Appendix H

Technical working paper: Traffic and transport

WestConnex

Roads and Maritime Services

WestConnex – M4-M5 Link

Technical working paper: Traffic and transport

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Client: Roads and Maritime Services

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Glossary of terms and abbreviations

Term	Definition
A	
AADT	Annual Average Daily Traffic. The total volume of traffic (24 hours) passing a roadside observation point over a period of a year; divided by the number of days per year. It is calculated from mechanically obtained axle counts
ADT	Average Daily Traffic. The total volume of traffic (24 hours) passing a roadside observation point over a seven-day period during a set number of weeks; divided by the total number of days. It is calculated from mechanically obtained axle counts
AM peak hour	Unless otherwise stated, this refers to vehicle trips arriving at their destination during the average peak one hour in the AM peak period between 7.00 am–9.00 am on a normal working weekday
At-grade	A road at ground level, not on an embankment or in a cutting
ATC	Automatic Traffic Count
AWT	Average Weekday Traffic. The total volume of traffic (24 hours) passing a roadside observation point over a five-day weekday period during a set number of weeks (outside of school/public holidays); divided by the total number of days. It is generally calculated from axle counts of passing vehicles
B	
Bus lane	A traffic lane dedicated to buses, but which can also be used by taxis, bicycles and motorcycles
C	
Campbell Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at St Peters
Campbell Road motorway operations complex	An area where operational ancillary facilities are established. Located within the St Peters interchange, south of Campbell Road at St Peters, on land occupied during construction by the Campbell Road civil and tunnel site
Campbell Road ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at St Peters, within the St Peters interchange site
Capacity	The nominal maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction during a given time period under prevailing roadway conditions
Carriageway	The portion of a roadway used by vehicles including shoulders and ancillary lanes
CBD	Central Business District
CCTV	Closed-Circuit Television
CEMP	Construction Environmental Management Plan. A site specific plan developed for the construction phase of a project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that environmental risks are properly managed
City Centre Access Strategy	Sydney Centre Access Strategy (Transport for NSW 2013)
CNVG	*Construction Noise and Vibration Guideline* (Roads and Maritime, 2016)
CNVIS	Construction Noise and Vibration Impact Statements

Term	Definition
CNVMP	Construction Noise and Vibration Management Plan
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility and provide basis for estimating and to determine further investigations needed for detailed design
Construction	Includes all physical work required to construct the project
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to construction sites (civil and tunnel), sediment basins, temporary water treatment plants, precast yards and material stockpiles, laydown areas, workforce parking, maintenance workshops and offices
Construction fatigue	Impact on receivers in the vicinity of concurrent and/or consecutive construction activities
Corridor	A substantial segment of the transport network, in which parallel, possibly competing, transport routes (and modes, where appropriate) operate between two locations
CSSI	Critical State significant infrastructure
CTAMP	Construction Traffic and Access Management Plan
Cul-de-sac	A street or road that is open for vehicular traffic at one end only
Culvert	A structure that allows water to flow under a road
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own
Cut-and-cover	A method of tunnel construction whereby the structure is built in an open excavation and subsequently covered
D	
Darley Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Leichhardt
Darley Road motorway operations complex	An area where operational ancillary facilities are established. Located at Leichhardt, south of City West Link and the Inner West Light Rail line on land occupied during construction by the Darley Road civil and tunnel site
Design speed	A nominal speed which determines the geometric design features of a road
Detailed design	The phase of the project following concept design where the design is refined, and plans, specifications and estimates are produced, suitable for construction
Detour	An alternative route, using existing roads, made available to traffic
Design speed	A nominal speed which determines the geometric design features of a road
Divided road	A road with a separate carriageway for each direction of travel created by placing a physical separation (eg median) between the opposing traffic directions
Do minimum	A model scenario that does not incorporate the proposed project infrastructure
Do something	A model scenario that incorporates the proposed project infrastructure
Do something cumulative	A model scenario that incorporates the proposed project infrastructure and other relevant project infrastructure
DP&E	NSW Department of Planning and Environment
E	
EB	Eastbound

Term	Definition
EIS	Environmental Impact Statement
Enabling works	Works which are required to enable the commencement of the main construction works
Entry ramp	A ramp by which one enters a limited-access highway/tunnel
Environment	Includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings (from EP&A Act)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
Exit blocking	Queuing traffic from a downstream link or intersection that blocks traffic from being able to travel through and exit an intersection
Exit ramp	A ramp by which one exits a limited-access highway/tunnel
F	
F6 Extension (previously referred to as SouthLink)	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor. The project is being delivered by NSW Roads and Maritime Services and would be subject to separate assessment and planning approval
Footpath	The paved area in a footway
Footprint	The extent of the impact that a development (in plan-view) makes on the land
Footway	An area open to the public designated for the movement of pedestrians or has one of its main uses for pedestrians
Freeways	Fast, high volume, access controlled roads that primarily link regional hubs and cities usually with grade separated intersections and without traffic lights
Freight Strategy	NSW Freight and Ports Strategy (Transport for NSW 2013b)
G	
Gateway to the South	An accelerated pinch points program, the Gateway to the South Pinch Points Program aims to ease congestion and improve journey reliability on Sydney's key southern corridors. The NSW Government has committed $300 million to address critical pinch points along the A1, A3 and A6 routes south of the M5 Motorway
Grade separation	The separation of road, rail or other transport modes, so that crossing movements at intersections are at different levels
GMA	Greater Metropolitan Area. This area includes the Sydney Greater Capital City Statistical Area and the Illawarra and Lower Hunter regions.
GVM	Gross Vehicle Mass
H	
h	Hour
ha	Hectare/s
Haberfield civil and tunnel site/Haberfield civil site	Construction ancillary facilities for the M4-M5 Link project located at Haberfield
HCV	Heavy Commercial Vehicle. Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System

Term	Definition
I	
IDM	Intersection Diagnostic Monitor
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
Inner West Council	The amalgamation of the former local government areas of Ashfield, Leichhardt and Marrickville, proclaimed on 12 May 2016
Inner West subsurface interchange	A subsurface interchange at Leichhardt and Annandale that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link
Inside shoulder	The area of pavement outside the traffic lanes that is closest to the 'fast' lane
Interchange	An intersection of two or more roads that typically uses grade separation, and one or more ramps, to permit traffic on at least one carriageway to pass through the junction without directly crossing any other traffic stream
Iron Cove Link	Around one kilometre of twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge
Iron Cove Link civil site	A construction ancillary facility for the M4-M5 Link project located at Rozelle
Iron Cove Link motorway operations complex	An area where operational ancillary facilities are established. Located south of the realigned Victoria Road carriageway between Callan Street and Springside Street at Rozelle, on land occupied during construction by the Iron Cove Link civil site
Iron Cove Link ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at Rozelle
J	
Junction	A place where two or more roads meet
K	
KGRIU	King Georges Road Interchange Upgrade A component of the WestConnex program of works. Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project
km/h	Kilometres per hour
L	
Local road	A road or street used primarily for access to abutting properties
LCV	Light Commercial Vehicle. Vehicles up to 4.5 tonnes Gross Vehicle Mass (GVM), including cars which have been registered for business use
LGA	Local Government Area
Local road	A road or street used primarily for access to abutting properties
LoS	Level of service. A qualitative measure describing operational conditions within a traffic stream or intersection and the perception by motorists and/or passengers
M	
M4 East mainline stub tunnels	Eastbound and westbound extensions of the M4 East mainline tunnel being built as part of the M4 East project (to connect with the M4-M5 Link)

Term	Definition
M4 East mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the M4 East mainline stub tunnels
M4 East Motorway/project	A component of the WestConnex program of works. Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange
M4 Motorway	The M4 Motorway is a 40 kilometre motorway that extends from Concord in Sydney's inner west to Lapstone at the foothills of the Blue Mountains
M4 Widening	A component of the WestConnex program of works. Widening of the existing M4 Motorway from Parramatta to Homebush
M4-M5 Link	The project which is the subject of this EIS. A component of the WestConnex program of works
M5 East Motorway	Part of the M5 Motorway corridor. Located between Beverly Hills and Sydney Airport (General Holmes Drive)
M5 motorway corridor	The M5 East Motorway and the M5 South West Motorway
M5 South West Motorway	Part of the M5 Motorway corridor. Located between Prestons and Beverly Hills
Mainline tunnels	The M4-M5 Link mainline tunnels connecting with the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters
Managed motorway	A managed motorway uses active traffic management to reduce congestion, improve reliability of travel times and inform travellers of real-time incidents and expected travel times to set destination along the motorway
Median	The central reservation which divides a carriageway for traffic travelling in opposite directions
Midblock	A general location on a road between two intersections
Mode	A type or method of transport movement – including for the road corridor: cars, buses, bikes and pedestrians
Motorway	Fast, high volume controlled access roads. May be tolled or untolled
N	
National Road Network	AusLink National Land Transport Network
NB	Northbound
Network productivity	Indication of efficiency of a road network, which can be expressed in terms of vehicle kilometres travelled and vehicle hours travelled per day
New M5 Motorway/project	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction)
New M5 mainline stub tunnels	Northbound and southbound extensions of the New M5 mainline tunnel being built as part of the New M5 project (to connect with the M4-M5 Link)
New M5 mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the New M5 mainline stub tunnels

Term	Definition
Northcote Street civil site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
NSW	New South Wales
O	
OOHW	Out-of-hours work
Outside shoulder	The area of pavement outside the traffic lanes that is closest to the 'slow' lane
Overbridge	Bridge that conveys another road, rail or pedestrians over the described road
P	
Parramatta Road corridor	The Parramatta Road corridor is the area from Parramatta CBD to Sydney CBD, generally between the Main Western Rail line in the south and the Parramatta River to the north
Parramatta Road East civil site	A construction ancillary facility for the M4-M5 Link project at Haberfield
Parramatta Road Transformation Strategy	The Parramatta Road Corridor Urban Transformation Strategy (UrbanGrowth NSW 2016)
Parramatta Road ventilation facility	A ventilation facility located on the south-eastern corner of the Parramatta Road / Wattle Street intersection (referred to as the Eastern ventilation facility in the M4 East project EIS). The facility is being built as part of the M4 East project. As part of the M4-M5 Link project, fitout works would be carried out on a section of this facility
Parramatta Road West civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at Ashfield
Peak spreading	Increases in traffic demand in time periods immediately before or after the critical AM peak and PM peak periods, with commensurate decreases in the forecast peak period traffic demand
PCU	Passenger Car Unit
PM peak hour	Unless otherwise stated, this refers to trips travelling on the network during the average peak one hour in the PM peak period between 3.00 pm–6.00 pm on a weekday hour
Portal	The entry and/or exit to a tunnel
Pre-construction	All work prior to, and in respect of the State significant infrastructure, that is excluded from the definition of construction
Private vehicle	Includes all motorised vehicles such as cars, 4WDs, vans, motorbikes, motor scooters, utes and trucks, not registered for business use
Project	A new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange
Proponent	The person or organisation that proposes to carry out the project or activity. For the purpose of the project, the proponent is NSW Roads and Maritime Services
Public transport	Includes train, bus (government and private), ferry (government and private) and light rail (government and private) services

Term	Definition
PV	Passenger vehicle
Pyrmont Bridge Road tunnel site	A construction ancillary facility for the M4-M5 Link project at Annandale
R	
REF	Review of Environmental Factors
RNP	Road Noise Policy
Roads and Maritime	NSW Roads and Maritime Services (formerly NSW Roads and Traffic Authority (RTA))
Roadside furniture	A general term covering all signs, street lights, protective devices for the control, guidance and safety of traffic and convenience of road users
Road reserve	An area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel
Roadside	The area from the edge of the carriageway to the boundary of the road reserve
Roundabout	An intersection where all traffic travels in one direction clockwise around a central island
Rozelle civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Lilyfield and Rozelle
Rozelle East motorway operations complex	An area where operational ancillary facilities are established. Located at the western end of the Rozelle Rail Yards on land occupied during construction by the Rozelle civil and tunnel site
Rozelle interchange	A new interchange at Lilyfield and Rozelle that would connect the M4-M5 Link mainline tunnels with City West Link, Anzac Bridge, the Iron Cove Link and the proposed future Western Harbour Tunnel and Beaches Link
Rozelle Rail Yards	The Rozelle Rail Yards is bound by City West Link to the south, Lilyfield Road to the north, Balmain Road to the west, and White Bay to the east. Note that the project only occupies part of the Rozelle Rail Yards site
Rozelle ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at the Rozelle Rail Yards, the ventilation supply facility is located at the Rozelle West motorway operations complex and a ventilation exhaust facility at the Rozelle East motorway operations complex
Rozelle West motorway operations complex	An area where operational ancillary facilities are established. Located at the central/eastern end of the Rozelle Rail Yards, on land occupied during construction by the Rozelle civil and tunnel site
RTA	NSW Roads and Traffic Authority (now NSW Roads and Maritime Services)
S	
s	Seconds
SACL	Sydney Airport Corporation Limited
Saturation flow	The number of vehicles per hour that could pass through a signalised intersection on a specific approach lane if the signal remained green for the entire 60 minutes
SB	Southbound
SCATS	Sydney coordinated adaptive traffic system

Term	Definition
Screenline	Theoretical boundaries specifically designed to collectively analyse directional and two-way traffic volumes
SEARs	Secretary's Environmental Assessment Requirements Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of the Planning and Environment under section 115Y of the *Environmental Planning and Assessment Act 1979* (NSW)
Sensitive receiver/receptor	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, retail spaces and industrial premises)
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement
Smart Motorway Operations	A Smart Motorway uses technology to monitor, provide intelligence and control the motorway to ease congestion and keep traffic flowing more effectively. Technology, including lane use management signs, vehicle detection equipment, CCTV cameras and on-ramp signals, allows road operators to manage, in real-time, traffic entering, exiting and traversing the motorway
SMC	Sydney Motorway Corporation
SMPO	Sydney Motorways Project Office
STM	Strategic Travel Model, operated by Transport for NSW Transport Performance and Analytics
St Peters interchange	A component of the New M5 project, located at the former Alexandria Landfill site at St Peters. Approved and under construction as part of the New M5 project. Additional construction works proposed as part of the M4-M5 Link project.
Staging	Refers to the division of the project into multiple contract packages for construction purposes, and/or the construction or operation of the overall project in discrete phases
Stub tunnel	Driven tunnels constructed to connect to potential future motorway links
Sydney Gateway	A high-capacity connection between the St Peters interchange (under construction as part of the New M5 project) and the Sydney Airport and Port Botany precinct
T	
The Bays Precinct Transformation Plan	Transformation Plan: The Bays Precinct, Sydney (UrbanGrowth NSW 2015)
The Crescent civil site	A construction ancillary facility for the M4-M5 Link project located at Annandale
Traffic efficiency	Measured by savings (and delays) in travel time
Transport infrastructure	Permanent installations including roads, rail, buildings and storage associated with transport
TCS	Traffic Control Signal
TfNSW	Transport for New South Wales
TMC	Transport Management Centre

Term	Definition
TPA	Transport Performance and Analytics business unit within Transport for NSW (formerly Transport for NSW's Bureau of Transport Statistics and Bureau of Freight Statistics)
Transport for NSW	NSW Government Department Transport for NSW
Truck and dog construction vehicle	A vehicle with 20 cubic metre capacity and maximum length of 19 metres
U	
Unreleased demand	In a microsimulation traffic model, this is the number of vehicles unable to enter the model due to congestion extending back into model entry points. The number of unreleased vehicles is an indication of the effectiveness of the modelled network in meeting the forecast traffic demand. The lower the number of unreleased vehicles, the better the modelled network is able to accommodate the forecast demand flows
V	
Veh	Vehicle
Veh/h	Vehicle per hour
Ventilation facility	Facility for the mechanical removal of air from the mainline tunnels, or mechanical introduction of air into the tunnels. May comprise one or more ventilation outlets
VHT	Vehicle Hours Travelled
Victoria Road civil site	A construction ancillary facility for the M4-M5 Link project located at Rozelle
VKT	Vehicle Kilometres Travelled
V/C	Volume to Capacity ratio
VTTS	Value of Travel Time Savings
W	
Wattle Street civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
Wattle Street interchange	An interchange to connect Wattle Street (City West Link) with the M4 East and the M4-M5 Link tunnels. Approved and under construction as part of the M4 East project. Additional construction works proposed as part of the M4-M5 Link project
WB	Westbound
WDA	WestConnex Delivery Authority
Western Harbour Tunnel and Beaches Link	The Western Harbour Tunnel component would connect to the M4-M5 Link at the Rozelle interchange, cross underneath Sydney Harbour between the Birchgrove and Waverton areas, and connect with the Warringah Freeway at North Sydney. The Beaches Link component would comprise a tunnel that would connect to the Warringah Freeway, cross underneath Middle Harbour and connect with the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Seaforth. It would also involve the duplication of the Wakehurst Parkway between Seaforth and Frenchs Forest
WestConnex program of works	A program of works that includes the M4 Widening, King Georges Road Interchange Upgrade, M4 East, New M5 and M4-M5 Link projects
WRTM	WestConnex Road Traffic Model

Executive summary

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Together with the other components of the WestConnex program of works and the proposed future Sydney Gateway, the project would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-western Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and local communities.

The other component projects of WestConnex include the M4 East and New M5 (both with planning approval granted and under construction), M4 Widening and King Georges Road Interchange Upgrade (both with planning approval granted, construction completed and open to traffic). Related projects include the proposed future Sydney Gateway, Western Harbour Tunnel and Beaches Link and the F6 Extension (undergoing concept development and subject to separate planning approval processes).

The key strategic traffic objectives of the project are to:

- Provide an efficient motorway link between the M4 and M5 motorways and improve traffic flow on the motorway network
- Enable long term development of the motorway network, including facilitating new cross-harbour capacity and connections to Sydney's south
- Improve accessibility and reliability of commercial vehicle movement in the M4 and M5 corridors to economic centres, including to Sydney Airport and Port Botany economic zone
- Improve traffic conditions and ease future congestion on the inner western and south-western road network, including Parramatta Road, supporting urban regeneration and growth
- Improve overall network productivity.

The project objectives support the overarching objectives of the WestConnex program of works, which are described in **Chapter 3** (Strategic context and project need) of the environmental impact statement (EIS).

Existing traffic and transport environment

The project is located within an east–west corridor, between Haberfield and Rozelle, and within a north–south corridor, between Rozelle and St Peters. The western end of the project would tie into the M4 East tunnels and the Wattle Street interchange, while the southern end would tie into the New M5 tunnels and the St Peters interchange. The project would include an interchange at Rozelle, north of City West Link, a tunnel connection between the Rozelle interchange and Victoria Road near the eastern abutment of Iron Cove Bridge (the Iron Cove Link), and connections to the existing road network including City West Link and Victoria Road/Anzac Bridge.

The study area for this assessment was informed by the forecast traffic and transport changes from the WestConnex Road Traffic Model version 2.3 (WRTM v2.3), a strategic traffic model that covers the Sydney metropolitan area. The study area broadly encompasses an area extending from the Parramatta River in the north to Sydney Airport in the south and from the Eastern Distributor in the east to Haberfield and Marrickville in the west. It contains major road transport corridors including parts of four of the main travel demand corridors in Sydney, being:

- Parramatta to the Sydney central business district (CBD) via Strathfield (which includes the M4 East, Parramatta Road and City West Link)

- Parramatta to the Sydney CBD via Ryde (which includes Victoria Road)
- Sydney Airport to the Sydney CBD (which includes Princes Highway and Southern Cross Drive)
- Liverpool to Sydney Airport (which includes the M5 East Motorway).

The study area also contains major public transport corridors and infrastructure including parts of the Sydney Trains suburban railway network, light rail and bus networks. Public transport corridors that extend into the study area include the Parramatta to the Sydney CBD via Strathfield corridor, serviced by train and bus, the Parramatta to the Sydney CBD via Ryde corridor, serviced by bus, the Bankstown to the Sydney CBD corridor, serviced by rail, and the Sydney Airport to the Sydney CBD corridor, serviced by train.

There are key freight routes that extend within the study area on the road network, including:

- M4 Motorway to Sydney Airport and Port Botany via Parramatta Road, Sydenham Road and Canal Road
- Southwest Sydney to Sydney Airport and Port Botany via the existing M5 East Motorway
- Southwest Sydney to the Sydney CBD via the M5 and M1 motorways.

Freight train movements through the study area use parts of both the Sydney Trains suburban network and the Metropolitan Freight network. The Metropolitan Freight network connects Port Botany to intermodal terminals including those at Cooks River and Enfield, and also to the NSW TrainLink network.

The existing active transport (pedestrian and cycle) network within the study area comprises regional and local routes. The majority of regional routes are segregated pedestrian and cycle paths, with the local routes primarily being either shared paths or pedestrian paths supported by on-road cycle paths. While there are significant local active transport routes throughout the M4-M5 Link corridor, there are gaps in regional routes. Existing and proposed active transport networks within the study area are detailed in **Appendix N** (Technical working paper: Active transport strategy) of the EIS.

Existing road network performance

The road network in the study area currently functions under high levels of traffic demand, which often exceeds the operational capacity, especially citybound during the AM peak period.

The four main travel demand corridors mentioned above include some of the most highly congested road corridors in Sydney, with demand already exceeding capacity during peak periods. Major routes in the study area, such as Parramatta Road, City West Link, Victoria Road, Anzac Bridge/Western Distributor, Southern Cross Drive, Princes Highway and King Street, all experience significant congestion with resultant increase in travel time and variability, which can cause typical morning and evening peak hours to spread over longer periods, and extend the peak period.

Over the past five years, the majority of crashes on the major roads in the study area were rear-end crashes, which is consistent with roadways operating at or beyond capacity and on which significant queuing occurs.

In the AM peak period, eastbound traffic operations in the vicinity of the proposed Rozelle interchange are limited by various existing road network configurations, capacities and operational behaviours on and around Anzac Bridge/Western Distributor. These include the merge between The Crescent underpass and Victoria Road left turn, and general weaving on Anzac Bridge and the Western Distributor, which can affect traffic flows to entry and exit ramps.

Tidal operations (changes to the configuration of lanes) occur in the AM peak period on the Sydney Harbour Bridge with the northbound lanes reduced from four lanes to three lanes. This reduction, combined with weaving and merging on the Sydney Harbour Bridge deck and approach, causes queuing on the Western Distributor. Downstream capacity constraints at the Bathurst Street exit ramp also cause queues back onto the Western Distributor. All of these factors limit the eastbound throughput of Anzac Bridge/Western Distributor.

In the Haberfield, Rozelle and St Peters road networks, current average speeds of less than 30 kilometres per hour in the AM and PM peak periods are reported on several key roads. Intersection

analyses demonstrate that several locations experience significant congestion and operate at a poor level of service during the AM and PM peak hour periods. These congested conditions may cause traffic to seek alternate routes.

Strategic context

The transport network in Sydney is expected to be put under increasing pressure over the next 20 years. *A Plan for Growing Sydney* (NSW Government 2014) indicates that from 2011 to 2031, Sydney's population is forecast to increase from 4.3 to 5.9 million, which equates to an average of 80,000 additional residents per year. Moreover, by 2036, the number of trips made around Sydney each day is forecast to increase by 31 per cent from 16 to 21 million vehicle movements. This growth will place increasing pressure on the NSW transport network and the key travel demand corridors connecting regional cities and major centres across the greater Sydney metropolitan area.

Key corridors currently accommodate high levels of daily traffic including freight, commuter and leisure travel. Users of these corridors frequently experience congestion and delay, particularly during weekday and weekend peak periods. Both the *NSW Long Term Transport Master Plan* (Transport for NSW 2012) and the *State Infrastructure Strategy Update 2014* (*State Infrastructure Strategy*) (Infrastructure NSW 2014) identified the need to plan and invest in the future of Sydney's motorway network, which provides vital infrastructure connections within and between travel demand corridors. Any investment in motorway infrastructure has to be aligned with supporting public and active transport initiatives to achieve an increase in capacity, while aiming to reduce the reliance on and demand for private vehicles on the future road network.

The WestConnex project is one part of a broader solution to these emerging pressures. While public transport is also part of this mix, it is recognised that not all trips in Sydney can be served by public transport, especially trips to dispersed destinations or commercial trips requiring the movement of large or heavy goods/materials. A congested road network also affects road-based public transport, increasing bus travel times and journey time variability.

For these reasons, the NSW Government is also investigating and investing in light rail, metro, bus rapid transit and motorways to provide a multi-modal response to the future challenges. In this context, WestConnex is an enabler of integrated transport and land use planning, supporting the development of initiatives including The Bays Precinct and the *Parramatta Road Corridor Urban Transformation: Infrastructure Schedule* (UrbanGrowth NSW 2016).

Methodology

The preliminary environmental investigations conducted prior to carrying out this EIS and the Secretary's Environmental Assessment Requirements (SEARs) indicated that traffic and transport was one of the key environmental considerations for the project. This report details the subsequent traffic and transport assessment undertaken as part of the EIS for the project.

The traffic forecasting and modelling undertaken for this assessment consisted of both strategic and operational modelling. Strategic modelling using the WRTM was carried out to derive future traffic demands, based on planned and forecast changes in population and employment, and to understand the metropolitan-wide impacts of the project, while operational modelling (using microsimulation models) was carried out to understand the more detailed impacts such as the performance of interchanges and the level of service performances of tunnels and at merges and weaves.

The assessment has covered the following scenarios:

- Base case (2015): the road network prior to the commencement of the M4 East and New M5 or other new projects or upgrades. For operational traffic modelling, 2015 was adopted as the base case to match the year of traffic survey data
- Construction (2021): future road network assessed with NorthConnex, M4 Widening, M4 East, King Georges Road Interchange Upgrade (KGRIU) and New M5 complete and operational. Nominal construction year adopted as representative of the peak construction traffic generation of the project
- At opening (2023): it is proposed that the project would be constructed and fully operational by 2023. The following scenarios have been assessed in the project year of opening:

- Operation ‘do minimum’ or ‘without project’ (2023): with M4 Widening and KGRIU operational and assumes that NorthConnex, M4 East, and New M5, which are approved, fully funded and under construction, are complete, but that the M4-M5 Link has not been built. It is called ‘do minimum’ rather than ‘do nothing’ as it assumes ongoing improvements would be made to the broader road and public transport network over time including some new infrastructure and intersection enhancements to improve capacity and cater for traffic growth
- Operation ‘with project’ (2023): with the 2023 ‘do minimum’ projects completed and the M4-M5 Link complete and open to traffic
- Operation ‘cumulative’ (2023): with 2023 ‘do minimum’ projects and M4-M5 Link completed, and in addition, the proposed future Sydney Gateway and Western Harbour Tunnel projects operational. The proposed future Western Harbour Tunnel has been tested without an operational surface connection at Rozelle

- Future 10 years after opening (2033): assessment of the future operation of the project and transport network elements 10 years after opening. The following scenarios have been assessed:
  - Operation ‘do minimum’ or ‘without project’ (2033): with the same 2023 ‘do minimum‘ projects complete and some upgrades to the broader road and public transport network over time to improve capacity and cater for traffic growth but does not include the M4-M5 Link
  - Operation ‘with project’ (2033): with the 2033 ‘do minimum’ projects completed and the M4-M5 Link complete and open to traffic
  - Operation ‘cumulative’ (2033): with the 2033 ‘do minimum’ projects and M4-M5 Link completed, and in addition, the proposed future Sydney Gateway, Western Harbour Tunnel, Beaches Link and the F6 Extension projects complete and operational. The proposed future Western Harbour Tunnel and Beaches Link has been tested without an operational surface connection at Rozelle.

These scenarios are summarised in **Table ES-1**.

Table ES-1 Traffic assessment scenarios

Scenario	Year	Existing road network	WestConnex					NorthConnex	Sydney Gateway	Western Harbour Tunnel (to North Sydney)	Beaches Link (to Seaforth)	F6 Extension
			M4 Widening	M4 East	KGRIU	New M5	M4-M5 Link					
Base year	2015	✓										
Construction	2021	✓	✓	✓	✓	✓		✓				
Do minimum (without project)	2023	✓	✓	✓	✓	✓		✓				
With project		✓	✓	✓	✓	✓	✓	✓				
Cumulative		✓	✓	✓	✓	✓	✓	✓	✓	✓		
Do minimum (without project)	2033	✓	✓	✓	✓	✓		✓				
With project		✓	✓	✓	✓	✓	✓	✓				
Cumulative		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Future conditions without the project (including M4 East and New M5)

In the future, there is a forecast growth in travel demand for both traffic and public transport, due to a forecast increase in population and employment. This causes increased congestion levels on the road network. The section below provides an overview of conditions on the future road network without the M4-M5 Link project.

Sydney metropolitan road network

The overall forecast growth in traffic demand is consistent with the forecast increase in population in the Sydney Metropolitan Area. Importantly, this growth in traffic is not confined to major routes – increased traffic on many roads in Sydney is forecast without the project in the 2023 and 2033 peak periods, as vehicles seek to avoid the congested arterial road network by travelling along lower order roads.

A reduction in daily traffic is forecast along Parramatta Road (west of the M4 East Parramatta Road ramps) in 2023 and 2033 as a result of the M4 East, and on the M5 East as a result of the New M5. However, increased daily traffic is forecast along Parramatta Road (east of the M4 East Parramatta Road ramps), Southern Cross Drive, Sydney Harbour Tunnel, Sydney Harbour Bridge, Western Distributor and Anzac Bridge, as well as other urban arterial roads, such as Victoria Road, City West Link, Hume Highway, Canterbury Road, Stoney Creek Road, Olympic Drive, Centenary Drive and Anzac Parade approaching the Sydney CBD in both 2023 and 2033.

Wattle Street interchange and surrounds

With forecast traffic growth, the network performance in Haberfield around the Wattle Street interchange without the project is forecast to deteriorate over time. This part of the road network is forecast to be unable to accommodate the future traffic demands, with slow average speeds (less than 15 kilometres per hour) and queuing forecast during peak periods by 2033.

The forecast traffic demand results in increased congestion along Dobroyd Parade, Parramatta Road and Frederick Street in the future. Intersection performance is expected to be an issue in the vicinity of the Wattle Street interchange, such as at the Parramatta Road/Wattle Street and Parramatta Road/Liverpool Road intersections.

Rozelle and surrounds

With forecast traffic growth, the network performance in the vicinity of Rozelle without the project is forecast to deteriorate over time, with longer queues forecast on the Western Distributor and flow breakdown on Anzac Bridge, Victoria Road and City West Link in the AM peak period. In the PM peak period, the network performance is also forecast to deteriorate over time, with the network unable to accommodate the future traffic demands.

Intersection performance analysis demonstrates that by 2033, without the project, more intersections along Victoria Road are forecast to experience significant congestion during the peak hours than currently do.

St Peters interchange and surrounds

As with the other interchanges, forecast traffic growth without the project is expected to negatively impact the network performance around the St Peters interchange and surrounds. The introduction of the St Peters interchange with the opening of the New M5 project – but without the M4-M5 Link project – along with increased demand to and from Sydney Airport, is forecast to increase traffic demand in an already congested area, and cause a drop in average speeds in the network during peak hours.

The main areas of congestion are forecast to be in Mascot, in particular Gardeners Road, O'Riordan Street, Botany Road and the Princes Highway corridors. Intersections along these corridors are forecast to be unable to cope with increased demand and many are forecast to experience significant congestion during the peak hours. Poor overall intersection performance is likely to contribute not only to local congestion, but, in extreme cases, may cause queuing on the St Peters interchange exit ramps back to the mainline of the New M5 Motorway.

Future conditions with the project (operational traffic assessment)

A number of key benefits and improvements are forecast as a result of the project:

- Non-motorway roads in the Inner West local government area (LGA) are forecast to experience faster trips with the daily average speed increasing by about 10 per cent. Similarly, the vehicle distance travelled on non-motorway roads is forecast to reduce by about 12 per cent. This indicates that on average, these trips are fewer in number and faster
- Improved network productivity on the metropolitan network, with more trips forecast to be made or longer distances travelled on the network in a shorter time. The forecast increase in vehicle kilometres travelled (VKT) and reduction in vehicle hours travelled (VHT) is mainly due to traffic using the new motorway, with reductions in daily VKT and VHT also forecast on non-motorway roads
- The project, along with investment in other road, public transport and active transport projects, would help to accommodate the forecast growth in population and travel demand in the Sydney metropolitan area
- Reduced travel times are forecast on key corridors, such as between the M4 Motorway corridor and the Sydney Airport/Port Botany precinct
- Reduced traffic is forecast on sections of major arterial roads including City West Link, Parramatta Road, Victoria Road, King Street, King Georges Road and Sydenham Road
- Around 2,000 heavy vehicles are forecast to be removed from Parramatta Road, east of the M4 East Parramatta Road ramps, each weekday.

Where the project would connect to the existing road network, increased congestion is forecast in parts of Mascot, along Frederick Street at Haberfield, Victoria Road north of Iron Cove Bridge, Johnston Street at Annandale and on the Western Distributor. A number of these areas are forecast to improve when the proposed future Sydney Gateway and the proposed future Western Harbour Tunnel and Beaches Link are completed.

Forecast traffic in the mainline tunnels

Table ES-1 presents the two-way daily average weekday traffic (AWT) volumes that are forecast on the mainline tunnel sections of the project. Analysis indicates that operational performance levels of the mainline tunnels are forecast to be satisfactory in the 2023 scenarios and in the 2033 'with project' scenario. The 2033 'cumulative' scenario analysis indicates traffic flows on the motorway are forecast to be denser compared to the 2033 'with project' scenario, with a corresponding reduction in level of service in the peak hours. This is due to the additional motorway links in the 'cumulative' scenario (proposed future Western Harbour Tunnel and Beaches Link, Sydney Gateway, and F6 Extension projects), resulting in more traffic in the M4-M5 Link. Even with this increased density, average motorway speeds are still forecast to be 60 kilometres per hour or above in the peak hours.

Table ES-1 Two-way daily average weekday traffic (AWT) forecast in the M4-M5 Link mainline tunnels

Scenario	Year	Location	
		Between Wattle Street interchange and Rozelle interchange	Between Rozelle interchange and St Peters interchange
With project	2023	89,000	61,500
Cumulative		107,000	96,000
With project	2033	99,500	70,000
Cumulative		126,000	119,500

Source: WRTM v2.3, 2017

Network productivity

The addition of the M4-M5 Link provides a significant overall improvement to network productivity. As shown in **Table ES-2**, an overall increase in daily VKT and a reduction in daily VHT on the road network are forecast. This means that more trips could be made or longer distances travelled on the network in a shorter time. The forecast increase in VKT and reduction in VHT is mainly due to traffic using the new motorway, with reductions in daily VKT and VHT forecast on the non-motorway roads. This indicates the additional network capacity provided by the project would assist in accommodating the forecast growth in population and travel demand that would otherwise contribute to worsening road network and traffic conditions without the project. This trend continues in the 'cumulative' scenario, with reduced daily VKT and VHT forecast for the non-motorway roads.

Table ES-2 Comparison of daily VKT and VHT for metropolitan Sydney under future scenarios

Scenario	Year	Daily VKT ('000 km)			Daily VHT ('000 hours)		
		Motorway	Other	Total	Motorway	Other	Total
Base case	2015	23,940	74,810	98,750	400	2,520	2,920
Do minimum (without project)	2023	26,880	86,520	113,400	470	3,160	3,630
With project		27,730	86,050	113,780	480	3,120	3,600
Cumulative		27,980	85,970	113,950	470	3,110	3,570
Do minimum (without project)	2033	31,030	101,900	132,930	590	4,670	5,560
With project		32,010	101,410	133,430	600	4,610	5,220
Cumulative		33,780	100,650	134,420	600	4,500	5,100

Source: WRTM v2.3, 2017

Parallel routes analysis

As a result of the additional road network capacity provided by the project, the two-way future year AWT traffic demand compared to a 'without project' scenario is predicted to significantly decrease on:

- City West Link and Parramatta Road, east of the M4 East Wattle Street and Parramatta Road ramps respectively, by about 25 per cent in the 2023 and 2033 'with project' and 'cumulative' scenarios
- King Street in St Peters by about 20 per cent in the 2023 and 2033 'with project' scenarios
- Stanmore Road in Stanmore by about 15 per cent in the 2023 and 2033 'with project' and 'cumulative' scenarios
- Lyons Road in Russell Lea by about 15 per cent in the 2023 and 2033 'with project' scenarios, and about 20 per cent in the 2023 and 2033 'cumulative' scenarios
- Southern Cross Drive and the Sydney Harbour Tunnel by about 20 per cent and 25 per cent respectively in the 2023 and 2033 'cumulative' scenarios.

The M4-M5 Link would provide alternative parallel options to the roads listed above in the 'with project' scenario and with the proposed future Western Harbour Tunnel and Sydney Gateway (and Beaches Link and F6 Extension in 2033) in the 'cumulative' scenarios. The screenline analysis, presented in **Chapter 9**, found no major shifts in daily traffic onto parallel routes as a result of the project.

The reduction in traffic demand on these major traffic routes is likely to improve speed, journey reliability and safety on these corridors compared to a 'without project' scenario. The M4-M5 Link, combined with proposed future Sydney Gateway would improve connectivity between Sydney's international gateways (Sydney Airport and Port Botany), western Sydney and places of business across the Sydney region. The project would also provide additional route options along the corridor and therefore increase network resilience in the event of accidents or network disturbances.

There are significant reductions in forecast daily traffic volumes along Victoria Road (south of the proposed Iron Cove Link), King Georges Road, Stanmore Road, Addison Road and Sydenham Road compared to the 'without project' scenario. A decrease in the daily volume of heavy vehicles on surface roads is also forecast, as heavy vehicles shift onto the M4-M5 Link. Daily heavy vehicle volumes on Parramatta Road and City West Link are forecast to drop by 40 to 50 per cent, and roads in the Inner West, such as Stanmore Road, Sydenham Road, Marrickville Road and King Street, are forecast to drop by 20 to 50 per cent.

With the project, 2023 and 2033 peak period travel times are forecast to reduce between the M4 corridor and the Sydney Airport/Port Botany precinct, with traffic shifting from the A3 (King Georges Road) corridor to the M4-M5 Link. Between Parramatta and Sydney Airport, average peak period travel times are forecast to reduce by about 10 minutes, which is part of a 25 to 30 minute saving comparing the 'project' scenario to a scenario without WestConnex.

Further reductions on this route would occur in the 2023 and 2033 'cumulative' scenarios. Between Parramatta and Sydney Airport, average peak period travel times are forecast to reduce by a further 10 minutes in the 2023 'cumulative' scenario. This saving is part of a 35 minute saving comparing the 2023 'cumulative' scenario to a scenario without WestConnex. Average peak period travel times are forecast to reduce by a further five minutes in the 2033 'cumulative' scenario. This saving is part of a 40 minute saving comparing the 2033 'cumulative' scenario to a scenario without WestConnex.

In the 2033 'cumulative' scenario, increases are forecast in daily two-way volumes on Johnston Street, north of Parramatta Road in Annandale (about five to 15 per cent in the 'with project' scenario and about 10 to 20 per cent in the 'cumulative' scenario) and on Gladesville Bridge (about five per cent in the 'with project' scenario and 10 to 20 per cent in the 'cumulative' scenario). These increases reflect the forecast demand to and from the Rozelle area due to the new connectivity being provided by the Rozelle interchange.

Wattle Street interchange and surrounds

'With project' operational performance summary

In 2023, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- The impacts in the AM peak period are positive with travel times improving compared to 'without project' conditions. The number of vehicles on the surface road network is reduced as a result of traffic shifting to the M4-M5 Link, with subsequent benefits to the surface traffic network
- The network is also expected to undergo general improvement in performance in the PM peak when compared to 'without project' conditions, with vehicles travelling eastbound on Parramatta Road and citybound on City West Link experiencing the greatest benefits. As in the 'without project' scenario, demand for Frederick Street southbound remains high and so travel times along this section of the network remain long with queuing back along Wattle Street.

In 2033, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- In both AM and PM peak hours, the 'with project' scenario is forecast to better accommodate anticipated increases in demand than the 'without project' scenario, with intersection and network performance improvements across this part of the road network, although parts of the network are forecast to still experience congestion.

'Cumulative' operational performance summary

In both 2023 and 2033, comparing the 'cumulative' scenario to the 'with project' scenario, there are relatively minor changes in network performance, with the exception of a reduction in queuing and delays from Frederick Street to City West Link, as a result of a reduction in forecast demand to City West Link.

Rozelle interchange and surrounds

'With project' operational performance summary

By 2023, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- There is a substantial increase in overall forecast traffic demand in this area during the AM peak hour due to the new connectivity being provided by the Rozelle interchange, with eastbound congestion issues on the Western Distributor, mainly due to downstream exit blocking from Sydney Harbour Bridge. Congestion on the Western Distributor and across Anzac Bridge in the eastbound direction is forecast to cause queuing and delays on City West Link and Victoria Road and, for brief periods, the M4 eastbound exit ramp and the Iron Cove Link ramp to Anzac Bridge. Approaches to address this are discussed in the mitigation section
- In the PM peak hour, there are travel time improvements in the peak westbound direction towards City West Link and Victoria Road due to the Iron Cove Link and M4 connectivity. There are also forecast eastbound delays on the same roads caused by forecast traffic demand increases to Sydney Harbour Bridge.

By 2033, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- In the AM peak period, Anzac Bridge/Western Distributor is more congested citybound because of a forecast increase in demand due to the new connectivity being provided by the Rozelle interchange. As in 2023, citybound movements are mainly affected by the downstream exit blocking from Sydney Harbour Bridge. Congestion on the Western Distributor and across Anzac Bridge is forecast to cause delays and queues on City West Link and Victoria Road, as well as the M4 East exit ramp and the Iron Cove Link ramp to Anzac Bridge. Approaches to address this are discussed in the mitigation section
- In the PM peak period, the modelled road network with the project performs better than the 'without project' scenario, especially westbound from the Sydney CBD, due to the introduction of free flow connections from Anzac Bridge to the M4 East and Iron Cove. There is large unreleased demand on Western Distributor (as in the base case), The Crescent and Johnston Street by the end of the peak hour, indicating vehicles are likely to struggle to enter the modelled network in the peak hour.

'Cumulative' operational performance summary

In both 2023 and 2033, comparing the 'cumulative' scenario to the 'with project' scenario:

- Anzac Bridge/Western Distributor is forecast to be less congested eastbound in the AM peak period due to traffic reassigning to the proposed future Western Harbour Tunnel (and Beaches Link in the 2033 'cumulative' scenario)
- In the PM peak period, the network functions similar to the project case, with fewer unreleased vehicles on Western Distributor due to traffic reassigning to Western Harbour Tunnel (and Beaches Link in the 2033 'cumulative' scenario).

Primarily due to capacity constraints on Anzac Bridge and the Western Distributor, forecast demands cannot access the road network during the peak periods due to congestion extending back into model entry points. This occurs at the model boundaries on Victoria Road, City West Link and The Crescent/Johnston Street. Potential mitigation measures are discussed in **section 11.2**.

St Peters interchange and surrounds

The surface road network in the model is unable to accommodate the forecast peak hour demands without the additional road capacity provided by the proposed future Sydney Gateway. The proposed future Sydney Gateway introduces a bypass to Mascot town centre and, in its absence, it would be necessary to introduce upgrades at a number of intersections.

'With project' operational performance summary

In 2023, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- With the intersection upgrades, the 'with project' scenario performance is forecast to be similar to the 'without project' scenario. While average AM peak hour network traffic speeds and travel times are comparable, average network speeds in the PM peak hour are 28 per cent slower.

In 2033, comparing the 'with project' scenario to the 'do minimum' or 'without project' scenario:

- In the AM peak hour, with the intersection upgrades, the 'with project' scenario is forecast to provide improved network operation when compared with the 'without project' case. In the PM peak hour, the 'with project' scenario performs worse, with lower average network speed and longer travel times. Intersections are forecast to operate at similar or worse level of service.

Consistent with what was reported in the New M5 EIS, these results indicate that the complete WestConnex program of works, as well as the Sydney Gateway, is required to ensure the St Peters interchange area operates satisfactorily.

'Cumulative' operational performance summary

In 2023, comparing the 'cumulative' scenario to the 'with project' scenario:

- The 'cumulative' scenario has higher forecast traffic demands than the 'with project' scenario. Sydney Gateway provides a bypass to Mascot town centre, which contributes to improved network performance. Even with the forecast increased traffic demands, higher average network speed are forecast in both peaks
- Average network speed improves as a result of Sydney Gateway. However, buses only use the surface road network, which is still congested in both scenarios. As a result, despite higher average speed in the overall network, buses spend a similar amount of time travelling in the network.

In 2033, comparing the 'cumulative' scenario to the 'with project' scenario:

- Similar to the 2023 network performance results, the 'cumulative' scenario has a higher forecast demand than the 'with project' scenario, but both peaks are forecast to perform better than the 'with project' scenario. In both peaks, higher average network speeds are predicted in the 'cumulative' scenario network in spite of higher demands in the network. Similar to the 2023 scenarios, buses spend a comparable amount of time travelling in the network in the 2033 'cumulative' scenario.

Operations under staged opening

The mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters are planned for completion in 2022, while the Rozelle interchange is planned for completion in 2023. Therefore, there would be a period of around 12 months during which the mainline tunnels would be operational without the Rozelle interchange and the Iron Cove Link, although at a reduced lane capacity of only two lanes in each direction. Constructing the project in two stages would allow the mainline tunnels to operate independently before the completion of the Rozelle interchange and the Iron Cove Link and allow the benefits to the Sydney metropolitan road network of linking the M4 East and the New M5 component projects to be realised as soon as possible.

Under the staged opening, a two-way AWT of about 49,500 vehicles per day is forecast to use the mainline tunnels. Operational modelling indicates that the forecast peak hour volumes would be within the capacity of the two lanes and a level of service D or better is forecast.

In a 'mainline only' scenario, the Wattle Street and St Peters interchanges are the only entry and exit points for M4-M5 Link traffic. A comparison was made of the forecast traffic volumes at the Wattle Street interchange area and the St Peters interchange area in this 'mainline only' scenario with the other scenarios tested in this EIS. This comparison found that the forecast two-way traffic in a 'mainline only' scenario for the AM peak, PM peak and daily time periods was less than forecast traffic in some of the other scenarios tested in the EIS. Therefore, the temporary 'mainline only' scenario was not modelled as a separate scenario as the impact of higher forecast traffic volumes was tested in other scenarios in this assessment.

Management of impacts – operational

The management of operational traffic and transport impacts would be focused around the three interchanges at Wattle Street, Rozelle and St Peters. As with the M4 East and New M5 projects, Roads and Maritime would undertake a Road Network Performance Review, in consultation with Transport for NSW and relevant councils. This would confirm the operational traffic impacts of the M4-M5 Link on surrounding arterial roads and major intersections at both 12 months and five years after

the commencement of operation of the M4-M5 Link. The assessment would be based on future updated traffic surveys taken during operation and the methodology used would be comparable with that used in this assessment.

Wattle Street interchange and surrounds

The analysis has identified key constraints impacting the performance of the network on Frederick Street (southbound), Parramatta Road (eastbound) and City West Link (citybound) in the 'without project' scenario. The forecast congestion on Parramatta Road and City West Link are generally reduced by the M4-M5 Link project, particularly in 2023. It is expected that the M4 East Road Network Performance Review would examine potential management measures following the collection of updated (post-opening) data that would facilitate an understanding of actual project outcomes and update management measures, if necessary.

Notwithstanding the above, Roads and Maritime proposes to investigate the identified exit blocking from Frederick Street through the Parramatta Road/Wattle Street intersection in the 'with project' scenario. The exit blocking arises from forecast increase in southbound traffic demand, combined with capacity restrictions at downstream intersections and limited storage space on Frederick Street. Management measures to be investigated, in consultation with relevant local councils, could include:

- Queuing and capacity monitoring and management on the Frederick Street/Milton Street corridor
- Managing lane use and utilisation to improve the operation of the corridor.

Rozelle interchange and surrounds

The analysis has shown that Anzac Bridge/Western Distributor is currently at or close to capacity in the 2015 base case, particularly in the AM peak where existing operational and geometric features of the road network limit the capacity. As a result, the predicted increase in traffic demands in all future scenarios cannot be accommodated without some form of traffic or network management.

With the M4-M5 Link operational, there is an increase in the forecast eastbound AM peak hour demand, because the M4 East exit ramp and the Iron Cove Link to Anzac Bridge/Western Distributor provide bypasses of City West Link and Victoria Road respectively. Once the proposed future Western Harbour Tunnel and Beaches Link is operational, this forecast growth in demand reduces, but is still forecast to exceed the capacity of Anzac Bridge/Western Distributor.

Roads and Maritime is developing a strategy to ensure appropriate network integration in the areas surrounding the Rozelle interchange, including:

- Capacity improvement measures – a number of areas have been identified for investigation to improve capacity including the intersection of the Western Distributor and Pyrmont Bridge Road at Pyrmont, the merge and weave arrangements on the Western Distributor close to Darling Harbour, modifications through the use of moveable medians on the approaches to the Harbour Bridge and a review of kerbside use of the road network at the interfaces with the Western Distributor to remove key bottlenecks and allow additional capacity where appropriate
- Project staging options – effective staging of the opening of major projects would also keep forecast demands closer to capacity and adjustments to current staging and program timelines for major projects with the surrounding network may be required. Investigations are underway by Roads and Maritime to determine the effect and viability of altering key project timelines to achieve the best road network performance. This may include timing projects to reduce 'spikes' in the forecast demand that would exceed capacity operation and ensure effective control of traffic. As many of these projects are still in development, the requirements for staging are yet to be determined
- Demand management measures – demand management measures are being considered to effectively manage peak demand on critical links. These include the use of Smart Motorways (including ramp metering, variable speed limits and lane use management) and arterial

management through the re-optimisation of the Sydney coordinated adaptive traffic system (SCATS)[1] to manage the altered traffic patterns that will occur with the introduction of the project.

Specific measures will be identified as investigations progress and their implementation will depend on their complexity and appropriate timing to minimise impact on the community. Roads and Maritime will carry out these investigations in consultation with councils and the NSW Department of Planning and Environment to develop a program of works.

The Crescent, Johnston Street and Ross Street are forecast to experience increased levels of demand with the introduction of the project, with people travelling to and from the southern fringe of the Sydney CBD through the Annandale area. A strategy is being developed by Roads and Maritime to ensure the impacts of the project and other proposed transport projects are minimised. The strategy will involve investigating and identifying capacity improvement and mitigation measures along The Crescent, Ross Street and Johnston Street. These measures will be implemented in a staged approach to accommodate forecast demand, firstly for the M4-M5 Link and thereafter for the proposed future Western Harbour Tunnel and Beaches Link.

St Peters interchange and surrounds

The analysis has indicated a deteriorated network performance in the St Peters and Mascot area with the project. However, once Sydney Gateway is in place, a considerable amount of traffic would be removed from the St Peters and Mascot area and the network performance improved to a level generally better than in the 'without project' scenarios. Sydney Gateway is expected to be open at a similar time to the M4-M5 Link and separate planning, environmental assessment and approvals processes are underway. Specific interim mitigation measures for the 'with project' scenario are therefore not proposed.

Should the Sydney Gateway project be delayed for a significant length of time, it is expected that both the New M5 Road Network Performance Review Plan (conditioned as part of the New M5 approval) and the proposed M4-M5 Link Road Network Performance Review would confirm the operational traffic impacts of the projects on surrounding arterial roads and major intersections. These reviews are scheduled at 12 months and five years after the commencement of operation of the New M5 and the M4-M5 Link respectively. Key intersections in the St Peters and Mascot areas are already identified for review in the New M5 Road Network Performance Review Plan as part of the New M5 conditions of approval and the following additional intersections should be included in the M4-M5 Link Road Network Performance Review Plan:

- Gardeners Road/Kent Road
- Gardeners Road/O'Riordan Street
- Kent Road/Coward Street
- Bourke Road/Coward Street
- Kent Road/Ricketty Street.

These reviews would examine potential management measures at these locations, and other locations as identified in the Road Network Performance Review, to improve performance following the collection of data that would facilitate a clearer understanding of actual project impacts.

Construction traffic assessment

The majority of the project footprint is located underground within the mainline tunnels. However, surface areas would be required to support tunnelling activities, construction of the tunnel portals, the Rozelle interchange, interfaces with the Wattle Street interchange and the St Peters interchange, other surface roadworks, ventilation facilities, tunnel support facilities and other ancillary operations buildings and facilities.

[1] The Sydney coordinated adaptive traffic system (SCATS) is a traffic management system used to synchronise traffic signals to optimise traffic flow.

Construction of the project is expected to occur over a period of around five years (2018 to 2023). Based on the indicative construction program, 2021 was used as the assessment year for construction impacts, as this is when peak construction traffic volumes are expected. Heavy vehicles would be required to deliver and remove construction plant, equipment and materials as well as remove spoil and waste from the construction sites. Wherever possible, access to construction ancillary facilities is proposed to be gained directly from major arterial roads. Some use of local roads by heavy vehicles delivering materials and/or equipment may also be required, however this would be minimised as far as practicable. Additionally, construction would result in increased use of light vehicles on the surrounding road network associated with the construction workforce, including shift workers for tunnelling activities.

While construction traffic would impact on the operation of the road network surrounding the construction facilities, the analysis indicates that the intersection levels of service are forecast to generally not be significantly impacted, with the exception of the Wattle Street/Ramsay Street, Dobroyd Parade/Timbrell Drive, City West Link/James Street and City West Link/The Crescent intersections. This is due to City West Link and Wattle Street being one of the key routes for construction traffic. Impacts due to temporary lane closures and speed reductions, particularly during traffic staging, would also occur. A Construction Traffic and Access Management Plan (CTAMP) will be prepared and implemented to minimise disruption to road users.

As the volume of traffic generated by construction is expected to be relatively low compared to existing traffic, the effects of this short term increase on the existing road network is not expected to significantly impact road safety in the study area, though there is still a risk with construction traffic interacting with general traffic.

Management of impacts – construction

Prior to the commencement of construction of the project, a CTAMP would be prepared as part of the Construction Environmental Management Plan. The CTAMP would include the guidelines, general requirements and principles of traffic management to be implemented during construction. It would be prepared in accordance with Austroads *Guide to Road Design* (with appropriate Roads and Maritime supplements), the RTA *Traffic Control at Work Sites* manual and AS1742.3: *Manual of uniform traffic control devices – Part 3:Traffic control for works on roads*, and any other relevant standard, guide or manual. It would seek to minimise delays and disruptions, and identify and respond to any changes in road safety as a result of construction works.

Specifically, the CTAMP would include a detailed travel management strategy for construction staff at the various worksites, in consultation with local councils and stakeholders associated with any facilities adjacent to the project site. This strategy would include the promotion of public transport and carpooling to reduce worksite-related vehicle movements, and also investigate feasible options for the provision of vehicle parking strategies to reduce parking on local roads. In addition to development of CTAMP, mitigation strategies would be implemented to manage and control construction traffic, where reasonably practical.

1 Introduction

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Together with the other components of the WestConnex program of works and the proposed future Sydney Gateway, the project would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-western Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and local communities.

Approval is being sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) for the project. A request has been made for the NSW Minister for Planning to specifically declare the project to be State significant infrastructure and also critical State significant infrastructure. An environmental impact statement (EIS) is therefore required.

1.1 Overview of WestConnex and related projects

The M4-M5 Link is part of the WestConnex program of works. Separate planning applications and assessments have been completed for each of the approved WestConnex projects. Roads and Maritime has commissioned Sydney Motorway Corporation (SMC) to deliver WestConnex, on behalf of the NSW Government. However, Roads and Maritime is the proponent for the project.

In addition to linking to other WestConnex projects, the M4-M5 Link would provide connections to the proposed future Western Harbour Tunnel and Beaches Link, the Sydney Gateway (via the St Peters interchange) and the F6 Extension (via the New M5).

The WestConnex program of works, as well as related projects, are shown in **Figure 1-1** and described in **Table 1-1**.

Table 1-1 WestConnex and related projects

Project	Description	Status
WestConnex program of works		
M4 Widening	Widening of the existing M4 Motorway from Parramatta to Homebush.	Planning approval under the EP&A Act granted on 21 December 2014. Open to traffic.
M4 East	Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange.	Planning approval under the EP&A Act granted on 11 February 2016. Under construction.
King Georges Road Interchange Upgrade	Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project.	Planning approval under the EP&A Act granted on 3 March 2015. Open to traffic.

Project	Description	Status
New M5	Duplication of the M5 East from King Georges Road in Beverly Hills with tunnels from Kingsgrove to a new interchange at St Peters. The St Peters interchange allows for connections to the proposed future Sydney Gateway project and an underground connection to the M4-M5 Link. The New M5 tunnels also include provision for a future connection to the proposed future F6 Extension.	Planning approval under the EP&A Act granted on 20 April 2016. Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) granted on 11 July 2016. Under construction.
M4-M5 Link (the project)	Tunnels connecting to the M4 East at Haberfield (via the Wattle Street interchange) and the New M5 at St Peters (via the St Peters interchange), a new interchange at Rozelle and a link to Victoria Road (the Iron Cove Link). The Rozelle interchange also includes ramps and tunnels for connections to the proposed future Western Harbour Tunnel and Beaches Link project.	The subject of this EIS.
Related projects		
Sydney Gateway	A high-capacity connection between the St Peters interchange (under construction as part of the New M5 project) and the Sydney Airport and Port Botany precinct.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
Western Harbour Tunnel and Beaches Link	The Western Harbour Tunnel component would connect to the M4-M5 Link at the Rozelle interchange, cross underneath Sydney Harbour between the Birchgrove and Waverton areas, and connect with the Warringah Freeway at North Sydney. The Beaches Link component would comprise a tunnel that would connect to the Warringah Freeway, cross underneath Middle Harbour and connect with the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Seaforth. It would also involve the duplication of the Wakehurst Parkway between Seaforth and Frenchs Forest.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.
F6 Extension	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor.	Planning underway by Roads and Maritime and subject to separate environmental assessment and approval.

1.2 Study area

The study area for this assessment was informed by the forecast traffic and transport changes from the WestConnex Road Traffic Model version 2.3 (WRTM v2.3), a strategic traffic model that covers the Sydney metropolitan area. The extent of the study area and the areas requiring operational modelling assessment were determined through analysis of forecast WRTM v2.3 traffic flow differences as a result of the project.

The study area broadly encompasses an area extending from the Parramatta River in the north to Sydney Airport in the south and from the Eastern Distributor in the east to Haberfield and Marrickville in the west. It is predominantly focused on the corridor between Haberfield and Rozelle, the corridor

between Rozelle and St Peters, the corridor between Haberfield and St Peters, as well as the surface road networks around the Wattle Street, Rozelle and St Peters interchanges, as shown in **Figure 1-2**. Changes on strategic roads outside of this study area are assessed in the Sydney metropolitan road network sections and those outside the operational model areas are assessed through a screenline analysis, presented in **Chapter 9**. Further justification of the operational modelling areas is contained in **Annexure B**.

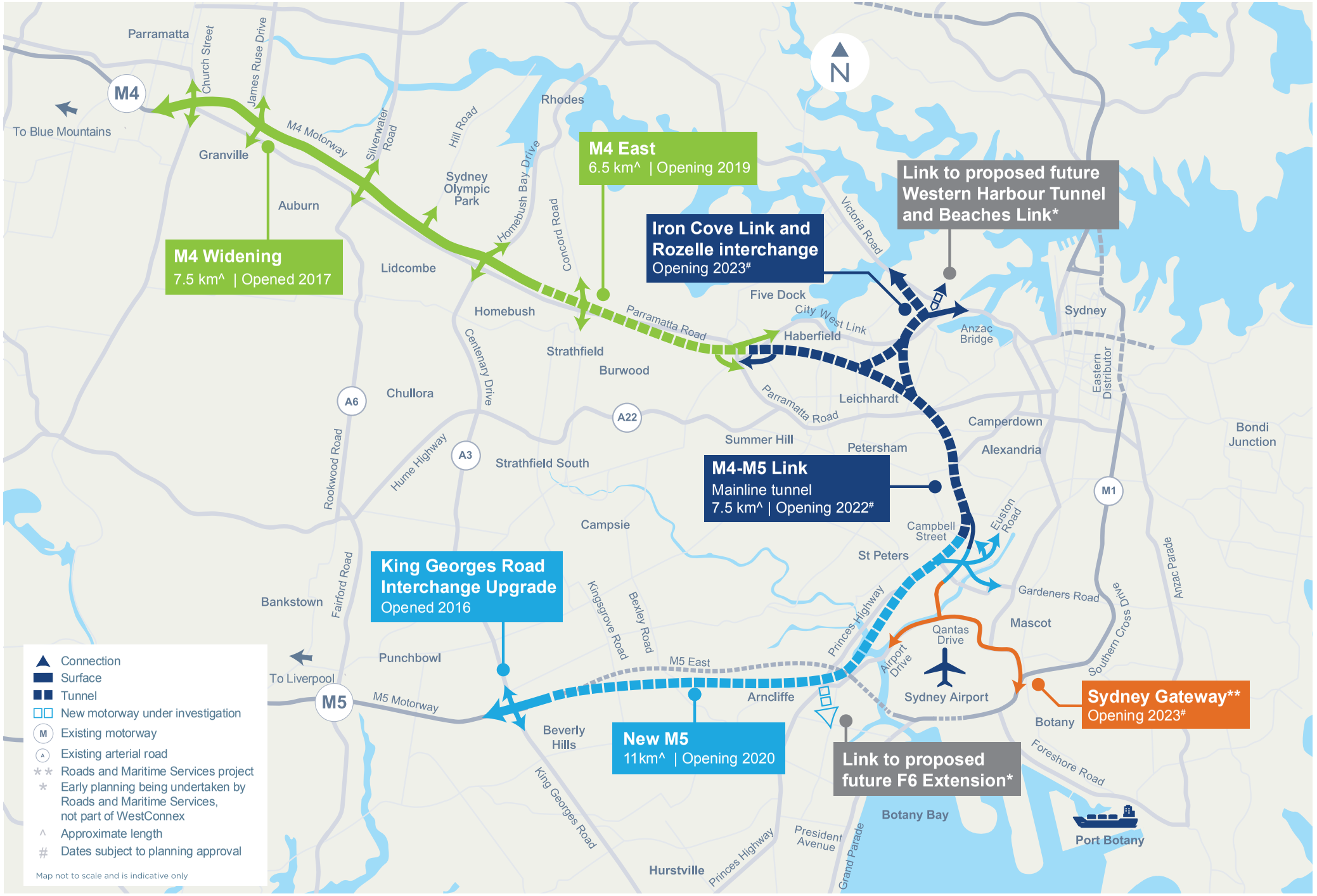


Figure 1-1 Overview of WestConnex and related projects

LEGEND

Existing features

- Waterway
- Railway
- Light rail
- Suburb boundary
- Arterial road
- Subarterial road
- Local road

Traffic study area

- Boundary

Figure 1-2 Study area

1.3 Purpose of this report

The purpose of this traffic and transport assessment is to support the EIS for the project by assessing and reporting existing and future traffic conditions. Specifically, the assessment includes the following:

- A review of existing traffic conditions, including a description of transport infrastructure in the study area, daily and peak hour traffic patterns, details of public transport frequency and mode share, and a review of active transport (pedestrian and cycle) networks, including pedestrian and cyclist networks
- Existing and future year intersection and roadway traffic volumes utilising outputs from the WRTM v2.3, with a particular focus on the project area between Haberfield, Rozelle and St Peters; including the predicted transfer of fixed and induced travel demand to the project from alternative transport corridors
- Construction traffic impacts, including an assessment of construction-related vehicles travelling on strategic and local roads that would provide access to the construction ancillary facilities
- Report on the operational performance of the existing and future road network around the Wattle Street, Rozelle and St Peters interchanges, as well as the M4-M5 Link in-tunnel traffic performance, during the AM peak and PM peak hours
- A holistic traffic and transport assessment that also includes crash analysis, travel speeds and travel time analysis and opportunities to enhance public transport networks within the project area. Opportunities to enhance active transport networks are discussed and presented in a separate active transport report (refer to **Appendix N** (Technical working paper: Active transport strategy) of the EIS)
- A suite of measures proposed to mitigate and manage traffic and transport impacts of the project during construction and operation.

1.4 SEARs and agency comments

In preparing this Technical working paper: Traffic and transport, the Secretary's Environmental Assessment Requirements (SEARs), issued for the M4-M5 Link project (SSI 7485) on 3 March 2016 and revised on 9 November 2016 and 3 May 2017, have been addressed. The key matters raised by the SEARs for consideration in the Technical working paper: Traffic and transport and where this technical working paper addresses these matters are outlined in **Table 1-2**.

In addition, agency letters, which accompany the SEARs and are applicable to traffic and transport, were issued by Inner West Council, City of Sydney Council, NSW Health and Port Authority of NSW. Details of how these matters were addressed in this assessment are included as **Annexure A**.

Table 1-2 How SEARs have been addressed in this report

SEARs	
Traffic and Transport	
Requirement	**Section where addressed in report**
1. The Proponent must assess **construction** transport and traffic (vehicle, pedestrian and cyclists) impacts, including, but not necessarily limited to:	– **Chapter 7**
(a) a considered approach to route identification and scheduling of transport movements, particularly outside standard construction hours;	– **Section 7.3**
(b) the number, frequency and size of construction related vehicles (passenger, commercial and heavy vehicles, including spoil management movements);	– **Section 7.3**
(c) construction worker parking;	– **Section 7.3**
(d) the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times and sensitive road users and parking arrangements);	– **Section 7.4** and **7.5**

SEARs	
Traffic and Transport	
Requirement	**Section where addressed in report**
(e) access constraints and impacts on public transport, pedestrians and cyclists;	– **Section 7.4** and **7.5**
(f) the need to close, divert or otherwise reconfigure elements of the road, cycle and pedestrian network associated with construction of the project. Where the closure, diversion or reconfiguration are temporary, provide an estimate of the duration of the altered access arrangements; and	– **Section 7.4** and **7.5**
(g) the cumulative traffic impacts of other key infrastructure projects preparing for or commencing construction, including but not limited to other stages of WestConnex.	– **Section 7.6**
2. The Proponent must model and/or assess the **operational** transport impacts of the project including, but not necessarily limited to:	– **Chapters 9, 10 and 12**
(a) forecast travel demand and traffic volumes (expressed in terms of total numbers and heavy and light vehicle numbers) for the project and the surrounding road, cycle and public transport network, including potential shifts of traffic movements on alternate routes outside the proposal area (such as toll avoidance) and impact of permanent street closures directly attributable to the SSI;	– **Chapters 9, 10** and **Annexure D**
(b) travel time analysis;	– **Sections 10.1**, **10.3**, **10.4**, **10.5**, **12.2**, **12.4**, **12.5** and **12.6**
(c) performance of key interchanges and intersections by undertaking a level of service analysis at key locations, for peak periods;	– **Sections 10.1**, **10.3**, **10.4**, **10.5**, **12.2**, **12.4**, **12.5** and **12.6**
(d) wider transport interactions (local and regional roads, cycling, public and freight transport), taking into account the Sydney City Centre Access Strategy, planned future urban release areas such as The Bays Precinct and planned future port activities and uses;	– **Section 3.4**, **10.1**, **10.4**, **12.2** and **12.5**
(e) the redistribution of traffic and impacts on traffic volumes and levels of service on the road network resulting from changes to the design of the M4-M5 Link as modelled in the traffic assessments for the M4 East and New M5 projects;	– **Annexure C**, **Sections 9**, **10.1**, **10.3**, **10.4**, **10.5**, **12.2**, **12.4**, **12.5** and **12.6**
(f) induced traffic and operational implications for existing and proposed public transport (particularly with respect to strategic bus corridors and bus routes and permanent closure/relocation of bus stops) and consideration of opportunities to improve public transport;	– **Sections 10.1**, **10.3**, **10.4**, **10.5**, **12.2**, **12.4**, **12.5** and **12.6**
(g) impacts on cyclists and pedestrian access and safety, including on known routes and future proposals, such as along Lilyfield Road;	– **Appendix N** (Technical working paper: Active transport strategy) of the EIS
(h) opportunities to integrate cycling and pedestrian elements with surrounding networks and within the project; and	– **Appendix N** (Technical working paper: Active transport strategy) of the EIS

SEARs	
Traffic and Transport	
Requirement	**Section where addressed in report**
(i) property and business access and on street parking. The assessment must provide an explanation for the scope of the modelled area, including justification of the nominated boundaries.	– **Sections 10.3**, **10.4**, **10.5**, **12.4**, **12.5** and **12.6** – **Section 1.4** and **Annexure B**

1.5 Structure of this report

This report has been structured as follows:

- **Chapter 2** presents an overview of the project
- **Chapter 3** provides an appreciation of the strategic transport context of the project
- **Chapter 4** documents the traffic modelling approach adopted to predict future travel demand and traffic volumes for the project and surrounding road network and to assess construction and operational impacts
- **Chapter 5** provides an overview of the existing traffic and transport conditions, including details of public transport frequency and patronage and a summary of daily and peak hour traffic patterns
- **Chapter 6** outlines the operational performance of the existing road network in terms of network performance and intersection levels of service, travel times and crashes
- **Chapter 7** documents the impact assessment undertaken for the construction scenarios
- **Chapter 8** provides details of future traffic and transport operational conditions without the project
- **Chapter 9** presents a strategic assessment of future daily and peak hour traffic volumes and patterns with the project
- **Chapter 10** documents the impact assessment undertaken for peak hour operational scenarios with the project
- **Chapter 11** documents management measures that are proposed to mitigate the traffic and transport impacts of the project
- **Chapter 12** documents the impact assessment undertaken for the cumulative peak hour operational scenarios
- **Chapter 13** provides a conclusion to the traffic and transport assessment.

A separate active transport report (refer to **Appendix N** (Technical working paper: Active transport strategy) of the EIS) addresses pedestrian and cycling impacts of the project, as well as planned active transport infrastructure as part of the project.

2 The project

2.1 Project location

The project would be generally located within the City of Sydney and Inner West local government areas (LGAs). The project is located about two to seven kilometres south, southwest and west of the Sydney central business district (CBD) and would cross the suburbs of Ashfield, Haberfield, Leichhardt, Lilyfield, Rozelle, Annandale, Stanmore, Camperdown, Newtown and St Peters. The local context of the project is shown in **Figure 2-1**.

2.2 Overview of the project

Key components of the project are shown in **Figure 2-1** and would include:

- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and would generally accommodate up to four lanes of traffic in each direction
- Connections of the mainline tunnels to the M4 East project, comprising:
  - A tunnel-to-tunnel connection to the M4 East mainline stub tunnels east of Parramatta Road near Alt Street at Haberfield
  - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project)
  - Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking
- Connections of the mainline tunnels to the New M5 project, comprising:
  - A tunnel-to-tunnel connection to the New M5 mainline stub tunnels north of the Princes Highway near the intersection of Mary Street and Bakers Lane at St Peters
  - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project)
  - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and line marking
- An underground interchange at Leichhardt and Annandale (the Inner West subsurface interchange) that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link (see below)
- A new interchange at Lilyfield and Rozelle (the Rozelle interchange) that would connect the M4-M5 Link mainline tunnels with:
  - City West Link
  - Anzac Bridge
  - The Iron Cove Link (see below)
  - The proposed future Western Harbour Tunnel and Beaches Link
- Construction of connections to the proposed future Western Harbour Tunnel and Beaches Link project as part of the Rozelle interchange, including:
  - Tunnels that would allow for underground mainline connections between the M4 East and New M5 motorways and the proposed future Western Harbour Tunnel and Beaches Link (via the M4-M5 Link mainline tunnels)
  - A dive structure and tunnel portals within the Rozelle Rail Yards, north of the City West Link / The Crescent intersection
  - Entry and exit ramps that would extend north underground from the tunnel portals in the

Rozelle Rail Yards to join the mainline connections to the proposed future Western Harbour Tunnel and Beaches Link

  - A ventilation outlet and ancillary facilities as part of the Rozelle ventilation facility (see below)
- Twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge (the Iron Cove Link). Underground entry and exit ramps would also provide a tunnel connection between the Iron Cove Link and the New M5 / St Peters interchange (via the M4-M5 Link mainline tunnels)
- The Rozelle surface works, including:
  - Realigning The Crescent at Annandale, including a new bridge over Whites Creek and modifications to the intersection with City West Link
  - A new intersection on City West Link around 300 metres west of the realigned position of The Crescent, which would provide a connection to and from the New M5/St Peters interchange (via the M4-M5 Link mainline tunnels)
  - Widening and improvement works to the channel and bank of Whites Creek between the light rail bridge and Rozelle Bay at Annandale, to manage flooding and drainage for the surface road network
  - Reconstructing the intersection of The Crescent and Victoria Road at Rozelle, including construction of a new bridge at Victoria Road
  - New and upgraded pedestrian and cyclist infrastructure
  - Landscaping, including the provision of new open space within the Rozelle Rail Yards
- The Iron Cove Link surface works, including:
  - Dive structures and tunnel portals between the westbound and eastbound Victoria Road carriageways, to connect Victoria Road east of Iron Cove Bridge with the Iron Cove Link
  - Realignment of the westbound (southern) carriageway of Victoria Road between Springside Street and the eastern abutment of Iron Cove Bridge
  - Modifications to the existing intersections between Victoria Road and Terry, Clubb, Toelle and Callan streets
  - Landscaping and the establishment of pedestrian and cycle infrastructure
- Five motorway operations complexes; one at Leichhardt (MOC1), three at Rozelle (Rozelle West (MOC2), Rozelle East (MOC3) and Iron Cove Link (MOC4)), and one at St Peters (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets, offices, on-site storage and parking for employees
- Tunnel ventilation systems, including ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels
- Three new ventilation facilities, including:
  - The Rozelle ventilation facility at Rozelle
  - The Iron Cove Link ventilation facility at Rozelle
  - The Campbell Road ventilation facility at St Peters
- Fitout (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of M4 East project) for use by the M4-M5 Link project
- Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities. Water treatment would occur at
  - Two operational water treatment facilities (at Leichhardt and Rozelle)
  - The constructed wetland within the Rozelle Rail Yards
  - A bioretention facility for stormwater runoff within the informal car park at King George Park at

Rozelle (adjacent to Manning Street). A section of the existing informal car park would also be upgraded, including sealing the car park surface and landscaping

- Treated water would flow back to existing watercourses via new, upgraded and existing infrastructure
- Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage)
- Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems
- Utility works, including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities. A Utilities Management Strategy has been prepared for the project that identifies management options for utilities, including relocation or adjustment. Refer to **Appendix F** (Utilities Management Strategy) of the EIS.

The project does not include:

- Site management works at the Rozelle Rail Yards. These works were separately assessed and determined by Roads and Maritime through a Review of Environmental Factors under Part 5 of the EP&A Act (refer to **Chapter 2** (Assessment process) of the EIS)
- Ongoing motorway maintenance activities during operation
- Operation of the components of the Rozelle interchange which are the tunnels, ramps and associated infrastructure being constructed to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project.

Temporary construction ancillary facilities and temporary works to facilitate the construction of the project would also be required.

2.2.1 Staged construction and opening of the project

It is anticipated the project would be constructed and opened to traffic in two stages (as shown in **Figure 2-1**).

Stage 1 would include:

- Construction of the mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnels open to traffic in 2022. At the completion of Stage 1, the mainline tunnels would operate with two traffic lanes in each direction. This would increase to generally four lanes at the completion of Stage 2, when the full project is operational.

Stage 2 would include:

- Construction of the Rozelle interchange and Iron Cove Link including:
  - Connections to the stub tunnels at the Inner West subsurface interchange (built during Stage 1)
  - Ancillary infrastructure at the Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and Iron Cove Link motorway operations complex (MOC4)
  - Connections to the surface road network at Lilyfield and Rozelle
  - Construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project
- Stage 2 works are expected to commence in 2019 with these components of the project open to traffic in 2023.

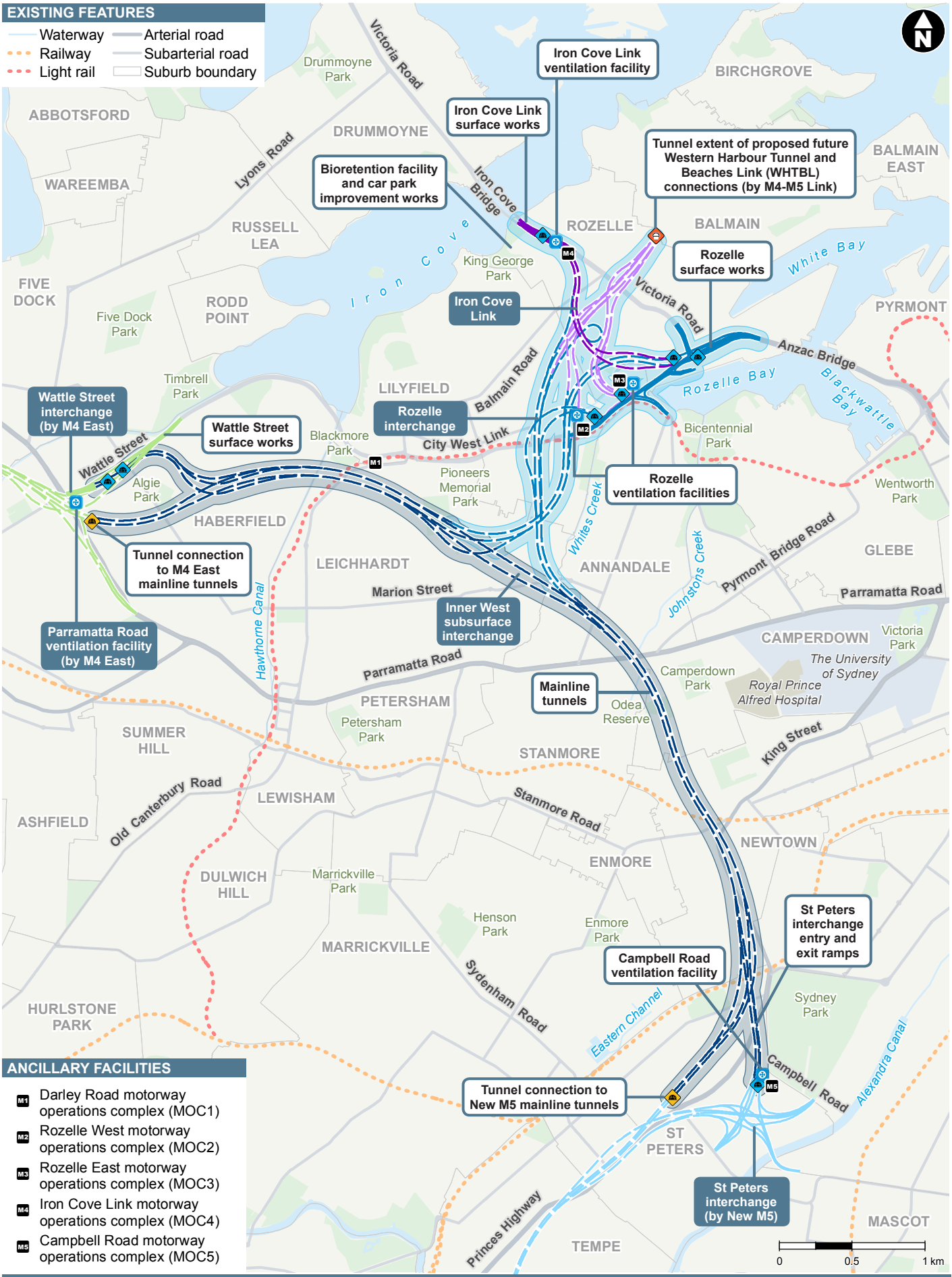


Figure 2-1 Overview of the project

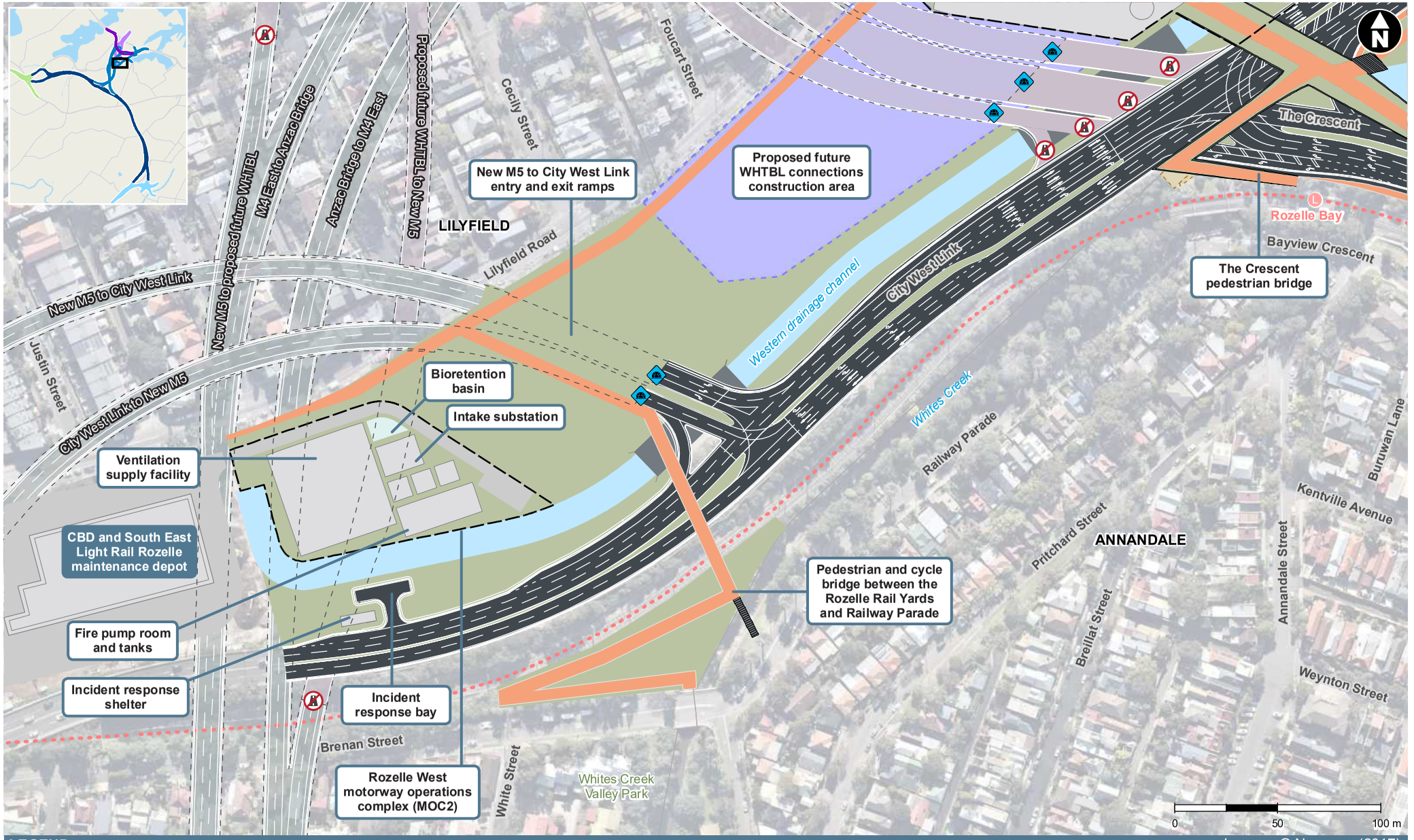


Figure 2-2 Rozelle interchange surface works overview - Map 1

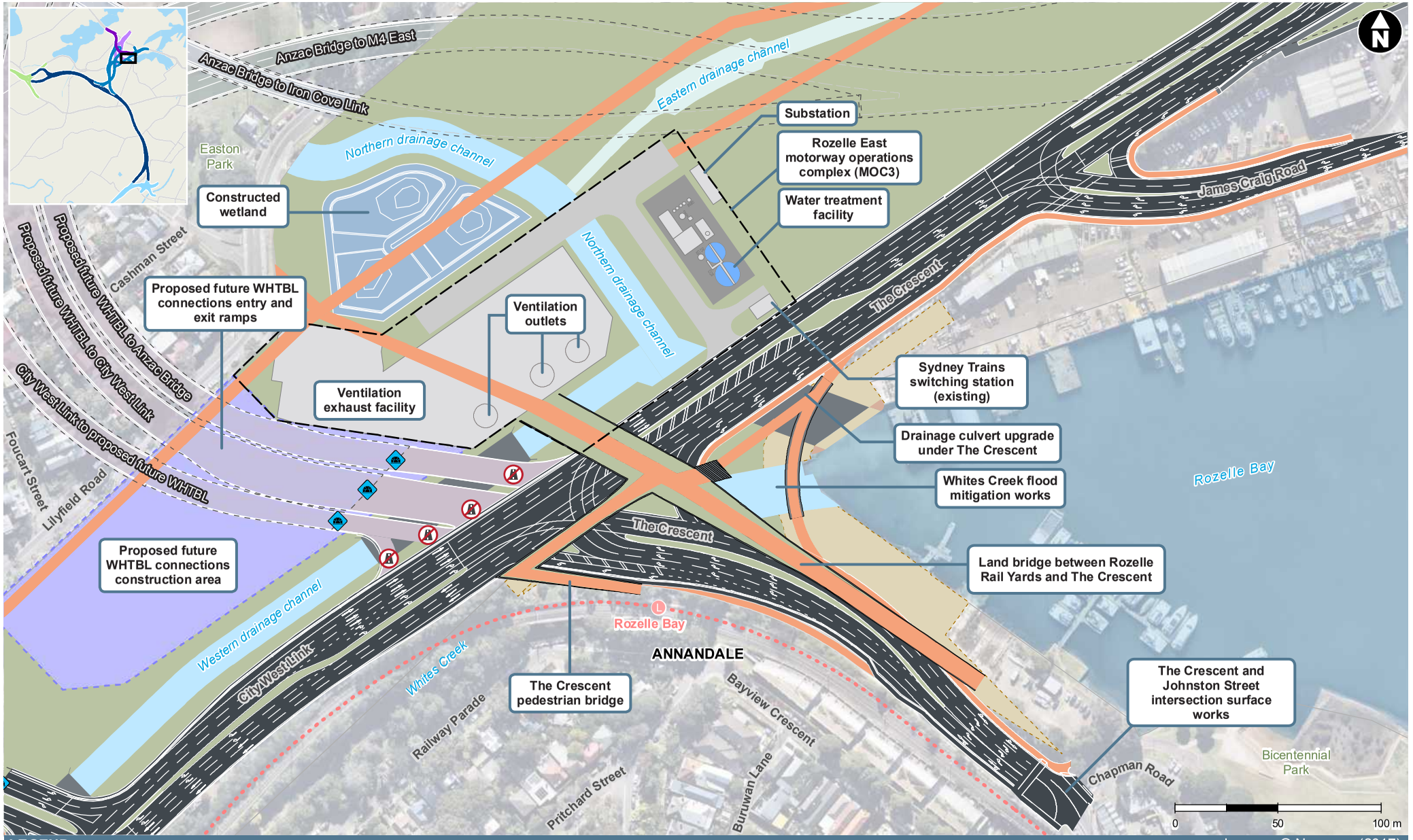


Figure 2-3 Rozelle interchange surface works overview - Map 2

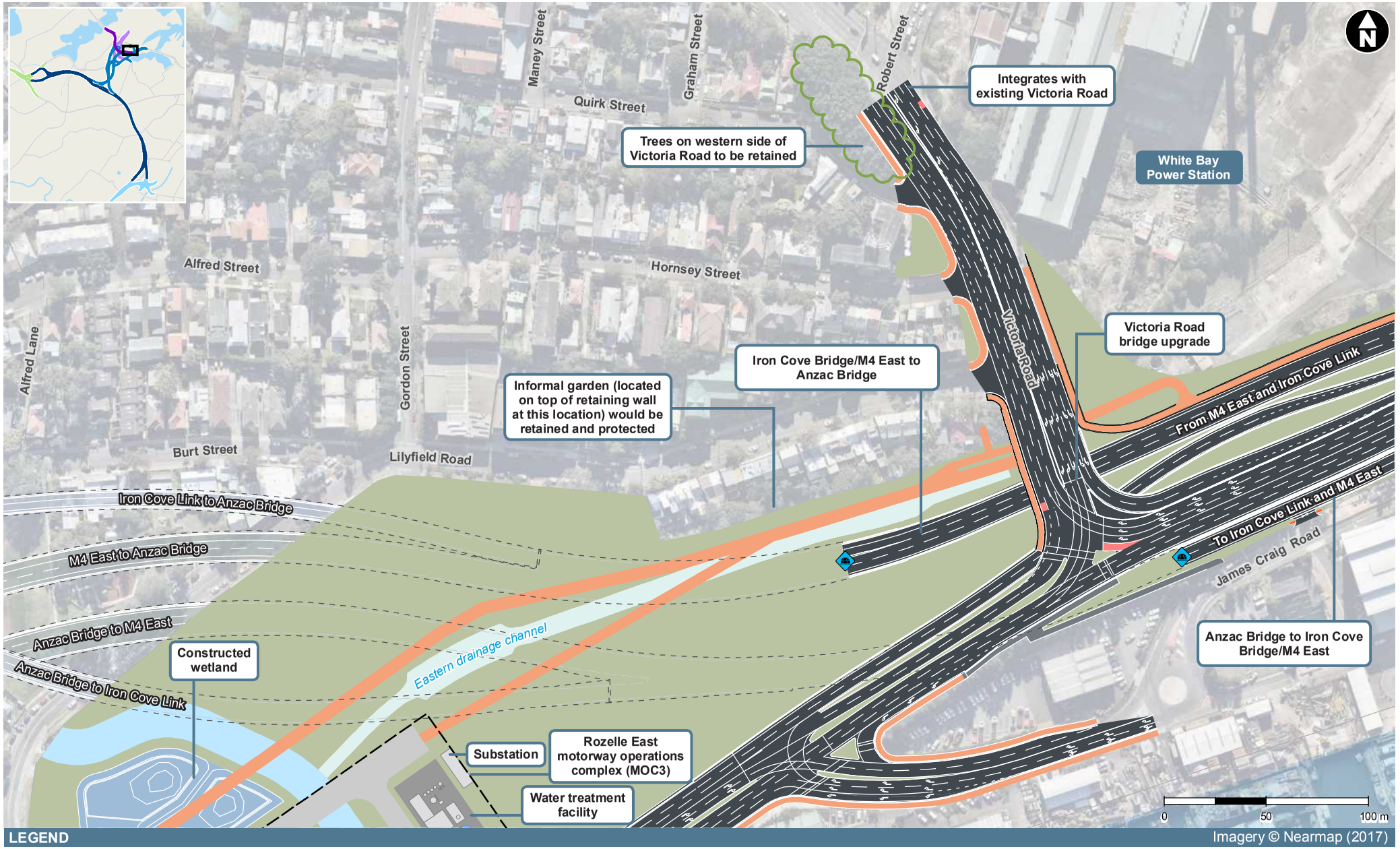


Figure 2-4 Rozelle interchange surface works overview - Map 3

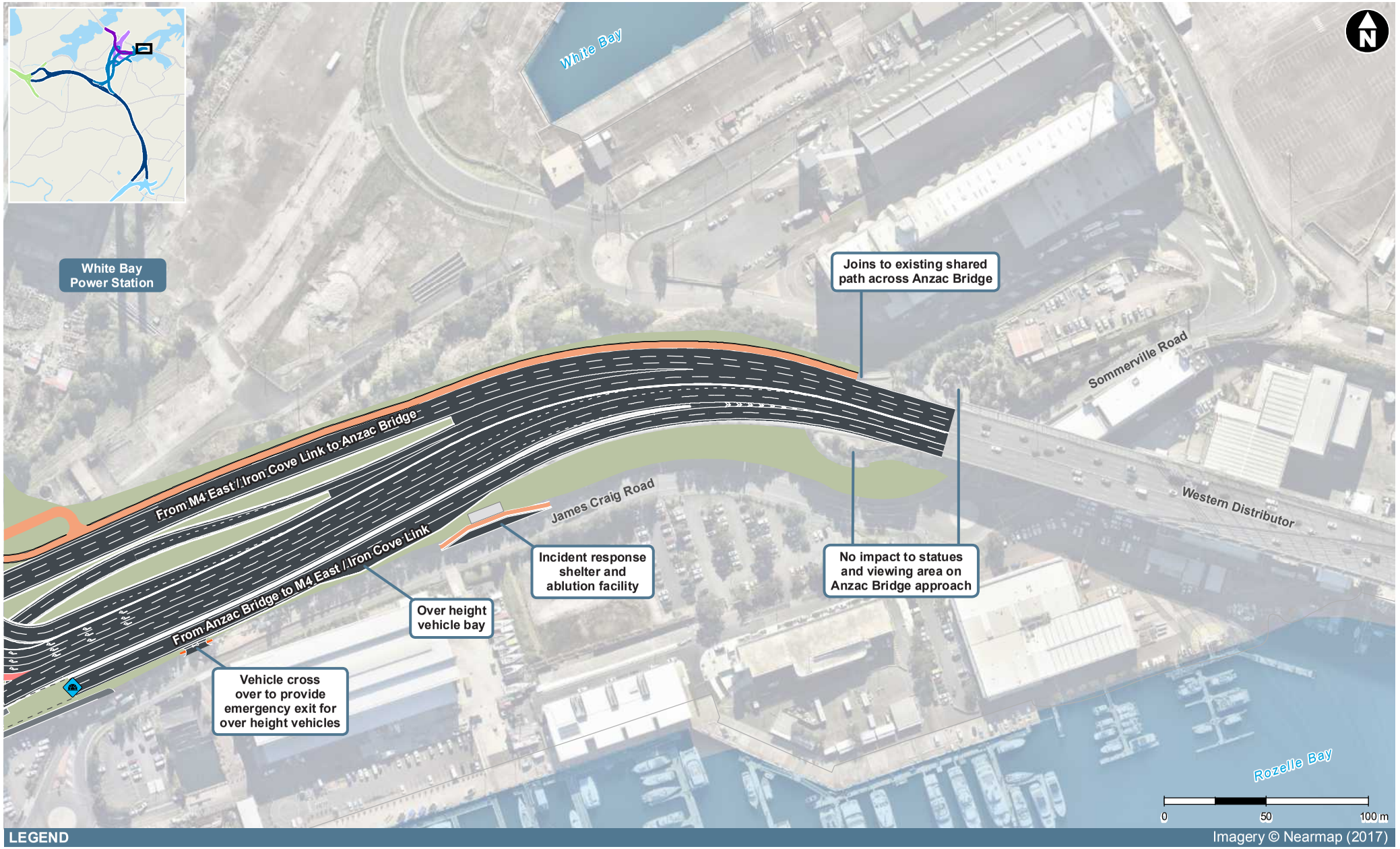


Figure 2-5 Rozelle interchange surface works overview - Map 4

Figure 2-6 Iron Cove Link surface works - Map 1

Figure 2-7 Iron Cove Link surface works - Map 2

2.3 Construction activities

2.3.1 Overview

An overview of the key construction features of the project is shown on **Figure 2-8** and would generally include:

- Enabling and temporary works, including provision of construction power and water supply, ancillary site establishment including establishment of acoustic sheds and construction hoarding, demolition works, property adjustments and public and active transport modifications (if required)
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure
- Haulage of spoil generated during tunnelling and excavation activities
- Fitout of the road tunnels and support infrastructure, including ventilation and emergency response systems
- Construction and fitout of the motorway operations complexes and other ancillary operations buildings
- Realignment, modification or replacement of surface roads, bridges and underpasses
- Implementation of environmental management and pollution control facilities for the project.

A more detailed overview of construction activities is provided in **Table 2-1**.

Table 2-1 Overview of construction activities

Component	Typical activities
Site establishment and enabling works	• Vegetation clearing and removal • Utility works • Traffic management measures • Install safety and environmental controls • Install site fencing and hoarding • Establish temporary noise attenuation measures • Demolish buildings and structures • Carry out site clearing • Heritage salvage or conservation works (if required) • Establish construction ancillary facilities and access • Establish acoustic sheds • Supply utilities (including construction power) to construction facilities • Establish temporary pedestrian and cyclist diversions
Tunnelling	• Construct temporary access tunnels • Excavation of mainline tunnels, entry and exit ramps and associated tunnelled infrastructure and install ground support • Spoil management and haulage • Finishing works in tunnel and provision of permanent tunnel services • Test plant and equipment
Surface earthworks and structures	• Vegetation clearing and removal • Topsoil stripping • Excavate new cut and fill areas • Construct dive and cut-and-cover tunnel structures • Install stabilisation and excavation support (retention systems) such as sheet pile walls, diaphragm walls and secant pile walls (where required) • Construct required retaining structures • Excavate new road levels
Bridge works	• Construct piers and abutments • Construct headstock • Construct bridge deck, slabs and girders • Demolish and remove redundant bridges

Component	Typical activities
Drainage	• Construct new pits and pipes • Construct new groundwater drainage system • Connect drainage to existing network • Construct sumps in tunnels as required • Construct water quality basins, constructed wetland and bioretention facility and basin • Construct drainage channels • Construct spill containment basin • Construct onsite detention tanks • Adjustments to existing drainage infrastructure where impacted • Carry out widening and naturalisation of a section of Whites Creek • Demolish and remove redundant drainage
Pavement	• Lay select layers and base • Lay road pavement surfacing • Construct pavement drainage
Operational ancillary facilities	• Install ventilation systems and facilities • Construct water treatment facilities • Construct fire pump rooms and install water tanks • Test and commission plant and equipment • Construct electrical substations to supply permanent power to the project
Finishing works	• Line mark to new road surfaces • Erect directional and other signage and other roadside furniture such as street lighting • Erect toll gantries and other control systems • Construct pedestrian and cycle paths • Carry out earthworks at disturbed areas to establish the finished landform • Carry out landscaping • Closure and backfill of temporary access tunnels (except where these are to be used for inspection and/or maintenance purposes) • Site demobilisation and preparation of the site for a future use

Twelve construction ancillary facilities are described in this EIS (as listed below).To assist in informing the development of a construction methodology that would manage constructability constraints and the need for construction to occur in a safe and efficient manner, while minimising impacts on local communities, the environment, and users of the surrounding road and other transport networks, two possible combinations of construction ancillary facilities at Haberfield and Ashfield have been assessed in this EIS. The construction ancillary facilities that comprise these options have been grouped together in this EIS and are denoted by the suffix a (for Option A) or b (for Option B).

The construction ancillary facilities required to support construction of the project include:

- Construction ancillary facilities at Haberfield (Option A), comprising:
  - Wattle Street civil and tunnel site (C1a)
  - Haberfield civil and tunnel site (C2a)
  - Northcote Street civil site (C3a)
- Construction ancillary facilities at Ashfield and Haberfield (Option B), comprising:
  - Parramatta Road West civil and tunnel site (C1b)
  - Haberfield civil site (C2b)
  - Parramatta Road East civil site (C3b)
- Darley Road civil and tunnel site (C4)
- Rozelle civil and tunnel site (C5)

- The Crescent civil site (C6)
- Victoria Road civil site (C7)
- Iron Cove Link civil site (C8)
- Pyrmont Bridge Road tunnel site (C9)
- Campbell Road civil and tunnel site (C10).

The number, location and layout of construction ancillary facilities would be finalised as part of detailed construction planning during detailed design and would meet the environmental performance outcomes stated in the EIS and the Submissions and Preferred Infrastructure Report and satisfy criteria identified in any relevant conditions of approval.

The construction ancillary facilities would be used for a mix of civil surface works, tunnelling support, construction workforce parking and administrative purposes. Wherever possible, construction sites would be co-located with the operational footprint to minimise property acquisition and temporary disruption. The layout and access arrangements for the construction ancillary facilities are based on the concept design only and would be confirmed and refined in response to submissions received during the exhibition of this EIS and during detailed design.

2.3.2 Construction program

The total period of construction works for the project is expected to be around five years, with commissioning occurring concurrently with the final stages of construction. An indicative construction program is shown in **Table 2-2**.

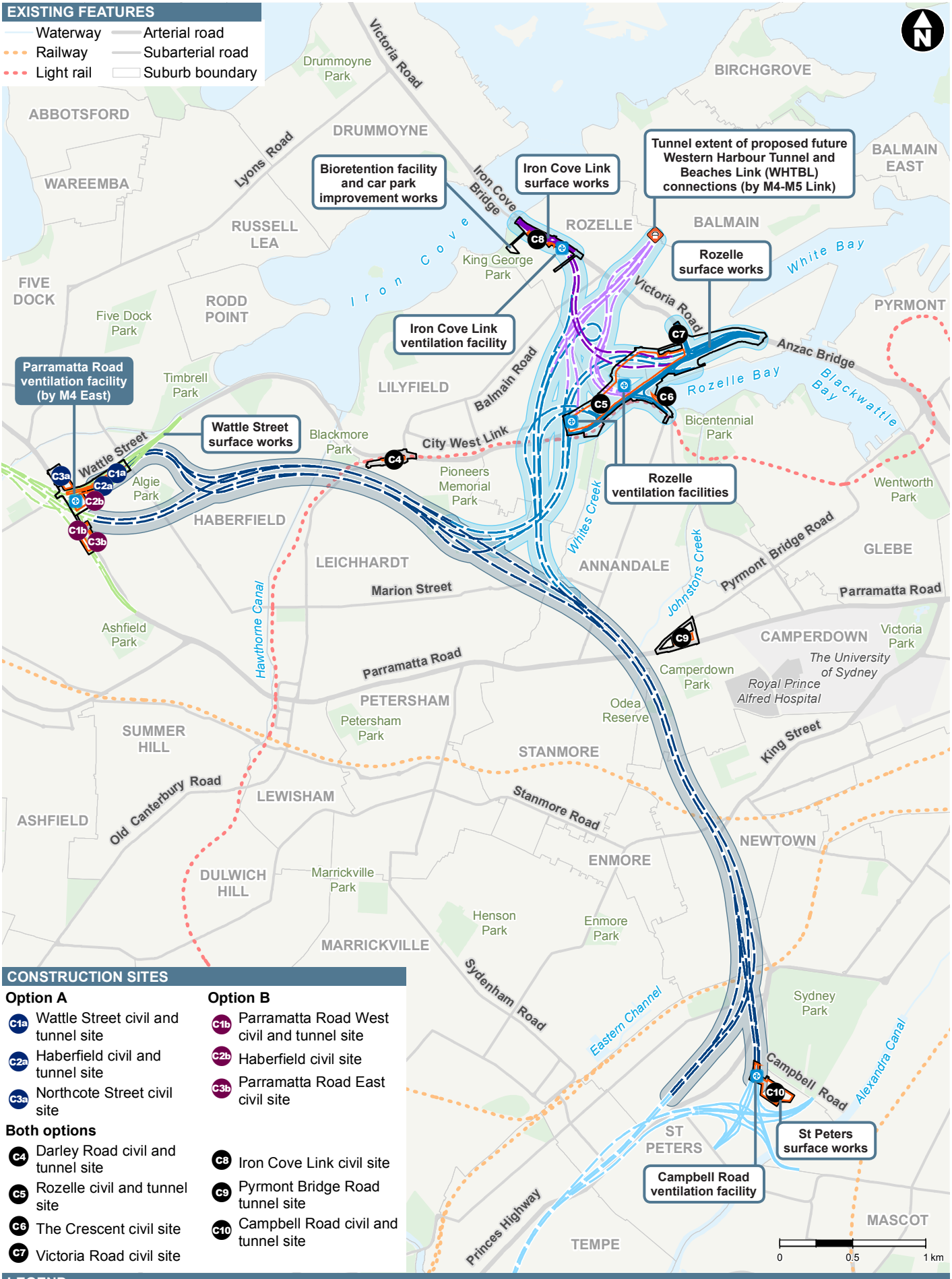


Figure 2-8 Overview of project footprint and ancillary facilities

Table 2-2 Indicative construction program

Construction activity	Indicative construction timeframe																							
	2018				2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mainline tunnels																								
Site establishment and establishment of construction ancillary facilities			■	■	■	■	■	■	■	■														
Utility works and connections			■	■	■	■	■	■																
Tunnel construction				■	■	■	■	■	■	■	■	■	■											
Portal construction				■	■	■	■	■																
Construction of permanent operational facilities												■	■	■	■	■								
Mechanical and electrical fitout works														■	■	■								
Establishment of tolling facilities															■	■								
Site rehabilitation and landscaping																■	■	■	■					
Surface road works																	■	■	■					
Demobilisation and rehabilitation																			■	■				
Testing and commissioning																■	■	■	■	■				
Rozelle interchange and Iron Cove Link																								
Site establishment and establishment of construction ancillary facilities				■	■	■	■	■	■															
Utility works and connections and site remediation				■	■	■	■	■																
Tunnel construction									■	■	■	■	■	■	■	■	■							
Portal construction						■	■	■	■															
Construction of surface road works						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Construction of permanent operational facilities						■	■	■	■	■	■	■	■	■	■	■								
Mechanical and electrical fitout works													■	■	■	■	■	■	■	■				
Establishment of tolling facilities																		■	■					
Site rehabilitation and landscaping																			■	■				
Demobilisation and rehabilitation																						■		
Testing and commissioning																			■	■	■	■		

3 Strategic transport context

3.1 Appreciation of the strategic context

The traffic and transport assessment methodology was developed with consideration of relevant strategic planning and transport policies to provide a firm understanding of the traffic and transport effects of the project and how they respond to the WestConnex objectives.

Investment in customer focused transport infrastructure is a NSW Government priority and essential to sustainable economic growth and prosperity, in Sydney and the wider region. *A Plan for Growing Sydney* (NSW Government 2014) indicates that over the 20 years from 2011 to 2031, Sydney's population is forecast to increase from 4.3 to 5.9 million, which equates to an average of 80,000 additional residents per year. Moreover, by 2036, the number of trips made around the city each day is forecast to increase by 31 per cent from 16 to 21 million vehicle movements[2].

This growth, particularly with population and employment located in different parts of the city, would put increasing pressure on the NSW transport network and the 46 travel demand corridors connecting the regional cities and major centres across the greater Sydney metropolitan area, as shown in **Figure 3-1**. It is recognised that not all trips can be served by public transport, especially leisure trips or commercial trips that require the movement of large or heavy goods/materials. Each corridor currently accommodates high levels of daily traffic including freight, commuter and leisure travel and the trips using the corridors experience congestion and delay, particularly during the weekday and weekend peak periods.

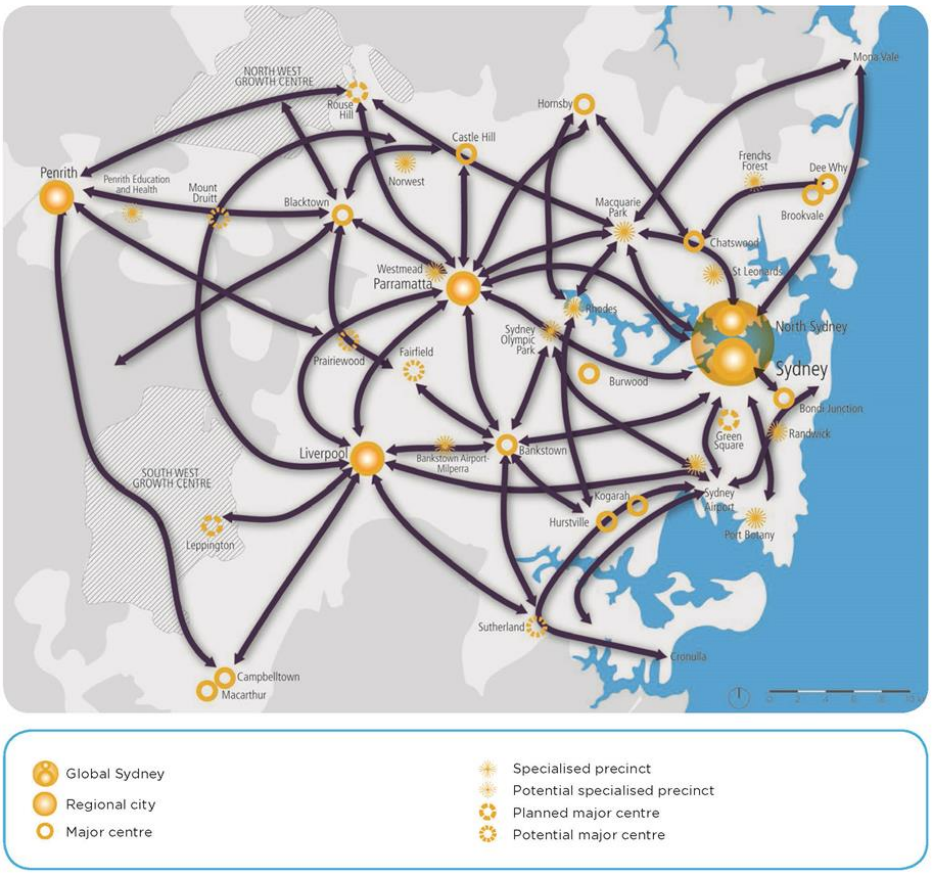


Figure 3-1 Sydney travel demand corridors

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

[2] NSW Government, *A Plan for Growing Sydney,* 2014.

Changes in transport technology and trip patterns, due to developments like autonomous vehicles, and increased use of web-based transport on demand services, may affect future travel demand, but there is a lack of conclusive quantitative evidence on what these effects might be. Therefore, this has been excluded from the analysis. For the purposes of this study and the traffic forecasts used, assumptions around technology and the economics of energy and economic performance are assumed to be constant for all future scenarios, ie with and without the project.

The study area for the traffic and transport assessment includes parts of the Sydney Trains suburban railway network, light rail and bus networks, freight rail and road access to the Sydney CBD, Port Botany, and Sydney Airport. The study area also covers parts of four of the main travel demand corridors:

- Parramatta to the Sydney CBD via Strathfield
- Parramatta to the Sydney CBD via Ryde
- Sydney Airport to the Sydney CBD
- Liverpool to Sydney Airport.

3.1.1 Parramatta to the Sydney CBD via Strathfield

This is the main corridor connecting western Sydney to the Global Economic Corridor (a corridor that extends from the CBD north to Macquarie Park and south to Sydney Airport and Port Botany) and carries the highest number of transit passengers of any corridor in Sydney (with over 40,000 in the peak hour period towards the Sydney CBD).

Key transport routes within this corridor include the Western Rail Line, M4 Motorway and Parramatta Road, City West Link and the Inner West Light Rail. Continued investment is proposed to ease congestion and provide capacity for future growth, including the M4 East (which is under construction), the M4-M5 Link, and the proposed Parramatta Light Rail and Sydney Metro West.

The corridor is one of the most constrained strategic transport corridors in Sydney, as illustrated by the following operational performance statistics in the *NSW Long Term Transport Master Plan* (Transport for NSW 2012) (*Transport Master Plan*):

- The majority of rail services along the Western Rail Line have load factors greater than 100 per cent of seated capacity from Strathfield onwards in the AM peak period
- For drivers travelling between Parramatta and the Sydney CBD, both the M4 Motorway and Parramatta Road are congested and at capacity during peak periods
- Most bus services on Parramatta Road are full during peak periods and experience variable travel times, with an average variance of up to eight minutes in the morning (AM) and evening (PM) peak periods due to congestion at the CBD end of the journey
- Growth in demand on this corridor is forecast to result in car travel times increasing by 16 minutes between the Sydney CBD and Parramatta during peak travel times by 2031 compared to 2011, assuming no increase in road capacity, ie a 'do nothing' scenario
- Rail passenger demand is forecast to exceed existing capacity by 2031.

Recent Transport for NSW data measured at Redfern Station in March 2016 confirm congested rail conditions:

- T1 Western Line trains have an average load factor of 148 per cent of seated capacity in the AM peak period
- T1 Northern Line via Strathfield trains have an average load factor of 148 per cent of seated capacity in the AM peak period
- T2 Inner West Line trains have an average load factor of 126 per cent of seated capacity in the AM peak period
- T2 South Line trains have an average load factor of 109 per cent of seated capacity in the AM peak period.

Figure 3-2 illustrates the impacts a 'do nothing' scenario would have on the performance of public and private transport along the Parramatta to the Sydney CBD via Strathfield transport corridor. The figure shows that AM peak volume/capacity (V/C) ratios are consistently increasing (particularly for Dobroyd Parade/City West Link and Anzac Bridge) over the 20 year period. This suggests that an increase in capacity across the network is required to maintain the level of service currently provided.

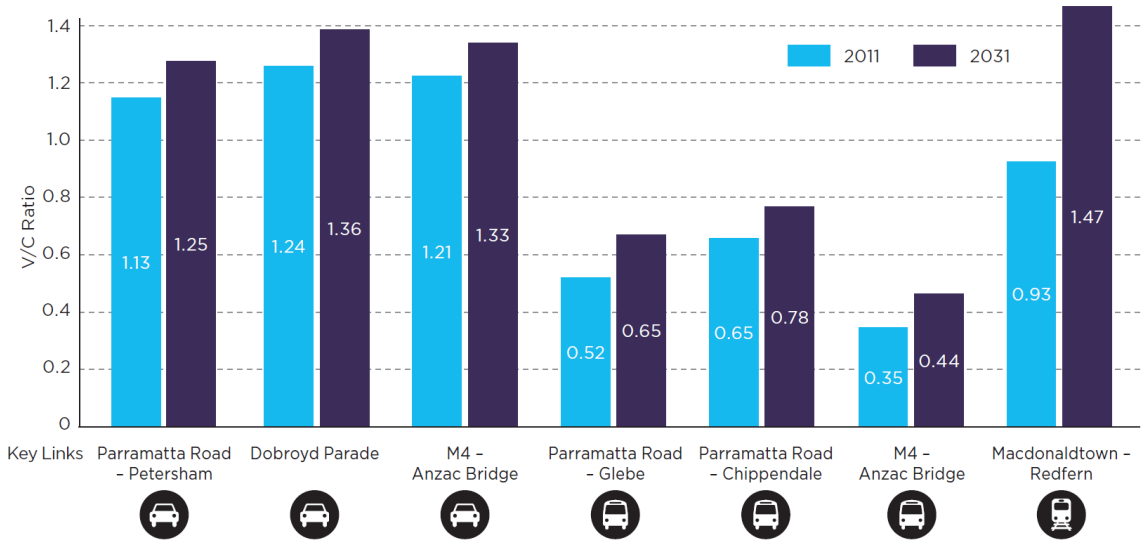


Figure 3-2 Parramatta to the Sydney CBD via Strathfield corridor: AM peak V/C – 2011 | 2031 'do nothing' scenario

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

3.1.2 Parramatta to the Sydney CBD via Ryde

This corridor is centred on Victoria Road, which connects Parramatta with the Sydney CBD and services a range of travel demands. The section of Victoria Road between Drummoyne and Anzac Bridge carries an average of around 75,000 vehicles each weekday across Iron Cove Bridge. It is one of the most congested road corridors in Sydney, as illustrated by the following operational performance statistics in the *Transport Master Plan*:

- Average peak period speeds below 20 kilometres per hour between Hunters Hill and Rozelle
- Between Drummoyne and Anzac Bridge, 19 bus routes carry an average 40,000 passengers across Anzac Bridge each weekday, one of the busiest bus corridors in Sydney
- Transit lanes on Victoria Road have improved bus flow, providing citybound bus commuters with travel time savings of up to 17 minutes in the AM peak period before the installation of the transit lanes. Even so, there is still variability in bus travel times of between eight and 10 minutes due to the volume of buses.

Figure 3-3 illustrates the impacts a 'do nothing' scenario would have on the performance of public and private transport along Victoria Road at Iron Cove. The figure shows that AM peak V/C ratios are consistently increasing over the 20 year period. Forecast growth in this corridor is also high due to growth at Ryde and Macquarie Park, inner Sydney and Parramatta. This suggests that an increase in capacity across the network is required to maintain the level of service currently provided.

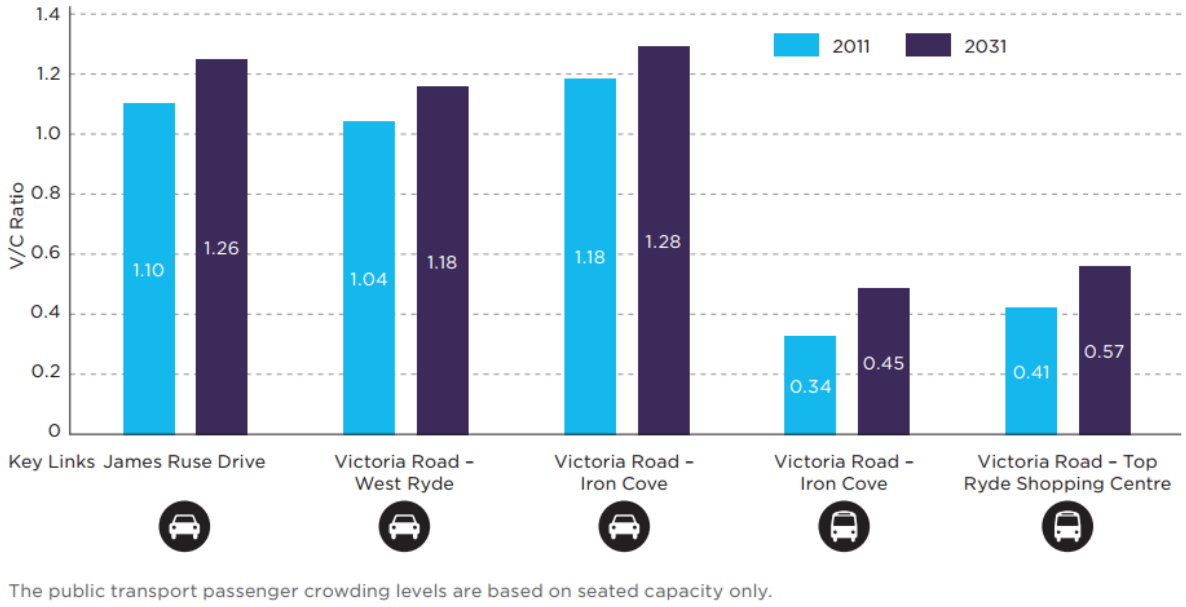


Figure 3-3 Parramatta to the Sydney CBD via Ryde corridor: AM peak V/C – 2011 | 2031 'do nothing' scenario

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

3.1.3 Sydney Airport to the Sydney CBD

The corridor linking Sydney Airport to the Sydney CBD is serviced by a motorway link (Southern Cross Drive/Eastern Distributor); an arterial road network that provides access to Redfern, Central Station and the southern end of the Sydney CBD; and the East Hills Rail Line that connects the Airport to Central Station and the City Circle.

The Sydney Airport to Sydney CBD corridor experiences high levels of congestion, as illustrated by the following operational performance statistics in the 2012 *Transport Master Plan*:

- Southern Cross Drive operates at capacity during the AM peak period, with average speeds of 35 kilometres per hour
- Due to congestion on the Eastern Distributor, traffic diverts onto the adjacent arterial road network including O'Riordan and Bourke Streets, which are also congested
- The Airport Rail Line is approaching seated capacity between Green Square Station and Central Station.

Transport for NSW data measured at Green Square Station in March 2016 confirms increased rail congestion:

- The T2 Airport Rail Line has an average load factor of 130 per cent of seated capacity in the AM peak period. Continued rapid growth in residential development at Mascot, Green Square and surrounds is likely to place greater demand on this line.

Figure 3-4 illustrates the impacts a 'do nothing' scenario would have on the performance of public and private transport along the Sydney Airport to Sydney CBD corridor. The figure shows that AM peak V/C ratios are consistently increasing over the 20 year period.

Increasing activity at Sydney Airport and Port Botany, population and employment growth in the South Sydney and airport areas (including Green Square) would result in higher traffic volumes along strategic connections to the growing southwest region of Sydney, including the M5 Motorway, placing increasing pressure on this corridor. This suggests that an increase in capacity across the network is required to maintain the level of service currently provided.

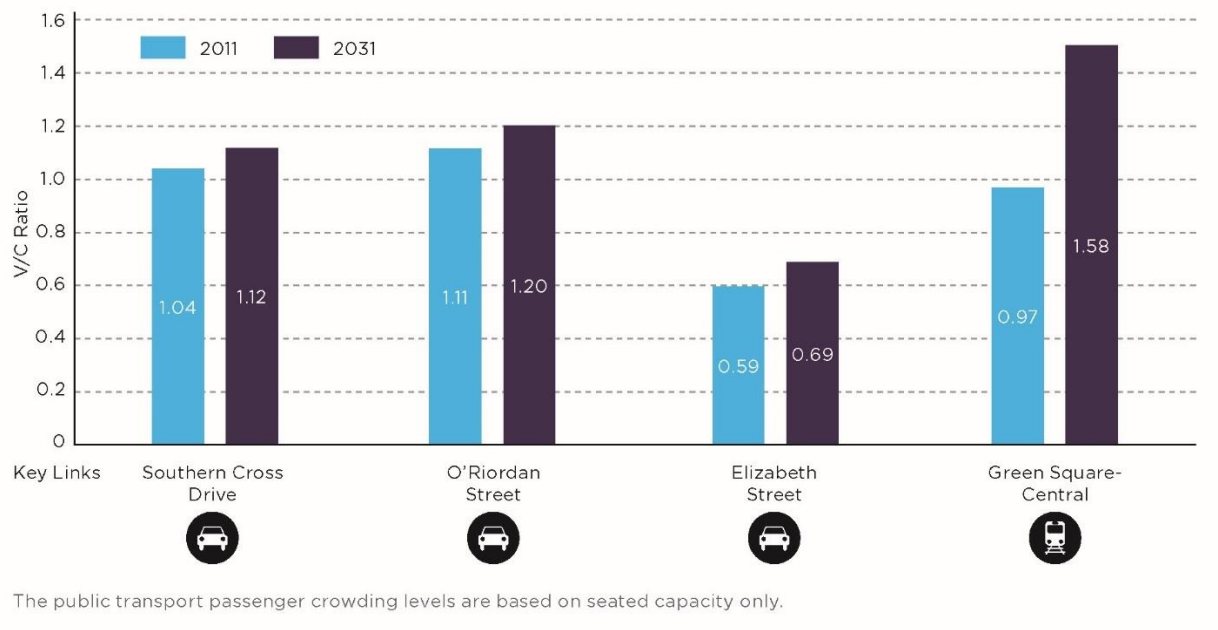


Figure 3-4 Sydney Airport to the Sydney CBD corridor: AM peak V/C – 2011 | 2031 'do nothing' scenario

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

3.1.4 Liverpool to Sydney Airport

This corridor, linking regional NSW and southwest Sydney to Sydney Airport and Port Botany, is serviced by the M5 South West and the M5 East motorways and the East Hills Rail Line that connects stations from the southwest to Central Station via the airport.

The Liverpool to Sydney Airport corridor experiences high levels of congestion, as illustrated by the following operational performance statistics in the 2012 *Transport Master Plan*:

- The M5 Motorway is very congested and operates at capacity during the peak hours, with average speeds below 40 kilometres per hour
- The East Hills Line is approaching capacity at Wolli Creek and further growth has implications for the capacity of the rail system to accommodate demand at Sydney Airport.

Figure 3-5 illustrates the impacts a 'do nothing' scenario would have on the performance of public and private transport along the Liverpool to Sydney Airport corridor. The figure shows that AM peak V/C ratios are consistently increasing over the 20 year period.

The high population growth forecast in southwest Sydney would place increasing pressure on this corridor. This suggests that an increase in capacity across the network is required to maintain the level of service currently provided.

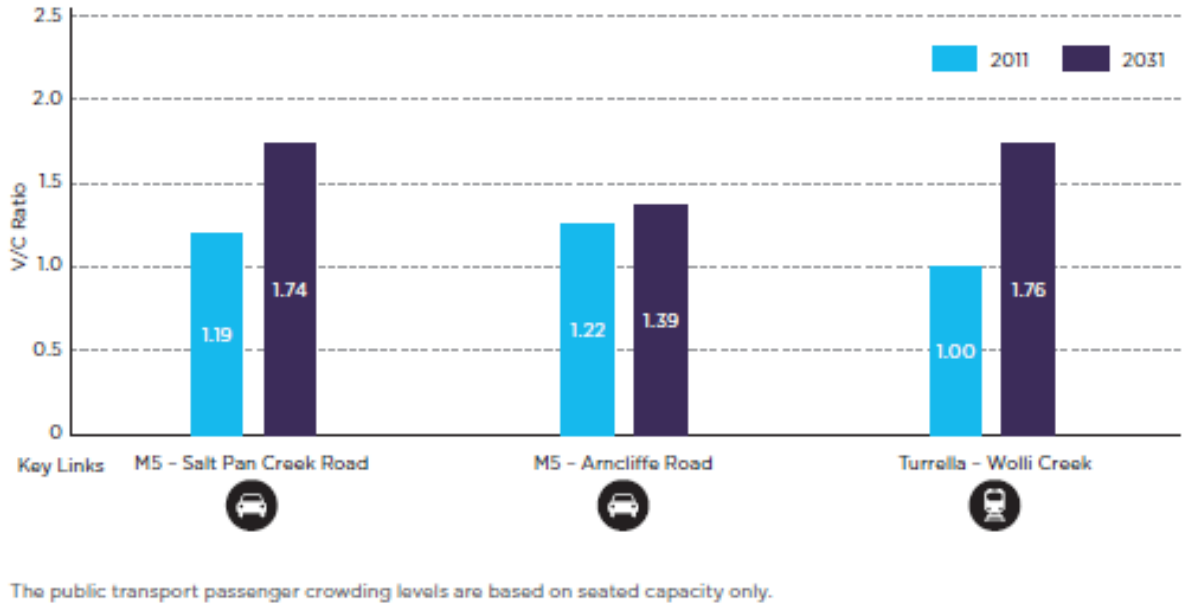


Figure 3-5 Liverpool to Sydney Airport corridor: AM peak V/C – 2011 | 2031 'do nothing' scenario

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

3.2 Sydney metropolitan transport movement – general traffic

The M4-M5 Link would provide a new strategic connection that is currently performed by other motorways (eg Southern Cross Drive), arterial roads (eg Victoria Road, City West Link, Parramatta Road and Botany Road) and lower-order roads, which are nearing capacity as ongoing development and population growth places additional pressure on the road network. The proposed M4-M5 Link would also provide for network redundancy.

Most of the motorways and arterial roads in the Parramatta to Sydney CBD and the Sydney Airport to Sydney CBD corridors experience significant congestion in the peak traffic periods, with high travel time variability for private and public transport vehicles.

Average weekday traffic (AWT) volumes on strategic roads in the vicinity of the project in the base case are shown in **Figure 3-6**. Observations on the traffic movements along these strategic roads are:

- East of the Wattle Street interchange, east–west traffic movement is focused on Dobroyd Parade/City West Link and Parramatta Road. City West Link then merges with Victoria Road and links to Anzac Bridge/Western Distributor to provide the main east–west movement to the east of the Rozelle interchange
- Southeast of the Rozelle interchange, north–south traffic movement is focused on the Eastern Distributor, with Abercrombie Street, Regent Street, Chalmers Street and Elizabeth Street providing secondary north–south routes
- North of the St Peters interchange, north–south traffic is mainly focused on the Princes Highway and King Street, while traffic from the airport and Port Botany area also use O'Riordan Street and Botany Road.

Traffic movements across the Sydney Harbour primarily use either the Sydney Harbour Bridge via the Western Distributor or Sydney Harbour Tunnel via the Eastern Distributor, making these two connections among the most critical in the broader road network. The proposed future Western Harbour Tunnel and Beaches Link, in conjunction with the M4-M5 Link, would create a bypass of the Sydney CBD for traffic movements between the North Shore and western Sydney, reducing the volume of traffic using the existing cross-harbour connections and Anzac Bridge.

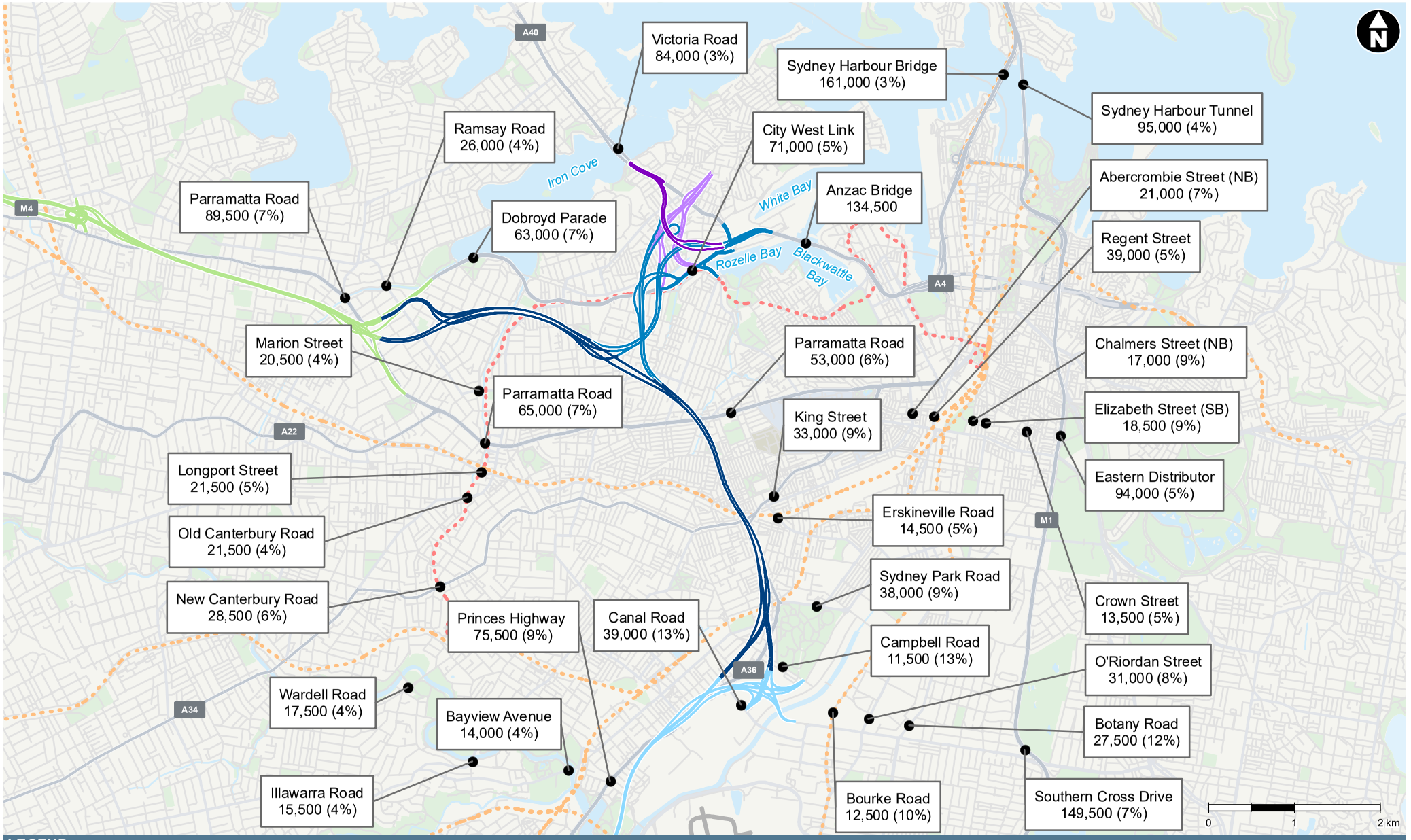


Figure 3-6 Average weekday traffic (AWT) volumes on strategic roads

3.3 Sydney metropolitan transport movement – freight traffic

3.3.1 General

The NSW freight network consists of a system of rail lines, roads, ports, Sydney Airport and regional airports, and intermodal terminals. The *NSW Freight and Ports Strategy* (Transport for NSW 2013) (the *Freight Strategy*) states that the NSW freight task is expected to almost double over the next 20 years. This forecast growth has implications for the capacity of the existing road network, with increased heavy vehicle volumes forecast on King Georges Road, M4, M5 and M7 motorways, and key connections to Port Botany, as shown in **Figure 3-7**.

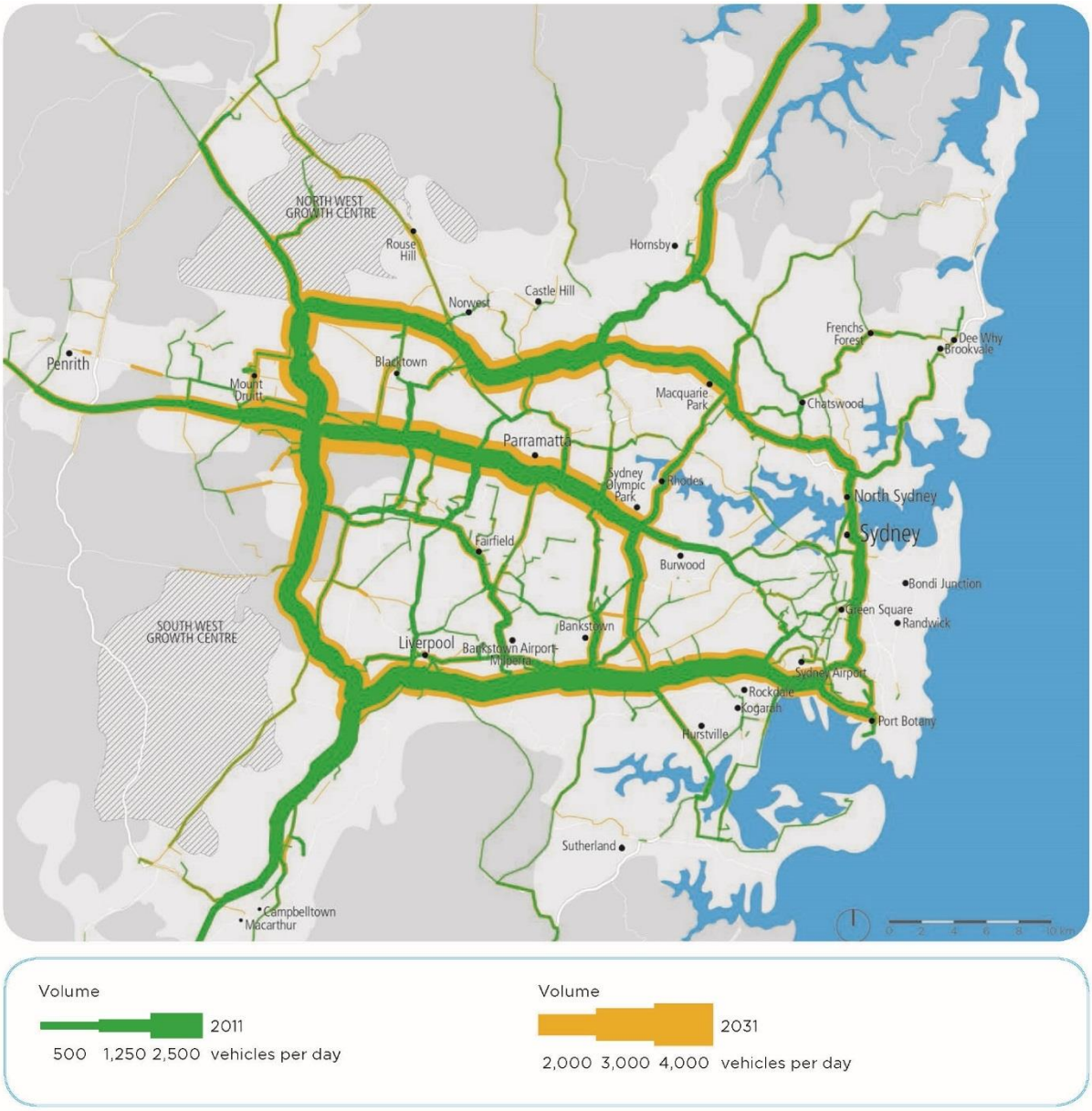


Figure 3-7 Heavy vehicle movements in Sydney, 2011 and 2033

Source: *NSW Long Term Transport Master Plan* (Transport for NSW 2012)

To deliver a freight network that supports the projected growth of the NSW economy, one of the actions in the *Freight Strategy* is '*Action 2B: Develop and maintain capacity for freight on the road network*', with a task to '*connect and complete Sydney's motorway network*'[3]. The WestConnex program of works is included in a list of key motorway connections that would provide operational benefits for freight movement by providing additional capacity on corridors where existing motorways or arterial roads currently provide the transport task, including the M4 Motorway/Parramatta Road corridor and the M5 Motorway corridor.

The M4 Motorway/Parramatta Road corridor is the principal east–west transport corridor connecting the Sydney CBD and Inner West to Parramatta via Sydney Olympic Park. Parramatta Road also provides an important local and regional traffic function, which has often conflicted with its strategic importance to the wider road network.

The M5 Motorway corridor is a key freight, commercial and passenger route between Sydney Airport, Port Botany, the St George area, south-western Sydney and the Southern Highlands. Without additional motorway capacity, it is estimated that the M5 Motorway corridor would not be able to accommodate the additional traffic by 2031[4].

Sydney's heavy vehicle freight task is highly dependent on the motorway network. More than 37 per cent of all heavy vehicle freight kilometres travelled in the Sydney Metropolitan Area is on the motorway and highway network, even though the network represents less than 17 per cent of the arterial road network[5]. Road freight accounted for 63 per cent of total freight tonnes transported around NSW in 2011. If the coal freight task is excluded, which is predominantly rail-borne, the road share of the freight task was 90 per cent in 2011[6].

Average weekday heavy vehicle volumes on strategic roads in the vicinity of the project are shown on **Figure 3-8**. Heavy vehicle movements are focused on the motorway links (Sydney Harbour Bridge, Eastern Distributor, Southern Cross Drive and Anzac Bridge) and the major arterial roads (Parramatta Road, Dobroyd Parade/City West Link, Princes Highway), as well as Botany Road to and from the Port Botany/Sydney Airport precinct.

[3] Transport for NSW, NSW Freight and Ports Strategy, November 2013.
[4] Transport for NSW, December 2012.
[5] Jacobs, WestConnex M5 – King Georges Road interchange upgrade: Traffic and transport assessment, August 2014.
[6] Transport for NSW, November 2013.

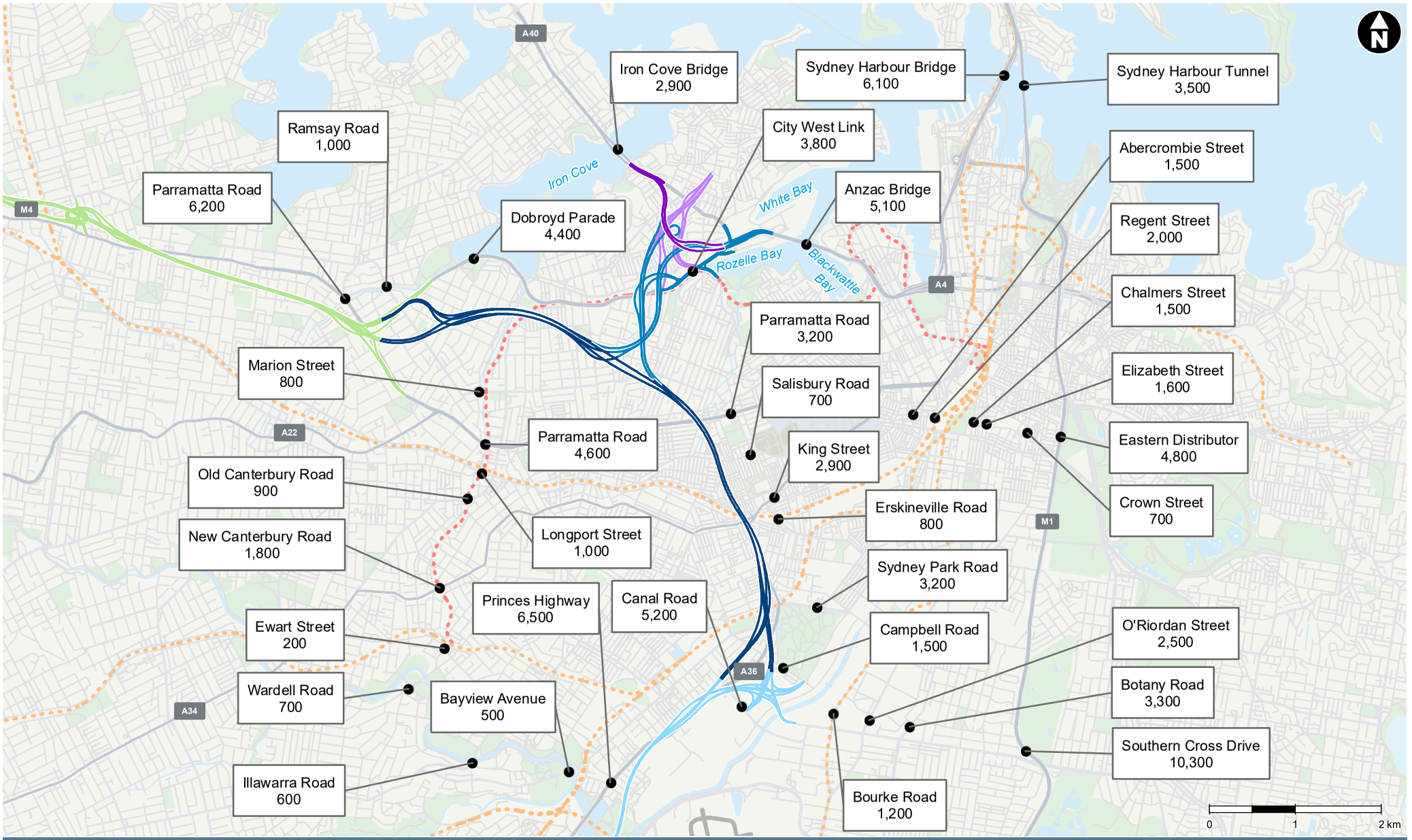


Figure 3-8 Average weekday heavy vehicle volumes on strategic roads

3.3.2 Port Botany and Sydney Airport precinct

Port Botany is Sydney's container terminal, and a major source of freight movements. Freight access into Port Botany is therefore crucial. The *Freight Strategy* identifies a missing motorway link between the M4 Motorway and Port Botany – this is particularly significant when it is considered the majority of Port Botany containers are destined for locations in or along the M4 Motorway corridor[7].

Sydney Airport is also a major source of freight movement. The airport handles about 48 per cent of Australian international air freight and is Australia's largest transport and logistics hub[8]. Sydney Airport provides an interchange between air, sea and land freight and serves as an air freight hub for NSW.

Figure 3-9 indicates the current Sydney Road Freight Hierarchy and highlights the use of other routes, such as King Georges Road to the west, O'Riordan Street, Bourke Road, Coward Street, Kent Road and Canal Road, north of Sydney Airport, and routes further north towards Parramatta Road, such as Railway Road, Sydenham Road, Livingstone Road and Old Canterbury Road, which serve as arterial links to and from Port Botany. These routes perform a mix of functions (mobility and access), which consequently conflict during peak periods resulting in a drop in the operational performance.

The 2011 throughput of containers at Port Botany is projected to more than triple by 2031. The *Freight Strategy* notes that even with a targeted increase in rail mode share, the M5 Motorway would not be able to accommodate additional container traffic when combined with the forecast background growth from employment and population by 2031. By 2033, Sydney Airport is projected to handle about 1.0 million tonnes of freight, an increase of more than 60 per cent from 2012 volumes.

Port deliveries are already moving into the off-peak periods to avoid congestion. Existing congestion and low travel speeds on the M5 Motorway reduces the hourly throughput of vehicles below its capacity for many hours of the day. Accommodating forecast growth in this corridor will require a package of solutions to meet the needs of freight and other road users. Actions in the *Transport Master Plan* focusing on road upgrades and improved rail operations to support a doubling of freight on rail by 2020 are critical to meeting the forecast growth at Port Botany by 2031.[9]

In addition to capacity constraints, other network constraints also limit the operation of higher productivity vehicles. In the study area, these include[10]:

- Higher Mass Limits (HML) semi-trailer and B-double restriction on the Giovanni Brunetti Bridge on Marsh Street over the Cooks River
- 4.3 metre clearance limit in the Airport and Cooks River Tunnel on the M5 East Motorway
- Circuitous 4.6 metre over height vehicle surface route between the M5 East Main Tunnel and Port Botany
- 4.28 metre clearance limit at light rail bridge on Johnston Street.

[7] NSW Government, *Port Botany and Sydney Airport Transport Improvement Program: Submission to Infrastructure Australia*, November 2011.
[8] Sydney Airport Corporation Limited, *Sydney Airport Master Plan 2033*, December 2013.
[9] Transport for NSW, November 2013.
[10] NSW Government, November 2011.

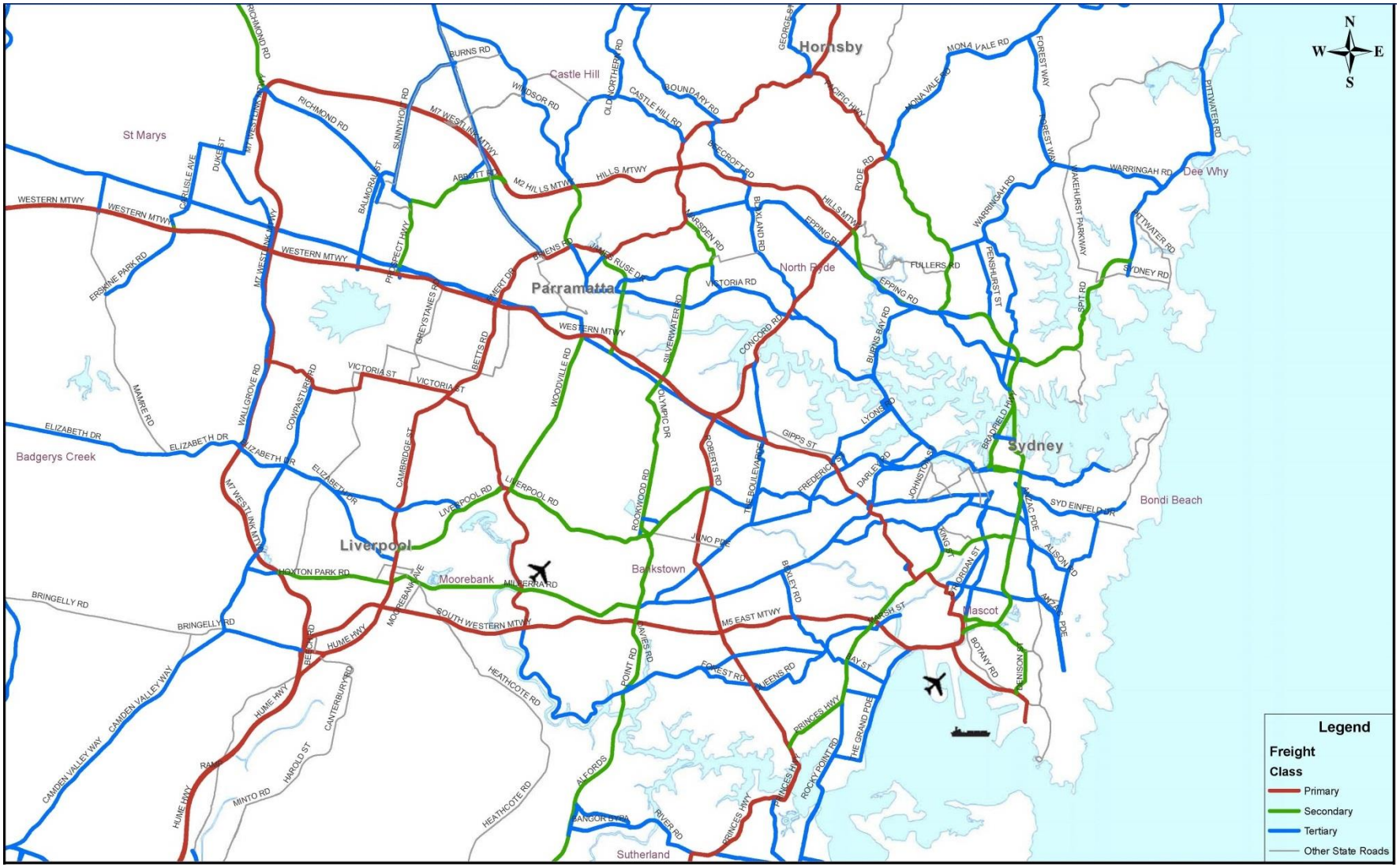


Figure 3-9 Sydney Road Freight Hierarchy

Source: Metropolitan Road Freight Hierarchy on the State Road Network Practice Note, June 2011

3.4 Transport policy and plans

3.4.1 NSW Long Term Transport Master Plan

To improve existing conditions with regard to road safety, traffic efficiency and people movement and to meet the future challenges facing the operation and performance of strategic corridors, the NSW Government and Roads and Maritime identified the need for a clear and integrated long term transport plan. The *Transport Master Plan* sets out a framework to provide clear direction and guidance for transport infrastructure projects in NSW over the next 20 years identifying investment in roads, rail and public and active transport modes. The *Transport Master Plan* identifies challenges in the NSW transport system and provides details of various projects, such as the North West Rail Link (now part of Sydney Metro) and CBD and South East Light Rail, and feasibility investigations of light rail or other high capacity public transport for corridors including Victoria Road and Parramatta Road, to address these challenges and provide an integrated and modern transport system.

One of the key transport areas identified in both the *Transport Master Plan* and the *State Infrastructure Strategy Update 2014* (*State Infrastructure Strategy*) (see **section 3.4.2**) is the need to plan and invest in the future of Sydney's motorway network, which provides vital infrastructure connections within and between the 46 travel demand corridors. Investment in motorway infrastructure has to be aligned with supporting public and active transport initiatives to achieve an increase in capacity, while aiming to reduce the reliance and demand of private vehicles on the future road network. The NSW Government is investigating and investing in Light Rail, Metro, Bus Rapid Transit and motorway projects to provide a multi-modal response to the future challenges.

Figure 3-10 provides details of the proposed motorway improvement measures that have been developed to bridge gaps in the Sydney motorway network by 2031. The *Transport Master Plan* recognises that WestConnex would support Sydney's long term economic growth through improved motorway access and connections linking Sydney's international gateways including the Sydney Airport, Port Botany, western Sydney and employment areas across Sydney. It also states that WestConnex would relieve road congestion and thereby improve the speed, reliability and safety of travel in the M4 and M5 corridors, including parallel arterial roads.

The *Transport Master Plan* identifies the need for progressive delivery of WestConnex. The *Transport Master Plan* commits the NSW Government to develop integrated land use and transport outcomes in conjunction with the delivery of WestConnex. These are recognised in the *Transport Master Plan* and include public transport projects, such as Sydney Metro (North West, City and Southwest) and the CBD and South East Light Rail.

3.4.2 State Infrastructure Strategy 2012–2032

The *State Infrastructure Strategy* is a 20 year strategy that identifies and prioritises the delivery of critical public infrastructure to drive productivity and economic growth. Infrastructure NSW's assessment of the state's existing infrastructure highlighted critical deficiencies in urban road capacity. The *State Infrastructure Strategy* identifies strategic infrastructure options to meet the challenges of population growth and substantial increases in freight volumes.

The *State Infrastructure Strategy* recognises the economic impacts and other constraints created by reduced functionality along the project corridor. This corridor is important for freight and business transport, and provides connections to Global Sydney, its cultural precincts and its 'global economic corridor'. The WestConnex program of works is identified in the *State Infrastructure Strategy* as a critical program of work with a range of benefits including reduced congestion, improved access to the major international gateways of Sydney Airport and Port Botany (facilitated through connections provided by the St Peters interchange), the future Western Sydney Airport, and improved industrial and business efficiency including along the project corridor.

In November 2014, Infrastructure NSW released a revised State Infrastructure Strategy – the *State Infrastructure Strategy Update 2014* (Infrastructure NSW 2014; *State Infrastructure Strategy Update*) – to guide the allocation of funds from the NSW Government's asset recycling program, as part of the NSW Government's Rebuilding NSW initiative.

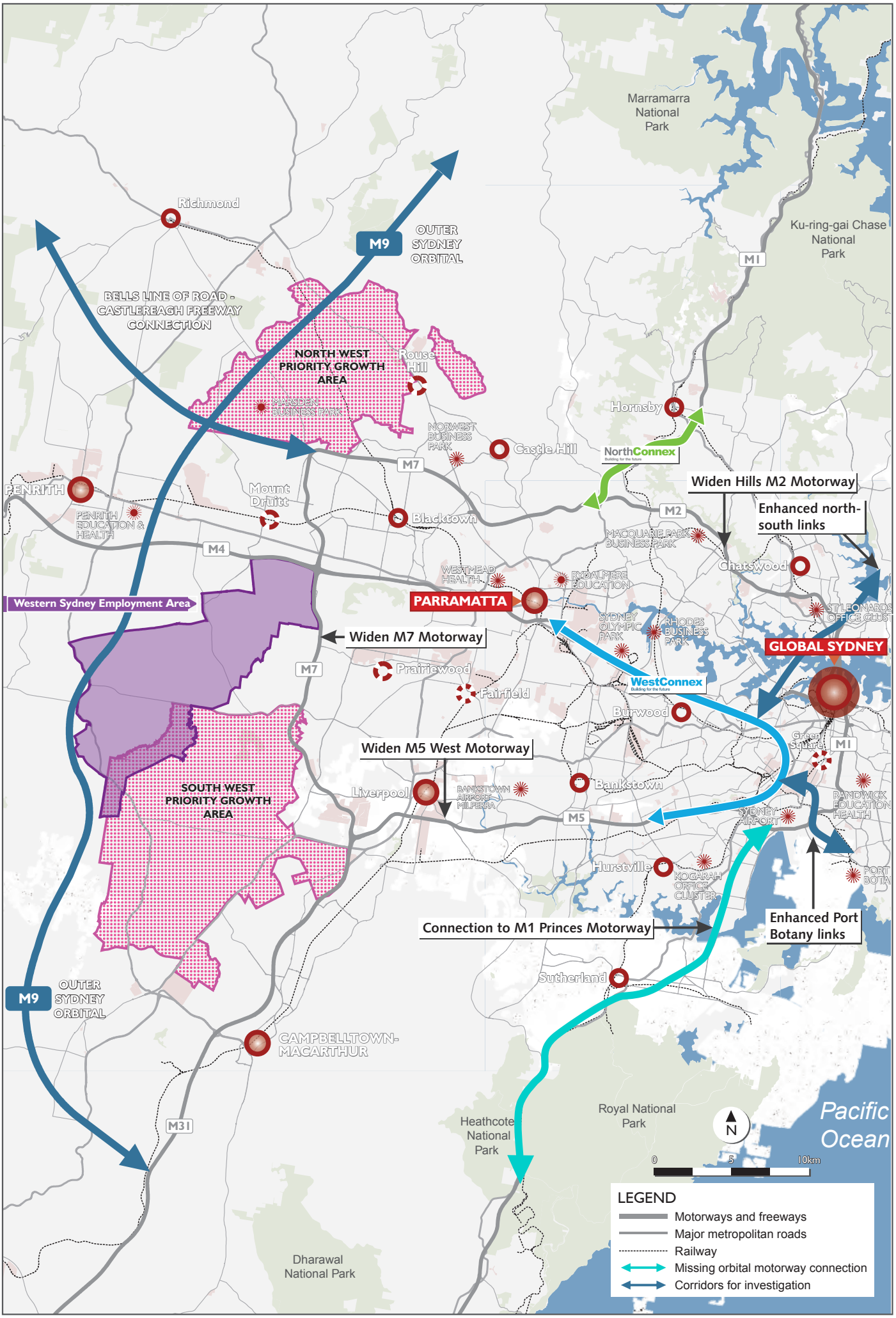


Figure 3-10 Proposed motorway improvement measures

The *State Infrastructure Strategy Update* identified extensions to WestConnex to include connections to Victoria Road and Anzac Bridge to the north and a connection to President Avenue at Rockdale to the south. These extensions (the proposed future Western Harbour Tunnel and Beaches Link, and the F6 Extension), coupled with a completed WestConnex program of works, would provide a western bypass of the CBD, reducing pressure on the Sydney orbital network and reducing journey times to Sydney's southern suburbs. The update identified the Western Sydney Airport Motorway link extending west from the M7, and Outer Sydney Orbital, which would link to Western Sydney Airport.

3.4.3 NSW Freight and Ports Strategy

The aim of the *Freight Strategy* is to provide a transport network in NSW that allows the efficient flow of goods to the market.

The *Freight Strategy* identified that the NSW road network carried 63 per cent of the total freight volume in 2011, with 33 per cent of freight carried by rail in the same year, and that the role of heavy vehicles in moving freight across NSW is substantial and would continue to be for the foreseeable future. The *Freight Strategy* identifies the challenge of increasing the capacity of NSW roads to support the growth in freight task. The traffic analysis in this report has considered the impact that the planned future port activities and uses would have on the road network as part of the forecast traffic volumes assessed in the future year scenarios.

The *Freight Strategy* has two main objectives: to deliver a freight network that efficiently supports the projected growth of the NSW economy and to balance freight needs with those of the broader community and the environment. The project supports the following strategic action programs identified in the *Freight Strategy*:

- Network efficiency – the project would improve network efficiency, delivering travel time savings. This would provide more efficient movement of freight, thereby reducing operational freight costs
- Network capacity – the project would provide increased road capacity along the corridor between the M4 and M5 corridors, a key missing link between these two freight movement corridors which are currently heavily congested
- Network sustainability – the provision of an alternative route and the resultant travel time savings and reduced vehicle hours travelled would also lead to savings in greenhouse gas emissions.

The *Freight Strategy* recognises there are significant economic efficiency implications for NSW if major changes are not made to ports and related road and rail systems in the next 20 years. While dedicated freight rail lines are relatively well served by capacity development plans, there is limited available capacity on the shared rail network in metropolitan areas for freight traffic. One action of the *Transport Master Plan* is to implement rail freight infrastructure enhancements to increase the share of freight carried on the rail network.

There are opportunities to move more freight on the rail network, which is considered a priority for the NSW Government. Notwithstanding this, should the current target of doubling the share of container freight moved via rail by 2020 be met through initiatives such as those outlined above, more than 70 per cent of Port Botany's trade would still be transported using the road network, requiring significant investment to support the port and airport precincts.

Improvements to the freight rail network would contribute to relieving road congestion by shifting freight away from the road network. However, as the freight task and Sydney's population continue to expand, and the road transport demand along the M4 and M5 motorways continues, road congestion would persist. This would impede the economic growth of Sydney and the productivity of freight generating land uses such as Port Botany. Although improvements to freight rail would enhance movements along the rail network, these initiatives would not cater for diverse travel demands that require road as well as rail transport.

The *Freight Strategy* includes an action to connect and complete Sydney's motorway network including priority freight movements. It recognises the infrastructure provided through WestConnex, including the M4-M5 Link, would be a key component in expanding capacity on NSW roads that would provide benefits for freight movement, particularly around major freight activity centres such as Sydney's international gateways, Port Botany and Sydney Airport.

3.4.4 Sydney City Centre Access Strategy

The *Sydney City Centre Access Strategy* (Transport for NSW 2013) (*City Centre Access Strategy*) is the NSW Government's long term strategy to deliver a fully integrated transport network in Sydney's city centre that meets the growing transport needs for all transport modes. The *City Centre Access Strategy* aims to prioritise and allocate street space for public transport, general traffic, pedestrians, cyclists, taxis and service vehicles.

The anticipated impacts of the project, and the objectives and actions contained in the *City Centre Access Strategy*, have been considered together to determine potential transport interactions between the project and the strategy. The planned actions contained in the *City Centre Access Strategy* are reflected in the Strategic Travel Model (STM). STM is operated by Transport for NSW Transport Performance and Analytics and is used to project travel patterns in Sydney, Newcastle and Wollongong under different land use, transport and pricing scenarios. STM provided the trip forecasts used in WRTM, and therefore the planned actions contained in the *City Centre Access Strategy* are accounted for in the project evaluation.

Traffic forecasts show that the project is generally anticipated to have little impact, or to reduce traffic on some roads that are identified in the strategy as city centre bypass routes, such as the Cahill Expressway. However, other roads identified as city centre bypass routes are forecast to have increased traffic as a result of the project, including the Western Distributor, and the Cross City Tunnel. While these forecast increases are not counter to the *City Centre Access Strategy*, changes in traffic volumes on these roads should be considered in the planning and implementation of the traffic and bypass priority routes. There is little impact forecast on the roads within the CBD, while reductions are forecast for access roads to the CBD from the south, such as Broadway and City Road.

3.4.5 The Bays Precinct Transformation Plan

The Bays Precinct, located about two kilometres west of the Sydney CBD, encompasses the areas surrounding Blackwattle Bay, Rozelle Bay and White Bay. The Bays Precinct comprises eight precincts, including the former Rozelle Rail Yards, White Bay Power Station, White Bay and Rozelle Bay and Bays Waterways. The *Bays Precinct Urban Transformation Plan* (UrbanGrowth NSW 2015) (*The Bays Precinct Transformation Plan*) establishes the strategy for how The Bays Precinct would be developed over 20 years for residential, employment, entertainment and open space uses.

The NSW Government's direction for The Bays Precinct is 'to drive an internationally competitive economy, through the creation of great destinations on Sydney Harbour that would transform Sydney, NSW and Australia' (UrbanGrowth NSW 2015). The Bays Precinct delivery is intended to be staged and coordinated with the planning and delivery of WestConnex and the long term considerations of The Bays Precinct's port uses. *The Bays Precinct Transformation Plan* recognises that an efficient transport system enables urban transformation, and that transport solutions for The Bays Precinct would need to integrate with planning for a growing Sydney, including the consideration of varied transport modes, but with a focus on improving public and active transport options. Planning for the project has considered the planned impact that the transformation of The Bays Precinct would have on the road network. This includes anticipated changes in the volume of vehicle trips to and from The Bays Precinct.

3.4.6 Parramatta Road Corridor Urban Transformation Strategy

The *Parramatta Road Corridor Urban Transformation Strategy* (UrbanGrowth NSW 2016) (*Parramatta Road Transformation Strategy*) identifies areas along the corridor (between Granville in the west to Camperdown in the east) where there would be a focus on encouraging growth and changes in the long term (about 30 years). The aim of the strategy is to create an environment with good design, land use mix, housing choice and infrastructure, as well as improved access to community facilities and services and access to public and active transport.

WestConnex is identified within the *Parramatta Road Transformation Strategy* as a catalyst for the restoration of the Parramatta Road corridor, as it is forecast to reduce through traffic on the surface roads in the corridor. 'Through traffic' in this context refers to traffic that travels more than five kilometres along Parramatta Road to destinations away from Parramatta Road. The reduction in

traffic, particularly trucks, would provide opportunities to improve public and active transport along Parramatta Road and in its immediate surrounds.

As the project is forecast to significantly reduce traffic volumes on Parramatta Road east of the M4 East Parramatta Road ramps, it would help to support future planned development in three of the urban renewal precincts identified in the *Parramatta Road Transformation Strategy*, namely Taverners Hill, Leichhardt and Camperdown.

A key element of the *Parramatta Road Transformation Strategy* is the delivery of improved public transport services along Parramatta Road, including the potential development of bus rapid transit. This project, together with the M4 East project, is forecast to reduce traffic on Parramatta Road between Burwood and the Sydney CBD, which would in turn allow for potential improvements in public transport priority along Parramatta Road. One of the conditions of approval for the M4 East project includes a requirement for the M4 East project to dedicate at least two lanes of Parramatta Road between Burwood and Haberfield for the sole use of public transport. This space-proofing requirement is incorporated into the design of the M4 East project so that future public transport initiatives on Parramatta Road can be integrated with the WestConnex program of works. The project, together with the M4 East project, therefore complements the plans envisaged in the *Parramatta Road Transformation Strategy*.

The *Parramatta Road Transformation Strategy* also plans for the future construction and delivery of walking and cycling infrastructure at key locations along the Parramatta Road corridor. This new infrastructure is not part of the project and would be subject to separate planning assessment and approval. Improvements to the active transport network that would be delivered by the project are described in **Appendix N** (Technical working paper: Active transport strategy) of the EIS. The forecast reduction in traffic volumes on Parramatta Road would also help to improve the north–south connectivity across Parramatta Road, which is currently a major constraint in the corridor.

4 Assessment methodology

4.1 Relevant guidelines and policies

The following guidelines were followed in carrying out this assessment:

- *Guide to Traffic Management – Part 3 Traffic Studies and Analysis* (Austroads 2013)
- *Traffic Modelling Guidelines* (Roads and Maritime 2013)
- *Guide to Traffic Generating Developments Version 2.2* (NSW Roads and Traffic Authority (RTA) 2002).

4.2 Methodology – traffic forecasting and modelling process

This section provides an overview of the three stage traffic forecasting and modelling that was undertaken for this assessment, as outlined in **Figure 4-1**. The objective was to make best use of available traffic count data and modelling software to determine base and future traffic conditions for the project and surrounding road network in terms of estimating travel demand and traffic volumes. These traffic conditions were then used to assess the operational performance of the network, in scenarios with and without the project. Subsequent sections provide further details of the process and assumptions for each stage of the forecasting and modelling.

4.2.1 Stage 1 – Traffic demand forecasting

The WRTM v2.3, which was developed and operated by Roads and Maritime Services, provides a platform to understand changes in future weekday travel patterns under different land use, transport infrastructure and pricing scenarios. Although the WRTM is a network-wide model that encompasses existing and future road networks in the Sydney Metropolitan area, it was principally developed to assess infrastructure improvements associated with the WestConnex component projects individually and in combination. The WRTM v2.3 was used for this EIS, and as traffic models undergo constant development and refinement, it is anticipated that future projects would use further iterations of WRTM as they become available.

Modelling approach

The WRTM was developed in the following stages:

- A review of the available transport planning models and data was undertaken to determine the optimal models and data to provide an appropriate foundation for the WRTM
- Base and future population and employment data for metropolitan Sydney was sourced from Transport for NSW Transport Performance and Analytics (TPA), which are available at five year intervals
- Available toll choice modelling techniques were assessed in the current Sydney context where multiple competing toll roads cover a substantial portion of the developed Greater Sydney metropolitan area
- Project specific Value of Travel Time Savings (VTTS) surveys of drivers' willingness to pay tolls were undertaken to inform the toll choice modelling to enable the model to best reflect current driver behaviour in the specific context of the WestConnex component projects
- Existing road infrastructure was reviewed for the base year. A set of future road infrastructure projects for the modelled Sydney metropolitan area for future years was developed and is consistent with its current funding and planning policies. These projects formed the basis for the future 'do minimum' networks modelled in WRTM.

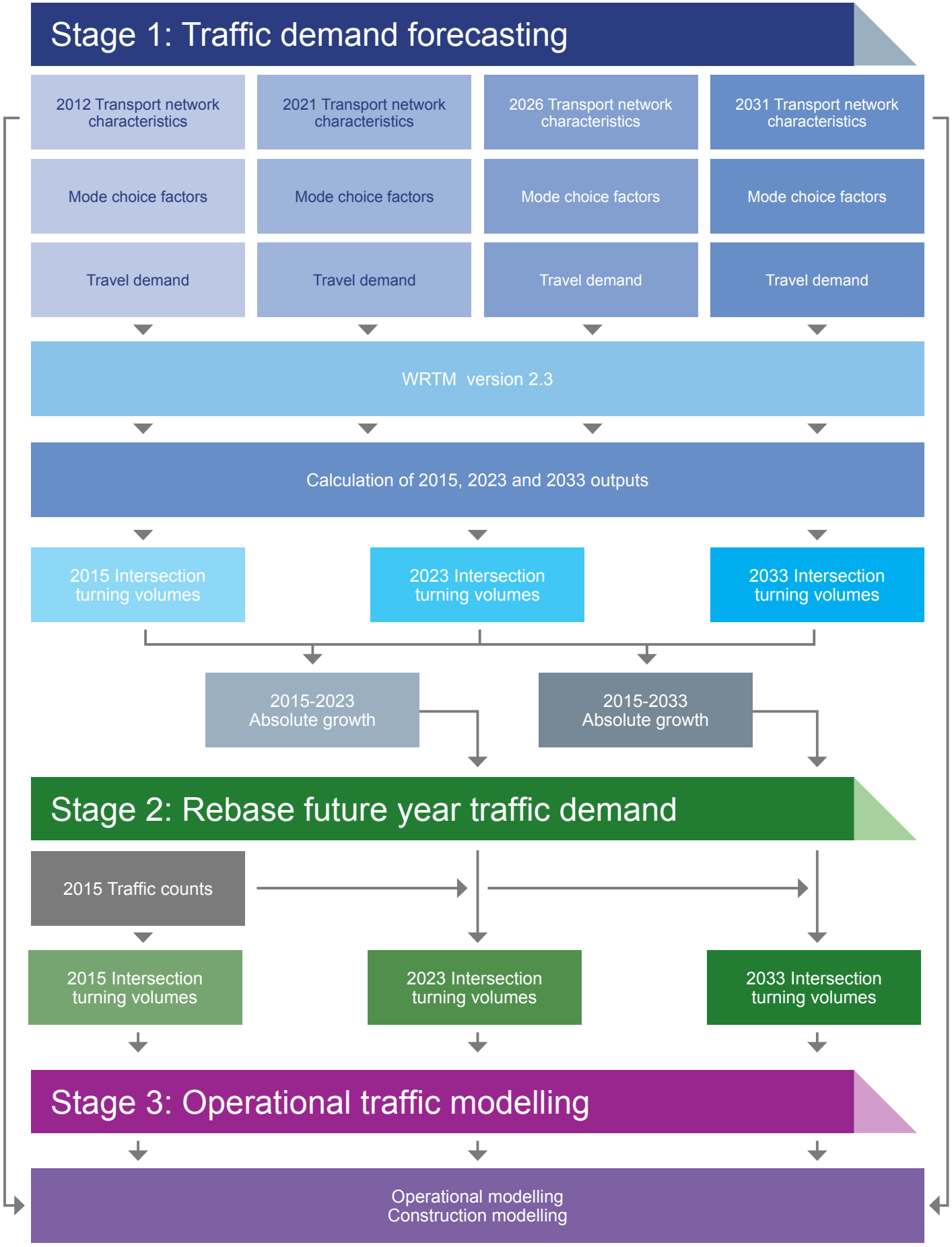


Figure 4-1 Overview of traffic forecasting and modelling approach

- The WRTM project model was developed and calibrated to current observed travel behaviour, then validated against 2012 Sydney-wide travel behaviour from a series of traffic count and travel time surveys. It was then adjusted to reflect driver behaviour on Sydney's toll roads as indicated by the VTTS surveys. The model calibration and validation processes maintained a specific focus and refinement in the area of the WestConnex program of works. The WRTM comprises separate weekday time period sub-models, with average one hour peak multi-class traffic assignments run for[11]:
  - AM period: (7.00 am – 9.00 am)
  - Daytime inter-peak: (9.00 am – 3.00 pm)
  - PM period: (3.00 pm – 6.00 pm)
  - Evening off-peak: (6.00 pm – 7.00 am)
- The WestConnex program of works was coded into the WRTM future year models
- Future demands were estimated by applying future year traffic growth forecast by the STM to the WRTM to produce the most likely or future base case scenario. Traffic estimates were produced by the WRTM for the years 2021, 2026 and 2031. The demands for 2023 (assumed year of opening) were then determined by interpolating between the 2021 and 2026 demands. The demands for 2033 (assumed year of opening plus 10 years) were determined by extrapolating the demands from the 2026 and 2031 demand matrices. This produced vehicle demands by time period for an average weekday at each year and vehicle class for toll assessment.

Traffic demand data contained within this traffic and transport assessment was taken from the WRTM, following assessment of the model calibration and validation by independent peer reviewers and agreement that the model is suitable for this purpose.

Data inputs into the WRTM

Available data was initially used as primary inputs for the development of the WRTM including:

- Traffic volume counts for screenlines and project specific counts
- Road travel time surveys undertaken in December 2012
- Base 2011 and future year vehicle demand matrices by travel purpose from the STM sourced from TPA in June 2016
- Population and employment by small zone area provided by TPA consistent with demographics released by NSW Department of Planning and Environment (DP&E) in September 2014 (version Land Use (LU)14v4)
- Household travel survey data collected by TPA
- Private car driver stated and revealed preference value of travel time survey data collected in early 2013
- Commercial vehicle stated preference value of travel time survey data collected in late 2012
- Aerial photography collected for detailed auditing of road networks
- Recently completed and future infrastructure project lists, including information from Transport for NSW. Transport for NSW is delivering and planning the following Sydney Metro projects:
  - Sydney Metro Northwest (Rouse Hill to Chatswood) – under construction, the first stage of Sydney Metro would deliver eight new railway stations and 4,000 commuter car parking spaces to Sydney's Northwest and has been included in the future strategic modelling

[11] A comparison of weekday and weekend traffic volumes in the study area was undertaken. This revealed that the peak weekday hourly volumes are similar or higher than the peak weekend hourly volumes. Therefore, the weekday scenario is the worst traffic situation and is appropriate to be tested as such. This is also standard assessment methodology and consistent with all previous WestConnex assessments.

- Sydney Metro City and Southwest (Chatswood to Bankstown) – the second stage of Sydney Metro would extend the metro rail across Sydney Harbour, through Sydney CBD and to Bankstown. It would deliver seven new railway stations and is currently in the planning phase. It has been included in the future strategic modelling
- Sydney Metro West was recently announced by NSW Government and is planned to link Parramatta and Sydney's CBDs and serve Sydney Olympic Park and The Bays Precinct along the route. This project is at the early stage of development and has not been included in the future strategic modelling

- Existing strategic models and data within the Sydney region.

Structure of the WRTM

The regional WRTM traffic forecasting model process comprises two separate elements: Base Demand Model (based on STM with updates to incorporate more recent data) and WRTM toll choice assignment model (an assignment module to incorporate toll choice behaviour). The role of each element of WRTM, and interaction between each element, is outlined in the following subsections:

Base demand model

The base demand model was developed using the STM with updated information used to produce improved travel demand matrices for detailed toll choice route assignment and project appraisal testing. The base demand model provides the forecast capability to address changes in land use, trip distribution and mode choice and produces vehicle traffic demands for peak and off-peak periods for subsequent allocation to routes in the detailed WRTM toll choice assignment model.

Toll choice assignment model

The WRTM toll choice assignment model was developed to test impacts of toll and infrastructure strategies and provide infrastructure project traffic forecasts. The model is designed to forecast the traffic choosing to use tolled and non-tolled routes for the representative peak and inter-peak periods of the day. The development of the Toll choice assignment model included:

- VTTS survey analysis to investigate people's willingness to pay tolls to use toll roads based on project specific market research surveys
- Development of improved road traffic demand matrices for the following vehicle classifications:
  - Private vehicles: cars not registered for business use
  - Light commercial vehicles (LCV): vehicles up to 4.5 tonnes gross vehicle mass (GVM) (or under 2.8 metre height/12.5 metre length), including cars registered for business use
  - Heavy commercial vehicles (HCV): all vehicles with a GVM of more than 4.5 tonnes that have been registered for business use[12].

To support the development of the WRTM, an investigation was undertaken into the various toll choice assignment methods in the Sydney and Australian context. Based on the assessment, it was determined that the WRTM toll choice assignment model should adopt a distributed Value of Time (VOT) multi-class equilibrium assignment methodology.

The key reasons were:

- The methodology was considered a valid approach for the WRTM toll choice assignment model for assessing WestConnex. It would address the functional requirements of the project model with capabilities to consider a range of tolling strategies and scenario tests
- The approach appears to be emerging as an industry standard and has recently been used as the preferred modelling approach for a number of Australian toll roads.

[12] Within the WRTM, trucks are all vehicles of Austroads class 3 and higher. While trucks carrying hazardous materials would not be able use the tunnels, most of these restrictions apply to a subset of articulated vehicles and are not relevant to rigid vehicles, which are the majority of the truck class.

The WRTM toll choice assignment model was constructed to model the range of driver behaviour and was adjusted to match the observed patronage on the existing toll facilities. A series of validation checks was undertaken to verify the performance of the WRTM.

Land use projections

The WRTM is linked to the STM, which includes the trip generation, trip distribution and mode choice modules and incorporates demographic data related to land uses including population, employment and education enrolment projections. For WRTM v2.3, this data has been supplied by TPA as data extracts from the STM and is based on the latest population and employment projections.

These population and employment projections are based on the latest land use data (version LU14v4) provided by TPA. This data has been projected from 2011 Census data and incorporates known major urban renewal projects and developments, including those around Green Square and Mascot town centres. The base vehicle demands from STM are consistent with these demographic assumptions and therefore provide a consistent base for the future demands used in the WRTM. Projects and developments included in the WRTM v2.3 modelling also include the strategic directives contained in *A Plan for Growing Sydney* (NSW Government 2014) in 14 transport and land use corridors:

- Arncliffe to Banksia
- The Bays Precinct
- Broader Western Sydney Employment Area
- Central to Eveleigh
- Glenfield to Macarthur
- Greater Macarthur Investigation Area
- North-western Growth Area
- Parramatta
- Second (Western) Sydney Airport
- South-western Growth Area
- Sydney Metro – Bankstown to Sydenham
- Sydney Metro – City and Inner Southwest
- Sydney Metro – Northwest
- Sydney to Parramatta (including the Parramatta Road Urban Transformation Strategy).

The WRTM has also included planned future port activities and uses, for instance at Port Botany, Sydney Airport Freight terminal and intermodal terminals.

Induced demand

Traffic growth on new or upgraded roads is generally a result of the following influences:

- Regional increase in number of trips due to population growth and increased economic activity
- Trips attracted from competing routes or modes as a result of improved travel times on the new or upgraded road
- Induced demand as a result of improved travel times between homes and destinations, such as workplaces, shopping centres and education facilities, which cause changes to region-wide trip patterns.

Even with no growth in regional population and economic activity, a new or substantially upgraded road can induce changes in trip patterns which then appear as induced traffic demand. The WRTM includes the changes in traffic associated with all three of the above sources of traffic, with induced demand equating to about 0.3 per cent additional daily trips in the Sydney metropolitan area in 2033.

Modelled scenarios

In considering the future, several scenarios need to be considered, reflecting the timeframe under which the project would be delivered and the extent of other infrastructure developments. These scenarios were explored through development of specific modelled scenarios, reflecting various future travel demands.

Examined demand cases were represented by specific forecast years:

- 2015 was adopted as the base case
- 2023 was adopted as the project opening case for the project
- 2033 was adopted as the case for 10 years after opening as required in the Roads and Maritime assessment guidelines.

The scenarios were modelled in the WRTM by combining future year demands with future networks. As WRTM has a base year of 2012 and models future years in five year intervals, the above years were calculated by interpolating and extrapolating between 2012, 2021, 2026 and 2031 outputs. Traffic was assigned using the calibrated road assignment model, taking account of changes in toll choice behaviour over time. The WRTM provided growth in AM peak and PM peak roadway and intersection turning volumes for input to operational traffic modelling stage scenarios:

- **Base case (2015)**: current road network with no new projects or upgrades. For the operational modelling, 2015 was adopted as the base case to match the year of traffic survey data collection, and represents road network conditions prior to the start of construction of the M4 Widening, M4 East, KGRIU and the New M5 projects
- **Operation 'do minimum' or 'without project' (2023)**: The 'do minimum' or 'without project' scenario assumes that NorthConnex, M4 Widening, M4 East, KGRIU and New M5 are complete, but that the third stage of the WestConnex program of works, the M4-M5 Link, has not been built. It is called 'do minimum' rather than 'do nothing' as it assumes that ongoing improvements would be made to the broader road and public transport network including some new infrastructure and intersection improvements to improve capacity and cater for traffic growth
- **Operation 'with project' (2023)**: With the 2023 'do minimum' projects completed and the M4-M5 Link complete and open to traffic
- **Operation 'cumulative' (2023)**: With the 2023 'do minimum' projects completed, the M4-M5 Link complete and open to traffic, and in addition, the proposed future Sydney Gateway and the Western Harbour Tunnel component of the proposed future Western Harbour Tunnel and Beaches Link complete and operational
- **Operation 'do minimum' or 'without project' (2033)**: a future network including NorthConnex, M4 Widening, M4 East, KGRIU and New M5 and some upgrades to the broader road and public transport network over time to improve capacity and cater for traffic growth but does not include the M4-M5 Link
- **Operation 'with project' (2033)**: With the 2033 'do minimum' projects completed and the M4-M5 Link complete and open to traffic
- **Operation 'cumulative' (2033)**: With the 2033 'do minimum' projects completed, the M4-M5 Link complete and open to traffic, and in addition, the proposed future Sydney Gateway, Western Harbour Tunnel and Beaches Link and F6 Extension complete and operational.

Bandwidth plots used in this assessment are produced directly from WRTM for 2012 and future years in five year intervals. Therefore, the bandwidth plots in this report use 2012 as a proxy for 2015, 2021 as a proxy for 2023, and 2031 as a proxy for 2033.

While the construction impact of the proposed future Western Harbour Tunnel entry and exit ramps at the Rozelle interchange is included in this EIS, a comprehensive operational traffic impact of these ramps is not part of this EIS. Due to the ongoing development of the proposed future Western Harbour Tunnel and Beaches Link project, this would be assessed in the future Western Harbour Tunnel and Beaches Link EIS. While a high level assessment of potential impacts is provided in **Chapter 12,** the above modelled cumulative scenarios assume a sub-surface, motorway-to-motorway connection between the proposed future Western Harbour Tunnel and Beaches Link and the M4-M5

Link, but do not assume a surface connection to and from the proposed future Western Harbour Tunnel and Beaches Link at the Rozelle interchange.

Changes from the M4 East and New M5 EIS assessments

As mentioned above, strategic traffic models typically undergo constant development and refinement. WRTM v2.3 was used for this EIS, while WRTM v2.1 was used for both the M4 East EIS and the New M5 EIS. Since the M4 East and New M5 EIS traffic assessments were undertaken, updates to the WRTM inputs have occurred, as well as enhancements to the WRTM zones and growth processing. These updates and enhancements include:

- NSW DP&E updated land use forecasts, including in particular, revised land use development along Parramatta Road, The Bays Precinct and in Mascot town centre, as well as increased precision in respect of the land use zoning used in the WRTM
- Evolution and refinement of the M4-M5 Link design, with increases in the number of lanes in the mainline tunnels from three lanes to four lanes, revised layout for the refined Rozelle interchange, the addition of the Iron Cove Link and the removal of the previously proposed Camperdown interchange.

The future years assessed in the M4 East and New M5 EIS traffic assessments were 2021 and 2031. Due to the delivery timeframe of the M4-M5 Link project, 2023 and 2033 have been used. Therefore, the travel demand and traffic volumes are also being forecast to different years compared to the EISs for the M4 East and New M5 projects. A direct comparison between the modelled results of the previous EIS and this EIS would therefore not be a like-for-like comparison.

The changes in forecast traffic volumes resulting from the changes in design of the M4-M5 Link compared to that used in the traffic assessments for the M4 East and New M5 projects is presented in **Annexure C**.

4.2.2 Stage 2 – Future year traffic demand for operational assessment

The WRTM was used to generate base and future year traffic demand matrices for the weekday AM peak and PM peak hours. As mentioned above, the key objective of the WRTM demand modelling was to forecast traffic demand and growth in traffic volumes in the M4 and M5 corridors, the M4-M5 Link, and other key roads in the project area, based on expected population and employment changes, and proposed road network improvements for the six future modelling scenarios. From this, the forecast growth in travel demand and traffic volumes on the road network could be derived for each scenario for application in the more detailed operational modelling.

This growth in traffic volumes was then applied to the balanced turning counts, derived from traffic surveys undertaken on the road network, and used to create the traffic flows used in the future year operational modelling, based on practices described in Roads and Maritime modelling guidelines. Where a future reduction in traffic demand is anticipated, the absolute growth is expressed as a negative.

This approach, which is consistent with the modelling adopted for the previous M4 Widening, M4 East and New M5 EISs, makes the best use of observed traffic count data as the basis for future year travel demand and traffic volumes and patterns. More specifically, this approach provides the most accurate representation of how the modelled increase in future traffic would affect existing observed network travel demands and the resultant network operation.

4.2.3 Stage 3 – Operational traffic modelling assessment

M4-M5 Link motorway

The M4-M5 Link mainline tunnels, from the interface with the M4 East mainline in the north at the Wattle Street interchange in Haberfield to the New M5 mainline tunnels in the south at St Peters were modelled using microsimulation modelling software. The ability for this software to model individual vehicle behaviour and interaction with the road network and other road users enabled densities and level of service for the mainline tunnels of the project to be reported. AM and PM peak period models were developed and the mainline tunnels divided into five sections for reporting purposes:

- Section 1: Interface with M4 East, east of Wattle Street interchange ramps

- Section 2: Wattle Street interchange ramps to Rozelle interchange ramps
- Section 3: Rozelle interchange bypass
- Section 4: Rozelle interchange ramps to St Peters interchange ramps
- Section 5: Interface with the New M5, south of St Peters interchange ramps.

Using future year travel demands, densities and levels of service were assessed at 200 metre intervals along the mainline for 2023 and 2033 for the 'with project' and 'cumulative' scenarios.

Interchanges and surrounding road network

While the WRTM provides strategic travel demand forecasts across the Sydney metropolitan area, more detailed models were required to fully evaluate operational impacts on the surrounding road network in the vicinity of each of the Wattle Street, Rozelle and St Peters interchanges.

Traditional analytical intersection assessment tools, eg SIDRA, do not provide a whole of network assessment and tend to work best at evaluating individual, isolated intersections or small networks of intersections. Microsimulation modelling software, which models individual vehicle behaviour, such as weaves and merges and interactions with the network and other road users, are better tools for evaluating network operation particularly in congested networks with motorway entry and exit ramps that would have weaving and merging movements.

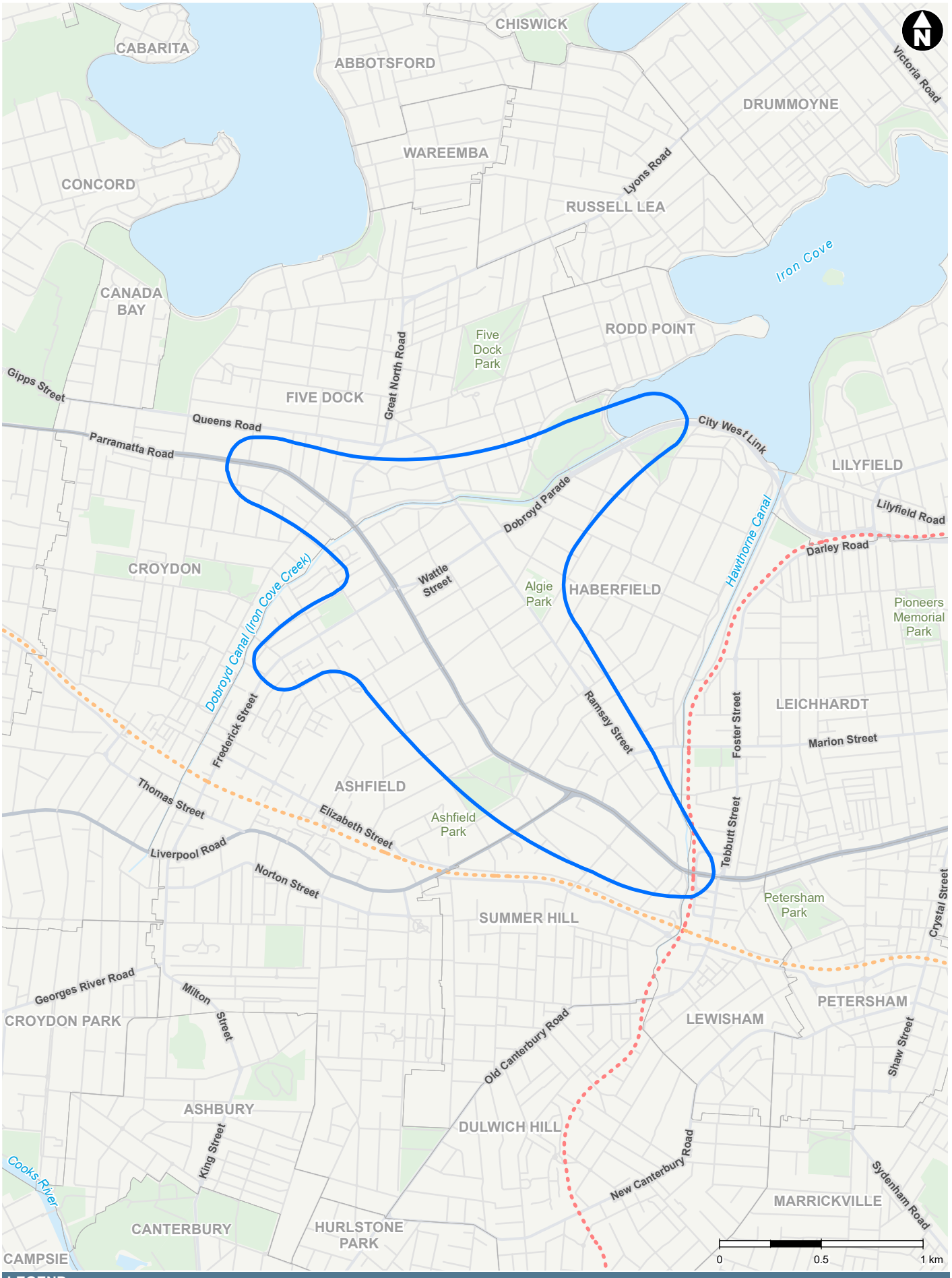
The VISSIM microsimulation modelling package was used to model impacts at the Wattle Street and Rozelle interchange locations while the operational traffic modelling for the St Peters interchange was undertaken in the Paramics microsimulation modelling package, using the same model as was used in the New M5 EIS. Traffic demands used in the New M5 EIS were based on WRTM v2.1, while demands used in this EIS were from WRTM v2.3. LinSig, a micro-analytical network modelling software package was also used to provide the initial traffic signal settings for the microsimulation operational models.

Base year model development – operational

It is standard modelling practice to create base year models that replicate existing traffic conditions before developing any future year scenarios. Base models of the road network around each of the Wattle Street and Rozelle interchange locations for the AM and PM peak periods were developed, calibrated and validated to simulate the operation of the existing road network under present day traffic demands. A 2014 calibrated and validated base model at the St Peters interchange had been developed for the New M5 EIS and was used as a proxy for the 2015 base year model for this project.

The boundary for the operational modelling area was informed by the forecast WRTM v2.3 traffic volume differences around the interchanges as a result of the project. These modelling area boundaries at the Wattle Street interchange and St Peters interchange are generally consistent with those for the M4 East and New M5 EISs. Further justification of the operational modelling areas is contained in Annexure B.

The base year model extents at each of the interchange locations are indicated in **Figure 4-2** to **Figure 4-4**. A separate intersection model was developed at the Victoria Road/Lyons Road intersection to assess the forecast impacts on Lyons Road and Victoria Road in this vicinity, as shown in **Figure 4-2**.



LEGEND

Existing features

- Waterway
- Railway
- Light rail
- Suburb boundary
- Arterial road
- Subarterial road
- Local road

Model boundary

- Microsimulation area

Figure 4-2 Wattle Street interchange operational model boundary

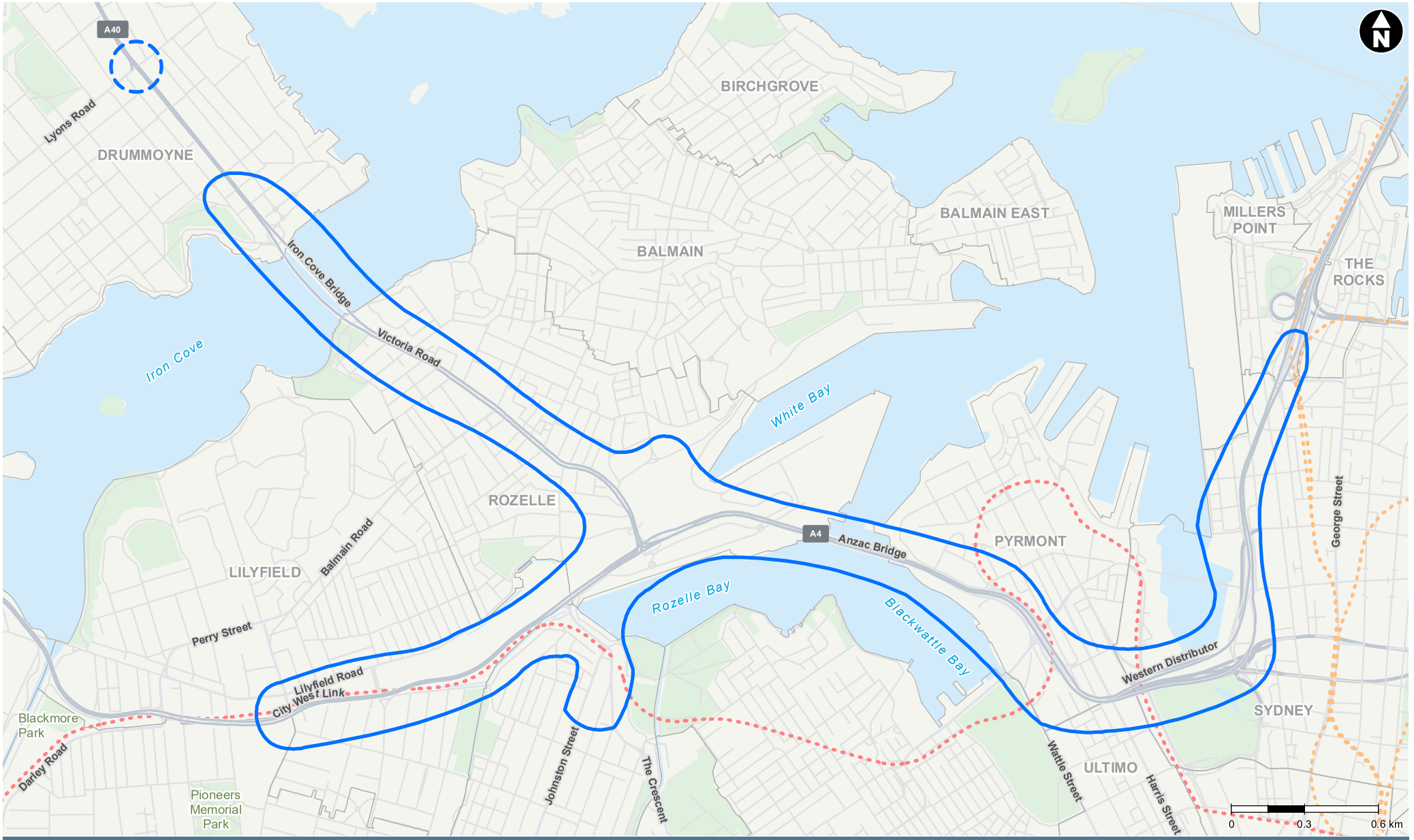


Figure 4-3 Rozelle interchange operational model boundary

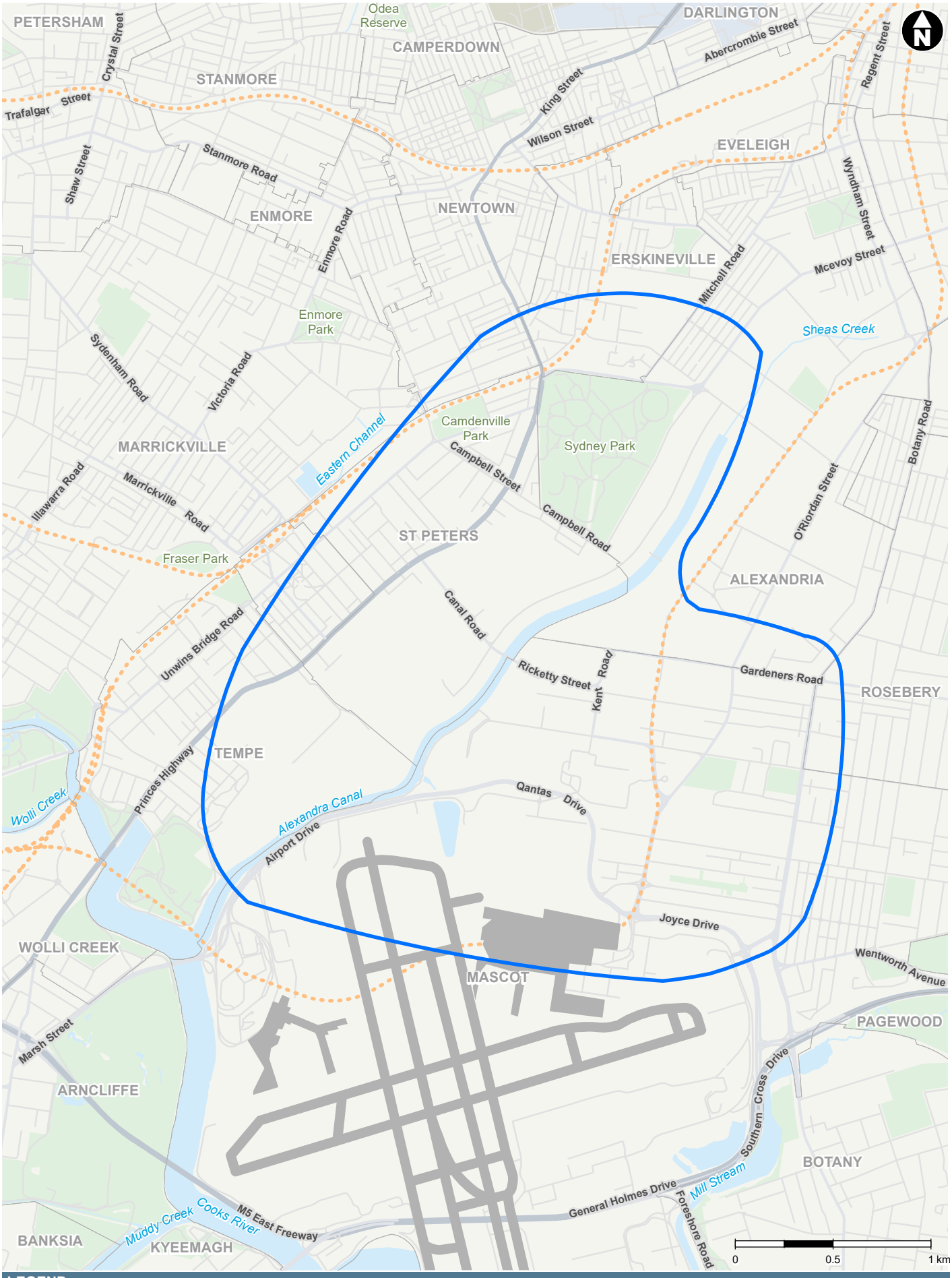


Figure 4-4 St Peters interchange operational model boundary

To ensure an accurate representation of existing traffic conditions, the base simulation models were calibrated and validated as per Roads and Maritime modelling guidelines to align with existing traffic conditions. The following data sources were used in the calibration and validation process:

- Aerial photography: The modelled network layout was primarily based on aerial photography and Traffic Control Signal (TCS) plans. Additionally, intersection geometry was verified during site inspections
- Intersection turning counts: a series of AM peak and PM peak hour turning count surveys were undertaken in 2015 at the majority of the modelled intersections. In addition, Sydney Coordinated Adaptive Traffic System (SCATS) traffic count data was used to derive turning volumes for intersections where no survey data was available
- Intersection Diagnostic Monitor data (IDM): IDM data provides a comprehensive record of traffic signal operation statistics (cycle and phase timings etc) at signalised intersections
- Saturation flows: SCATS LX data was used to identify the saturation flow characteristics for individual approach lanes
- Site inspections: AM peak and PM peak site visits were completed at all intersection locations by the traffic modellers to observe and document:
  - Intersection geometry
  - Lane usage
  - Sample traffic signal timings
  - 'Dead green' time (green traffic light phase, but vehicles unable to advance due to queuing ahead or downstream blocking effects)
  - Pedestrian delays
  - Posted speed limits
  - Location of parking and bus stop (if applicable)
  - Bottlenecks and pinch points in the study area
- Strategic model cordon matrices ie volume of traffic going in and out of the boundary of the modelled road network from specified origins to specified destinations.

The operational model demand matrices comprised were developed in the following stages:

- Cordon applied to WRTM v2.3 to obtain initial origin/destination matrices for the model areas
- Initial matrices were expanded to match the simulation model zoning system (there are fewer zones in the WRTM cordon area due to the nature of this model and these zones needed to be disaggregated for the simulation models)
- 'Target' zone origin and destination totals were determined based on observed count data where available. At locations where count data was not available, the WRTM totals were retained
- Matrices were furnessed to match 'target' volumes. Furnessing is a common process used in transport modelling to factor the rows and columns of a demand matrix in an iterative manner to obtain totals that match the 'target' volumes.

The resulting matrices were then used as inputs to the simulation models with ensuing refinements carried out as part of the calibration process.

Future year model development – operational

Following the calibration and validation of the AM and PM peak period base year simulation models, future year networks and traffic demands were developed for 2023 and 2033 to assess the future performance of the study area. These 2023 and 2033 models catered for the assessment of the following scenarios:

- 'Without project' or 'do minimum' scenario

- ‘With project’ scenario
- ‘Cumulative’ scenario.

The growth in WRTM forecasts was used to grow the demands from the base year to the relevant future year models. While the simulation models are over two to four hour peak periods, WRTM forecasts typical one hour peak (AM and PM) volumes. The forecast one hour volumes were extrapolated across the full simulation periods to reflect typical demand profiles on either side of the peak hours. This profile was based on observed count data across the relevant networks, eg the road networks surrounding the M4-M5 Link interchanges.

In some cases, the forecast one hour future demand would exceed the physical road capacity. This calculated future excess demand was then distributed into the hours before and after the peak hour to correspond with anticipated peak spreading, effectively predicting longer peak periods in future.

In the St Peters interchange model area, the demand growth forecast by the WRTM in the ‘with project’ scenarios caused the operational models to become inoperable during the AM and PM peak hours, primarily due to the forecast growth in peak hour trips to and from Sydney Airport. This suggests that not all of the forecast demand to and from the airport could be accommodated in the peak hour without the proposed future Sydney Gateway project.

The airport peak hour demand was therefore reduced in the ‘with project’ scenarios as summarised in **Table 4-1**. For consistency and comparison purposes, this peak hour demand reduction was also applied to the ‘do minimum’ or ‘without project’ scenario. Forecast trips that were removed are reported in the network performance tables. In the ‘cumulative’ scenarios, with Sydney Gateway, no growth reduction was applied, with the full forecast demand to and from the Sydney Airport precinct used in the models.

Table 4-1 Summary of growth reduction factors used in operational modelling in ‘without project’ and ‘with project’ scenarios

Model zone	AM peak		PM peak	
	2023	2033	2023	2033
Sydney Airport (Domestic Airport terminals)	0.75	0.75	0.7	0.7

The modelling reflects the design of proposed local road upgrades and interchanges proposed as part of the project. Projects within other Roads and Maritime programs were included in the operational modelling. Projects and programs include:

- Pinch Point Program through the Easing Sydney’s Congestion office – this include upgrades to the Parramatta Road/Great North Road and the Princes Highway/Railway Road intersections
- Airport North Precinct – upgrades to roads north of Sydney Airport to improve traffic flow and connections to the airport and Port Botany.

The Alexandria to Moore Park Connectivity Upgrade project is outside of the operational modelling boundary at the St Peters interchange. While investigations into the King Street Gateway project are underway, no confirmed road layout changes are available, and so this project has not been included in the operational modelling around the St Peters interchange.

Construction modelling

Base year model development

Similar to the operational assessment, the construction modelling methodology included deriving base year traffic patterns and developing base and future year traffic models. To ensure an accurate representation of existing conditions, further network traffic counts were gathered across the study area in the locations of the proposed construction ancillary facilities.

Base year construction models were developed in LinSig as, unlike the interchanges assessed in the operational case, detailed interactions such as weaving and merging are not prevalent. This is a similar approach to that used in the M4 East and New M5 EIS construction impacts assessments. The construction models were calibrated in a similar manner to that already described for the operational models.

Future year model development

Based on the planned construction activities, a worst case construction traffic scenario was assumed to be the period of spoil removal from tunnel construction during 2021. The current road network with the addition of the M4 East and New M5 projects was assumed for the road network in the construction scenario.

AM and PM peak hour models for 2021 were developed to assess the future performance of the road network during construction. In a similar way to the future operational demand volumes, the growth forecast by the WRTM was used to derive the background traffic demand for 2021.

Construction traffic was then added to the background traffic. This was based on the proposed construction methodology, covering vehicle types, volumes and construction traffic routes to and from the various construction ancillary facilities. The performances of the intersections in the vicinity of the constructions ancillary facilities were then calculated.

4.3 Methodology – assessment criteria

Generally, traffic operational performance can be assessed in several ways, including:

- At a network level, in terms of total distance travelled and total time travelled
- For single-point assessment at a mid-block level, showing changed travel routes and impacts
- At an intersection level, showing changed performance of these typically constraining elements of urban road networks.

Traditionally, shorter distance and less time travelled through a network imply increased network efficiency. However, because demands and networks may be different, higher values may well be indicative of a better performing network because more vehicles are able to travel through the network to reach their destinations, while shorter distance may be caused by congestion and slower vehicle speeds.

Given the existing congested traffic in the study area, single-point assessment criteria do not present a complete picture of road network traffic operations. Traditional mid-block and intersection levels of service do not recognise that traffic is often constrained upstream, meaning that vehicles cannot get to the evaluation point giving an unrealistically low level of demand. Similarly, they do not recognise that traffic is constrained downstream; meaning vehicles are queued through the evaluation point. The measurements therefore reveal only throughput at that point, not realistic performance. The operation of the modelled road network as a whole is regarded as being of prime importance, recognising that there may be single locations where there may be improvement, while at others some deterioration. These should therefore not be considered in isolation. The critical evaluation is that the project does not overburden the network and provides more efficient network operations as a whole.

4.3.1 Interchange network performance

As discussed above, the WRTM was used to assign traffic demand on the strategic road network using the land use and demographic assumptions based on input provided by the STM. The WRTM is intended for use as a Sydney-wide traffic assignment model and is not intended to be used for detailed traffic operational analysis of the road network, which requires more specialised software, such as microsimulation software, which has been used in this assessment.

The project involves interaction of wide, congested multi-lane carriageways and development of interchanges between at-grade and sub-surface road infrastructure. Given the complex nature of these interactions, it is important to recognise and visualise the impact that the project would have on the road network. Of particular importance is merge behaviour at tunnel portals and potential blocking of entry and exit ramps. Such behaviour is best represented by microsimulation modelling.

Microsimulation software was selected for detailed network and intersection analysis due to its ability to model individual vehicle interactions, traffic signal effects, overtaking manoeuvres, and queuing. The visual representation and interaction of individual vehicles is of particular importance where merge and weave behaviour, as well as differential lane utilisation, are expected to have an impact on traffic capacity.

Modelling parameters collected and reported for the AM and PM peak hours in each scenario modelled were:

- Total vehicle demand – number of vehicles wanting to use the modelled network
- Vehicle kilometres travelled – total distance travelled by vehicles travelling through the modelled network
- Vehicle time travelled approaching and in network – the total time taken by vehicles to enter and drive through the modelled network
- Total vehicles arrived – the number of vehicles completing their journey on the network
- Total stops made by vehicles in the network, either due to intersection controls or congestion – the number of stops that vehicles make while travelling through the modelled network. Generally, the fewer stops, the less congested the network is
- Average speed of vehicles – the average speed at which vehicles travel through the network. Calculated by dividing the VKT by the vehicle time travelled. Generally, the higher the speed, the better the network operates
- Travel time for typical cross-network trips – the time taken by vehicles to travel between two points in the network. Used as a comparison of how the network is performing, although with changes in the network, vehicles can take different routes between points
- Unreleased demand at the end of peak hour – the number of vehicles unable to enter the model due to congestion extending back to model entry points. The number of 'unreleased' vehicles is an indication of the effectiveness of the network. Generally, the lower the number of unreleased vehicles, the better the network is able to accommodate travel demand.

4.3.2 Level of service

Level of service (LoS) is a measure to describe the operational conditions and efficiency of a roadway or intersection. The definition of LoS generally outlines the operating conditions in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and road safety. It is a qualitative measure describing operational conditions within a roadway or intersection, as perceived by motorists and/or passengers.

Mid-block levels of service

Table 4-2 shows the six levels of service for mid-block carriageway locations, ranging from LoS A–F, with LoS A representing optimum operating conditions (free flow) and LoS F the poorest (forced or breakdown in flow). When a roadway performance falls below LoS D, investigations are generally initiated to determine if suitable remediation can be provided. In built up areas, limited road capacity and high demand mean that LoS E and LoS F are regularly experienced by motorists at pinch points on the existing strategic road network in Sydney. These conditions are generally experienced during peak periods. Roads and Maritime has an established program office (*Easing Sydney's Congestion*) aimed at delivering improvements to relieve congestion at pinch points and improving performance on strategic roads.

The level of service for freeways or motorways is calculated from the vehicle density, which is the traffic volume divided by the average passenger car speed. Density is measured in passenger car units (PCU[13]) per kilometre per lane (PCU/km/ln). The assessment of level of service for the M4-M5 Link mainline tunnels has used these density measurements.

As explained above, due to the existing congested traffic conditions experienced on the surface road network in the study area during peak periods, it is not proposed to report mid-block level of service for the surface road network, but rather the network performance and intersection level of service.

[13] PCU = passenger car unit. This accounts for the amount of road space differing types of vehicles use, with heavy vehicles or buses taking up more space than cars or light commercial vehicles.

Intersection levels of service

Average delay is commonly used to assess the operational performance of intersections, with level of service used as an index. A summary of the intersection level of service criteria is shown in **Table 4-3**.

For the purpose of analysing intersection performance in this assessment, all exit blocking constraints, applied in the microsimulation models to reflect network congestion beyond the modelled network extents, were removed. This allows for an assessment of the intersections within the modelled network, irrespective of any downstream queuing that would mask the actual operation of the intersection.

Similar to the mid-block performance measures, common practice suggests that when intersection performance falls to LoS D, investigations should be initiated to determine if suitable remediation can be provided. However, limited road capacity and high demand mean that LoS E and LoS F are regularly experienced by motorists at pinch points on the existing strategic road network in Sydney, generally during peak periods. It should also be noted that capacity constraint can be used as a demand management technique, which discourages car travel and that conversely, over-provision of capacity can encourage more car use.

Table 4-2 Mid-block level of service definitions and criteria

LoS	Definition	Multi-lane roads[1]	Freeways[2]
		V/C ratio	Density (PCU/km/ln)
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high.	≤ 0.26	≤ 7.0
B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort is a little less than with level of service A.	0.27 to 0.41	7.1 to 11.0
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	0.42 to 0.59	11.1 to 16.0
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow would generally cause operational problems.	0.60 to 0.81	16.1 to 22.0
E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream would cause breakdown.	0.82 to 1.00	22.1 to 28.0
F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.	> 1.00	> 28.0

Notes: [1] Where free flow speed is taken as 70 kilometres per hour
[2] Where free flow speed is taken as 90 kilometres per hour

Source: A*ustroads, Guide to Traffic Management – Part 3 Traffic Studies and Analysis*, Second Edition 2013

Table 4-3 Level of service criteria for intersections

LoS	Average delay/vehicles (sec/veh)	Traffic signals/roundabouts	Give way and stop signs
A	≤ 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents would cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

Source: *Guide to Traffic Generating Developments*, RTA 2002

5 Existing traffic and transport environment

5.1 Introduction

This section outlines the existing traffic and transport environment within the study area, which includes the area around the proposed Wattle Street, Rozelle and St Peters interchanges, and the corridors between proposed Wattle Street and Rozelle interchanges, Rozelle and St Peters interchanges, and Wattle Street and St Peters interchanges. All data presented in this section represents the base case or existing traffic and transport conditions and is founded on the latest publicly available information.

The existing traffic and transport environments of the areas around the Wattle Street and St Peters interchanges are derived from the Traffic and Transport Assessment of the M4 East EIS (AECOM, September 2015) and Traffic and Transport Technical working paper of the New M5 EIS (AECOM, November 2015). Therefore, the existing conditions discussed at the Wattle Street and St Peters interchanges reflect conditions prior to the commencement of construction of the M4 East and the New M5.

5.2 Wattle Street interchange and surrounds

The existing travel behaviours and volumes in the vicinity of the project are heavily influenced by the current function of Parramatta Road. Classified as a state road, it forms a major east–west Sydney metropolitan road corridor. Consequently, the balance between traffic function and access generally favours through traffic movements, with a focus on capacity and congestion management measures that enhance the operational performance for large volumes of trips along Parramatta Road.

Alternative east–west arterial roads within the study area include Frederick Street/Wattle Street/Dobroyd Parade/City West Link, Queens Road/Gipps Street/Patterson Street, Ramsay Street and the Hume Highway. The Frederick Street/Wattle Street/Dobroyd Parade/City West Link corridor is a major connector between Sydney's western and south-western suburbs and the Sydney CBD as well as for local traffic. The corridor is part of a northeast link which extends for about 13 kilometres from the intersection of Punchbowl Road and King Georges Road in Punchbowl, to join the Western Distributor at its intersection with Victoria Road. It provides an alternative route to Parramatta Road into the Sydney CBD from inner-southern and inner-western Sydney.

The Hume Highway, to the south of Parramatta Road, is classified as a state road which provides an important metropolitan connection for local and regional traffic. It extends from Liverpool in south-western Sydney, to join Parramatta Road near Summer Hill.

5.2.1 Modes of travel

The Wattle Street interchange is located within the Inner West LGA. Travel mode share for the Inner West LGA in comparison with the Sydney Greater Metropolitan Area (GMA) is shown in **Table 5-1**. The Inner West LGA has a higher share of public transport due to the area's proximity to the Sydney CBD and frequent bus services. The largest difference to the Sydney GMA data is in 'walk only' trips, which account for 32 per cent of all trips in the Inner West LGA compared to 18 per cent in the Sydney GMA. This could be attributed to factors including the walkability of many neighbourhoods in the area.

Table 5-1 Average weekday travel mode share for Inner West Local Government Area

LGA	Private vehicles			Rail	Bus	Walk only	Other modes
	Driver	Passenger	Total				
Inner West LGA	36%	13%	49%	7%	8%	32%	5%
Sydney GMA	47%	22%	69%	5%	6%	18%	2%

Note: Inner West Council data has been derived by combining data from the former Leichhardt, Ashfield and Marrickville LGAs
Source: NSW Bureau of Transport Statistics (BTS), Household Travel Survey Report: Sydney 2012/13, Nov 2014 Release

5.2.2 Public transport services

Rail services

Figure 5-1 displays the rail network and associated stations that are close to the Wattle Street interchange and surrounds, which are serviced by the Northern, Western and Inner West and South Rail Lines. Ashfield Station is the closest rail station. To the north, North Strathfield Station is serviced by the Northern Line which provides limited stops services to the Sydney CBD. To the south, up to 10 stations are serviced by one or more of the Inner West, South, Western or Northern Lines. Additionally, limited stop express services to the Sydney CBD can be boarded at Flemington, Strathfield, Burwood, and Ashfield stations. Homebush and Croydon stations are served exclusively by the Inner West Line all stops services.

Source: Extract of Sydney train network map around the Wattle Street interchange and surrounds

Figure 5-1 Rail network around the Wattle Street interchange site

Bus services

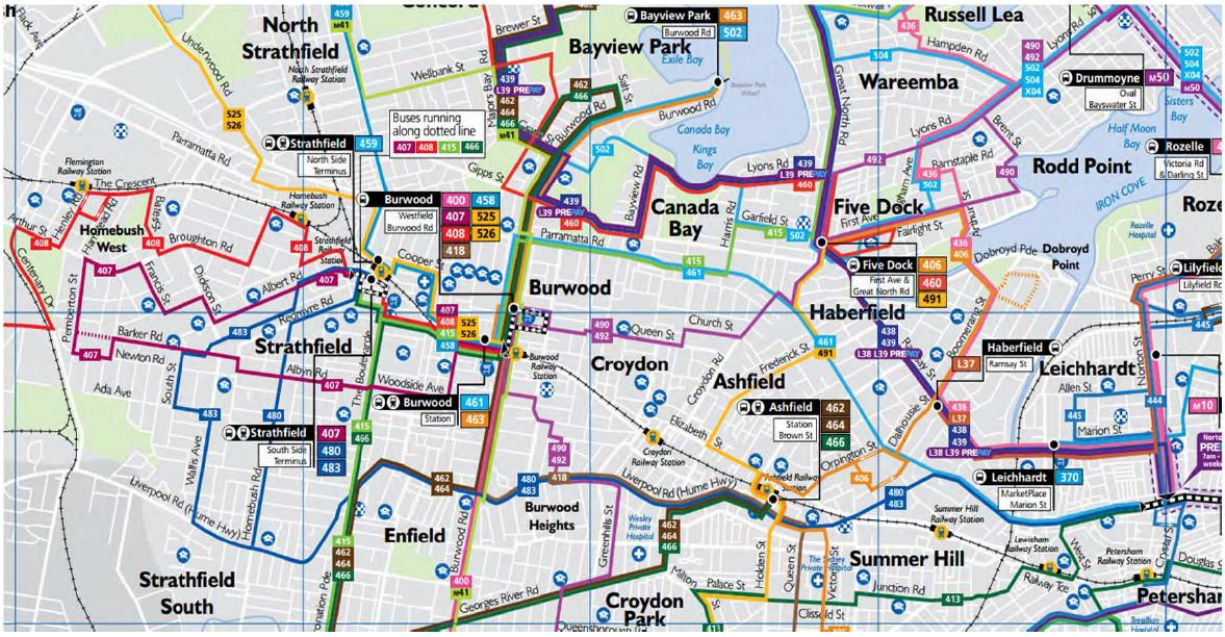
Figure 5-2 shows the bus network close to the Wattle Street interchange and surrounds, including Metrobus M41: Hurstville to Macquarie Park strategic north–south bus corridor, and Route 461: Burwood to the CBD strategic east–west bus route, which runs along Parramatta Road. The figure shows that there are several bus routes that operate within particular sections of the Wattle Street interchange and surrounding area via train station hubs, such as Strathfield, Burwood and Ashfield.

Specifically, the following bus routes utilise sections of Parramatta Road between Homebush Bay Drive and Wattle Street:

- Routes 525 and 526 travel along Parramatta Road between Underwood Road and Concord Road

- Route 461, Burwood to The Domain, operates along Parramatta Road from Burwood Road to Broadway
- Route 415, Chiswick to Burwood, which runs along Parramatta Road between Burwood Road and Harris Road
- Routes 490 and 492, Drummoyne to Hurstville and Rockdale, utilise the section of Parramatta Road between Arlington Street and Great North Road
- Route 491, Five Dock to Hurstville, utilises the section of Parramatta Road between Great North Road and Frederick Street.

There are a further six Sydney metropolitan bus region 6 routes that intersect Parramatta Road between Homebush Bay Drive and Wattle Street during peak periods.



Source: Sydney Buses, 2015

Figure 5-2 Bus network around the Wattle Street interchange site

Table 5-2 provides details of peak period bus services and frequencies for the routes within the Wattle Street interchange and surrounding area.

Table 5-2 Bus services around the Wattle Street interchange and surrounds

Route	Operator	AM peak services (7–9am)	AM peak frequency (mins)	PM peak services (4–6pm)	PM peak frequency (mins)
525 Burwood to Parramatta	Sydney Buses	6	10–25	7	10–30
526 Burwood to Sydney Olympic Park Wharf	Sydney Buses	3	30–60	6	30
461 Burwood to The Domain	Sydney Buses	11	10–20	6	10
415 Chiswick to Campsie	Sydney Buses	4	20–35	5	30
490 Drummoyne to Hurstville	Sydney Buses	4	30	4	30
492 Drummoyne to	Sydney Buses	4	25–30	4	30

Route	Operator	AM peak services (7–9am)	AM peak frequency (mins)	PM peak services (4–6pm)	PM peak frequency (mins)
Rockdale					
491 Five Dock to Hurstville	Sydney Buses	4	30	4	30
458 Burwood to Ryde	Sydney Buses	1	–	0	No PM services
459 Strathfield to Macquarie University	Sydney Buses	4	25–30	3	Last service departs Strathfield at 5.07am
M41 Marsfield to Hurstville	Sydney Buses	N/A	10	N/A	10
464 Ashfield to Mortlake	Sydney Buses	10	10–15	7	20
463 and 466 Ashfield to Cabarita Wharf	Sydney Buses	7	10–30	8	5–30
480 and 483 Strathfield Station to City	Sydney Buses	12	10–15	13	5–15 (return service only)
406 Five Dock to Hurlstone Park	Sydney Buses	2	60	2	60
418 Burwood to Bondi Junction	Sydney Buses	6	20	6	20
436 Chiswick to City	Sydney Buses	5	20–30	4	30
462 Ashfield to Mortlake	Sydney Buses	0	Weekend and off-peak service only	0	Weekend and off-peak service only
413 Campsie Station to City	Sydney Buses	8	15	4	30
439 Mortlake to City	Sydney Buses	2	30 (Service commences at 08:13)	4	30
440 Rozelle to City	Sydney Buses	18	5–10	10	10
445 Campsie to Balmain East	Sydney Buses	0	Inter-peak service	0	Inter-peak service
444 Campsie to Balmain East	Sydney Buses	10	10–20	8	15
502 Bayview Park to City	Sydney Buses	6	10 (Services ends at 08:00)	0	0 (AM peak service only)
M10 Leichhardt to Maroubra	Sydney Buses	12	10	12	10
X25 Strathfield to Homebush Bay	Sydney Buses	12	10	10	10 (Services commence at approx. 4.30pm)
N60 City to Fairfield	Sydney Buses	5	00:45	04:45	60
N61 City to Carlingford	Sydney Buses	3	01:45	03:45	60
N70 City to Penrith	Sydney Buses	4	01:05	04:05	60

Route	Operator	AM peak services (7–9am)	AM peak frequency (mins)	PM peak services (4–6pm)	PM peak frequency (mins)
N71 City to Richmond	Sydney Buses	5	00:35	04:35	60
N80 City to Hornsby (via Strathfield)	Sydney Buses	5	00:40	04:46	60

Note: frequencies rounded to the nearest five minutes
Source: M4 East EIS, AECOM, September 2015

5.2.3 Walking and cycling facilities

Details of existing walking and cycling facilities can be found in **Appendix N** (Technical working paper: Active transport strategy) of the EIS.

5.2.4 Existing traffic volumes and patterns

Automatic traffic count (ATC) surveys were completed in 2014 to understand and analyse existing traffic volumes and patterns at the Wattle Street interchange and surrounds. Specifically, classified hourly traffic volumes at the following roadway locations were recorded over a one-week period:

- Parramatta Road west of Wattle Street
- Ramsay Road between Henley Marine Drive and Wolseley Street
- Dobroyd Parade east of Timbrell Drive
- Parramatta Road at Hawthorne Canal.

The AM peak hour, PM peak hour and average weekday traffic (AWT) volumes at each of these survey locations are summarised in **Table 5-3**.

On Parramatta Road, peak period traffic volumes show similar trends to daily figures with a fairly 'flat' profile of traffic throughout the day between the AM peak and PM peak periods. At the Hawthorne Canal, there are clear changes in peak direction between the AM peak hour and the PM peak hour, with more vehicles travelling towards the city in the AM peak hour, and more vehicles travelling away from the city in the PM peak hour.

During the AM peak hour, the traffic volume on Dobroyd Parade is similar in both directions, while during the PM peak hour, the eastbound volume is indicated as higher. This was due to congested traffic conditions. The surveyed volumes therefore only represent the satisfied demand and, due to downstream congestion and queuing at this location, underestimate the actual demand.

Table 5-3 Average peak mid-block traffic volumes at key locations around the Wattle Street interchange and surrounds (2014 count data)

Location	Direction	AM peak hour		PM peak hour		AWT	
		veh/hr	HCV%	veh/hr	HCV%	veh/hr	HCV%
Parramatta Road, west of Wattle Street	Eastbound	2,530	6%	2,370	4%	43,500	7%
	Westbound	2,640	11%	2,790	2%	46,000	7%
Ramsay Road, between Henley Marine Drive and Wolseley Street	Eastbound	930	6%	840	2%	13,000	4%
	Westbound	830	3%	990	3%	13,000	3%
Dobroyd Parade, east of Timbrell Drive	Eastbound	1,670	9%	2,120	3%	32,500	7%
	Westbound	1,630	7%	1,820	5%	30,500	7%
Parramatta Road, at the Hawthorne Canal	Eastbound	2,380	10%	1,880	2%	33,000	7%
	Westbound	1,620	6%	2,280	5%	32,000	7%

Source: WDA traffic surveys (2014)