaces.

15.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition (of construction activity and equipment) and loss of elements (most notably to trees) within the Barton precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops
- Installation of lighting, signage, and landscaping
- Temporary traffic changes.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years).

As such, the magnitude of change during construction would be high within the Barton precinct due to the visual clutter of construction and the removal of trees. This would result in a high adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Barton precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- High sensitivity of most viewpoints to change
- High heritage and aesthetic values of views across this precinct
- High magnitude of works anticipated throughout construction that would be visible in the fore, middle, and background of most viewpoints.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 15-32. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints. These differences have been specified as appropriate in the table below.

Table 15-32 Viewpoints construction impact summary – Barton precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint B1: Edmund Barton Building	During construction, traffic conditions would undergo occasional changes to accommodate construction works. Construction of the Project would be seen in the fore, middle, and background of the view. The visual clutter of construction activity would become a dominant feature of the view, with additional large elements and construction activities evident within the view. Additionally, tree removal would comprise a substantial change within the view. The change would be in contrast to the existing, established view of an intersection with mature street trees.	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint B2: National Circuit at Bligh Street	The construction would be visible in the fore, middle, and background. Tree removal and the addition of a light rail stop (Bligh Street Stop) within a narrow streetscape would comprise the most substantial changes, as well as the construction activities and equipment within the road corridor directly in front of the Hotel Kurrajong entrance. The changes, while temporary, would be in contrast to the existing, established view. The visual clutter of construction activity would become a dominant feature of the view. This is further exacerbated by the removal of mature trees within the view.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint B3: National Circuit at Brisbane Avenue	The construction would be seen in the fore, middle, and background of the view and over a large proportion of the view. The view is highly sensitive, including views along a main avenue, within close proximity to heritage items in a nationally significant precinct. The visual clutter of construction activity would become a dominant feature of the view, with additional large elements and construction activities evident within the view. The removal of a mature avenue of trees would also reduce the quality of the view.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint B4: Sydney Avenue	<p>State Circle East alignment option: Changes would be seen within a very small portion of the view in the background. No detail of the construction activity would be visible, with the changes likely to be seen as the fencing and hoarding on State Circle, or the larger equipment used for construction visible. Tree removal is unlikely to be seen as any trees removed would have a backdrop of more trees, which would reduce the visual prominence of this change.</p> <p>National Triangle-Barton alignment option: Changes would be seen within the fore, middle, and background and would contrast with the existing view. The construction activity would be visually prominent within the view, particularly due to the close proximity of the changes and the scale of construction equipment required. The visual clutter of construction activity would become the dominant feature within the view, rather than the composition of the extended view along a main avenue towards a landmark feature.</p>	Sensitivity: High
		Magnitude: Low (State Circle East alignment option) High (National Triangle-Barton alignment option)
		Overall impact: Moderate (State Circle East alignment option) High (National Triangle-Barton alignment option)
		Qualitative rating: Adverse (Both alignment options)

Night-time visual impact assessment

Some works in the Barton precinct may need to be undertaken outside standard construction hours (Monday to Saturday, 7am to 6pm). Night works would contrast with the lower light levels of this precinct. The removal of mature street trees would also allow additional existing road lighting to be seen more clearly from these adjacent properties. There would be no construction compounds located within the Barton precinct.

Lighting associated with potential night works within the precinct may be seen from the adjacent heritage listed buildings:

- Edmund Barton Building (CHL)
- Former Patent Office Building (CHL)
- Hotel Kurrajong (ACTHR)
- Telopea Park High School (ACTHR).

Any night works within the precinct would create a noticeable reduction in the amenity of this area, resulting in a **high adverse** impact at night.

15.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project would impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 15-33 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 15-33 Landscape character impact assessment summary in the Barton precinct – National Triangle-Barton alignment option only

Alignment option	Anticipated change	Impact rating
National Triangle-Barton alignment option only	<p>The Project would result in the addition of light rail infrastructure within several streetscapes within the Barton precinct, changing the composition of these corridors. The impact to existing verge widths along Macquarie Street, Bligh Street and National Circuit, would lead to a substantial change to the landscape character through the removal of mature street trees which are characteristic of Barton streetscapes. Replacement trees would be located closer to the property boundaries and may never replace the current tunnel-like effect due to over-head branching of the avenue trees. However, the Project would preserve the key spatial characteristics of the precinct and consideration of heritage elements (including the view corridors). Replacement tree species have been selected to retain the heritage character of the precinct, while considering species resilience to more extreme climatic conditions due to climate change.</p> <p>While National Circuit and Sydney Avenue are existing bus routes, these corridors are not frequent large vehicle routes due to proximity to larger transport corridors such as State Circle, and therefore LRV movements would not be characteristic of these roads. In addition, the LRVs would be positioned centrally within these corridors, which is a change from the existing condition.</p> <p>The Project would also result in the addition of light rail infrastructure within, or crossing, three main avenues in the precinct including a stop on Sydney Avenue. Although the stop infrastructure is large, the overall spatial arrangement would predominantly be retained, with the light rail located within the wide median. Also, the light rail stop would not intercept vistas</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Alignment option	Anticipated change	Impact rating
	to Parliament House due to the topography of the Avenue and the side platform design. The Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, including through the use of wire-free running.	

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Barton precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- High to moderate sensitivity of most viewpoints to change
- Viewpoints ranging from high to moderate magnitude of change, the main impact being views of passing light rail vehicles (LRVs) and the two stops at Bligh Street and Sydney Avenue.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 15-34. Potential impacts would differ between the State Circle East and National Triangle-Barton alignment options for some of these viewpoints. These differences have been specified as appropriate in the table below.

Table 15-34 Viewpoints operation impact summary – Barton precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint B1: Edmund Barton Building	While the addition of light rail infrastructure would slightly alter the view, the more substantial changes would include the reduction in hardscape between Commonwealth Avenue and Kings Avenue due to the introduction of green track in the foreground of the view, passing LRVs, and the removal of trees on Macquarie Street, which would increase the visual prominence of the Edmund Barton Building within the view. The visual prominence of the building would be softened by wire-free running. An indicative visualisation of the Project, once operational, from Viewpoint B1 is provided in Figure 15-23.	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint B2: National Circuit at Bligh Street	The Project would be seen along Bligh Street and into National Circuit with the most substantial changes involving the removal of mature trees, passing LRVs, and a light rail stop within a narrow streetscape. The visual prominence of the light rail infrastructure would be softened by wire-free running. Vehicle movement along Bligh Street would be replaced with the light rail stop and associated infrastructure within the corridor. Mature trees on Bligh Street and National Circuit would be removed and replaced with juvenile trees in similar locations. The addition of light rail infrastructure would continue into National Circuit. Changes would be seen in close proximity of this viewpoint within the fore, middle and background. They would include the introduction of a light rail stop, trackform, juvenile trees and passing LRVs within the view.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse

Viewpoint	Anticipated change in view	Impact rating
Viewpoint B3: National Circuit at Brisbane Avenue	<p>The Project would result in the addition of light rail infrastructure within National Circuit between vehicular traffic lanes, extending across Brisbane Avenue. The Project would result in the addition of light rail infrastructure within National Circuit between vehicular traffic lanes, extending across Brisbane Avenue. LRVs would be seen passing by, however the view along the main avenue to Parliament House would remain unchanged. The visual prominence of the building would be softened by wire-free running.</p> <p>The reduction in canopy overhanging the road would be a substantial change within half of the view. Juvenile trees would be planted on either side of National Circuit. The reduction in canopy overhanging the road would be a substantial change within half of the view which would reduce the visual impact as they mature but may never reach the existing canopy spread.</p>	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint B4: Sydney Avenue	<p>State Circle East alignment option: Changes due to the Project would be predominantly screened from view by existing foreground vegetation within the view from this location. The magnitude of change at this viewpoint during the operation of the Project is negligible. Due to the distance of viewing (over 350 m), the only element of the Project likely to be seen would be the passing LRVs on State Circle, which would resemble buses within the road corridor.</p> <p>National Triangle-Barton alignment option: While the grass in the central median would be preserved, the addition of a light rail stop, replacement of mature tree plantings with juvenile trees, and the introduction of LRVs within the view would increase the scale and activity of transport infrastructure in this view. The distinct columnar conifers in the foreground of the view would be replaced with deciduous trees on either side of the light rail tracks, however, the dark conifers would be replaced in the middle to background to the north-west of the light rail stop.</p> <p>The view to landmark elements (Parliament House and Capital Hill) would be preserved, including through the use of wire-free running, which would reduce the visual clutter associated with over-head infrastructure.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint B4 is provided in Figure 15-25.</p>	Sensitivity: High
		Magnitude: Negligible (State Circle East alignment option) High (National Triangle-Barton alignment option)
		Overall impact: Negligible (State Circle East alignment option) High (National Triangle-Barton alignment option)
		Qualitative rating: Neutral (Both alignment options)



Figure 15-22 Existing view from Viewpoint B1 looking south-east towards Edmund Barton Building



Figure 15-23 Indicative visualisation of Viewpoint B1 during operation for National Triangle-Barton alignment option



Figure 15-24 Existing view from Viewpoint B4 looking north-west along Sydney Avenue



Figure 15-25 Indicative visualisation of Viewpoint B4 during operation for National Triangle-Barton alignment option

Night-time visual impact assessment

The priority within this precinct would be to deliver lighting that would retain the existing character of the streetscapes within Barton. The Project would implement lighting to respond to the widening of the road corridor while retaining the existing street lighting layout approach. There would not be an increase in the street lighting along Macquarie Street or National Circuit, however, additional lighting would be required within the median of Sydney Avenue.

Due to the tree removal required as part of the Project, the lighting along the proposed route would become more prominent. Replacement trees would reduce the prominence of these lighting elements as they mature over time.

Lighting of the light rail stops is vital to prioritise passenger safety at night, however, additional lighting associated with the Bligh Street Stop combined with tree removal would comprise a substantial increase in light spill to surrounding properties, particularly affecting the Hotel Kurrajong.

The Sydney Avenue Stop would introduce additional lighting which may distract from the feature lighting of Parliament House. Light spill from the additional lighting along Sydney Avenue would impact surrounding commercial properties and be seen from the heritage listed Presbyterian Church of St Andrew and Telopea Park High School. There would be a considerable reduction in visual amenity at night due to the addition of stop lighting and frequency of LRVs within close proximity to heritage listed buildings, residences and commercial properties.

The resulting night-time visual impact during operation would therefore be **high adverse**.

15.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for landscape character and visual amenity impacts at the Barton precinct.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

15.7 Socioeconomic

This section describes the potential socioeconomic impacts of the Project within the Barton precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

15.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown in Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. The Barton SA2 was analysed for the Barton precinct
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- **ACT:** in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor, and the ACT. Capital refers to various forms of resources that contribute to the well-being, sustainability, and resilience of a community.

A summary of community capitals for the Barton precinct is provided in Table 15-35. Section 11.7 provides a summary of community capitals for the corridor and the ACT.

Table 15-35 Community capitals summary – Barton precinct

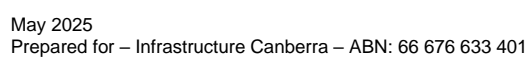
Capital	Summary
Human capital	The population of Barton is 1,949, with a median age of 39 and a nearly balanced gender distribution (49% male and 51% female). About 1% of residents identify as Aboriginal and Torres Strait Islander. The demographic includes a notable proportion of younger adults, with 26.6% aged 25 to 34 years and 12% aged 65 to 74 years. Educational levels are high, with 65% of residents having attained a bachelor's degree or higher and 6.6% holding postgraduate qualifications. Health statistics show that 24.4% of adults aged 18 and over have one of four key risk factors, and a significant 91.3% of those aged 15 to 24 are engaged in learning or earning.

Capital	Summary
Social capital	In this area, 71.7% of residents speak only English, with other languages including German (5.3%) and Greek (1.5%). The prominent ancestries reported are English (34.9%), Irish (15.6%), and Scottish (12.3%). The household distribution shows 46.6% of households are single or lone households, while 48.2% are family households. The population exhibits a relatively high mobility rate, with 27.8% having lived at a different address one year ago and 62.1% having moved within the past five years. Community engagement is evident, with 17.8% of residents having volunteered through an organisation or group in the past 12 months, and 1.8% of the population requiring assistance with core activities.
Economic capital	In Barton, the median total personal income is \$1,775 per week, with a median household income of \$2,462 per week, indicating strong economic capital. However, housing costs are substantial, with median mortgage repayments at \$2,015 per month and median rent at \$525 per week. Despite the high incomes, financial stress is evident, with 9.6% of residents facing mortgage stress and 19.8% experiencing rent stress. Barton also boasts a high labour force participation rate of 69.9% and a low unemployment rate of 1.7%. Major industries in the area include Central Government Administration (31.6%) and Defence (12.7%), with the workforce primarily engaged in Professional (46.5%) and Managerial (24.7%) occupations.
Physical capital	In this area, 23% of properties are owned outright, while 28.6% are owned with a mortgage, and 47.6% are rented. A significant majority of occupied private dwellings are flats or apartments (90.9%), with 6.3% being separate houses and 3% semi-detached, row, or terrace houses. The average household size is 1.7. For commuting, 26.1% of residents walk only, 41.4% either drive or are passengers in a car, 12.3% work from home, and 6.4% use public transport.
Natural capital	The area's natural capital features prominent sites such as Lake Burley Griffin and its foreshores, including the central and east basins, Bowen Park, and Telopea Park. Residents benefit from a range of lifestyle amenities, including parks, gardens, and picnic areas. Recreational opportunities include rowing, sailing, dragon boating, and stand-up paddleboarding, largely supported by Lake Burley Griffin. There are also running and cycling tracks around the lake, with facilities supporting elite training in triathlon, national rowing, and sailing.

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Barton precinct's area of social influence is shown in Figure 15-26.

The precinct includes education and research institutions, parks, playgrounds, sports clubs, places of worship, and a law and emergency service facilities.



15.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project' construction for those living, working in, or visiting the Barton precinct is provided in Table 15-36.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those living and working in the area, and users of government buildings, hotels, childcare centres, schools and medical centres.

Participants in consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)) indicated construction noise and vibration as a concern due to potential for disruptions to hotel guests, residents, patients, workers and hospitality venues. Stakeholders indicated concern for access to parking for workers, visitors, guests and residents. For businesses, maintaining access to both the frontage for trade and loading docks or spaces for deliveries was also highlighted during consultation.

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 15-36 and Chapter 21 (Environmental management and mitigation measures).

Table 15-36 Socioeconomic impacts during construction – Barton precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to social amenity during demolition and construction, potentially leading to a decline in health and wellbeing, especially affecting individuals with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 15.1.4, Section 15.3, and Section 15.6 (in relation to traffic, noise and visual impacts, respectively).</p>	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Disruptions to the road network and parking – impacts to road users Temporary impact to road users due to temporary traffic changes, (including several staged road closures requiring traffic diversions) which may impact travel times particularly during major events. Further detail on transport and access impacts within this precinct is provided in Section 15.1.4.	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) 	Medium (possible/moderate)
Disruptions to the road network and parking - impacts to accessibility for businesses, services, and workplaces Decline in accessibility to business and services due to temporary loss of parking during construction, which would impact up to 291 on-street spaces throughout the precinct. Further detail on transport and access impacts within this precinct is provided in Section 15.1.4.	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) Preparation of event impact assessments for major events, and implementation of tailored mitigation measures in consultation with event organisers. This could include providing temporary facilities or alternative access arrangements for event related activities if construction impacts are unavoidable (refer to measure SE5 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Visual landscape and heritage</p> <p>Changes to aesthetic value and impact to nearby cultural festivals and heritage items, affecting connection to place and shared histories. Construction activity within Barton's 'Garden City' streetscapes, including changes to road layouts and removal of street trees, would significantly alter the landscape character of the precinct. There would be a significant and permanent impact on the heritage values of the Hotel Kurrajong, with the removal of historic oak trees along Bligh Street and National Circuit.</p> <p>Further detail in landscape and visual impacts in this precinct is provided in Section 15.6.</p> <p>Further detail on impacts to heritage in this precinct is provided in Section 15.5.</p>	National Triangle-Barton alignment option	Medium (possible/moderate)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)

15.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in or visiting the Barton precinct is provided in Table 15-37.

Table 15-37 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 15-37. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Participants in consultation activities (which are described in Chapter 4 (Community and stakeholder consultation)) indicated concern for access to parking for workers, visitors, guests, and residents during operation of the Project.

Table 15-37 Socioeconomic impacts during operation – Barton precinct

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Landscape and visual changes</p> <p>Change to community character due to permanent changes to local visual landscape. The introduction of light rail infrastructure, would alter the precinct's 'Garden City' streetscapes, resulting in potential adverse impacts. This change may impact people's overall experience and connection to the area.</p> <p>Changes to the landscape and visual environment in this precinct are detailed in Section 15.6.</p>	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users 	Low (possible/minor)
<p>Heritage and culture</p> <p>Changes to connection to place due to permanent changes to items of heritage value. The Project has been designed to avoid direct impacts on several key heritage places within the Barton precinct, such as the Former Patent Office, Edmund Barton Offices, and Brassey Hotel. The Hotel Kurrajong, however, would experience impacts due to changes in kerb alignment and streetscape which may affect how residents and visitors perceive the historical landscape.</p> <p>Further detail regarding impacts to heritage values are detailed in Section 15.5</p>	National Triangle-Barton alignment option	Medium (likely/minor)	<ul style="list-style-type: none"> Implementation of heritage mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users 	Very low (unlikely/minor)

Description of impact	Relevant alignment option	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
Disruptions to the road network and parking Some decline in accessibility to businesses and services due to permanent loss of around 115 parking spaces and changes to pedestrian and motorist access. Impacts to parking are detailed in Section 15.1.4.	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, measures to minimise accessible parking loss and optimise the interface between the Project and other transport modes (refer to measures TT8, TT9, and TT10 in Chapter 21 (Environmental management and mitigation measures)) Continued engagement with local businesses via the Community Engagement and Social Management Plan (refer to Appendix L (Environmental Management Plan outline)) 	Medium (likely/minor)
Access and mobility Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. formalising and signalling pedestrian crossings at several critical intersections). Refer to Section 5.8 of Chapter 5 (Project description) for further detail on active travel arrangements.	National Triangle-Barton alignment option	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (likely/positive)
Operational noise Potential decline in social amenity and ability to experience services at the First Church of Christ, Scientist, due to ongoing operational noise. Further detail on noise and vibration impacts in this precinct are detailed in Section 15.3.	National Triangle-Barton alignment option	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of operational noise and vibration mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) 	Medium (likely/minor)

15.7.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage socioeconomic impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for socioeconomic impacts within the Barton precinct.

16.0 Inner South precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Inner South precinct and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 16.1.2)
- Noise and vibration (Section 16.3)
- Biodiversity (Section 16.4)
- Historic heritage (Section 16.5)
- Landscape character and visual amenity (Section 16.6)
- Socioeconomic impacts (Section 16.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

16.1 Overview

The Inner South precinct comprises the extent of Adelaide Avenue, generally between the intersection of Adelaide Avenue and National Circuit and the Cotter Road on- and off-ramps just west of Kent Street. Adelaide Avenue is lined with embassies and The Lodge, home of Australia's Prime Minister.

The Project within this precinct would be consistent for both alignment options. The light rail alignment within this precinct would be within the median along Adelaide Avenue. The precinct would also include new light rail bridges between the existing Adelaide Avenue eastbound and westbound carriageways over Hopetoun Circuit.

The precinct would include two grade separated stops located in the median of Adelaide Avenue – Hopetoun Circuit Stop and Kent Street Stop. The Hopetoun Circuit Stop would be located immediately to the west of Hopetoun Circuit, and the Kent Street Stop would be located immediately to the east of Kent Street overbridge.

At the Hopetoun Circuit Stop, the light rail would transition from wire-free running to use of over-head wiring. Over-head wiring would be adopted from this location through to the Woden Interchange.

The precinct would also include a traction power substation (TPS 8), located off Guilfoyle Street within an existing grassed area.

Key Project features within the Inner South precinct are shown in Figure 16-1. Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

16.1.1 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Key construction activities within the Inner South precinct would include:

- Construction of light rail bridges over Hopetoun Circuit between the existing Adelaide Avenue eastbound and westbound carriageways (as described in Section 6.3.4)
- Construction of the TPS off Guilfoyle Street (as described in Section 6.3.8).

There would be no construction compounds within the Inner South precinct.

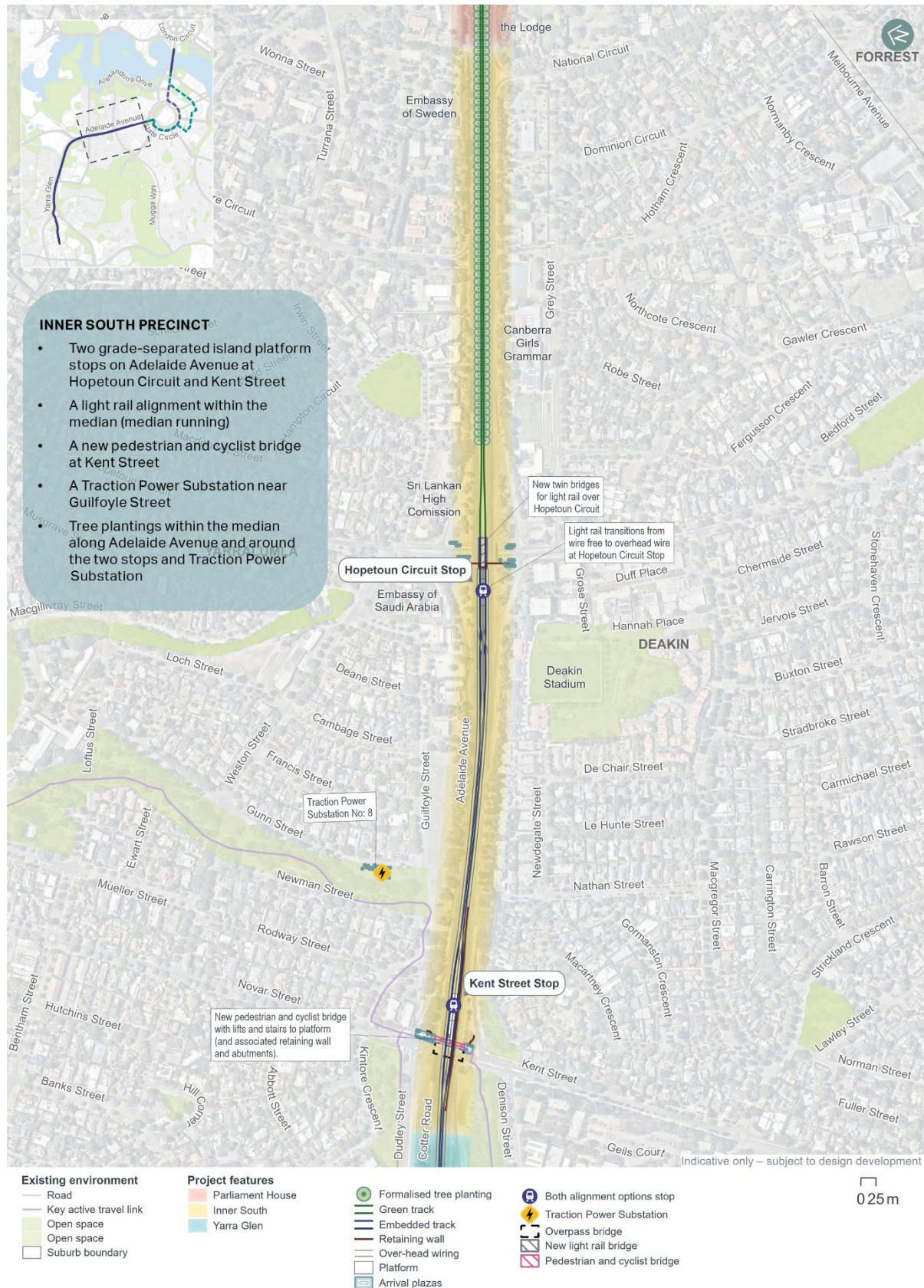


Figure 16-1 Inner South precinct overview – both alignment options

16.1.2 Environmental impact overview – construction

Key impacts within the Inner South precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Traffic and transport

Construction of the Project in the Inner South precinct would be undertaken within and adjacent to the road reserve, and as such would result in the loss of 62 on-street kerbside parking spaces and one bus zone. The loss of these spaces is likely to be staged, so temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction-related traffic and site access, parking availability, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, road works, decommissioning of utilities, construction of stops and construction of bridges on land, are expected to generate noise that could moderately to highly affect nearby residential and non-residential buildings during the day and night, particularly during 'peak' construction scenarios, which represent the noisiest works requiring the use of noise-intensive equipment such as concrete saws and rock breakers. During the night-time hours, a number of sensitive residential receivers are predicted to experience noise levels exceeding the awakening reaction levels, when no mitigations are in place.

Mitigation measures that would be implemented to manage these impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised through effective construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 2014* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 3.02 hectares of vegetation within the Inner South precinct, 0.41 hectares of which is characterised as native. Removal of this vegetation would impact suitable habitat for the Golden Sun Moth (*Synemon plana*) (listed as vulnerable under the EPBC Act and NC Act), foraging habitat for the Gang-gang Cockatoo (*Callocephalon fimbriatum*) (endangered under the EPBC Act and NC Act) and Superb Parrot (*Polytelis swainsonii*) (vulnerable under the EPBC Act and NC Act), and foraging and breeding habitat for the Diamond Firetail (*Stagonopleura guttata*) (vulnerable under the EPBC Act and NC Act). A total of 19 mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been identified in the proposed clearance footprint within the Inner South precinct.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Historic heritage:** The Lodge (listed on the Commonwealth Heritage List) is the only heritage item in the Inner South precinct. No direct impacts as a result of the Project would be experienced, however The Lodge has the potential to be indirectly affected by the Project during construction through vibration caused by construction activities. These impacts would be avoided through appropriate equipment selection, identification, and determination and monitoring of safe vibration levels
- **Landscape character and visual amenity:** Construction activities, such as the establishment of construction compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area. Night-time construction work, where necessary, would also involve lighting that could impact nearby residential properties, particularly near construction activities around the Hopetoun Circuit stop. Works on Hopetoun Circuit would be more prominent in the landscape due to the road corridor sitting above the surrounding landscaping, and would be visible from key locations such as Parliament House and the Telstra Tower on Black Mountain. Mitigation measures, such as high-quality construction hoarding, planting of mature trees to provide some visual buffering, efforts to minimise light spill, and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Socioeconomic:** Potential impacts include disruptions to local amenity, disruptions to the local road network and parking, and adverse impacts to health and wellbeing due to noise, vibration, and visual impacts, which may particularly affect workers, visitors, and accommodation providers in the area. Mitigation measures, such as the implementation of Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP(s) and sub plans, and is included as Appendix L (Environmental Management Plan outline).

16.1.3 Environmental impact overview – operation

Key impacts within the Inner South precinct during the operational stage of the Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Inner South precinct would require several changes to the road network, including adjustments to existing lanes, key intersections and access arrangements to accommodate the light rail infrastructure. Irrespective of the alignment option, the Project would include signalisation of the Adelaide Avenue on/off ramp intersections with Hopetoun Circuit, which would result in substantial decreases in delays in the AM peak hour. Additionally, there would be a permanent loss of three kerbside car spaces along Hopetoun Circuit.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles, and pedestrians with light rail during operation, and review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed on a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Landscape character and visual amenity:** The introduction of light rail infrastructure, including tracks, stops, and over-head wiring, would result in permanent changes to the landscape character and visual amenity of the area. Moderate adverse visual impacts are predicted within Inner South precinct. The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to the management and mitigation of landscape and visual impacts of the Project during operation
- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 16.1.2), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include the potential risk of fauna strike from light rail vehicles (LRVs) or over-head wiring. Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Socioeconomic:** Benefits of the Project within the Inner South precinct include provision of an alternative to private vehicle use, which can enhance accessibility and, over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, most notably from operational noise, disrupting social amenity, and providing additional noise at places of worship and educational facilities. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support the design of high quality and manage these potential impacts
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the precinct, with noise and vibration levels predicted to comply with relevant criteria at most receivers. Some minor exceedances of criteria for airborne and ground-borne noise are predicted at receivers closest to the alignment, such as buildings associated with Canberra Girls Grammar School and the Canberra House of Prayer. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures and operational maintenance planning. These measures would enable residual impacts to be limited
- **Historic heritage:** No direct impacts to heritage places within this precinct are predicted during the operation of the Project. The Lodge (listed on the Commonwealth Heritage Register) has the potential to experience indirect impacts due to plantings on the median of Adelaide Avenue partially impeding views to and from The Lodge, however, these changes would not detract from the place's heritage value and visual prominence.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

16.2 Traffic and transport

This section provides a summarised assessment of the potential multimodal traffic and transport impacts associated with the construction and operation phases of the Project within the Inner South precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

16.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Inner South precinct and the respective study area is indicatively shown in Figure 16-2.

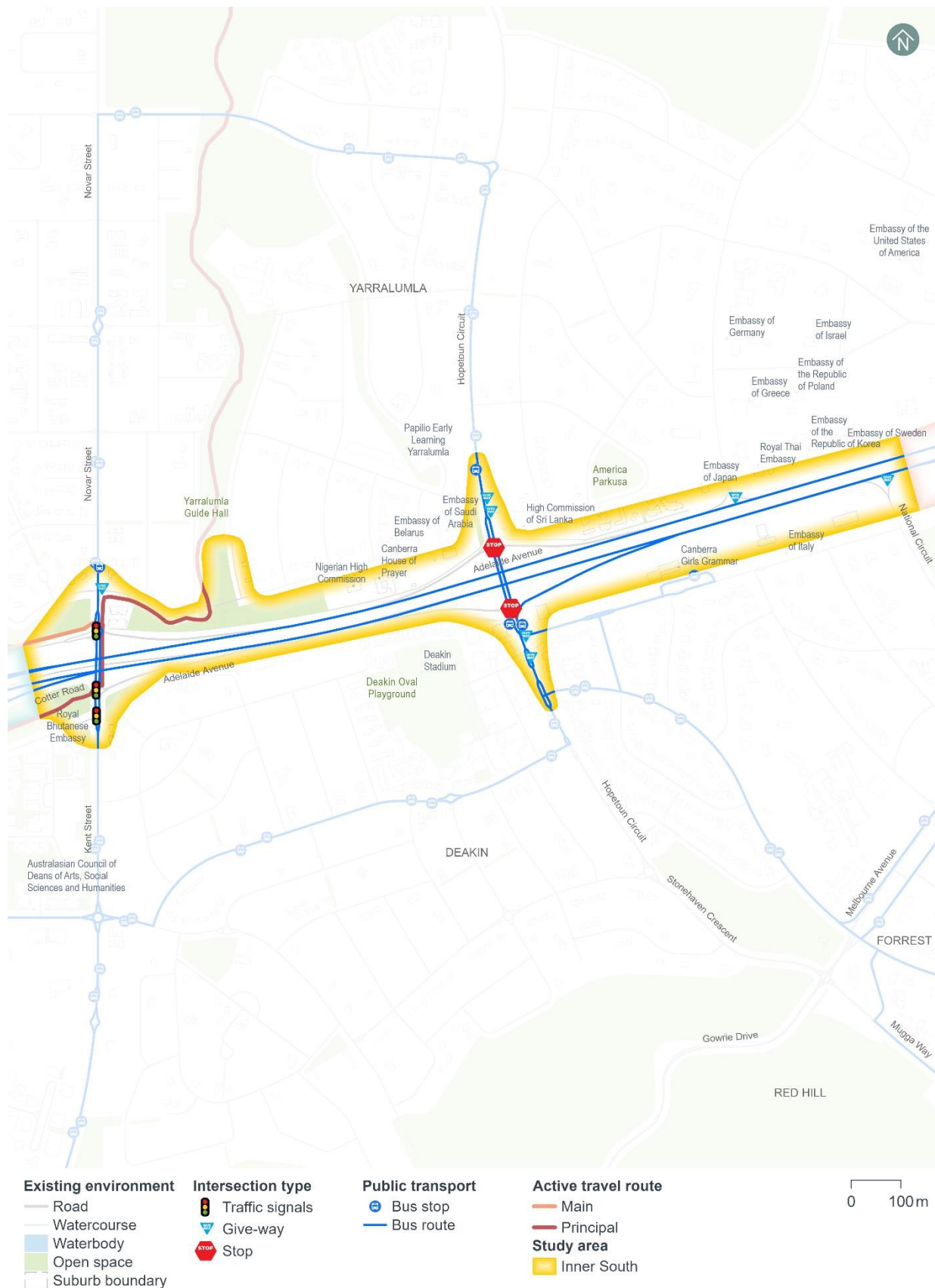


Figure 16-2 Overview of the existing transport network for the Inner South precinct study area

Road network

The characteristics and features of key roads within the Inner South precinct are summarised in Table 16-1.

Table 16-1 Overview of key roads within the Inner South precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Adelaide Avenue	Arterial	Two-way	Three lanes in each direction	80 km/h
Hopetoun Circuit	Major collector	Two-way	One lane in each direction	60 km/h
National Circuit		Two-way	One lane in each direction	50 km/h
Empire Circuit		Two-way	One lane in each direction	50 km/h
Kent Street		Two-way	Two lanes in each direction along Adelaide Avenue overpass. One lane in each direction on either side of overpass	60 km/h
Novar Street		Two-way	One lane in each direction	60 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peak hour traffic counts for various mid-block locations within the Inner South precinct have been analysed and are summarised in Figure 16-3. The 2024 data indicates that traffic volumes along Adelaide Avenue are similar in 2017 and 2024, during the AM and PM peak hours.



Figure 16-3 2017 and 2024 peak hourly traffic volumes within the Inner South precinct study area

Historical average weekday traffic volume, heavy vehicle composition and 85th percentile speed data have also been analysed for key roads within the Inner South precinct, with a summary provided in Table 16-2. The data indicates that heavy vehicles account for around 3% to 4% of the total daily traffic volumes on the key roads through the precinct. Adelaide Avenue's 85th percentile vehicle speed is also slightly higher than the posted speed limit.

Table 16-2 Average weekday traffic volume characteristics on key roads within the Inner South precinct

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
Adelaide Avenue	Between Hopetoun Circuit and Kent Street	2023	49,950	3%	83 km/h
Hopetoun Circuit	Between Grey Street and Grose Crescent	2016	11,360	4%	56 km/h

The weekday average daily traffic volume profile for Adelaide Avenue (refer to Figure 16-4), which indicates a clear AM peak hour between 8:00 am and 9:00 am and a PM peak hour between 5:00 pm and 6:00 pm. Traffic volumes on Adelaide Avenue are typically much lower during off-peak periods.

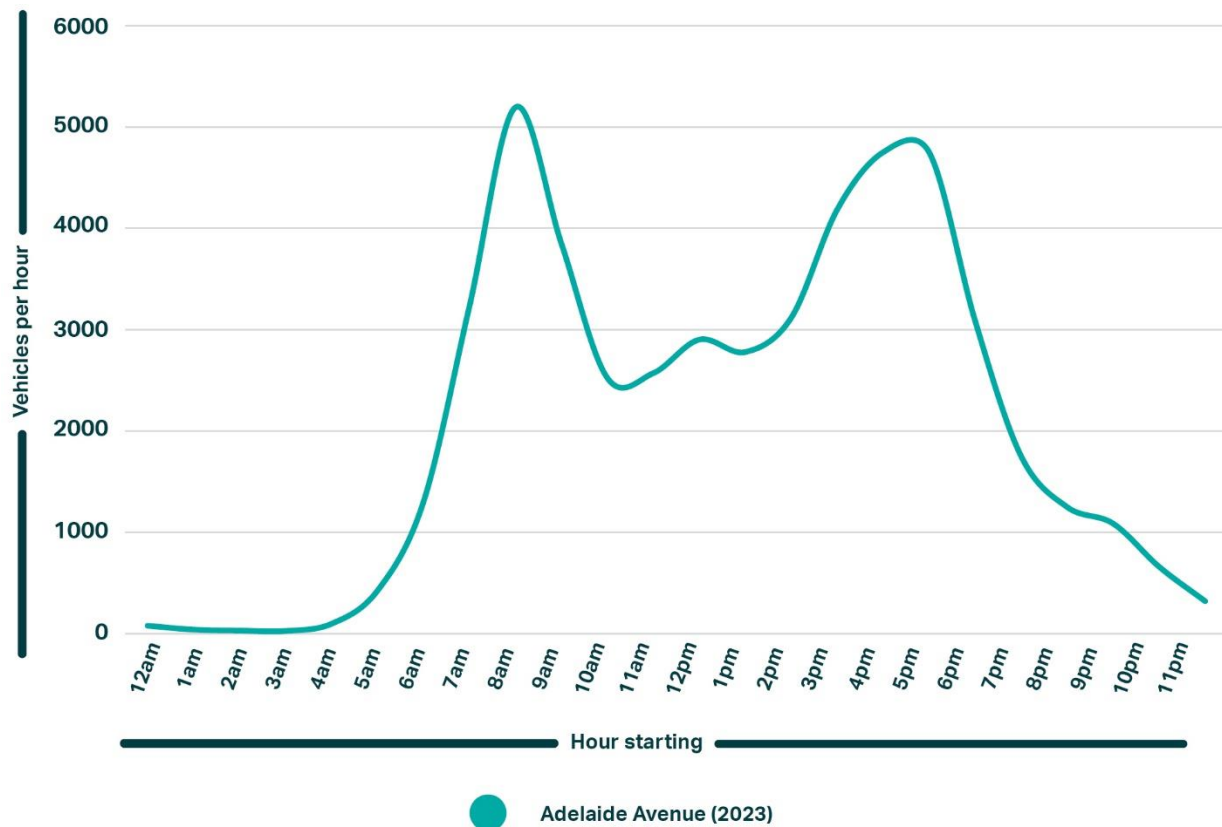


Figure 16-4 Weekday average daily traffic volume profile on Adelaide Avenue

Intersection performance

The operation of the key intersections within the Inner South precinct has been assessed using the microsimulation model which has been calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct existing performance of the assessed intersections is shown in Figure 16-5.

The Adelaide Avenue/Kent Street (south) intersection operated at a level of service F in the AM peak hour in 2017. Level of service represents the extent of delays experienced by drivers at an intersection. It is noted that this intersection is unsignalised and instead priority-controlled in 2017, with the high vehicle delay associated with vehicles trying to find gaps in traffic when turning onto Kent Street from the Adelaide Avenue off-ramp. This intersection has since been upgraded and is now signalised. All other intersections operated satisfactorily at a level of service B or better during the weekday peak hours.

Current observations in June 2024 indicate there are some short periods of congestion on Hopetoun Circuit at the intersections with the Adelaide Avenue on/off-ramps during the AM and PM peak hours. This would reduce the ability for vehicles to turn onto Hopetoun Circuit from the on/off-ramps.



Figure 16-5 2017 AM and PM peak hour intersection performance within the Inner South precinct study area

Public transport

No bus stops are located along Adelaide Avenue within the Inner South precinct. However, there are bus stops on Kent Street and Hopetoun Circuit immediately adjacent to the precinct. These bus stops serve the 57 bus route operated by Transport Canberra, offering connections between the Woden Interchange and the City Interchange.

Multiple bus routes use Adelaide Avenue. However, these buses do not stop within the Inner South precinct. Dedicated T2 transit lanes on Adelaide Avenue within the precinct can only be used by buses and other permitted vehicles.

Active transport

Footpaths adjacent to Adelaide Avenue are throughout the Inner South precinct, typically measuring less than 1.5 m wide. Most connecting side roads, including Empire Circuit, Hopetoun Circuit, Kent Street and Novar Street, feature footpaths on both sides.

Crossing points across Adelaide Avenue are limited to overpasses or underpasses at Kent Street and Hopetoun Circuit. Beyond Adelaide Avenue, signalised pedestrian crossings are at the following intersections:

- Kent Street/Novar Street/Dudley Street on the north and east approaches
- Kent Street/Adelaide Avenue off-ramp on the east and south approaches.

On-road cycle lanes are on both sides of Adelaide Avenue. These cycle lanes cross on-ramps and off-ramps along Adelaide Avenue at multiple locations.

The City to Tuggeranong via Woden principal cycle route runs along the east side of the Kent Street overpass over Adelaide Avenue through the precinct. As identified in the Active Travel Plan 2024-2030 (ACT Government, 2024), an extension of this principal cycle route along Adelaide Avenue between

State Circle and Kent Street is currently being considered to provide an alternative to the existing on-road cycle lanes. In addition, a future network cycling link is also planned on Hopetoun Circuit.

Pedestrian and cyclist count data from 2024 has been used to understand current active travel demand within the Inner South precinct. The AM and PM peak hour counts at key locations within the precinct are summarised in Figure 16-6. As shown, around 30 to 50 cyclists have been recorded at the locations shown below in Figure 16-6. Pedestrian and cyclist volumes along Hopetoun Circuit are low, equating to less than 20 people.

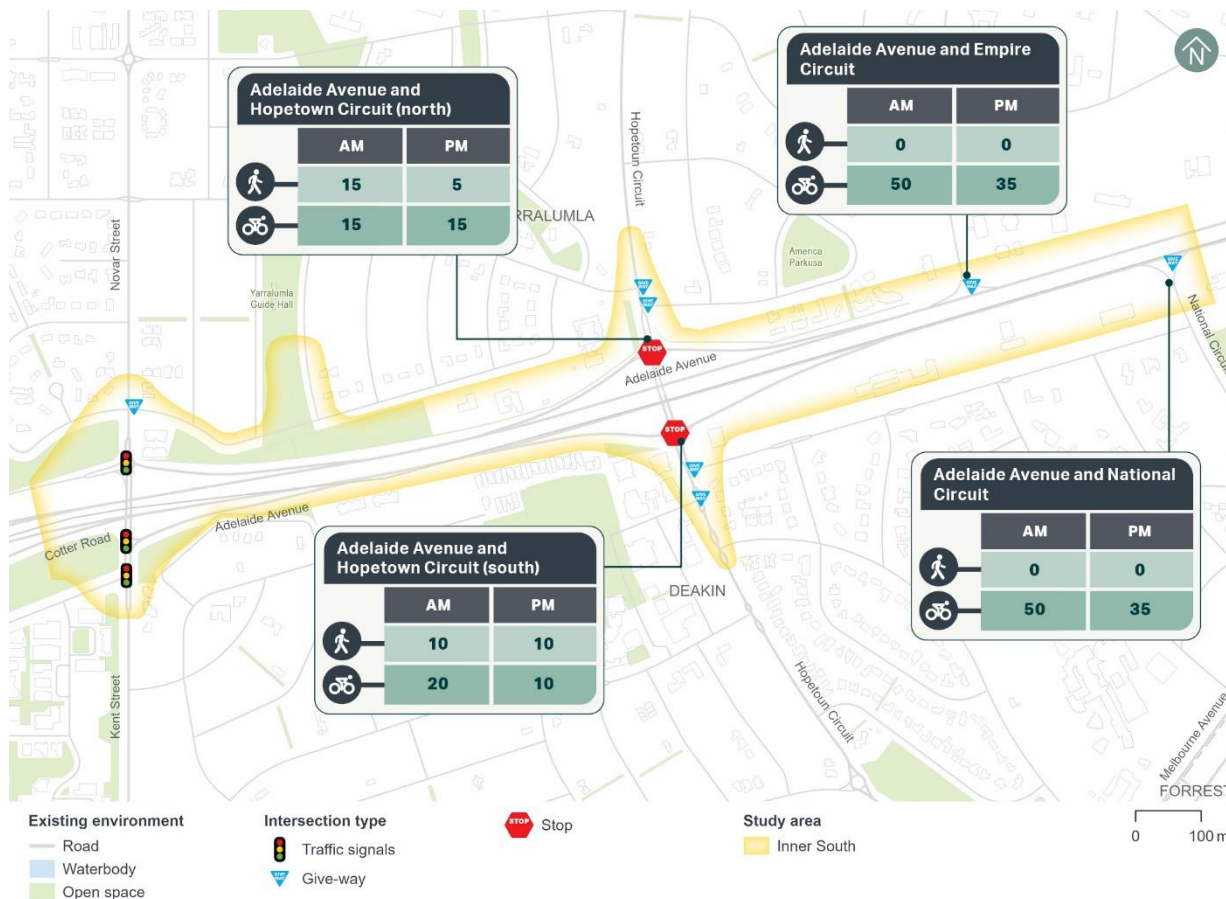


Figure 16-6 2024 peak hour active travel volumes within the Inner South precinct study area

Car parking, kerbside uses, and access

Kerbside uses

The existing kerbside uses including on-street parking within the Inner South precinct are summarised in Table 16-3.

Table 16-3 Inner South precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
Off alignment	Hopetoun Circuit	Precinct study area boundary and Weston Street	East	Unrestricted	6
			West	Unrestricted	7
				Bus zone (public)	N/A
		Weston Street and Adelaide Avenue	East	Unrestricted	3
			West	Unrestricted	6

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
		Adelaide Avenue and Grose Street	East	Bus zone (public)	N/A
			West	Bus zone (public)	N/A
				2P	6
		Grose Street and precinct study area boundary	West	Taxi zone	2
				1/4P	3
	Kintore Crescent/ Guilfoyle Street	Novar Street and Gunn Street	North	Unrestricted	11
			South	Unrestricted	18
	Denison Street	Kent Street and Geils Court	South	Bus zone	N/A
Total					62

Off-street parking

No off-street parking is located within the Inner South precinct. Further afield and adjacent to the Inner South precinct, a mix of restricted and unrestricted off-street parking is provided for the retail and commercial areas within Deakin.

Property access

There is only one property access within the Inner South precinct, which is a two-way access on Adelaide Avenue at the Lodge.

Crash history

Figure 16-7 shows the five year crash history (1 January 2018 to 31 December 2022) within the Inner South precinct.

A total of 216 crashes have been recorded during the five year period, including:

- One crash that resulted in a serious injury (less than 1%)
- 21 crashes that resulted in a minor injury (around 10%)
- 194 crashes that resulted in property damage only (around 90%).

The following common crash types occurred:

- Around 69% of crashes involved a rear end collision
- Around 11% of crashes involved right angle collision
- Around 11% of crashes involved a same direction side swipe.



Figure 16-7 Crash data between 2018 and 2022 within the Inner South precinct study area

Modelling approach

The transport modelling assumptions have adopted the 'committed and funded expenditure approach' as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The 'committed and funded expenditure approach' requires that only transport projects identified as 'committed and funded' are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as 'committed and funded' are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

16.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside use

It is estimated that all 62 identified on-street kerbside spaces and one bus zone would be lost within the Inner South precinct, including:

- 33 spaces on Hopetoun Circuit (off-alignment)
- 29 spaces on Kintore Crescent/Guilfoyle Street (off-alignment)
- One bus zone on Denison Street.

Of these kerbside uses, three on-street kerbside spaces along Hopetoun Circuit would be permanently lost as part of the Project's permanent works. The remaining spaces would be temporarily lost during construction. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

Off-street parking

The Project's construction would not change any off-street parking within the Inner South precinct.

Local area access

The Project's construction would not change any local area access arrangements within the Inner South precinct.

Property access

The Project's construction would not change any property accesses within the Inner South precinct.

16.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.3 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Inner South precinct would include adjustments to existing lanes, key intersection adjustments, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Inner South precinct, particularly on Adelaide Avenue, Hopetoun Circuit, Kent Street/Novar Street and Cotter Road.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

The Project would result in traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) across the broader road network as drivers seek alternative routes to maintain travel times. This results in some differences in traffic volumes between the with and without Project scenarios, even in locations where there would be no road network changes as part of the Project. Although the two alignment options are the same within the Inner South precinct, different travel patterns are also expected throughout the precinct due the different alignment configurations further afield in the Commonwealth Avenue, Parliament House, National Triangle and Barton precincts.

Traffic volume changes caused by the State Circle East alignment option are summarised in Table 16-4 and Table 16-5, and those caused by the National Triangle-Barton alignment option are summarised in Table 16-6 and Table 16-7. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance, particularly the Project's reduced capacity on State Circle and Adelaide Avenue, caused by lane reductions and the introduction of light rail signal phases and the signalisation of the Hopetoun Circuit interchange intersections
- Changes in mode choice due to the introduction of light rail.

*State Circle East alignment option***Table 16-4 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Inner South precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Adelaide Avenue	Between Hopetoun Circuit and Empire Circuit	Eastbound	4,590	4,280	-310	-7%	4,030	4,220	190	5%
		Westbound	2,570	2,260	-310	-12%	2,710	2,330	-380	-14%
Hopetoun Circuit	Below Adelaide Avenue	Northbound	590	570	-20	-3%	590	560	-30	-5%
		Southbound	1,460	1,270	-190	-13%	1,430	1,250	-180	-13%
Kent Street	Above Adelaide Avenue	Northbound	690	790	100	14%	750	820	70	9%
		Southbound	600	670	70	12%	520	750	230	44%

Table 16-5 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Inner South precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Adelaide Avenue	Between Hopetoun Circuit and Empire Circuit	Eastbound	2,210	2,030	-180	-8%	2,620	2,260	-360	-14%
		Westbound	3,860	3,920	60	2%	3,760	3,630	-130	-3%
Hopetoun Circuit	Below Adelaide Avenue	Northbound	630	540	-90	-14%	580	480	-100	-17%
		Southbound	790	780	-10	-1%	840	1,020	180	21%
Kent Street	Above Adelaide Avenue	Northbound	1,430	1,320	-110	-8%	1,330	1,360	30	2%
		Southbound	360	370	10	3%	370	470	100	27%

*National Triangle-Barton alignment option***Table 16-6 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Inner South precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Adelaide Avenue	Between Hopetoun Circuit and Empire Circuit	Eastbound	4,590	4,270	-320	-7%	4,030	3,910	-120	-3%
		Westbound	2,570	2,480	-90	-4%	2,710	2,310	-400	-15%
Hopetoun Circuit	Below Adelaide Avenue	Northbound	590	640	50	8%	590	590	0	0%
		Southbound	1,460	1,220	-240	-16%	1,430	1,280	-150	-10%
Kent Street	Above Adelaide Avenue	Northbound	690	710	20	3%	750	760	10	1%
		Southbound	600	610	10	2%	520	660	140	27%

Table 16-7 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Inner South precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Adelaide Avenue	Between Hopetoun Circuit and Empire Circuit	Eastbound	2,210	2,230	20	1%	2,620	2,410	-210	-8%
		Westbound	3,860	3,970	110	3%	3,760	3,920	160	4%
Hopetoun Circuit	Below Adelaide Avenue	Northbound	630	610	-20	-3%	580	590	10	2%
		Southbound	790	700	-90	-11%	840	840	0	0%
Kent Street	Above Adelaide Avenue	Northbound	1,430	1,480	50	3%	1,330	1,470	140	11%
		Southbound	360	450	90	25%	370	480	110	30%

Road network performance

The Project's impacts on the road network in the Inner South precinct are primarily confined to the longitudinal corridor along Adelaide Avenue and its closely spaced interchanges with Hopetoun Circuit and Kent Street/Novar Street.

AM peak hour

During the AM peak hour in 2031 and 2041, the eastbound off-ramp from Adelaide Avenue to the unsignalised intersection with Hopetoun Circuit would experience lengthy delays and high levels of congestion without the Project due to the increased vehicle flows along Hopetoun Circuit. These delays would cause vehicle queuing to extend onto Adelaide Avenue and back to Cotter Road and the Carruthers Street interchange. The vehicle queuing blocks the on-ramp from Kent Street/Novar Street which would cause congestion and vehicle delays along Kent Street/Novar Street and at its intersections.

The Project, irrespective of the alignment option, would include signalisation of the Adelaide Avenue on/off ramp intersections with Hopetoun Circuit. As a result, vehicle delays during the AM peak hour in both 2031 and 2041 scenarios would decrease substantially with the Project, particularly eastbound along Adelaide Avenue and on the off-ramp to Hopetoun Circuit.

PM peak hour

During the PM peak hour in 2031 and 2041, the westbound off-ramp from Adelaide Avenue to the unsignalised intersection with Hopetoun Circuit would experience lengthy delays without the Project due to increased vehicle flows along Hopetoun Circuit.

The Project's changes to the Inner South precinct's road network and associated traffic reassignment (irrespective of the alignment option) would cause the following changes to congestion and delay when compared to the without Project scenario in 2031 and 2041 in the PM peak hour:

- Increased congestion and delay on Adelaide Avenue in the westbound direction between National Circuit and the Hopetoun Circuit interchange due to the reduced number of lanes on Adelaide Avenue
- Increased congestion and delay on National Circuit due to insufficient gaps in the westbound traffic stream on Adelaide Avenue.

Intersection performance

State Circle East alignment option

The performance of the key intersections within the Inner South precinct with and without the Project for the State Circle East alignment option is provided in Table 16-8 and Table 16-9. Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport. Key findings relating to intersection performance are as follows:

AM peak hour:

- The assessed intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios. The exception is the Dudley Street/Novar Street/Kent Street intersection which would operate at a level of service E in the 2031 scenario, although noting it would be on the boundary of level of service D and E
- All intersections generally operate better with the Project compared to without the Project. On Hopetoun Circuit, this is primarily a result of the signalisation of the Adelaide Avenue on/off ramp intersections. The signalisation of the Hopetoun Circuit intersections would also reduce eastbound queuing on Adelaide Avenue, which has a flow-on impact of improving the performance of the Dudley Street/Novar Street/Kent Street (north).

PM peak hour:

- The assessed intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios
- Similar to the AM peak hour, most intersections operate better with the Project compared to without the Project. This is primarily as a result of the signalisation of the Adelaide Avenue on/off ramp intersections and its flow on impacts.

Table 16-8 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Inner South precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Adelaide Avenue/Hopetoun Circuit (north) - on/off ramps	>150	F	51	D	>150	F	51	D
Adelaide Avenue/Hopetoun Circuit (south) - on/off ramps	18	B	15	B	28	C	17	B
Dudley Street/Novar Street/Kent Street (north)/Adelaide Avenue - on/off ramps	>150	F	56	E	>150	F	53	D
Kent Street (south)/Adelaide Avenue - on/off ramps	82	F	41	D	115	F	41	D

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 16-9 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Inner South precinct (State Circle East alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Adelaide Avenue/Hopetoun Circuit (north) - on/off ramps	19	B	40	D	16	B	40	D
Adelaide Avenue/Hopetoun Circuit (south) - on/off ramps	>150	F	33	C	>150	F	28	C
Dudley Street/Novar Street/Kent Street (north)/Adelaide Avenue - on/off ramps	35	C	29	C	44	D	31	C
Kent Street (south)/Adelaide Avenue - on/off ramps	20	B	21	C	25	C	26	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

National Triangle-Barton alignment option

The performance of the key intersections within the Inner South precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 16-10 and Table 16-11. Key findings relating to intersection performance are as follows:

AM peak hour:

- The following intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios. The following intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041 scenarios:
 - Adelaide Avenue/Hopetoun Circuit (north) - on/off ramps
 - Adelaide Avenue/Hopetoun Circuit (south) - on/off ramps
 - Adelaide Avenue/Kent Street (south) - on/off ramps
- The Dudley Street/Novar Street/Kent Street intersection would operate at a level of service E with the Project in 2031 and 2041 scenarios
- All intersections generally operate better with the Project compared to without the Project. On Hopetoun Circuit, this is primarily a result of the signalisation of the Adelaide Avenue on/off ramp intersections. The signalisation of the Hopetoun Circuit intersections would also reduce eastbound queuing on Adelaide Avenue, which has a flow-on impact of improving the performance of the Dudley Street/Novar Street/Kent Street (north).

PM peak hour:

- The assessed intersections would generally operate satisfactorily at a level of service C or better with the Project in 2031 and 2041 scenarios
- Similar to the AM peak hour, the Adelaide Avenue/Hopetoun Circuit (south) and Dudley Street/Novar Street/Kent Street intersections operate better with the Project compared to without the Project. This is primarily due to the signalisation of the Adelaide Avenue on/off ramp intersections and its flow-on impacts.

Table 16-10 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Inner South precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Adelaide Avenue/Hopetoun Circuit (north) - on/off ramps	>150	F	44	D	>150	F	44	D
Adelaide Avenue/Hopetoun Circuit (south) - on/off ramps	13	B	17	B	28	C	19	B
Dudley Street/Novar Street/Kent Street (north)/Adelaide Avenue - on/off ramps	>150	F	61	E	>150	F	63	E
Kent Street (south)/Adelaide Avenue - on/off ramps	81	F	28	C	119	F	26	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 16-11 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Inner South precinct (National Triangle-Barton alignment option)

Intersection	2031 scenario				2041 scenario			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Adelaide Avenue/Hopetoun Circuit (north) - on/off ramps	18	B	33	C	31	C	35	C
Adelaide Avenue/Hopetoun Circuit (south) - on/off ramps	>150	F	33	C	>150	F	33	C
Dudley Street/Novar Street/Kent Street (north)/Adelaide Avenue - on/off ramps	36	D	31	C	42	D	35	C
Kent Street (south)/Adelaide Avenue - on/off ramps	20	B	22	C	23	C	27	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Active travel

For much of the Project, existing active travel arrangements would be retained and would be complemented by new active travel arrangements or treatments. The key pedestrian and cyclist pathways that would be provided within the Inner South precinct as part of the Project and their benefits or impacts are summarised in Table 16-12.

Table 16-12 Active travel provisions within the Inner South precinct and associated impacts and benefits

Proposed treatment	Impact or benefit
New traffic signals would be provided on the on and off ramp intersections with Hopetoun Circuit.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
Existing on-road cycleways on Adelaide Avenue would be retained, however minor modifications would be required at the upgraded intersections located at the on and off ramps with Adelaide Avenue and Hopetoun Circuit.	The reconfiguration of the Adelaide Avenue on-road cycleways at Hopetoun Circuit would generally not impact the existing level of active travel accessibility.
A new public plaza would be provided on Hopetoun Circuit.	The plaza would provide improved pedestrian and cyclist amenity and a connection to the Hopetoun Circuit Stop.
The unsignalised crossings on the left turn exits of the Adelaide Avenue off ramps at Kent Street would be signalised to facilitate higher volume pedestrian crossings.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
A new bridge and pedestrian plazas would be provided as part of the Project to provide pedestrian and cyclist connections at the Kent Street Stop.	The plazas and bridge would provide pedestrian and cyclist connectivity to the Kent Street Stop.

Investigations into the feasibility of an Adelaide Avenue and Yarra Glen cycleway have identified a potential alignment for a future shared path link along these road corridors. Some elements of this shared path will be progressed outside of this Environmental Impact Statement (EIS) process, as an allied or related project(s) with separate approvals. The Project has considered and would not preclude future development of cycling infrastructure along Adelaide Avenue and Yarra Glen.

Kerbside use

The Project would remove three on-street kerbside spaces along Hopetoun Circuit within the Inner South precinct. Historical aerial imagery and site observations from 11 June 2024 indicate that these spaces are currently not well utilised.

Off-street parking

The Project would not change any off-street parking within the Inner South precinct.

Local area access

The Project would not change any local area access arrangement within the Inner South precinct.

Property access

The Project would not change any property accesses within the Inner South precinct.

16.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Part C (Mitigation and residual environmental risks). This includes construction and operational mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the Inner South precinct.

16.3 Noise and vibration

This section provides an assessment of the potential noise and vibration risks associated with the Project within the Inner South precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

16.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas were determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Area 7 was identified for the noise assessment of the Inner South precinct. Noise Catchment Area 7 and associated sensitive receivers are shown in Figure 16-8.

The majority of the land uses within Noise Catchment Area 7 are suburban residential developments to the north and south of Adelaide Avenue. Other land uses include commercial, public buildings, childcare centres, and educational land uses. There are also several mixed-use land uses (international embassies) to the east of the catchment area.

The Lodge (listed on the Commonwealth Heritage List) is also located within the Noise Catchment Area at its eastern extent, near its boundary with the Parliament House precinct. Further detail on heritage places in this precinct is included in Section 16.5.

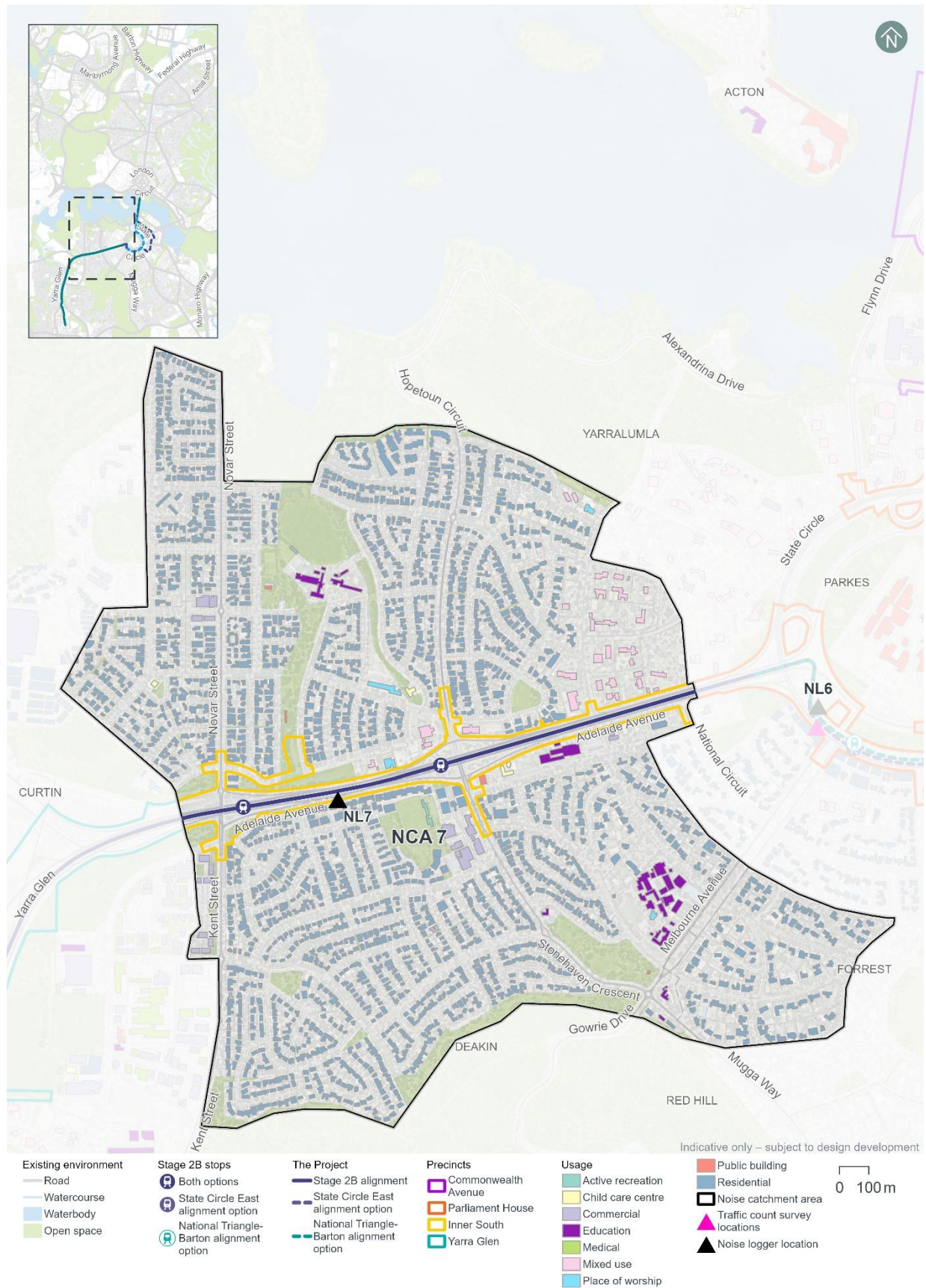


Figure 16-8 Noise catchment area and sensitive receivers – Inner South precinct

Existing noise levels

Unattended noise monitoring was carried out at one location in the Inner South precinct (at noise logger 7 (NL7)) between 2 and 15 May 2024, to provide a representation of existing background noise levels. The background noise levels at this location are primarily driven by proximity to the Adelaide Avenue road corridor. The results of this monitoring are summarised in Table 16-13.

The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 16-13 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL7	63 Newdegate Street, Deakin	59	30 ³	70	62

Notes:

- $dB(A)$ represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
- In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 16-14.

Table 16-14 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL7	68	61	Noise recorded was primarily traffic noise from Adelaide Avenue.

16.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Inner South precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project; therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures). All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 16-15, which assumes no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 16-16.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Construction noise modelling indicates that there would be no difference in noise impacts in this precinct based on the alignment option selected.

Table 16-15 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place) – Inner South precinct

Construction scenario	Construction work category	Predicted noise affected residential buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 7				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	49	903	196
	Typical	4	287	72
Earthworks, road works, and construction of light rail infrastructure	Peak	44	792	196
	Typical	20	477	118
Construction of stops	Typical/peak	-	31	-
Construction of bridges on land	Peak	5	843	88
	Typical	-	213	21

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

Table 16-16 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) – Inner South precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 7		
Protection, relocation, treatment and/or decommissioning of utilities - peak	Child care centre	3
	Education	2
	Place of worship	1
	Public buildings	2
Protection, relocation, treatment and/or decommissioning of utilities - typical	Child care centre	2
	Education	2
	Place of worship	1
	Public buildings	1
Earthworks, road works, and construction of light rail infrastructure – peak	Child care centre	2
	Education	2
	Place of worship	1
	Public buildings	2
Earthworks, road works, and construction of light rail infrastructure – typical	Child care centre	2
	Education	2
	Place of worship	1
	Public buildings	2
Construction of bridges on land - peak	Child care centre	2
	Education	1
	Place of worship	1
	Public buildings	1
Construction of bridges on land – typical	Child care centre	2

Notes:

1. Where a construction scenario did not result in any non-residential building being moderately noise affected, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the Inner South precinct during the daytime indicate:

- The 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in 49 residential buildings being moderately noise affected

- The 'peak' protection, relocation, treatment and/or decommissioning of utilities scenario is predicted to result in eight non-residential receiver buildings being moderately noise affected, including two buildings within Canberra Girls Grammar Junior School, two buildings within Canberra Girls Grammar School Early Learning Centre, Papilio Early Learning Yarralumla, the Margaret Dimoff Art Gallery, the Yarralumla Guide Hall, and Canberra House of Prayer. It is understood that Canberra House of Prayer offers temporary residential accommodation. To be conservative the building has been assessed as a place of worship as this attracts a more stringent noise criteria compared to a hotel or commercial development.

The findings of the unmitigated peak and typical construction noise impact assessments for the Inner South precinct during the night-time period indicate:

- During out of hours, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in 903 residential buildings being moderately noise affected, and a total of 196 receivers are expected to be highly noise affected at times
- During out of hours, 'typical' earthworks, road works and construction of light rail infrastructure is predicted to result 477 residential receiver buildings being moderately noise affected, and a total of 118 receivers are expected to be highly noise affected
- There are two hotel (commercial) receiver buildings – Gates Cottage Bed & Breakfast and Practically Lakeside B&B – within the noise catchment area. They are not predicted to be moderately noise affected.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical works' case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 16-17 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Area 7, in the absence of mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently, and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 16-17 Number of residential buildings where noise levels may exceed awakening reaction levels for night works (assuming no mitigation measures are in place)

Construction scenario (typical works)	Number of residential buildings where unmitigated noise levels may exceed the sleep awakening reaction level
Protection, relocation, treatment and/or decommissioning of utilities	400
Earthworks, road works, and construction of light rail infrastructure	703
Construction of stops	50
Construction of bridges on land	412

Noting the awakening reaction level is exceeded by a number of residential buildings with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments. Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. A number of residential buildings are located within the human response minimum working distance for a large hydraulic hammer (73 m from the Project area boundary). There is potential for exceedances of the human comfort criteria to occur depending on the duration, nature and location of the construction activity within the construction footprint. Any exceedances would be expected to be relatively short in duration due to the intermittent nature of vibration emissions.

Cosmetic damage

A number of light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures). One heritage-listed structure, The Lodge (listed on the Commonwealth Heritage List), is located 32 metres from the Project area, within the minimum working distance (60 m for heritage and other sensitive structures).

The Lodge is located near the boundary of the Parliament House and Inner South precincts, and has the potential to be affected by works from both precincts. Potential noise and vibration impacts from works in the Parliament House precinct on The Lodge are assessed in Section 13.3.2.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further information on mitigation measures is provided in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (AM peak period, 8am to 9am) and night-time (10pm to 7am) are presented in Table 16-18. The year 2031 was selected as representative of the peak year of construction.

No increases in road traffic noise greater than 2 dB(A) have been identified along the proposed haulage routes within the Inner South precinct during either the daytime or night-time periods. Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener.

Table 16-18 Construction road traffic noise peak hourly traffic counts

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Adelaide Avenue between Hopetoun Circuit and Kent Street	Westbound	1,520	114	1	5	0.1
	Eastbound	2,302	173	1	5	0.0
Night-time assessment						
Adelaide Avenue between Hopetoun Circuit and Kent Street	Westbound	215	16	19	2	0.5
	Eastbound	119	9	19	2	0.8

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

16.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Inner South precinct. The potential impacts are common to both alignment options, given the consistent Project design in this precinct.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of the alignment. This included a total of 1,254 receivers in the Inner South precinct, including residential receivers, mixed use receivers, education and childcare centres, places of worship, medical receivers, public buildings and active recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

The results of the operational rail noise assessment identified six exceedances of the airborne noise trigger levels, across four different receivers that would be in close proximity to the alignment. The noise sensitive receivers that would experience exceedances of the noise trigger level are presented in Table 16-19 and Table 16-20. At multistorey buildings, the airborne rail noise assessment documents noise levels for the most affected floor.

The majority of receivers assessed are not predicted to experience exceedances of the noise trigger levels. Predicted noise impacts are intermittent and last for a relatively short duration as the LRV passes the receiver and is not representative of a constant noise source.

Table 16-19 Inner South precinct noise sensitive receiver L_{AFmax} exceedances (daytime and night-time, assuming no mitigation measures are in place) – residential receivers

ID	Usage	Address	Predicted L_{AFmax} noise level, dB(A)	L_{AFmax} noise trigger level, dB(A)	Exceedance dB(A)
2915	Residential	41 Hampton Circuit, Yarralumla	81	80	1

Table 16-20 Inner South precinct noise sensitive receiver daytime $L_{Aeq,1hr}$ exceedances (daytime; assuming no mitigation measures are in place)– non-residential receivers

ID	Usage	Address	Predicted daytime $L_{Aeq,1hr}$ noise level, dB (A)	Daytime $L_{Aeq,1hr}$ noise trigger level, dB(A) ¹	Exceedance dB(A)
2529	Education	Canberra Girls Grammar School, 24 Grey Street Deakin	59	53	6
2631	Education	Canberra Girls Grammar School, 24 Grey Street Deakin	56	53	3
3527	Childcare Centre	Canberra Girls Grammar School Early Learning Centre, 20 Grey Street Deakin	57	53	4
4035	Childcare Centre	Canberra Girls Grammar School, 24 Grey Street Deakin	57	53	4
4139	Place of Worship	Canberra House of Prayer, 28 Guilfoyle Street Yarralumla	58	53	5

Notes:

1. Refer to Appendix F of Technical Report 9 – Noise and vibration for the location of identified receivers.

The predicted L_{AFmax} noise levels are up to 1 dB(A) in excess of the trigger levels for residential receivers. Changes in noise level by up to 2 dB(A) are not considered to be perceptible by the average listener. Therefore, it is not considered reasonable to consider additional noise mitigation measures.

The predicted $L_{Aeq,1hr}$ noise levels are up to 6 dB(A) in excess of the trigger levels for non-residential receivers, assuming no mitigation measures are in place.

Mitigation measures in Chapter 21 (Environmental management and mitigation measures) of the EIS would be implemented to manage potential operational noise impacts.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Inner South precinct at the most affected (closest) receiver is presented in Table 16-21. Ground-borne noise levels at the most affected receiver (41 Hampton Circuit, Yarralumla) was predicted to exceed the ground-borne noise trigger levels.

Table 16-21 Inner South precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted ground-borne noise level, dB(A) L_{ASmax}
41 Hampton Circuit, Yarralumla	Residential	30	70	35	37

Targeted mitigation is recommended when ground-borne noise levels are higher than the airborne noise levels. The airborne noise levels for internal spaces with windows open are predicted to be L_{ASmax} 70 dB(A) for the most affected receiver during the night-time period. These airborne noise levels are higher than the ground-borne noise levels, and therefore no additional treatment is considered necessary for the alignment within the Inner South precinct to manage this impact.

Rail vibration assessment

The predicted vibration levels for the Inner South precinct at the most affected (closest) receiver is presented in Table 16-22. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria.

Table 16-22 Inner South precinct – vibration assessment results (human comfort; assuming no mitigation measures are in place)

Address and building usage	Distance from track centreline, m	Vibration Criteria (Daytime), m/s ^{1.75}	Predicted equivalent vibration dose value (Daytime), m/s ^{1.75}	Vibration Criteria (Night), m/s ^{1.75}	Predicted equivalent vibration dose value (Night), m/s ^{1.75}
41 Hampton Circuit, Yarralumla <i>Residential</i>	30	0.2	0.008	0.13	0.004

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is provided in Table 16-23.

Table 16-23 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, L _{Aeq,15hr}	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected to represent the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Inner South precinct, existing road traffic noise levels on Adelaide Avenue are greater than 60 dBA. Future predicted road traffic noise levels would not noticeably increase, and are therefore considered acceptable.

The results of the road traffic noise assessment for each alignment option are presented in Table 16-24 to Table 16-27, for 2031 and 2041 scenarios respectively.

Table 16-24 Road traffic noise assessment, 2031 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Adelaide Avenue	71 Newdegate Street, Deakin	Westbound	30,682	2,668	-2,328	-202	0	Yes, no increase in traffic noise level
		Eastbound	53,302	4,635	-2,730	-237		

Table 16-25 Road traffic noise assessment, 2031 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Adelaide Avenue	71 Newdegate Street, Deakin	Westbound	30,682	2,668	-1,375	-120	0	Yes, no increase in noise level
		Eastbound	53,302	4,635	-6,115	-532		

Table 16-26 Road traffic noise assessment, 2041 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Adelaide Avenue	71 Newdegate Street, Deakin	Westbound	31,740	2,760	-2,857	-248	0	Yes, no increase in noise level
		Eastbound	48,562	4,223	2,539	221		

Table 16-27 Road traffic noise assessment, 2041 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Adelaide Avenue	71 Newdegate Street, Deakin	Westbound	31,740	2,760	-3,174	-276	0	Yes, no increase in noise level
		Eastbound	48,562	4,223	-4,020	-350		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the LA10, 15min assessment noise level at any location. Within the Inner South precinct, stops are located at Hopetoun Circuit and Kent Street.

The Hopetoun Circuit Stop is located approximately 60 m from the nearest residential receivers.. Although noise from road traffic along Adelaide Avenue would dominate the noise environment, there is potential for annoyance if PA systems are audible at residences. The subjective impacts are however likely to be minimal given the relative infrequency of announcements, and existing background noise levels.

The Kent Street Stop is located approximately 60 m from the nearest residential receivers. Noise from Adelaide Avenue would dominate the noise environment. However, subjective impacts are likely to be minimal given the relative infrequency of announcements and the existing road embankments on the north and south sides of Adelaide Avenue that is likely to shield noise from the PA systems.

Fixed facilities noise assessment – Traction power substation noise

Within this precinct, TPS8 would be located off Guilfoyle Street. The predicted TPS noise levels at the nearest affected receiver are presented in Table 16-28. Based on the assessment, the TPS design is anticipated to meet applicable noise criteria.

Table 16-28 Predicted TPS noise level at affected receivers

TPS location	Distance to nearest receiver, m	Predicted L _{A10} noise level, dB(A)	Night-time noise zone standard, L _{A10,15min} , dB(A) ¹	Compliance
TPS8 – Yarralumla	30	31	35	Yes

Notes:

1. Determined based on the Environmental Protection Regulation 2005

16.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage noise and vibration impacts that are specific to the Inner South precinct are shown in Table 16-29.

Table 16-29 Noise and vibration mitigation measures – Inner South precinct

ID	Objective	Management and mitigation measure	Timing
NV14	Minimising operational noise and vibration through design – from traction power stations	Traction power substations will be designed to: <ul style="list-style-type: none"> • Maximise setbacks to sensitive receiver • Locate noise sources, including ventilation openings away from sensitive receivers and/or within an acoustic enclosure. 	Design and operation

16.4 Biodiversity

This section describes the potential impacts of the Project on biodiversity and provides a summary of the biodiversity assessment for the Inner South precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 3 of Technical Report 2 – Biodiversity.

16.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Inner South precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 9.27 ha of vegetation is present in the Inner South precinct. Vegetation within the Inner South precinct is comprised of four vegetation communities. Table 16-30 and Figure 16-9 depict the extent and distribution of each vegetation community within the Inner South precinct.

Table 16-30 **Extent of vegetation communities within the Project area in the Inner South precinct**

Vegetation community	Area (ha)
ACT01.2 Tablelands Dry Tussock Grassland – (moderate diversity)	0.01
Landscape plantings – Native	3.33
Landscape plantings – Exotic	1.62
Exotic grassland	4.31
Total vegetation	9.27



Figure 16-9 Distribution of vegetation communities, hollow-bearing and mature trees in the Inner South precinct

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Hollow-bearing trees and mature trees

A total of 41 hollow-bearing trees and 95 mature trees have been recorded in the Inner South precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 16-31 summarises the number of hollow-bearing and mature trees within the Inner South precinct and is shown in Figure 16-9.

Field work carried out between 2022 and 2024 has identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 16-31 Summary of hollow-bearing and mature trees within the Project area in the Inner South precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Inner South	41	8	23	26	32	1	95

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat assessment

The Golden Sun Moth is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 0.98 ha of potential Golden Sun Moth habitat has been recorded within the Inner South precinct. This habitat has been identified as high quality (0.03 ha), low-quality (0.07 ha), low-density (0.27 ha), and high-density (0.61 ha) Chilean needlegrass habitat (refer to Figure 16-10).

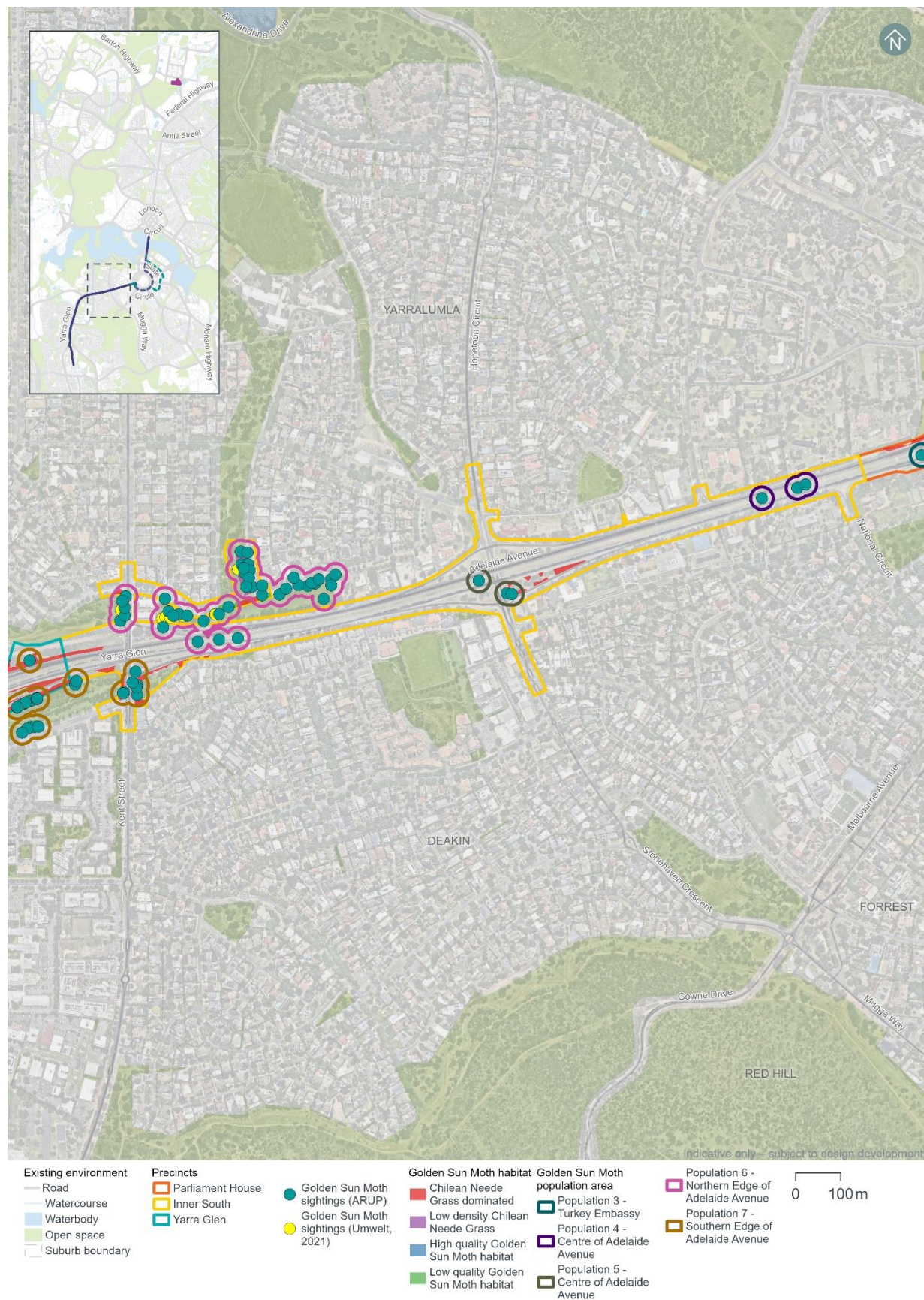


Figure 16-10 Golden Sun Moth habitat and sightings in the Inner South precinct

Five Golden Sun Moth populations has been identified in the Inner South precinct, through previous biodiversity assessments reviewed for this EIS (ARUP, 2021). The locations of the populations are shown in Figure 16-10 and include:

- Population 2 – around State Circle and Barton (Parliament House and Inner South precincts)
- Population 4 and 5 – in centre of Adelaide Avenue
- Population 6 - along the northern edge of Adelaide Avenue near the Cotter Road Junction
- Population 7 – along the southern edge of Adelaide Avenue near the Cotter Road Junction (Inner South and Yarra Glen precinct).

Other Golden Sun Moth populations and habitat across the Project area are identified in Section 11.2 in Chapter 11 (Project-wide issues).

Other potential threatened fauna habitat identified within the Inner South precinct includes:

- Gang-gang Cockatoo (listed as endangered under both the EPBC Act and the NC Act) – the Inner South precinct supports 3.33 ha of foraging habitat and 32 breeding trees (refer to Figure 16-11)
- Superb Parrot (listed as vulnerable under both the EPBC Act and the NC Act) – the Inner South precinct supports 3.33 ha of foraging habitat for this species (refer to Figure 16-11)
- Diamond Firetail (listed as vulnerable under both the EPBC Act and the NC Act.) – 3.33 ha of the Landscape Planting – Native community has been identified within the Inner South precinct and may provide suitable habitat for the Diamond Firetail as shown in Figure 16-11
- Perunga Grasshopper (*Perunga ochracea*) (listed as endangered under the NC Act) – the two small patches (0.01 ha) of moderate quality grassland (ACT01.2) community within the Inner South precinct may provide potential habitat for the Perunga Grasshopper
- Canberra Raspy Cricket (*Cooraboorama canberra*) (recognised as rare but not listed under the EPBC Act or NC Act) – the two small patches (0.01 ha) of moderate quality grassland (ACT01.2) community within the Inner South precinct may provide suitable habitat for the Canberra Raspy Cricket
- Striped Legless Lizard (*Delma impar*) (listed as vulnerable under both the EPBC Act and NC Act.) – the two small patches (0.01 ha) of moderate quality grassland (ACT01.2) community within the Inner South precinct may provide suitable habitat for the Striped Legless Lizard. Although this patch of potential habitat is subject to routine mowing, due to the quality of the patch there is potential for it to support the species.

No habitat was identified in the Inner South precinct for the Swift Parrot (*Lathamus discolor*), or Key's Matchstick Grasshopper (*Keyacris scurra*).

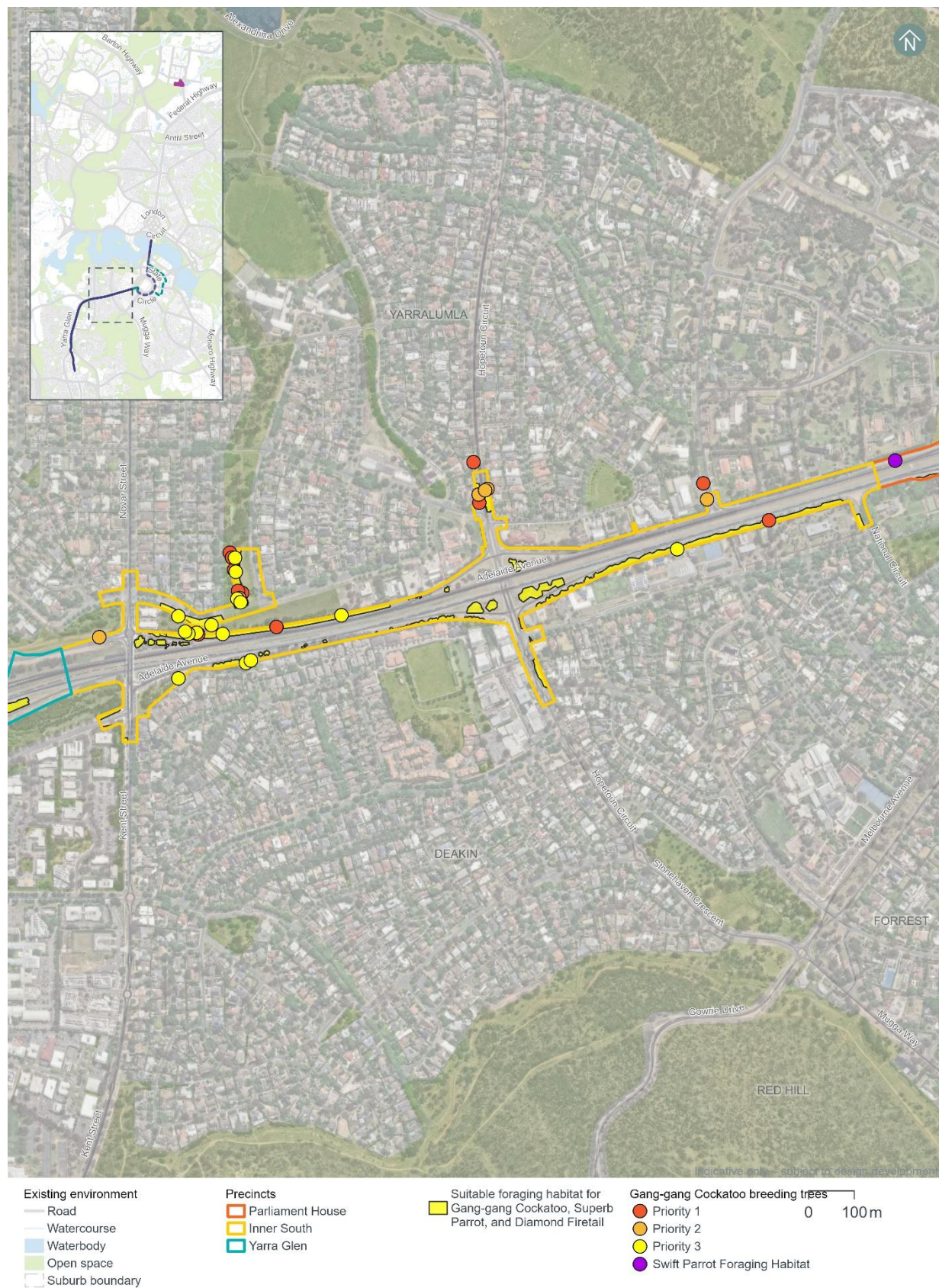


Figure 16-11 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Inner South precinct

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Inner South precinct. Impacts to threatened or rare flora species are therefore not anticipated.

Three pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Inner South precinct:

- Chilean needlegrass (*Nassella neesiana*) – a Weed of National Significance
- African lovegrass (*Eragrostis curvula*)
- Monterey pine (*Pinus radiata*).

16.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Inner South precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 16-12. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 16-32. Only 0.41 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 16-32 **Extent of vegetation communities within the clearance footprint in the Inner South precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	0.41
Landscape plantings – Exotic	0.17
Exotic grassland	2.44
Total vegetation	3.02



Figure 16-12 Clearance footprint in the Inner South precinct

A total of 19 mature native trees have been recorded within the clearance footprint in the Inner South precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence. Table 16-31 summarises the number of hollow-bearing and mature native trees within the Inner South precinct and is shown in Figure 16-9.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Inner South precinct would include impacts to the following through habitat removal:

- Golden Sun Moth – 0.43 ha of habitat, including habitat associated with Golden Sun Moth populations 2, 4, 5, 6, and 7
- Gang-gang Cockatoo – 0.41 ha of foraging habitat and one breeding tree, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 0.41 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 0.41 ha of Landscape Planting – Native vegetation which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Inner South precinct clearance footprint for the Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Chapter 11 (Project-wide issues).

16.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops

- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike
- Fauna strike with over-head wires and associated infrastructure (from Hopetoun Circuit Stop onwards heading south).

Further detail on these indirect impacts for operational activities is discussed in Chapter 11 (Project-wide issues).

16.4.4 Precinct specific management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, through the development of a minimised clearance footprint within the Project area (refer to Figure 16-12).

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Inner South precinct.

16.5 Historic heritage

This section provides a summary assessment of the potential historic heritage impacts associated with the construction and operation phases of the Project within the Inner South precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

16.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Inner South precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The heritage significance of the Inner South precinct arises from its expression of National Capital Development Commission (NCDC) -era (1960 to 1980) development of Canberra and connection with the surrounding suburbs. Attributes include the wide boulevard of Adelaide Avenue, as one of the pieces of major infrastructure which helped complete Canberra, and the long views to distant mountains which give a strong backdrop to the NCDC-era suburbs (such as Deakin).

Additionally, the Inner South precinct provides features which create reminders the unique character of Canberra as the national capital. These include The Lodge, the visual and physical connection with Capital Hill, and views from Adelaide Avenue containing national institutions such as The Lodge and a variety of embassies.

The historic heritage assessment identified two heritage places (one listed and one unlisted) surrounding the Inner South precinct, as noted below in Table 16-33 and shown in Figure 16-13.

Table 16-33 Heritage places within and surrounding the Inner South precinct

Heritage places	Description
Commonwealth Heritage List	
The Lodge (refer to Figure 16-14)	<ul style="list-style-type: none"> The Lodge is historically important as the official residence of the Prime Minister of Australia and was constructed in 1925 to 1927. The Lodge is in close proximity to Parliament House and it is readily accessible from Adelaide Avenue Views from Adelaide Avenue in to the north-east side of the house and outwards to the north-eastern mountains are a historically important element of the property, though now greatly shielded by walls and perimeter plantings The Lodge is important for cultural features that were acquired and for display of Australian art and crafts to important visitors.
Unlisted significant heritage places	
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> Symbolic and physical importance as the nation's seat of government Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 16-13 and is not considered further in this precinct assessment.</p>

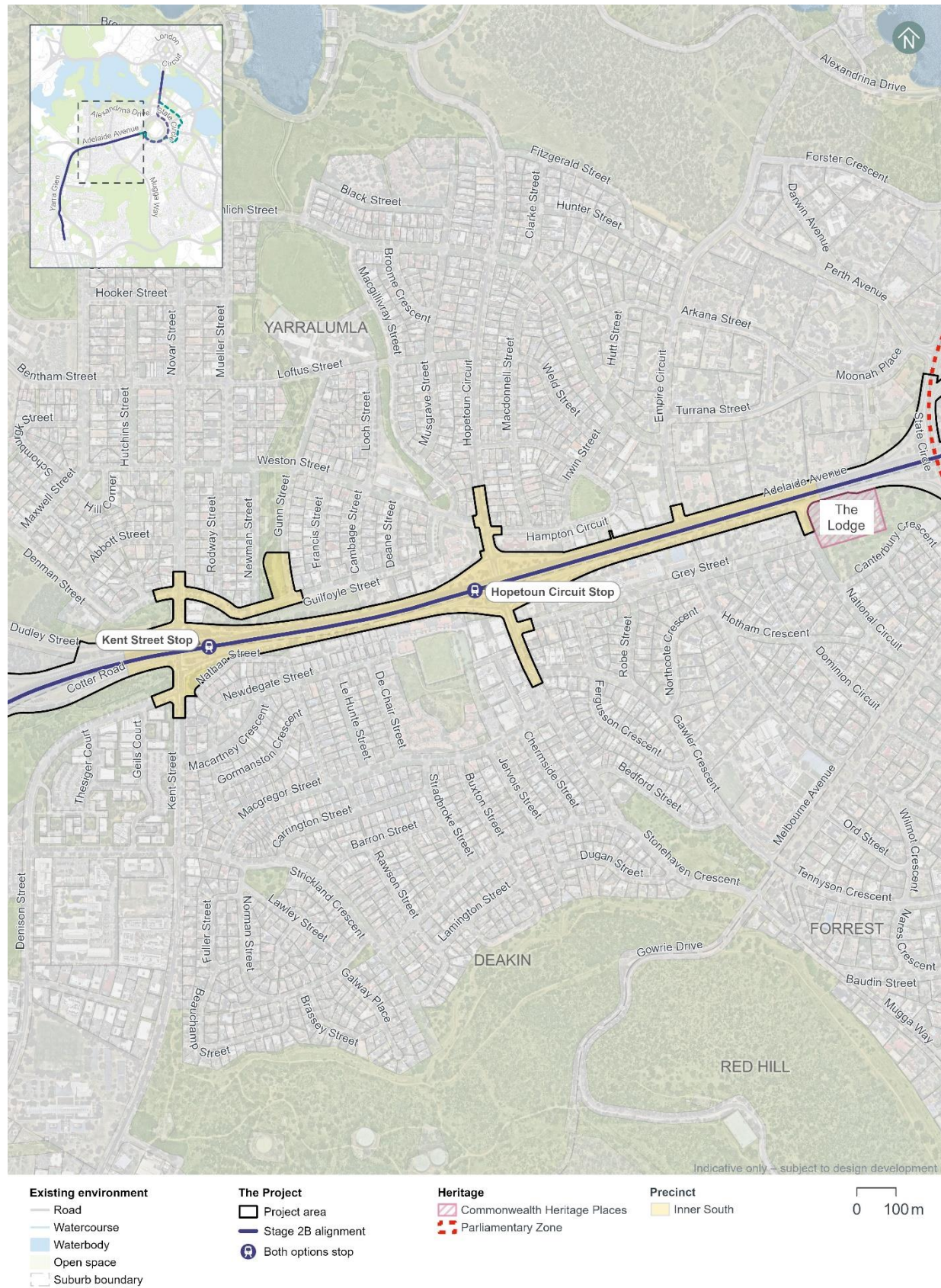


Figure 16-13 Heritage places relevant to the Inner South precinct



Figure 16-14 The Lodge from Adelaide Avenue

Condition, integrity, and sensitivity to change

The existing heritage within the Inner South precinct is generally in good condition. The roads and verges, landscape and planting, and significant heritage places are well maintained.

The integrity of the heritage values is good. The heritage features of the precinct are effective in expressing their character as part of the historic NCDC-era. Adelaide Avenue forms a significant piece of NCDC-era architecture passing through the suburbs of the Inner South which were constructed during the rapid population growth of the 1960s and 70s. The view to the mountains to the south-west is unimpeded.

The precinct has low to moderate sensitivity to change. The expression of the precinct's heritage character is via the location and form of Adelaide Avenue, its proximity to surrounding suburbs and relationship to inner and distant hills. These features can tolerate a reasonable amount of change. Views to the mountains south-west of the precinct along the corridor of Adelaide Avenue are more sensitive to change from development which would obscure these view lines.

16.5.2 Potential impacts – construction

Table 16-34 summarises the potential construction impacts of the Project on heritage places in the Inner South precinct.

Table 16-34 Construction impacts on heritage places within the Inner South precinct

Heritage place	Construction impact
Commonwealth Heritage List	
The Lodge	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be the Lodge within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

16.5.3 Potential impacts – operation

Table 16-35 summarises the potential operation impacts of the Project on heritage places in the Inner South precinct.

Table 16-35 Operation impacts on heritage places within the Inner South precinct

Heritage place	Operation impact
Commonwealth Heritage List	
The Lodge	Minor to moderate <ul style="list-style-type: none"> No direct impacts to heritage place Plantings on the median of Adelaide Avenue between State Circle and Hopetoun Circuit would partially impede historical views of the Lodge from the northern side and views outward towards mountains in the north-east from the Lodge No operational vibration impacts to heritage place.

Operation impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

16.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for historic heritage impacts at the Inner South precinct.

16.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Inner South precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural and heritage attributes of the landscape, planning designations and desired character within each of the precincts. The assessment

of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown in Figure 16-15.

16.6.1 Existing environment

The Inner South precinct follows Adelaide Avenue between the suburbs of Deakin and Yarralumla, from the National Capital Authority's (NCA) Diplomatic Precinct, including The Lodge and the employment area of west Deakin, to transition into Yarra Glen.

Adelaide Avenue is a dual carriageway with a wide turf median, and the view towards Parliament House is framed by mature native roadside vegetation that primarily screens adjacent built structures. Beyond this vegetated boundary are embassies, schools, religious institutions, and an art gallery, with the remaining land primarily consisting of residential development.

Figure 16-15 Landscape character zone and viewpoints in the Inner South precinct

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Landscape character

The key aspects of the landscape character in the Inner South precinct can be seen in Figure 16-16 to Figure 16-17. The Project would extend along Adelaide Avenue from National Circuit to slightly west of the Kent Street and the Novar Street Bridge. As a main avenue, Adelaide Avenue comprises part of the major design components of Canberra. The key focal points of Adelaide Avenue are Parliament House to the north-east (the corridor is one of the radiating avenues from State Circle, and the Brindabella Range to the south-west (refer to Figure 16-16). The focal points outside the precinct are accentuated with raised landform and include Capital Hill / Parliament House. Views along the main avenue are an integral design element, with dense buffer plantings on either side of the road corridor and minimal planting in the central median.



Figure 16-16 View along Adelaide Avenue from near the Embassy of the Philippines

The north-eastern portion of the precinct interfaces with the Diplomatic Missions of Yarralumla, whereby the architecture of these buildings reflects their country's national architectural style, as shown in Figure 16-17. These buildings are situated on large blocks of land, often with large security infrastructure, in contrast to the residential areas. The Lodge, a Commonwealth Heritage listed property, lies adjacent to the route. Adelaide Avenue lies within NCA's 'Designated Land' as set out in the NCP, with a mix of land uses extending out beyond the corridor.

Fringing land uses adjacent to the precinct primarily include Suburban Residential, Community Facilities and Urban Open Spaces, typical of the low to medium density residential suburbs of Yarralumla and Deakin (refer to Figure 16-18).



Figure 16-17 High Commission of Papua New Guinea (Source: ABC News, 2017)



Figure 16-18 Residential street in Deakin

Viewpoints

Representative viewpoints that have been identified to assess changes to the Inner South precinct which are and shown in Figure 16-15 and described in Table 16-36. Images of all viewpoints can be found in Technical Report 10 – Landscape character and visual amenity.

Table 16-36 Inner South precinct viewpoints and description

Viewpoint	Description	Sensitivity rating
Viewpoint IS1: Hopetoun Circuit Covered Section	<p>This viewpoint is located on the western verge of Hopetoun Circuit looking north towards the northbound and southbound Adelaide Avenue carriageways (refer to Figure 16-20). The central view covers the road corridor of Hopetoun Circuit, extending from the foreground right of frame to the central background of the view. The connecting roads to Adelaide Avenue extend to the east and west in the foreground.</p> <p>Visual receptors seeing this view would primarily be pedestrians and motorists travelling along Hopetoun Circuit. Others would be residents seeing the view from their apartments.</p> <p>The viewpoint sensitivity is moderate. While residential receptors are a sensitive visual receptor group, the number of residents who would see this view is low, with a much higher number briefly passing this location in their cars or on foot.</p>	Moderate
Viewpoint IS2: Traction Power Substation 8	<p>This viewpoint looks towards a small park within a residential area, with the park flanked on two sides by residential streets (refer to Figure 16-22). The proposed Traction Power Substation (TPS) 8 would be located in the centre left of this viewpoint.</p> <p>Visual receptors seeing this view would primarily be residents of properties along the flanking streets, and pedestrians and motorists traveling past the park.</p> <p>The viewpoint sensitivity is high. The viewpoint is positioned within a residential street, where the sensitivity would relate to local residents who consider views from or near their properties important. The Project would be visible from within the street and potentially from within private properties.</p>	High
Viewpoint IS3: Kent Street Overpass	<p>This viewpoint is located on the eastern pedestrian path at the northern end of the Kent Street and Novar Street Bridge overpass, looking east down onto Adelaide Avenue (refer to Figure 16-19). It includes a linear view along the road corridor, which is bounded by dense vegetation which screens views beyond the road.</p> <p>Visual receptors seeing this view would primarily be pedestrians crossing the bridge, looking over the path barricade to Adelaide Avenue below.</p> <p>The viewpoint sensitivity is low. Motorists are unlikely to be a sensitive visual receptor group as they would only see the view for short periods of time as they drove past the viewpoint, similarly, pedestrian receptors are likely to have a passing interest in the view.</p>	Low



Figure 16-19 Existing view from Viewpoint IS3 looking east along Adelaide Avenue

Night-time lighting

Both alignment options would sit within Adelaide Avenue road corridor and its surrounds. Due to its prominence within the structure of the Griffin Plan and its urban transport corridor character, Adelaide Avenue is an area of A4: High district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023). Existing lighting within the precinct accentuates the Adelaide Avenue vista with surrounding roads sitting within the A3: Medium district brightness category.

The lighting following the proposed Project would contribute to the high quality landscape boulevards and direct views towards the feature lighting of Parliament House. Relevant design requirements of strategy 1a of the NCA's Outdoor Lighting Policy for the Inner South precinct include:

- i. Emphasise the three node points of the Griffins' National Triangle by creating and maintaining strong visual 'anchors' at Parliament House, City Hill and Russell
- ii. Use full cut-off light fittings in all landscape areas, roads, paths and car parks within the Central National Area
- iii. Use full cut-off street and pedestrian lighting on all main avenues that contributes to their development as high quality landscape boulevards
- iv. Align lighting hardware to strengthen the framing of the National Triangle, main avenues and formally landscaped open spaces.

16.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition (of construction activity and equipment) and loss of elements (most notably to trees) within the Inner South precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops, retaining walls, bridges, and covered sections
- Installation of lighting, signage, and landscaping
- Temporary traffic changes.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years). As such, the magnitude of change during construction would be high within the Inner South precinct due to the visual clutter of construction and the removal of trees. This would result in a high to moderate adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Inner South precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to the high magnitude of changes to each viewpoint.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 16-37.

Table 16-37 Viewpoints construction impact summary – Inner South precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint IS1: Hopetoun Circuit Covered Section	Construction would introduce temporary fencing, hoarding, signage, and traffic equipment, along with earthworks, drainage adjustments, and road improvements across both sides of the road. Construction of the light rail stop on Adelaide Avenue west of Hopetoun Circuit including access to the platform from Hopetoun Circuit and the light rail bridge structure over Hopetoun Circuit would also be introduced. The activity would be visually prominent in the fore, middle, and background, due to the scale and proximity of construction, contrasting with the established landscape, although no tree removal would occur. The moderate sensitivity of this view, proximity to residential properties, and the extensive visual changes -including height of construction along Adelaide Avenue above ground level-would result in a high to moderate adverse impact, as construction elements and visual clutter would dominate the view.	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint IS2: Traction Power Substation 8	Construction of the TPS would introduce earthworks, installation of substation structure and electrical equipment, and ground finishing. The activity would be visually prominent within a moderate portion of the view in the middle ground due to the scale and proximity of the equipment, contrasting with the established landscape, although no tree removal would occur. The high sensitivity of this view, and the substantial amount of change within the view, including large construction elements would result in a high adverse impact, as construction elements and visual clutter would dominate the view, rather than the parkland.	Sensitivity: High
		Magnitude: High
		Overall impact: High
		Qualitative rating: Adverse
Viewpoint IS3: Kent Street Overpass	Construction would introduce temporary fencing, hoarding, signage, and traffic equipment, along with earthworks and construction of trackform, drainage adjustments, vegetation removal, and road improvements across both sides of the road. Construction of the light rail stop in the median of Adelaide Avenue east of the bridge, and the pedestrian and cyclist bridge structure over Adelaide Avenue would also be introduced. The activity would be visually prominent within the framed view along the road corridor, due to the scale and proximity of construction. The low sensitivity of this view and the proximity of construction activity within the road corridor, would result in a moderate adverse impact, as construction elements and visual clutter would dominate the view.	Sensitivity: Low
		Magnitude: High
		Overall impact: Moderate
		Qualitative rating: Adverse

Night-time visual impact assessment

Works within this precinct may need to be undertaken outside standard construction hours (Monday to Saturday, 7am to 6pm). Night works may also be required within the precinct with most of the night works occurring within and adjacent to the existing road corridor. No construction compounds would be located within the precinct.

The construction of Hopetoun Circuit carriageway under the northbound and southbound Adelaide Avenue carriageways would result in the most prominent lighting. These works would be more prominent in the landscape due to the road corridor sitting above the surrounding landscape and the large equipment required to construct these elements. This would be visible from key locations such as the Parliament House and the Telstra Tower on Black Mountain.

While night works would increase the existing light levels of this precinct, interventions such as planting, and use of topography would limit impact to surrounding properties. Residential properties most affected by the night works lighting would be those surrounding the Hopetoun Circuit Stop.

Lighting associated with night works may also draw attention away from the feature lighting of Parliament House, however mature tree planting would provide some visual buffering in sections of the precinct.

For these reasons, the visual impact during construction at night would be **moderate adverse**.

16.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considered the change due to the Project on the landscape as a resource in its own right. The assessment has been based on the sensitivity to change and the magnitude of the change that is likely to occur. A description of the anticipated change, and the associated potential impact is summarised in Table 16-38.

Table 16-38 Landscape character impact assessment summary in the Inner South precinct – both alignment options

Alignment option	Anticipated change	Impact rating
Both alignment options	<p>The Project would introduce light rail infrastructure along Adelaide Avenue, including two stops, a light rail bridge between the existing Adelaide Avenue carriageways over Hopetoun Circuit, and the Hopetoun Circuit Stop Plaza. There would also be adjustments and the addition of trees to the Adelaide Avenue median. While the associated light rail infrastructure would be a new addition along Adelaide Avenue, it would retain the overall characteristic of the linear nature of the transport corridor framed by vegetative screening.</p> <p>Increased lighting and movement in response to the addition of the light rail stop in the median of Adelaide Avenue east of the bridge may impact adjacent residential properties, embassies, and art gallery.</p> <p>The addition of a substation within the residential suburb of Yarralumla would comprise a change to a very small portion of the precinct and would not alter any broader aspects of the precinct due to its small size and position within an existing reserve.</p> <p>While the Project would thoughtfully integrate with the existing infrastructure and preserve key spatial characteristics, it would result in an adverse change in the precinct's character due to the introduction of light rail infrastructure (including two stops and over-head wiring from Hopetoun Circuit westwards).</p>	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Adverse

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Inner South precinct, in most cases the overall impact at each viewpoint has been assessed as being high to moderate due to:

- A high to moderate magnitude of changes at each viewpoint
- The visual prominence of changes seen from each viewpoint.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 16-39.

Table 16-39 Viewpoints operation impact summary – Inner South precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint IS1: Hopetoun Circuit Covered Section	<p>The Project would introduce light rail infrastructure, including a light rail stop, over-head wiring, and passing LRVs, juvenile trees along Hopetoun Circuit and Adelaide Avenue, and adjustments to footpaths. While there would be substantial changes within the view, these would be in keeping with the character of a transport corridor and would be visually softened by tree planting, resulting in a moderate overall impact. Trees planted would also, over time, screen the view to built elements within the plaza and at the stop.</p> <p>The overall impact would be neutral as there are positive (e.g. additional trees) and negative (e.g. light rail infrastructure) aspects of the Project when viewed from this location.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint IS1 is provided in Figure 16-21.</p>	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Neutral
Viewpoint IS2: Traction Power Substation 8	<p>The Project would introduce a piece of electrical infrastructure within the existing small residential park, resulting in a high to moderate overall impact. Although there would be an adverse effect on the view, the change would only affect a small to moderate proportion of the view and would become more visually recessive over time with the appropriate surrounding landscaping, including tree planting.</p> <p>An example of a TPS from LRS1 is provided in Figure 16-23.</p>	Sensitivity: High
		Magnitude: Moderate
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint IS3: Kent Street Overpass	<p>The Project would introduce a pedestrian and cyclist bridge with associated entry plaza, light rail stop below the eyeline of the view along Adelaide Avenue, light rail tracks within the median with occasional passing LRVs, as well as juvenile trees within the foreground of the view. The multiple changes would be seen from close proximity and in a high amount of detail, resulting in a moderate overall visual impact.</p> <p>Although the changes would be adverse, the most sensitive visual receptors (pedestrians) would not see the view at operation as they would be using the footbridge to cross Adelaide Avenue. Passing motorists are unlikely to see the change in as much detail.</p>	Sensitivity: Low
		Magnitude: High
		Overall impact: Moderate
		Qualitative rating: Adverse



Figure 16-20 Existing view from Viewpoint IS1 looking north along Hopetoun Circuit



Figure 16-21 Indicative visualisation of viewpoint IS1 during operation



Figure 16-22 Existing view from Viewpoint IS2 looking south-west from Gunn Street



Figure 16-23 Example of TPS structure (from LRS1) within viewpoint IS2 during operation

Night-time visual impact assessment

The Project would introduce additional lighting within the median, two light rail stops, and LRV headlights along the tracks. The proposed interventions would include the retention of existing street light poles along the road verge, and the installation of additional lighting to the light rail track. These lighting elements would be lower poles adjacent to the light rail track, aligned with the new trees. The proposed tree planting within the median would provide visual filtering of the lighting over time as the trees mature.

The most substantial change within the precinct due to the Project would be the lighting associated with the light rail bridge, stops, and Hopetoun Circuit under the northbound and southbound Adelaide Avenue carriageways. The light rail bridge would infill a previously open space between the carriageways, necessitating the need for additional lighting for Hopetoun Circuit during day and night. The development of the entry plaza to the proposed stop at Hopetoun Circuit would create opportunities for positive lighting outcomes, increasing safety for users and focus on gender sensitive urban design. The lighting associated with the Hopetoun Circuit Stop and covered section would create an increase in light spill for surrounding residences and diplomatic missions.

The light rail stop at Kent Street, would also introduce additional lighting within the precinct. However, retained dense vegetation would filter the impacts of light spill to surrounding residences.

Interventions such as planting, and use of topography along a majority of the alignment would limit the impact to surrounding properties. Properties most affected by the change would be those surrounding the Hopetoun Circuit Stop and properties facing the proposed TPS 8 structure. Low level strip lighting would be applied to the TPS 8 structure in line with the LRS1 and LRS2A designs. The lighting would sit within the TPS structure, behind the façade, however minor light spill would occur through the façade.

While the Project would introduce additional lighting elements within the precinct, the light rail corridor would align with the outcomes of the existing A4: High district brightness area within the context of a major transport corridor.

There would be a reduction in visual amenity at night due to the large extent of additional lighting, frequency of LRVs, and light spill surrounding local residences at the Hopetoun Circuit Stop. This is, however, a high district brightness environment, therefore the visual impact during operation would result in a **moderate adverse** impact at night.

16.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage landscape character and visual amenity impacts that are specific to the Inner South precinct are shown in Table 16-40.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Table 16-40 Landscape and visual management and mitigation measures – Inner South precinct

ID	Objective	Management and mitigation measure	Timing
LV10	Visual integration of traction power substations	The scale and bulk of traction power substations will be refined to enable greater integration into the surrounding landscape. Material selection and finishes, lighting, landscaping and screen planting (including trees) will be used to minimise the visual presence of the substations.	Design and operation

16.7 Socioeconomic

This section describes the potential socioeconomic impacts of the Project within the Inner South precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

16.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown in Figure 11-86 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. SA2s analysed for the Inner South precinct include:
 - Yarralumla SA2
 - Deakin SA2
 - Forrest SA2
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- **ACT:** in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor and the ACT. Capital refers to various forms of resources that contribute to the well-being, sustainability, and resilience of a community.

A summary of community capitals for the Inner South precinct is provided in Table 16-41. Section 11.7 provides a summary of community capitals for the corridor and the ACT.

Table 16-41 Community capitals summary – Inner South precinct

Capital	Summary
Human capital	The population of 10,516 has a median age of 47, with a slightly higher proportion of females (52.8%) compared to males (47.2%). About 0.9% of the population identifies as Aboriginal and Torres Strait Islander. The area has a notable older adult demographic, with 14% of residents aged 65 to 74 and 8.4% aged 75 to 84. Educational attainment is relatively high, with 58.6% of residents holding a bachelor's degree or higher. In terms of health, 23% of adults aged 18 and over report having one of four key risk factors, while 4.1% of the population has one or more long-term health conditions.

Capital	Summary
Social capital	In this area, 78.61% of people speak only English, with other spoken languages including Mandarin (2.2%) and French (0.7%). Prominent ancestries reported are Australian (29.8%), Irish (14.9%), and Scottish (12.6%). Family households make up 67.4% of all households, while 28.8% are single-person households. In terms of residential mobility, 17.6% of residents lived at a different address one year ago, and 45% lived at a different address five years ago. Community engagement is reflected in 26.2% of residents having volunteered through an organisation or group in the past 12 months, while 4.1% of the population require assistance with core activities.
Economic capital	The Inner South precinct has a median total personal income of \$1,694.67 per week and the highest median household income at \$3,269 per week, indicating considerable economic capital. However, living costs are also high, with median mortgage repayments at \$3,041.67 per month and a median rent of \$559 per week, both among the highest in the region. Financial stress is present, with 12.6% of households experiencing mortgage strain and 21% facing rental stress, despite higher income levels. The area has a lower labour force participation rate at 62.3% and a moderate unemployment rate of 2.9%. Key industries include Central Government Administration (16.8%) and Hospitals (4%), with the majority of workers in Professional (42.1%) and Managerial (24.4%) occupations.
Physical capital	A significant portion of properties are owned outright (43.2%), with an additional 28.2% owned with a mortgage, while rented properties make up 24.7%. The area accommodates diverse lifestyle preferences and demographics through a range of housing types, with 56.5% of occupied private dwellings being separate houses, 20.7% being semi-detached, row, or terrace houses, and 22.7% consisting of flats or apartments. The average household size is 2.3. In terms of commuting, 60.3% of the working population drive or travel as passengers in a car to work, while 6.2% walk and 3.5% use public transport.
Natural capital	Natural capital features within the precinct include: the west basin of Lake Burley Griffin and associated foreshore reserves such as Yarralumla Bay District Park. The area includes significant nature reserves including Stirling Park and Red Hill Nature Reserve. Furthermore, several notable parks and gardens such as Lennox Garden, Canberra Beijing Garden, and Canberra Nara Peace Park, and leisure hubs such as Royal Canberra Golf Course, Weston Park, and La Trobe Park are situated in the vicinity of the precinct.

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural, or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Inner South precinct's area of social influence is shown in Figure 16-24.

The precinct includes parks, open spaces, playgrounds, sports clubs, playing fields, hospitals, educational institutions, aged care facilities, places of worship, commercial hubs, and government institutions.

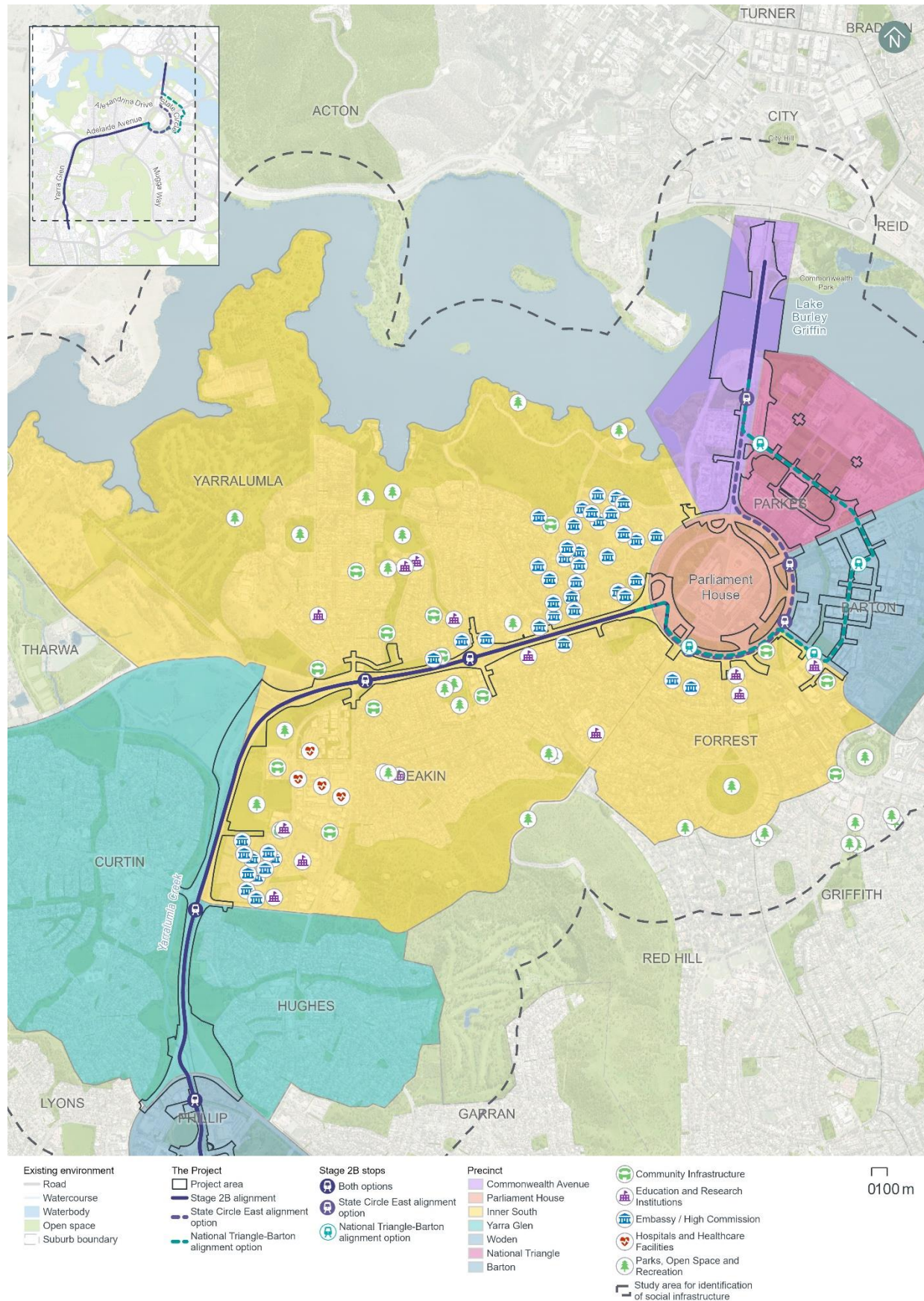


Figure 16-24 Social infrastructure within the Inner South precinct

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16.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those living, working in, or visiting the Inner South precinct is provided in Table 16-42. Construction-phase socioeconomic impacts within the Inner South precinct would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those living in the area near the Project area, and those in nearby offices that people are likely to occupy for eight hours a day. There are also some childcare centres and the Canberra Girls Junior School in this precinct that may be particularly sensitive to change.

Residents, workers and students provided feedback via online surveys and other consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)), indicating that construction noise and vibration and traffic disruption are key community concerns. Participants expressed interest in how impacts would be mitigated, and several participants recognised that the construction impacts would be temporary and that the Project would deliver longer term benefits once operational.

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 16-42 and Chapter 21 (Environmental management and mitigation measures).

Table 16-42 Socioeconomic impacts during construction – Inner South precinct

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to local amenity during construction, potentially leading to a decline in health and wellbeing. This may particularly affect people with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 16.1.2, Section 16.3, and Section 16.6 (in relation to traffic, noise and visual impacts, respectively).</p>	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)
<p>Disruptions to the road network and parking – impacts to road users</p> <p>Impact to road users due to temporary loss of about 60 on-street kerbside spaces including along Hopetoun Circuit, Kintore Crescent/Guilfoyle Street, and one bus zone on Denison Street. However, construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.</p>	Medium (likely/minor)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking 	Low (possible/minor)

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Further detail on transport and access impacts within this precinct is provided in Section 16.1.2.		<ul style="list-style-type: none"> Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) 	
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>Decline in accessibility to business and services due to temporary loss of on-street parking during construction, as described above.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 16.1.2.</p>	Medium (likely/minor)		Low (possible/minor)
<p>Visual landscape and heritage</p> <p>Changes to vistas and surroundings of the Lodge by introducing construction activity and removal of trees, may affect those people visiting, working, or living in the area by diminishing their connection to place and shared histories.</p> <p>Further detail in landscape and visual impacts in this precinct is provided in Section 16.6.</p> <p>Further detail on impacts to heritage in this precinct is provided in Section 16.5.</p>	Low (possible/moderate)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Very Low (unlikely/minor)

16.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in or visiting the Inner South precinct is provided in Table 16-42. Socioeconomic impacts within the Inner South precinct would be common to both alignment options.

Table 16-43 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 16-43. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Participants at consultation drop-in sessions, online feedback as well as many stakeholders' discussions indicated light rail operational benefits for the Precinct including support for active travel provisions and improved transport options for residents. Transport-related socioeconomic benefits would apply to people across the light rail corridor and are considered further in Chapter 11 (Project-wide issues).

Table 16-43 Socioeconomic impacts during operation – Inner South precinct

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Landscape and visual changes</p> <p>Permanent changes to local visual landscape may impact the community. While the introduction of light rail infrastructure would alter the road layout and tree arrangement, resulting in a potential adverse impact, key landscape features such as the linear avenue design and vegetative screening would be largely retained.</p> <p>Changes to the landscape and visual environment in this precinct are detailed in Section 16.6.</p>	Low (possible/minor)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users (and ultimately result in a benefit) Engagement with community groups and local users of proposed grade separated stops to provide input into the attractive, safe and efficient design that best meet the urban design drivers for the Project. 	Beneficial (possible/positive)
<p>Heritage and culture</p> <p>The Project would add new plantings on the median of Adelaide Avenue between State Circle and Hopetoun Circuit, which would partially obstruct views toward and outward from The Lodge. These changes may reduce people's connection to the area.</p> <p>Impacts to heritage are discussed further in Section 16.5.</p>	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of heritage mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users 	Beneficial (possible/positive)

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
Access and mobility Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints through safety-related changes to active travel (e.g. signalised crossings and a new bridge to provide pedestrian and cyclist connections at Kent Street Stop). Refer to Section 5.8 of Chapter 5 (Project description) for further detail on active travel arrangements.	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (likely/positive)
Operational noise Potential decline in social amenity and disruption to place of worship and educational services due to operational rail noise impacts at the Presentation Sisters Convent on Guilfoyle Street and Canberra Girls Junior School, respectively. Further detail on noise and vibration impacts in this precinct are detailed in Section 16.3.	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of operational noise and vibration mitigation measures identified in Chapter 21 (Environmental management and mitigation measures), to review and minimise operational rail noise impacts 	Medium (possible/moderate)

16.7.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage socioeconomic impacts in the Inner South precinct are shown in Table 16-40.

Table 16-44 Socioeconomic management and mitigation measures – Inner South precinct

ID	Objective	Management and mitigation measure	Timing
SE4	Minimising socio-economic impacts through design	The Project will consider opportunities to augment the community's sense of place and connection. As part of the Community Reference Group established for the project, local users of proposed grade separated stops will be engaged to provide input into the attractive, safe and efficient design that best meet the urban design drivers for the Project.	Design and operation

17.0 Yarra Glen precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Yarra Glen precinct and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 17.1.2)
- Noise and vibration (Section 17.3)
- Biodiversity (Section 17.4)
- Historic heritage (Section 17.5)
- Landscape character and visual amenity (Section 17.6)
- Socioeconomic impacts (Section 17.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

17.1 Overview

The Yarra Glen precinct comprises the Yarra Glen road corridor from west of Kent Street, ending on the southern side of the Yarra Glen roundabout. Yarra Glen sits along the major transport route from the city to Woden. The corridor is characterised by a wide median of grass and tree planting and mounded verges with valley views towards the Brindabellas to the south and west. The northern area surrounding the precinct is characterised by wide urban open spaces with the planned North Curtin Residential Area to the west of Yarra Glen and the Deakin playing fields surrounding the Royal Australian Mint to the east.

The Project within this precinct would be consistent for both alignment options. The light rail alignment would predominately be located within the Yarra Glen median (median running).

The Project would include the reconfiguration of the Yarra Glen/Melrose Drive/Yamba Drive roundabout into a new at-grade intersection and associated at-grade crossing of this new intersection by light rail. A new light rail bridge over Yarralumla Creek would be provided.

The existing active travel link would be relocated to the eastern side of Yarralumla Creek, and the existing Melrose Drive road vehicle bridge over Yarralumla Creek would be widened and relocated north.

The precinct would include one grade separated stop, the Carruthers Street Stop, located immediately to the south of Carruthers Street in the median of Yarra Glen. A new pedestrian and cyclist bridge would also be provided over Yarra Glen at Carruthers Street, with lifts and stairs provided from the pedestrian and cyclist bridge to the Carruthers Street Stop.

Within the Yarra Glen precinct, the light rail would include over-head wiring.

The precinct would also include a traction power substation (TPS 9) located off Yarra Glen, adjacent to the active travel link at the south-west corner of Deakin Ovals.

Key Project features within the Yarra Glen precinct are shown in Figure 17-1. Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

17.1.1 Key construction activities

Construction activities required within this precinct would be generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Key construction activities within the Yarra Glen precinct would include:

- Reconstruction of the Yarra Glen roundabout to a new at-grade intersection of Yamba Drive and Melrose Drive (as described in Section 6.3)
- Removal of the existing Melrose Drive road bridge over Yarralumla Creek between Yamba Drive and Melrose Drive (as described in Section 6.3.4)
- Construction of the new light rail bridge over Yarralumla Creek (as described in Section 6.3.4)
- Construction of the TPS off Yarra Glen (as described in Section 6.3.8).

Compound G (Parkland east of Yarra Glen/Yamba Drive/Melrose Drive roundabout, Hughes) would be located within the Yarra Glen precinct. The location of the compound is shown in Figure 6-3 in Chapter 6 (Construction).

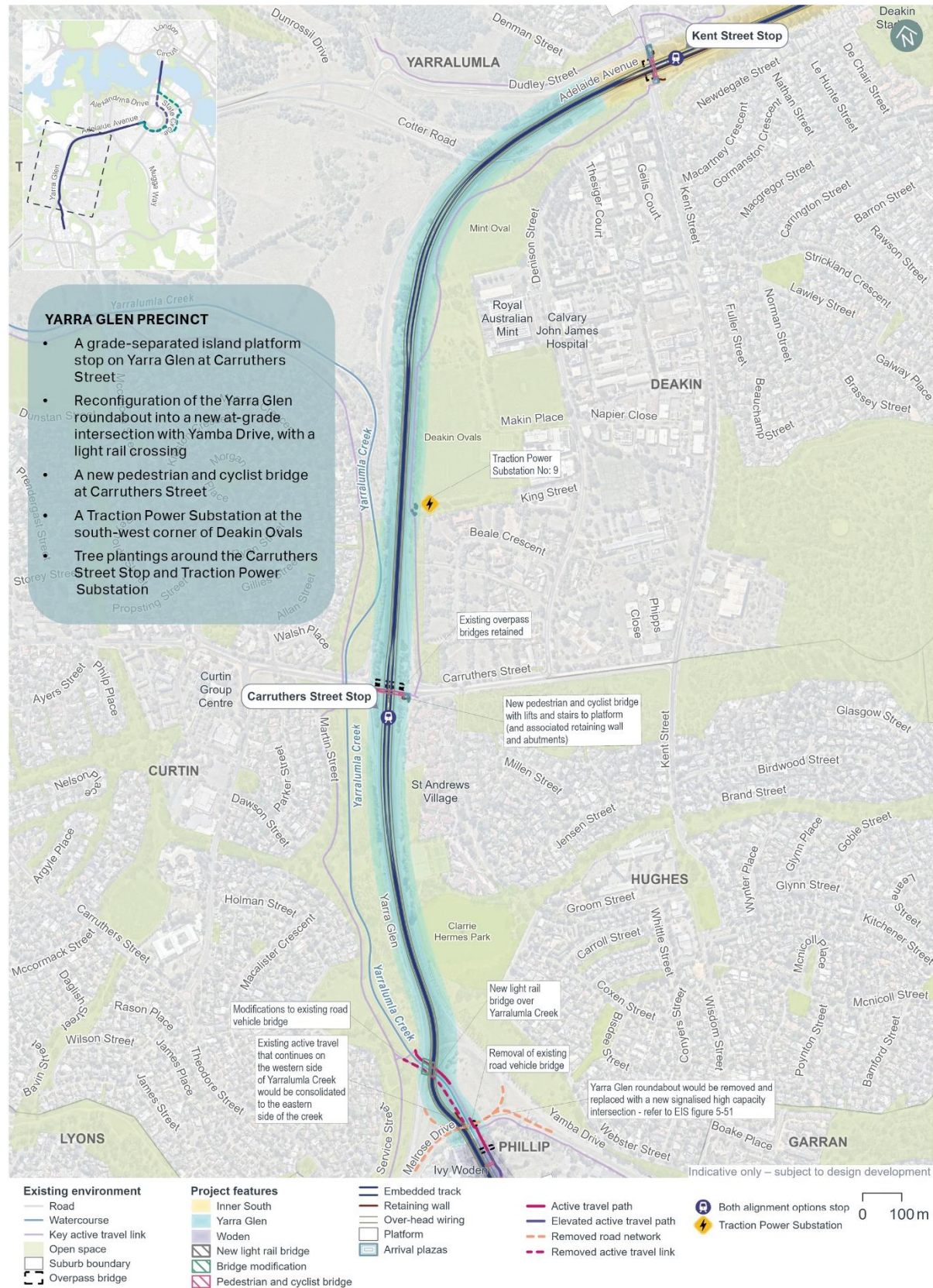


Figure 17-1 Yarra Glen precinct overview – both alignment options

17.1.2 Environmental impact overview – construction

Key impacts within the Yarra Glen precinct from the construction of the Project are summarised below, and assessed in further detail in this precinct-based assessment chapter.

Traffic and transport

Construction of the Project would result in local area access diversions due to the conversion of the Yarra Glen/Yamba Drive/Melrose Drive roundabout to traffic signals. The conversion would be phased, with the largest impact occurring when all traffic between Melrose Drive and Yarra Glen would likely be temporarily redirected to Launceston Street, Theodore Street or alter their route entirely. These diversions would likely result in a slight increase in travel time for impacted motorists.

The Project's construction would not change any off-street parking within the Yarra Glen precinct. Broader road network impacts are assessed in Chapter 11 (Project-wide issues).

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project, with a focus on managing construction-related traffic and site access, and the adequate performance of the road network in proximity to construction site accesses and haulage routes. Notwithstanding, construction would result in residual traffic impacts following the implementation of these measures. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, road works, the decommissioning of utilities, construction of stops and bridges on land, and the establishment of construction compounds, are expected to generate noise that could moderately to highly affect nearby residential and non-residential buildings during the day and night, particularly during 'peak' construction scenarios, which represent the noisiest works requiring the use of noise-intensive equipment such as concrete saws and rock breakers. In the night-time hours, a number of residential receivers located close to the Project footprint would experience noise that exceeds the sleep awakening reaction level (in instances where night works are required).

Mitigation measures that would be implemented to manage these impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised where possible through construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 2014* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 15.97 hectares of vegetation within the Yarra Glen precinct, 1.68 hectares of which is characterised as native. Removal of this vegetation would impact on suitable habitat for the Golden Sun Moth (*Synemon plana*) (listed as vulnerable under the EPBC Act and NC Act), foraging habitat for the Gang-gang Cockatoo (*Callocephalon fimbriatum*) (endangered under the EPBC Act and NC Act) and Superb Parrot (*Polytelis swansonii*) (vulnerable under the EPBC Act and NC Act), and breeding and foraging habitat for the Diamond Firetail (*Stagonopleura guttata*) (vulnerable under the EPBC Act and NC Act). Nine hollow-bearing and 28 mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been identified within the clearance footprint in the Yarra Glen precinct.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Historic heritage:** The Royal Australian Mint (listed on the Commonwealth Heritage List) is located within the Yarra Glen precinct, however would not experience any direct impacts as a result of construction. Some temporary indirect impacts to the visual setting of this heritage place may occur.
- **Landscape character and visual amenity:** Construction activities, including the establishment of construction compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area, particularly from viewpoints around The Mint Oval and Traction Power Substation 9. Night-time construction work, which may be necessary, would also involve lighting that would increase the existing light levels experienced by receptors, however dense vegetation, topography and the distance from receivers to the works would provide visual buffering. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill, and the preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Socioeconomic:** Potential impacts include disruptions to local amenity, disruptions to the road network and adverse impacts to health and wellbeing due to noise, vibration, and visual impacts, which may particularly affect workers, visitors, and accommodation providers in the area. Mitigation measures, such as the implementation of Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP(s) and sub plans, and is included as Appendix L (Environmental Management Plan outline).

17.1.3 Environmental impact overview – operation

Key impacts within the Yarra Glen precinct during the operational stage of the Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Yarra Glen precinct would require several changes to the road network, including road closures, adjustments to existing lanes, key intersection adjustments and adjustments to access arrangements to accommodate the light rail infrastructure.

Within the Yarra Glen precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios (for both alignment options) in the AM and PM peak hours in both 2031 and 2041, particularly on the approaches to intersections. Additionally, there would be changes that remove the existing right turn movement from Melrose Drive to Yamba Drive. However due to the arterial function of these roads, it is anticipated that motorists would change their route further afield with a slight increase in travel time.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles, and pedestrians with light rail during operation, and a review of options to further optimise the interface between different transport modes. Other operational impacts have been assessed on a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Landscape character and visual amenity

The introduction of light rail infrastructure, including tracks, stops, and over-head wiring, would result in permanent changes to the landscape character and visual amenity of the area. Moderate to low adverse visual impacts are predicted for the Yarra Glen precinct due to the scale of change the Project would introduce within this precinct.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to the management and mitigation of landscape and visual impacts of the Project during operation.

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 17.1.2), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops, or potential risk of fauna strike from light rail vehicles (LRVs) and overhead wires. Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design, including the use of appropriate lighting to reduce light spill
- **Socioeconomic:** Benefits of the Project within the Yarra Glen precinct include provision of an alternative to private vehicle use, which can enhance accessibility and, over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, such as changes to the local visual landscape and community character due to the introduction of light rail infrastructure, which could potentially affect the experience and connection people have with the area. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support high-quality design and manage these potential impacts during operation in the Yarra Glen precinct
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the Yarra Glen precinct, with noise and vibration levels predicted to comply with relevant criteria at the majority of receivers. A minor exceedance of criteria for ground-borne noise is predicted at the closest receiver to the alignment. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures and operational maintenance planning. These measures would enable residual impacts to be limited
- **Historic heritage:** No impacts to the Royal Australian Mint (listed on the Commonwealth Heritage List) would be experienced through the operation of the Project.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

17.2 Traffic and transport

This section provides a summarised assessment of the potential multimodal traffic and transport impacts associated with the construction and operation phases of the Project within the Yarra Glen precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and

transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

17.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Yarra Glen precinct and the respective study area is indicatively shown in Figure 17-2.

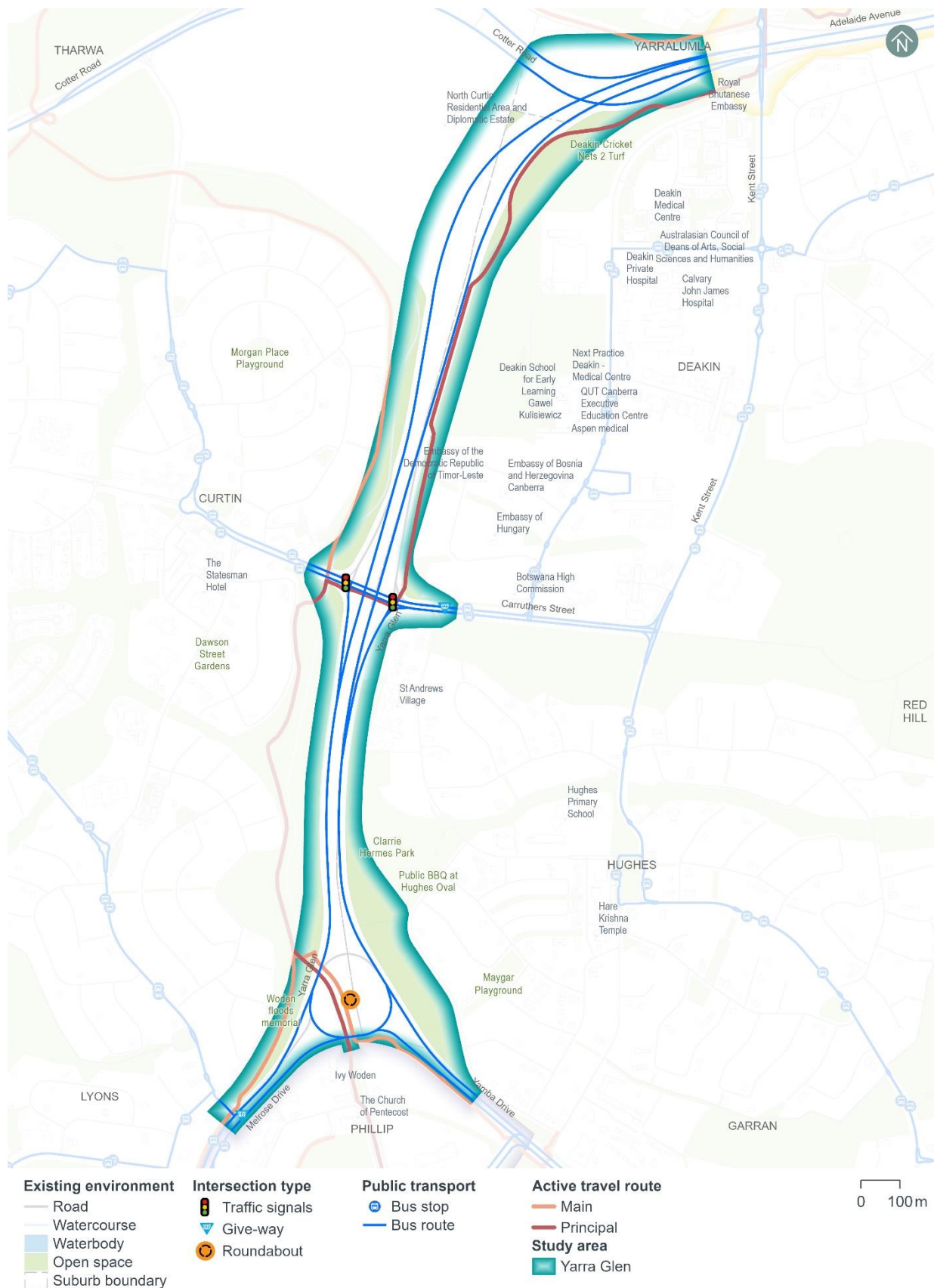


Figure 17-2 Overview of the existing transport network for the Yarra Glen precinct study area

Road network

The characteristics of key roads within the Yarra Glen precinct are summarised in Table 17-1.

Table 17-1 Overview of key roads within the Yarra Glen precinct

Road	Classification	Direction	Configuration	Speed limit
Yarra Glen	Arterial	Two-way	Two to three lanes in each direction, separated by a median that varies in width between 10 m and 75 m	80 km/h
Cotter Road			Two lanes in each direction, separated by a 40 m median	80 km/h
Yamba Drive			Two lanes in each direction	80 km/h
Melrose Drive			Two northbound lanes and three southbound lanes	60 km/h
Carruthers Street	Major collector	Two-way	Two lanes in each direction	60 km/h

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peak hour traffic counts for various mid-block locations within the Yarra Glen precinct have been analysed and are summarised in Figure 17-3. The 2024 data indicates that traffic has reduced during the AM and PM peak hours along Yarra Glen since 2017. The exception is to the south of Carruthers Street, where there would be a slight increase in the northbound direction in the PM peak hour.



Figure 17-3 2017 and 2024 peak hourly traffic volumes within the Yarra Glen precinct study area

Historical average weekday traffic volume, heavy vehicle composition and 85th percentile speed data has also been analysed for key roads within the Yarra Glen precinct, with a summary provided in Table 17-2. The data indicates that heavy vehicles account for around 3% to 4% of the total daily traffic volumes on the key roads through the precinct. The 85th percentile vehicle speed on Yarra Glen and Carruthers Street is also higher than the posted speed limit for these roads.

Table 17-2 Average weekday traffic volume characteristics on key roads within the Yarra Glen precinct

Road	Location	Date of available data	Average weekday traffic volume (vehicles per day)	Heavy vehicle %	85 th percentile speed
Yarra Glen	Between Carruthers Street and Adelaide Avenue	2023	28,460	4%	85 km/h
Carruthers Street	Between Denison Street and Kent Street	2016	5,300	3%	66 km/h

Figure 17-4 shows the weekday average daily traffic volume profile for Yarra Glen, which indicates a clear AM peak hour between 8:00 am and 9:00 am and a PM peak hour between 5:00 pm and 6:00 pm. Traffic volumes on Yarra Glen are typically much lower during off-peak periods.

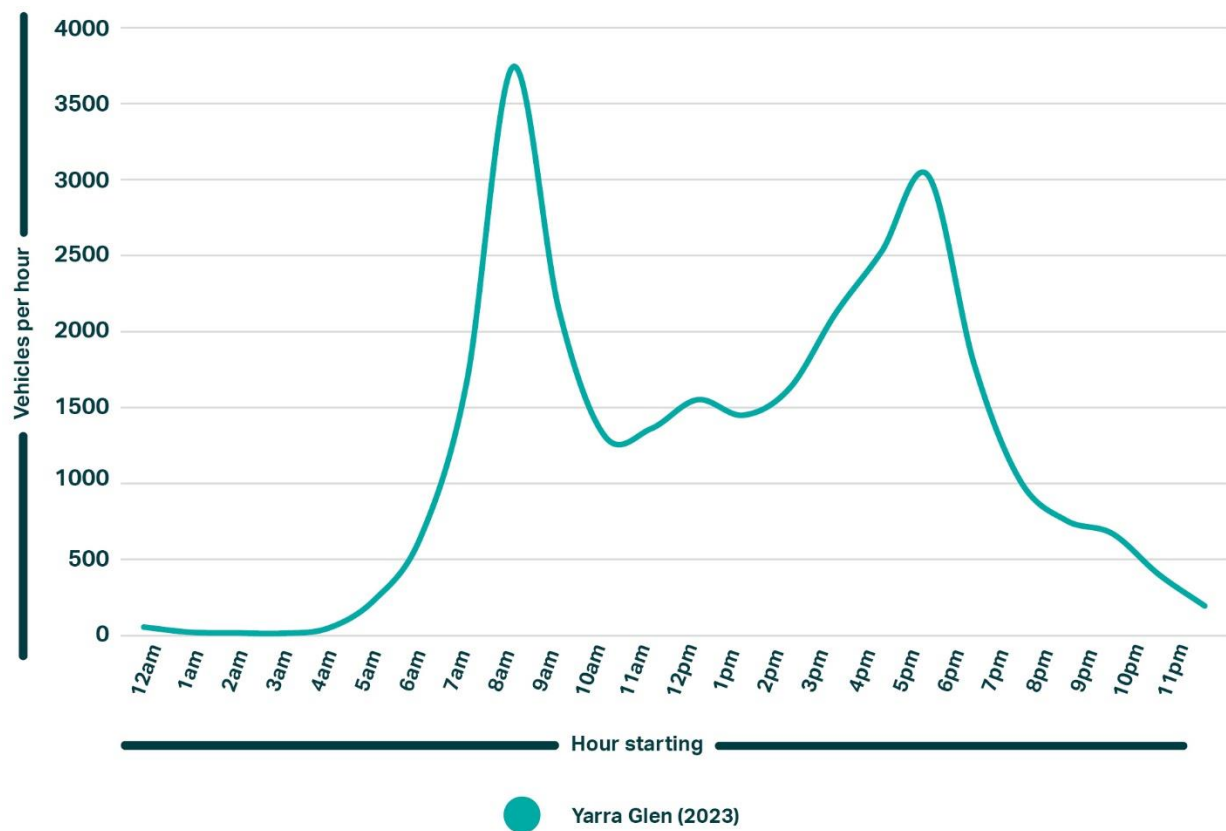


Figure 17-4 Weekday average daily traffic volume profile on Yarra Glen

Intersection performance

The operation of the key intersections within the Yarra Glen precinct has been assessed using a combination of the mesoscopic and microsimulation models which have been calibrated to 2017 traffic conditions and data, as discussed in Chapter 10 (Assessment methodologies). The 2017 intersection performance within the precinct is summarised in Figure 17-5.

All the assessed intersections within the Yarra Glen precinct operated satisfactorily in 2017 at a level of service D or better during the weekday peak hours.



Figure 17-5 2017 AM and PM peak hour intersection performance within the Yarra Glen precinct study area

Public transport

No bus stops are located along Yarra Glen within the precinct. However, bus stops are located on Carruthers Street, immediately adjacent to the precinct. These bus stops serve the 58 bus route operated by Transport Canberra, offering connections between the Woden Interchange and the City Interchange.

Multiple bus routes use Yarra Glen; however, they do not stop within the Yarra Glen precinct. A northbound T2 transit lane is provided on Yarra Glen, between Carruthers Street and Cotter Road. In addition, a slip lane dedicated to northbound buses is provided from Melrose Drive to Yarra Glen at the Yarra Glen/Melrose Drive/Yamba Drive intersection.

Active travel

The C4 city to Tuggeranong via Woden principal cycle route runs adjacent to Yarra Glen along its eastern side between Kent Street and Carruthers Street. The cycle route crosses to the western side of Yarra Glen via the Carruthers Street overpass and continues south to the Yarra Glen/Melrose Drive/Yamba Drive intersection. The route crosses under the Yarra Glen/Melrose Drive/Yamba Drive intersection and continues along Yarralumla Creek.

A shared path bridge is provided to the north-west of the Yarra Glen/Melrose Drive/Yamba Drive intersection that connects the shared path to the east of Yarralumla Creek.

On-road cycle lanes are provided on both sides of Yarra Glen within the precinct. These lanes cross on and off-ramps along Yarra Glen at multiple locations.

Signalised pedestrian crossings are provided at the following intersections:

- Yarra Glen ramps/Carruthers Street east of Yarra Glen on the eastern approach
- Yarra Glen ramps/Carruthers Street west of Yarra Glen on the southern approach.

Zebra crossings are provided on the slip lanes between Carruthers Street and the Yarra Glen on and off-ramps.

Pedestrian and cyclist count data from 2024 during the weekday peak hours are provided at the location shown below in Figure 17-6. No pedestrians and only around five to 25 cyclists were recorded at this location during PM peak hours.

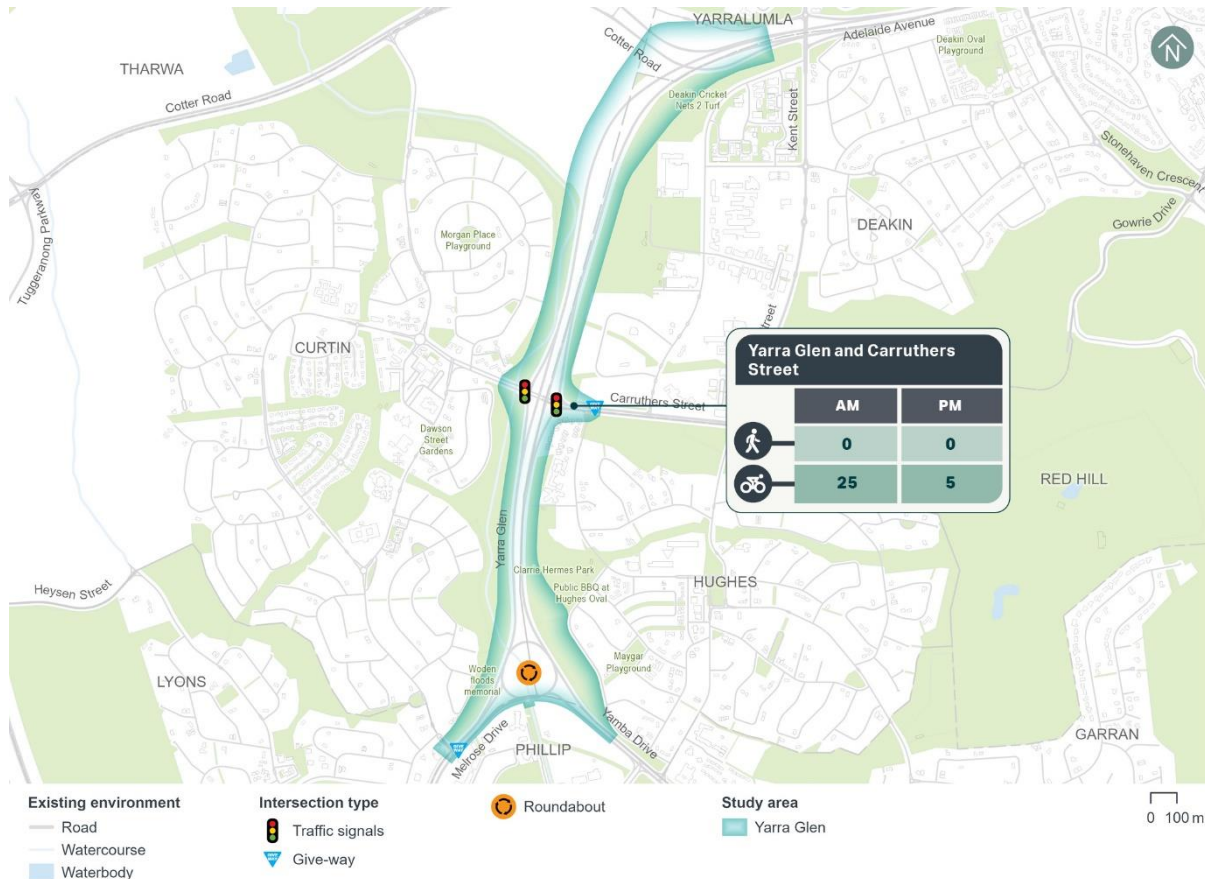


Figure 17-6 2024 peak hour active travel volumes within the Yarra Glen precinct study area

Car parking, kerbside uses and access

There are no existing kerbside uses, off-street car parks or property accesses located along the alignment within the Yarra Glen precinct.

Crash history

Figure 17-7 shows the five year crash history (1 January 2018 to 31 December 2022) within the Yarra Glen precinct. A total of 214 crashes have been recorded within the Yarra Glen precinct during the five year period, including:

- One fatal crash resulting from a driver losing control of a vehicle on the road
- Two crashes that resulted in a serious injury (around 1%)
- Eight crashes that resulted in a minor injury (around 4%)
- 201 crashes that resulted in property damage only (around 95%).

The following common crash types occurred:

- Around 75% of crashes involved a rear end collision
- Around 8% of crashes involved a right angle collision.

One of the crashes involved a pedestrian.



Figure 17-7 Crash data between 2018 and 2022 within the Yarra Glen precinct study area

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

17.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside uses

The Project's construction would not change any kerbside uses within the Yarra Glen precinct.

Off-street parking

The Project's construction would not change any off-street parking within the Yarra Glen precinct.

Local area access

The conversion of the Yarra Glen/Yamba Drive/Melrose Drive roundabout to traffic signals would be constructed in the following phases:

- Phase 1: Construction of the new northbound carriageway from Yamba Drive to Yarra Glen
- Phase 2: Construction of the new Yarra Glen to Melrose Drive carriageways including closure of the western side of the existing roundabout.

During Phase 2, all traffic travelling between Melrose Drive and Yarra Glen would likely be redirected to Launceston Street, Theodore Street, or would alter their route further afield. Similarly, any traffic travelling between Melrose Drive and Yamba Drive would also be redirected via the same alternative route. The right turn from Melrose Drive to Yamba Drive would be removed as part of the Project's permanent works, resulting in a permanent change to local area access arrangement within the Yarra Glen precinct.

The required local area access diversions would likely result in a slight increase in travel time for impacted motorists.

Mitigation measures TT3 and TT6 in Chapter 21 (Environmental management and mitigation measures) would address local area access impacts.

Property access

The Project's construction would not change any property accesses within the Yarra Glen precinct.

17.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Yarra Glen precinct would include road closures, adjustments to existing lanes, key intersection adjustments, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Yarra Glen precinct, particularly on Melrose Drive, Yamba Drive and Yarra Glen.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

The Project would result in traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) across the broader road network as drivers seek alternative routes to maintain travel times. This results in some differences in traffic volumes between the with and without Project scenarios, even in locations where there would be no road network changes as part of the Project. Although the two alignment options are the same within the Yarra Glen precinct, different travel patterns are also expected throughout the precinct due the different alignment configurations further afield in the Commonwealth Avenue, Parliament House, National Triangle and Barton precincts.

Traffic volume changes associated with the State Circle East alignment option are summarised in Table 17-3 and Table 17-4, and those caused by the National Triangle-Barton alignment option are summarised in Table 17-5 and Table 17-6. These traffic flow changes are due to the following:

- Regional and local traffic reassignment caused by the Project's road network changes (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance, particularly the intersection geometry changes at the Yarra Glen/Melrose Drive/Yamba Drive intersection, which would not permit northbound vehicles on Melrose Drive to turn right onto Yamba Drive
- Changes in mode choice due to the introduction of light rail.

*State Circle East alignment option***Table 17-3 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Yarra Glen precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Yarra Glen	Between Carruthers Street and Cotter Road	Northbound	2,980	2,840	-140	-5%	2,990	2,980	-10	0%
		Southbound	1,590	1,350	-240	-15%	1,590	1,310	-280	-18%
Melrose Drive	Between Launceston Street and Yarra Glen	Northbound	2,170	1,690	-480	-22%	2,210	1,660	-550	-25%
		Southbound	1,210	960	-250	-21%	1,220	920	-300	-25%
Yamba Drive	Between Launceston Street and Yarra Glen	Northbound	1,290	1,210	-80	-6%	1,360	1,240	-120	-9%
		Southbound	1,220	930	-290	-24%	1,190	910	-280	-24%

Table 17-4 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Yarra Glen precinct in 2031 and 2041 scenarios with and without the Project (State Circle East alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Yarra Glen	Between Carruthers Street and Cotter Road	Northbound	1,310	1,440	130	10%	1,550	1,440	-110	-7%
		Southbound	2,130	2,150	20	1%	2,330	2,240	-90	-4%
Melrose Drive	Between Launceston Street and Yarra Glen	Northbound	1,030	900	-130	-13%	1,110	830	-280	-25%
		Southbound	1,630	1,330	-300	-18%	1,650	1,550	-100	-6%
Yamba Drive	Between Launceston Street and Yarra Glen	Northbound	1,100	990	-110	-10%	960	990	30	3%
		Southbound	1,250	1,270	20	2%	1,360	1,250	-110	-8%

*National Triangle-Barton alignment option***Table 17-5 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Yarra Glen precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)**

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Yarra Glen	Between Carruthers Street and Cotter Road	Northbound	2,980	2,800	-180	-6%	2,990	2,640	-350	-12%
		Southbound	1,590	1,360	-230	-14%	1,590	1,370	-220	-14%
Melrose Drive	Between Launceston Street and Yarra Glen	Northbound	2,170	1,650	-520	-24%	2,210	1,680	-530	-24%
		Southbound	1,210	910	-300	-25%	1,220	980	-240	-20%
Yamba Drive	Between Launceston Street and Yarra Glen	Northbound	1,290	1,240	-50	-4%	1,360	1,200	-160	-12%
		Southbound	1,220	1,000	-220	-18%	1,190	860	-330	-28%

Table 17-6 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Yarra Glen precinct in 2031 and 2041 scenarios with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031 scenario				2041 scenario			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Yarra Glen	Between Carruthers Street and Cotter Road	Northbound	1,310	1,490	180	14%	1,550	1,450	-100	-6%
		Southbound	2,130	2,190	60	3%	2,330	2,420	90	4%
Melrose Drive	Between Launceston Street and Yarra Glen	Northbound	1,030	1,030	0	0%	1,110	890	-220	-20%
		Southbound	1,630	1,420	-210	-13%	1,650	1,610	-40	-2%
Yamba Drive	Between Launceston Street and Yarra Glen	Northbound	1,100	930	-170	-15%	960	980	20	2%
		Southbound	1,250	1,220	-30	-2%	1,360	1,270	-90	-7%

Road network performance

State Circle East alignment option

Within the Yarra Glen precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

The Project's changes to the Yarra Glen/Melrose Drive/Yamba Drive intersection and associated traffic reassignment and signal operation changes would decrease congestion and vehicle delays on Yamba Drive on the northbound approach to this intersection during the AM and PM peak hours in 2031.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041.

National Triangle-Barton alignment option

Within the Yarra Glen precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios in the AM and PM peak hours in both 2031 and 2041, such as on the approaches to intersections.

The Project's changes to the Yarra Glen/Melrose Drive/Yamba Drive intersection and associated traffic reassignment and signal operation changes would decrease congestion and vehicle delays on Yamba Drive on the northbound approach to this intersection during the AM and PM peak hours in 2031.

Similar changes to network congestion and vehicle delays would occur during the AM and PM peak hours in 2041.

Intersection performance

State Circle East alignment option

The AM and PM performance of the key intersections within the Yarra Glen precinct with and without the Project for the State Circle East alignment option is provided in Table 17-7 and Table 17-8 respectively and is summarised below. Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport.

- AM peak hour:
 - The assessed intersections would generally operate satisfactorily at a level of service C or better with the Project in 2031 and 2041
 - The Yarra Glen/Melrose Drive/Yamba Drive intersection performance would be better with the Project than without the Project, primarily because this intersection would be upgraded from a roundabout to a signalised intersection
- PM peak hour:
 - The assessed intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041
 - Similar to the AM peak hour, Yarra Glen/Melrose Drive/Yamba Drive intersection performance would be better with the Project than without the Project, primarily because of the signalisation of this intersection with the Project.

Table 17-7 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Yarra Glen precinct (State Circle East alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Carruthers Street (east)/Yarra Glen – on/off ramps	15	B	18	B	16	B	19	B
Carruthers Street (west)/Yarra Glen – on/off ramps	19	B	20	B	20	B	22	C
Yarra Glen/ Melrose Drive/ Yamba Drive	61	E	35	C	68	E	35	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option. The Carruthers Street/Yarra Glen on/off ramp intersections have also been assessed using the mesoscopic model as they are located outside the microsimulation model boundary.

Table 17-8 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Yarra Glen precinct (State Circle East alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Carruthers Street (east)/Yarra Glen – on/off ramps	18	B	19	B	25	C	23	C
Carruthers Street (west)/Yarra Glen – on/off ramps	13	B	35	C	22	C	32	C
Yarra Glen/ Melrose Drive/ Yamba Drive	94	F	38	D	131	F	49	D

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option. The Carruthers Street/Yarra Glen on/off ramp intersections have also been assessed using the mesoscopic model as they are located outside the microsimulation model boundary.

National Triangle-Barton alignment option

The AM and PM performance of the key intersections within the Yarra Glen precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 17-9 and Table 17-10 respectively. Key findings relating to intersection performance are as follows, for both the AM and PM peak hours:

- The assessed intersections would generally operate satisfactorily at a level of service D or better with the Project in 2031 and 2041
- The Yarra Glen/Melrose Drive/Yamba Drive intersection performance would be better with the Project than without the Project, primarily because this intersection would be upgraded from a roundabout to a signalised intersection.

Table 17-9 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 scenarios with and without the Project within the Yarra Glen precinct (National Triangle-Barton alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Carruthers Street (east)/Yarra Glen – on/off ramps	15	B	19	B	16	B	18	B
Carruthers Street (west)/Yarra Glen – on/off ramps	19	B	24	C	20	B	22	C
Yarra Glen/ Melrose Drive/ Yamba Drive	58	E	34	C	61	E	36	D

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option. The Carruthers Street/Yarra Glen on/off ramp intersections have also been assessed using the mesoscopic model as they are located outside the microsimulation model boundary.

Table 17-10 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 scenarios with and without the Project within the Yarra Glen precinct (National Triangle-Barton alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Carruthers Street (east)/Yarra Glen – on/off ramps	18	B	20	B	25	C	31	C
Carruthers Street (west)/Yarra Glen – on/off ramps	13	B	38	C	22	C	39	D
Yarra Glen/ Melrose Drive/ Yamba Drive	116	F	38	D	144	F	46	D

Note: As discussed in Technical Report 1 – Traffic and transport, separate VISSIM microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option. The Carruthers Street/Yarra Glen on/off ramp intersections have also been assessed using the mesoscopic model as they are located outside the microsimulation model boundary.

Active travel

For much of the Project, existing active travel arrangements would be retained and would be complemented by new active travel arrangements or treatments. The key pedestrian and cyclist provisions that would be provided within the Yarra Glen precinct as part of the Project and their benefits or impacts are summarised in Table 17-11.

Table 17-11 Active travel provisions within the Yarra Glen precinct and associated impacts and benefits

Proposed treatment	Impact or benefit
Signalised pedestrian crossings would be provided at the Yarra Glen off ramps on Carruthers Street.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
The Yarra Glen on and off ramp intersections with Carruthers Street would be upgraded to accommodate an expected increase in pedestrian movements including the signalisation of both continuous left turns from the off ramps to Carruthers Street.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
A new bridge and public plazas would be provided as part of the Project to provide pedestrian and cyclist connections at the Carruthers Street Stop.	The bridge would provide pedestrian and cyclist connectivity to the Carruthers Street Stop
Existing active travel arrangements would be reconfigured and consolidated onto the eastern side of Yarralumla Creek.	The reconfiguration and consolidation of active travel arrangements would generally not impact the existing level of active travel accessibility or journey time for pedestrians and cyclists, noting bridge connections would be available at key locations to cross Yarralumla Creek if required.

Kerbside use

The Project would not change any kerbside uses within the Yarra Glen precinct.

Off-street parking

The Project would not change any off-street parking within the Yarra Glen precinct.

Local area access

The existing right turn movement from Melrose Drive to Yamba Drive would be removed due to the conversion of this intersection from a roundabout to traffic signals as part of the Project.

Noting the arterial function of Melrose Drive and Yamba Drive, vehicles that currently perform this movement would likely change their trip further afield and either travel south via Melrose Drive itself or connect with Yamba Drive via Launceston Street or Hindmarsh Drive.

These changes to local area access would likely result in a slight increase in travel time for impacted motorists depending on where drivers are travelling to/from and how far afield they adjust their travel route.

Property access

The Project would not change any property accesses within the Yarra Glen precinct.

17.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole. No further precinct-specific measures have been identified for traffic and transport impacts at the Yarra Glen precinct.

17.3 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts associated with the construction and operation of the Project within the Yarra Glen precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

17.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas have been determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Areas 8, 9 and 10 have been identified for the noise assessment of the Yarra Glen precinct. Noise Catchment Areas 8, 9 and 10 and associated sensitive receivers are shown in Figure 17-8.

Noise Catchment Areas 8, 9 and 10 mostly comprise suburban residential land uses, including the residential areas of Hughes and Curtin to the west and east of Yarra Glen, respectively. Noise Catchment Area 8 also includes a mix of commercial, medical, mixed use and educational land uses, such as the Calvary John James Hospital, Alfred Deakin High School, and several international embassies and high commissions. The Royal Australian Mint is a heritage item, listed on the Commonwealth Heritage List, and located within Noise Catchment Area 8. Further detail on heritage places in the precinct is included in Section 17.4.

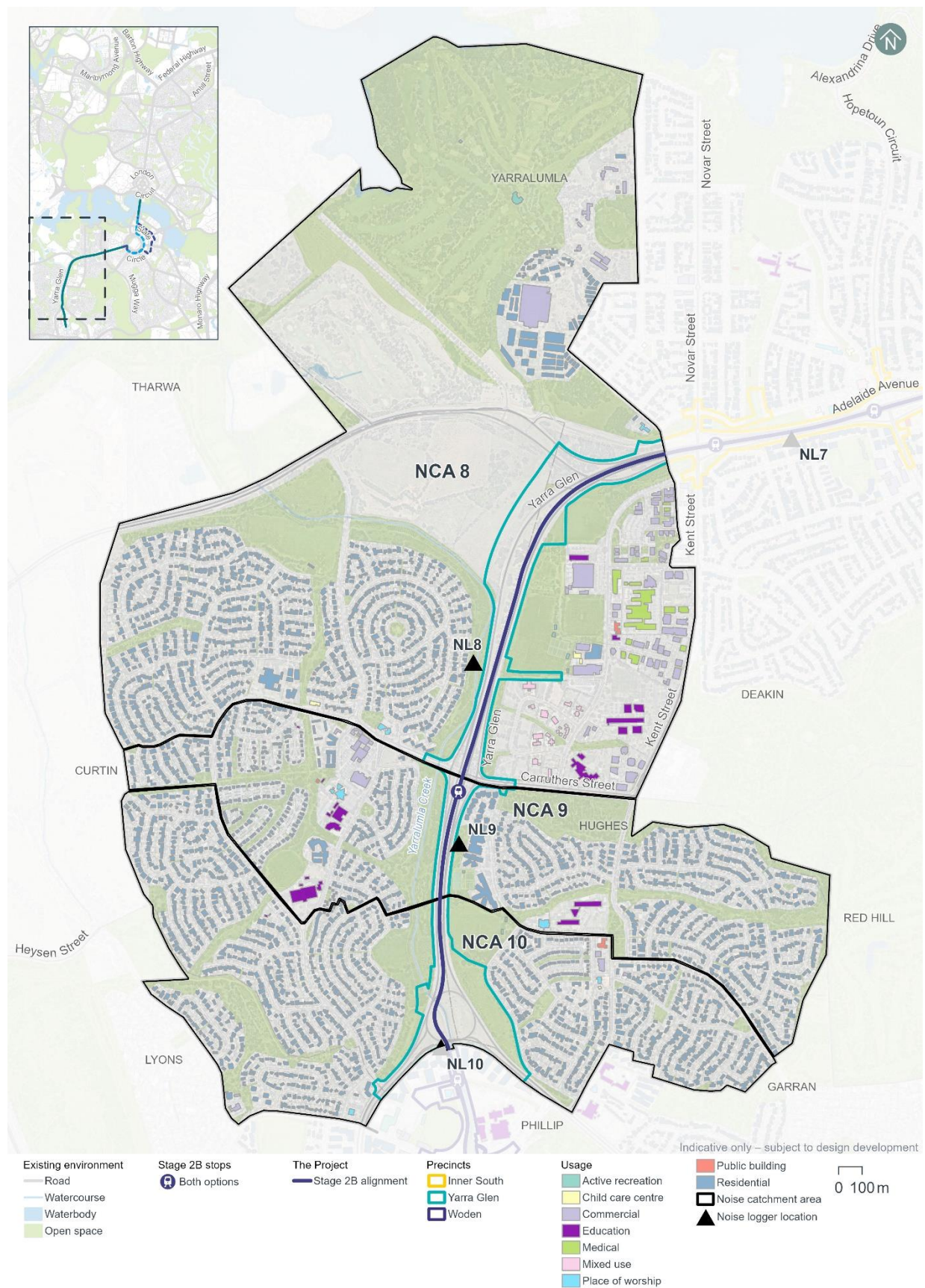


Figure 17-8 Noise catchment area and sensitive receivers

Existing noise levels

Unattended noise monitoring was carried out at three locations in the Yarra Glen precinct (at noise loggers 8, 9 and 10 (NL8, NL9, NL10)) between 2 and 15 May 2024, and between 17 and 22 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 17-12.

The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 17-12 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL8	29 Allan Street, Curtin	51	34	60	52
NL9	95 Groom Street, Hughes	56	31	62	54
NL10	15 Irving Street, Phillip	51	35	67	58

Notes:

- $dB(A)$ represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
- In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
 Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
 Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
 Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 and 2 May 2024 during the daytime period. The results of this monitoring are summarised in Table 17-13.

Table 17-13 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL8	59	53	Noise was dominated by constant road traffic (primarily from Yarra Glen). In lulls, rustling leaves and some bird noise was audible.
NL9	61	56	Noise was dominated by constant road traffic. Some rustling leaves and insects were audible. Loud birds were also audible.
NL10	63	51	Noise included road traffic. Mechanical plant from a nearby apartment building was audible during lulls in traffic. Some faint construction noise was audible.

17.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks,

noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Yarra Glen precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project, therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures).

All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into ‘peak and ‘typical’ works to represent the likely range of potential noise impacts. ‘Peak’ works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while ‘typical’ works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the ‘typical’ scenarios would result in a reduced number of noise affected receivers compared to ‘peak’ scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls

identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 17-14, which assumed no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 17-15.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Construction noise modelling indicates that there would be no difference in noise impacts in this precinct based on the alignment option selected.

Table 17-14 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place) – Yarra Glen precinct

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 8				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	4	146	22
	Typical	1	21	2
Earthworks, road works, and construction of light rail infrastructure	Peak	1	131	22
	Typical	1	59	3
Construction of stops	Typical/peak	-	-	-
Construction of bridges on land	Peak	-	51	3
	Typical	-	3	-
Noise Catchment Area 9				
Mobilisation and establishment of construction compound sites	Peak	-	N/A	-
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	6	176	20
	Typical	-	30	6
Earthworks, road works, and construction of light rail infrastructure	Peak	7	184	20
	Typical	1	88	14
Construction of stops	Typical/peak	-	9	-

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Construction of bridges on land	Peak	1	130	14
	Typical	-	31	5
Noise Catchment Area 10				
Mobilisation and establishment of construction compound sites	Peak	22	N/A	44
	Typical	-	N/A	20
Protection, relocation, treatment and/or decommissioning of utilities	Peak	24	226	52
	Typical	-	46	1
Earthworks, road works, and construction of light rail infrastructure	Peak	5	170	36
	Typical	-	82	10
Construction of stops	Typical/peak	-	-	-
Construction of bridges on land	Peak	-	134	8
	Typical	-	8	-

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

Table 17-15 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) – Yarra Glen precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 8, 9 and 10		
Protection, relocation, treatment and/or decommissioning of utilities - peak	Education	1
	Place of worship	1
Earthworks, road works, and construction of light rail infrastructure – peak	Child care centre	2
	Place of worship	1

Notes:

1. Where a construction scenario did not result in an exceedance for a non-residential receiver, it has not been included in this table
2. Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.
3. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.

The findings of the unmitigated peak and typical construction noise impact assessments for the Yarra Glen precinct during the daytime indicate:

- During standard construction hours, the protection, relocation, treatment and/or decommissioning of utilities is predicted to result in 34 residential buildings being moderately noise affected
- There are three non-residential receiver building predicted to be moderately noise affected due to the 'peak' earthworks, road works and construction of light rail infrastructure scenario, including Yarralumla Uniting Church and two buildings within Deakin School for Early Learning.

The findings of the unmitigated peak and typical construction noise impact assessments for the Yarra Glen precinct during the night-time period indicate:

- During out of hours, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result 548 residential buildings being moderately noise affected, and a total of 94 residential buildings being highly noise affected
- During out of hours, 'typical' earthworks, road works and construction of light rail infrastructure is predicted to result in 229 residential buildings being moderately noise affected, and a total of 26 receivers being highly noise affected. The high number of affected receivers is partly due to the extent of this precinct (compared to other precincts) and the density of nearby residential receivers
- There is one hotel (commercial) receiver building (The Statesman) within the Yarra Glen precinct. It is not predicted to be moderately noise affected.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical' works case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 17-16 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Areas 8, 9, and 10, in the absence of mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 17-16 Number of residential buildings where noise levels may exceed sleep awakening reaction levels for night work (assuming no mitigation measures are in place)

Construction scenario (typical works)	Number of residential buildings where noise levels may exceed the sleep awakening reaction level
Noise Catchment Area 8	
Protection, relocation, treatment and/or decommissioning of utilities	92
Earthworks, road works, and construction of light rail infrastructure	183
Construction of stops	-
Construction of bridges on land	41
Noise Catchment Area 9	
Protection, relocation, treatment and/or decommissioning of utilities	66
Earthworks, road works, and construction of light rail infrastructure	184
Construction of stops	14
Construction of bridges on land	68
Noise Catchment Area 10	
Protection, relocation, treatment and/or decommissioning of utilities	158
Earthworks, road works, and construction of light rail infrastructure	285
Construction of stops	-
Construction of bridges on land	134

Noting the awakening reaction level is exceeded by a number of residential buildings in Noise Catchment Areas 8, 9 and 10 with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of bridges on land.

Noise relating to construction of stops also exceeds the awakening reaction level in Noise Catchment Area 9.

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. A number of residential buildings are located within the human response minimum safe working distance for the large hydraulic hammer (within 73 m of the Project area boundary). There is potential for exceedances of the human comfort criteria to occur depending on the duration, nature and location of the construction activity within the construction footprint. Any exceedances would be expected to be short in duration due to the intermittent nature of vibration emissions.

Cosmetic damage

No light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures) for cosmetic damage. No heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage-listed structures) for cosmetic damage.

This presents a worst-case conservative assessment which has assumed that vibration-intensive equipment could be used at the boundary of the Project area. In reality, vibration intensive equipment is not likely to be used throughout the entire Project area. Instead, this equipment would typically be limited to areas of the footprint away from boundary of the Project area, where it could be used to construct the light rail alignment, for example, in road medians and verges.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further information on mitigation measures is provided in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network with Yarra Glen serving as a key route for construction traffic within this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (AM peak period, 8am to 9am) and night-time (assessed for 10pm to 7am) are presented in Table 17-17. The year 2031 was selected as representative of the peak year of construction.

These findings indicate that construction traffic during the AM peak period or night-time hours would not result in relative increases of more than 2 dB(A) and therefore construction traffic is expected to be barely or not perceptible at all to noise sensitive receivers. The NSW Road Noise Policy (NSW Department of Environment, Climate Change and Water, 2011) indicates that an increase of up to 2 dB(A) represents a minor impact that is considered barely perceptible to the average person.

No increases in road traffic noise greater than 2 dB(A) have been identified along the proposed haulage routes within the Yarra Glen precinct.

Table 17-17 Construction road traffic noise peak hourly traffic counts

Route	Direction	Existing traffic (average hourly)		Additional construction traffic (peak hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Yarra Glen between Kent Street and Carruthers Street	Northbound	1,562	118	2	6	0.1
	Southbound	833	63	2	6	0.1
Yamba Drive between Melrose Drive and Launceston Street	Northbound	608	46	2	6	0.2
	Southbound	640	48	2	6	0.2
Night-time assessment						
Yarra Glen between Kent Street and Carruthers Street	Northbound	86	6	8	3	0.8
	Southbound	140	11	8	3	0.5
Yamba Drive between Melrose Drive and Launceston Street	Northbound	72	5	8	3	0.9
	Southbound	82	6	8	3	0.8

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce light vehicles and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

17.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Yarra Glen precinct. The potential impacts are common to both alignment options, given the consistent Project design in this precinct.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m each of the alignment. This involved assessment of noise levels at a total of 1,169 receivers in the Yarra Glen precinct, including residential receivers, mixed use receivers, education and childcare centres, places of worship, public buildings, and active recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

The results of the operational rail noise assessment indicated compliance with both daytime and night-time airborne noise trigger levels, and no exceedances of the trigger levels were predicted. Rail noise impacts would be intermittent and last for a relatively short duration as the LRV passes the receiver, would not represent a constant noise source.

Operational rail noise contours for the Project are presented in Appendix F of Technical Report 9 – Noise and vibration.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Yarra Glen precinct at the most affected (closest) receiver is presented in Table 17-18.

Table 17-18 Yarra Glen precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) $L_{A\text{Smax}}$	Predicted ground-borne noise, dB(A) $L_{A\text{Smax}}$
99 Groom Street, Hughes	Residential	53	70	35	36

Targeted mitigation is recommended when ground-borne noise levels are higher than the airborne noise levels. The airborne noise levels for internal spaces with windows open are predicted to be $L_{A\text{Smax}}$ 72 dB(A) for the most affected receiver during the night-time period. These airborne noise levels are higher than the ground-borne noise levels, and therefore no additional treatment is considered necessary for the alignment within the Yarra Glen precinct to manage this impact.

Rail vibration assessment

The predicted vibration levels for the Yarra Glen precinct at the most affected (closest) receiver is presented in Table 17-19. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria.

Table 17-19 Yarra Glen precinct – vibration results (human comfort; assuming no mitigation measures are in place)

Address and building use	Distance from track centreline, m	Vibration Criteria (Daytime), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Daytime), $\text{m/s}^{1.75}$	Vibration Criteria (Night), $\text{m/s}^{1.75}$	Predicted equivalent vibration dose value (Night), $\text{m/s}^{1.75}$
99 Groom Street, Hughes <i>Residential</i>	53	0.2	0.005	0.13	0.003

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018).. The road traffic noise criteria applicable to upgrading roads in existing areas is presented in Table 17-20.

Table 17-20 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the 'without Project' and 'with Project' scenarios for the year 2031 (selected to represent the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road

network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Yarra Glen precinct, existing road traffic noise levels are between 55-60 dB(A) on Irving Street, Phillip, and >60 dB(A) on Allan Street, Curtin. Future predicted road traffic noise levels either would not increase, or would not exceed 60 dB(A), and are therefore considered acceptable.

The results of the road traffic noise assessment are presented for each alignment option in Table 17-21 to Table 17-24, for 2031 and 2041 scenarios respectively.

Table 17-21 Road traffic noise assessment, 2031 – State Circle East alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Yarra Glen	29 Allan Street, Curtin	Southbound	22,372	932	-1,015	-42	0	Yes, no increase in traffic noise level
		Northbound	11,957	498	-1,805	-75		
Melrose Drive	15 Irving Street, Phillip	Southbound	9,137	381	-677	-28	0	Yes, no increase in traffic noise level
		Northbound	16,198	675	-978	-41		

Table 17-22 Road traffic noise assessment, 2041 – State Circle East alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Yarra Glen	29 Allan Street, Curtin	Southbound	11,957	498	-2,106	-88	0	Yes, no increase in traffic noise level
		Northbound	22,485	937	-75	-3		
Melrose Drive	15 Irving Street, Phillip	Southbound	13,987	583	-301	-13	0	Yes, no increase in traffic noise level
		Northbound	22,635	943	-827	-34		

Table 17-23 Road traffic noise assessment, 2031 –National Triangle Barton alignment

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Yarra Glen	29 Allan Street, Curtin	Southbound	22,372	932	-1,316	-55	0	Yes, no increase in traffic noise level
		Northbound	11,957	498	-1,730	-72		
Melrose Drive	15 Irving Street, Phillip	Southbound	14,739	614	-376	-16	0	Yes, no increase in traffic noise level
		Northbound	22,560	940	-526	-22		

Table 17-24 Road traffic noise assessment, 2041 –National Triangle Barton alignment

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Yarra Glen	29 Allan Street, Curtin	Southbound	11,957	498	-1,654	-69	0	Yes, no increase in traffic noise level
		Northbound	22,485	937	-2,632	-110		
Melrose Drive	15 Irving Street, Phillip	Southbound	13,987	583	-75	-3	0	Yes, no increase in traffic noise level
		Northbound	22,635	943	-978	-41		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the LA10, 15min assessment noise level at any location.

Within the Yarra Glen precinct, the Carruthers Street Stop is located 50 m away from the nearest sensitive receiver, the Warrigal Residential Aged Care village. The nearest residential receiver is 195 m away from the stop platform. Noise from the Yarra Glen road corridor would dominate the noise environment. However, subjective impacts are likely to be minimal given the relative infrequency of announcements and the existing road embankment that is likely to shield much of the noise from the PA systems.

Fixed facilities noise assessment – Traction power substation noise

Within this precinct, TPS9 is located off Yarra Glen adjacent to the bicycle paths at the south-west corner of Deakin Ovals. The predicted TPS noise levels at the nearest affected receiver are presented in Table 17-25. Based on the assessment, the TPS design is anticipated to meet applicable noise criteria.

Table 17-25 Predicted TPS noise level at affected receivers

TPS location	Distance to receiver, m	Predicted LA10 noise level, dB(A)	Night-time noise zone standard, LA10,15min, dB(A)	Compliance
TPS9 – Deakin	80	23	35	Yes

17.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage noise and vibration impacts that are specific to the Yarra Glen precinct are shown in Table 17-26.

Table 17-26 Noise and vibration mitigation measures – Yarra Glen precinct

ID	Objective	Management and mitigation measure	Timing
NV8	Minimising night-time construction road traffic noise	Where night-time road traffic noise levels at sensitive receivers are predicted to increase by more than 2 dB(A), alternative construction vehicle haulage routes will be investigated. Where there are no alternative haulage routes available early consultation with the affected sensitive receivers will be undertaken.	Construction

17.4 Biodiversity

This section describes the potential impacts of the Project on biodiversity and provides a summary of the biodiversity assessment for the Yarra Glen precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 3 of Technical Report 2 – Biodiversity.

17.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Yarra Glen precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 35.11 ha of vegetation is present in the Yarra Glen precinct. Vegetation within the Yarra Glen precinct is comprised of three vegetation communities. Table 17-27 and Figure 17-9 depict the area and distribution of each vegetation community within the Yarra Glen precinct.

Table 17-27 **Extent of vegetation communities within the Project area in the Yarra Glen precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	3.92
Landscape plantings – Exotic	8.09
Exotic grassland	23.10
Total vegetation	35.11



Figure 17-9 Vegetation communities, hollow-bearing and mature trees in the Yarra Glen precinct

Hollow-bearing trees and mature trees

A total of 29 hollow-bearing trees and 68 mature trees have been recorded in the Yarra Glen precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

The majority of the recorded hollow-bearing trees are species that are endemic to the ACT. A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues). Table 17-28 summarises the number of hollow-bearing and mature trees within the Yarra Glen precinct and is shown in Figure 17-9.

Field surveys carried out between 2022 and 2024 have identified evidence of some of the hollows being actively used with birds (including Gang-gang Cockatoos) entering and leaving the hollows and displaying breeding behaviours (i.e. chewing around the hollow entrance).

Table 17-28 Summary of hollow-bearing and mature trees within the Project area in the Yarra Glen precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Yarra Glen	29	13	28	10	7	2	68

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna habitat

The Golden Sun Moth is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 10.34 ha of three potential Golden Sun Moth habitats has been recorded within the Yarra Glen precinct. This habitat has been identified as 0.06 ha of low quality habitat, 4.88 ha of low-density Chilean needlegrass habitat, and 5.43 ha of high-density Chilean needlegrass (refer to Figure 17-10).

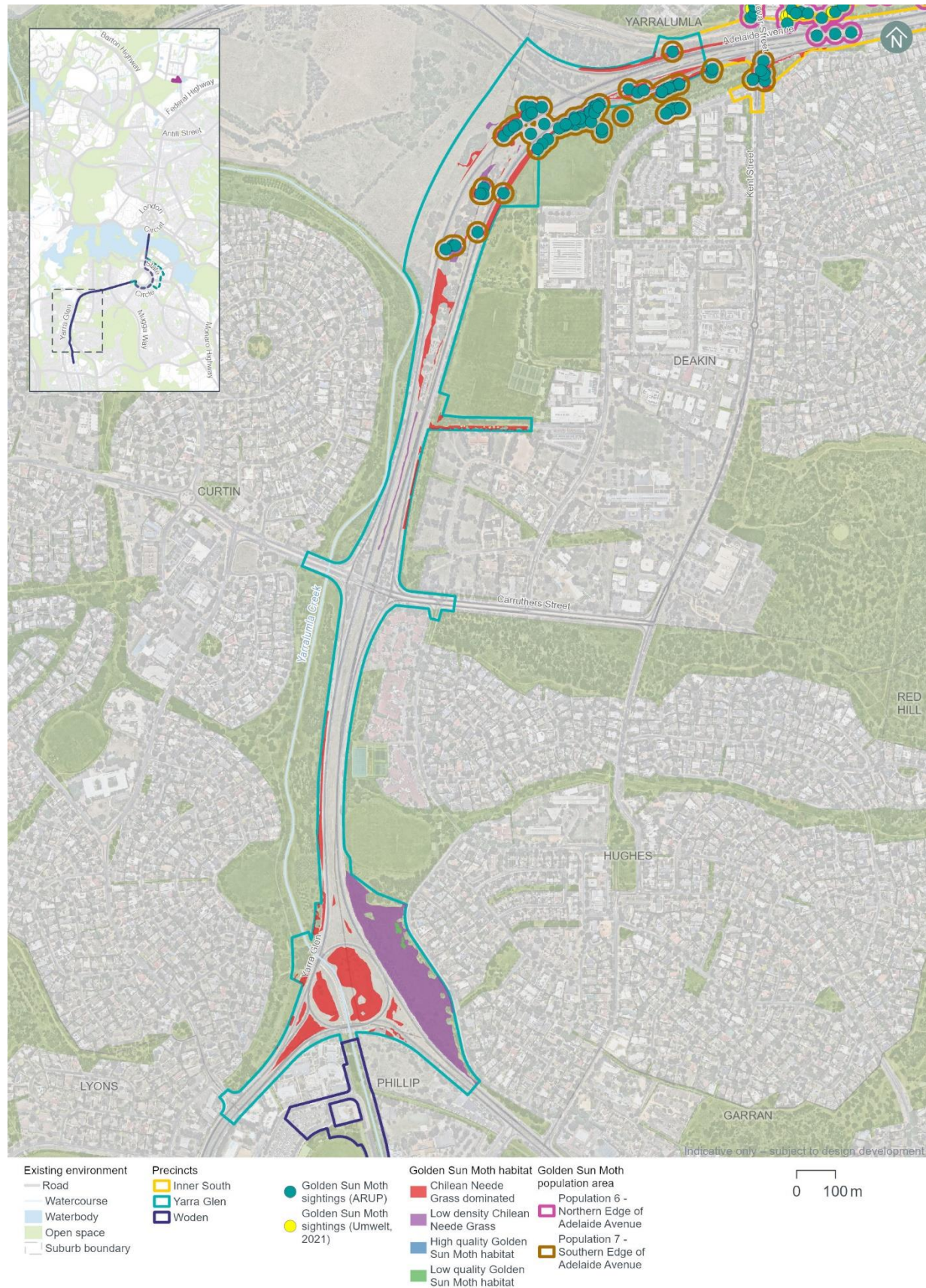


Figure 17-10 Golden Sun Moth habitat and sightings in the Yarra Glen precinct

One Golden Sun Moth population has been identified in the Yarra Glen precinct. The location of the population is shown in Figure 17-10. Other Golden Sun Moth individuals, populations and habitat across the Project area are identified in Section 11.2 of Chapter 11 (Project-wide issues).

Other potential threatened fauna habitat identified within the Yarra Glen precinct includes:

- Gang-gang Cockatoo (listed as endangered under both the EPBC Act and the NC Act) – the Yarra Glen precinct supports 3.92 ha of foraging habitat for the species (refer to Figure 17-11)
- Superb Parrot (vulnerable under both the EPBC Act and the NC Act) – the Yarra Glen precinct supports 3.92 ha of foraging habitat for this species (refer to Figure 17-11)
- Diamond Firetail (listed as vulnerable under both the EPBC Act and the NC Act.) – 3.92 ha of the Landscape Planting – Native community has been identified within the Yarra Glen precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 17-11).

No habitat was identified in the Yarra Glen precinct for the Swift Parrot (*Lathamus discolor*), Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberrae*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).



Figure 17-11 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Yarra Glen precinct

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Yarra Glen precinct. Impacts to threatened or rare flora species are therefore not anticipated.

Seven pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Yarra Glen precinct:

- Chilean needlegrass (*Nassella neesiana*) – a Weed of National Significance
- Serrated tussock (*Nassella trichotoma*) – a Weed of National Significance
- African lovegrass (*Eragrostis curvula*)
- St John's wort (*Hypericum perforatum*)
- Monterey pine (*Pinus radiata*)
- White poplar (*Populus alba*)
- English ivy (*Hedera helix*).

17.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Yarra Glen precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 17-12. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 17-29. Only 1.68 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 17-29 **Extent of vegetation communities within the clearance footprint in the Yarra Glen precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	1.68
Landscape plantings – Exotic	1.87
Exotic grassland	12.42
Total vegetation	15.97

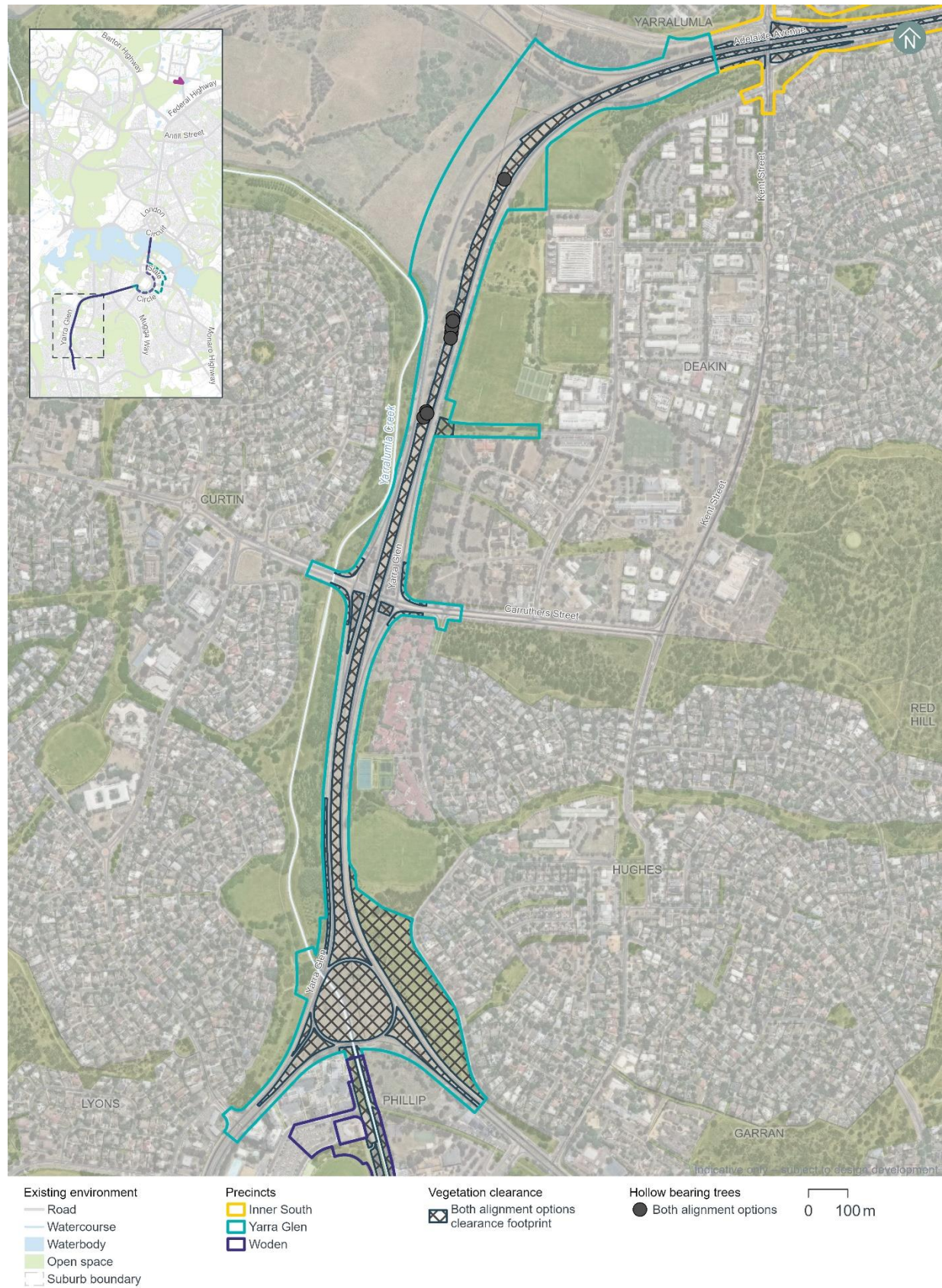


Figure 17-12 Clearance footprint in the Yarra Glen precinct

A total of nine hollow-bearing trees and 28 mature native trees have been recorded within the clearance footprint in the Yarra Glen precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence. Table 17-30 summarises the number of hollow-bearing and mature native trees within the Yarra Glen precinct and is shown in Figure 17-12.

Table 17-30 Hollow-bearing and mature native trees within the clearance footprint in the Yarra Glen precinct

Precinct	Number of hollow-bearing trees	Hollows ¹					Number of mature native trees
		Extra-small (<2.5 cm)	Small (2.5–5 cm)	Medium (5–10 cm)	Large (10–30 cm)	Extra-Large (>30 cm)	
Yarra Glen	9	1	13	6	1	2	28

Notes:

1. Some hollow-bearing trees have been recorded as containing more than one hollow.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Yarra Glen precinct would include impacts to the following through habitat removal:

- Golden Sun Moth – 6.99 ha of habitat, including habitat associated with Golden Sun Moth population 7
- Gang-gang Cockatoo – 1.68 ha of foraging habitat, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species. There are no breeding trees present in the Yarra Glen precinct
- Superb Parrot – 1.68 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 1.68 ha of the Landscape Planting – Native community within the precinct which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Yarra Glen precinct clearance footprint for the Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Section 11.2.2 of Chapter 11 (Project-wide issues).

17.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within an existing transport corridor increasing the risk of fauna strike
- Fauna strike with over-head wires and associated infrastructure.

Further detail on these indirect impacts for operational activities is discussed in Section 11.2.3 of Chapter 11 (Project-wide issues).

17.4.4 Precinct specific management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, through the development of a minimised clearance footprint within the Project area (refer to Figure 17-12).

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Yarra Glen precinct.

17.5 Historic heritage

This section provides a summary assessment of the potential historic heritage impacts associated with the construction and operation phases of the Project within the Yarra Glen precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

17.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Yarra Glen precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The heritage significance of this precinct arises from its expression of National Capital Development Commission (NCDC)-era (1960 to 1980) development of Canberra and connection with the surrounding suburbs. Attributes include the wide boulevard of Adelaide Avenue, as one of the pieces of major infrastructure which helped complete Canberra, and the long views to distant mountains which give a strong backdrop to the NCDC-era suburbs (such as Hughes).

Additionally, national institutions visible from Adelaide Avenue such as The Royal Australian Mint, as well as a variety of embassies, create a reminder of the unique character of Canberra as the national capital.

The historic heritage assessment identified two heritage places (one listed and one unlisted) near the Yarra Glen precinct, as noted below in Table 17-31 and shown in Figure 17-13.

Table 17-31 Heritage places within and surrounding the Yarra Glen precinct

Heritage places	Description
Commonwealth Heritage List	
The Royal Australian Mint (refer to Figure 17-14)	<p>The Royal Australian Mint holds significant heritage value due to its role as the sole producer of the nation's circulating coins since its establishment in 1965.</p> <p>Its Stripped Classical architectural style is characteristic of the architectural type and identifies it as a national institution, linking it with other similarly designed national institutions in Canberra.</p>
Unlisted significant heritage places	
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 17-13 and is not considered further in this precinct assessment.</p>

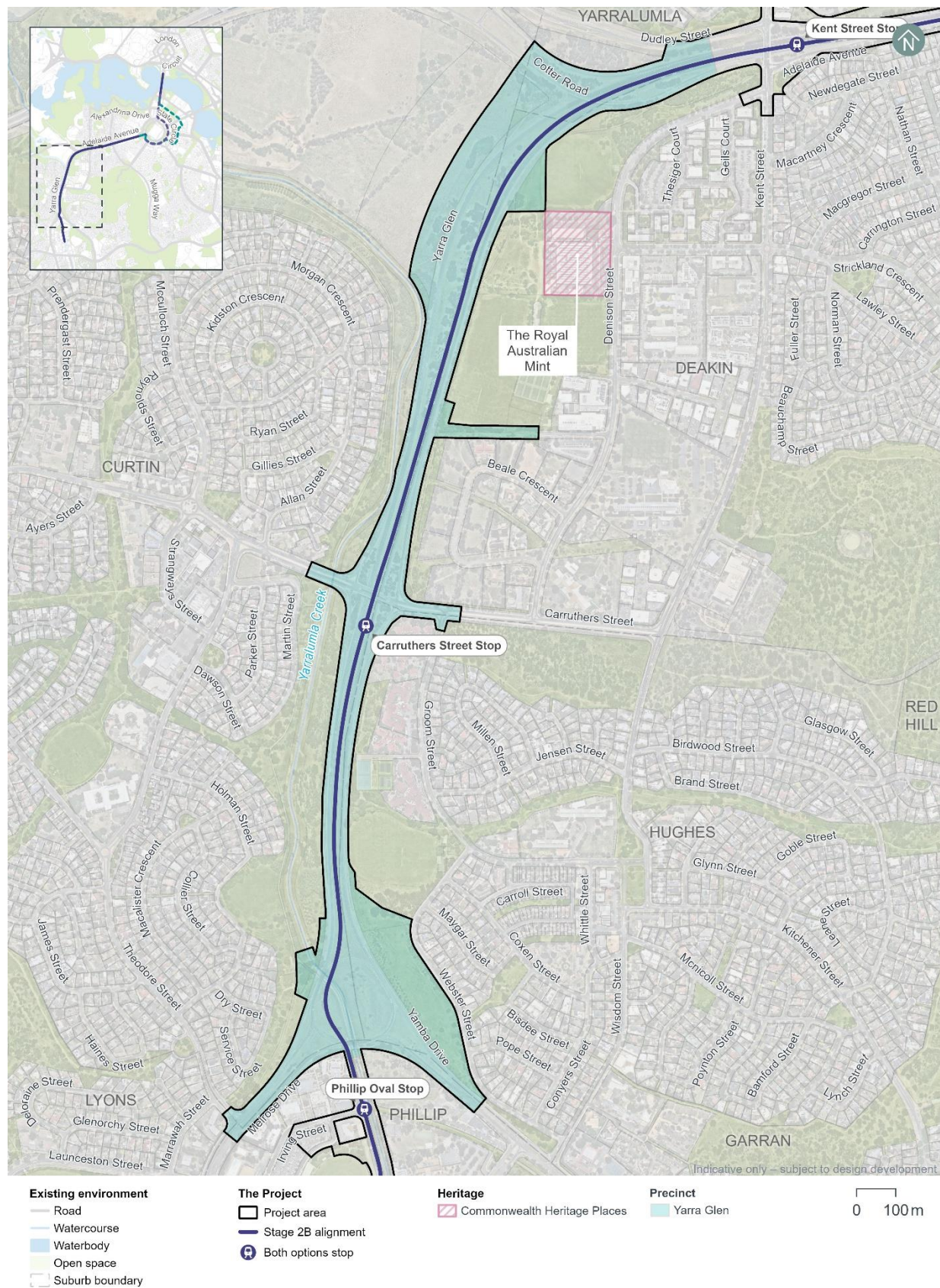


Figure 17-13 Heritage places relevant to the Yarra Glen precinct



Figure 17-14 The Royal Australian Mint

Condition, integrity, and sensitivity to change

The existing heritage values within the Yarra Glen precinct are generally in good condition. The roads and verges, landscape and planting, and significant heritage places are well maintained.

The integrity of the heritage values is good. The heritage features of the precinct are effective in expressing the historic NCDC-layer of the landscape, as a significant piece of NCDC architecture passing through the suburbs of the Inner South and Woden Valley which were constructed during the rapid population growth of the 1960s and 70s. The view to the mountains to the south-west is unimpeded.

The precinct has low to moderate sensitivity to change. The expression of the precinct's heritage character is via the location and form of Adelaide Avenue, its proximity to surrounding suburbs and relationship to inner and distant hills. These features can tolerate a reasonable amount of change. Views to the mountains south-west of the precinct along the corridor of Adelaide Avenue are more sensitive to change from development which would obscure these view lines.

17.5.2 Potential impacts – construction

Table 17-32 summarises the potential construction impacts of the Project on heritage places in the Yarra Glen precinct.

Table 17-32 Construction impacts on heritage places surrounding the Yarra Glen precinct

Heritage place	Construction impact
Commonwealth Heritage List	
The Royal Australian Mint	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place Temporary impacts to the visual setting of this heritage place No vibration impacts to this heritage place.

Construction impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

17.5.3 Potential impacts – operation

Table 17-33 summarises the potential operation impacts of the Project on heritage places in the Yarra Glen precinct.

Table 17-33 Operation impacts on heritage places surrounding the Yarra Glen precinct

Heritage place	Operation impact
Commonwealth Heritage List	
The Royal Australian Mint	Nil <ul style="list-style-type: none"> No direct impacts to this heritage place No permanent impacts to the visual setting of this heritage place No operational vibration impacts to this heritage place.

Operation impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

17.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for historic heritage impacts at the Yarra Glen precinct.

17.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Yarra Glen precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural and heritage attributes of the landscape, planning designations and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown in Figure 17-15.

17.6.1 Existing environment

The Yarra Glen precinct is characterised similarly to the Inner South precinct, dominated by the expansive corridor of the Yarra Glen crossing low-rise residential neighbourhoods of Curtin and Hughes. Notable landmarks include the Australian Mint, and the employment area of West Deakin.

The Yarra Glen precinct extends from the Kent Street overpass to the roundabout at the junction of Yamba Drive and Melrose Drive along Yarra Glen. Yarra Glen is a dual carriageway with a broad turf median (exotic grasslands) with some central tree planting (landscape plantings – native and landscape plantings – exotic), flanked by bushland and exotic tree buffer planting.

The Yarra Glen precinct falls within the low-lying land surrounding Yarralumla Creek with a now formalised Yarralumla Creek drainage corridor running adjacent to the proposed Project alignment.

The precinct does not contain any heritage items, but its heritage value is influenced by the Commonwealth Heritage listed Australian Mint. Further information on heritage items can be found in Section 17.5.



Figure 17-15 Landscape character zone and viewpoints in the Yarra Glen precinct

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Landscape character

The key aspects of landscape character in the Yarra Glen precinct can be seen in Figure 17-16 to Figure 17-18. Yarra Glen is a dual carriageway with a broad turf median with some central tree planting. A series of over-head road and pedestrian bridges span the road corridor. The road corridor is flanked by bushland and exotic tree plantings, with views typically focussed along and within the road corridor, as well as open lawn areas (refer to Figure 17-18).

The Yarra Glen precinct falls within the low-lying land surrounding Yarralumla Creek with a now formalised (concrete channel) Yarralumla Creek drainage corridor running adjacent to Yarra Glen along most of its length within the precinct.

Adjacent parklands and public open space areas provide opportunities for active and passive recreation, such as playing fields and active transport trails (refer to Figure 17-16). Bands and stands of mature tree planting are scattered throughout these areas providing shade. Trees planted within the precinct are typically native, with some exotic species (including deciduous or coniferous trees).



Figure 17-16 Active transport route along Yarra Glen near the Australian Mint

The Australian Mint Commonwealth Heritage Listing (CHL) adjacent to the Mint Oval and Deakin sports fields (refer Figure 17-17), lie adjacent to the precinct and contribute to its heritage values. Additionally, a lone conifer tree which is a remnant of the Yarra Glen Homestead site is located north of the Carruthers Street overpass (shown in Figure 17-18).



Figure 17-17 The view across the Mint Oval towards the Australian Mint



Figure 17-18 Yarra Glen seen from the Carruthers Street overpass, including a conifer associated with the Yarra Glen Homestead in the median

Viewpoints

Representative viewpoints that have been identified to assess visual impacts within the Yarra Glen precinct are shown in Figure 17-15 and described in Table 17-34. Images of all viewpoints can be found in Technical Report 10 – Landscape character and visual amenity.

Table 17-34 Yarra Glen precinct viewpoints and description

Viewpoint	Description	Sensitivity rating
Viewpoint YG1: The Mint Oval	<p>This viewpoint is located within the Mint Oval public open space, adjacent to a shared use path along Yarra Glen (Figure 17-16). The foreground of the view comprises the shared user path and wide, open lawn area between the path and road corridor. Although recreational receptors using the area would have a higher sensitivity to change due to the context of the public open space setting, the focus of these receptors is likely to be towards the open space, rather than on the road corridor.</p> <p>The sensitivity to change of this viewpoint is moderate. Although recreational receptors would have a higher sensitivity to change due to the context of the public open space setting, the focus of these receptors is likely to be towards the open space, rather than on the road corridor.</p>	Moderate

Viewpoint	Description	Sensitivity rating
Viewpoint YG2: Traction Power Substation 9	<p>This viewpoint is located within Deakin Oval looking south-west towards the proposed Traction Power Substation (TPS) 9 (refer to Figure 17-19). Yarra Glen is visible through a band of deciduous trees at the oval's edge. Although recreational receptors using the area would have a higher sensitivity to change due to the context of the public open space setting, the focus of these receptors is likely to be towards the open space and their recreational activities, rather than on the park edges. Sensitive receptors would also include pedestrians and cyclists utilising the shared user path behind the trees in the middle ground, and those utilising the sports field. Visual receptors are likely to be locals within the context of a primarily residential area, as well as visitors utilising the field for sports events.</p> <p>The sensitivity to change of this viewpoint is moderate. Although recreational receptors would have a higher sensitivity to change due to the context of the public open space setting, the focus of these receptors is likely to be towards the open space and their recreational activities, rather than on the park edges.</p>	Moderate
Viewpoint YG3: Yarralumla Creek	<p>This viewpoint is located within the Yarra Glen, Melrose Drive and Yamba Drive 'roundabout,' looking south adjacent to the Yarralumla Creek Corridor (refer to Figure 17-21). A road bridge transects the midground of the view, with a pedestrian underpass. The roadway is raised above the viewpoint, with passing vehicles indicating the location of the road within the view. Receptors using the shared path would have a passing interest in the view as they move along the path at a slow to moderate speed. It is unlikely receptors would be experiencing the view over a longer period of time due to the proximity of the surrounding roads and lack of protective vegetation.</p> <p>The sensitivity to change of this viewpoint is moderate. Although recreational receptors would have a higher sensitivity to change due to the context of the open space setting, the focus of these receptors is likely to be on the path, rather than the surrounding landscape.</p>	Moderate

Night-time lighting

Both alignment options sit within Yarra Glen corridor which is a major grade separated arterial road connecting to the Woden Town Centre and south-western suburbs. Due to its scale as a major transport corridor, Yarra Glen is an area of A4: High district brightness based on Australian Standard 4282:2023 (Standards Australia, 2023).

17.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition (of construction activity and equipment and construction compounds) and loss of elements (most notably to trees) within the Yarra Glen precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops, retaining walls, and bridges

- Installation of lighting, signage, and landscaping
- Temporary traffic changes.

These changes would alter many aesthetic aspects and key characteristics within the precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years).

As such, the magnitude of change during construction would be high within the Yarra Glen precinct due to the visual clutter of construction and the removal of trees. This would result in a high to moderate adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Yarra Glen precinct, overall impacts varied greatly between viewpoints, ranging from high to moderate to negligible due to varied visibility of construction activities from each viewpoint.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 17-35.

Table 17-35 Viewpoints construction impact summary – Yarra Glen precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint YG1: The Mint Oval	Changes would be seen with a portion of the view in the middle ground contrasting with the existing view. The construction would introduce construction elements and activity within a wide, open view in close proximity to recreational receptors and from a distance of approximately 20 m, with no vegetation screening. The visual clutter of construction activity would become a dominant feature of the view.	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Adverse
Viewpoint YG2: Traction Power Substation 9	Construction activities would be in clear view of the viewpoint and contrast with the existing view of parkland. This would include the removal of some trees and addition of construction activities and equipment to the view. The construction activity would be visually prominent within the view, particularly due to the close proximity of the changes, the scale of the equipment, and the location of the viewpoint within an open green space adjacent to a major road corridor.	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint YG3: Yarralumla Creek	While considerable construction activity, equipment and a construction compound would be positioned at and around this viewpoint, it would not be accessible during construction; therefore, the visual impact would be negligible.	Sensitivity: Moderate
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral

Night-time visual impact assessment

To minimise traffic and access impacts along key road corridors within the precinct, works may need to be undertaken outside standard construction hours (Monday to Saturday, 7am to 6pm). Most of the night works would occur within and directly adjacent to the existing road corridor. A construction compound within the precinct would be established within the parkland east of Yarra Glen/Yamba Drive roundabout in Hughes, providing support for the construction activities. The construction compound would require temporary lighting for safety and security.

The construction of a light rail stop at Carruthers Street and the reconfiguration of the intersection at Yarra Glen, Melrose Drive and Yamba Drive would comprise the most substantial works within the precinct. While night works would increase the existing light levels experienced by receptors, interventions such as dense vegetation and topography, as well as distance from the works would provide visual buffering.

For these reasons, the visual impact during construction at night is **minor adverse** impact.

17.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project would impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 17-36 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 17-36 Landscape character impact assessment summary in the Yarra Glen precinct – both alignment options

Alignment option	Anticipated change	Impact rating
Both alignment options	<p>Changes due to the Project would include:</p> <ul style="list-style-type: none"> The light rail positioned within the median along the extent of Yarra Glen, comprising primarily green track within the trackform A light rail stop south of the Carruthers Street on Yarra Glen, including a canopy structure Juvenile trees would replace trees removed during construction within the median of Yarra Glen Substantial traffic arrangement changes to Yamba Drive and Melrose Drive including the removal of the existing Melrose Drive off ramp and bridge, and the addition of a twin turning bays connecting Yarra Glen with Yamba Drive and Melrose Drive TPS 9 would be positioned in a corner of Deakin Cricket Ground near Yarra Glen. <p>The addition of light rail infrastructure would comprise new elements within the precinct. The key aesthetic and perceptual aspects of the precinct would be retained and protected, including the spatial arrangement within the Yarra Glen corridor. Although the intersection of Yarra Glen, Melrose Drive and Yamba Drive would be altered, this remains characteristic of the existing conditions within the precinct in that the roads lie within a widened interchange visually dominated by undulating areas of turf and the Yarralumla Creek corridor. While the changes would be permanent, they are predominantly visually recessive and somewhat characteristic of the existing infrastructure and movement of traffic along the corridor. The TPS 9 would be only perceivable within its immediate landscape setting and would not affect the overall landscape character. The replanting of trees and the re-arrangement of the Yarra Glen, Melrose Drive and Yamba Drive intersection (which would result in an overall reduction in hardscape within</p>	Sensitivity: Moderate
		Magnitude: Low
		Overall impact: Moderate to low
		Qualitative rating: Adverse

Alignment option	Anticipated change	Impact rating
	the precinct) would be a positive qualitative outcome. Therefore, the overall impact on landscape character would be moderate to low .	

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Yarra Glen precinct, in most cases the overall impact at each viewpoint has been assessed as being moderate to low due to:

- Moderate sensitivity of each viewpoint to change
- The addition of new infrastructural elements to each view, balanced by the retention of key landscaping elements.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 17-37.

Table 17-37 Viewpoints operation impact summary – Yarra Glen precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint YG1: The Mint Oval	The existing Kent Street/Novar Street bridge structure would be retained, and the grassy central median would be mostly preserved. Tree removal would not be required in this viewpoint. The addition of passing LRVs within the median would result in a contrast to the existing condition, however, the elements that would be added to the view are somewhat visually recessive, similar to passing buses and temporary within the view as they pass. Over-head wires and poles would be visible from this viewpoint, seen partly against a backdrop of existing grey infrastructure and in keeping with other vertical elements such as light poles. While the addition of light rail infrastructure within the view would change the composition of some elements within view, the infrastructure is consistent with the character of the major road corridor.	Sensitivity: Moderate
		Magnitude: Low
		Overall impact: Moderate to low
		Qualitative rating: Adverse
Viewpoint YG2: Traction Power Substation 9	The TPS site would be around 270 m ² in area, in the centre left of the view. The TPS would have a demountable building consisting of an air-conditioned switchgear room and a separate ventilated room. Power would be distributed from the TPS via over-head wiring strung on poles to the LRVs. Tree planting and landscaping surrounding the TPS is proposed. These changes would be seen within a small portion of the overall view, however, would comprise a new structural element within an otherwise open green space. While these changes would be permanent and in contrast to the existing condition, the façade of the structure would be designed to be aesthetically recessive within the landscape. The maturation of proposed tree planting surrounding the TPS would also provide visual softening of the TPS structure. An indicative visualisation of the Project from Viewpoint YG2 once operational is provided in Figure 17-20.	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Adverse

Viewpoint	Anticipated change in view	Impact rating
Viewpoint YG3: Yarralumla Creek	<p>The Project would result in the addition of light rail infrastructure within the parkland area adjacent to Yarralumla Creek. Although this would introduce a new element to the view, the removal of Melrose Drive and the road bridge would reduce the amount of transport infrastructure visible.</p> <p>The changes would be visually prominent within the view, extending from the foreground into the background of the view. The most prominent elements would include the removal of the Melrose Drive infrastructure and the addition of light rail tracks, resulting in a change to the composition of the elements within the view. The repurposing of this space from an open, green setting to a more utilitarian space, in conjunction with the changes sitting within a wide, open view due to lack of vegetative screening would amplify the changes for receptors, however, the removal of traffic along Melrose Drive and connection to a broader open green space would balance these changes.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint YG3 is provided in Figure 17-22.</p>	Sensitivity: Moderate
		Magnitude: Moderate
		Overall impact: Moderate
		Qualitative rating: Neutral



Figure 17-19 Existing view from Viewpoint YG2



Figure 17-20 Example of TPS structure (from LRS1) within viewpoint YG2 during operation



Figure 17-21 Existing view from Viewpoint YG3 looking south with Yarralumla Creek in the foreground



Figure 17-22 Indicative visualisation of viewpoint YG3 during operation

Night-time visual impact assessment

The Project would introduce additional lighting along the alignment, including:

- New lighting poles to be located near the light rail track within the median
- Two light rail stops with associated lighting
- LRV headlights along the tracks
- Lighting of the TPS 9 structure
- Adjustments to lighting within the Yarra Glen, Melrose Drive, and Yamba Drive intersection.

The reconfiguration of the intersection at Yarra Glen, Melrose Drive, and Yamba Drive would comprise the most substantial change within the precinct, with alterations to the existing road and associated lighting within this section.

Lighting of the light rail stop at Carruthers Street is vital to prioritise passenger safety at night, however, would create a new lighting element within the road corridor and its surrounding environment. Topography and retained dense vegetation would contain light spill within the road corridor. The addition of a foot bridge and stop access and associated lighting would become a prominent feature within the road corridor. However, the lighting would be consistent with the character of the existing road corridor. The existing overpass would be lit with additional lighting proposed to provide safety for the community.

Low level strip lighting would be applied to the TPS 9 structure. The lighting would sit within the TPS structure, behind the façade, however minor light spill would occur through the façade.

Additional lighting within the median would increase light levels in the landscape. Particularly sensitive areas include:

- Mint Oval public open space with existing sports field lighting
- Deakin public sports fields with the fields adjacent to the road corridor featuring existing lighting
- Clarrie Hermes Park public open space with existing sports field lighting
- Yarralumla Creek corridor and surrounding green space which is currently unlit

- North Curtin Territory Agistment area, which is currently unlit, however is anticipated to undergo redevelopment as part of the planned North Curtin Residential Area and Diplomatic Estate development.

The surrounding open space and green spaces may experience an increase in light spill from the Project, the lighting is characteristic of the exiting, lit transport corridor. While there would be a noticeable reduction in visual amenity at night due to the frequency of LRVs and additional lighting corridor, this is a high district brightness environment.

The night-time visual impact during operation for the Project would result in a **minor adverse** impact.

17.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage landscape character and visual amenity impacts that are specific to the Yarra Glen precinct are shown in Table 17-38.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Table 17-38 Visual amenity management and mitigation measures – Yarra Glen precinct

ID	Objective	Management and mitigation measure	Timing
LV4	Landscape enhancement at the Mint Oval	Opportunities to visually screen the active travel path at the Mint Oval from the Project's operational infrastructure will be considered. This may include landscaping plantings along the verge adjacent to the active travel path.	Design
LV10	Visual integration of traction power substations	The scale and bulk of traction power substations will be refined to enable greater integration into the surrounding landscape. Material selection and finishes, lighting, landscaping and screen planting (including trees) will be used to minimise the visual presence of the substations.	Design and operation

17.7 Socioeconomic

This section describes the potential socioeconomic impacts of the Project within the Yarra Glen precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

17.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown in Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- **Precincts:** this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. SA2s analysed for the Yarra Glen precinct include:
 - Curtin SA2
 - Hughes SA2
- **Corridor:** this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- **ACT:** in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor and the ACT. Capital refers to various forms of resources that contribute to the well-being, sustainability, and resilience of a community.

A summary of community capitals for the Yarra Glen precinct is provided in Table 17-39. Section 11.7 provides a summary of community capitals for the corridor and the ACT.

Table 17-39 Community capitals summary – Yarra Glen precinct

Capital	Summary
Human capital	The Yarra Glen precinct has a population of 8,779, with a slightly higher proportion of females (52%) than males (48%). A small percentage (1%) identify as Aboriginal and Torres Strait Islander. The community includes a notable proportion of children and younger adults, with 14.3% aged 5 to 14 years and 10.4% aged 25 to 34 years, while 8.5% of the population is aged 65 to 74 years. Educational attainment is significant, with 54% of residents holding a bachelor's degree or higher. In terms of health, 29.9% of adults have one of four key risk factors, and 20.9% of the population is living with one or more long-term health conditions. Additionally, 5.9% of people require assistance with core activities, the highest proportion among the precincts.
Social capital	In this region, 81.3% of residents speak only English, with other spoken languages including Mandarin (3.5%) and Malayalam (4.8%). The predominant ancestries reported are Australian (36.5%), Irish (15.4%), and Scottish (12.7%). A notable 73% of households are family households, while 24.4% are single or lone households. Regarding residential mobility, 14.8% of residents lived at a different address one year ago, and 39.4% lived at a different address five years ago. Community involvement is evident, with 24.2% of residents having volunteered through an organisation or group in the past 12 months, and 7% of the population requiring assistance with core activities.

Capital	Summary
Economic capital	In the Yarra Glen precinct, the median total personal income stands at \$1,320 per week, with a median household income of \$2,841.50 per week, indicating robust economic capital. The median mortgage repayments are \$2,650 per month, and median rent is \$425 per week, reflecting moderate to high housing costs. Financial stress from mortgages is relatively low at 6.6%, while rent stress is moderate at 17.7%, suggesting overall favourable financial health concerning housing. Yarra Glen features the highest labour force participation rate at 79.5% and a moderate unemployment rate of 3.7%. Prominent industries include Central Government Administration (21.4%) and Defence (4.8%), with major occupations being Professional (38%) and Managers (22.3%).
Physical capital	In this precinct, 38.4% of properties are owned outright, while 34.7% are owned with a mortgage, and 24.1% are rented. The majority of residences are separate houses (78.7%), with 9.1% being semi-detached, row, or terrace houses, and 12.3% consisting of flats or apartments. The average household size is 2.6. For commuting, 64.1% of the working population either drive or are passengers in a car, 6.2% walk, 12.4% work from home, and 4.4% use public transport.
Natural capital	Yarra Glen's natural capital includes the Oakey Hill Nature Reserve, which provides significant lifestyle benefits. Residents can enjoy various amenities such as parks, gardens, and picnic areas, as well as opportunities for cycling and horse-riding.

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Yarra Glen precinct's area of social influence is shown in Figure 17-23.

The precinct includes parks, open spaces, gardens, neighbourhood parks, playgrounds, reserves, sports playing fields, early childhood facilities, education institutes, places of worship, memorials, and aged care facilities.

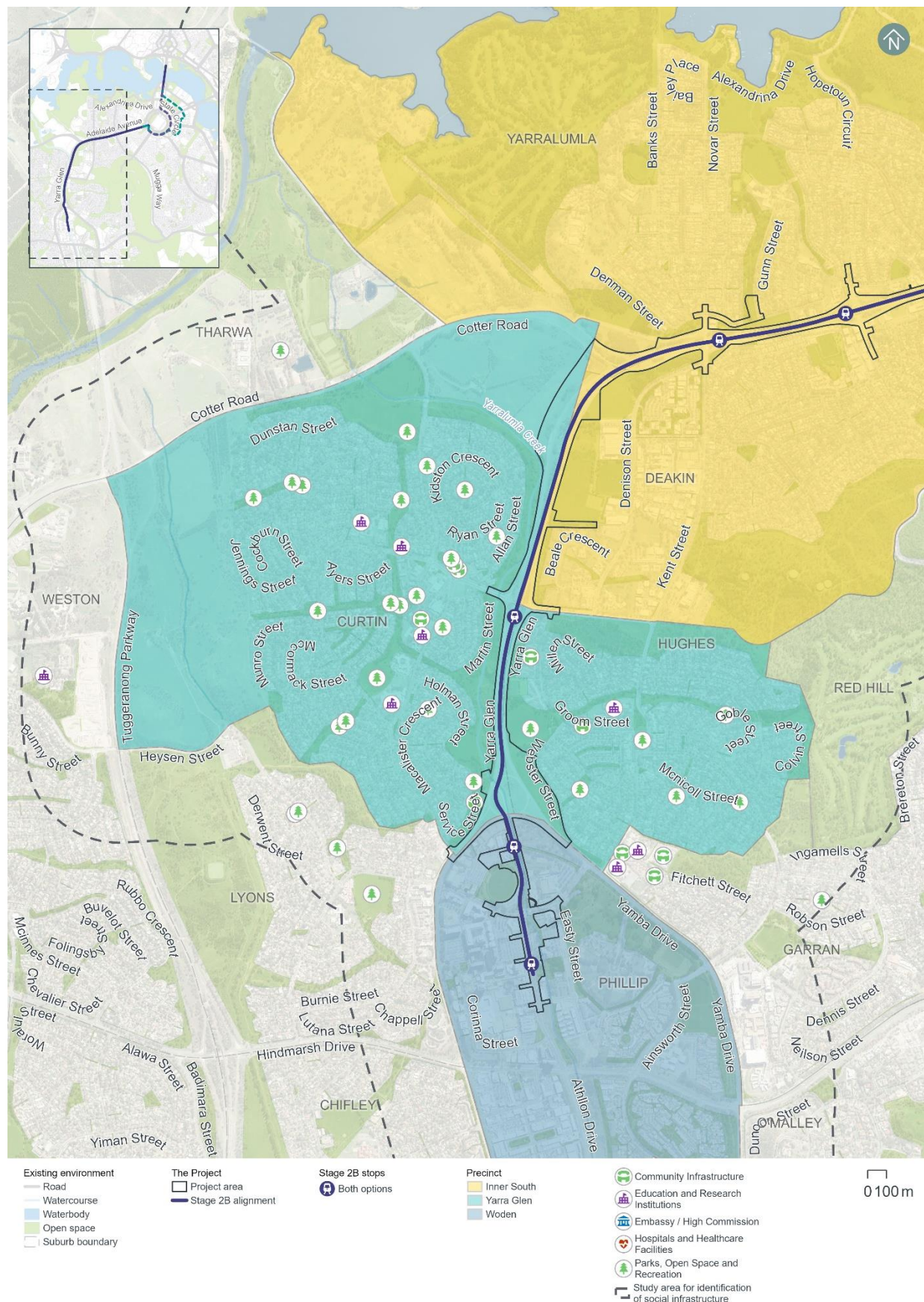


Figure 17-23 Social infrastructure within the Yarra Glen precinct

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17.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those living, working in, or visiting the Yarra Glen precinct is provided in Table 17-40. Socioeconomic impacts within the Yarra Glen precinct would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those living in the area near the Project area, and those in nearby offices that people are likely to occupy for eight hours a day. There are also several aged care facilities in the precinct that may be particularly sensitive to change.

Residents, workers and students provided feedback via online surveys and other consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)), indicating that construction noise and vibration and traffic disruption are key community concerns. Participants expressed concern regarding potential construction impacts on commuting time through the precinct (e.g. via bus or private vehicle). Participants also expressed the importance of maintaining green and open spaces.

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly temporary and would be minimised through the implementation of the mitigation measures identified in Table 17-40 and Chapter 21 (Environmental management and mitigation measures).

Table 17-40 Socioeconomic impacts during construction – Yarra Glen precinct

Description of impact	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Health and wellbeing</p> <p>Disruptions to social amenity during demolition and construction, potentially leading to a decline in health and wellbeing, especially affecting individuals with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 17.1.2, Section 17.3, and Section 17.6 (in relation to traffic, noise, and visual impacts, respectively).</p>	<p>Very high (likely/ major)</p>	<ul style="list-style-type: none"> • Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans • Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) • Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	<p>Medium (possible/ moderate)</p>

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Disruptions to the road network and parking – impacts to road users</p> <p>Temporary impact to road users on existing road network during construction due to temporary traffic changes, which may impact travel times. This would include temporary traffic diversions to enable works at the Yarra Glen/Yamba Drive/Melrose Drive roundabout.</p> <p>Further detail on transport and access impacts within this precinct is provided in Section 17.1.2.</p>	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) 	Medium (likely/minor)
<p>Visual landscape and heritage</p> <p>Changes to visual aesthetics, vistas and surroundings during construction with the introduction of visual clutter and construction activities temporarily diminishing view quality. There are no heritage impacts predicted to arise due to construction of the Project.</p> <p>Refer to Sections 17.6 and 17.5, for further detail on landscape character and visual amenity, and historic heritage, respectively.</p>	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Very low (unlikely/minor)

17.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in, or visiting the Yarra Glen precinct is provided in Table 17-41. Socioeconomic impacts within the Yarra Glen precinct would be common to both alignment options.

Table 17-41 identifies socioeconomic impacts and evaluates the likelihood and magnitude of impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 17-41. For beneficial impacts, measures which would enhance Project benefits have been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

Of relevance to operational impact, participants in consultation activities (which are described in Chapter 4 (Stakeholder and community consultation)) expressed the importance of maintaining green and open spaces.

Table 17-41 Socioeconomic impacts during operation – Yarra Glen precinct

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Landscape and visual changes</p> <p>The addition of light rail infrastructure, including a stop at Carruthers Street, would introduce new elements into the landscape and visual environment, however these would generally be compatible with the existing character of the precinct. The use of green track and replanting of trees would a positive qualitative outcome.</p> <p>Changes to the landscape and visual environment in this precinct are detailed in Section 17.6.</p>	Very low (unlikely/minor)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users Engagement with community groups and local users of proposed grade separated stops to provide input into the attractive, safe and efficient design that best meet the urban design drivers for the Project 	Beneficial (possible/positive)
<p>Access and mobility</p> <p>Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. signalised pedestrian crossings and a new bridge and public plazas would be constructed to facilitate pedestrian and cyclist connections to the Carruthers Street Stop).</p> <p>Refer to Section 5.8 of Chapter 5 (Project description) for further discussion of active travel arrangements.</p>	Beneficial (possible/positive)	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	Beneficial (likely/positive)

17.7.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to socioeconomic impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage socioeconomic impacts in the Yarra Glen precinct are shown in Table 17-38.

Table 17-42 Socioeconomic management and mitigation measures – Yarra Glen precinct

ID	Objective	Management and mitigation measure	Timing
SE4	Minimising socio-economic impacts through design	The Project will consider opportunities to augment the community's sense of place and connection. As part of the Community Reference Group established for the project, local users of proposed grade separated stops will be engaged to provide input into the attractive, safe and efficient design that best meet the urban design drivers for the Project.	Design and operation

18.0 Woden precinct

This chapter provides an assessment of potential impacts during operation and construction that relate to the Woden precinct, and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 18.1.2)
- Noise and vibration (Section 18.3)
- Biodiversity (Section 18.4)
- Historic heritage (Section 18.5)
- Landscape character and visual amenity (Section 18.6)
- Socioeconomic impacts (Section 18.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this precinct have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

18.1 Overview

The Woden precinct extends from south of the Yarra Glen roundabout to around Neptune Street near the Woden town centre. The town centre has, and continues to expand rapidly, with new high-rise residential buildings, planned redevelopment of the Hellenic Club, and the new Canberra Institute of Technology (CIT) Campus in Woden set to open soon.

The Project within this precinct would be consistent for both alignment options.

From the southern extent of the Yarra Glen roundabout, the light rail alignment would continue south along the western side of Yarralumla Creek, across Launceston Street, along Callam Street, terminating north of Bradley Street. The light rail would be within the road median (median running), with the exception of the light rail alignment between the Yarra Glen/Melrose Drive/Yamba Drive intersection and Launceston Street which would be outside of the road reserve.

The precinct would include two stops, the Phillip Oval Stop near Irving Street immediately north of Phillip Oval, and the Woden Interchange located on Callam Street between Bowes Street and Bradley Street.

The existing active travel arrangements (shared path) on the western side of Yarralumla Creek would be consolidated onto the eastern side of the creek. A section of this new active travel path would be on an elevated structure to respond to existing flood characteristics of the area, extending north and south around the Phillip Oval Stop.

The existing pedestrian bridge across Yarralumla Creek north of Phillip Oval would be removed.

Within the Woden precinct, the light rail would include over-head wiring.

The precinct would also include a traction power substation (TPS 10) in an existing carpark off Spoering Street near Phillip Oval.

Key Project features within the Woden precinct are shown in Figure 18-1. Refer to Chapter 5 (Project description) for a more detailed description of the Project within this precinct.

18.1.1 Key construction activities

Construction activities required within this precinct would be otherwise generally similar to those required across other precincts. Construction activities are considered at a Project-wide level within Chapter 6 (Construction).

Key construction activities within the Woden precinct would include:

- Construction of turnback facilities south of the Woden Interchange, such as installation of track and kerbs

- Construction of an elevated structure to provide for an active travel path, extending north and south around the Phillip Oval Stop area, including installation of piers and abutments (as described in Section 6.3.7)
- Construction of the TPS off Spoering Street near Phillip Oval (as described in Section 6.3.8).

Compound H (Easty Street car park in Woden) would be located within the Woden precinct. The location of the compound is shown in Figure 6-3 in Chapter 6 (Construction).

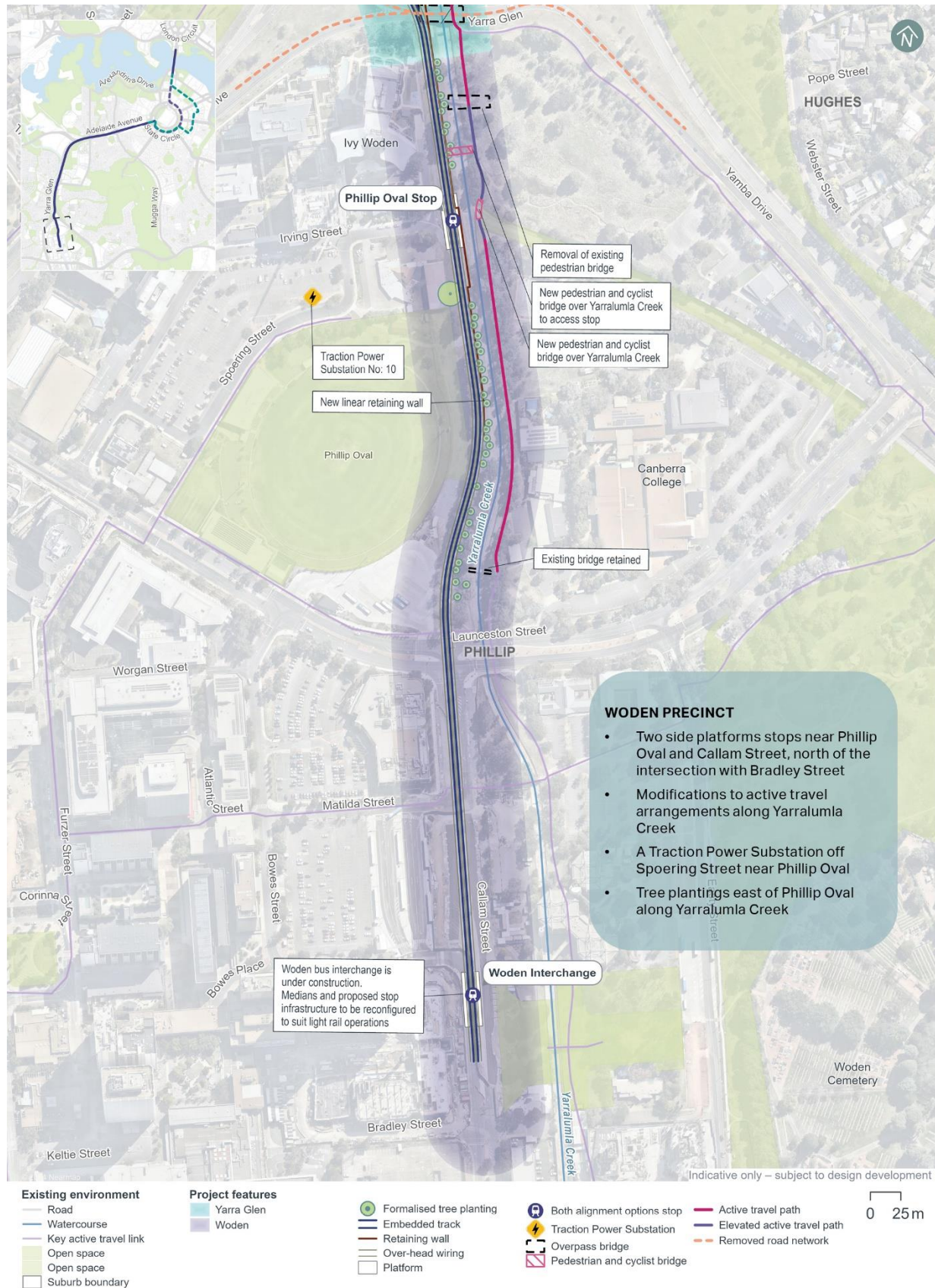


Figure 18-1 Woden precinct overview – both alignment options

18.1.2 Environmental impact overview – construction

Key impacts within the Woden precinct from the construction of the Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The construction of the Project within the Woden precinct would occur within and adjacent to the road reserve, leading to the temporary loss of up to 44 on-street kerbside parking spaces, around 380 off-street car parking spaces, and 11 off-street motorcycle spaces. Broader road network impacts are assessed in Chapter 11 (Project-wide issues). Construction activities are likely to be staged, so the temporary loss of on-street kerbside spaces may be less at any given time during the construction program.

Activity- and site-specific traffic management measures would be developed and implemented through the Construction Environmental Management Plan(s) for the Project. These measures would focus on managing construction-related traffic, site access, parking availability, and ensuring the adequate performance of the road network in proximity to construction site accesses and haulage routes.

However, construction is expected to result in residual traffic impacts even after these measures are implemented. Construction planning would continue with the aim of minimising disruption to the road and transport networks.

Noise and vibration

Construction activities, including earthworks, road works, the decommissioning of utilities, construction of stops, and the establishment of construction compounds, are expected to generate noise that could moderately to highly affect nearby residential and non-residential buildings during the day and night, particularly during 'peak' construction scenarios (which represent the noisiest works that require the use of noise intensive equipment such as concrete saws and rock breakers).

In the night-time hours, residential receivers located adjacent to the proposed haulage routes on parts of Easty Street may be affected by the increases in road traffic noise levels (in instances where night works are required). Some residential buildings may also experience night time noise exceeding the sleep awakening reaction level.

Mitigation measures that would be implemented to manage these impacts, such as scheduling to minimise high-noise activities outside of standard construction hours, are expected to reduce the identified potential impacts. Works outside of standard hours would also require assessment and approval on a case-by-case basis. Despite these measures, some temporary disturbances are anticipated, but they are expected to be minimised through construction planning and community consultation.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 1992* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 1.23 hectares of vegetation within the Woden precinct, 0.65 hectares of which is characterised as native. Removal of this vegetation would impact upon suitable habitat for the Golden Sun Moth (*Synemon plana*) (listed as vulnerable under the EPBC Act and NC Act), foraging habitat for the Gang-gang Cockatoo (*Callocephalon fimbriatum*) (endangered under the EPBC Act and NC Act) and Superb Parrot (*Polylestes swainsonii*) (vulnerable under the EPBC Act and NC Act), and breeding and foraging habitat for the Diamond Firetail (*Stagonopleura guttata*) (vulnerable under the EPBC Act and NC Act). A total of 31 mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been in the proposed clearance footprint for the Woden precinct.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be

avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Historic heritage:** The Callam Offices, listed on the ACT Heritage Register, has been identified within the Woden Precinct. While direct impacts have been avoided, the Callam offices have the potential to be indirectly affected by the Project during construction through vibration caused by construction activities, and by temporary visual impacts due to temporary infrastructure proposed for the carpark to the north. However, these impacts would be avoided through appropriate equipment selection, and determination and monitoring of safe vibration levels
- **Landscape character and visual amenity:** Construction activities such as the establishment of construction compounds and the use of large-scale equipment, would be visually prominent and may temporarily disrupt the visual amenity of the area. Night-time construction work would involve lighting that could impact nearby residential and commercial properties. Mitigation measures, such as high-quality construction hoarding, efforts to minimise light spill and preparation of a visual impact (including light spill) management plan, would be implemented to manage these impacts and maintain the area's visual integrity
- **Socioeconomic:** Potential impacts would include disruptions to local amenity, road network and parking as well as adverse impacts to health and wellbeing due to noise, vibration, and visual impacts, which may particularly affect workers, residents and visitors in the area. Mitigation measures, such as the implementation of Construction Environmental Management Plan(s), proactive communication strategies, and public awareness campaigns, would be implemented to minimise these impacts.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for the Project to guide the development of the CEMP(s) and sub plans, and is included as Appendix L (Environmental Management Plan outline).

18.1.3 Environmental impact overview – operation

Key impacts within the Woden precinct during the operational stage of Project are summarised below, and assessed in further detail throughout this precinct-based assessment chapter.

Traffic and transport

The operational phase of the Project in the Woden precinct would require changes to the road network, including road closures and adjustments to existing lanes, intersections and access arrangements to accommodate the light rail infrastructure.

Within the Woden precinct, there would be localised areas where higher congestion levels would occur in both the with and without Project scenarios (for both alignment options) in the AM and PM peak hours in both 2031 and 2041.

No kerbside parking spaces would be lost as a part of the Project, however public access to the Phillip Oval car park via Irving Street would be permanently removed, with the existing car park of around 50 spaces being made unavailable to the public. Additionally, 33 car parking spaces and six motorcycle parking spaces would be removed from the Spoering Street car park.

Further design development and management measures would be implemented to address these changes, such as public awareness campaigns to increase understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation, and review of

options to further optimise the interface between different transport modes. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Other impacts

Other operational environmental impacts identified in this precinct-based assessment chapter are outlined below:

- **Landscape character and visual amenity:** The introduction of light rail infrastructure, including tracks, stops, and over-head wiring, would result in permanent changes to the landscape character and visual amenity of the area. A moderate to low overall impact is predicted in the Woden precinct for both alignment options. The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. As identified in mitigation measure LV1 in Chapter 21 (Environmental management and mitigation measures), these principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation
- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 18.1.2), native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations, increased light pollution on sensitive habitats and species around light rail stops, or potential risk of fauna strike from light rail vehicles (LRVs) or over-head wiring. Proposed mitigation measures include strategies to minimise fauna strike through effective landscape design
- **Noise and vibration:** Operation of the Project would result in limited noise and vibration impacts within the precinct, with noise and vibration levels predicted to comply with relevant criteria at the majority of receivers. Some minor exceedances of criteria for airborne noise are predicted at receivers closest to the alignment (Canberra College and CIT Woden), assuming no mitigation measures are in place. The Project would be designed and operated to minimise operational noise and vibration impacts on sensitive receivers, predominantly through consideration of track design measures, and operational maintenance planning. These measures that would enable residual impacts to be limited
- **Socioeconomic:** Benefits of the Project within the Woden precinct include provision of an alternative to private vehicle use, which can enhance accessibility and over time, reduce potential traffic congestion. Adverse socioeconomic impacts may also arise, for example, at Canberra College and CIT Woden, where operational noise of light rail infrastructure could potentially affect social amenity. Continued implementation of design principles and guidance documented in the Public Domain Master Plan would support design of a high quality and manage these potential impacts
- **Historic heritage:** No impact to the Callam Offices (listed on the ACT Heritage Register) would occur during operation of the Project.

Environmental management and mitigation measures proposed to address the specific impacts of the Project within this precinct are detailed in Chapter 21 (Environmental management and mitigation measures). An Operational Environmental Management Plan (OEMP) with supporting sub plans would be implemented as a framework for environmental management during operation. An Environmental Management Plan outline has been developed for the Project to guide the development of the OEMP, and is included as Appendix L (Environmental Management Plan outline).

18.2 Traffic and transport

This section provides an assessment of the potential multimodal traffic and transport impacts associated with the construction and operation of the Project within the Woden precinct. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport.

Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

18.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, traffic volumes, intersection performance, public and active transport, carparking (including kerbside uses and access), and crash history.

Transport network

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the precinct study area). The existing transport network within the Woden precinct and the respective study area is indicatively shown in Figure 18-2.

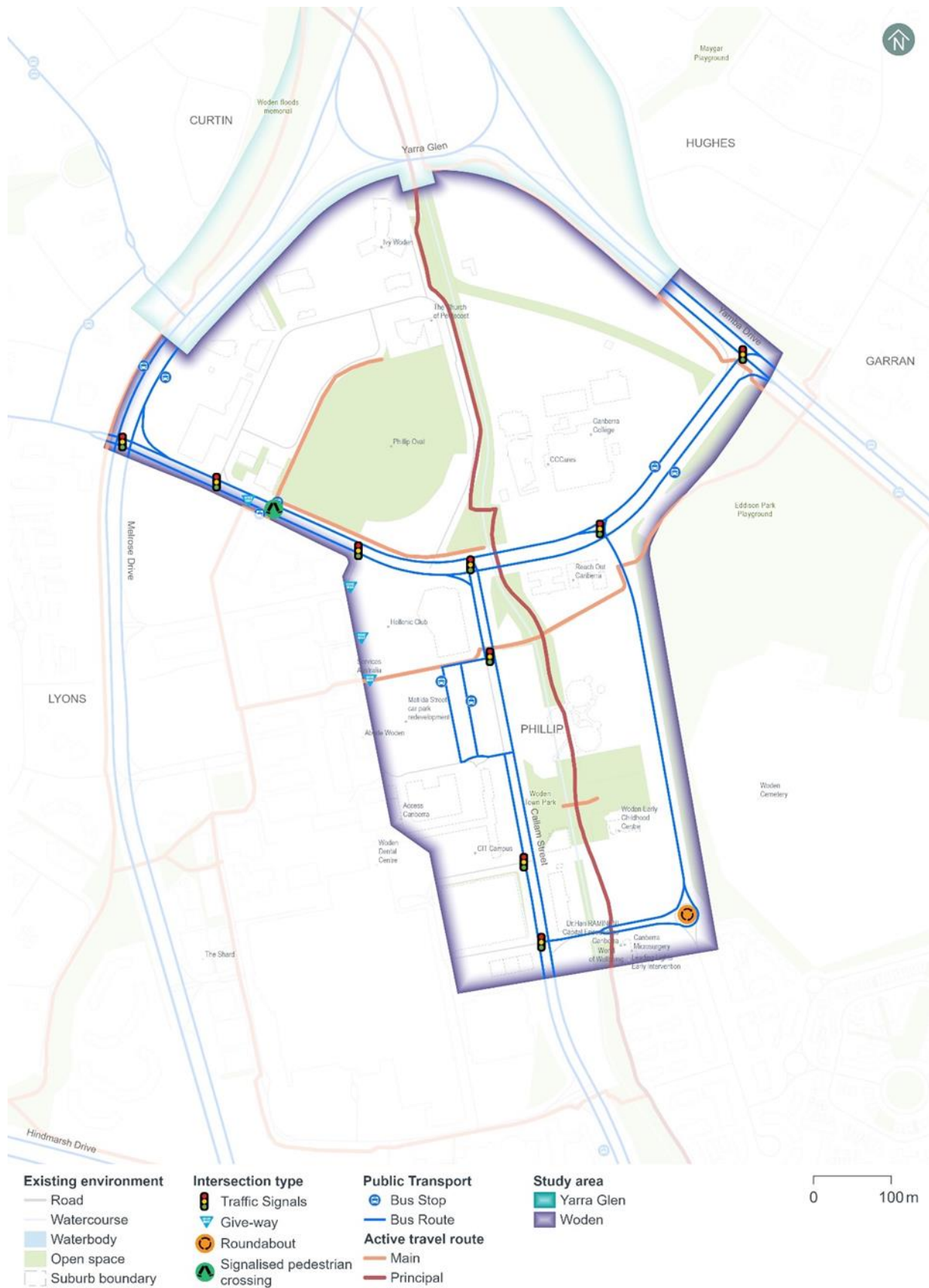


Figure 18-2 Overview of the existing transport network for the Woden precinct study area

Road network

The characteristics of key roads within the Woden precinct are summarised in Table 18-1.

Table 18-1 Overview of key roads within the Woden precinct

Road	Classification	Direction	Configuration	Speed limit ¹
Melrose Drive	Arterial	Two-way	Two northbound lanes and three southbound lanes	60 km/h
Yamba Drive			Two lanes in each direction	80 km/h
Launceston Street	Major collector	Two-way	Two lanes in each direction	60 km/h
Callam Street			Currently no access as it is under construction and will to be restricted to buses only between Matilda Street and Bradley Street upon completion of the Woden Interchange project	60 km/h
Irving Street	Local access	Two-way	One lane in each direction	50 km/h
Matilda Street			One lane in each direction	50 km/h
Bowes Street			One lane in each direction	40 km/h

Notes:

- Where no speed limit was signposted, the speed limit was assumed to be 50 km/h, which is the default speed limit for a built-up area.

Traffic volumes

Existing 2024 and historical 2017 weekday AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peak hour traffic counts for various mid-block locations within the Woden precinct have been analysed and are summarised in Figure 18-3. The 2024 data along Launceston Street indicates a reduction in traffic during the AM and PM peak hours since 2017. No 2024 data is available for the locations along Callam Street, given the ongoing construction works in the area associated with CIT Woden and the new bus interchange.

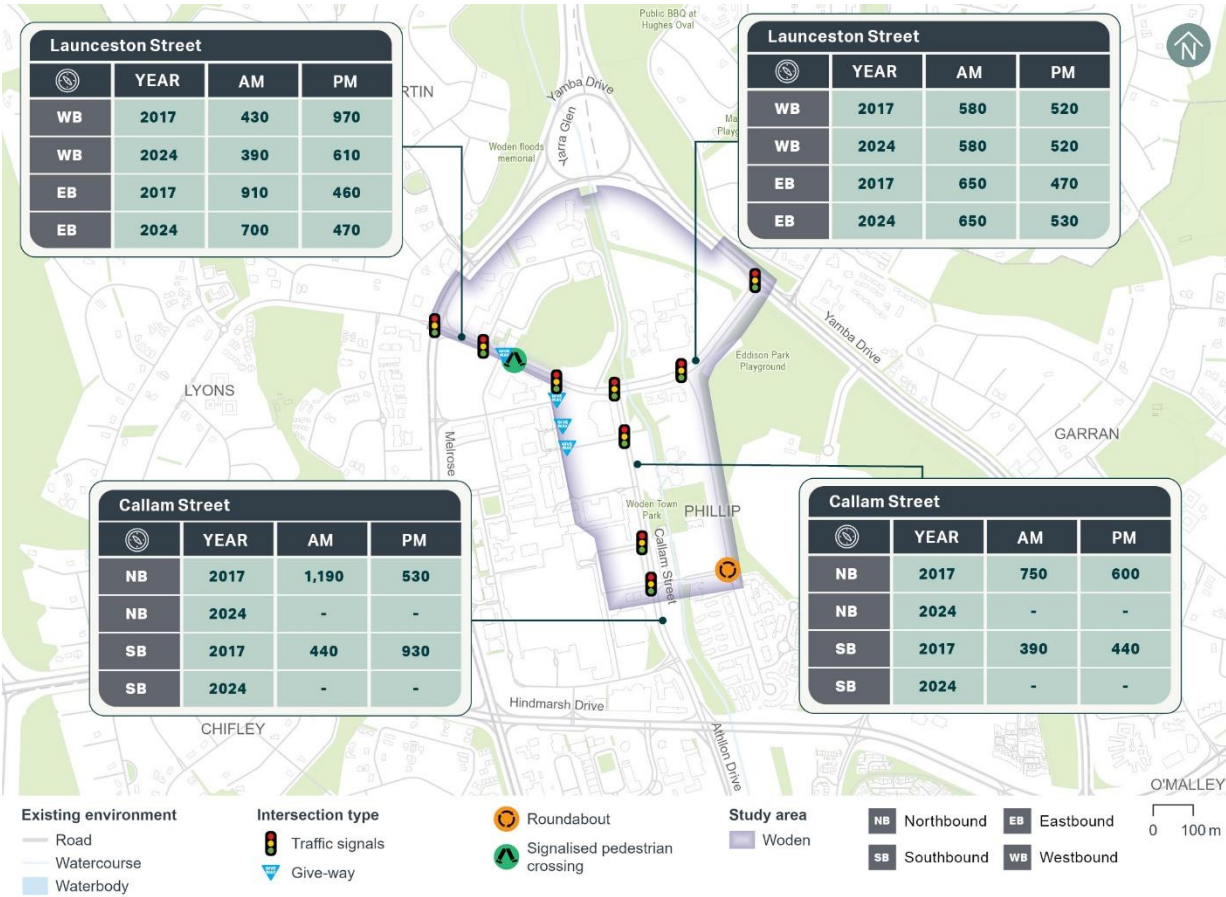


Figure 18-3 2017 and 2024 peak hourly traffic volumes within the Woden precinct study area

Intersection performance

The existing operation of the key intersections within the Woden precinct has been assessed using the microsimulation model, as discussed in Chapter 10 (Assessment methodologies). The existing performance of the assessed intersections is shown in Figure 18-4.

All the assessed intersections within the Woden precinct operated satisfactorily in 2017 at a level of service C or better during the weekday peak hours. Level of service represents the extent of delays experienced by drivers at an intersection.



Figure 18-4 2017 AM and PM peak hour intersection performance within the Woden precinct study area

Public transport

The Woden bus interchange is located within the Woden Town Centre and services local and rapid services.

The interchange is currently being reconfigured, as discussed in Section 3.5.3 Technical Report 1 – Traffic and transport, to increase capacity and allow for future integration with light rail services being delivered as part of this Project. The current temporary configuration involves six platforms adjacent to Callam Street between Bowes Street and Matilda Street. The new interchange is located immediately to the east of the temporary interchange and once constructed, will include eight platforms servicing busses along Callam Street between Bradley Street and Matilda Street, as well as allowance for light rail services through the centre of the interchange.

Transport Canberra operates bus routes servicing this precinct and provides services to the city centre, Weston Creek and Tuggeranong. The Woden precinct contains the Woden Interchange, meaning a higher number of bus routes operate within this precinct when compared to others. The bus routes that operate within the Woden precinct are: R4, R5, R6, 57, 58, 59, 60/61, 62, 63, 64, 65, 66, 70, 71, 72, 73, 76, 77, and 902.

In addition to the local and rapid bus services multiple school routes use the Woden Interchange. On school days, these school bus services typically have one service each in the morning and afternoon.

A bus layover is located on the northern side of Launceston Street, accommodating 24 buses. Access is provided via the Launceston Street/Bowes Street intersection and/or the Launceston Street/Callam Street intersection.

Active travel

The C4 City to Tuggeranong via Woden principal cycle route runs along Yarralumla Creek through the Woden precinct, generally from the Yarra Glen/Melrose Drive/Yamba Drive intersection towards Hindmarsh Drive to the south. East-west on-road cycle lanes are provided on both sides of Launceston Street. A two-way off-road cycle path is provided on Matilda Street between Bowes Street and Callam Street. Signalised pedestrian crossings are provided at the following intersections:

- Launceston Street/Easty Street on all approaches
- Launceston Street/Callam Street on all approaches
- Launceston Street/Bowes Street on all approaches
- Callam Street/Wilbow Street/Neptune Street on all approaches
- Callam Street/Corinna Street on all approaches.

Zebra crossings are provided at the north and south ends of the current temporary Woden bus interchange and on the slip lanes at surrounding intersections.

Due to the ongoing reconfiguration of Callam Street, pedestrian accessibility between Launceston Street and Wilbow Street/Neptune Street is currently impeded in various locations.

Plans for the new Woden Interchange indicate that the Callam Street/Matilda Street and Callam Street/Bradley Street intersections would be signalised. In addition, two signalised pedestrian crossings would be provided mid-block within the interchange on either end of the light rail platforms.

Pedestrian and cyclist count data from 2024 has been used to understand current active travel demand within the Woden precinct. The AM and PM peak hour counts at key locations within the precinct are summarised in Figure 18-5. As shown, pedestrian volumes along Launceston Street are higher near Easty Street and Melrose Drive due to the more densely populated land uses near these locations. Cyclist volumes ranged between 10 and 30 cyclists during the peak hours at the surveyed locations.

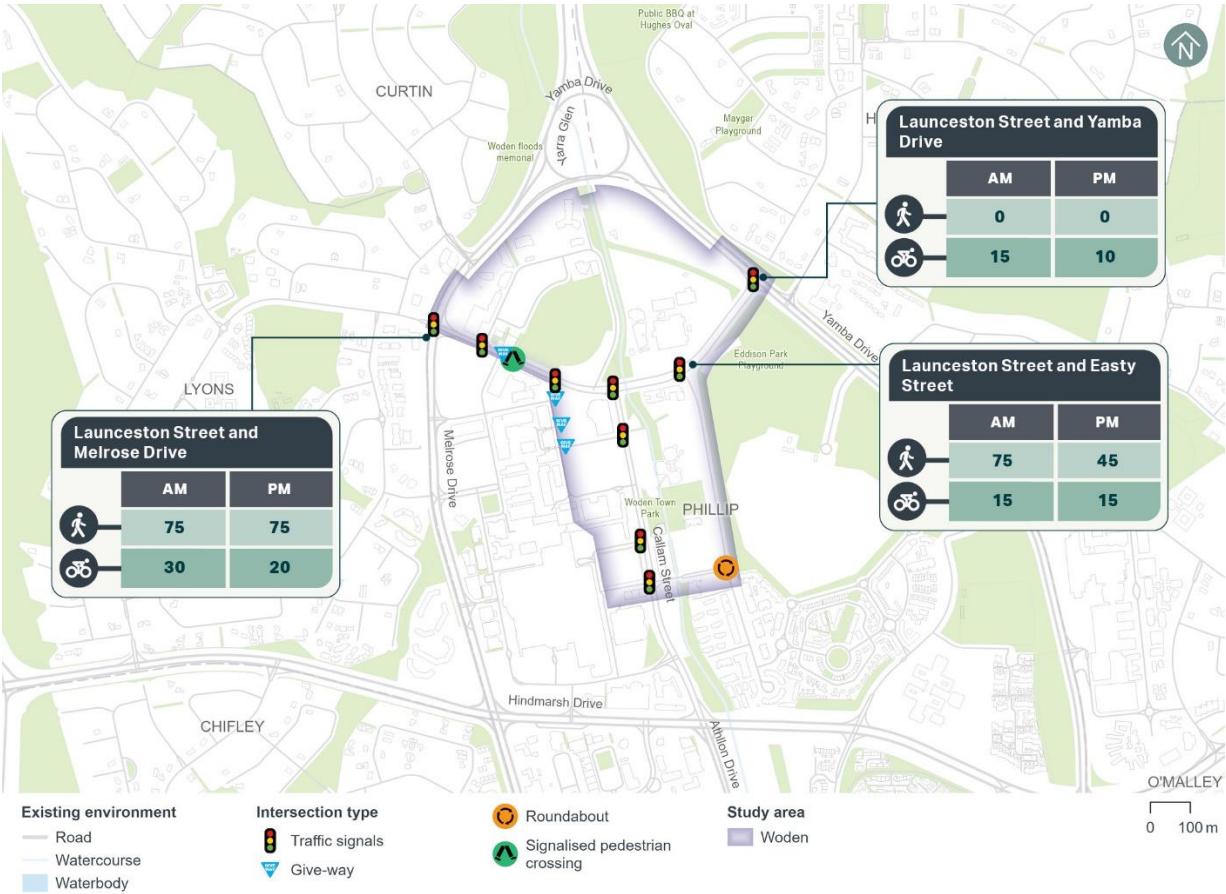


Figure 18-5 2024 peak hour active travel volumes within the Woden precinct study area

Car parking, kerbside uses and access

Kerbside uses

The existing kerbside uses including on-street parking within the Woden precinct are summarised in Table 18-2.

Table 18-2 Woden precinct kerbside uses

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
Off alignment	Irving Street	North of Launceston Street	North	2P (8:30 am – 5:30 pm Monday to Friday)	8
				No parking, pick-up and set-down only	1
				Bus zone (public)	N/A
				P5min (7:30 am - 6:00 pm Monday to Friday)	5
		South	South	2P (8:30 am – 5:30 pm Monday to Friday)	28

On/off alignment	Road	Between	Side of road	Restriction	Number of existing spaces
	Spoering Street	Irving Street and Irving Street	East	2P (8:30 am – 5:30 pm Monday to Friday)	26
			West	2P (8:30 am – 5:30 pm Monday to Friday)	22
	Bowes Street	Launceston Street and Callam Street	East/north	No parking, pick-up and set-down only	3
				1/4P (7:30am - 6:00 pm Monday to Friday)	6
			West/south	Loading zone (7:30am - 6:00 pm Monday to Friday)	3
				No parking, pick-up and set-down only	4
	Neptune Street	Bradley Street and Callam Street	South	30 min loading zone (7:30 am - 6:00 pm Monday to Friday)	2
				P5min	3
Total					111

Off-street parking

There are several existing off-street public car parks located within the Woden precinct including:

- Spoering Street car park: at-grade car park with around 420 spaces
- Phillip Oval car park: at-grade car park with around 50 spaces
- Matilda Street car park: at-grade car park with around 270 spaces
- Easty Street car park: at-grade car park with around 275 spaces.

These car parks accommodate around 1,015 car parking spaces, as shown in Figure 18-6. In addition, there are several other car parks throughout the town centre associated with Westfield Woden.

Based on parking counts from 2022, the Phillip Oval and Easty Street car parks experienced moderate demand, with around 40-50% of the car parking spaces occupied at the busiest time of the day. The Phillip Oval car parks also accommodate parking for events held at the oval, contributing to fluctuations in demand beyond typical daily usage. The Spoering Street and Matilda Street car parks all experienced high parking demand, with peak occupancy between 85% and 95%.

Site observations on 11 June 2024 confirmed that the Spoering Street car park is well utilised. However, it is estimated that around 30-40% of the vehicles parked are associated with nearby construction worker activity.



Figure 18-6 Off-street car parking within the Woden precinct

Property access

There are several property accesses located along the Project's alignment within the Woden precinct, summarised in Table 18-3.

Table 18-3 Existing property access arrangements along the Project's alignment within the Woden precinct

Road	Site address	Site access arrangement
Irving Street	Ivy Apartments	Single access point on Irving Street
	Phillip Oval car park	Single access point on Irving Street
Launceston Street	Bus layover area	Vehicle egress via the northern leg of the Launceston Street/Callam Street

Crash history

Figure 18-7 shows the five year crash history (1 January 2018 to 31 December 2022) within the Woden precinct.

A total of 159 crashes have been recorded within the Woden precinct during the five year period, including:

- Three crashes that resulted in a serious injury (around 2%)
- 11 crashes that resulted in a minor injury (around 7%)
- 145 crashes that resulted in property damage only (around 91%).

The following common crash types occurred:

- Around 32% of crashes involved a rear end collision
- Around 23% of crashes involved right angle collision
- Around 18% of crashes involved a same direction side swipe.
- Three of the crashes involved pedestrians.



Figure 18-7 Crash data between 2018 and 2022 within the Woden precinct

Modelling approach

The transport modelling assumptions have adopted the 'committed and funded expenditure approach' as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The 'committed and funded expenditure approach' requires that only transport projects identified as 'committed and funded' are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as 'committed and funded' are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

18.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the precinct are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside uses

It is estimated that up to 44 on-street kerbside spaces would be temporarily lost within the Woden precinct, including:

- 21 spaces on Irving Street (off-alignment)
- 23 spaces on Spoering Street (off-alignment).

Construction works are likely to be staged, so the temporary loss of on-street kerbside spaces across the precinct may be less at any given time during the construction program.

Off-street parking

The Project's construction compounds and Project area within the Woden precinct would temporarily reduce off-street car parking by around 380 spaces and 11 motorcycle parking spaces at the following locations:

- Site compound H – Easty Street car park: loss of around 180 parking spaces
- Phillip Oval car park: loss of around 50 parking spaces
- Spoering Street car park: loss of around 150 parking spaces and 11 motorcycle parking spaces.

Local area access

The Project's construction would not change any local area access arrangements in the Woden precinct other than the traffic diversions along Launceston Street during the reconstruction of the Yarra Glen/Yamba Drive/Melrose Drive intersection, as discussed in Section 5.8.3 of Technical Report 1 - Traffic and transport.

Property access

The Project's construction would not change any property accesses within the Woden precinct.

18.2.3 Potential impacts – operation

Potential operational impacts on the road network, active travel and parking of relevance to the precinct are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues).

Road network changes

The road network changes within the Woden precinct to accommodate the Project would include road closures, adjustments to existing lanes, adjustments to intersections, and adjustments to access arrangements. Refer to Chapter 5 (Project description) for further discussion on road network changes.

Traffic volumes and patterns

Traffic volumes and patterns have been modelled to compare weekday peak hour changes in traffic flow across the Woden precinct, particularly on Melrose Drive, Yamba Drive, and Launceston Street.

2031 and 2041 were adopted as the future years for the traffic modelling. The years 2031 and 2041 were used to represent indicative future scenarios, providing a benchmark for assessing the potential operational impacts of the Project.

Traffic volume changes associated with the State Circle East alignment option are summarised in Table 18-4 and Table 18-5, and those associated with the National Triangle-Barton alignment option are summarised in Table 18-6 and Table 18-7. These traffic flow changes are due to the following:

- Regional and local traffic reassignment (when traffic is redistributed as drivers choose alternative routes due to changes in the road network) caused by the Project's road network changes and consequent impacts to road network performance, particularly the intersection geometry changes at the Yarra Glen/Melrose Drive/Yamba Drive intersection, which would not permit northbound vehicles on Melrose Drive to turn right onto Yamba Drive
- Changes in mode choice due to the introduction of light rail.

*State Circle East alignment option***Table 18-4 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Woden precinct in 2031 and 2041 with and without the Project (State Circle East alignment option)**

Road	Location	Direction	2031				2041			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Melrose Drive	North of Launceston Street	Northbound	2,070	1,740	-330	-16%	2,090	1,720	-370	-18%
		Southbound	1,460	1,330	-130	-9%	1,380	1,180	-200	-14%
Yamba Drive	North of Launceston Street	Northbound	1,160	1,200	40	3%	1,250	1,200	-50	-4%
		Southbound	1,020	920	-100	-10%	1,250	910	-340	-27%
Launceston Street	Between Callam Street and Easty Street	Eastbound	590	780	190	32%	660	740	80	12%
		Westbound	330	460	130	39%	270	400	130	48%

Table 18-5 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Woden precinct in 2031 and 2041 with and without the Project (State Circle East alignment option)

Road	Location	Direction	2031				2041			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Melrose Drive	North of Launceston Street	Northbound	1,160	1,110	-50	-4%	1,260	1,070	-190	-15%
		Southbound	1,480	1,370	-110	-7%	1,570	1,620	50	3%
Yamba Drive	North of Launceston Street	Northbound	970	1,070	100	10%	930	1,020	90	10%
		Southbound	1,240	1,270	30	2%	1,360	1,230	-130	-10%
Launceston Street	Between Callam Street and Easty Street	Eastbound	300	350	50	17%	300	350	50	17%
		Westbound	550	710	160	29%	680	820	140	21%

*National Triangle-Barton alignment option***Table 18-6 AM peak hour (8:00 am to 9:00 am) traffic volumes on key roads within the Woden precinct in 2031 and 2041 with and without the Project (National Triangle-Barton alignment option)**

Road	Location	Direction	2031				2041			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Melrose Drive	North of Launceston Street	Northbound	2,070	1,700	-370	-18%	2,090	1,750	-340	-16%
		Southbound	1,460	1,320	-140	-10%	1,380	1,260	-120	-9%
Yamba Drive	North of Launceston Street	Northbound	1,160	1,200	40	3%	1,250	1,150	-100	-8%
		Southbound	1,020	1,010	-10	-1%	1,250	1,150	-100	-8%
Launceston Street	Between Callam Street and Easty Street	Eastbound	590	860	270	46%	660	840	180	27%
		Westbound	330	500	170	52%	270	450	180	67%

Table 18-7 PM peak hour (5:00 pm to 6:00 pm) traffic volumes on key roads within the Woden precinct in 2031 and 2041 with and without the Project (National Triangle-Barton alignment option)

Road	Location	Direction	2031				2041			
			Without Project	With Project	Difference		Without Project	With Project	Difference	
Melrose Drive	North of Launceston Street	Northbound	1,160	1,200	40	3%	1,260	1,110	-150	-12%
		Southbound	1,480	1,450	-30	-2%	1,570	1,690	120	8%
Yamba Drive	North of Launceston Street	Northbound	970	890	-80	-8%	930	900	-30	-3%
		Southbound	1,240	1,240	0	0%	1,360	1,270	-90	-7%
Launceston Street	Between Callam Street and Easty Street	Eastbound	300	310	10	3%	300	360	60	20%
		Westbound	550	820	270	49%	680	820	140	21%

Road network performance

State Circle East alignment option

A comparison of vehicle delay across the Woden precinct's road network with and without the Project in the 2031 scenario has been conducted for the AM and PM peak hours, respectively.

The Project's changes to the Yarra Glen/Melrose Drive/Yamba Drive intersection and associated traffic reassignment and signal operation would cause the following changes to vehicle delay when compared to the without Project scenario in 2031:

- Increased delay on Launceston Street on its approaches to Yamba Drive and Melrose Drive during the AM peak hour compared to the without Project scenario in 2031
- Increased delay on Yamba Drive on its approach to Launceston Street during the AM and PM peak hours.

The local and regional traffic reassignment caused by the Project, discussed above, and associated signal operation changes would also increase vehicle delays along the following corridors located adjacent to the Woden precinct when compared to the without Project scenario:

- Increased delay on Melrose Drive on its southbound approach to Hindmarsh Drive during the AM peak hour and decreased delay on the same approach during the PM peak hour
- Decreased delay on Hindmarsh Drive on its approaches to Callam Street during the AM and PM peak hours
- Increased delay on Irving Street on its approach to Launceston Street during the AM peak hour.

National Triangle-Barton alignment option

A comparison of vehicle delay across the Woden precinct's road network with and without the Project in the 2031 scenario has been conducted for the AM and PM peak hours, respectively.

The Project's changes to the Yarra Glen/Melrose Drive/Yamba Drive intersection and associated traffic reassignment and signal operation changes would cause the following changes to vehicle delay when compared to the without Project scenario in 2031:

- Increased delay on Launceston Street on its approach to Yamba Drive during the AM peak hour and on its approach to Melrose Drive during the AM and PM peak hours
- Increased delay on Yamba Drive on its approach to Launceston Street during the AM and PM peak hours.

The local and regional traffic reassignment caused by the Project's road network changes, discussed above, and associated signal operation changes would also increase vehicle delays along the following corridors located adjacent to the Woden precinct when compared to the without Project scenario:

- Increased congestion and delay on Melrose Drive on its southbound approach to Hindmarsh Drive during the AM peak hour and decreased delay on the same approach during the PM peak hour
- Decreased congestion and delay on Hindmarsh Drive on its approaches to Callam Street during the AM and PM peak hours
- Increased delay on Irving Street on its approach to Launceston Street during the AM peak hour.

Similar changes to vehicle delays would occur during the AM and PM peak hours in 2041.

Intersection performance

State Circle East alignment option

The performance of the key intersections within the Woden precinct with and without the Project for the State Circle East alignment option is provided in Table 18-8 and Table 18-9. Intersection performance is evaluated using the level of service and average delay assessed for each intersection. Level of service represents the extent of delays experienced by drivers at an intersection. Further detail on intersection performance can be found in Technical Report 1 – Traffic and transport.

Key findings relating to intersection performance are as follows:

- The assessed intersections would operate satisfactorily at a level of service D or better with the Project during the weekday peak hours in 2031 and 2041
- Average vehicle delays at the assessed intersections are generally similar with and without the Project. The exception is the Callam Street/Launceston Street and Callam Street/Matilda Street intersections, where the introduction of the Project alignment and associated signal phasing changes result in these intersections reducing from a level of service B or C without the Project to a level of service C or D with the Project during the weekday peak hours in 2031 and 2041.

Table 18-8 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 with and without the Project within the Woden precinct (State Circle East alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Launceston Street/ Yamba Drive	31	C	34	C	32	C	32	C
Launceston Street/ Easty Street	26	C	26	C	25	C	25	C
Callam Street/ Launceston Street	16	B	37	D	12	B	34	C
Callam Street/ Matilda Street	28	C	47	D	28	C	42	D
Callam Street/ Bradley Street	6	A	4	A	7	A	4	A
Callam Street/ Neptune Street/ Wilbow Street	27	C	28	C	25	C	23	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 18-9 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 with and without the Project within the Woden precinct (State Circle East alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Launceston Street/ Yamba Drive	23	C	22	C	29	C	23	C
Launceston Street/ Easty Street	29	C	27	C	31	C	27	C
Callam Street/ Launceston Street	14	B	41	D	12	B	47	D
Callam Street/ Matilda Street	24	C	42	D	21	C	44	D
Callam Street/ Bradley Street	4	A	4	A	4	A	3	A
Callam Street/ Neptune Street/ Wilbow Street	40	D	33	C	47	D	32	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

National Triangle-Barton alignment option

The performance of the key intersections within the Woden precinct with and without the Project for the National Triangle-Barton alignment option is provided in Table 18-10 and Table 18-11. Key findings relating to intersection performance are as follows:

AM peak hour:

- The assessed intersections would operate satisfactorily at a level of service D or better with the Project during the weekday peak hours in 2031 and 2041
- Average vehicle delays at the intersections along Launceston Street and at the Callam Street/Matilda Street intersection are slightly higher with the Project due to the signal phasing changes and higher traffic volumes resulting from traffic reassignment
- Average vehicle delays at the Callam Street/Bradley Street and Callam Street/Neptune Street/Wilbow Street intersections are generally similar with and without the Project.

PM peak hour:

- The assessed intersections would operate satisfactorily at a level of service D or better with the Project during the weekday peak hours in 2031 and 2041
- Average vehicle delays at the assessed intersections are generally similar with and without the Project. The exceptions are the Callam Street/Launceston Street and Callam Street/Matilda Street intersections, where the introduction of the Project alignment and associated signal phasing changes result in these intersections reducing from a level of service B or C without the Project to a level of service C or D with the Project during the weekday peak hours in 2031 and 2041.

Table 18-10 Weekday AM peak hour (8:00 am to 9:00 am) intersection performance in 2031 and 2041 with and without the Project within the Woden precinct (National Triangle-Barton alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Launceston Street/ Yamba Drive	31	C	46	D	32	C	34	C
Launceston Street/ Easty Street	25	C	37	D	26	C	27	C
Callam Street/ Launceston Street	16	B	42	D	12	B	37	D
Callam Street/ Matilda Street	28	C	50	D	26	C	47	D
Callam Street/ Bradley Street	6	A	3	A	7	A	4	A
Callam Street/ Neptune Street/ Wilbow Street	27	C	26	C	26	C	27	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Table 18-11 Weekday PM peak hour (5:00 pm to 6:00 pm) intersection performance in 2031 and 2041 with and without the Project within the Woden precinct (National Triangle-Barton alignment option)

Intersection	2031				2041			
	Without Project		With Project		Without Project		With Project	
	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
Launceston Street/ Yamba Drive	25	C	17	B	29	C	17	B
Launceston Street/ Easty Street	29	C	27	C	31	C	28	C
Callam Street/ Launceston Street	14	B	41	D	13	B	41	D
Callam Street/ Matilda Street	25	C	45	D	22	C	40	D
Callam Street/ Bradley Street	4	A	6	A	4	A	5	A
Callam Street/ Neptune Street/ Wilbow Street	40	D	31	C	43	D	33	C

Note: As discussed in Technical Report 1 – Traffic and transport, separate microsimulation models have been used to assess the State Circle East and National Triangle-Barton alignment options which may result in small intersection performance differences between the without Project scenarios for each alignment option.

Active travel

For much of the Project, existing active travel arrangements would be retained and would be complemented by new active travel arrangements or treatments. The key pedestrian and cyclist provisions that would be provided within the Woden precinct as part of the Project and their benefits or impacts are summarised in Table 18-12.

Table 18-12 Active travel provisions within the Woden precinct and associated impacts and benefits

Proposed treatment	Impact or benefit
Signalised pedestrian crossings on the northern and southern sides of the Launceston Street/Callam Street intersection.	The signalised pedestrian crossings would provide a controlled and typically safer crossing facility. However, providing signalised pedestrian crossings could result in higher delays for pedestrians waiting to cross the road.
<p>The light rail alignment and Phillip Oval Stop would be located on the western side of Yarralumla Creek. The existing active travel arrangements (shared path) on the western side of Yarralumla Creek would be consolidated onto the eastern side of the creek.</p> <p>A section of this new shared path would be on an elevated structure, extending north and south around the Phillip Oval Stop area. This elevated path would provide connection to two new pedestrian and cyclist bridges:</p> <ul style="list-style-type: none"> • A bridge over Yarralumla Creek to provide east-west access between Irving Street and Block 4, Section 79 in Woden. A ramp would provide connection from the eastern landing of this bridge to the Phillip Oval Stop • A bridge over the Yarralumla Creek main drain to provide north-south access along the eastern side of Yarralumla Creek. <p>An existing pedestrian bridge across Yarralumla Creek north of Phillip Oval would be removed.</p> <p>The existing pedestrian and cycle bridge over Yarralumla Creek north of Launceston Street would be retained.</p>	The active travel connection over Yarralumla Creek would generally be maintained in a similar location. However, the new bridge location would provide a closer connection to the Phillip Oval Stop.

Kerbside use

The Project would not change any kerbside uses within the Woden precinct.

Off-street parking

The Project would permanently remove public access to the Phillip Oval car park via Irving Street. An alternative access would be provided but limited to maintenance vehicles only. Consequently, the existing car park, which has around 50 spaces, would no longer be available to the public. The Phillip Oval car park has been surveyed to be occupied by up to 20 vehicles (40%) in May 2022. A similar number of vehicles have been observed to park in the Phillip Oval car park on 11 June 2024. It is noted that the Phillip Oval car park also accommodates parking for events held at the oval, contributing to fluctuations in demand beyond typical daily usage.

The Project includes a TPS within the Spoering Street car park, which would remove 33 parking spaces and six motorcycle spaces. In May 2022, the Spoering Street car park has been surveyed to be occupied by up to 400 vehicles and three motorcycles (95%). Site observations on 11 June 2024 confirmed that the Spoering Street car park is well utilised. However, it is estimated that around 30-40% of the vehicles parked are associated with nearby construction worker activity.

Local area access

The Project would increase vehicle delays along Launceston Street and its intersections, particularly during the AM peak hour. This would increase vehicle travel times for origins and destinations within the Woden precinct. However, the Project would improve public transport access, encouraging more of these trips by public transport, where possible.

Property access

The existing vehicle access to the Phillip Oval maintenance facility would be relocated from Irving Street to the corner of Spoering Street as part of the Project. The Project would not change any other property accesses within the Woden precinct.

18.2.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Part C (Mitigation and residual environmental risks). This includes construction and operational mitigation measures (where relevant) in Chapter 21 (Environmental management and mitigation measures) that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for traffic and transport impacts at the Woden precinct.

18.3 Noise and vibration

This section provides an assessment of the potential noise and vibration impacts associated with the construction and operation of the Project within the Woden precinct. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

18.3.1 Existing environment

Sensitive receivers and noise catchment area

Noise Catchment Areas have been determined based on the general ambient noise environment of the area, and the types of receivers and land uses potentially affected by the Project. Noise Catchment Area 11 has been identified for the noise assessment of the Woden precinct. Noise Catchment Area 11 and associated sensitive receivers are shown in Figure 18-8.

The land uses within Noise Catchment Area 11 primarily consist of a mix of commercial properties of varying scale in the Woden Town Centre, including Westfield Woden, government offices, and hotels. There is also a large commercial area located south of Hindmarsh Drive. The residential areas of Lyons and Garran lie approximately 500 m west and 1 km east of Woden Town Centre respectively.

At the northern boundary of the catchment area, there are multiple residential apartment buildings, active recreation uses (including Phillip Oval), and educational land uses such as Canberra College and Saints Peter and Paul Primary School.

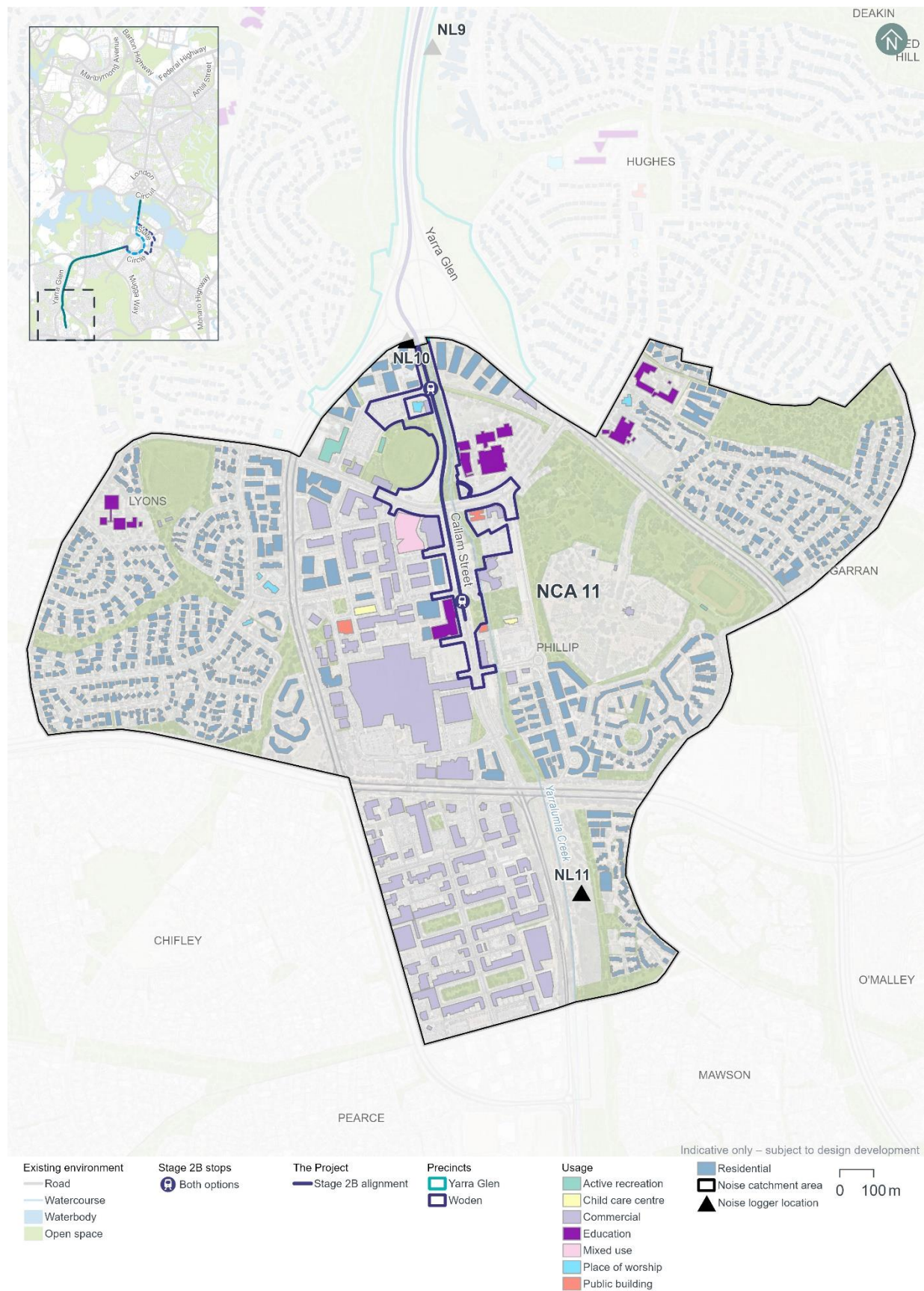


Figure 18-8 Noise catchment area and sensitive receivers

Existing noise levels

Unattended noise monitoring was carried out at one location in the Woden precinct (at noise logger 11 (NL11)) between 2 and 15 May 2024, and between 17 and 22 May 2024, to provide a representation of existing background noise levels. The results of this monitoring are summarised in Table 18-13. The L_{A90} level is the noise level exceeded for 90% of the sample period, and the L_{Aeq} level is the energy averaged noise level over the 15-minute period.

Table 18-13 Unattended background noise monitoring results

Location ID	Noise logger address	Rating background level (L_{A90}), dB(A) ¹		Ambient noise level (L_{Aeq}), dB(A) ¹	
		Day ²	Night ²	Day ²	Night ²
NL11	21 Horbury Street, Phillip	50	35	57	49

Notes:

- $dB(A)$ represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
- In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
 Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
 Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
 Evening (not included in table) – the period from 6 pm to 10 pm.

Attended noise measurements were also carried out at each unattended monitoring location on 1 May 2024 during the daytime period. The results of this monitoring are summarised in Table 18-14.

Table 18-14 Attended noise measurements

Location ID	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL11	57	54	Some traffic noise from main road. Noise from construction site across the road dominant. Concrete pump operating constantly.

18.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the “Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail.” Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that “the construction and maintenance of roads is central to the economic and social well-being of the community.”

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the

NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver, and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The noise assessment considers noise impacts from concurrent construction work across multiple precincts, but the results are reported at a precinct level.

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Woden precinct:

- Mobilisation and establishment of construction compound sites
- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

Finishing works, including rectification of any defects, would be carried out progressively during construction and have been considered in the assessment of each scenario described above. Testing and commissioning works are not expected to entail any additional noise and vibration impact beyond the standard operation of the Project; therefore a quantitative assessment has not been undertaken.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures).

All construction scenarios have been assessed based on work occurring during standard construction hours and during out of standard hours periods, with the exception of mobilisation and establishment of construction compound sites, which was only assessed as occurring during standard construction hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Assessment results

The number of residential buildings where receivers are predicted to be moderately or highly noise affected is shown in Table 18-15, which assumes no mitigation measures are in place. The number of buildings where noise levels are predicted to result in moderately affected receivers are separated into day and night-time periods, as appropriate.

The number of non-residential buildings predicted to be moderately noise affected is shown in Table 18-16.

Construction noise modelling has been completed assuming the noisiest equipment would be in use on the boundary of the Project area footprint, allowing for a worst-case scenario to be assessed. Section 3.2 of Technical Paper 9 – Noise and vibration provides further detail on the assessment approach.

Construction noise modelling indicates that there would be no difference in noise impacts in this precinct based on the alignment option selected.

Table 18-15 Moderately or highly noise affected residential buildings (assuming no mitigation measures in place – Woden precinct)

Construction scenario	Construction work category	Predicted noise affected buildings ¹ (unmitigated)		
		Standard construction hours – moderately noise affected	Outside of standard construction hours (night-time) – moderately noise affected	Highly noise affected ²
Noise Catchment Area 11				
Mobilisation and establishment of construction compound sites	Peak	2	N/A	5
	Typical	-	N/A	-
Protection, relocation, treatment and/or decommissioning of utilities	Peak	17	57	23
	Typical	14	20	15
Earthworks, road works, and construction of light rail infrastructure	Peak	17	28	19
	Typical	16	21	17
Construction of stops	Typical/peak	2	7	4
Construction of bridges on land	Peak	7	20	9
	Typical	3	9	6

Notes:

1. The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor
2. Moderately noise affected receivers have been determined with consideration of the measured existing ambient noise levels, while the highly noise affected noise criteria do not consider existing ambient noise levels. Therefore, a receiver can be counted as both moderately noise affected and highly noise affected.

Table 18-16 Moderately noise affected non-residential buildings (assuming no mitigation measures in place) – Woden precinct

Construction scenario ¹	Building/area usage	Number of non-residential noise sensitive buildings assessed to be moderately noise affected ^{2,3} (unmitigated)
Noise Catchment Area 11		
Mobilisation and establishment of construction compound sites - peak	Public buildings	1
Mobilisation and establishment of construction compound sites - typical	Public buildings	1
Protection, relocation, treatment and/or decommissioning of utilities - peak	Active recreation	2
	Child care centre	1
	Education	5
	Place of worship	1
	Public buildings	2
Protection, relocation, treatment and/or decommissioning of utilities - typical	Education	3
	Place of worship	1
	Public buildings	2
Earthworks, road works, and construction of light rail infrastructure – peak	Active recreation	1
	Child care centre	1
	Education	5
	Place of worship	1
	Public buildings	2
Earthworks, road works, and construction of light rail infrastructure – typical	Education	5
	Place of worship	1
	Public buildings	2
Construction of stops – typical	Education	1
	Place of worship	1
	Public buildings	1
Construction of bridges on land – peak	Education	4
	Place of worship	1
	Public buildings	1
Construction of bridges on land – typical	Education	2
	Place of worship	1
	Public buildings	1

Notes:

1. *Where a construction scenario did not result in an exceedance for a non-residential receiver, it has not been included in this table*
2. *Buildings have been assessed when in use, which is assumed to be the daytime period for most buildings, except hotels which have been assessed for day and night-time periods.*
3. *The noise levels in this assessment represent predicted noise levels at each building façade. Individual buildings have each been assessed as a single receiver, including where they are located at the same address or are part of the same facility. At multistorey buildings, the construction noise assessment documents noise levels for the most affected floor.*

The findings of the unmitigated peak and typical construction noise impact assessments for the Woden precinct during the daytime indicate:

- During standard construction hours, the protection, relocation, treatment and/or decommissioning of utilities is predicted to result 17 residential receivers being moderately noise affected.
- The 'peak' earthworks, road works and construction of light rail infrastructure is predicted to result in 11 non-residential receiver buildings being moderately noise affected, including CIT Woden, four buildings within Canberra College, two buildings at Phillip Oval, Koomarri, Woden Youth Centre, Woden Early Childhood Centre, and the Church of Pentecost Australia.

The findings of the unmitigated peak and typical construction noise impact assessments for the Woden precinct during the night-time period indicate:

- During out of hours, 'peak' protection, relocation, treatment and/or decommissioning of utilities is predicted to result in 57 receivers being moderately noise affected, and 23 receivers being highly noise affected.
- During out of hours, 'typical' earthworks, road works and construction of light rail infrastructure is predicted to result in 21 receivers being moderately noise affected, and 17 receivers are being highly noise affected.
- Hotel (commercial) buildings have also been assessed for the night-time period, however no hotels in the Woden precinct were predicted to be moderately noise affected.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the 'typical' works case for each scenario, except for the mobilisation and establishment of construction compound sites (which has been assessed for standard construction hours only, and therefore not included in the assessment). The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night. The assessment approach is described further in Section 3.2 of Technical Report 9 – Noise and vibration.

Table 18-17 summarises the number of residential buildings where noise levels are predicted to exceed the awakening reaction criteria for Noise Catchment Area 11, in the absence of mitigation measures.

Work would be carried out during standard construction hours where possible, and work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that night works would involve several large-scale construction activities occurring concurrently, and works such as road works or track installation would generally move progressively along the Project area. Therefore, not all receivers would be affected at any one time, or for the whole duration of the works. As a result, the assessment of sleep awakening impacts is considered to be conservative. Proposed construction work hours are described further in Section 6.5 of Chapter 6 (Construction).

Table 18-17 Number of residential buildings where noise levels may exceed sleep awakening reaction levels for night work (assuming no mitigation measures are in place)

Construction scenario (typical works)	Number of residential buildings where unmitigated noise levels may exceed the sleep awakening reaction level
Protection, relocation, treatment and/or decommissioning of utilities	45
Earthworks, road works, and construction of light rail infrastructure	46
Construction of stops	11
Construction of bridges on land	20

Noting the awakening reaction level is exceeded by a number of residential buildings with noise relating to the following construction scenarios:

- Protection, relocation, treatment and/or decommissioning of utilities
- Earthworks, road works and construction of light rail infrastructure
- Construction of stops
- Construction of bridges on land.

The assessment and approval process for any out of hours works that cannot otherwise be avoided (as noted above, in accordance with mitigation measure NV3) would involve confirming mitigation measures to be applied and consultation with potentially affected receivers. Should extended periods of night work be required, respite periods would be scheduled.

Construction vibration

Vibration intensive work has the potential to cause human discomfort or cosmetic damage to buildings and structures, if not appropriately managed. Key potential sources of vibration from the proposed construction activities would include vibratory rollers, vibratory piling rigs, and excavators with hydraulic hammer attachments.

Table 4-3 of Technical Report 9 – Noise and vibration presents the minimum working distances to be maintained between vibration intensive work to avoid cosmetic damage or human discomfort. Appendix E of Technical Report 9 – Noise and vibration provides mapping of the minimum working distances for a large hydraulic hammer (which has been selected to represent one of the most vibration intensive pieces of equipment proposed to be used) for human response and cosmetic damage.

Human comfort

Potential exceedances of human comfort vibration criteria have been assessed for residential buildings. A number of residential buildings are located within the human response minimum working distance for a large hydraulic hammer (within 73 m of the Project area boundary). There is potential for exceedances of the human comfort criteria to occur depending on the duration, nature and location of the construction activity within the construction footprint. Any exceedances would be expected to be short in duration due to the intermittent nature of vibration emissions.

Cosmetic damage

A number of light-framed structures are located within the minimum working distance for a large hydraulic hammer (22 m for light-framed structures). No heritage-listed structures are located within the minimum working distance for a large hydraulic hammer (60 m for heritage and other sensitive structures) for cosmetic damage.

Where the use of vibration intensive equipment within the relevant minimum working distances cannot be avoided, detailed inspection, vibration monitoring and consultation with the sensitive receivers would be undertaken. Further information on mitigation measures is provided in Chapter 21 (Environmental management and mitigation measures).

Construction road traffic noise

Construction traffic associated with construction compounds would be distributed across the road network, with Easty Street and Callam Street being key construction traffic routes within this precinct. Section 6.7.1 of Chapter 6 (Construction) describes proposed heavy vehicle haulage routes. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

A summary of the forecast 2031 traffic volumes without the Project, the additional traffic contributed by construction of the Project, and the resultant relative change in noise levels during the daytime (AM peak period, 8am to 9am) and night-time (10pm to 7am) are presented in Table 18-18. The year 2031 was selected as representative of the peak year of construction.

The majority of haulage routes would receive relative noise level increases of less than 2 dB(A). Changes in noise levels of up to 2 dB(A) are not considered to be perceptible by the average listener.

However, in the night-time hours, traffic both northbound and southbound on Easty Street between Launceston Street and Wilbow Street is predicted to exceed 2 dB(A) for an increase in noise levels. Residential receivers are located adjacent to the proposed haulage route sections of Easty Street. These receivers would potentially be affected by the increases in road traffic noise levels caused by the additional construction traffic for the Project. The increase in relative noise levels is driven by the low traffic on Easty Street during night-time hours, when compared to the AM peak. Noise mitigation measures would be implemented to manage this potential impact, as outlined in Section 18.3.4 and Chapter 21 (Environmental management and mitigation measures).

Table 18-18 Construction road traffic noise peak hourly traffic counts

Route	Direction	Existing traffic (average)		Additional construction traffic (hourly)		Relative increase, dB(A)
		Light	Heavy	Light ¹	Heavy ¹	
Daytime assessment						
Easty Street between Launceston Street and Wilbow Street	Northbound	178	13	2	2	0.3
	Southbound	136	10	2	2	0.4
Callam Street between Neptune Street and Corinna Street	Northbound	477	36	2	2	0.1
	Southbound	325	24	2	2	0.2
Night-time assessment						
Easty Street between Launceston Street and Wilbow Street	Northbound	16	1	9	1	2.3
	Southbound	13	1	9	1	2.7
Callam Street between Neptune Street and Corinna Street	Northbound	44	3	9	1	1.0
	Southbound	53	4	9	1	0.8

Notes:

1. Peak hourly volumes for additional construction light vehicles have been determined by first combining estimated volumes for construction activities and workforce and then halving for each direction. Peak hourly volumes for additional construction heavy vehicles have also been halved for each direction.

18.3.3 Potential impacts – operation

Operational rail noise and vibration

The following sections provide a summary of potential operational rail noise and vibration impacts in the Woden precinct. The potential impacts are common to both alignment options, given the consistent Project design in this precinct.

Airborne rail noise assessment

Operational rail noise levels were predicted at each of the receivers within 300 m of the alignment. This involved assessment of noise levels at a total of 131 receivers in the Woden precinct, including residential receivers, mixed use receivers, education and childcare centres, places of worship, public buildings and active recreation receivers, assuming no mitigation measures are in place. Operational rail noise was modelled based on indicative LRV design speeds identified along the alignment during the design development process.

The results of the operational rail noise assessment indicated that six sensitive receivers experience exceedances of the airborne noise trigger levels. The noise sensitive receivers that experienced exceedances of the L_{AFmax} and $L_{Aeq,1hr}$ noise trigger levels are presented in Table 18-19 and Table 18-20 respectively. At multistorey buildings, the airborne rail noise assessment documents noise levels for the most affected floor.

Table 18-19 Woden precinct noise sensitive receiver L_{AFmax} exceedances (daytime and night-time) – residential receivers

ID	Usage	Address	Predicted L_{AFmax} noise level, dB(A)	L_{AFmax} noise trigger level, dB(A)	Exceedance dB(A)
4395	Residential	15 Irving Street Phillip	81	80	1

Table 18-20 Woden precinct noise sensitive receiver $L_{Aeq,1hr}$ exceedances (night-time) – residential receivers

ID	Usage	Address	Predicted $L_{Aeq,1hr}$ noise level, dB (A)	$L_{Aeq,1hr}$ noise trigger level, dB(A) ¹	Exceedance dB(A)
2865	Education	Canberra College Woden Campus, 40 Launceston Street, Phillip	55	53	2
4122	Place of Worship	The Church of Pentecost Australia- Canberra, 12 Irving Street, Phillip	55	53	2
4361	Education	Canberra College Woden Campus, 40 Launceston Street, Phillip	63	53	10
4362	Education	Canberra College Woden Campus, 40 Launceston Street, Phillip	61	53	8
4431	Education	CIT Woden Campus, Bradley Street, Woden	56	53	3

Noise levels at the residential receivers northern façade at 15 Irving Street, Phillip, directly adjacent to Melrose Drive are exceeding the L_{AFmax} noise trigger levels, however the exceedances of the trigger levels are 1 dB(A). As changes in noise level of up to 2 dB(A) are not considered to be perceptible by the average listener no further treatment is recommended.

The predicted $L_{Aeq,1hr}$ noise levels for non-residential receivers are up to 10 dB(A) in excess of the trigger levels at receivers Canberra College and CIT Woden. Mitigation measures to manage potential impacts to these receivers are discussed in Chapter 21 (Environmental management and mitigation measures) of the EIS.

Ground-borne rail noise assessment

Ground-borne noise impacts for the Woden precinct at the most affected (closest) receivers are presented in Table 18-21.

No sensitive receivers are expected to experience ground-borne noise levels over the project trigger levels, and as such specific additional mitigation for receivers would not be required.

Table 18-21 Woden precinct – ground-borne noise results (assuming no mitigation measures are in place)

Address	Building use	Distance from track centreline, m	Modelled speed of LRV, km/h	Ground-borne noise criteria (Night), dB(A) L_{ASmax}	Predicted ground-borne noise, dB(A) L_{ASmax}
CIT Woden	Education	15	15	45	32
15 Irving Street, Phillip	Residential	20	50	35	35
50 Launceston Street, Phillip	Residential	29	50	35	33
Corner Callam Street and Matilda Street	Residential	33	60	35	32

Rail vibration assessment

The predicted vibration levels for the Woden precinct at the most affected (closest) receivers are presented in Table 18-22. No sensitive receivers are expected to experience vibration dose value over the nominated human comfort criteria.

Table 18-22 Woden precinct – vibration assessment results (human comfort; assuming no mitigation measures are in place)

Address	Distance from track centreline, m	Vibration Criteria (Daytime), $m/s^{1.75}$	Predicted equivalent vibration dose value (Daytime), $m/s^{1.75}$	Vibration Criteria (Night), $m/s^{1.75}$	Predicted equivalent vibration dose value (Night), $m/s^{1.75}$
Slovenian-Australian Association (12 Irving Street, Phillip) <i>Commercial</i>	10	0.4	0.013	0.4	0.007
CIT Woden <i>Education</i>	15	0.4	0.005	0.4	0.002
15 Irving Street, Phillip <i>Residential</i>	20	0.2	0.008	0.13	0.004
50 Launceston Street, Phillip <i>Residential</i>	29	0.2	0.006	0.13	0.003
Corner Callam Street and Matilda Street <i>Residential</i>	33	0.2	0.007	0.13	0.004

Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the Roads ACT Noise Management Guideline (Transport Canberra and City Services, 2018). The road traffic noise criteria applicable to upgrading roads in existing areas is presented in Table 18-23.

Table 18-23 Operational traffic noise compliance criteria for upgraded road in existing areas of noise sensitive land use (ground level)

Existing traffic noise level at adjacent buildings, $L_{Aeq,15hr}$	Traffic noise level at adjacent buildings after road works completed
> 60 dB(A)	Equal to existing level (not greater than 65 dB(A))
55 – 60 dB(A)	60 dB(A)
< 55 dB(A)	Not more than 5 dB(A) above existing level

To assess the potential impact of the Project on noise sensitive buildings, relative increases in future road traffic noise levels have been predicted for the ‘without Project’ and ‘with Project’ scenarios for the year 2031 (selected to represent the year of opening) and 2041 (selected to represent 10 years after opening). The future traffic volumes take into account increased traffic growth and changes to the road network from the Project such as changes in traffic lane configuration, signals and redirected traffic (described further in Chapter 5 (Project description)).

For the Woden precinct, existing road traffic noise levels are between 55 and 60 dB(A) and future predicted road traffic noise levels would not exceed 60 dB(A) and are therefore acceptable.

The results of the 2031 and 2041 road traffic noise assessment are presented in Table 18-24 to Table 18-27.

Table 18-24 Road traffic noise assessment, 2031 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Athllon Drive	21 Horbury Street, Phillip	Southbound	3,884	292	-582	-44	-1	Yes, no increase in traffic level
		Northbound	8,767	660	-747	-56		

Table 18-25 Road traffic noise assessment, 2031 - National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Athllon Drive	21 Horbury Street, Phillip	Southbound	3,884	292	-1,132	-85	-1	Yes, no increase in traffic noise level
		Northbound	8,767	660	-668	-50		

Table 18-26 Road traffic noise assessment, 2041 – State Circle East alignment option

Road assessed	Location	Direction	Traffic volumes without the Project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Athllon Drive	21 Horbury Street, Phillip	Southbound	4,482	337	-393	-30	0	Yes, no increase in traffic noise level
		Northbound	7,941	598	-393	-30		

Table 18-27 Road traffic noise assessment, 2041 – National Triangle-Barton alignment option

Road assessed	Location	Direction	Traffic volumes without the project (15hr)		Additional traffic with the Project (15hr)		Predicted relative increase noise level, dB(A)	Compliance
			Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle		
Athllon Drive	21 Horbury Street, Phillip	Southbound	4,482	337	-1,022	-77	-1	Yes, no increase in traffic noise level
		Northbound	7,941	598	-315	-24		

Fixed facilities noise assessment – Public Address systems

Public Address (PA) systems at light rail stops would present a fixed noise source during operations. Passenger announcements from PA systems at the various stops are likely to be infrequent and generally limited to emergency situations or where notable disruptions in service occur. The short-term nature of PA noise means that it is unlikely to dominate the $L_{A10,15min}$ assessment noise level at any location. Within the Woden precinct, stops are located at Phillip Oval and Woden Interchange.

The Phillip Oval Stop is located nearby to the sensitive receivers of the Slovenian-Australian Association and Church of Pentecost Canberra at 19 Irving Street, Canberra College at 2 Launceston Street, and nearby residential receivers. It is likely that the façade of the residences would have been designed to provide adequate insulation of road traffic noise, given they are relatively newly built. The subjective impacts are likely to be minimal given the relative infrequency of announcements, and existing background noise levels.

The stop is within the Woden Interchange where buses would be operating prior to the commencement of light rail operations. The stop at Woden Interchange is located approximately 45 m from the nearest residential receivers. As the Woden Interchange would already incorporate the use of PA systems, the subjective impacts of the noise from new light rail PA systems are likely to be minimal given the relative infrequency of announcements and the existing environment.

Fixed facilities noise assessment – Traction power substation noise

Within this precinct, TPS 10 would be located within the existing carpark off Spoering Street. The predicted TPS noise levels at the nearest affected receiver are presented in Table 18-26. Based on the assessment, the TPS design is anticipated to meet applicable noise criteria.

Table 18-28 Predicted TPS noise level at affected receivers

TPS location	Distance to nearest receiver, m	Predicted L_{A10} noise level, dB(A)	Night-time noise zone standard, $L_{A10,15min}$, dB(A)	Compliance
TPS10 – Phillip	50	27	35	Yes

18.3.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage noise and vibration impacts that are specific to the Woden precinct are shown in Table 18-29.

Table 18-29 Noise and vibration mitigation measures –Woden precinct

ID	Objective	Management and mitigation measure	Timing
NV8	Minimising night-time construction road traffic noise	Where night-time road traffic noise levels at sensitive receivers are predicted to increase by more than 2 dB(A), alternative construction vehicle haulage routes will be investigated. Where there are no alternative haulage routes available early consultation with the affected sensitive receivers will be undertaken.	Construction

18.4 Biodiversity

This section provides an assessment of the potential biodiversity impacts associated with the construction and operation of the Project for the Woden precinct. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 3 of Technical Report 2 – Biodiversity.

18.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Woden precinct. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 of Chapter 11 (Project-wide issues) including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Vegetation assessment

A total of 3.89 ha of vegetation is present in the Woden precinct. Vegetation within the Woden precinct is comprised of three vegetation communities. Table 18-30 and Figure 18-9 depict the area and distribution of each vegetation community within the Woden precinct.

Table 18-30 **Extent of vegetation communities within the Project area in the Woden precinct**

Vegetation community	Area (ha)
Landscape plantings – Native	1.61
Landscape plantings – Exotic	1.33
Exotic grassland	0.95
Total vegetation	3.89

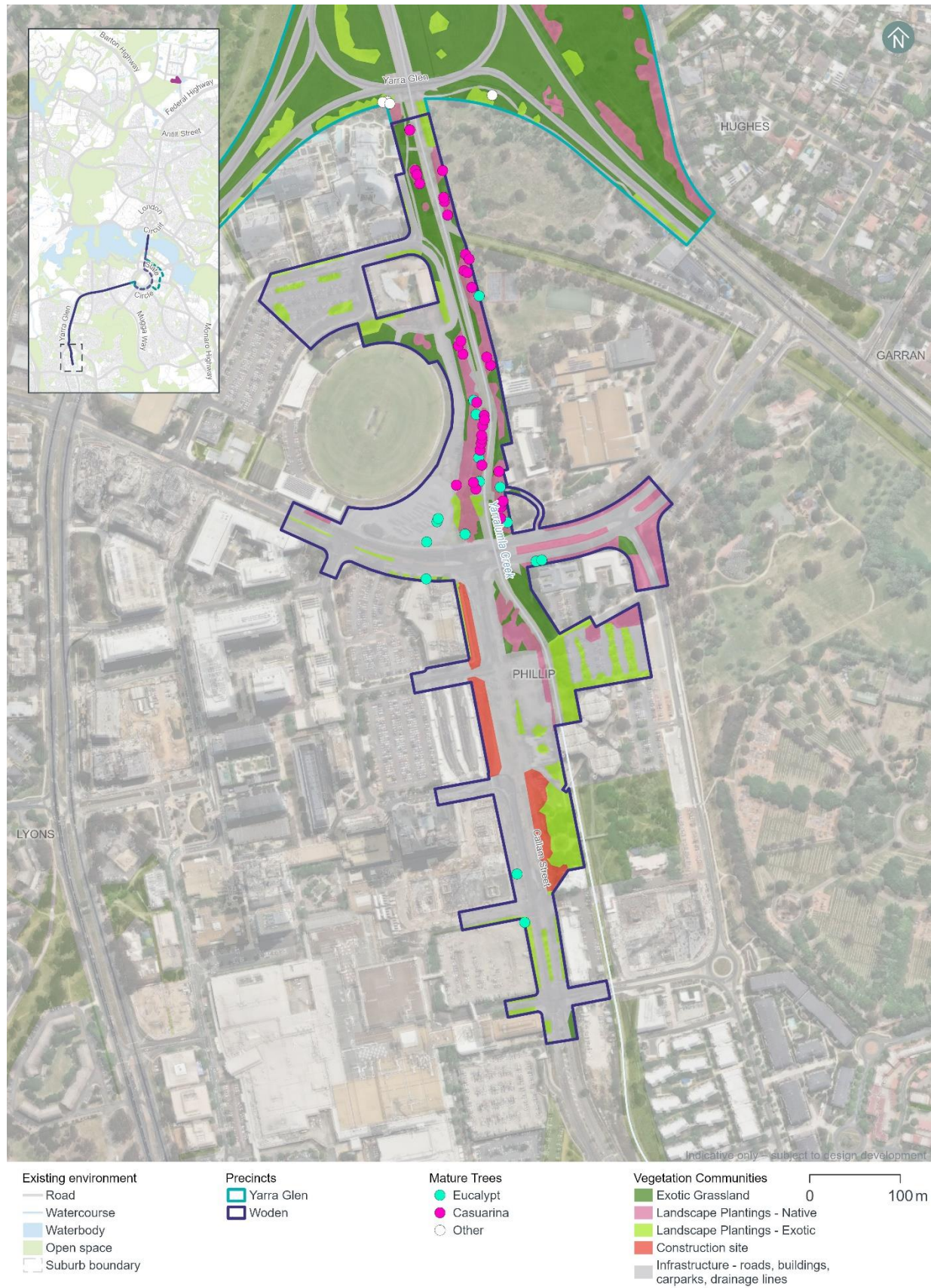


Figure 18-9 Vegetation communities, and mature trees in the Woden precinct

Hollow-bearing trees and mature trees

A total 51 mature trees were recorded in the Woden precinct as seen in Figure 18-9. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

No hollow-bearing trees have been recorded in the Woden precinct.

A list of hollow-bearing and mature tree species across the Project area is provided in Section 11.2.1 of Chapter 11 (Project-wide issues).

Threatened fauna habitat

The Golden Sun Moth is listed as vulnerable under both the EPBC Act and the NC Act. A total area of 0.01 ha of potential Golden Sun Moth habitat has been recorded within the Woden precinct which was identified as low-density Chilean needlegrass habitat (refer to Figure 18-10). However, no Golden Sun Moth individuals have been recorded in the Woden precinct. Other Golden Sun Moth individuals, Populations, and habitat across the Project area are identified in Section 11.2 of Chapter 11 (Project-wide issues).



Figure 18-10 Golden Sun Moth habitat in the Woden precinct

Other potential threatened fauna habitat identified within the Woden precinct includes:

- Gang-gang Cockatoo (listed as endangered under both the EPBC Act and the NC Act) – the Woden precinct supports 1.61 ha of foraging habitat for the species (refer to Figure 18-11)
- Superb Parrot (vulnerable under both the EPBC Act and the NC Act) – the Woden precinct supports 1.61 ha of foraging habitat for this species (refer to Figure 18-11)
- Diamond Firetail (listed as vulnerable under both the EPBC Act and the NC Act.) – 1.61 ha of the Landscape Planting – Native community has been identified within the Woden precinct and may provide suitable habitat for the Diamond Firetail (refer to Figure 18-11).

No habitat was identified in the Woden precinct for Swift Parrot (*Lathamus discolor*), Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberrae*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).



Figure 18-11 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Woden precinct

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Woden precinct. Impacts to threatened or rare flora species are therefore not anticipated.

Four pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Woden precinct:

- Chilean needlegrass (*Nassella neesiana*) – a Weed of National Significance
- African lovegrass (*Eragrostis curvula*)
- White poplar (*Populus alba*)
- Firethorn (*Pyracantha angustifolia*).

18.4.2 Potential impacts – construction

The following section summarises the potential impacts of the Project on biodiversity as a result of construction in the Woden precinct.

Vegetation assessment

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 18-12. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 18-31. Only 0.65 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 18-31 Extent of vegetation communities within the clearance footprint in the Woden precinct

Vegetation community	Area (ha)
Landscape Plantings – Native	0.65
Landscape plantings – Exotic	0.10
Exotic grassland	0.48
Total vegetation	1.23



Figure 18-12 Clearance footprint in the Woden precinct

A total 31 mature native trees have been recorded in the clearance footprint in the Woden precinct. These trees provide suitable breeding and/or foraging habitat for woodland birds including those identified as having a moderate or high likelihood of occurrence.

No hollow-bearing trees have been recorded in the clearance footprint.

Threatened fauna

Potential impacts on threatened fauna within the clearance footprint in the Woden precinct would include impacts to the following through habitat removal:

- Golden Sun Moth – 0.01 ha of habitat
- Gang-gang Cockatoo – 0.65 ha of foraging habitat, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 0.65 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 0.65 ha of Landscape Planting – Native vegetation which may provide suitable habitat for the species.

Potential impacts on threatened fauna habitat across the whole clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

No habitat has been identified in the Woden precinct clearance footprint for the Swift Parrot, Diamond Firetail, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities may include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Section 11.2.2 of Chapter 11 (Project-wide issues).

18.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species, for example due to lighting around light rail stops
- The addition of light rail vehicles within existing transport corridor would increase the risk of fauna strike
- Fauna strike with over-head wires and associated infrastructure.

Further detail on these indirect impacts for operational activities is discussed in Section 11.2.3 of Chapter 11 (Project-wide issues).

18.4.4 Precinct specific management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, including through the development of a minimised clearance footprint within the Project area (refer to Figure 18-12).

Environmental management and mitigation measures are detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No precinct-specific measures have been identified for biodiversity impacts in the Woden precinct.

18.5 Historic heritage

This section provides an assessment of the potential historic heritage impacts associated with the construction and operation of the Project within the Woden precinct. Further detail on the heritage impact assessment is provided in Technical Report 3 – Heritage. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 2 of Technical Report 3 – Heritage.

Historic cultural landscapes, natural heritage, and heritage views and vistas have been assessed on a Project-wide basis as such features span across multiple precincts (refer to Section 11.3 of Chapter 11 (Project-wide issues)).

18.5.1 Existing environment

This section provides an overview of the existing historic heritage features within the Woden precinct. It also considers the condition, integrity, and sensitivity to change of historic heritage features within the precinct.

Heritage character

The heritage character of this precinct primarily arises from its position adjacent to the Woden Town Centre. Historically defined by Melrose Drive, Hindmarsh Drive, Callam Street, and Yarralumla Creek to the east, the precinct expresses the urban character of an early- National Capital Development Commission (NCDC) designed town centre (around 1960). This is reflected in the combination of government, retail, and community services arrayed in a cross shape around the town square and defined by the surrounding roads. The Callam Offices contributes to the expression of this heritage significance as a group of government offices adjacent to the town centre.

The historic heritage assessment identified two heritage places (one listed and one unlisted) near the Woden precinct, as noted below in Table 18-32 and shown in Figure 18-13.

Table 18-32 Heritage places within and surrounding the Woden precinct

Heritage places	Description
ACT Heritage Register	
Callam Offices	The Callam Offices complex is significant, built in a late twentieth-century structuralist style of architecture by acclaimed architect John Andrews AO. It features elevated octagonal office pods interconnected by bridges displaying 'space-age' aesthetics. This enables the building to be above the 100-year flood level of Yarralumla Creek. The Callam Offices are a landmark of the Woden Town Centre, and of Canberra.

Heritage places	Description
Unlisted significant heritage places	
Canberra: the Planned National Capital	<p>Canberra's planned national landscape is a significant expression of the Griffin Plan that is highly valued by the Canberra and Australian communities. It is formed of public parklands, significant views along axes and across the Central National Area, tree-lined boulevards, a geometric layout, and Lake Burley Griffin. The landscape is nationally significant due to its:</p> <ul style="list-style-type: none"> • Symbolic and physical importance as the nation's seat of government • Demonstration of a high degree of creative and technical achievement in town planning, urban design, and urban horticulture • Special association for Aboriginal people as the place where significant progress has been made towards Indigenous rights and reconciliation. <p>Given this heritage place spans multiple precincts, it is assessed in Section 11.3 of Chapter 11 (Project-wide issues). It also applies to the landscape of Canberra as a whole and is therefore excluded from Figure 18-13 and is not considered further in this precinct assessment.</p>



Figure 18-13 Heritage places relevant to the Woden precinct

Condition, integrity, and sensitivity to change

The existing heritage values within the Woden precinct are generally in good condition. The Callam Offices is in fair condition.

The integrity of the heritage values is low to moderate. Changes over time have obscured and degraded the original form of the NCDC-era Town Centre plan, such as the recent addition of residential towers in the northern recreational precinct and general development within the Town Centre itself which has obscured the original layout centred around the Town Square.

This precinct has low to moderate sensitivity to change. The precinct's heritage character is via the expression of the NCDC-era planning for the precinct, for example the location, definition and form of the Town Centre, and its segmentation into different purposes. These features can tolerate a reasonable amount of change, but the loss of integrity that has already occurred and obscured the historic layer has reduced this tolerance.

18.5.2 Potential impacts – construction

Table 18-33 summarises the potential construction impacts of the Project on heritage places in the Woden precinct.

Table 18-33 Construction impacts on heritage places within the Woden precinct

Heritage place	Construction impact
ACT Heritage Register	
Callam Offices	Nil <ul style="list-style-type: none"> No direct impacts to heritage place Temporary infrastructure is proposed for the carpark immediately north of the Callam Offices and would cause temporary visual impacts Technical Report 9 – Noise and vibration identifies that there is the potential for vibration intensive equipment to be operated near the Callam Offices within the minimum working distance for cosmetic damage to heritage structures. Heritage impacts from vibration would be avoided with appropriate equipment selection, identification and monitoring of safe vibration levels, and other vibration mitigation measures as discussed in mitigation measure NV6 in Chapter 21 (Environmental management and mitigation measures).

Construction impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

18.5.3 Potential impacts – operation

Table 18-34 summarises the potential operation impacts of the Project on heritage places in the Woden precinct.

Table 18-34 Operation impacts on heritage places within the Woden precinct

Heritage place	Construction impact
ACT Heritage Register	
Callam Offices	Nil <ul style="list-style-type: none"> No direct impacts to heritage place No permanent impacts to visual setting of heritage place as a result of light rail infrastructure and operations No operational vibration impacts to heritage place.

Operation impacts on Canberra: the Planned National Capital have been assessed in Section 11.3 of Chapter 11 (Project-wide issues).

18.5.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage historic heritage impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for historic heritage impacts at the Woden precinct.

18.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Woden precinct. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural, and heritage attributes of the landscape, planning designations, and desired character within each of the precincts. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

For the purposes of this assessment, the precinct boundaries have been expanded beyond the Project area, as shown in Figure 18-14.

18.6.1 Existing environment

Situated in the suburb of Phillip within the Woden Valley, the Woden precinct is characterised by the high density commercial, medical, large-scale retail buildings, and surface level carparking facilities. The new CIT campus and Woden Interchange are also notable landmarks in the Woden Town Centre. Yarralumla Creek comprises the lowest areas within this precinct, with the landscape rising to localised topographical peaks including Red Hill, Oaky Hill, Davidson Hill, Mount Mugga Mugga, and Issacs Ridge.

While not as heritage rich as other precincts, there are a small number of heritage items in the vicinity of the Woden precinct which contribute to the overall heritage value of the precinct. These include the ACT Heritage Register listed Callam Offices. Further information on the heritage items listed above can be found in Section 18.5.



Figure 18-14 Landscape character zone and viewpoints in the Woden precinct

Landscape character

The key aspects of landscape character in the Woden precinct can be seen in Figure 18-15 to Figure 18-17. The topography within Phillip is typically flat to gently undulating, with Yarralumla Creek comprising the lowest areas within this precinct (refer Figure 18-15). Yarralumla Creek comprises an open concrete channel, flowing northwards from Mawson towards the Molonglo River. The landscape rises to localised topographical peaks including Red Hill, Oaky Hill, Davidson Hill, Mount Mugga Mugga, and Issacs Ridge.

Vegetation within the precinct is limited to areas of landscape plantings – native, which typically occur along Yarralumla Creek and to the eastern edge of the precinct. Some exotic street tree plantings line the roads within the township.



Figure 18-15 Open space along Yarralumla Creek to the right of frame

The street network within this precinct typically follows a grid system informed by the road network with a grid approach to allow for large-scale buildings in contrast to the more informal, curving residential streets to the east and west of the precinct. The suburb of Phillip is visually dominated by hardscape (refer to Figure 18-16), including high rise buildings and large areas of car parking (refer to Figure 18-17).



Figure 18-16 Commercial streetscape in Phillip



Figure 18-17 Car parking to service the commercial area in Phillip

Viewpoints

Representative viewpoints that have been identified to assess changes to the Woden precinct which are and shown in Figure 18-14 and described in Table 18-35.

Table 18-35 Woden precinct viewpoints and description

Viewpoint	Description	Sensitivity rating
Viewpoint W1: Irving Street	<p>The existing view from this location is shown in Figure 18-18. The foreground of this view includes a turf verge transitioning into the gravel of the adjacent community hub carpark. A row of trees extends along the turf verge into Irving Street. The midground comprises the unmarked, sealed carpark access road with road barrier transitioning into the Irving Street corridor. Visual receptors at this viewpoint would mostly be those travelling on the active travel path. A lower number of receptors would use the road, most of whom would be passers-by who see this view.</p> <p>The sensitivity of this viewpoint is moderate. Although it would have a high susceptibility to change due to the close proximity to the Project, many existing visual receptors are unlikely to be sensitive to these changes.</p>	Moderate
Viewpoint W2: Traction Power Substation 10	<p>This viewpoint looks west from the footpath of a street across a car park (refer to Figure 18-20). The fore and middle ground of the view are visually dominated by parked cars, with occasional deciduous trees partially screening the view to the background. High rise apartment buildings are seen in the background of the view, screening the view to the horizon.</p> <p>The sensitivity to change of this viewpoint is low. Motorists are unlikely to be a sensitive visual receptor group as they would be focussed on searching for a car park. Pedestrian receptors are likely to have a passing interest in the view. While residential receptors would typically be more sensitive to views surrounding their homes, this location is positioned within an area designated for car parking and with limited aesthetic value.</p>	Low

Viewpoint	Description	Sensitivity rating
Viewpoint W3: Callam Street at Bradley Street	<p>This viewpoint primarily comprises the Callam Street corridor including narrow concrete and gravel median (refer to Figure 18-22). To the left of the view, wire construction fencing lines the edge of the road with grassed areas visible through the fencing, as well as the far edge of a multi-storey carpark. A building is currently under construction on the north-west corner of the intersection.</p> <p>The sensitivity to change of this viewpoint is low. Motorists are unlikely to be a sensitive visual receptor group as they would only see the view for short periods of time, similarly, pedestrian receptors are likely to have a passing interest in the view. The planning and allowance for the Project within the future design of the town centre further lowers the viewpoints sensitivity to the Project.</p>	Low

Night-time lighting

The Woden Town Centre in Phillip is a major commercial hub with high rise mixed use buildings and supporting facilities and therefore sits within an A4: High district brightness zone based on Australian Standard 4282:2023 (Standards Australia, 2023). The precinct is experiencing ongoing development and construction works and while these works are disruptive it is characteristic of a precinct undergoing urban renewal.

The Project passes Phillip Oval and terminates at the Woden Interchange adjacent to the CIT Woden campus. These venues are activity hubs which require a high degree of lighting, contributing to the A4 zoning.

The alignment within this precinct transverses different urban typologies. The lighting design outcomes would prioritise implementing the relevant policy objectives within the National Capital Authority's (NCA) Outdoor Lighting Policy, these include:

- i. Lighting must contribute to the creation of a high quality public realm
- ii. Lighting must provide a safe night-time environment for residents of, and visitors to the National Capital
- iii. Minimise the obtrusive effects of artificial lighting on the natural environment.

18.6.2 Potential impacts – construction

Landscape character impact assessment

The construction of the Project would result in both the addition and loss of elements within the Woden precinct, including:

- The addition of temporary fencing, hoarding, signage, and traffic safety equipment
- Removal of existing vegetation (most notably, trees), furniture, and signage, as needed
- Activities including earthworks, track construction, drainage adjustments, and road improvements
- Construction of structures, including light rail stops, retaining walls, and bridges
- Installation of lighting, signage, and landscaping
- Temporary traffic changes
- Establishment of construction compounds.

These changes would alter many aesthetic aspects and key characteristics within the Precinct.

Construction activities in any one location would be temporary and experienced over the short term (up to five years).

As such, the magnitude of change during construction would be high within the Woden precinct due to the visual clutter of construction and the removal of trees. This would result in a high to moderate adverse impact on landscape character during construction.

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During the construction phase within the Woden precinct, in most cases the overall impact at each viewpoint has been assessed as being moderate to low due to:

- Moderate to low sensitivity of most viewpoints to change
- High to moderate magnitude of works anticipated throughout construction that would be visible within view of most viewpoints and construction occurring in neighbouring sites.

A description of the anticipated change in view and associated potential impacts on the Project during construction is provided in Table 18-36.

Table 18-36 Viewpoints construction impact summary – Woden precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint W1: Irving Street	This location would not be accessible during construction; therefore, the visual impact would be negligible. As no changes would be seen from this viewpoint during construction, the magnitude of change experienced at this viewpoint would be negligible. This combined with a moderate sensitivity rating makes the overall impact negligible.	Sensitivity: Moderate
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral
Viewpoint W2: Traction Power Substation 10	Construction of the TPS would be seen within a moderate portion of the view in the middle ground and would be in contrast to the existing view. While construction within this view would not involve tree removal, the addition of construction activities and equipment would comprise a high degree of contrast to the existing, established landscape. Construction activities would be visually prominent within the view, particularly due to the close proximity of the changes and the scale of the equipment.	Sensitivity: Low
		Magnitude: High
		Overall impact: Moderate
		Qualitative rating: Adverse
Viewpoint W3: Callam Street at Bradley Street	Construction activities, especially of the Woden Interchange, would be seen within the road corridor in the middle ground of this view. Alongside other planned nearby projects, the visual clutter of construction activity would remain a dominant feature of the view, with additional large elements and construction activities evident within the view.	Sensitivity: Low
		Magnitude: Moderate
		Overall impact: Moderate to Low
		Qualitative rating: Adverse

Night-time visual impact assessment

Works in the Woden precinct may be required outside standard construction hours (Monday to Saturday, 7am to 6pm).

Night works would increase the existing light levels of this precinct. A construction compound within the precinct would be established within Easty Street car park in Woden, providing support for the construction activities. The construction compound would require temporary lighting to prioritise safety and security of the facility.

Lighting associated with night works within the precinct would be seen from surrounding commercial and residential properties.

For these reasons, the visual impact during construction at night would be **minor adverse**.

18.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project would impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 18-37 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 18-37 Landscape character impact assessment summary in the Woden precinct – both alignment options

Alignment option	Anticipated change	Impact rating
Both alignment options	<p>The Project would result in the addition of light rail infrastructure within the Callam Street corridor in the precinct, as well as through the land reserve to the east of Phillip Oval. Further to this, minor adjustments to road arrangements, footpaths, and planting (particularly street trees) would be required. Tree removal to accommodate the active transport path would not be able to replace all trees lost, which would be an adverse qualitative outcome to small sections within the precinct.</p> <p>The addition of light rail adjacent to the Yarralumla Creek corridor would comprise a locally substantial change, particularly due to the removal of trees and the shift in land use from car park and 'back of house' area adjacent to a park to light rail, including a light rail stop at Phillip Oval. The addition of the light rail within Callam Street would characteristically align to a main road within a commercial centre.</p> <p>Overall, the changes would be beneficial to the landscape surrounding the Woden precinct with the addition of public transport infrastructure that fits into the main road corridor within a town centre. While existing active transport infrastructure north of Launceston Street would be impacted, the active transport route would be replaced on the eastern side of the creek, including portions of raised boardwalks which would protect the route from flooding.</p>	Sensitivity: Moderate
		Magnitude: Low
		Overall impact: Moderate to low
		Qualitative rating: Beneficial

Visual impact assessment

The visual impact assessment considered the sensitivity of existing viewpoints to change and the magnitude (scale, character, and distance) of the change of view. During operation within the Woden precinct, in most cases the overall impact at each viewpoint has been assessed as being high to low due to:

- Low sensitivity of most viewpoints to change
- Viewpoints ranging from high to low magnitude of change, the main impact being views of passing LRVs and associated infrastructure.

A description of the anticipated change in view and associated potential impacts on the Project during operation is provided in Table 18-38.

Table 18-38 Viewpoints operation impact summary – Woden precinct

Viewpoint	Anticipated change in view	Impact rating
Viewpoint W1: Irving Street	<p>The Project at operation would result in the addition of light rail infrastructure within this view. Planted trees would replace some (but not all) of those removed during construction. The new light rail stop at Phillip Oval would be visually dominant within the view. Those using the active travel path would be shifted to the eastern side of the creek and would not see this view along the light rail corridor. The Project would be seen across a large part of the view, including replacing an existing green space with the addition of a light rail stop, trackform and over-head wires extending into the distance, and passing LRVs.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint W1 is provided in Figure 18-19.</p>	Sensitivity: Moderate
		Magnitude: High
		Overall impact: High to moderate
		Qualitative rating: Adverse
Viewpoint W2: Traction Power Substation 10	<p>The TPS site would be around 270 m², sitting within the middle ground, central portion of the view. The TPS would have a demountable building consisting of an air-conditioned switchgear room and a separate ventilated room.</p> <p>These changes would be seen within a small to moderate portion of the overall view, however, would comprise a new structural element within an existing car park. While these changes would be permanent and in contrast to the existing condition, the façade of the structure would be designed to be aesthetically recessive within the landscape.</p> <p>An example of a TPS from LRS1 is provided in Figure 18-21.</p>	Sensitivity: Low
		Magnitude: Moderate
		Overall impact: Moderate to low
		Qualitative rating: Neutral
Viewpoint W3: Callam Street at Bradley Street	<p>The Project would result in the addition of light rail infrastructure within the existing central area of Callam Street. Light rail tracks would terminate on the northern side of the intersection. The Project would be seen from a slightly oblique viewing angle, but within the focal point of a road corridor as it extends away from the viewpoint. The changes, while positioned prominently within the view would be somewhat visually recessive, with the overall composition of the view subject to ongoing change in response to external projects.</p> <p>An indicative visualisation of the Project, once operational, from Viewpoint W3 is provided in Figure 18-23.</p>	Sensitivity: Low
		Magnitude: Low
		Overall impact: Low
		Qualitative rating: Neutral

**Figure 18-18 Existing view from Viewpoint W1 looking north towards Irving Street**



Figure 18-19 Indicative visualisation of Viewpoint W1 during operation



Figure 18-20 Existing view from Viewpoint W2



Figure 18-21 Example of TPS structure (from LRS1) within Viewpoint W2 during operation



Figure 18-22 Existing view from Viewpoint W3 looking north along Callam Street



Figure 18-23 Indicative visualisation of Viewpoint W3 during operation

Night-time visual impact assessment

While the Project would introduce additional lighting, including LRV headlights along the tracks, the light rail corridor would align with the outcomes of the existing A4: High district brightness area.

The CIT Woden, its associated street lighting upgrade and the transport interchange upgrade, would provide sufficient lighting for the Project within the Callam Street corridor. Additional cut-off street and pedestrian lighting would be implemented along the corridor to the north of Launceston Street. This would contribute to high quality landscape and safety outcomes of the Project, while limiting the impact to the surrounding environment.

Removal of tree coverage to the western side of Yarralumla Creek surrounding the Phillip Oval area would result in an increase in light spill from both light rail lighting and the adjacent sporting facility into the surrounding vegetated area surrounding Yarralumla creek and Canberra College Woden Campus. An increase in tree canopy along the alignment and from other proposed developments would reduce the impact of lighting over time.

The light rail stops (Phillip Oval and Woden Interchange), would introduce additional lighting within the view corridor. Lighting of the stop is vital for passenger safety at night, however, the Phillip Oval Stop would establish a new lighting element adjacent to residential properties. The Phillip Oval Stop would result in light spill and a high degree of change. The Woden Interchange would not contribute a noticeable change to the surrounding landscape and receptors.

Low level strip lighting would be applied to the TPS 10 structure within the Spoering Street car park. The lighting would sit within the TPS structure, behind the façade, however minor light spill would occur through the façade.

Lighting associated with the Project would be designed to limit spill into non-target areas and up-lighting would be capped by structures. Light colour would be designed to complement the adjacent area and public safety cameras would be selected to function without unnecessary lighting.

While there would be a noticeable reduction in visual amenity at night due to the Project, particularly within the northern portion of the alignment, this is a high district brightness environment. The visual impact during operation would result in a **minor adverse** impact at night.

18.6.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

In addition to the Project-wide measures, mitigation measures to manage landscape character and visual amenity impacts that are specific to the Woden precinct are shown in Table 18-39.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

Table 18-39 Landscape and visual management and mitigation measures – Woden precinct

ID	Objective	Management and mitigation measure	Timing
LV3	Landscape enhancement in Phillip/ Woden	<p>Opportunities to soften landscape and visual impacts on the Phillip / Woden area will include consideration of:</p> <ul style="list-style-type: none"> Water sensitive urban design strategies and elements within the Woden town centre The landscape design response between the Phillip Oval light rail stop and nearby residential properties. 	Design
LV10	Visual integration of traction power substations	The scale and bulk of traction power substations will be refined to enable greater integration into the surrounding landscape. Material selection and finishes, lighting, landscaping and screen planting (including trees) will be used to minimise the visual presence of the substations.	Design and operation

18.7 Socioeconomic

This section provides an assessment of the potential socioeconomic impacts associated with the construction and operation of the Project within the Woden precinct. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

Some socioeconomic impacts would be applicable to the Project as a whole (including this precinct) and are assessed in Section 11.7 of Chapter 11 (Project-wide issues).

18.7.1 Existing environment

Community characteristics

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The area of social influence forms the study area for this assessment and is shown in Figure 11-1 in Section 11.7.

The assessment has considered the following in defining the social area of influence for the Project:

- Precincts: this term is applied to a geographic area designated for the purposes of the Project where people are most likely to experience both construction and operational socioeconomic impacts from the Project, or a level of direct impact. Statistical Area level 2 (SA2) areas have been selected for each precinct to represent the community where direct socioeconomic impacts could potentially occur. The Phillip SA2 was analysed for the Woden precinct

- Corridor: this term is applied through the assessment where the spatial extent of socioeconomic impacts on people is generally broader than the precinct area. Statistical Area level 3 (SA3) areas have been selected to represent the corridor, including:
 - South Canberra SA3
 - Woden Valley SA3
- ACT: in some instances, the social area of influence is extended to a 'region' to reflect broader potential socioeconomic impacts, compared to the 'corridor'. This assessment refers to the 'region' as the Australian Capital Territory (ACT).

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor, and the ACT. Capital refers to various forms of resources that contribute to the wellbeing, sustainability, and resilience of a community.

A summary of community capitals for the Woden precinct is provided in Table 18-40. Section 11.7 provides a summary of community capitals for the corridor and the ACT.

Table 18-40 Community capitals summary – Woden precinct

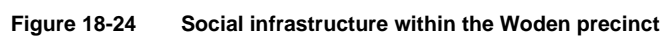
Capital	Summary
Human capital	The population of 5,197 in this area is relatively young, with a strong presence of adults aged 25 to 34 and a slightly higher proportion of females (51.6%). A small percentage (1.7%) identify as Aboriginal and Torres Strait Islander. Educational attainment is notably high, with more than half of the population (55.6%) holding a bachelor's degree or higher. In terms of health, around a quarter of adults (23.4%) have one of four key risk factors, while a similar proportion experience long-term health conditions. Additionally, a small percentage of residents (2.9%) require assistance with core activities.
Social capital	In this area, 36.3% of the population speaks a language other than English, with Mandarin (3.5%) and Tagalog (2.5%) being the most common. Notable ancestries include Australian (20.7%), Indian (8.1%), and Chinese (7.1%). Family households make up just under half (49.8%) of all households, while 44.2% are single-person households. The community shows high mobility, with 35.8% of residents having lived at a different address one year ago and 77.4% having moved within the past five years. Volunteering rates are lower (13.1%).
Economic capital	Woden has a median total personal income of \$1,342 per week and a median household income of \$2,075 per week, reflecting moderate economic capital. Housing costs are also moderate, with the lowest median mortgage repayments at \$1,608 per month and a median rent of \$440 per week. Financial stress from mortgages is moderate (7.7%), while rent stress is relatively high (21%), indicating housing-related financial pressures. Woden has a high labour force participation rate (79.5%) and a low unemployment rate (3.4%). Key industries include Central Government Administration (19.4%) and Computer System Design (3.3%), with most residents working in Professional (38.6%) and Clerical and Administrative (14.3%) roles.
Physical capital	The area has a lower proportion of home ownership, with only 13.9% of properties owned outright and 34.8% owned with a mortgage, while rented properties account for nearly half (49.4%) of all housing. Most occupied private dwellings are flats or apartments (67%), with 32.8% being semi-detached, row, or terrace houses. The average household size is smaller, at 1.9 people. A significant portion of the working population walks to work (13.1%), and 9.9% use the bus, while the majority (56.5%) either drive or are passengers in a car.

Capital	Summary
Natural capital	The natural capital of the area includes key green spaces like Eddison District Park, Woden Town Park, and the Mount Taylor Nature Reserve, providing residents with access to nature and outdoor activities. These areas offer lifestyle benefits such as parks, gardens, and picnic spots for relaxation and recreation. Additionally, the community enjoys facilities for activities like skateboarding, enhancing the area's appeal for diverse age groups and active lifestyles.

Social infrastructure

Social infrastructure comprises social services or facilities that are used for the physical, social, cultural, or intellectual development or welfare of the community. Social infrastructure within a 500 m buffer of the Woden precinct's area of social influence is shown in Figure 18-24.

The Woden precinct's social infrastructure includes parks, open spaces, playgrounds, sports playing fields, medical centres, education and research institutions, libraries, places of worship, swimming pools, cemeteries commercial/shopping centres, and law and emergency services facilities.



18.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for those living, working in or visiting the Woden precinct is provided in Table 18-41. Socioeconomic impacts within the Woden precinct would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The people most likely to be affected by change in this precinct would include those living in the area, childcare centres, schools, and workplaces such as businesses and offices where people spend significant time daily. This precinct is also currently undergoing urban renewal with new developments such as the CIT Woden campus and a new public transport interchange enhancing connectivity.

Participants in consultation activities for the precinct (which are described in Chapter 4 (Stakeholder and community consultation)) indicated that construction noise and vibration and traffic disruption are key community concerns. Participants cited recent experience of construction noise impacts in the precinct and expressed concern with early morning and night-time works. A high proportion of consultation participants in this precinct indicated concern over existing traffic congestion and the cumulative impacts of other construction projects in the precinct with light rail construction perceived to exacerbate these delays (refer further to Chapter 20 (Cumulative impacts) for detail on potential cumulative impacts of the Project and other projects).

Although some construction impacts remain rated as medium even after mitigation, impacts are predominantly of low significance (once mitigated) and temporary. Impacts would be minimised through the implementation of the mitigation measures identified in Table 18-41 and Chapter 21 (Environmental management and mitigation measures).

Table 18-41 Socioeconomic impacts during construction – Woden precinct

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
<p>Health and wellbeing</p> <p>Disruptions to local amenity during construction, potentially leading to a decline in health and wellbeing affecting workers, visitors, and residents. This may particularly affect people with disabilities or chronic illnesses.</p> <p>Changes to local amenity to this precinct are assessed further in Section 18.1.2, Section 18.3, and Section 18.6(in relation to traffic, noise and visual impacts, respectively).</p>	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Medium (possible/moderate)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>Decline in accessibility to business and services due to temporary loss of parking during construction, including on-street parking on Irving Street and Spoering Street, and around 380 off-street spaces (and 11 motorcycle parking spaces) in the Easty Street, Phillip Oval, and Spoering Street car parks where construction compounds are proposed.</p>	High (likely/moderate)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking 	Medium (possible/moderate)

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation approach	Mitigated impact (likelihood/magnitude)
Further detail on transport and access impacts within this precinct is provided in Section 18.1.2.		<ul style="list-style-type: none"> Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) A public awareness campaign of possible disruption to the transport network during construction, and promote alternative travel arrangements (as part of the Community Engagement Strategy) 	
<p>Landscape and visual changes</p> <p>Changes to visual aesthetics and views would occur within the precinct however, large portions of the Woden Town Centre are under construction at present.</p> <p>Further detail on impacts to heritage and visual landscape in this precinct is provided in Section 18.5 and 18.6, respectively.</p>	Low (possible/minor)	<ul style="list-style-type: none"> Implementation of heritage and landscape and visual mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) Use of high quality construction hoarding (wherever possible) with consideration given to the potential for local public art or heritage interpretation, to manage visual impacts and enhance community connection (refer to landscape and visual measures in Chapter 21 (Environmental management and mitigation measures)) 	Very low (unlikely/minor)

18.7.3 Potential impacts – operation

A summary of the potential socioeconomic impacts of operation of the Project for those living, working in or visiting the Woden precinct is provided in Table 18-41. Socioeconomic impacts within the Woden precinct would be common to both alignment options.

Table 18-42 identifies socioeconomic impacts and evaluates the likelihood and magnitude of these impacts before and after the implementation of proposed mitigation measures. Where the impact is beneficial, this has been noted in Table 18-42. For beneficial impacts, measures which would enhance Project benefits have also been considered. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

During consultation activities for the Woden precinct, most consultation participants indicated benefits of light rail including alternatives to car travel and potential to improve the visual amenity of the landscape through tree planting and urban design.

Table 18-42 Socioeconomic impacts during operation – Woden precinct

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
Landscape and visual changes Improvements to the aesthetic value of the area by creating attractive and active public spaces centred around light rail stops, that reflect the character of the surrounding area. Changes to the landscape and visual environment in this precinct are detailed in Section 18.6.	Beneficial (likely/ positive)	<ul style="list-style-type: none"> Continued implementation of design principles and guidance documented in the Public Domain Master Plan, would contribute to creating good public spaces and a high-quality experience for light rail users 	Beneficial (likely/ positive)
Disruptions to the road network and parking - impacts to accessibility for businesses, services, and workplaces Decline in accessibility to business and services due to permanent loss of parking, including off street spaces. This includes the removal of 50 public parking spaces at the Phillip Oval car park and 33 spaces (and six motorcycle spaces) at the Spoering Street car park. Impacts to parking are detailed in Section 18.1.2.	Low (possible/ minor)	<ul style="list-style-type: none"> Implementation of operational traffic and transport mitigation measures, measures to minimise accessible parking loss and optimise the interface between the Project and other transport modes (refer to measures TT8, TT9, and TT10 in Chapter 21 (Environmental management and mitigation measures)) Continued engagement with local businesses via the Community Engagement and Social Management Plan (refer to Appendix L (Environmental Management Plan outline)) 	Very low (unlikely/ minor)
Operational noise Potential decline in social amenity and ability to experience services due to operational rail noise impacts. Further detail on noise and vibration impacts in this precinct are detailed in Section 18.3.	High (likely/ moderate)	<ul style="list-style-type: none"> Implementation of operational noise and vibration mitigation measures identified in Chapter 21 (Environmental management and mitigation measures) to review and minimise potential operational noise impacts 	Medium (possible/ moderate)

Description of impact	Pre-mitigation impact (likelihood/magnitude)	Mitigation or enhancement approach	Mitigated impact (likelihood/magnitude)
<p>Access and mobility</p> <p>Enhanced accessibility and safety for pedestrians and cyclists, including those with mobility constraints, through safety-related changes to active travel (e.g. enhanced active travel connection along Yarralumla Creek).</p> <p>This includes shared paths and two new pedestrian and cyclist bridges. Refer to Section 5.8 of Chapter 5 (Project description) for further detail on active travel arrangements.</p>	<p>Beneficial (Likely/positive)</p>	<ul style="list-style-type: none"> Implementation of a public awareness campaign to promote understanding of new arrangements and interactions between cars, bicycles and pedestrians with light rail during operation (refer to measures SE1 and TT5 in Chapter 21 (Environmental management and mitigation measures)) 	<p>Beneficial (likely/positive)</p>

18.7.4 Precinct specific management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage socioeconomic impacts, that are applicable to the Project as a whole.

No further precinct-specific measures have been identified for socioeconomic impacts at the Woden precinct.

19.0 Mitchell Depot site

This chapter provides an assessment of potential impacts during operation and construction that relate to the Mitchell Depot site and identifies mitigation measures to address these impacts. Environmental issues assessed in this chapter include:

- Traffic and transport (Section 19.1.2)
- Noise and vibration (Section 19.3)
- Biodiversity (Section 19.4)
- Historic heritage (Section 19.5)
- Landscape character and visual amenity (Section 19.6)
- Socioeconomic impacts (Section 19.7).

The assessment of some aspects of traffic and transport, biodiversity, historic heritage, and socioeconomic impacts are applicable to the Project as a whole. These aspects have also been assessed in Chapter 11 (Project-wide issues).

Some additional environmental issues relevant to this site have been considered at a Project-wide level only in Chapter 11 (Project-wide issues), as the potential impacts and management approach associated with the issue are applicable to the Project as a whole.

19.1 Overview

The Mitchell Depot is used as a stabling, operational control and maintenance area for the existing Light Rail network. The Mitchell Depot has recently been adjusted to support an additional five light rail vehicles for the approved LRS2A. To meet the Project's operational requirements, further adjustments to the Mitchell Depot would be required to support up to 12 additional light rail vehicles (LRVs).

The Mitchell Depot site would be extended to include an additional land parcel to the north (adjoining Sandford Street) to accommodate additional staff, contractor and visitor parking, and covered storage. New stabling roads would be provided within the Mitchell Depot for the additional LRVs.

An overview of the proposed adjustments to the Mitchell Depot is shown in Figure 19-1. Section 5.10.7 includes further details of the proposed adjustments to the Mitchell Depot.

19.1.1 Key construction activities

Construction activities are considered at a Project-wide level within Chapter 6 (Construction). Key construction activities within the Mitchell Depot site are described in Section 6.3.8 and would include earthworks and constructing soil retaining structures, drainage, and installing new stabling track, turnouts and buffer stops.

Construction compounds within the Mitchell Depot site would include Compound I1 (Sandford Street, north of the existing Mitchell Depot site) and Compound I2 (within the existing Mitchell Depot site). The location of these compounds is shown in Figure 6-4 in Chapter 6 (Construction).



Figure 19-1 Mitchell Depot site overview - both alignment options

19.1.2 Environmental impact overview – construction

Key impacts within the Mitchell Depot site from the construction of the Project are summarised below, and assessed in further detail in this chapter.

Biodiversity

The Project design has been developed with the aim of avoiding direct and indirect impacts to Matters of National Environmental Significance (MNES) and other biodiversity values in the landscape by minimising the construction footprint. Despite this, some clearing of native vegetation and habitat for species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Nature Conservation Act 1992* (ACT) (NC Act) would be required to construct and operate the Project. This would include a total of 1.44 hectares of vegetation within the Mitchell Depot site, 0.66 hectares of which is characterised as native. Removal of this vegetation would impact foraging habitat for the Gang-gang Cockatoo (*Callocephalon fimbriatum*) (endangered under the EPBC Act and NC Act) and Superb Parrot (*Polylepis swainsonii*) (vulnerable under the EPBC Act and NC Act); and breeding and foraging habitat for the Diamond Firetail (*Stagonopleura guttata*) (vulnerable under the EPBC Act and NC Act). Four mature native trees, which provide suitable breeding and/or foraging habitat for woodland birds, have also been identified in the proposed clearance footprint for the Project.

Opportunities to further avoid or minimise biodiversity impacts, and to enhance habitat and connectivity through Project landscaping would be considered through ongoing design development. A Biodiversity Offset Strategy has been developed for the Project to manage residual impacts which are unable to be avoided, and would be updated to reflect any further avoidance or minimisation of biodiversity impacts achieved through ongoing design development.

Other impacts

Other potential construction environmental impacts identified in this chapter are outlined below:

- **Traffic and transport:** No changes to kerbside uses, local vehicle access or property access would occur during the construction phase. Broader construction-related traffic and transport impacts have been assessed at a Project-wide basis, in Section 11.1.2 of Chapter 11 (Project-wide issues). During construction, five off-street car parking spaces would be temporarily lost, however these spaces are all private car parking spaces which support the existing operational activities at the Mitchell Depot
- **Noise and vibration:** Due to the distance between the Mitchell Depot site and sensitive residential receivers, construction noise and vibration levels are not predicted to exceed any criteria for both day- and night-time criteria. This is due to the level of acoustic shielding provided by industrial buildings surrounding the Mitchell Depot site
- **Landscape character and visual amenity:** While there would be some visual changes because of the Project, these would be contained within an existing private site and would generally be visually recessive. As such, the magnitude of change to the existing Depot during construction would be negligible. No night works would be required at this site, and any temporary lighting required for security of construction compounds would be consistent with existing lighting of the site
- **Socioeconomic:** Negligible impacts to health and wellbeing and accessibility for businesses, services and workplaces would occur as a result of works at the Mitchell Depot site, due to the existing character of the area as a predominantly industrial and commercial hub, without any well-established residential areas or a significant resident population
- **Heritage:** There would be no impacts expected to First Nations or historic heritage during construction of the Project at the Mitchell Depot site.

Environmental management and mitigation measures proposed to address the impacts of the Project are detailed in Chapter 21 (Environmental management and mitigation measures).

For construction related impacts, a Construction Environmental Management Plan(s) (CEMP) would be prepared as a framework for environmental management, including several sub plans (such as a noise and vibration and traffic and transport management plans) and mitigation measures. An Environmental Management Plan outline (addressing construction and operational aspects) has been developed for

the Project to guide the development of the CEMP(s) and sub plans, and is included as Appendix L (Environmental Management Plan outline).

19.1.3 Environmental impact overview – operation

Key impacts at the Mitchell Depot site during the operational stage of the Project are summarised below, and assessed in further detail throughout this chapter:

- **Traffic and transport:** Considering the large distance between the Project and the Mitchell Depot, the Project is not expected to impact the road network performance near the Mitchell Depot site. Broader operational impacts have been assessed at a Project-wide basis in Section 11.2.2 of Chapter 11 (Project-wide issues). An additional 40 car parking spaces would be provided as a part of the Project to accommodate the parking demand for any future potential staffing increases at the Mitchell Depot
- **Noise and vibration:** Proposed adjustments to stabling at Mitchell Depot may increase the noise from these activities by up to 2 dB, which would be imperceptible to the average listener. Given the large distances to the closest residential receivers, no change in noise level would be perceptible at those receivers. The likelihood of adverse noise and vibration impacts from the operation of the additional parking area at the Mitchell Depot would also be low given the site's proximity to residential receivers
- **Biodiversity:** In addition to direct biodiversity impacts associated with clearing of native vegetation and habitat of protected species (as described in Section 19.1.2), native vegetation and habitat adjacent to the clearance footprint have the potential to experience indirect impacts from the operation of the Project. This could include noise and vibration impacts from light rail operations or increased light pollution on sensitive habitats and species around light rail operations. The risk of fauna strikes with LRVs and over-head wiring at this location would be minimal, as over-head wires and LRVs already operate in this area
- **Landscape character and visual amenity:** There would be no change to the landscape character at the Mitchell Depot site as the changes would comprise an upgrade to existing light rail infrastructure within the Mitchell Depot site, and these upgrades would be consistent with current operational works that are already carried out at the Mitchell Depot site
- **Heritage:** There would be no impacts to First Nations or historic heritage during the operation of the Project.

19.2 Traffic and transport

This section provides a summarised assessment of the potential multimodal traffic and transport impacts associated with the construction and operation phases of the Project within the Mitchell Depot site. Further detail on the traffic and transport impact assessment is provided in Technical Report 1 – Traffic and transport. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 3 of Technical Report 1 – Traffic and transport. Impacts to traffic and transport for the Project as a whole are discussed in Section 11.1 of Chapter 11 (Project-wide issues).

19.2.1 Existing environment

This section provides an overview of the existing traffic and transport features within the Project area. To understand the existing environment relevant to traffic and transport, the following have been considered: the transport network, road network, public and active transport, and crash history.

Transport network

The existing Mitchell Depot is located at 9 Sandford Street, Mitchell. The Mitchell Depot comprises the administration building, which is used to operate LRS1 and approved for LRS2A, and functions as a stabling and maintenance facility. The Mitchell Depot site has 75 car parking spaces located on-site for use by staff and visitors, with vehicle access provided via an internal access road.

The study area for this assessment is based on the Project area with an additional buffer to incorporate the surrounding road network (the site study area). The existing transport network within the Mitchell Depot site and the respective study area is indicatively shown in Figure 19-2.

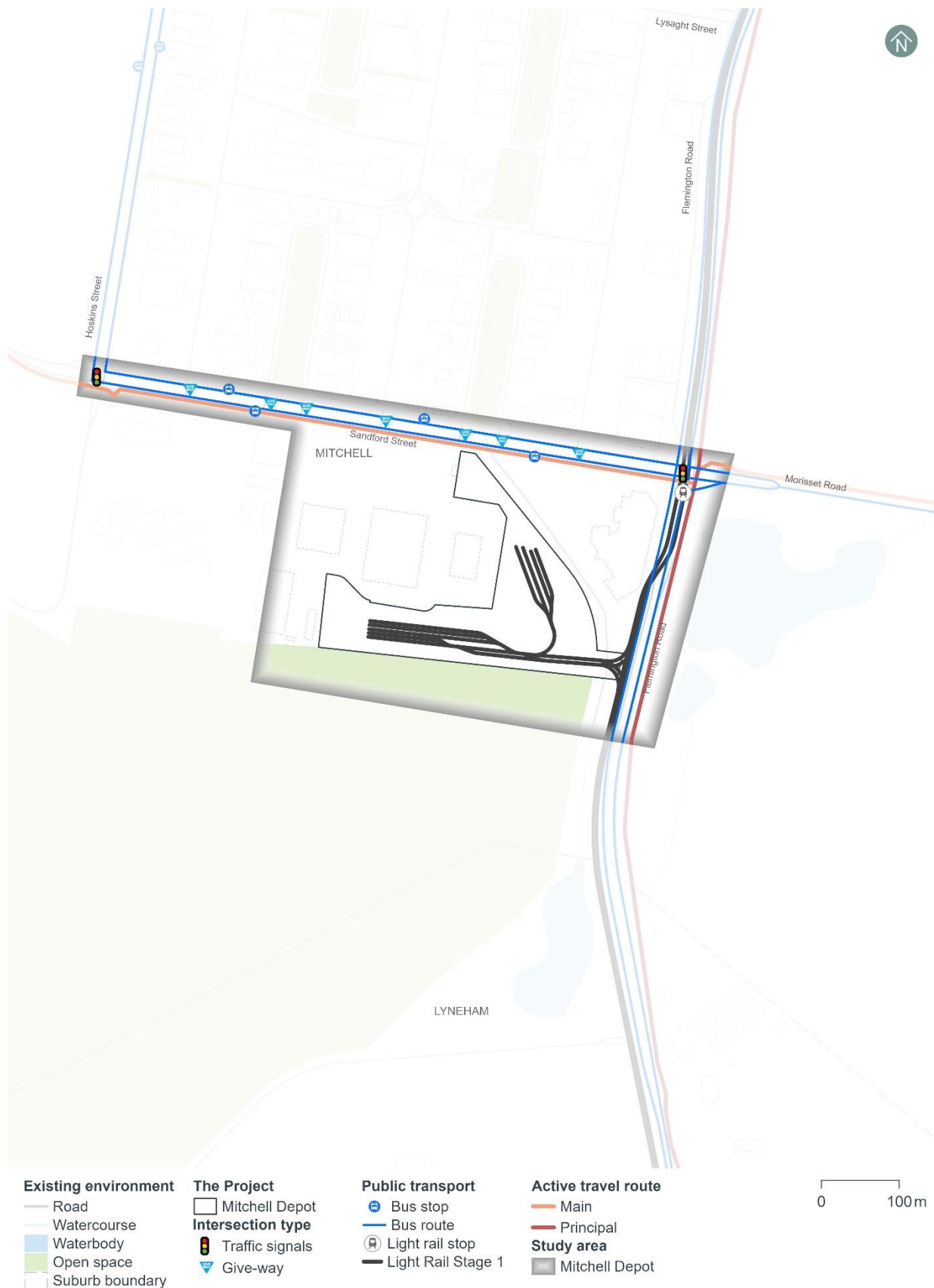


Figure 19-2 Overview of the existing transport network for the Mitchell Depot study area

Road network

Key roads near the Mitchell Depot site include Flemington Road and Sandford Street. The characteristics of these roads are summarised in Table 19-1.

Table 19-1 Overview of key roads near the Mitchell Depot

Road	Classification	Direction	Configuration	Speed limit
Flemington Road	Arterial	Two-way	Two lanes in each direction. Light rail alignment runs along the western side of the road to the south of the Sandford Street Stop and runs along the central median to the north Sandford Street Stop	70 km/h
Sandford Street	Major collector	Two-way	One lane in each direction	60 km/h

Public transport

Bus stops are located along Sandford Street north of the Mitchell Depot site. These bus stops are serviced by the number 18 bus route operated by Transport Canberra and provides connection to Dickson, Franklin, and the Gungahlin Interchange. In addition, the Mitchell Depot site is located immediately adjacent to the light rail Sandford Street Stop, currently providing light rail connections between Gungahlin Place and Alinga Street.

Active travel

Footpaths are provided on both sides of Sandford Street, although the footpath on the southern side is narrow. A shared path is available along the eastern side of Flemington Road. On the western side of the road, a path runs from the Flemington Road/Sandford Street intersection into the Mitchell Depot site.

Signalised pedestrian crossings are provided on all approaches at the Flemington Road/Sandford Street/Morriset Road intersection. The crossings on the southern approach facilitate access to the Sandford Street Stop. A zebra crossing is also located across the left turn slip lane from Morisset Road to Flemington Road.

In addition to the shared path along the eastern side of Flemington Road, on-road cycling lanes are provided along Flemington Road and Sandford Street. These routes are classified as principal cycle routes. There are plans for a future main cycle route along Morisset Road to the east (ACT Government, 2024).

Crash history

Figure 19-3 shows the five year crash history (1 January 2018 to 31 December 2022) within the Mitchell Depot site.

A total of 44 crashes have been recorded within the Mitchell Depot study area during the five year period, including:

- Two crashes that resulted in injury (around 5%)
- 42 crashes that resulted in property damage only (around 95%).

The following common crash types occurred:

- Around 41% of crashes involved a rear end collision
- Around 14% of crashes involved same direction side swipe.



Figure 19-3 Crash data between 2018 and 2022 within the Mitchell Depot study area

Modelling approach

The transport modelling assumptions have adopted the ‘committed and funded expenditure approach’ as per Infrastructure Australia guidance. This approach was agreed in consultation with Treasury and other key stakeholders including TCCS. The ‘committed and funded expenditure approach’ requires that only transport projects identified as ‘committed and funded’ are to be included in the 2031 and 2041 with and without Project scenarios.

As identified in the ACT Infrastructure Plan update – Transport (ACT Government, 2024), project priorities identified beyond the current budget are indicative and may change in response to community preferences, shifts in demand for services and the availability of funding. This means that any projects that might be in planning or may be required to accommodate expected travel demands but have not been identified as ‘committed and funded’ are not included in the traffic modelling for the Project. This is particularly prevalent in the 2041 scenarios during Project operation.

Based on the transport modelling inputs and assumptions presented above, the transport modelling assesses the impacts of the Project in isolation. It does not consider the broader network benefits that may be realised by the implementation of planned (but not committed and funded) transport infrastructure projects.

By not considering other changes to the transport network, the transport modelling presents an absolute worst-case scenario in relation to the performance of the future road network.

19.2.2 Potential impacts – construction

Potential impacts of the construction of the Project on parking and access within the site are summarised in the following sections. Other construction-related impacts have been assessed at a Project-wide basis, where relevant, in Section 11.1.2 of Chapter 11 (Project-wide issues).

Kerbside uses

There would be no changes to any kerbside uses around the Mitchell Depot site during the Project's construction.

Off-street parking

During construction, it is anticipated that the existing security fencing/access gate to the Mitchell Depot car park would be relocated further into the Mitchell Depot site. This would allow construction vehicles to move freely in and out of compound A2 (refer to Chapter 6 (Construction) for compound site locations) without being delayed at the security gate to the car park. The relocation of the car park security gate further east into the car park would result in the temporary loss of around five car parking spaces. These spaces are all private car parking spaces which support the operational activities at Mitchell Depot.

Local vehicle access

There would be no changes to local vehicle access around the Mitchell Depot site during the Project's construction.

Property access

There would be no changes to property access at or around the Mitchell Depot site during the Project's construction.

19.2.3 Potential impacts - operation

Potential operational impacts on the road network, active travel and parking of relevance to the site are summarised in the following sections. Other operational impacts have been assessed at a Project-wide basis, where relevant, in Section 11.2.2 of Chapter 11 (Project-wide issues). The Project would not have impacts on active travel, kerbside use, local vehicle access, or property access.

Road network changes and performance

Considering the large distance between the Project and the Mitchell Depot, the Project is not expected to impact the road network performance near the Mitchell Depot. Some minor staffing increases could be expected at the Mitchell Depot itself, however any potential increase in traffic generated by the site would likely be minor and have a negligible impact on the function of the surrounding road network.

Off-street parking

Around an additional 40 car parking spaces would be provided on the northern side of the Mitchell Depot which would accommodate the parking demand for any future potential staffing increases at the Mitchell Depot. These spaces would be designed in accordance with the dimensional requirements of the Australian Standards for off-street car parking (AS/NZS 2890.1:2004).

19.2.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage traffic and transport impacts, that are applicable to the Project as a whole.

No site-specific measures have been identified for traffic and transport impacts at the Mitchell Depot site.

19.3 Noise and vibration

This section provides an assessment of the describes the potential noise and vibration impacts associated with the construction and operation of the Project at the Mitchell Depot site. Further detail on the noise and vibration impact assessment is provided in Technical Report 9 – Noise and vibration. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 9 – Noise and vibration.

19.3.1 Existing environment

Sensitive receivers

The Mitchell Depot site generally comprises an existing light rail stabling and maintenance depot. Land uses to the north and west of the site are industrial in nature, which would likely have limited sensitivity to noise impacts. A National Archives of Australia site is located to the east of the Mitchell Depot site, at the corner of Sandford Street and Flemington Road. Further east and to the south are open space areas, including the Crace Grasslands Nature Reserve to the south. The nearest residential area is located in Watson, located approximately 1.2 km south-east of the site.

Existing noise levels

The receivers closest to Mitchell Depot are mostly commercial or industrial in nature and were all considered to share a similar ambient noise environment and typical background noise levels.

Unattended background noise monitoring was not conducted for the Mitchell Depot site. The 'R3 – areas with medium density transportation OR some commerce or industry' noise category area, as defined by the *Construction Noise and Vibration Guideline (for Public Transport Infrastructure)* (Transport for NSW, 2023), has instead been used to provide an indication of typical background noise levels. These typical background noise levels are summarised in Table 19-2.

Table 19-2 Typical background noise level for R3 noise category area

Noise category area	Rating background level (L_{A90}), dB(A) ¹	
	Day ²	Night ²
R3	50	40

Notes:

1. dB(A) represents A-weighted decibels, the relative frequency response used in sound measuring instruments.
2. In accordance with the NSW Noise Policy for Industry (NSW Environment Protection Authority, 2017) time of day is defined as follows:
Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
Night – 10 pm to 7 am (Monday to Saturday); 10pm to 8am (Sundays and public holidays)
Evening (not included in table) – the period from 6 pm to 10 pm.

19.3.2 Potential impacts – construction

The following sections present construction noise and vibration assessment results without the application of mitigation measures (referred to as unmitigated). Measures in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline) would be implemented to manage these potential impacts. With the application of these mitigation measures it is expected that the unmitigated impacts would be noticeably reduced or, in some cases, avoided altogether.

Construction noise

Approach

In accordance with Section 29 and Item 16 of Schedule 2 Table 2.3 of the ACT Environment Protection Regulation 2005, construction of light rail or major roads do not require noise to be assessed against specific numerical noise limits as they are not taken to cause environmental harm. Item 16 of Table 2.3 places no conditions on the "Noise emitted in the course of constructing or maintaining a major road, a dedicated bus way, a railway or light rail." Section 9.11 of the Environment Protection (Noise) Environment Protection Policy 2010 provides the following reasoning for the exemption of roadworks, noting that "the construction and maintenance of roads is central to the economic and social well-being of the community."

In the absence of Territory specific quantifiable criteria, the NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) has been used to guide this assessment, as the Project would be of a large scale and occur within a relatively close proximity to noise sensitive receivers.

While construction noise generated by the Project is not required to be assessed against specific numerical noise limits, the derived assessment levels used in this EIS provide an indication of potential noise impacts to assist in the identification of appropriate mitigation measures, and were based on the

NSW Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009).

The construction noise assessment presents a worst-case assessment which adopts conservative assumptions. For example, the noise model has used the shortest separation distance between worksites and each sensitive receiver and has assumed the noisiest equipment would be in use. Actual construction noise levels experienced by receivers would generally be lower than the construction noise predictions. Modelling assumptions are discussed further in Technical Report 9 – Noise and vibration.

Scenarios

The following construction scenarios have been modelled as a part of the noise and vibration impact assessment for the Mitchell Depot site:

- Construction compound site establishment
- Mitchell Depot adjustment works.

Construction activities for the Project would be undertaken between the hours of 7am and 6pm Monday to Saturday (standard construction hours), as far as practicable. As outlined in Section 6.5 of Chapter 6 (Construction), some work would likely be required outside of standard construction hours to minimise disruptions to traffic, minimise disturbance to surrounding landowners and businesses, and/or maintain safe and efficient operation of key roads and public transport facilities. Work proposed outside of standard construction hours would require assessment and approval on a case-by-case basis, as outlined in mitigation measure NV3 in Chapter 21 (Environmental management and mitigation measures).

Construction compound site establishment works have only been assessed for standard construction hours (as defined in the NSW *Interim Construction Noise Guideline* which has been used to guide this assessment), while adjustment works has been assessed as potentially occurring during both standard construction hours and out of hours.

Construction noise scenarios have been categorised into 'peak' and 'typical' works to represent the likely range of potential noise impacts. 'Peak' works represent the noisiest works which require the use of noise intensive equipment such as concrete saws and rock breakers, while 'typical' works represent typical noise emissions from a construction scenario when noise intensive equipment is not in use. Consequently, the 'typical' scenarios would result in a reduced number of noise affected receivers compared to 'peak' scenarios. Where possible, peak works and other high noise generating works would be carried out during standard construction hours. Should high noise impact activities be required to be undertaken outside of standard construction hours, they would be subject to specific controls identified in mitigation measures NV3 and NV4 (refer to Chapter 21 (Environmental management and mitigation measures)).

Construction noise and vibration assessment results

The results of the construction noise and vibration assessment for the Mitchell Depot site indicate the following:

- Construction noise levels are not predicted to cause receivers (including both residential and non-residential buildings) to be moderately or highly noise affected receivers. The nearest residential receivers are located over one kilometre away from the Mitchell Depot site and there is acoustic shielding provided by commercial and industrial buildings surrounding the Mitchell Depot site
- During works at night, no residential receivers are predicted to be moderately or highly noise affected
- Construction vibration impacts are unlikely for works at the Mitchell Depot site, given the distance to surrounding sensitive receivers.

Sleep awakening assessment

A sleep awakening assessment has been carried out using the typical works case for the Mitchell Depot adjustment works scenario, during out of hours. The 'typical' works case has been used as it is assumed that noise intensive equipment (for example concrete saws and rock breakers) used for peak works would not be used during the night.

There are no exceedances of the awakening reaction levels predicted at any residential receivers as a result of the Mitchell Depot adjustment works. This is likely due to the nearest residential receivers being located over 1 km away and the acoustic shielding provided by the industrial and commercial buildings surrounding the Mitchell Depot.

Construction road traffic noise

Construction traffic associated with construction compounds and the Mitchell Depot site would be distributed across the road network. Heavy vehicle movements, which are likely to have the largest noise and vibration impact, would generally be for deliveries of construction plant, supplies and infrastructure, and to transport soil and waste materials.

Gungahlin Drive, Barton Highway and Federal Highway are the main heavy vehicle haulage routes proposed for the Mitchell Depot site. Construction haulage routes are presented in Section 6.7.1 of Chapter 6 (Construction). Peak hourly and average hourly construction traffic volumes for each vehicle type for the Mitchell Depot site is presented in Section 5.13 of Technical Report 9 – Noise and vibration and Section 6.7.2 of Chapter 6 (Construction).

There are residential receivers located in proximity to Barton Highway and Federal Highway. The estimated addition of three heavy vehicle movements in the AM peak and one heavy vehicle movement in the PM peak along each of these roads would not be expected to increase road traffic noise levels by more than 2 dB(A), as these three roads are major roads with existing heavy vehicle movements.

19.3.3 Potential impacts – operation

As described in Section 5.9.6 in Chapter 5 (Project description), proposed adjustments to the Mitchell Depot would include additional parking to the north of the site to accommodate the additional staff, contractor and visitor parking; office accommodation; and two new stabling lanes to accommodate additional LRVs. Given that the exact number of proposed car spaces and details of changes to office accommodation are subject to further design development, and the adjustments would allow for a continuation of the current land uses at the Mitchell Depot, a qualitative noise assessment has been undertaken.

The proposed additional parking area would be located to the north of the existing Mitchell Depot, adjoining Sandford Street. Existing car parks are located to the north, east and west of the additional parking area, which would influence the existing acoustic environment. Land to the north of the Mitchell Depot is also largely industrial in nature.

The Mitchell Depot currently contains six stabling lanes to accommodate 19 LRVs for the existing rail network. Rail noise is generated at the Mitchell Depot from LRVs entering and exiting stabling lanes at low speeds (in line with established speed limits). This activity would likely peak around the start and end of light rail operating hours. The Project would involve the addition of two new stabling lanes and would result in the addition of up to 12 new LRVs to the Light Rail network, that would be stabled at Mitchell Depot. Rail noise generated by the new lanes and LRVs would be similar in nature to existing noise levels. The addition of stabling lanes and LRVs as part of this Project may increase the noise from stabling activities by up to 2 dB.

This level of increase would be imperceptible to the average listener. It is also likely that given the large distances to the closest residential receivers, that no change in noise level would be perceptible at residential receivers, as noise levels at these receivers would be influenced by more localised noise sources.

Given that there are existing car parks in the area and the distance to the closest residential receivers (over one kilometre to the south-east), the likelihood of adverse impacts from the operations of the additional parking area at the Mitchell Depot is low.

The proposed changes to office accommodation may include additional noise sources such as mechanical plant, for example air conditioning units and ventilation fans. The noise emissions from mechanical plant may be treated to achieve environmental noise criteria, through the implementation of acoustic attenuation, if required. Future design development would also continue to seek opportunities to reduce operational noise from the Mitchell Depot where feasible.

19.3.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage noise and vibration impacts, that are applicable to the Project as a whole.

No site-specific measures have been identified for noise and vibration impacts at the Mitchell Depot site.

19.4 Biodiversity

This section describes the potential impacts of the Project on biodiversity within the Mitchell Depot site. Impacts to biodiversity for the Project as a whole are discussed in Section 11.2 of Chapter 11 (Project-wide issues). This section provides a summary of the biodiversity assessment for the Mitchell Depot site.

Further detail on the biodiversity assessment is provided in Technical Report 2 – Biodiversity.

19.4.1 Existing environment

This section provides an overview of the existing environment with respect to biodiversity within the Mitchell Depot site. Some biodiversity characteristics of the Project would extend across multiple precincts and are discussed in Section 11.2 including habitat connectivity, vegetation assessments, threatened fauna habitat, threatened flora, and pest plants.

Habitat connectivity

The Mitchell Depot currently provides no habitat connectivity value for generalist, woodland (and forest) bird species. The site is however adjacent to east-west regional and local links that connect habitat from the Majura Nature Reserve to vegetation in the western edge of the ACT. Recently planted trees within the Mitchell Depot would sit near this regional link and are likely to contribute to improving connectivity, especially for forest and generalist species.

Vegetation assessment

A total of 1.442 ha of vegetation is present within the Mitchell Depot site and is comprised of three vegetation communities. Table 19-3 and Figure 19-4 depict the area and distribution of each vegetation community within the site. A description of these vegetation communities can be found in Section 11.2.1 of Chapter 11 (Project-wide issues).

The vegetation within the Mitchell Depot site includes patches of native tree plantings (some immature as they were recently planted) with an exotic dominated understory, including invasive species such as winter grass (*Poa annua*), capeweed (*Arctotheca calendula*), white clover (*Trifolium repens*), paspalum (*Paspalum dilatatum*), musky crowfoot (*Erodium moschatum*) and smooth catsear (*Hypochaeris glabra*). The site is a highly modified landscape, and site surveys have not recorded shrubs or herbaceous species, leaf litter, or trees with hollows or large crevices.

Table 19-3 Extent of vegetation communities within Project area in the Mitchell Depot site

Vegetation community	Area (ha)
Landscape Plantings – Native	0.66
Landscape Plantings – Exotic	0.002
Exotic grassland	0.78
Total vegetation	1.442

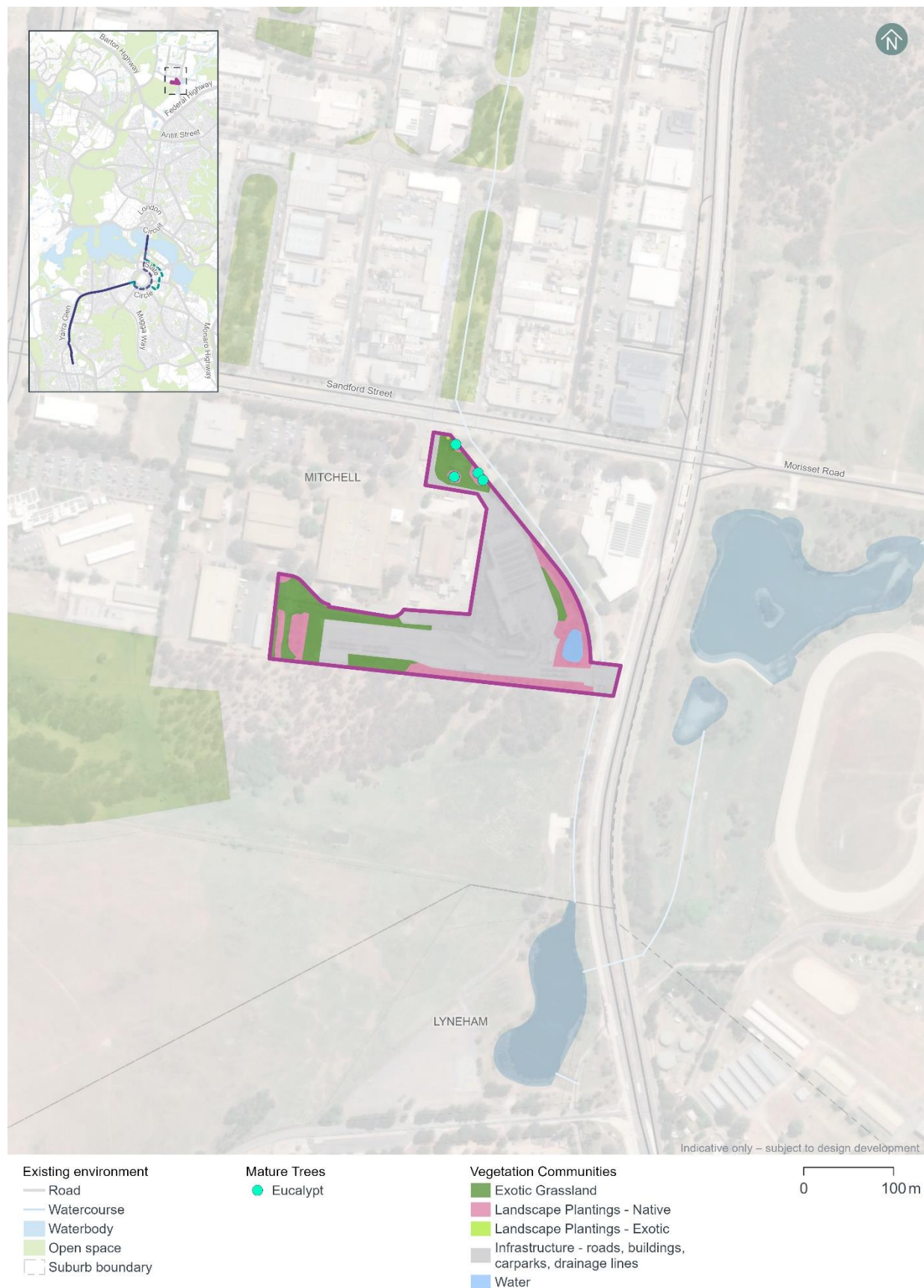


Figure 19-4 Vegetation communities and mature trees in the Mitchell Depot site

Hollow-bearing and mature trees

A total of four mature trees were recorded at the Mitchell Depot site (refer to Figure 19-4) and no hollow-bearing trees were recorded.

Threatened fauna habitat

Threatened fauna field surveys for the Project have been carried out in January 2021, January 2022, and November 2023.

The following section covers two species specific to the Mitchell Depot site. All other species are discussed in Section 11.2.1 of Chapter 11 (Project-wide issues).

Southern Whiteface

The Southern Whiteface (*Aphelocephala leucopsis*) is listed as vulnerable under both the EPBC Act and the NC Act.

Habitat critical to the survival of the Southern Whiteface includes relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both. The area must have a low tree density and an herbaceous understorey and litter cover, which provides essential foraging habitat, and living and dead trees with hollows and crevices which are essential for roosting and nesting (DCCEEW, 2023b).

These attributes are absent from the Mitchell Depot site. The site therefore does not support habitat critical for the survival of the species, and it is unlikely to be present within in or to rely on the site.

Brown Treecreeper

The Brown Treecreeper (*Climacteris picumnus victoriae*) is listed as vulnerable under both the EPBC Act and the NC Act. Habitat critical to the survival for the Brown Treecreeper includes relatively undisturbed grassy woodland with an open native understorey, large living, and dead trees, which are essential for roosting and nesting sites and for foraging, fallen timber, which provides essential foraging habitat, and hollows in standing dead or live trees and tree stumps (DCCEEW, 2023c).

These attributes are absent from the Mitchell Depot site. The site therefore does not support habitat critical for the survival of the species, and it is unlikely to be present within in or to rely on the site.

Other fauna

Other potential threatened fauna habitat identified within the Mitchell Depot site includes the following:

- Gang-gang Cockatoo (listed as endangered under both the EPBC Act and the NC Act) – the Mitchell Depot site supports 0.66 ha of foraging habitat for this species (refer to Figure 19-5)
- Superb Parrot (vulnerable under both the EPBC Act and the NC Act) – the Mitchell Depot site supports 0.66 ha of foraging habitat for this species (refer to Figure 19-5)
- Diamond Firetail (listed as vulnerable under both the EPBC Act and the NC Act.) – 0.66 ha of the Landscape Planting – Native community has been identified within the Mitchell Depot site and may provide suitable habitat for the Diamond Firetail (refer to Figure 19-5).

No habitat was identified in the Mitchell Depot site for the Golden Sun Moth (*Synemon plana*), Swift Parrot (*Lathamus discolor*), Perunga Grasshopper (*Perunga ochracea*), Canberra Raspy Cricket (*Cooraboorama canberra*), Key's Matchstick Grasshopper (*Keyacris scurra*), or Striped Legless Lizard (*Delma impar*).



Figure 19-5 Gang-gang Cockatoo, Superb Parrot, and Diamond Firetail foraging habitat in the Mitchell Depot site

Threatened flora and pest plants

No threatened or rare flora species have been recorded in the Mitchell Depot site. Impacts to threatened or rare flora species are therefore not anticipated.

No pest plant species declared under the *Pest Plants and Animals Act 2005* (PP&A Act) have been recorded in the Mitchell Depot site.

19.4.2 Potential impacts – construction

Vegetation assessment

The following section summarises the potential impacts of the Project on biodiversity as a result of construction at the Mitchell Depot site.

The Project design has been developed with the aim of avoiding direct and indirect impacts to MNES and other biodiversity values in the landscape. Through this process, a clearance footprint has been defined, as shown in Figure 19-6. Vegetation clearing would not be permitted outside this clearance footprint.

Native and non-native vegetation within the clearance footprint is comprised of three communities as summarised in Table 19-4. Only 0.66 hectares of this vegetation is characterised as native, and all of it is landscape planting rather than remnant native vegetation.

Table 19-4 Extent of vegetation communities within the clearance footprint in the Mitchell Depot site

Vegetation community	Area (ha)
Landscape Plantings – Native	0.66
Exotic grassland	0.78
Total vegetation	1.44

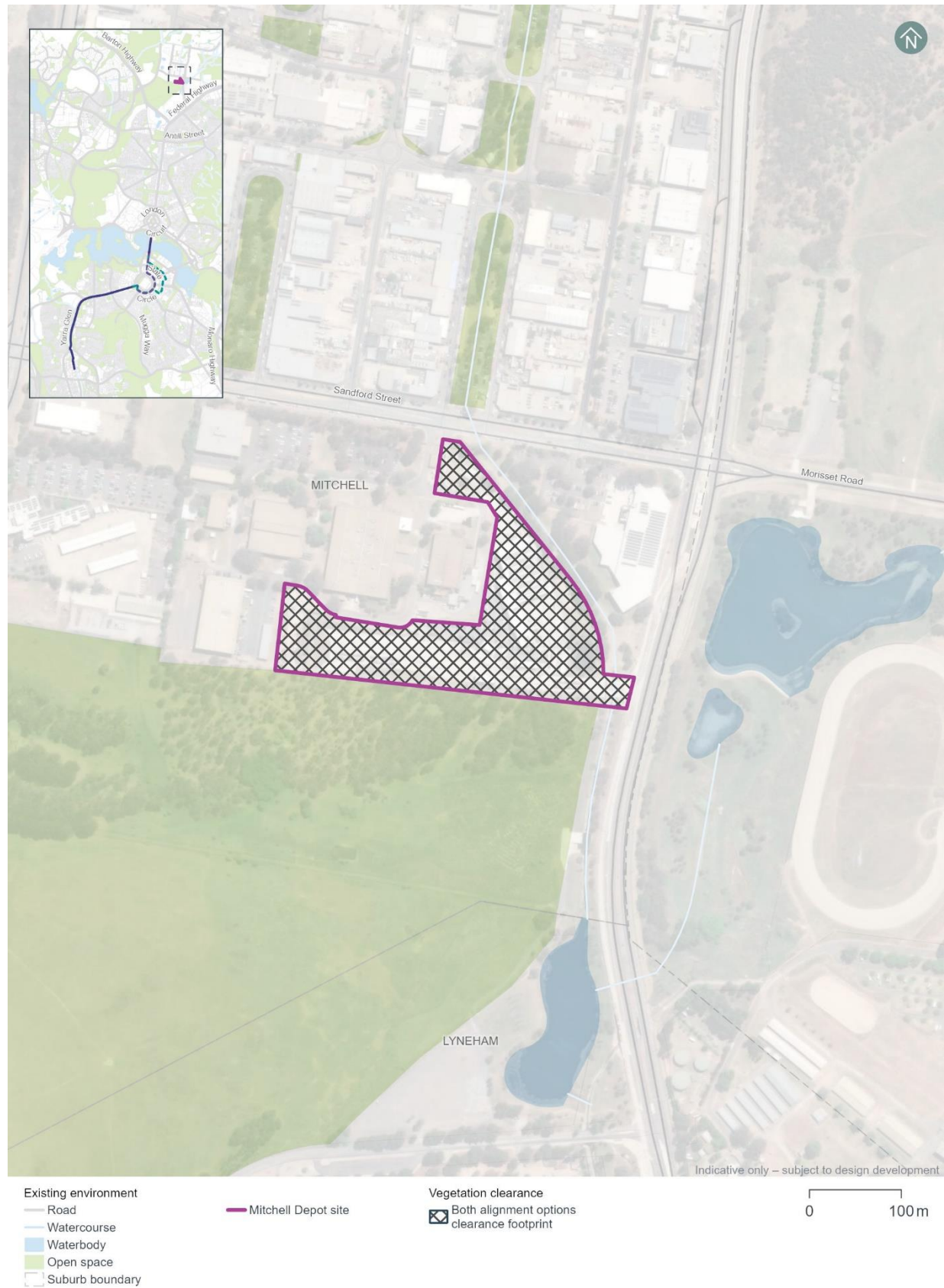


Figure 19-6 Clearance footprint in the Mitchell Depot site

A total of four mature native trees have been recorded within the clearance footprint at the Mitchell Depot site. No hollow-bearing trees have been recorded.

Threatened fauna

Potential impacts on threatened fauna in the Mitchell Depot site include impacts to the following through habitat removal:

- Gang-gang Cockatoo – 0.66 ha of foraging habitat, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Superb Parrot – 0.66 ha of foraging habitat for Superb Parrot, which when taken in total with all clearing required for the Project, has the potential to interfere with the recovery of the species
- Diamond Firetail – 0.66 ha of the Landscape Planting – Native community within the site which may provide suitable habitat for the species.

Due to the presence of a small dam at the Mitchell Depot site, there is the potential for Eastern Long-necked Turtle (*Chelodina longicollis*) to be present. Measures to minimise any potential impacts from the Project on this species would be included in the Construction Environmental Management Plan (CEMP) (refer to Chapter 21 (Environmental management and mitigation measures)). It is unlikely that the Project would significantly impact this species.

No habitat has been identified in the Mitchell Depot site clearance footprint for the Swift Parrot, Perunga Grasshopper, Canberra Raspy Cricket, Key's Matchstick Grasshopper, or Striped Legless Lizard.

Potential impacts on threatened fauna habitat across the whole Project clearance footprint is discussed further in Section 11.2.2 of Chapter 11 (Project-wide issues).

Indirect impacts

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the clearance footprint may be indirectly impacted by the construction works if appropriate management and mitigation measures are not implemented. Management and mitigation measures for biodiversity are discussed further in Chapter 21 (Environmental management and mitigation measures). Potential indirect impacts of construction activities would include:

- Spread of invasive species in the clearance footprint from equipment and machinery
- Noise and vibration impacts on fauna within the vicinity of construction works
- Erosion, sedimentation, and dust impacts on biodiversity values during ground disturbing works
- Waste impacts associated with the storage of fuels and disposal of waste from new equipment and the removal of existing infrastructure
- Increased light pollution on sensitive habitats and species from increased light spill and lighting intensity during construction works
- Fauna strike by construction vehicles within and adjacent to existing roadways.

Further detail on these indirect impacts for construction activities is discussed in Section 11.2.2 of Chapter 11 (Project-wide issues).

19.4.3 Potential impacts – operation

Native vegetation and habitat adjacent to the clearance footprint, and species using air space above the Project have the potential to experience indirect impacts from the operation of the Project, for example:

- Noise and vibration impacts within the vicinity of the alignment, from light rail operations
- Increased light pollution on sensitive habitats and species

Although construction of new over-head wires would occur at the Mitchell Depot site, they already exist in the area and therefore the risk of increased fauna strike with over-head wires would be minimal. These indirect impacts are discussed in detail in Section 11.2.3 of Chapter 11 (Project-wide issues).

19.4.4 Management and mitigation measures

The Project has sought to avoid and minimise impacts to MNES and other biodiversity values in the landscape, including through the development of a minimised clearance footprint within the Project area (refer to Figure 19-6).

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage biodiversity impacts, that are applicable to the Project as a whole.

No site-specific measures have been identified for biodiversity impacts in the Mitchell Depot site.

19.5 Historic heritage

No historic heritage sites have been identified at the Mitchell Depot site. The site is a highly disturbed landscape which holds no archaeological values. Therefore, no impacts to historic heritage at the Mitchell Depot site due to the Project are predicted. Further detail on the heritage impact assessment is provided in Section 2 of Technical Report 3 – Heritage.

19.6 Landscape character and visual amenity

This section provides an assessment of the potential landscape character and visual amenity impacts associated with the construction and operation of the Project within the Mitchell Depot site. Further detail on the landscape character and visual amenity assessment is provided in Technical Report 10 – Landscape character and visual amenity. The methodology applied for the assessment is summarised in Chapter 10 (Assessment methodologies) and Section 2 of Technical Report 10 – Landscape character and visual amenity.

The landscape character assessment describes the physical, cultural and heritage attributes of the landscape, planning designations, and desired character within the site. The assessment of visual impact has considered the impact of change on the views available to people and their visual amenity.

19.6.1 Existing environment

The Mitchell Depot site is located in the light industrial suburb of Mitchell on Flemington Road, approximately 7 km north of the Canberra central business district. The site is bounded by dense vegetation within an undeveloped block to the south, and by Flemington Road to the east. The surrounding landscape includes large areas of rural land with patches of bushland vegetation.

The surrounding light industrial development resides within an open, rural landscape, comprising a wide grid of evenly spaced streets with single storey warehouse buildings surrounded by car parking and scattered areas of turf. Some streets feature wide medians with trees and grassland.

Landscape character

The landscape includes large areas of rural land with patches of bushland vegetation. A distinct pocket of light industrial development lies within the more open, rural landscape, comprising a wide grid of evenly spaced streets with single storey warehouse / factory buildings surrounded by ample car parking and some areas of turf. More major streets within the development include native street trees and some wide medians with trees and grassland. The topography is flat to gently undulating.

Viewpoints

Although no representative viewpoints have been identified at Mitchell Depot site, visual impacts of the Project at the site have been considered, as outlined below.

Night-time lighting

The existing light rail depot at Mitchell features pole top lighting, to prioritise safety and security of the facility and its staff. While the facility is abutting some areas of urban fringe farm land which would be A1: Dark brightness zone based on Australian Standard 4282:2023 (Standards Australia, 2023), the facility itself, the adjacent main roads (Flemington Road and Sandford Road), industrial area and racecourses would be A3: Medium district brightness zone.

19.6.2 Potential impacts – construction

Landscape character impact assessment

Construction activities within the Mitchell Depot site would be temporary and experienced over the short term (up to five years). The construction of the Project would not result in additions or losses of visual elements within the Mitchell Depot site. While there would be changes, these would be contained within an existing private site and would be visually recessive.

As such, the magnitude of change during construction would be negligible within the Mitchell Depot site due to the:

- Small portion of the surrounding area affected
- Changes being characteristic of the area
- Contained nature of the changes within the Mitchell Depot site.

This would result in a negligible impact on landscape character during construction.

Visual impact assessment

The Project would require adjustments to the existing stabling and maintenance area at the Mitchell Depot site to increase storage and maintenance space for additional light rail vehicles (LRVs). Construction activities associated with this work are unlikely to affect visual amenity in the area due to:

- Land use at and around the Mitchell Depot site
- Limited public access, and construction activities generally not within view of potential receivers
- The location of the Mitchell Depot site, which lies within a light industrial area and potential construction visual impacts would be screened by surrounding trees and vegetation.

Night-time visual impact assessment

No night works would be required at this site. Temporary lighting may be required within the construction compounds for safety and security. Construction compounds within the Mitchell Depot site would be located:

- On Sandford Street in Mitchell
- Within the existing Mitchell Depot site.

This lighting would be consistent with the existing lighting of the site to minimise light spill, particularly to adjacent vegetated areas. The additional lighting would result in no perceived change in the amenity of this area, resulting in a **negligible** impact at night.

19.6.3 Potential impacts – operation

Landscape character impact assessment

The assessment of landscape effects considers how the Project would impact the landscape more broadly. It is based on the landscape's sensitivity to change and the expected scale of change. Table 19-5 summarises the anticipated changes and potential impacts of the Project on landscape character.

Table 19-5 Landscape character impact assessment summary in the Mitchell Depot site – both alignment options

Alignment option	Anticipated change	Impact rating
Both alignment options	The changes due to the Project include the upgrade of facilities within the Mitchell Depot site. The magnitude of change experienced at this viewpoint would be negligible. There would be no change to the landscape character due to the Project in the Mitchell Depot site. The changes would comprise upgrade to existing light rail infrastructure within the Mitchell Depot site. This combined with a low sensitivity rating would make the overall impact on landscape character is negligible.	Sensitivity: Low
		Magnitude: Negligible
		Overall impact: Negligible
		Qualitative rating: Neutral

Visual impact assessment

Changes due to the Project are unlikely to be visible to visual receptors outside the Mitchell Depot site. If changes to the Mitchell Depot site are visible, they would comprise an upgrade of existing light rail infrastructure within an existing facility. These upgrades would be consistent with current operational (including maintenance) works that are already carried out at the Mitchell Depot site and would therefore result in low to negligible visual change.

Night-time visual impact assessment

The Project would extend the existing lighting network within the Mitchell Depot site. This would slightly increase the lighting spill to adjacent properties and vegetation areas, however, would be consistent with the existing character of the light rail depot facility. The night-time visual impact during operation for the Mitchell Depot site would be **negligible**.

19.6.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage landscape character and visual amenity, that are applicable to the Project as a whole.

No site-specific measures have been identified for landscape character and visual amenity impacts at the Mitchell Depot site.

The Public Domain Master Plan (Appendix I) identifies design principles and guidance for the Project. These principles would be applied to the Project through ongoing design development and would contribute to management and mitigation of landscape and visual impacts of the Project during operation.

19.7 Socioeconomic

This section describes the potential socioeconomic impacts of the Project within the Mitchell Depot site. Further detail on the socioeconomic assessment is provided in Technical Report 6 – Socioeconomic. The methodology applied for this assessment is summarised in Chapter 10 (Assessment methodologies) and discussed in detail in Section 4 of Technical Report 6 – Socioeconomic.

19.7.1 Existing environment

The social area of influence encompasses the geographical extent of a project's potential impacts on people, including how positive and negative impacts may be reasonably perceived or experienced by different people. The Mitchell Depot site is situated within the Mitchell SA2, which has been analysed to provide insight into the social area of influence for the site.

The characteristics of the communities within the area of social influence is described as the social baseline. The social baseline has been analysed by considering the human, social, economic, physical, and natural capital present around each precinct, the corridor and the ACT. Capital refers to various forms of resources that contribute to the wellbeing, sustainability, and resilience of a community.

The Mitchell Depot site is located within a predominantly industrial and commercial hub. The suburb of Mitchell does not have well established residential areas or a significant resident population. As such, its primary function is to offer various business and trade services to the community, rather than serving as a residential neighbourhood. The 2021 ABS Census indicates that seven people live in four private dwellings in this SA2, and as such demographic trends have not been quantified as part of the social baseline. The Mitchell Depot site is situated close to natural assets, including the Gungaharra Grasslands Nature Reserve and Crace Nature Reserve.

19.7.2 Potential impacts – construction

A summary of the potential socioeconomic impacts of the Project's construction for within the vicinity of the Mitchell Depot site is provided in Table 19-6. Socioeconomic impacts would be common to both alignment options.

The significance of each impact has been evaluated taking into account its likelihood and magnitude, both before and after the implementation of proposed mitigation measures. The assessment approach is described further in Chapter 10 (Assessment methodologies) and Section 4 of Technical Report 6 – Socioeconomic.

The site is surrounded by light industrial areas to the north and west, dense vegetation to the south, and Flemington Road to the east. Changes to the Mitchell Depot site (including new stabling lanes, office accommodation, storage and parking areas) have the potential to impact those working in surrounding industrial and commercial businesses. However, with the implementation of the mitigation measures identified in Table 19-6 and Chapter 21 (Environmental management and mitigation measures), the socioeconomic impacts of construction at the Mitchell Depot would be negligible.

Table 19-6 Socioeconomic impacts during construction – Mitchell Depot site

Description of impact	Pre-mitigation impact (likelihood/ magnitude)	Mitigation approach	Mitigated impact (likelihood/ magnitude)
<p>Health and wellbeing</p> <p>Disruptions to social amenity during construction, potentially leading to a decline in health and wellbeing, especially affecting individuals with disabilities or chronic illnesses.</p> <p>Further detail is provided in Section 19.1.2, Section 19.3, and Section 19.6 (in relation to traffic, noise, and visual impacts, respectively).</p>	Negligible (unlikely/ minor)	<ul style="list-style-type: none"> Implementation of the Construction Environmental Management Plan (CEMP), Transport Management Plan, Noise and Vibration Management Plan, Dust Management Plan, as well as traffic, noise and visual impact mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plans Proactive, clear and inclusive communication through the implementation of a Community Engagement Strategy (refer to measure SE1 in Chapter 21 (Environmental management and mitigation measures), and Appendix L (Environmental Management Plan outline)) Implementation of a process to manage public grievances, that enables issues to be followed up and implementation of corrective treatments if required (refer to measure SE2 in Chapter 21 (Environmental management and mitigation measures)) 	Negligible (unlikely/ insignificant)
<p>Disruptions to the road network and parking – impacts to accessibility for businesses, services, and workplaces</p> <p>There would be no changes to kerbside uses, off-street parking, local vehicle access, or property access during the Project's construction.</p> <p>Further detail on transport and access impacts within this site is provided in Section 19.1.2.</p>	Negligible (unlikely/ insignificant)	<ul style="list-style-type: none"> Implementation of the construction Transport Management Plan, and traffic management and mitigation measures identified in Chapter 21 (Environmental management and mitigation measures). Appendix L (Environmental Management Plan outline) provides an overview of the proposed management plan This includes measures to maintain accessible parking spaces, and to review options for shuttle services and/or parking restrictions around the Project area to manage potential impacts of construction worker parking 	Negligible (remote/ insignificant)

19.7.3 Potential impacts – operation

During the operation of the Project, the Mitchell Depot would continue to be used for light rail stabling and maintenance activities. No socioeconomic impacts associated with the operation of the Project at the Mitchell Depot site have been predicted.

19.7.4 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational mitigation measures to manage socioeconomic impacts, that are applicable to the Project as a whole.

No site-specific measures have been identified for socioeconomic impacts at the Mitchell Depot site.

20.0 Cumulative impacts

This chapter provides an assessment of the potential cumulative and facilitated impacts of the Project with other nearby developments.

20.1 Cumulative impacts defined

Cumulative impacts have the potential to occur when benefits or impacts from a project overlap or interact with those of other projects, potentially resulting in a larger overall impact (positive or negative) on the environment or local communities. Cumulative impacts may occur when projects are constructed or operated concurrently or consecutively.

The extent to which another development or activity could interact with the construction and/or operation of the Project would depend on the scale, location and/or timing of the development or activity. Generally, cumulative impacts would be expected to occur where other long-duration or large magnitude construction activities are undertaken close to, and over a similar timescale to, construction activities for the Project; or where consecutive construction occurs in the same area. Additionally, operation of the Project could cause cumulative benefits when the Project interacts with or possibly enhances the benefits of other Projects.

20.2 Assessment approach

The cumulative impact assessment methodology for the Project included:

- Identifying relevant developments that could be included in the cumulative impact assessment
- Applying screening criteria to determine which developments should be included in the cumulative impact assessment
- Assessing the potential cumulative impacts of the projects screened into the cumulative impact assessment, including identification of relevant issues likely to have material cumulative impacts during construction and/or operation of the Project (e.g. traffic, noise and vibration, landscape character and visual amenity, etc.)
- Identifying suitable mitigation measures to manage potential cumulative impacts.

The Cumulative Impact Assessment Guidelines for State Significant Projects (DPIE, 2022) has been adopted in the absence of Territory specific qualitative criteria.

A summary of the cumulative impact assessment methodology is shown on Figure 20-1.



Figure 20-1 Summary of cumulative impact assessment methodology

20.2.1 Criteria for inclusion of potential projects

Potential projects identified for consideration in the cumulative impact assessment included those that met the following criteria for inclusion:

- Spatially relevant (i.e., where a development is considered to overlap with or occurs in close proximity to the Project)
- Timing (i.e., the expected timing of its construction and/or operation overlaps or occurs consecutively to construction and/or operation of the project)

- Scale (i.e., large-scale major development or infrastructure projects that have the potential to result in cumulative impacts with the Project, as listed on the Infrastructure Canberra (iCBR) and other ACT Government websites. Minor developments such as alterations to residential properties for example, were not included due to the nature and limited extent of those developments to interact cumulatively with the Project)
- Status (i.e., projects in development with sufficient publicly available information to inform this environmental impact statement and with an adequate level of detail to assess the potential cumulative impacts).

20.2.2 Projects included in, or excluded from the cumulative impact assessment

Projects identified and considered in the cumulative impact assessment are listed in Table 20-1. This table identifies construction and operational timeframes for each project (where known) considered in the cumulative impact assessment and how these overlap with the Project. Subject to planning approval and procurement, construction of the Project is anticipated to commence in 2029 and would take about four to five years to complete. The first passenger services are proposed to start in 2034.

The developments in Table 20-1 were identified as meeting the screening criteria at the time of the assessment. As noted in Section 20.2.1, projects have been screened out if insufficient project and environmental assessment information is publicly available.

Several large-scale infrastructure projects and developments within 1km of the Project area have been screened out from the cumulative impact assessment for the Project, primarily due to their planned timeframes for construction and operation. Developments anticipated to be in operation before the start of this Project's construction phase were excluded from further analysis because they would not overlap with the Project's construction timeline and thus would not generate cumulative construction impacts. Without concurrent construction periods, the potential for interaction between these projects and this Project would be minimised, removing the likelihood of compounded effects. As a result, these operational projects were not considered further in the cumulative impact assessment. Key projects screened out for these reasons include:

- National Security Office Precinct (Block 5 Section 1 Barton)
- Commonwealth Avenue Bridge Renewal Project
- CIT Woden Youth Foyer
- CIT Woden Education Campus
- Woden Interchange
- Southern Cross Club Build-to-Rent project.

These developments were assumed to be operational in relevant environmental assessments in Chapter 12 (Commonwealth Avenue precinct) to Chapter 19 (Mitchell Depot site), with traffic generated from their operations accommodated in the strategic traffic model.

As part of the revised, final Environmental Impact Statement (EIS), the cumulative impacts of the Project would be reassessed and would consider any new publicly available information that has been made available since the preparation of this assessment. Prior to the commencement of construction, proponents of other projects in the area would be identified and engaged with to understand potential cumulative impacts and coordinate mitigation and management (refer to mitigation measure CU1 in Section 20.7).

Table 20-1 Projects screened in for the cumulative impact assessment

Project, status and indicative timing	Description of the project	Location relative to the Project	Precincts where cumulative impacts may occur
Acton Waterfront – future city neighbourhood Status: Currently in planning and development Timing: Unknown	<p>A masterplan is currently in development for a city neighbourhood connecting the city to the lake immediately adjacent to Ngamawari. This would be located on the area behind the park and feature a proposed mix of shops, businesses, cafes, recreational activities, and residential accommodation. This area would be located immediately west of the approved Light Rail Stage 2A (LRS2A) Commonwealth Park Stop.</p> <p>Planning and consultation for the proposed Acton Waterfront neighbourhood commenced in October 2022, with a concept masterplan developed in 2023. The creation of an estate development plan is currently underway (City Renewal Authority, 2024).</p> <p>The Acton Waterfront – future city neighbourhood differs from the Acton Waterfront Development 'Ngamawari' public park Stage 1A (interim works) and Stage 1B (permanent works), which are planned to complete construction prior to construction of this Project, and were therefore screened out of this assessment.</p>	Acton Waterfront, northern foreshore of Lake Burley Griffin, immediately west of the approved Commonwealth Park Stop	Commonwealth Avenue
Signage in the National Triangle Status: Unknown Timing: Unknown	<p>This project is planned by the National Capital Authority (NCA) and involves upgrading the existing red vehicular directional and interpretive signage to improve the aesthetic across the National Triangle. The new signage would incorporate the new National Triangle branding and update the content of the signage. While the scale of this project is relatively minor, it has been included due to its potential contribution to visual impacts in a highly visually sensitive area (the National Triangle).</p>	Throughout the National Triangle precinct	National Triangle

Project, status and indicative timing	Description of the project	Location relative to the Project	Precincts where cumulative impacts may occur
Canberra Brickworks Redevelopment Status: Development application submitted Timing: Construction expected to commence in 2025, however planned completion is unknown	The Canberra Brickworks Redevelopment is planned to consist of parkland, residential, commercial and retail uses. The redevelopment would provide a maximum of 380 residential dwellings, including low density houses, terraces and apartment buildings, up to a maximum height of three storeys.	Around 500 m north of the Project area on Yarra Glen near Cotter Road (Blocks 1,7 and 20 Section 102, Division of Yarralumla)	Inner South Yarra Glen
North Curtin Residential Area and Diplomatic Estate Status: Planning underway, with Amendment 95 to the National Capital Plan (to enable to the development) approved by the Minister Timing: Unknown	The North Curtin Residential Area and Diplomatic Estate proposes 1,300 new dwellings, and seeks to accommodate the long-term growth in diplomatic missions in Australia's national capital.	Immediately west of the Project area on Yarra Glen near Cotter Road (Block 4, Section 106 and Block 5, Section 121, Division of Curtin)	Yarra Glen
Matilda Street car park redevelopment Status: Currently in planning and development Timing: Construction expected to commence in 2026/2027 however planned completion is unknown	The existing Matilda Street car park site is proposed for land release and future mixed use development. The planned redevelopment includes a mixed-use development with 200 dwellings.	Immediately west of the Woden Interchange (Block 1, Section 7, Division of Phillip)	Woden
Hellenic Club redevelopment Status: Approval received Timing: Construction expected to commence in 2024, however planned completion is unknown	The planned redevelopment includes mixed-use development including commercial, retail, entertainment, community and hotel uses at the existing site of the Hellenic Club.	Immediately north-west of the Woden Interchange (Block 21, Section 6, Division of Phillip)	Woden

Project, status and indicative timing	Description of the project	Location relative to the Project	Precincts where cumulative impacts may occur
Woden Zone Substation to Canberra Hospital Underground High Voltage and Optical Fibre Connection Status: Currently in planning and development Timing: Unknown	Installation of underground high voltage electrical and optical fibre communications infrastructure between Woden Zone Substation and Canberra Hospital to facilitate additional load at Canberra Hospital. The installation would be completed via trenching and under boring.	Infrastructure would pass through the Project area from Theodore Street, passing through Melrose Drive, continuing through Yamba Drive to the east	Woden

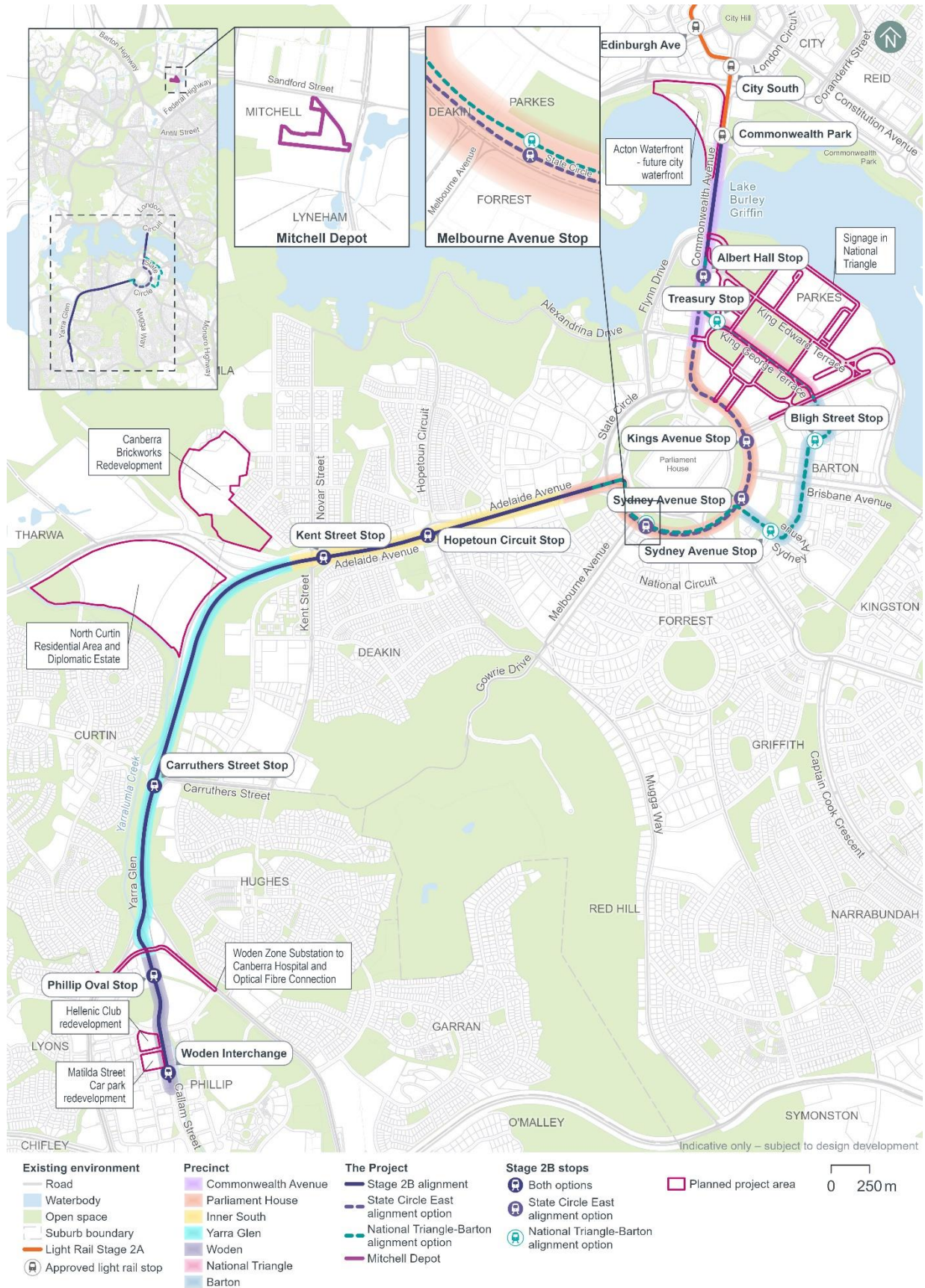


Figure 20-2 Projects screened in for the cumulative impact assessment

20.3 Previous Light Rail network stages

The Project would extend the existing and planned Light Rail network in Canberra. Light Rail Stage 1 (LRS1) is currently operational. Based on current program information LRS2A is anticipated to begin operation prior to the start of main construction works of the Project.

Given that previous stages of the Light Rail network would be operational by the time the Project commences construction, and due to the linear nature of the Project, and previous stages, cumulative impacts are not predicted to occur. LRS1 and LRS2A have been considered throughout Part B (Environmental impact assessment) as part of the baseline environment for the Project (e.g. the existing environment in which this Project would be constructed).

Construction compounds A1 and A2 are currently used as construction compounds for the LRS2A project. Off-street parking losses associated with the use of these construction compounds for LRS2A would continue for the Project. However, there would be a gap between completion of construction of LRS2A and construction of the Project commencing where the construction compound is not in use.

Benefits of the extended Light Rail network (including this Project and the previous Light Rail network stages) are considered in Chapter 2 (Need for the Project).

20.4 Cumulative impacts – construction

Potential cumulative impacts during construction are related to:

- Traffic and transport
- Biodiversity
- Non-Aboriginal heritage
- Landscape character and visual amenity
- Air quality
- Socioeconomic
- Hydrology, flooding, and water quality
- Noise and vibration.

These impacts are summarised in the following sections. Further details on the potential cumulative impacts during construction are presented in the respective technical reports.

The timeline for construction of several of the identified surrounding developments is currently unknown. For the purposes of this construction cumulative assessment, it was conservatively assumed that all of these surrounding developments would be under construction at the same time as the Project.

20.4.1 Traffic and transport

The Project would involve temporary construction traffic arrangements and construction activity at the construction compounds and ancillary facilities along the alignment. The construction impact assessment presented in Technical Report 1 – Traffic and transport considers the cumulative impacts of various temporary traffic arrangements being implemented concurrently along the Project alignment and the additional construction traffic generated by the Project.

The following developments were identified as potentially resulting in cumulative traffic impacts with the Project during construction:

- **Acton Waterfront – future city neighbourhood** – construction traffic would likely use Commonwealth Avenue, a proposed construction haulage route for the Project
- **Canberra Brickworks redevelopment** – construction traffic would likely use Yarra Glen, which is a proposed construction haulage route for the Project

- **North Curtin Residential Area and Diplomatic Estate** – construction traffic would likely use Yarra Glen, Carruthers Rd and/or Cotter Rd, which is a proposed construction haulage route for the Project
- **Hellenic Club redevelopment** – construction traffic would likely use Launceston Street, Yamba Drive, and/or Melrose Drive, which are proposed construction haulage routes for the Project
- **Matilda Street car park redevelopment** – construction traffic would likely use Launceston Street, Yamba Drive, and/or Melrose Drive, which are proposed construction haulage routes for the Project. Construction of this site would result in a further reduction in available off-street public car parking within the Woden precinct.

Construction traffic volumes associated with these surrounding development projects are currently unknown. However, these projects would be spread across the extent of the study area for the traffic and transport assessment, and therefore, the construction traffic associated with each of these projects would be distributed across various haulage routes.

The proposed construction methodology for the Project would retain road network accessibility by maintaining traffic flow along key transport corridors during the construction works. Intersection and track crossing works would occur during weekend closures when traffic volumes on the surrounding road network are lower. Diversions would be available when block closures are implemented during the construction of the National Triangle-Barton alignment option.

While the proposed construction haulage routes for the Project have been identified to be the most direct to the construction compounds from the arterial road network, construction vehicles associated with the surrounding projects would likely use some of the same routes, resulting in a cumulative construction traffic impact on road network operations.

Most construction vehicle activity (travelling to and from site) during the Project's construction would occur outside of AM and PM peak road network periods. Considering the distance between the surrounding developments and the likely distribution of construction vehicle volumes on the surrounding road network, the cumulative construction traffic impact of these developments with the Project would represent only a small proportional increase in the total traffic volumes on the broader road network. This may result in a minor increase in vehicle delay and travel time on the surrounding road network.

As outlined in Chapter 21 (Environmental management and mitigation measures) and Appendix L (Environmental Management Plan outline), a Construction Traffic Management Plan (CTMP) would be prepared for the Project to provide details on proposed measures to minimise the cumulative traffic impact of construction works on surrounding road users. Chapter 21 (Environmental management and mitigation measures) also includes mitigation measures that would be applied to manage impacts to the transport network.

Measures which would contribute to management of cumulative traffic impacts could include:

- Scheduling of most deliveries outside of peak road network periods (including outside of standard construction hours where required to minimise impacts on the road network)
- Encouraging workers to use alternative transport arrangements, such as active and public transport or to car-pool, thereby minimising the number of single-person private vehicles generated by the works
- Use of shuttle buses to transport workers to/from the Project area and between construction compounds and work areas.

Construction environmental management is discussed further in Chapter 21 (Environmental management and mitigation measures).

20.4.2 Biodiversity

The Project area is positioned within a highly modified urban environment. While it does not support ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* or *Nature Conservation Act 2014*, it does support habitat for a number of threatened species and contributes to connecting core habitat within the urban context.

A review of available information associated with the developments identified in Section 20.2.2 was carried out to determine the potential cumulative impacts on biodiversity-related Matters of National Environmental Significance (MNES) under the EPBC Act and protected species under the Territory's NC Act.

The North Curtin Residential Area and Diplomatic Estate had sufficient ecological information available to inform this assessment. The ecological assessment report for this project (Umwelt, 2022a) confirmed that this site supports patches of native vegetation, including native grasslands and amenity plantings, which provide habitat for woodland birds and Golden Sun Moth (*Synemon plana*) habitat. It is not known whether options to avoid or mitigate impacts on MNES and protected species from this project have been determined.

The Project area also supports Golden Sun Moth (*Synemon plana*) habitat that is contiguous with an adjacent site for the proposed National Security Office Precinct development (within the Barton precinct). These project examples demonstrate that current planned developments within the local landscape may contribute to a cumulative impact on the Golden Sun Moth and other species, which when combined with the impacts from this Project, may be significant.

20.4.3 Non-Aboriginal heritage

Cumulative heritage impacts have the potential to occur where developments near to the Project are constructed concurrently or consecutively. These are discussed in Table 20-2 and further detail can be found in Technical Report 3 – Heritage.

Table 20-2 Cumulative impacts during construction - Non-Aboriginal heritage

Precinct	Relevant projects	Assessment
Commonwealth Avenue	<ul style="list-style-type: none"> Acton Waterfront – future city neighbourhood 	The Acton Waterfront - future city neighbourhood would be expected to impact the heritage values of Lake Burley Griffin and Adjacent Lands from alterations to the significant generous, public spaces of its foreshores, and to the significant historical landscape of the Central National Area of Canberra more generally. It is likely that works for this project and the Project would be underway at the same time. At a landscape scale, it is likely that there would be cumulative impacts from both projects due to the separate but similar way in which they would have adverse impacts on the significant heritage values of their heritage context.
Yarra Glen	<ul style="list-style-type: none"> North Curtin Residential Area and Diplomatic Estate 	The scope of works and impacts from this project are yet to be further defined as it is in the early stages of strategic planning. It is possible that there may be associated impacts to the Project area with cumulative effects such as to the Royal Australian Mint on the other side of Adelaide Avenue.

Further consideration of other permanent changes to the setting of heritage items as a result of other projects, including those which would be complete prior to the construction of this Project, can be found in Technical Report 3 – Heritage.

20.4.4 Landscape character and visual amenity

Cumulative landscape and visual impacts have the potential to occur where developments near to the Project are constructed concurrently or consecutively. Potential cumulative landscape and visual impacts during construction are discussed in Table 20-3.

Table 20-3 Cumulative impacts during construction – landscape character and visual amenity

Precinct	Relevant projects	Assessment
Commonwealth Avenue	<ul style="list-style-type: none"> Acton Waterfront – future city neighbourhood 	<p>The Acton Waterfront has been subject to ongoing construction activity due to the lake reclamation, boardwalk extension and construction of Henry Rolland Park. Construction activity in the vicinity of this area is expected to continue during construction of the approved LRS2A.</p> <p>It is likely that the Project would be under construction at the same time as the Acton Waterfront – future city neighbourhood. The Project would prolong the occurrence of construction activity within the precinct near the Acton Waterfront, including construction compounds adjacent to Commonwealth Avenue (proposed as part of this Project).</p> <p>Further to this, the visible area of construction activity would extend from the existing land-based works to across Lake Burley Griffin, with visual receptors using the park and along the waterfront experiencing views to construction over a greater proportion of the surrounding landscape. This has the potential to be a substantial visual impact to sensitive visual receptors who may be using the existing park and waterfront for recreational purposes.</p> <p>If parts of the Acton Waterfront – future city neighbourhood are completed and occupied during the construction period of the Project, residential and commercial properties would potentially have views to the construction activity of the Project. This would be an ongoing visual impact during construction, although one that these visual receptors would have been aware of prior to taking up occupation of their properties, which may lessen their sensitivity to these anticipated temporary impacts.</p>
National Triangle	<ul style="list-style-type: none"> Signage in the National Triangle 	<p>If construction of this project were to occur simultaneously with the Project, there would be little to no increase in perceived construction activity if this project was located within the Project area. The replacement / upgrade of signage would also potentially be undertaken within the Project area, minimising the impact of these two projects where they are concurrent.</p>
Yarra Glen	<ul style="list-style-type: none"> Canberra Brickworks redevelopment North Curtin Residential Area and Diplomatic Estate 	<p>It is likely that the Project would be under construction at the same time as the Brickworks Precinct and the North Curtin Residential Area and Diplomatic Estate.</p> <p>Development of these sites may visually link construction activities, resulting in a substantial increase in the visible construction activity in the local area. This would comprise a substantial visual impact from surrounding roads, including Yarra Glen, Cotter Road, and from recreational visitors to Yarralumla Creek. It is unlikely that any residents would see all three projects under construction at once, however, would experience an overall increase in construction activity in the local area as they travelled to and from their homes.</p>

Precinct	Relevant projects	Assessment
Woden precinct	<ul style="list-style-type: none"> Hellenic Club redevelopment Matilda Street car park redevelopment Woden Zone Substation to Canberra Hospital Underground High Voltage and Optical Fibre Connection 	Construction of the Project would likely be experienced as an extension of construction activities related to other projects within the Woden area. The three identified projects would potentially have overlapping construction activities with the Project, reinforcing the visual character of an area under active development.

20.4.5 Air quality

The adoption of mitigation measures set out in Chapter 21 (Environmental management and mitigation measures) and the construction management approach set out in Appendix L (Environmental Management Plan outline) are expected to result in the adequate management of dust and other emissions for the Project. The air quality risks associated with construction of infrastructure are well known and generally well managed using standard mitigation measures. Potential cumulative air quality impacts would be temporary and managed through consultation with the relevant stakeholders and coordinating construction activities with other nearby developments.

20.4.6 Socioeconomic

The construction of the Project has the potential to result in socioeconomic benefits associated with increased employment and training opportunities, particularly for construction workers. Should other identified projects be constructed concurrently, this benefit may be enhanced.

Potential cumulative socioeconomic impacts during construction may arise where these projects are constructed concurrently with the Project, and could include economic, health and wellbeing and traffic and access benefits and challenges.

Economic

The cumulative economic effects associated with the construction of Project, alongside other concurrent projects, could result in both benefits and challenges. If other projects are constructed concurrently with the Project, the cumulative impact could amplify the socioeconomic benefits associated with employment and training opportunities. The combined demand for construction workers, traffic professionals, planners, and related professions could create a broader pool of jobs across multiple sectors. This increased demand would particularly benefit local workers, as well as vulnerable communities, including Indigenous and disadvantaged groups, who may have targeted employment opportunities. This could lead to workers gaining experience from multiple large-scale projects resulting in a more skilled local workforce, and increase future employability in infrastructure development.

Increased employment for construction workers would likely lead to greater local expenditure, benefiting businesses and services in the surrounding areas. The influx of workers and the economic activity generated by large-scale projects could also stimulate further investments in the region, potentially leading to long-term economic growth.

Conversely, the increased demand for construction workers, engineers, planners, and other skilled professionals could reduce the availability of labour for other local community projects or services. This reduction in available labour could increase wages and competition for workers, which may lead to delays in project timelines or cost overruns. This could also limit resources available for other sectors. For example, essential services, housing developments, or smaller-scale municipal projects might struggle to attract labour, particularly in trades like residential construction, leading to delays or higher costs impacting housing affordability.

Health and wellbeing

Cumulative impacts related to the construction of the Project, particularly when combined with other nearby projects, may substantially affect the wellbeing of some residents and communities. Continuous construction activities can impact daily life through increased traffic, noise, reduced pedestrian accessibility, and a decline in local amenity. These disruptions can lead to frustration, stress, and even construction fatigue, which may have a detrimental effect on both mental and physical health. The Commonwealth Avenue and Woden precincts are especially vulnerable due to the extended timeline and scope of overlapping large-scale developments.

For individuals with mobility constraints, these impacts may be even more pronounced. Reduced pedestrian accessibility and construction-related obstacles could affect their ability to navigate through impacted areas, exacerbating feelings of isolation and stress. Addressing these concerns through coordinated construction activity and engagement with nearby projects would mitigate some of the potential negative effects experienced by vulnerable groups.

Traffic and access

As identified in Section 20.4.1, there is potential for cumulative construction traffic impacts, which may further impact access to social infrastructure, events, and attractors in the area, causing inconvenience for residents and visitors.

Concurrent construction projects, such as the Acton Waterfront development the Canberra Brickworks redevelopment and development projects in Woden, would likely share proposed construction haulage routes or generally lead to an increase in construction vehicles. This could exacerbate congestion, especially during peak hours, leading to delays that affect access to local amenities and social infrastructure. It is also important to recognise that these cumulative impacts may disproportionately affect individuals with mobility constraints. Increased delays and reduced accessibility to public spaces can significantly hinder their ability to navigate the community effectively.

20.4.7 Hydrology, flooding and water quality

Potential cumulative hydrology, flooding, and water quality impacts during construction are discussed in Table 20-4.

Predicted cumulative impacts of these developments and the Project would be similar in nature to those discussed in Section 11.5.1 such as changes to surface water quality (e.g. through run off from construction sites) or changes to flood characteristics. Hydrology, flooding, and water quality mitigation measures would be implemented (as outlined in Chapter 21 (Environmental management and mitigation measures)) which would appropriately manage these risks. Potential cumulative impacts would also be managed through consultation with the relevant stakeholders and coordinating construction activities with other nearby developments.

Table 20-4 Cumulative impacts during construction – hydrology, flooding and water quality

Precinct	Relevant projects	Assessment
Yarra Glen	<ul style="list-style-type: none"> North Curtin Residential Area and Diplomatic Estate 	<p>The North Curtin Residential Area and Diplomatic Estate lies within and adjacent to the Project area west of Yarra Glen and south of Cotter Road, and is adjacent to Yarralumla Creek. Due to its proximity to the light rail alignment and the size of its construction footprint, this development is likely to have an impact on the hydrology, flooding, and water quality of the receiving waterways during the construction phase, and there is a risk of spills or other forms of contamination. It has been conservatively assumed that construction of this project would occur concurrently with the Project. The potential for cumulative impacts to occur would be appropriately mitigated through standard environmental controls to manage erosion and sedimentation, and risk of spills (refer further to Chapter 21 (Environmental management and mitigation measures)).</p>
Woden	<ul style="list-style-type: none"> Hellenic Club redevelopment Matilda Street car park redevelopment 	<p>The site of the Hellenic Club lies directly west of the light rail alignment. The proposed Matilda Street car park redevelopment is located between Matilda Street, Bowes Street, and Callam Street in the Woden town centre.</p> <p>For both of these developments, the existing sites are largely impervious, and as such, there would be little change to the ratio of pervious and impervious surfaces, and therefore no material change in drainage and flooding characteristics from the existing conditions. However, as the development sites are close to both the light rail alignment and Yarralumla Creek, the potential for spills and uncontrolled runoff from construction activities may be exacerbated.</p> <p>The potential for cumulative impacts to occur would be appropriately mitigated through standard environmental controls to manage erosion and sedimentation, and risk of spills (refer further to Chapter 21 (Environmental management and mitigation measures)).</p>

20.4.8 Noise and vibration

The following developments have been identified as potentially having cumulative construction noise and vibration impacts with the Project:

- Acton Waterfront – future city neighbourhood
- Canberra Brickworks redevelopment
- North Curtin Residential Area and Diplomatic Estate
- Hellenic Club redevelopment
- Matilda Street car park redevelopment
- Woden Zone Substation to Canberra Hospital Underground High Voltage and Optical Fibre Connection.

These developments are located at varying distances from the Project and may have an impact on the construction noise levels experienced at noise sensitive receivers depending on the construction activities occurring simultaneously and the distance from the Project. If another construction activity outside of the Project was occurring at a similar noise level to the Project construction activities, the resulting construction noise level may be 3 dB higher than the construction noise levels presented in the construction assessment for the Project (refer to Section 5 of Technical Report 9 – Noise and vibration). Similarly if two construction activities outside of the Project were occurring at a similar noise level to the Project construction activities, the resulting construction noise level may be 5 dB higher than the construction noise levels presented in the construction assessment for the Project (refer to Section 5 of Technical Report 9 - Noise and vibration).

In accordance with measures identified to manage cumulative construction impacts (refer to Section 20.7), proponents of other developments in the area would be consulted with during construction to confirm the potential for overlapping impacts and coordinate impact mitigation and management (for example, respite periods), where relevant.

20.5 Cumulative impacts – operation

Potential cumulative impacts during operations are related to:

- Traffic and transport
- Non-Aboriginal heritage
- Landscape character and visual amenity
- Hydrology, flooding and water quality
- Noise and vibration.

These impacts are summarised in the following sections. Further details on the potential cumulative impacts during operations are presented in the respective technical reports.

The timeline for the completion and operation of several of the identified surrounding developments is currently unknown. For the purposes of this operational cumulative assessment, it was conservatively assumed that all of the identified nearby developments would be completed and operational at the same time as the Project.

20.5.1 Traffic and transport

Most of the identified surrounding developments (in Section 20.4.1) would likely generate additional traffic once operational. Operational traffic associated with these future developments were considered in the Zenith Strategic Transport Model which informed the traffic and transport assessments. Therefore, the cumulative impact of these developments with the Project has already been considered in the traffic modelling and impact assessment presented in Technical Report 1 – Traffic and transport.

The Project would provide a relatively direct, alternative route for transport from these surrounding developments to other locations along the alignment and connections to other regional public transport services. As such, the Project has the opportunity to reduce the traffic generation of these surrounding developments by providing an alternative accessible mode of transport. The active travel infrastructure being delivered as part of the Project also has the potential to create a mode shift away from private vehicle travel increasing walking and cycling travel.

20.5.2 Non-Aboriginal heritage

Potential cumulative non-Aboriginal heritage impacts during operation of the Project are discussed in Table 20-5. Further detail can be found in Technical Report 3 – Heritage.

Table 20-5 Cumulative impacts during operation - Non-Aboriginal heritage

Precinct	Relevant projects	Assessment
Commonwealth Avenue	<ul style="list-style-type: none"> Acton Waterfront – future city neighbourhood 	<p>Once operational, the Project would comprise a continuation of light rail along Commonwealth Avenue extending south from the approved Commonwealth Park Stop.</p> <p>At a landscape scale, it is likely that there would be cumulative impacts from both projects due to the separate but similar way in which they would have adverse impacts on the significant heritage values of their heritage context.</p>
Yarra Glen	<ul style="list-style-type: none"> North Curtin Residential Area and Diplomatic Estate 	<p>The scope of works and impacts from this project are yet to be further defined as it is in the early stages of strategic planning. It is possible that there may be associated impacts to the Project area with cumulative effects such as to the Royal Australian Mint on the other side of Adelaide Avenue.</p>

Further consideration of other permanent changes to the setting of heritage items as a result of other projects, including those which would be complete prior to the operation of this Project, can be found in Technical Report 3 – Heritage.

20.5.3 Landscape character and visual amenity

Potential cumulative landscape and visual impacts during operation are discussed in Table 20-6.

During operation, cumulative landscape and visual impacts of the Project and other developments would be limited. The Project and developments discussed in Table 20-6 would be designed to integrate into the landscape, noting the importance of the Canberra city layout. These projects are each consistent with the continued visual nature of Canberra as a city and urbanised environment.

Table 20-6 Cumulative impacts during operation – landscape character and visual amenity

Precinct	Relevant projects	Assessment
Commonwealth Avenue	<ul style="list-style-type: none"> Acton Waterfront – future city neighbourhood 	<p>Once operational, the Project would comprise a continuation of light rail along Commonwealth Avenue extending south from the approved Commonwealth Park light rail stop. The Project would complement this development by providing public transport accessibility to the planned neighbourhood, which would be designed with consideration of the approved light rail stop at Commonwealth Park. The Project would be visually recessive and positioned within an existing transport corridor, and would not comprise a substantial increase in impact when considered cumulatively. As such the two projects would be visually complementary and would not result in adverse visual impacts.</p>
National Triangle	<ul style="list-style-type: none"> Signage in the National Triangle 	<p>Given that the Signage in the National Triangle project would generally involve replacement/upgrade of existing signage with signage of a similar scale, there would be no additional cumulative visual or landscape impact with this Project, once operational.</p>

Precinct	Relevant projects	Assessment
Yarra Glen	<ul style="list-style-type: none"> Canberra Brickworks redevelopment North Curtin Residential Area and Diplomatic Estate 	During operation of the Project, the North Curtin Residential Area and Diplomatic Estate would be likely to physically join the Canberra Brickworks redevelopment to the Project. There would be a substantial change in the landscape character of the land to the north / north-west of Yarra Glen, with the existing green open space shifting to residential and mixed-use development. The Project would not contribute substantially to this change in overall character shift of the area due to the relative low visual prominence of the Project in comparison to the large scale construction of residential and diplomatic built form.
Woden precinct	<ul style="list-style-type: none"> Hellenic Club redevelopment Matilda Street car park redevelopment Woden Zone Substation to Canberra Hospital Underground High Voltage and Optical Fibre Connection 	During operation of the Project, the Woden precinct would be substantially developed, however, exhibiting the commercial and residential town centre landscape character that already exists in the area. The Project and the identified developments would be visually consistent with this character, and are therefore not anticipated to result in adverse cumulative visual and landscape character impacts.

20.5.4 Hydrology, flooding and water quality

Potential cumulative hydrology, flooding and water quality impacts during operation are discussed in Table 20-7. Land use changes associated with planned development, where known, were included in the baseline flood models used to inform the assessment carried out for the Project. This has allowed for an assessment of impacts that considers developments which may not be existing currently but are likely to be present once the Project is operational. A complete list of these developments is included in Technical Report 4 – Hydrology, flooding and water quality.

Table 20-7 Cumulative impacts during operations – hydrology, flooding and water quality

Precinct	Relevant projects	Assessment
Yarra Glen	<ul style="list-style-type: none"> North Curtin Residential Area and Diplomatic Estate 	<p>At present, this area consists of pervious grassland, and the replacement of this with concrete, asphalt, and other impervious materials has the potential to contribute materially to overland flows and stormwater flows. These estimated land use changes were included in the baseline flood model for Yarralumla Creek (described further in Technical Report 4 – Hydrology, flooding and water quality).</p> <p>The replacement of the existing grassland and natural surfaces with a development is likely to lead to increases in some pollutants and hydrocarbons within the receiving waterways. The addition of buildings and other infrastructure such as retaining walls may also divert or obstruct existing overland flow paths. Localised ponding may also be worsened, and the existing drainage network may reach capacity sooner or in locations where it had not previously.</p> <p>During operation, the Project would affect the receiving waterways through additional pollutant loads generated by new impervious areas, and potentially negatively affect localised flood depths if not mitigated effectively through improved drainage and landscape design. Mitigation measures are proposed in Chapter 21 (Environmental management and mitigation measures) to manage this impact.</p>
Woden	<ul style="list-style-type: none"> Hellenic Club redevelopment Matilda Street car park redevelopment 	<p>While the Hellenic Club and Matilda Street car park redevelopments are unlikely to result in a major change of the ratio of pervious to impervious area, the addition of new buildings and infrastructure in this highly urbanised environment has the potential to negatively impact the peak flow and flood levels through the obstruction and diversion of existing overland flow paths. Localised ponding may also be worsened, and the existing drainage network may reach capacity sooner or in locations where it had not previously.</p> <p>During the operation of the Project, potential cumulative impacts of these developments with the Project could include increasing localised flooding due to new buildings and structures obstructing or diverting flow paths, or increased flood depths due to additional impervious areas. Mitigation measures are proposed in Chapter 21 (Environmental management and mitigation measures) to manage these potential impacts.</p>

20.5.5 Noise and vibration

No other light or heavy rail projects are currently proposed to be constructed in proximity of the Project area. Therefore, cumulative noise from operational rail activities is unlikely to impact noise sensitive receivers within the Project area.

The noise and vibration assessment of the Project in Technical Report 9 – Noise and vibration has also considered approved unbuilt developments that contain noise sensitive receivers as part of the baseline environment. This has allowed for an assessment of impacts to receivers which may not be existing currently but are likely to be present once the Project is operational. A complete list of these developments is included in Technical Report 9 – Noise and vibration.

20.6 Facilitated impacts

Facilitated impacts are consequences of actions taken by third parties, where the third-party action is facilitated to a major extent by the primary action, and the impacts of the third-party action could be reasonably foreseen. While there are developments located adjacent to the Project which would likely benefit from the extension of light rail from Commonwealth Park to Woden, these are not directly related and could occur regardless. Consideration of the cumulative impacts of these developments are detailed in Section 20.4 and Section 20.5. While these developments may give rise to environmental impacts, they would be subject to separate environmental assessment and approval activities.

20.7 Management and mitigation measures

Environmental management for this Project is detailed in Chapter 21 (Environmental management and mitigation measures). This includes construction and operational measures to manage cumulative impacts, that are applicable to the Project as a whole.

Management and mitigation measures have been proposed to reduce the potential cumulative impacts of the Project and other developments, which are identified in Table 20-8.

Table 20-8 Mitigation measures – cumulative impacts

ID	Objective	Management and mitigation measure	Timing	Relevant precinct(s)
CU1	Managing cumulative impacts	<p>During design development and construction phases, consultation will occur with proponents of other projects in the area to:</p> <ul style="list-style-type: none"> • Coordinate any interfacing design aspects • Increase awareness of construction timeframes, including overlapping construction activities, and identify potential impacts • Coordinate relevant impact mitigation and management responses between projects (e.g., respite periods). 	Design and construction	All