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BUILDING OUR FUTURE

NSW GOVERNMENT

M12 Motorway Environmental Impact Statement

Appendix F Transport and Traffic Assessment Report

Roads and Maritime Services | October 2019

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Glossary of terms and abbreviations

Term	Meaning
100MVKT	100 million vehicle kilometres travelled
Aimsun	A microsimulation tool for evaluation of road network performance
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.
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.
ATC	Automatic Traffic Count
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
CEMP	Construction environmental 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 ancillary facility	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
Corridor	substantial segment of the transport network, in which parallel, possibly competing, transport routes (and modes, where appropriate) operate between two locations
CTMP	Construction Traffic Management Plan
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own
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
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 future model scenario that does not incorporate the proposed project infrastructure
DPIE	NSW Department of Planning, Industry and Environment
EB	Eastbound

Term	Meaning
EIS	Environmental Impact Statement
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)
Footpath	The paved area in a footway
Footway	An area open to the public designated for the movement of pedestrians or has one of its main uses for pedestrians
Grade separation	The separation of road, rail or other transport modes, so that crossing movements at intersections are at different levels
GEH	A standard statistical measure used in the calibration of traffic models to compare the differences between modelled and observed traffic flows
GMA	Greater Metropolitan Area. This area includes the Sydney Greater Capital City Statistical Area and the Illawarra and Lower Hunter regions.
h/hr	Hour
ha	Hectare/s
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
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
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
km	Kilometres
LGA	Local Government Area
LoS	Level of Service
LU14	The 2014 version of land use (population and employment) projections for the Sydney Greater Metropolitan Area produced by the Transport and Performance Analytics section of Transport for NSW. This 2014 land use data has been supplemented with traffic data from 2015 and 2017.
Median	The central reservation which divides a carriageway for traffic travelling in opposite directions
Midblock	A general location on a road between two intersections
Motorway	Fast, high volume controlled access roads. May be tolled or un-tolled
NB	Northbound
NSW	New South Wales
PCU	Passenger Car Units
Private vehicle	Includes all motorised vehicles such as cars, 4WDs, vans, motorbikes, motor scooters, utes and trucks, not registered for business use

Term	Meaning
Project	A future model scenario that incorporates the proposed project infrastructure
Public transport	Includes train, bus (government and private), ferry (government and private) and light rail (government and private) services
R^2	A statistical measure of how close data are to a fitted regression line generated by a least-squares regression of two variables. It is an indication of how well the fitted regression line matches the data
Roads and Maritime	Roads and Maritime Services
Roundabout	An intersection where all traffic travels in one direction clockwise around a central island
s	Seconds
SCATS	Sydney Coordinated Adaptive Traffic System
Screen line	Theoretical boundaries specifically designed to collectively analyse direction and two-way traffic volumes
SEARs	Secretary's Environmental Assessment Requirements Requirements and specifications for an environmental assessment prepared by the Planning Secretary under section 115Y of the Environmental Planning and Assessment Act 1979 (NSW)
Sensitive road users	Term that refers to road users who are most at risk in traffic and who are most sensitive to road injury; defined as pedestrians and cyclists for the project
SIS	State Infrastructure Strategy
SSI	State Significant Infrastructure
STM	Sydney Strategic Travel Model; a travel demand forecasting model run by Transport for NSW
TfNSW	Transport for New South Wales
Transport infrastructure	Permanent installations including roads, rail, buildings and storage associated with transport
Truck and dog construction vehicle	A vehicle with 20 cubic metre capacity and maximum length of 19 metres with a gross vehicle mass of 40 tonnes
Unreleased traffic	In a simulation 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
Veh	Vehicle
Veh/hr	Vehicle per hour
V/C	Volume to Capacity ratio
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled

Term	Meaning
WB	Westbound
WRTM	WestConnex Road Toll Model
WSAGA	Western Sydney Airport Growth Area
WSIP	Western Sydney Infrastructure Plan

Executive summary

Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). The project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport.

Purpose of this report

This report has been prepared to support the environmental impact statement (EIS) for the M12 Motorway project (the project). The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364) and to enable the Minister for Planning to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to impact transport and traffic.

Overview of potential construction impacts

Impacts on traffic

Assessment of the project's impacts on traffic during construction has been undertaken using traffic modelling. The traffic model considers the impact of the changes to the road network associated with construction:

- Additional traffic including construction heavy vehicles and construction worker vehicles
- New or modified intersections to allow entry and exit to construction zones
- Traffic management to allow for safe entry and exit to construction zones.

The key performance measure from the model that reflects these changes is intersection Level of Service for intersections along Elizabeth Drive.

These impacts have been assessed for the following roads directly impacted by construction traffic changes:

- Elizabeth Drive between The Northern Road and M7 Motorway
- The Northern Road north and south of Elizabeth Drive (within the project study area)
- M7 Motorway north and south of Elizabeth Drive (within the project study area)
- Mamre Road north of Elizabeth Drive (within the project study area)
- Wallgrove Road north of Elizabeth Drive (within the project study area).

The performance of the road network has been assessed based on comparison with the peak year of construction activity, which corresponds to traffic conditions in 2024 if the project was not built but development surrounding M12, including the Western Sydney Airport was to continue at the forecast rate to 2026.

Intersection performance

The primary impact of construction on intersection performance would be the import of spoil. Although much of the spoil transport would be undertaken within the construction footprint and off public roads, there would still be a need for trucks to travel to the project on public roads.

With construction traffic added to the road network associated with the project, the following intersections would operate at Level of Service D or worse (based on the average delay measured at each intersection):

- Elizabeth Drive/Cecil Road (evening peak) – from Level of Service A to D with construction
- Elizabeth Drive/M7 Motorway northbound ramp/Wallgrove Road (morning peak) – from Level of Service C to D with construction
- Elizabeth Drive/M7 Motorway southbound ramps (evening peak) – from Level of Service D to F with construction
- Elizabeth Drive/Range Road (evening peak) – from Level of Service A to D with construction
- Elizabeth Drive/The Northern Road (evening peak) – from Level of Service C to D with construction.

In order to determine a haulage plan that would consider the nature of existing traffic on construction access routes as well as the number and size of construction related vehicles, the following approach has been undertaken:

- The heavy vehicle generation for each construction ancillary facility and work site has been identified (detailed below)
- The safest and most direct access to each construction ancillary facility and work site has been identified, as well as the movements that would be allowed onto and off the public road network (detailed below)
- The locations in greater Sydney from which construction materials and spoil would potentially be delivered were identified. For this project, it is possible due to timing that spoil would be delivered from other large construction projects with spoil surplus east of the project. Similarly, it is expected that the majority of construction materials would be delivered from locations east of the project. These trips are likely to be distributed equally to the north and south of Elizabeth Drive
- The higher order road network constraints were identified, in this case the critical constraint is the Elizabeth Drive M7 Motorway interchange. Alternative routes would be via M4 Motorway and The Northern Road from the north, and Bringelly Road and The Northern Road from the south. By the time construction of the project commences, The Northern Road and Bringelly Road upgrades would be completed to facilitate spoil haulage and earthworks for the Western Sydney Airport and would have enough capacity to accommodate additional spoil haulage
- Preliminary traffic modelling of the haulage routes was undertaken to determine how many sites could be accessed from the M7 Motorway without generating substantial additional delays on the M7 Motorway in the year of construction. This was undertaken by reassigning haulage routes from the M7 Motorway to The Northern Road until acceptable levels of delay were forecast for Elizabeth Drive and M7 Motorway.

As a result of the analysis, the development of haulage routes on public roads has been based on minimising impacts to the Elizabeth Drive/M7 Motorway/Wallgrove Road interchange. The haulage routes are as follows:

- AF1, AF2/AF3 and AF4 would be accessed via The Northern Road, Elizabeth Drive
- AF5 would be accessed via The Northern Road, Elizabeth Drive and Mamre Road
- Range Road, AF6, Wallgrove Road and AF9 would be accessed via the M7 Motorway and Elizabeth Drive.

Road Safety

Construction activity has the potential to have the following impacts on road safety:

- Increased risk of loss of traction or control on temporary pavement surfaces
- Increased risk of conflicts between general traffic and construction vehicles, particularly at construction site access and egress points
- Reduced lane widths and increased proximity to barriers, increasing the risk of crashes
- Increased risk of driver distraction around construction activities
- Decreased visibility of temporary line marking and other traffic control measures.

The potential for road safety impacts during construction would be addressed through the development of a Construction Traffic Management Plan (CTMP).

Impacts on bus services

Routes 801 and 813 operate along Elizabeth Drive between the M7 Motorway and Badgerys Creek Road. Route 789 operates on The Northern Road. During construction of the project the following impacts to buses and bus customers are likely:

- Reductions in speed when travelling through construction activity areas, resulting in longer travel times
- Temporary relocation of stops away from construction zones requiring some passengers to walk further, while other passengers may have a shorter distance to walk to their desired bus stop
- Alternative access to relocated bus stops may need to be provided, in some cases requiring passengers to walk further to reach their desired bus stop.

Impacts on pedestrians and cyclists

The off-road shared user path being constructed as part of The Northern Road upgrade will be positioned along the road's western side. While the project's construction would involve some works to configure the new intersection between The Northern Road and the M12 Motorway, the civil works at this location would be minimal and there would be no impact to the shared user path along the western side of The Northern Road. Therefore full pedestrian/cycle connectivity would be maintained and interaction with construction activities would be avoided.

The existing off-road shared user path along the M7 Motorway would require relocation to the east for about two kilometres between Villiers Road and south of Elizabeth Drive to accommodate the new off-load and on-load ramps between the M7 Motorway and M12 Motorway.

The realigned path would be constructed and opened to users prior to decommissioning the existing path to maintain access along the length of the facility. Safety barriers would separate users from the construction zone during construction of the new path and the decommissioning of the old path to provide safe passage during the realignment works. At tie-in locations any potential temporary disruptions (eg with final surfacing) would be managed to ensure users would be able to continue their journey.

Impacts on property access

Construction activities are expected to temporarily impact access to 29 properties through changes to existing access arrangements. New temporary access arrangements would be in place prior to construction commencing in consultation with the property owners. A construction traffic management plan (CTMP) would be prepared by the contractor and would outline all measures to manage potential property access impacts, including appropriate signage to businesses, local roads and residences where required to maintain access and minimise confusion for motorists.

Parking

There would be no impacts to parking as a result of the construction of the project, as there is currently no on-street parking available on the roads impacted by construction and sufficient off-street parking for workers would be provided at each construction site.

Overview of potential operational impacts

Impacts on traffic

Assessment of the project's impacts on traffic during operation has been undertaken using traffic modelling. These impacts have been assessed for the following roads directly impacted by the project:

- Elizabeth Drive between The Northern Road and the M7 Motorway
- The Northern Road north and south of Elizabeth Drive (within the project study area)
- M7 Motorway north and south of Elizabeth Drive (within the project study area)
- Mamre Road north of Elizabeth Drive (within the project study area)
- Wallgrove Road north of Elizabeth Drive (within the project study area).

In addition to these roads directly impacted by the project, traffic modelling has also considered the impacts to the regional road network, examining impacts of the higher-order roads within the area bounded by:

- M4 Motorway between the M7 Motorway and The Northern Road
- M7 Motorway between the M4 Motorway and Camden Valley Way
- Bringelly Road and Camden Valley Way between the M7 Motorway and The Northern Road
- The Northern Road between Bringelly Road and M4 Motorway.

The performance of the road network has been assessed based on comparison with a do minimum scenario, which corresponds to traffic conditions in 2026 and 2036 if the project was not built but the Western Sydney Airport was in operation.

Overall network performance indicates that the M12 Motorway would provide access to the Western Sydney Airport without incurring high traffic delays at intersections along Elizabeth Drive.

Intersection performance

Assessment of the future performance of the transport network in the study area indicates the following:

- The project would result in redistribution of traffic primarily along the Elizabeth Drive corridor from Elizabeth Drive to M12 Motorway, with minimal impacts to other regional roads in the study area. This redistribution would also benefit the M7 Motorway by reducing the volume of traffic that would need to travel through the existing Elizabeth Drive interchange and reducing the impact of capacity constraints at this location.
- Modelled intersection performance in the study area shows that the project would result in improved intersection performance along the Elizabeth Drive corridor between The Northern Road and Mamre Road. For intersections east of Mamre Road, trips using this section of Elizabeth Drive would not have access to the M12 Motorway as an alternative route, so the improvement in intersection performance in this section would be limited. Forecast traffic volumes and intersection performance at this location shows that the M7 and Elizabeth Drive interchange would perform unsatisfactorily under the Do Minimum scenario. While the project would reduce the number of conflicting movements at this intersection, forecast traffic demand would still exceed the capacity of this interchange and it would continue to perform unsatisfactorily with the project.

Travel time

The project would have the following impacts on travel times:

- Travel times along the M7 Motorway would generally increase with the project in the 2026 morning peak. These generally small increases of up to one minute in travel time would be due to additional merging of traffic at the locations where M12 Motorway interfaces with M7 Motorway to the immediate north and south of the Elizabeth Drive, M7 and M12 Interchange.
- Travel times on The Northern Road northbound between Elizabeth Drive and the M4 Motorway in the evening peak would increase with the project, due to the changes in access to the Western Sydney Airport.
- Travel times on Elizabeth Drive between The Northern Road and M7 Motorway would generally decrease, except for the 2026 scenario during the morning peak. This increase in travel times along Elizabeth Drive in the 2026 morning peak is due to the increased volumes of traffic travelling west along Elizabeth Drive from Cecil Hills and turning right from Elizabeth Drive into Mamre Road. The reverse movement in the evening peak is a left turn and would have minimal impact on travel times along Elizabeth Drive. Under the future Do minimum scenarios, a substantial volume of traffic heading westbound along Elizabeth Drive from Cecil Hills would be delayed at the Elizabeth Drive and M7 interchange and be unable to complete their journey within the peak period. The project would remove conflicting traffic from this interchange and allow more traffic from Cecil Hills into the modelled network within the peak period. This would result in a transfer of delay from this interchange to the intersection of Mamre Road and Elizabeth Drive, as more traffic would be able to reach this part of the network.

Impacts on road safety

The project would result in the following impacts on road safety:

- The change in arterial and motorway vehicle kilometres travelled indicates that the project would result in fewer kilometres of travel along arterial roads and more along motorways, which are generally considered safer roads. As the average crash rate for arterial roads in the study area is higher than that on M7 Motorway (based on the last five years of crash data), this indicates that overall crashes across the network could decrease by up to 217crashes per year as these trips would be travelling on safer roads.
- Reduced number of heavy vehicles that would need to use Elizabeth Drive for access to the Western Sydney Airport or for travelling between the M7 Motorway and The Northern Road. This would improve road safety by reducing opposing-lane overtaking of heavy vehicles and the associated risk of head-on crashes.
- Provision of a new separated shared user path for cyclists adjacent to the M12 Motorway may remove the risks associated with cycling on road adjacent to general traffic on Elizabeth Drive.
- The predicted reduction in congestion at the Elizabeth Drive / M7 Motorway Interchange is expected to reduce the likelihood of vehicle crashes, especially rear-end type crashes.

Impacts on public transport

The project would have minimal impact on existing bus routes and bus stops in the study area. The NSW Government proposes to establish rapid bus services from the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Aerotropolis before it opens (*Future Transport 2056, Transport for NSW (TfNSW) 2018*). The service frequencies for these buses would be determined based on the demand for travel to the airport.

It is likely that some of these buses that would offer direct service to and from Western Sydney Airport would use the M12 Motorway for access into and out of the airport site.

Operation of the M12 Motorway would have no impact on existing rail services and has been planned to integrate with the planned Sydney Metro Greater West, which would be grade separated from the M12 Motorway and Elizabeth Drive.

Impacts on freight transport

The project is expected to improve reliability and travel times for freight traffic travelling to and from the Western Sydney Airport. It would achieve this by providing additional traffic capacity and motorway standard access to Western Sydney Airport, minimising travel times and reducing vehicle operating costs for freight through a reduction in stop-start travel and provision of a higher standard of road.

The project would also reduce travel times and improve reliability and speed for trucks travelling between The Northern Road and the M7 Motorway. Currently, trucks use Elizabeth Drive which is a single lane in each direction and is capacity-constrained at its intersection with the M7 Motorway. With the upgrade of The Northern Road to a primary north-south freight route from the emerging South West Growth Area and the opening of the Western Sydney Airport, freight traffic travelling between The Northern Road and the M7 Motorway is expected to increase. The M12 Motorway would provide a safe and reliable route between major roads and to the airport.

Impacts on active transport (walking and cycling)

Provision of a shared user path as part of the project would connect two major regional cycling facilities at The Northern Road and the M7 Motorway. The section of the shared user path through the Western Sydney Parklands does not form part of this project and would be implemented by the Western Sydney Parklands Trust in accordance with the Trust's broader strategic plans for the Western Sydney Parklands. Roads and Maritime is liaising with the Western Sydney Parklands Trust through the development of the shared user path location.

In addition to connecting these two major cycling facilities, the shared user path provided as part of the project would also provide access to the following roads:

- Range Road and Wylde Mountain Bike Trail
- Elizabeth Drive at Mamre Road
- Salisbury Avenue
- Clifton Avenue
- Elizabeth Drive at Western Sydney Airport
- Luddenham Road.

This level of pedestrian and cycle connectivity would be a transformative addition to the regional active transport network, allowing pedestrians and cyclists to access currently very poorly accessible streets and properties on Elizabeth Drive and its adjacent cross-streets. In addition to the connectivity benefits, the proposed shared user path would also substantially improve safety for cyclists and pedestrians, by providing an off-road active transport corridor separated from vehicles, removing conflicts on-road and at crossing points.

Impacts on property access

Access to up to 29 properties would be affected by the project. The project would impact property access either because it would pass through a property and change access to a part of that property, or its existing access to the public road network would be changed. The affected properties would have their access reinstated as part of the project, unless property acquisition or amalgamation would make this unnecessary.

Cumulative impacts

The cumulative transport and traffic impacts associated with operation of the project and the other ongoing and planned developments in the area have been assessed as part of this report. The cumulative impacts were assessed in consideration of the following recently completed, ongoing and proposed projects:

- Western Sydney Airport
- Sydney Metro Greater West
- The Northern Road Upgrade
  - Stage 5 (Littlefields Road to Glenmore Park)
  - Stage 6 (Littlefields Road to Eaton Road)
- Other existing road network upgrades and potential road projects, including:
  - Elizabeth Drive Upgrade
  - Mamre Road Upgrade
  - Outer Sydney Orbital
- Major land releases, including:
  - Western Sydney Aerotropolis
  - Western Sydney Employment Area.

The cumulative operational assessment was undertaken quantitatively in respect of these projects, as they have been included with the traffic and transport modelling assumptions used in the assessment of the project. However, cumulative construction impacts of these projects could not be assessed quantitatively, as the details of their construction were not publicly available at the time of undertaking this assessment.

Overall the cumulative impact of the project with the construction of the Western Sydney Airport and The Northern Road Upgrade Stage 6 would be minor, as the peak spoil haulage construction phases of these projects would not overlap. There would likely be substantial overlap between the construction activities of the project with Sydney Metro Greater West, however the details of this construction traffic impact are not available at the time of this assessment. It is likely that there would be increased delays at intersections along Elizabeth Drive and The Northern Road as a result of the overlap of these projects.

In addition to these capacity and delay-based impacts associated with the cumulative construction traffic generation, drivers travelling through the wider study area are likely to experience construction fatigue due to the long duration and wide extent of changed traffic conditions associated with ongoing concurrent and consecutive construction.

Summary of environmental management measures

The key environmental management measure required to address the impacts of construction on transport and traffic would be CTMPs prepared as part of the Construction Environmental Management Plan (CEMP). These plans would be prepared by the construction contractor and would be required to outline the guidelines, general requirements and specific procedures to be used for any works that may have an impact on traffic operation.

The majority of operational impacts of the project have been addressed through the concept design and include the following:

- Maintenance of access to existing roads and properties, addressed through modification to access impacted by the M12 Motorway to ensure existing access is reinstated for most affected properties
- Management of traffic capacity constraints, addressed through the design of gradients, ramps and merge areas at motorway interfaces
- Provision of active transport facilities, addressed through the design by provision of a shared user path along the length of M12 Motorway, connecting with existing cycle and pedestrian facilities on the M7 Motorway and The Northern Road.

Conclusions

Overall, analysis of the road network performance under the 2026 and 2036 future horizon years shows that the M12 Motorway is required to allow forecast traffic volumes to access Western Sydney Airport. The M12 Motorway would improve access to Western Sydney Airport by providing a motorway standard access directly from the Sydney strategic motorway network. It would also reduce travel times and delays on Elizabeth Drive by providing a high-speed alternative to Elizabeth Drive between The Northern Road and the M7 Motorway.

1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). In addition, the project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport. The project would commence about 30 kilometres west of the Sydney central business district, at its connection with the M7 Motorway. The project traverses the local government areas of Fairfield, Liverpool and Penrith. The suburbs of Cecil Park and Cecil Hills are found to the east of the M12 Motorway, with Luddenham to the west.

The project is predominately located in greenfield areas. The topography in and around the project comprises rolling hills and small valleys between generally north–south ridge lines. The existing land uses are semi-rural residential, recreational, agricultural, commercial and industrial. The main residential areas are Kemps Creek, Mount Vernon and Cecil Hills.

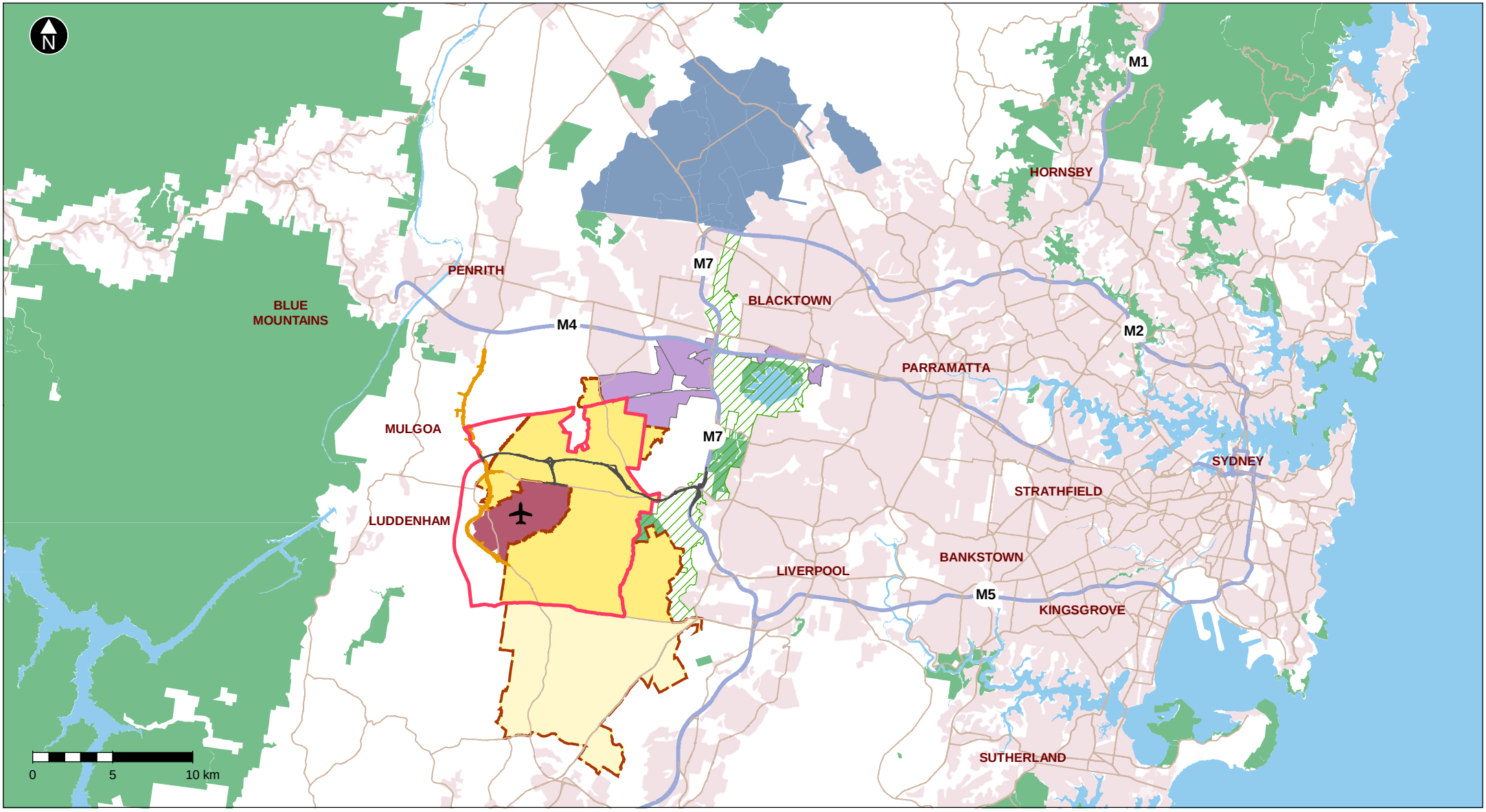
The project is required to support the opening of the Western Sydney Airport by connecting Sydney's motorway network to the airport. The project would also serve and facilitate the growth and development of western Sydney which is expected to undergo significant development and land use change over the coming decades. The motorway would provide increased road capacity and reduce congestion and travel times in the future and would also improve the movement of freight in and through western Sydney.

The project location is shown in **Figure 1-1** in relation to its regional context.

1.2 Project overview

The project would include the following key features:

- A new dual-carriageway motorway between the M7 Motorway and The Northern Road with two lanes in each direction with a central median allowing future expansion to six lanes
- Motorway access via three interchanges/intersections:
  - A motorway-to-motorway interchange at the M7 Motorway and associated works (extending about four kilometres within the existing M7 Motorway corridor)
  - A grade-separated interchange referred to as the Western Sydney Airport interchange, including a dual-carriageway four-lane airport access road (two lanes in each direction for about 1.5 kilometres) connecting with the Western Sydney Airport Main Access Road
  - A signalised intersection at The Northern Road with provision for grade separation in the future
- Bridge structures across Ropes Creek, Kemps Creek, South Creek, Badgerys Creek and Cosgroves Creek
- A bridge structure across the M12 Motorway into Western Sydney Parklands to maintain access to the existing water tower and mobile telephone/other service towers on the ridgeline in the vicinity of Cecil Hills, to the west of the M7 Motorway



The project
Motorways
Existing main roads
The Northern Road upgrade (currently under construction)

Western Sydney Parklands
NPWS estate / reserve
Urban areas
Main waterbodies

Growth areas

Western Sydney Priority Growth Area
South West Priority Growth Area
South West Growth Area
Western Sydney Airport

Western Sydney Aerotropolis
Western Sydney Employment Area
North West Growth Area

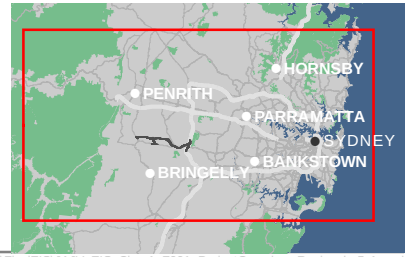


Figure 1-1 Project location (regional context)

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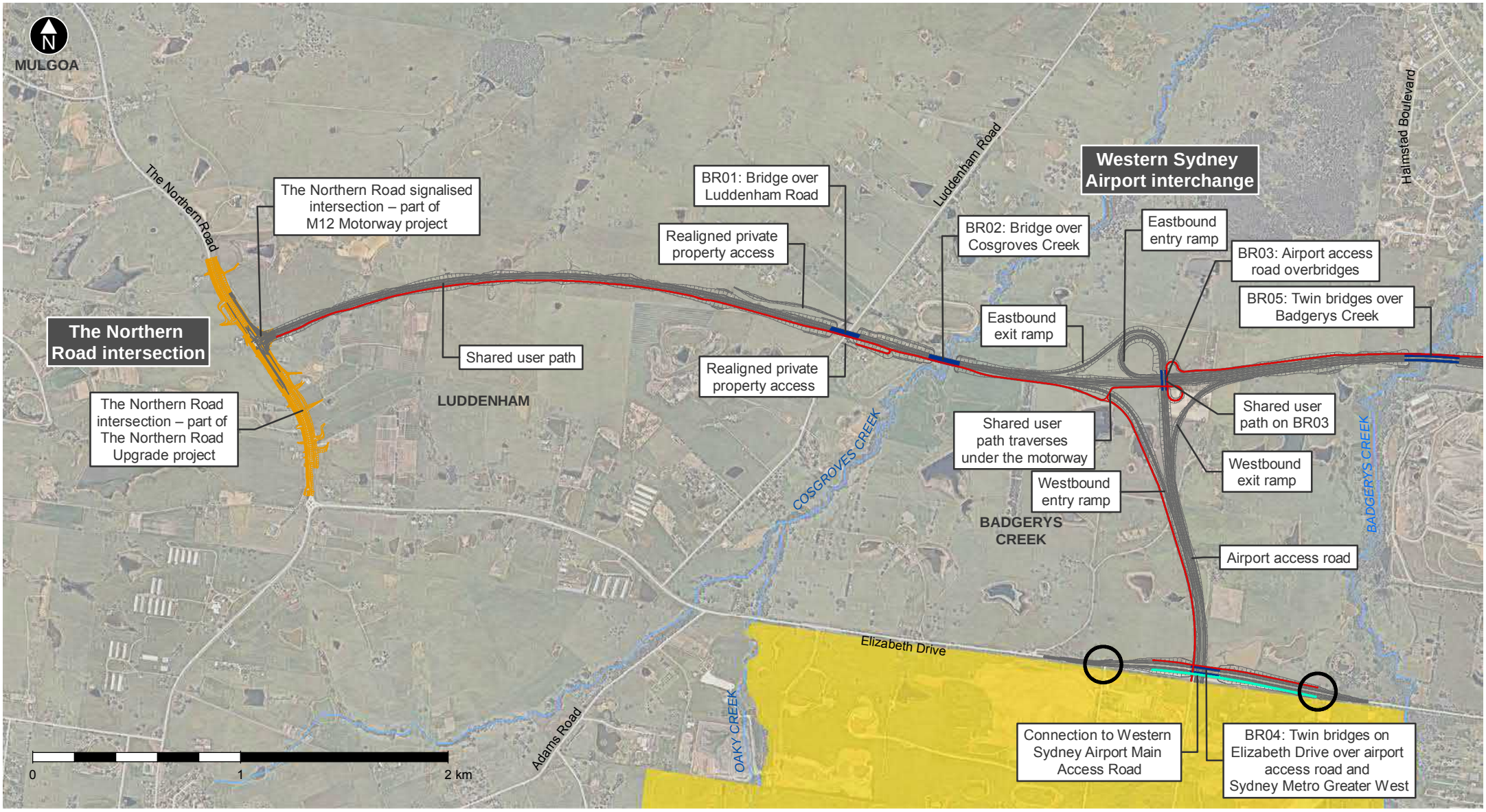
- Bridge structures at interchanges and at Clifton Avenue, Elizabeth Drive, Luddenham Road and other local roads to maintain local access and connectivity
- Inclusion of active transport (pedestrian and cyclist) facilities through provision of pedestrian bridges and an off-road shared user path including connections to existing and future shared user path networks
- Modifications to the local road network, as required, to facilitate connections across and around the M12 Motorway including:
  - Realignment of Elizabeth Drive at the Western Sydney Airport, with Elizabeth Drive bridging over the airport access road and future passenger rail line to the airport
  - Realignment of Clifton Avenue over the M12 Motorway, with associated adjustments to nearby property access
  - Relocation of Salisbury Avenue cul-de-sac, on the southern side of the M12 Motorway
  - Realignment of Wallgrove Road north of its intersection with Elizabeth Drive to accommodate the M7 Motorway northbound entry ramp
- Adjustment, protection or relocation of existing utilities
- Ancillary facilities to support motorway operations, smart motorways operation in the future and the existing M7 Motorway operation, including gantries, electronic signage and ramp metering
- Other roadside furniture including safety barriers, signage and street lighting
- Adjustments of waterways, where required, including Kemps Creek, South Creek and Badgerys Creek
- Permanent water quality management measures including swales and basins
- Establishment and use of temporary ancillary facilities, temporary construction sedimentation basins, access tracks and haul roads during construction
- Permanent and temporary property adjustments and property access refinements as required.

The project overview presented in this document represents the proposed concept design. If the project is approved, a further detailed design process would follow, which may include variations to the concept design. Flexibility has been provided in the concept design to allow for refinement of the project during detailed design, in response to any submissions received following the exhibition of the Environmental Impact Statement (EIS), or if opportunities arise to further minimise potential environmental impacts.

The key features of the project are shown on **Figure 1-2**.

1.2.1 Project location

This project is generally located primarily in the City of Penrith and extends into the City of Liverpool and City of Fairfield local government areas. The project is located 40 kilometres west of Sydney central business district (CBD).



The project

Part of The Northern Road upgrade project

Shared user path

Future shared user path (by others)

Existing roads

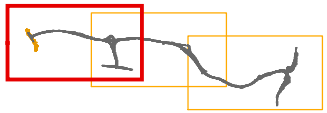
Waterways

Bridges

Western Sydney Airport

Note. The roads within this zone are being removed as part of airport construction.

Potential future intersections (by others)
Note: Locations to be confirmed



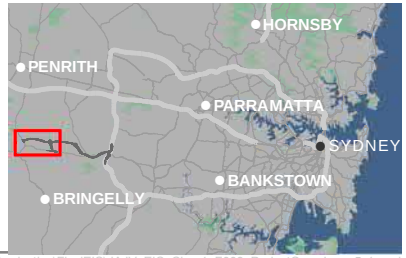


Figure 1-2 Key features of the project

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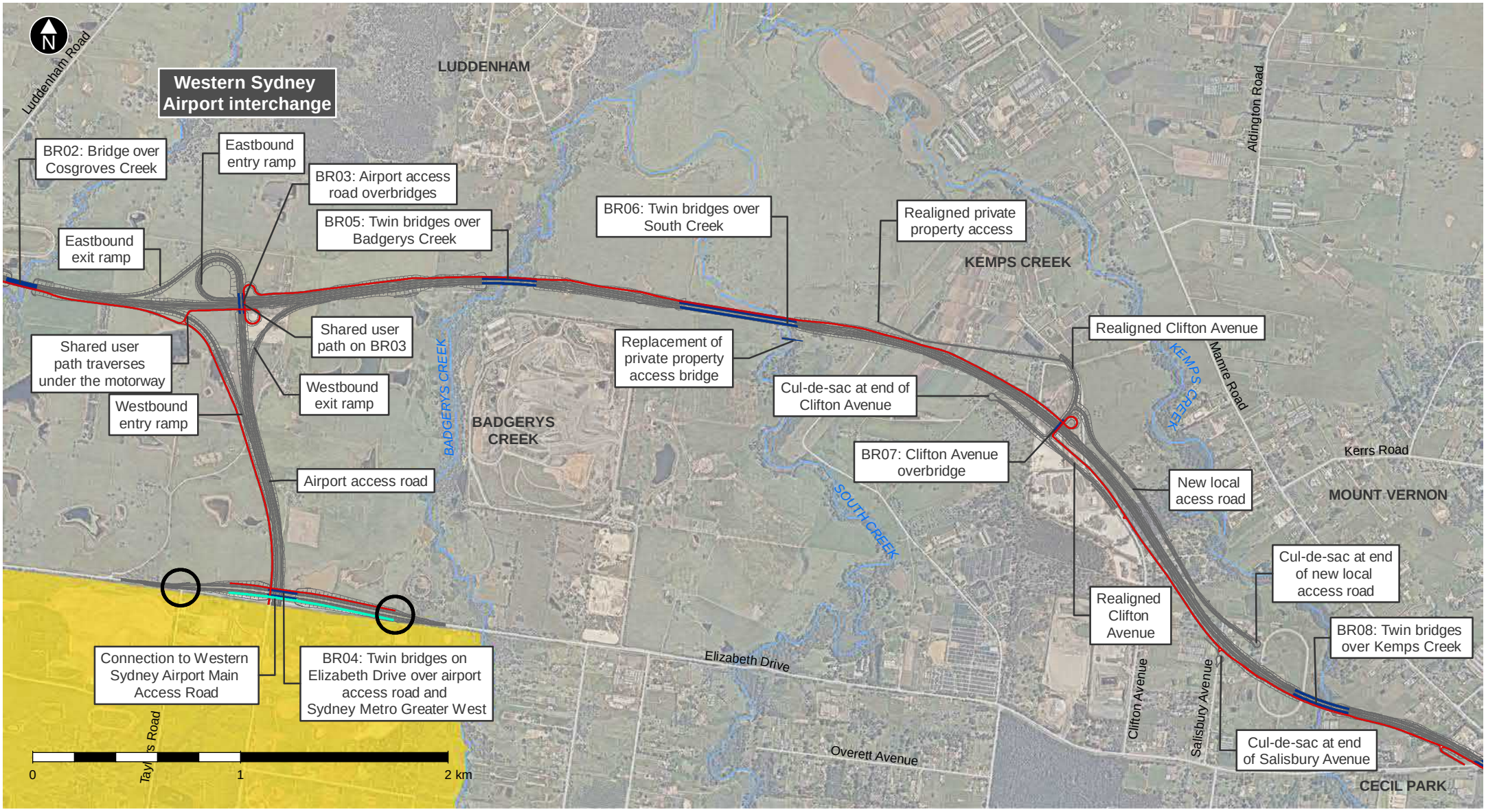


The project

Part of The Northern Road upgrade project

Shared user path

Future shared user path (by others)

Existing roads

Waterways

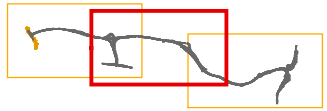
Bridges

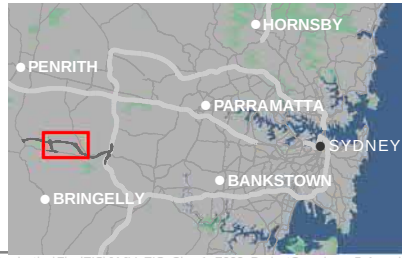
Western Sydney Airport

Note. The roads within this zone are being removed as part of airport construction.

Potential future intersections (by others)

Note: Locations to be confirmed





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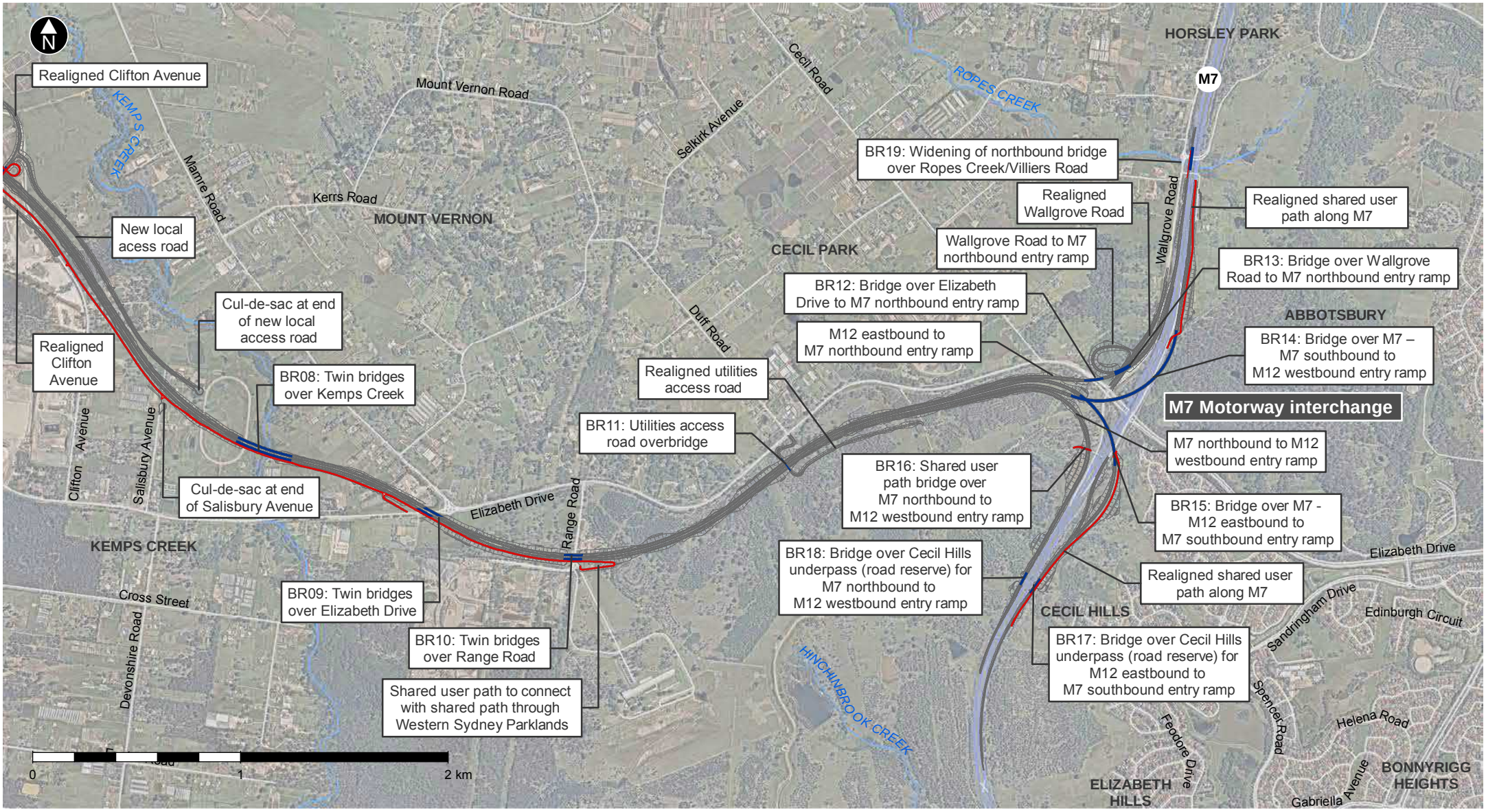

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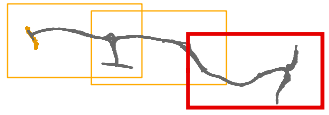

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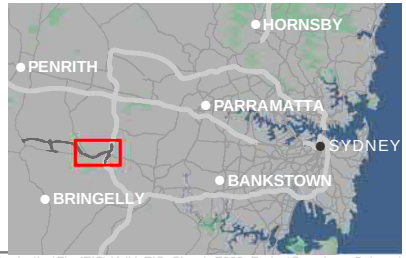

Figure 1-2 Key features of the project

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1.2.2Study area

The study area for the transport and traffic assessment of the project covers the area bounded by the following roads:

- M4 Motorway
- M7 Motorway
- The Northern Road
- Bringelly Road.

The area covered bounded by these roads is referred to as the wider study area and covers the strategic road network that is likely to be affected by the changes in travel patterns that would be likely as a result of the project, for the purposes of assessing the regional impacts of the project.

As the regional impact of the project is large, assessment of the impacts of direct changes to the local road network has been limited to a smaller area, referred to as the core study area, that covers those roads that directly interface with the project, including:

- Elizabeth Drive between The Northern Road and M7 Motorway and its associated intersection with other local roads
- M7 Motorway in the vicinity of Elizabeth Drive
- The Northern Road in the vicinity of Elizabeth Drive.

The locations and coverage of the wider study area and core study area are shown in **Figure 1-3**.

1.2.3Project objectives

Project-specific objectives for the M12 Motorway provide goals and assessment measures for achieving project justification and fitness for-purpose and to guide the success of the completed project. These objectives are:

- Provide direct motorway standard east–west connection between the M7 Motorway and The Northern Road via the Western Sydney Airport, allowing for future north–south connections
- Support the provision of an integrated regional and local public transport system
- Preserve the local access function of the existing Elizabeth Drive
- Provide active transport within the east–west corridor
- Provide for future connection to the Outer Sydney Orbital.

In doing so, it is intended the project would:

- Minimise its impacts on communities, the environment and heritage
- Integrate with current and proposed land uses.

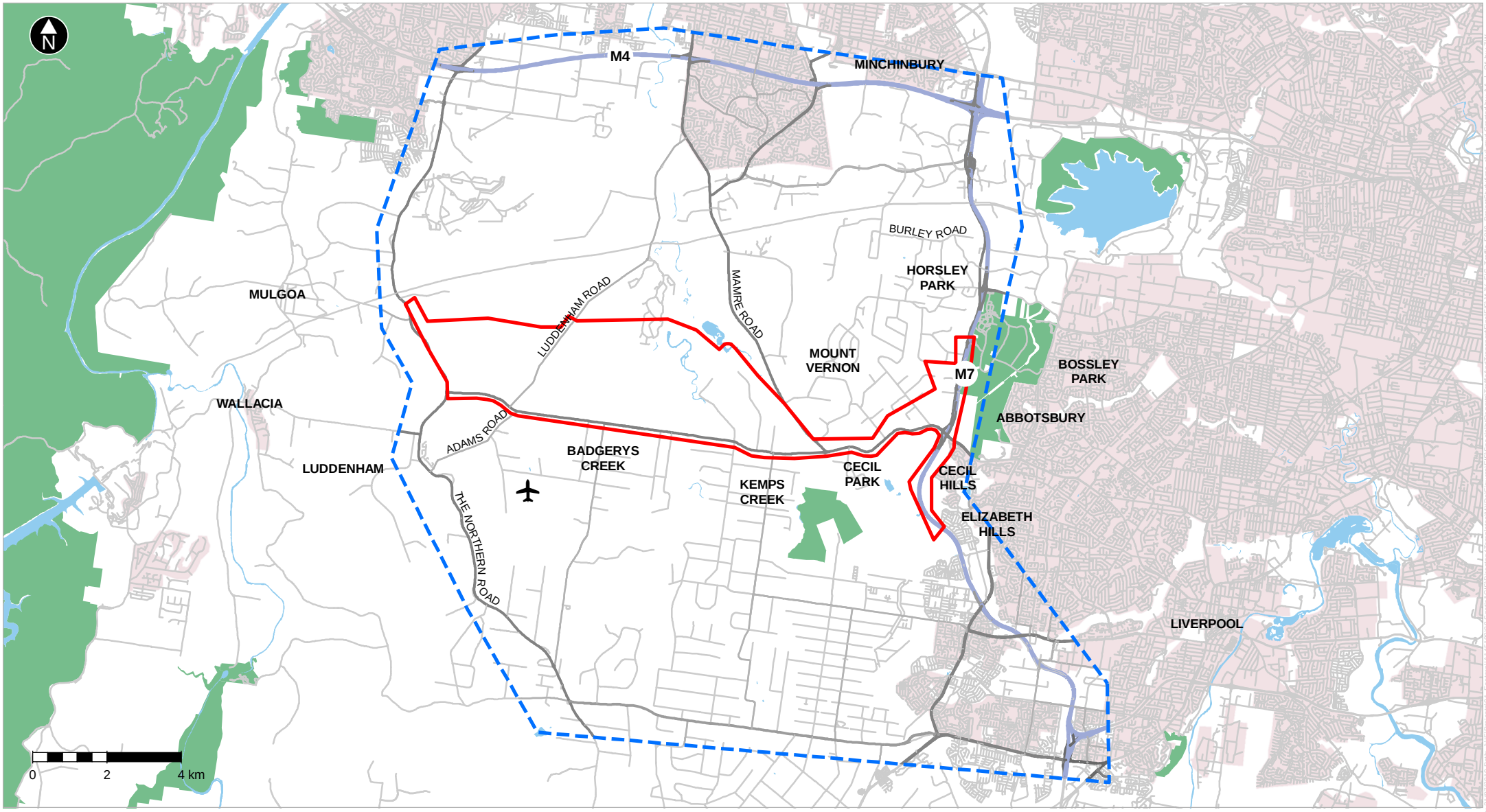

Figure 1-3 Project location, wider study area and core study area boundaries

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1.3 Purpose and scope of this report

This report has been prepared to support the EIS for the project. The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364), as well as the Australian Government assessment requirements under the EPBC Act. The EIS for the project provides sufficient information to enable the NSW Minister for Planning and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to impact transport and traffic.

To achieve this, the scope of the report is therefore to provide:

- A review of existing traffic conditions and the transport network, including a description of transport infrastructure in the study area, public transport service provision, and a review of the pedestrian and cycle networks
- Analysis of the operational performance of the existing road network in terms of network performance, travel times and crash history
- Assessment of construction traffic impacts, including the impact of construction-related vehicles travelling on roads providing access to construction work zones
- Assessment of the future operational performance of the road network without the project under the forecast 2026 and 2036 future years, based on strategic and operational traffic modelling
- Assessment of the future operational performance of the transport network with the project in operation under the forecast 2026 and 2036 future years based on traffic modelling
- Assessment of cumulative impacts on the transport network
- Identification of environmental management measures required to address these impacts.

The assessment takes into account the potential impacts of the M12 Motorway on existing roads and facilitating access to the Western Sydney Airport for both freight and passengers.

1.4 SEARs

On 18 June 2018, the Secretary of the NSW Department of Planning, Industry and Environment (Planning and Assessment) issued to Roads and Maritime the draft Secretary's environmental assessment requirements (SEARs) for the M12 Motorway EIS. The SEARS were finalised and reissued on 12 July 2018. The project was then determined to be a controlled action under the EPBC Act, and updated SEARs were issued on 30 October 2018 that include the Commonwealth assessment requirements under the EPBC Act. **Table 1-1** lists those requirements relating specifically to the assessment of the project's potential impacts on transport and traffic, with a reference to the chapter or section of this report where each requirement is addressed.

Table 1-1 SEARs (Transport and traffic)

Secretary's requirement	Where addressed
6. Transport and traffic	
1. The Proponent must assess construction transport and traffic (vehicle, marine, pedestrian and cyclists) impacts, including, but not necessarily limited to: a. a considered approach to route identification and scheduling of transport movements;	**Section 6.1**
b. the number, frequency and size of construction related vehicles (passenger, commercial and heavy vehicles, including spoil management movements);	**Section 6.1.1**
c. construction worker parking;	**Section 6.1.1**
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 4**
e. access constraints and impacts on public transport, pedestrians and cyclists;	**Section 6.1.2**
f. the need to close, divert or otherwise reconfigure elements of the road and cycle network associated with construction of the project.	**Section 6.1.2**
2. The Proponent must assess (and model) the operational transport impacts of the project, including: a. forecast travel demand and traffic volumes for the project and the surrounding road, cycle and public transport network;	**Section 6.2.2**
b. travel time analysis;	**Section 6.2.2**
c. performance of key interchanges and intersections by undertaking a level of service analysis at key locations;	**Section 6.2.2**
d. wider transport interactions (local and regional roads, cycling, public and freight transport);	**Section 6.2.2**
e. induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consideration of opportunities to improve public transport;	**Section 3.4.2** **Section 6.2.2**
f. impacts on cyclists and pedestrian access and safety; and	**Section 6.2.2**
g. opportunities to integrate cycling and pedestrian elements with surrounding networks and in the project.	**Section 6.1.2** **Section 6.2.2**

2. Strategic and planning context

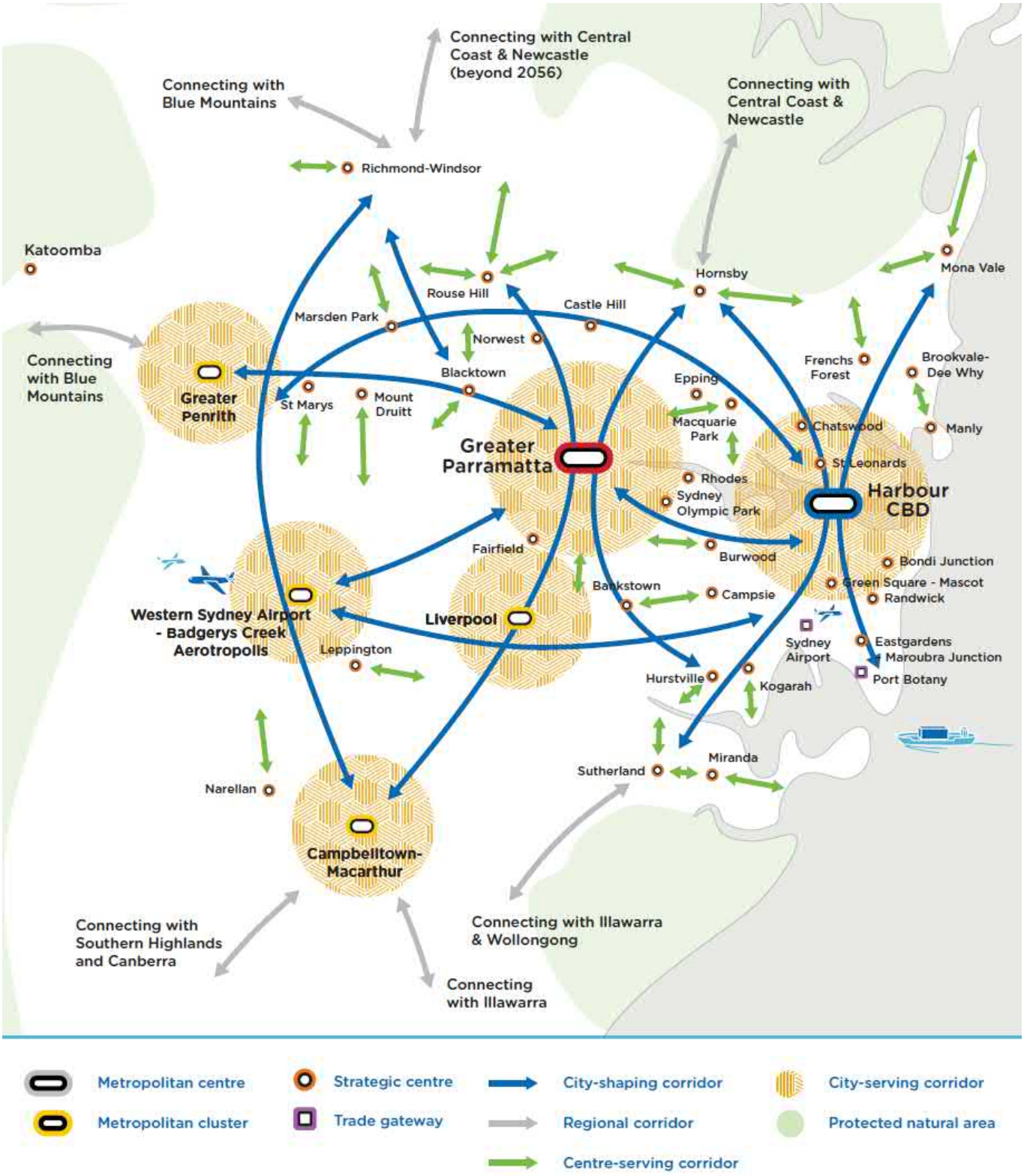
2.1 Strategic transport need for the project

Western Sydney's transport network faces complex challenges now and over the next 20 years. Western Sydney's population is anticipated to increase from two million today to three million by 2036, which equates to an average of 50,000 additional residents per year. This growth will put substantial pressure on the existing transport network, in particular the strategic transport corridors shown in **Figure 2-1**, which facilitate the movement of people and goods to population and employment centres across Greater Sydney. As part of a multimodal network-wide effort to tackle western Sydney's transport challenges, major investments in road capacity across western Sydney are required to address network underperformance and support western Sydney's long-term economic growth.

The solution to western Sydney's complex challenges is in identifying the right strategic investments to provide long-term network capacity, including modern road infrastructure, freight and passenger rail, and public and active transport, consistent with *Future Transport 2056* as discussed in **Section 2.3.3**. This means that while the project is a critical component to improving road network efficiency across western Sydney in the long term, it is also part of a wider integrated transportation plan that includes public transport initiatives.

The project would help address western Sydney's future transport challenges as follows:

- The project would address major capacity constraints on the arterial road network arising from the development and operation of the Western Sydney Aerotropolis. Without the project, ageing, narrow or lower-order roads would perform a traffic function that is better suited to motorway infrastructure, This reduces amenity and results in congestion, increased travel times, decreased travel time reliability and more traffic incidents.
- The project would facilitate the Greater Sydney Region Plan's goal of delivering a 30-minute city by facilitating greater access to jobs within 30 minutes of people's homes in western Sydney.
- The project would provide critical land transport network capacity to and from Western Sydney Aerotropolis. When operational and fully developed, these will be major trip generators and will be economically critical to Greater Sydney and the NSW economy. Even with major public transport and freight initiatives currently under investigation in western Sydney (for example Sydney Metro Greater West and the Western Sydney Freight Line), major new road capacity is needed to connect Western Sydney Aerotropolis to markets and customers across Greater Sydney.
- The project would serve Greater Sydney's wider, highly diverse freight and business travel task. The freight, commercial and service travel tasks require the distribution of goods and services across Greater Sydney, which relies on more diverse and dispersed point-to-point transport connections. The project supports this task by providing connections between Western Sydney Aerotropolis to other employment areas and population centres.
- The project would serve natural growth in demand from Greater Sydney's growing population and economy. Population and employment growth are major drivers of transport demand. Over the next 20 years, the number of average weekday trips across Greater Sydney is forecast increase by 40 per cent, while freight volumes are forecast to double. Much of this growth would occur on the motorway network.
- The project would better serve the fragmented land use patterns across Greater Sydney by supporting efficient transport connections for trips that are not well-served by other transport modes due to uneven or fragmented economic or residential development (for example residential land releases that are located away from trunk public transport corridors).



Source: *Future Transport 2056 (TfNSW, 2017)*

Figure 2-1 Greater Sydney strategic transport corridors

2.2 Regional transport and land use context

2.2.1 Supporting Western Sydney Aerotropolis in the short term

Western Sydney Airport, which will begin operations in 2026, and Western Sydney Aerotropolis, which will be developed over the next 20 years, will be transformative and become economically critical to Greater Sydney and the NSW economy. An estimated 28,000 jobs are expected be provided by 2031, which is expected to grow to nearly 48,000 by 2041[1]. There is a need to ensure that connections to the rest of Greater Sydney's transport network are provided to support and maintain Western Sydney Aerotropolis as the catalysts for economic growth in western Sydney.

In the longer term, Western Sydney Aerotropolis would be supported by both passenger rail, via Sydney Metro Greater West, and freight rail via the Western Sydney Freight Line and the Outer Sydney Orbital corridors. In the short to medium term, the primary means of access would be by road. The existing roads that surround Western Sydney Aerotropolis, including Elizabeth Drive, M7 Motorway and The Northern Road, are reaching the limits of their capacity during peak periods. The Western Sydney Infrastructure Plan (WSIP), further detailed in **Section 2.3.5**, seeks to address many of these constraints, particularly the current upgrade of The Northern Road. However even with this upgrade, access to Western Sydney Aerotropolis would still require travel along existing constrained corridors including Elizabeth Drive and the M7 Motorway.

2.2.2 Providing access to Western Sydney Aerotropolis

Elizabeth Drive is a primary arterial road that connects Liverpool to Luddenham serving residential land uses to the east of the M7 Motorway and rural land uses to the west of the M7 Motorway. Without the project, Elizabeth Drive would form the main road access between Western Sydney Aerotropolis and the rest of the strategic road network.

The M7 Motorway is the only north-south motorway corridor through western Sydney. It allows for uninterrupted movement between north-west and south-west Sydney, connecting to east-west motorways including the M5 Motorway, M4 Motorway and M2 Motorway. Strong growth in travel demand has resulted in traffic volumes on the M7 Motorway increasing to levels that approach capacity for much of the day. The project would provide an alternative to the M7 and M4 Motorways for trips travelling between Liverpool and Penrith.

The Northern Road connects Penrith to Narellan and is currently a single-lane rural road between Bringelly Road and the M4 Motorway. The Northern Road is currently being upgraded to realign the road around Western Sydney Airport site and to increase its capacity from a single lane in each direction to at least two lanes in each direction.

Roads and Maritime collects traffic volume data across the Sydney arterial and motorway road network; historic traffic count data on Elizabeth Drive east of the M7 Motorway between 2008 and 2018 is provided in **Figure 2-2**. These historic traffic counts show a steady trend of growth in traffic demand over the last 10 years, averaging 3 per cent per annum. This points to a strong trend in increasing traffic demand in Sydney over the last decade.

[1] Greater Sydney Commission (2018) *Western City District Plan*, Greater Sydney Commission, Parramatta NSW

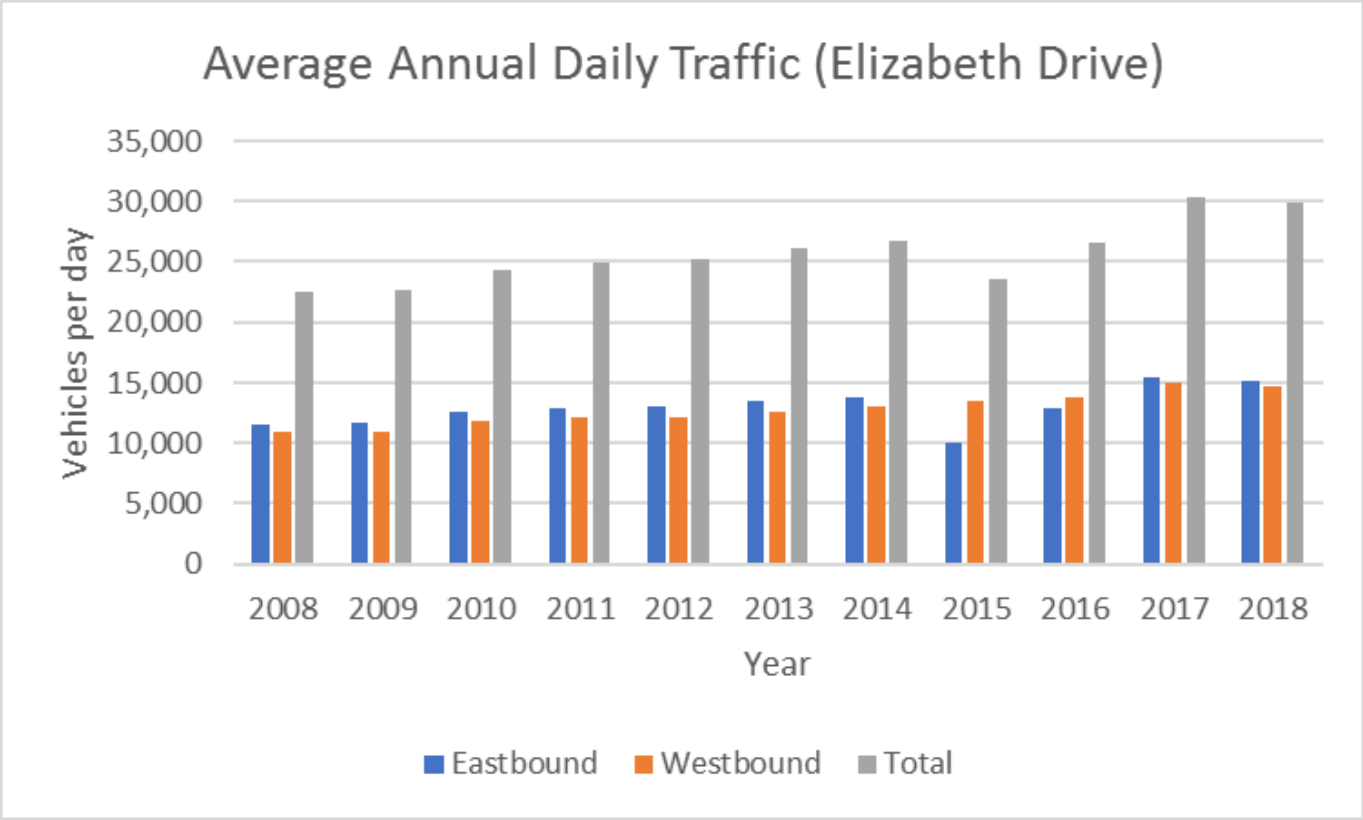


Figure 2-2 Historic traffic volumes on Elizabeth Drive east of the M7 Motorway

Strategic modelling of the road network in western Sydney undertaken by Roads and Maritime, and in particular surrounding Western Sydney Aerotropolis, shows that without the project the forecast traffic demand associated with increased population and employment in western Sydney would exceed the capacity of the existing road network. Plots of the forecast peak period volume-to-capacity ratios (the ratio of the forecast traffic demand and the available road capacity) of these roads by 2036 is shown in **Figure 2-3** (morning peak) and **Figure 2-4** (evening peak). Sections of road that are highlighted red indicate traffic volumes would exceed the available capacity. The project would provide an alternative east-west route between the M7 Motorway and The Northern Road, reducing the volumes on Elizabeth Drive and removing conflicting movements at key intersections such as the M7 and Elizabeth Drive interchange.

Forecast future traffic demand points to the need for a new high-capacity road to provide access to and from Western Sydney Aerotropolis and surrounding growth areas and allow this traffic to bypass the existing constrained road network including Elizabeth Drive and its interchange with the M7 Motorway. The project would support and maintain Western Sydney Aerotropolis as the catalysts for economic growth in western Sydney by providing a high-speed motorway standard access from the Sydney Motorway network at the M7 Motorway and the arterial road network at The Northern Road. This would allow traffic travelling to and from the Western Sydney Airport to avoid travelling on Elizabeth Drive.

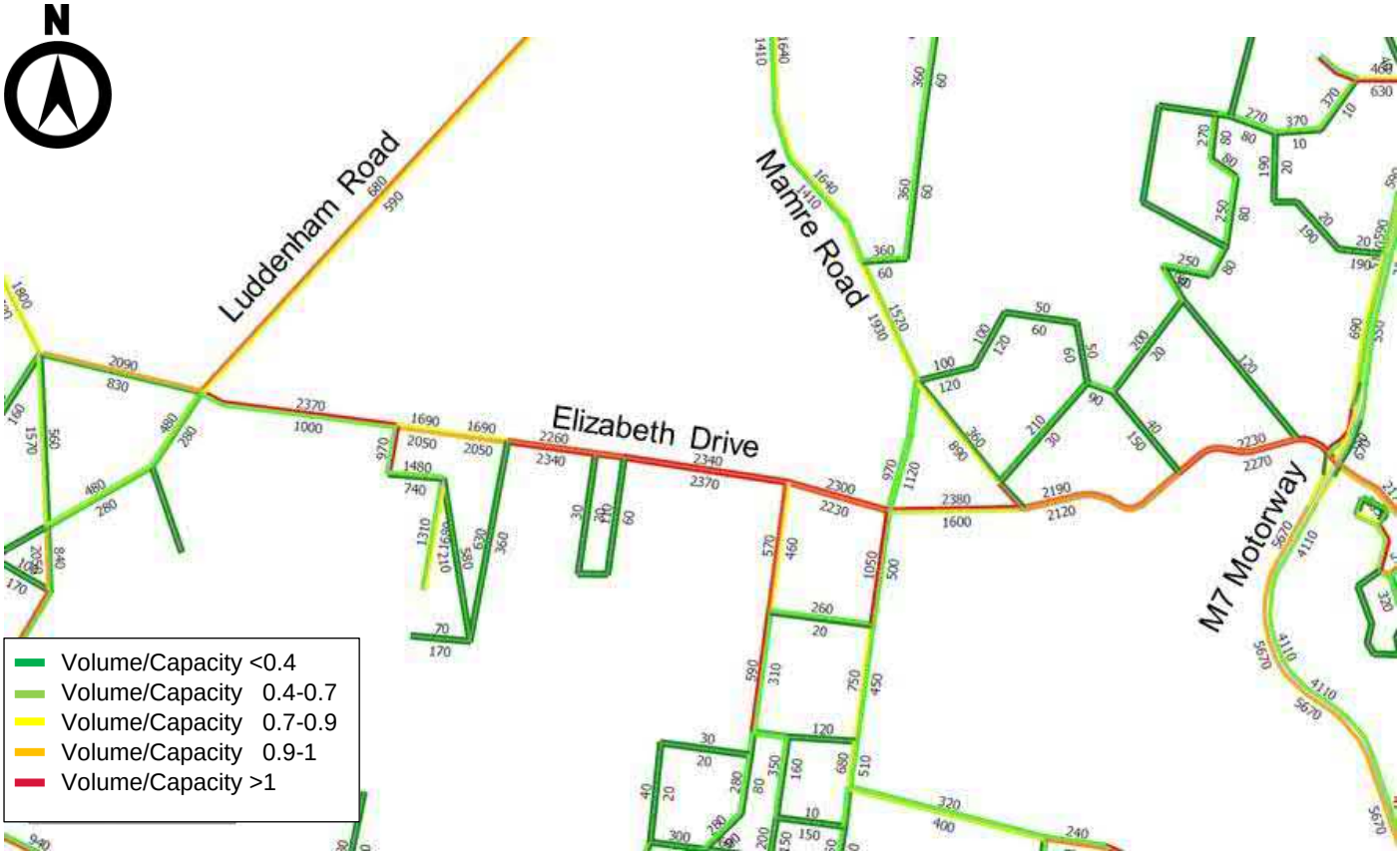


Figure 2-3 Forecast road volume-to-capacity ratios in 2036 without the project, morning peak

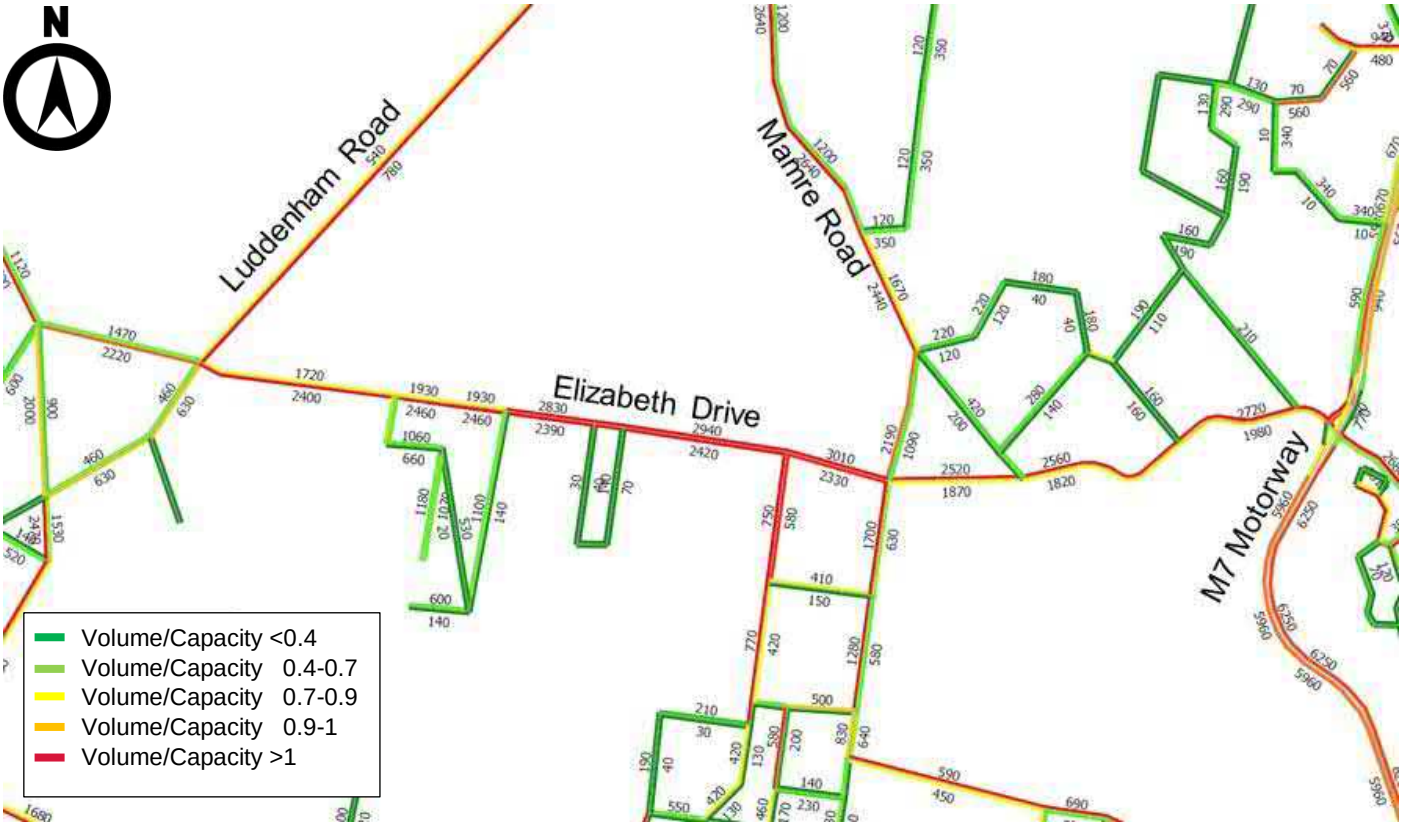


Figure 2-4 Forecast road volume-to-capacity ratios in 2036 without the project, evening peak

2.3 Alignment with transport policies and plans

The project addresses the broader NSW Government objective set in the *Premier's Priorities* (NSW Department of Premier and Cabinet 2017):

- Delivering infrastructure: Key metropolitan: regional and local infrastructure to be delivered on time and on budget.

The project supports or is recognised in strategic plans including:

- State Infrastructure Strategy 2018-2038 (SIS) (Infrastructure NSW, 2018)
- A Metropolis of Three Cities – the Greater Sydney Region Plan (Greater Sydney Commission, 2018)
- Future Transport Strategy 2056 and Greater Sydney Services and Infrastructure Plan (NSW Government, 2018)
- NSW Freight and Ports Plan (TfNSW, 2018)
- Western Sydney Infrastructure Plan (Roads and Maritime, 2016).

These strategies are detailed below.

2.3.1State Infrastructure Strategy 2018-2038

The *State Infrastructure Strategy 2018-2038* (SIS) 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 Sydney's road capacity. The SIS identifies strategic infrastructure options to meet the challenges of growth in travel demand and substantial increases in freight volumes.

Specifically, the strategy identifies the M12 Motorway as a key element of the strategic road network and that catering for the mass movement of people and valuable freight is crucial to support connectivity to Western Sydney Airport and the surrounding employment lands. The strategy also recognises the importance of smart motorway technology and digital infrastructure, which subject to the completion of business cases, is recommended to be deployed across the motorway network in time for the expected opening of the M12 Motorway.

2.3.2 A Metropolis of Three Cities – the Greater Sydney Region Plan

A Metropolis of Three Cities – the Greater Sydney Region Plan establishes a 40-year strategic land use plan for Sydney. The land use vision for Greater Sydney is a metropolis of three cities (Eastern Harbour City, Central River City and Western Parkland City). Consistent with *Future Transport 2056*, one of the key elements of the plan is the vision of a 30-minute city regardless of location.

The project supports the following objectives identified in the plan:

- Infrastructure supports the three cities – The project would improve mobility across the Western Parkland City and, in conjunction with the existing and future motorway network, improve accessibility to the Central River City and the Eastern Harbour City.
- Infrastructure aligns with forecast growth – The project would serve natural growth in demand from Sydney's growing population and economy.
- Integrated land use and transport creates walkable and 30-minute cities – The project, in conjunction with the existing motorway network and as part of a multimodal transport solution, would increase the number of people and places that are able to be reached within 30 minutes.

- Freight and logistics network is competitive and efficient – The project would improve network efficiency and deliver travel time savings. This would improve the efficiency of freight movement, resulting in reduced freight operational costs.
- Western Sydney Aerotropolis are economic catalysts for Western Parkland City – The project would provide critical land transport network capacity to and from Western Sydney Aerotropolis and provide connections to markets and customers across Greater Sydney.

2.3.3 Future Transport Strategy 2056 and Greater Sydney Services and Infrastructure Plan

Future Transport Strategy 2056 is a 40-year strategy for mobility for Sydney and regional NSW. It sets out a vision, strategic directions and customer outcomes with a focus on technology and innovation across the transport system to transform the customer experience, improve communities and boost economic performance.

A key element of the strategy is the vision of a "30-minute city". The 30-minute city is a guiding principle that provides people with access to education, jobs and services within 30 minutes of travel regardless of where they live. This means people can reach their nearest metropolitan and strategic centres within 30 minutes, seven days a week. The project, in conjunction with the existing motorway network and as part of a multimodal transport solution that includes a passenger rail link in the form of Sydney Metro Greater West, would increase the number of people and places that are able to be reached within 30 minutes.

The strategy identifies the project as a committed initiative in the zero to 10-year horizon. The project fulfils the strategic vision presented for the future strategic road network for Greater Sydney by supporting key movements by road for public transport, private vehicles and freight.

Supporting the strategy is the *Greater Sydney Services and Infrastructure Plan*, which builds on the transport outcomes identified in the strategy. It establishes specific outcomes that customers can expect and identifies the policy, service and infrastructure initiatives to achieve these outcomes. The project is identified in the plan as a key element in supporting integrated transport in western Sydney and capitalising on the economic benefits of Western Sydney Aerotropolis. The project is also identified in the plan as meeting several Greater Sydney transport customer outcomes including:

- Supporting the growth of our city
- Sustaining and enhancing our role as a global city
- Harnessing technology for the benefit of our customers.

2.3.4 NSW Freight and Ports Plan

The NSW Freight and Ports Plan is a core component of the overall strategic planning framework and supports the State Infrastructure Strategy 2018-2038, Future Transport Strategy 2056 and the Greater Sydney Services and Infrastructure Plan. The project would satisfy all five objectives contained in the plan including:

- Objective 1 – economic growth – The project would support the development of Western Sydney Aerotropolis as an economically critical component of the Greater Sydney and NSW economy.
- Objective 2 – efficiency, connectivity and access – The project would improve the flow of freight and provide connectivity and access between Western Sydney Aerotropolis and key freight destinations across Greater Sydney.

- Objective 3 – capacity – The project would address capacity constraints on the freight network. Freight volumes are forecast to double over the next 20 years, with much of this growth occurring on the motorway network.
- Objective 4 – safety – The project would improve road safety by reducing congestion and providing a higher-standard of road designed to accommodate a higher travel speed. Congestion leads to breakdowns in traffic flow, which contribute to unstable traffic conditions and undesirable driver behaviour including sudden braking and unnecessary lane changing that can result in increased traffic incidents. The design standard of a road allows traffic to travel at a higher speed with reduced risk of crashes.
- Objective 5 – sustainability – The project would improve sustainability by reducing congestion. Smoother traffic flow and reduced congestion results in reduced emissions.

2.3.5 Western Sydney Infrastructure Plan

The M12 Motorway forms a key part of the Western Sydney Infrastructure Plan (WSIP). The WSIP is a joint initiative of the Australian and NSW Governments to fund a $3.6 billion road investment program for western Sydney. The WSIP will:

- Deliver major road infrastructure upgrades to support an integrated transport solution for the western Sydney region. Road upgrades will improve connections within western Sydney and benefit the region's growing population by reducing travel times.
- Support and capitalise on the economic benefits of developing Western Sydney Aerotropolis. This will be transformational for western Sydney and be a catalyst for investment, growth and job creation for decades to come. They will need to be supported by a high-quality surface transport network to ensure the efficient movement of people and freight.
- Improve road transport capacity ahead of future traffic demand generated by planned residential and employment development. The M12 Motorway would contribute to the provision of improved road linkages within western Sydney and benefit the region's growing population by reducing commuting times.

3. Assessment methodology

3.1 Overview

This Chapter documents the assessment methodology carried out to determine the transport and traffic impacts of the project, including impacts of construction, operation and the cumulative impacts of the project in conjunction with other projects being planned and delivered in the vicinity of the project.

The assessment of transport impacts associated with the operation of projects is generally undertaken at year of opening and 10 years following opening as these years align with the standard land use forecast years which are produced every five years following the census year. As the project would be completed and open 6 months prior to the opening of the Western Sydney Airport, assessment of the project at opening would not adequately determine whether the project serves the needs of Western Sydney Airport in 2026.

For the purposes of this assessment, the project has been assessed both at 2026 and 2036 with the Western Sydney Airport in operation to ensure that the opening year assessment includes the traffic generated by this development and fulfils the objectives of the project.

Assessment of the transport and traffic impacts of the project includes consideration of the following aspects of the transport network both during construction and operation:

- **Regional and local road network**: assessed through the use of traffic modelling of the project to forecast traffic volumes, travel times and road network performance both in operation and during construction, accounting for both changes in road network arrangements and traffic volumes
- **Road safety**: assessed through analysis of existing road safety trends and forecast traffic volumes during operation and the effects of proposed construction activities on motor vehicles and sensitive road users (pedestrians and cyclists)
- **Access to local roads and properties**: assessed based on the changes to property access arrangements caused by the project both in operation and during construction
- **Public transport network**: assessed through the use of traffic modelling of the project to forecast changes in travel times that would impact on-road public transport in operation and during construction
- **Freight network**: assessed through the use of traffic modelling of the project to forecast changes in travel times that would impact freight movement on the road network in operation and during construction
- **Walking and cycling network**: assessed through analysis of existing walking and cycling facilities and demands in operation and the impacts that construction would have on pedestrians and cyclists travelling through the study area
- **Parking**: assessed through analysis of and increase or loss in on-street and off-street parking as part of the project both in operation and during construction.

Transport modelling is a fundamental component of the methodology used to assess the quantitative impacts of the project on the road network. It involves a multi-stage transport modelling approach to carry out a comprehensive assessment of the current and future performance of the project on the road network.

Transport modelling used in the assessment of the project has been undertaken based on a three-stage traffic modelling approach:

- **Stage 1 – Multi-modal strategic transport modelling**: undertaken using Sydney Strategic Travel Model (STM) to identify travel demand forecasts across all modes of travel for the Sydney metropolitan area based on land use and transport network assumptions
- **Stage 2 – Highway assignment strategic traffic modelling**: undertaken using WestConnex Road Toll Model (WRTM) to refine traffic demand forecasts undertaken in Stage 1 based on more detailed traffic assignment that accounts for toll-choice and induced demand
- **Stage 3 Simulation traffic modelling** – undertaken using Western Sydney Airport Growth Area (WSAGA) mesoscopic traffic models to identify the performance of the road network at a detailed level across the study area based on traffic demand forecasts derived from Stage 2.

A more detailed description of this three-stage process of traffic modelling is presented in **Section 3.4** including an overview of the steps undertaken within these stages, the assumptions used in each stage and how data is passed between each stage in the traffic modelling process.

3.2 Relevant guidelines and polices

The following guidelines were following in undertaking this transport and traffic impact assessment:

- Guide to Traffic Management – Part 3 Traffic Studies and Analysis (Austroads 2013)
- Highway Capacity Manual 2010 (Transportation Research Board 2010)
- Traffic Modelling Guidelines (Roads and Maritime 2013)
- Guide to Traffic Generating Developments Version 2.2 (NSW Roads and Traffic Authority (RTA) 2002).

3.3 Data collection

In order to inform an analysis of existing condition on the transport network as well as an input to the development, calibration and validation of the traffic model used to assess future impacts of the project, the following data was collected in the field specifically for this project:

3.3.1 Intersection turning movements

Intersections are the main capacity constraints in an urban road network and turning movement counts provide information regarding the traffic demand and capacity of intersections in the study area during peak periods. Intersection turning movement counts were undertaken at key intersections in the study area between 2015 and 2017 to inform the development and calibration of simulation traffic modelling undertaken as part of this assessment.

A plot of the locations where intersection turning movement counts were undertaken is provided in **Figure 3-1**. Intersection turning movement counts were collected for the morning and evening peak periods over the following:

- Morning peak: 6am to 10am
- Evening peak: 3pm to 7pm.

As the intersection traffic count data spans a two-year time period, analysis and adjustment of older counts data has been undertaken to account for any growth that may have occurred between the earliest and latest counts.

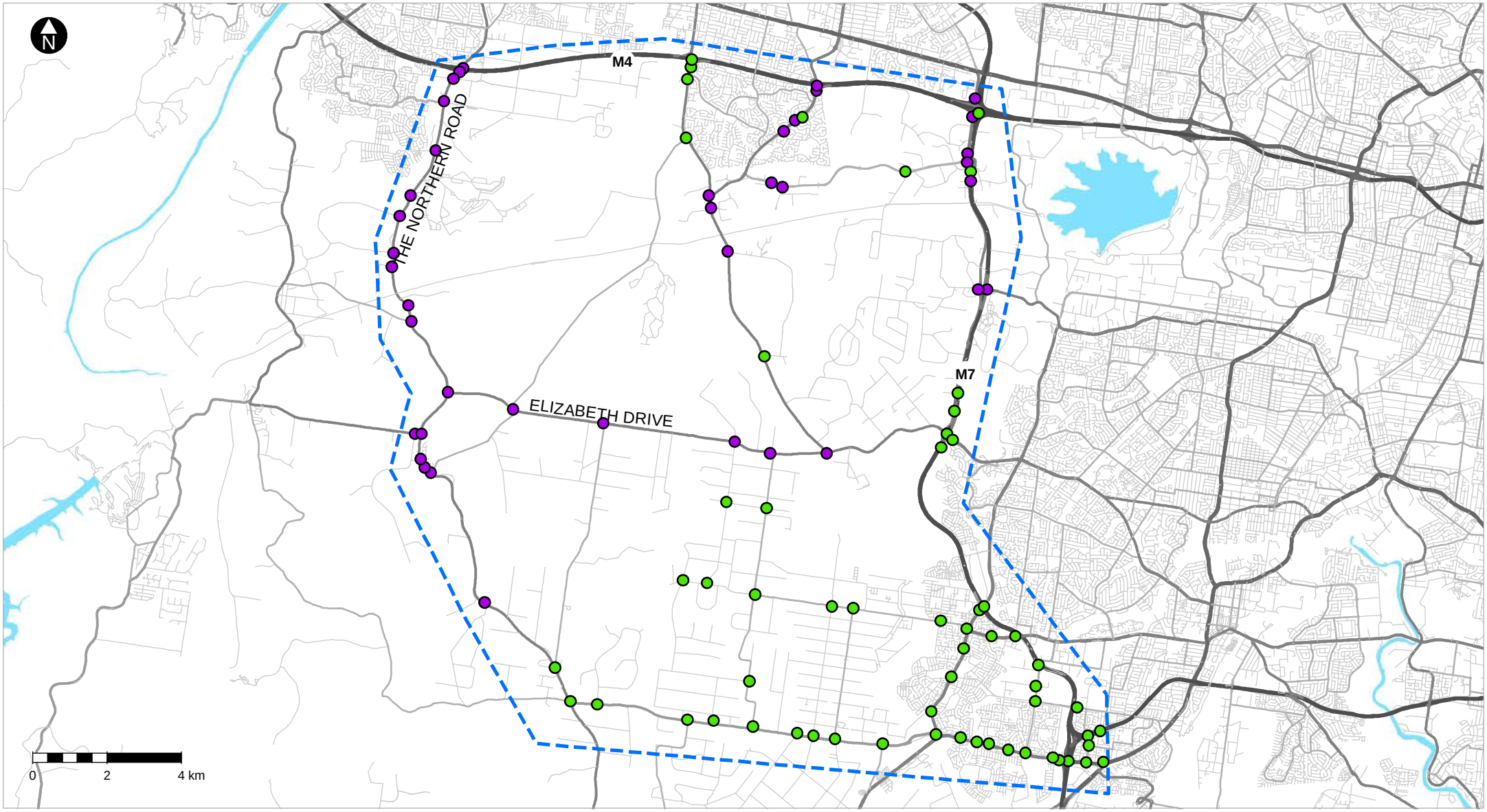


Figure 3-1 Intersection count locations

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3.3.2 Automatic traffic counts

Automatic traffic counts provide a record of traffic volumes every hour over a 24-hour period, typically over a week. These automatic traffic counts provide information about how traffic volumes vary over the day and over the week and also provide information regarding the makeup of traffic flows at that location and speeds. This information was used to convert peak hour traffic volumes to daily traffic volumes based on the observed profile of traffic at that location over a day.

Automatic traffic counts were undertaken at key location in the study area between 2015 and 2018. A plot of the locations where automatic traffic counts were undertaken is provided in **Figure 3-2**.

3.3.3 Travel times

Travel time surveys provide a record of the average travel time taken by vehicles along a route and can be broken down into subsections to understand the cumulative travel time along routes. This provides an understanding of where delays are typically experienced along these routes, as well as the typical speeds along these subsections. As travel times along roads are influenced by traffic volumes, intersection capacities and congestion, these data were used for the purposes on validation traffic models to ensure that they accurately reflect observed conditions.

Travel time surveys, where a survey car drives with the surrounding traffic to measure typical travel times, were undertaken along key corridors in the study area in 2017. A plot of the corridors for which travel time surveys were undertaken is provided in **Figure 3-3**.

3.3.4 Pedestrians and cyclists

Surveys of pedestrian and cycle volumes were undertaken on the M7 Motorway shared user path in 2019 to record the number of pedestrians and cyclists that use the M7 Motorway shared user path and the bridge across the M7 Motorway to the Western Sydney Parklands. This provided an understanding of the existing demand on these two facilities and the number of users that may be affected by construction works.

A plot of the location of these pedestrian and cycle counts is shown in **Figure 3-4**.

3.3.5 Other transport and traffic data

In addition to data collected in the field for this project, the following data were also collated to inform model development and impact assessment:

- Population and employment forecasts: used to develop travel demand forecasts, supplied by the Transport and Performance Analytics section of TfNSW as part of the 2014 version of land use (population and employment) projections for the Sydney Greater Metropolitan Area (LU14)
- Existing and future bus routes, stopping patterns and frequencies: used to model bus routes through the wider study area, supplied by TfNSW
- Traffic generation and distribution for Western Sydney Airport: used to refine traffic generation forecasts, supplied by WSA Co in early 2018
- Transport network project assumptions: used to develop the future year transportation networks, supplied by Roads and Maritime
- Aerial photography: used to validate road network coding of existing condition in traffic and transport models.

Traffic associated with the construction of the Western Sydney Airport is not included in the above data as surveys were carried out prior to the start of the airport construction works, which began in 2018.

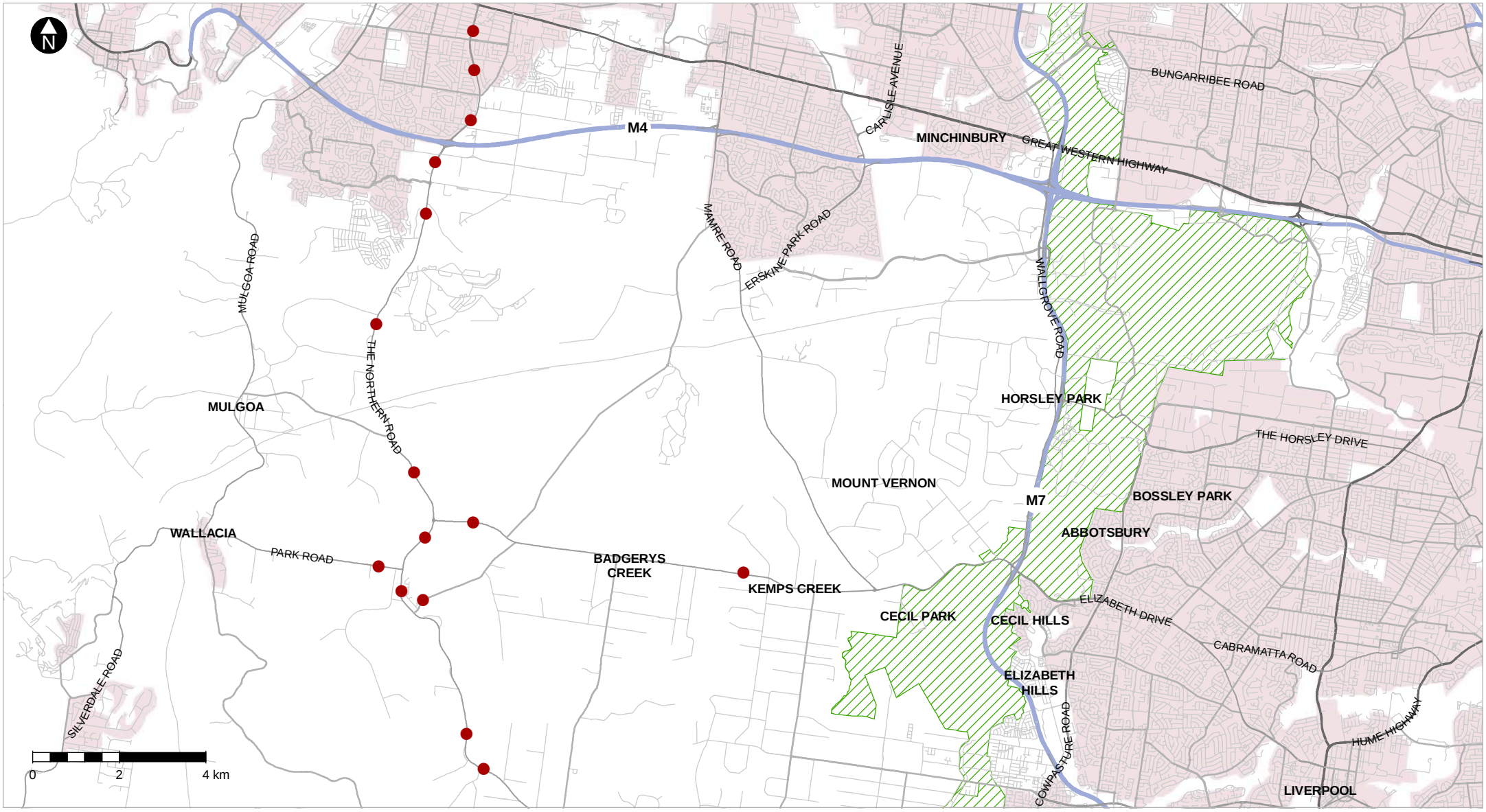

Figure 3-2 Automatic traffic count locations

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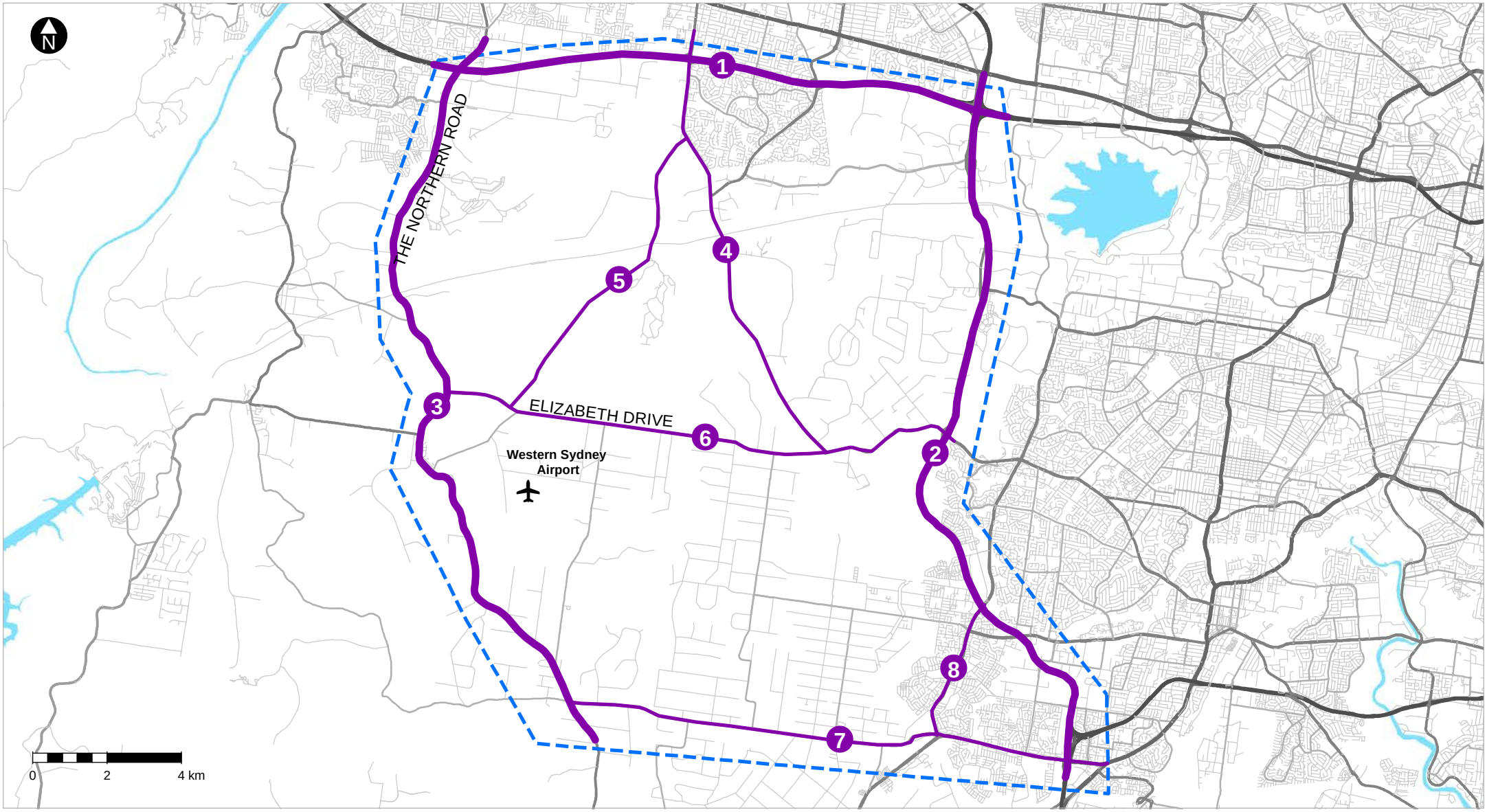

Figure 3-3 Travel time survey routes

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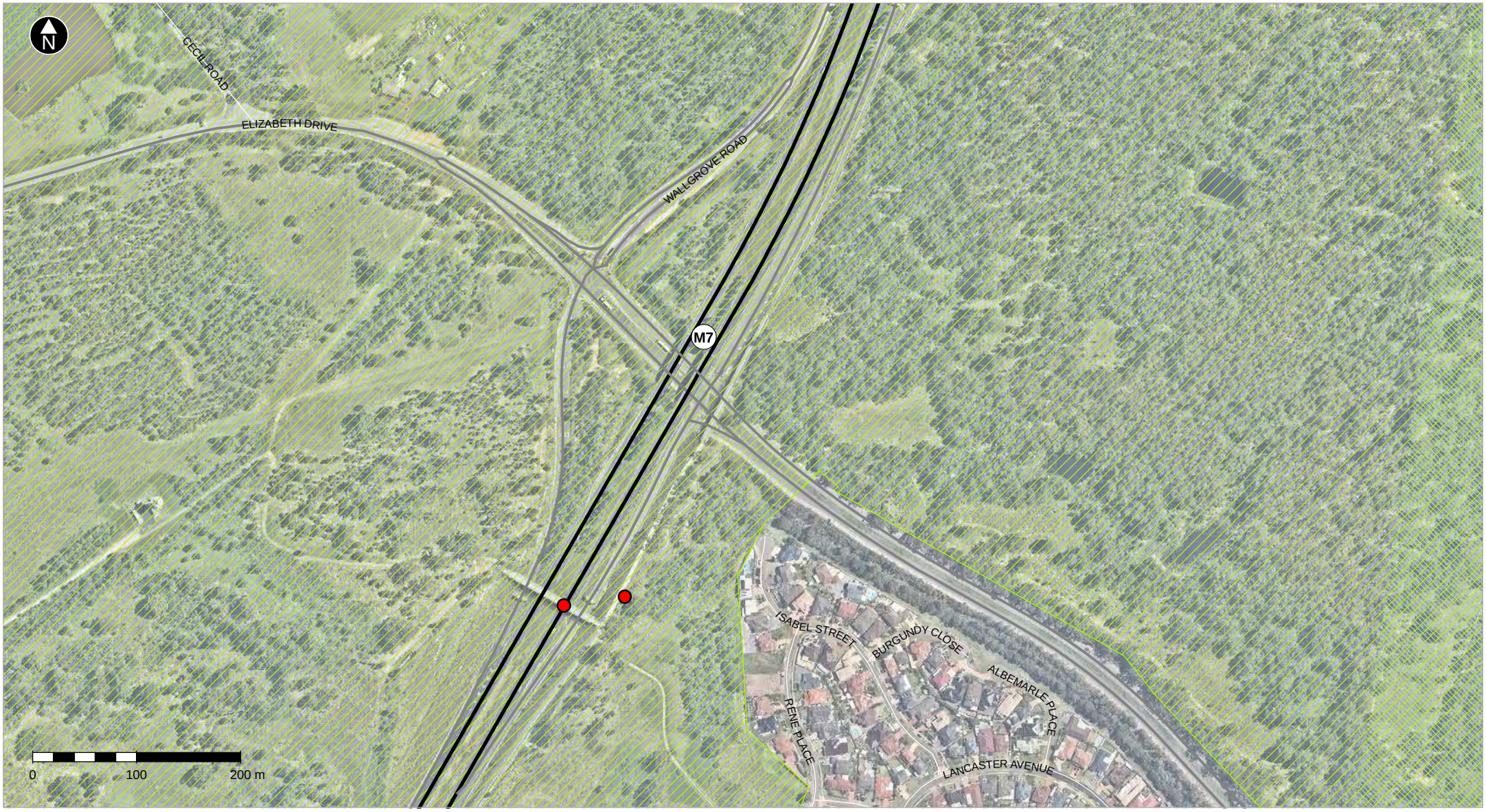

Figure 3-4 Pedestrian and cyclist count locations

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3.4 Transport forecasting and modelling process

The objective of the transport modelling process was to make the best use of the available transport and traffic data and existing transport models to estimate the base and future conditions on the transport network surrounding the project. These transport conditions were then used to assess the operational performance of the network based on scenarios with and without the project.

As the project is primarily road-based, the majority of the transport modelling process has been focussed around traffic modelling. The following sections provide an overview of the process by which land use forecasts and network assumptions at the wider Sydney Metropolitan level are refined and focussed to produce detailed traffic forecasts for the study area.

Transport modelling has been undertaken by Roads and Maritime using a combination of the following models:

- **Sydney Strategic Travel Model (STM)** – uses land use transport network inputs to generate trip forecasts for all modes for each forecast horizon year across greater Sydney
- **WestConnex Road Toll Model (WRTM)** – uses mechanised mode forecasts (car and truck) from STM to forecast traffic volumes and induced traffic demand across Greater Sydney.
- **Western Sydney Airport Growth Area simulation traffic model (WSAGA model)** – uses demand forecasts and toll-choice information from WRTM to model detailed operation of the road network during peak periods.

Traffic associated with the construction of the Western Sydney Airport is not included in the above data as surveys were carried out prior to the start of the airport construction works. Publicly available data from the Western Sydney Airport EIS did not provide the detail required to inform a quantitative assessment. Therefore construction traffic was addressed qualitatively (see **Section 7.1**).

An overview of the function of each of these models within the assessment methodology is presented below, based on the stages outlined in **Figure 3-5**.

3.4.1 Stage 1 - Sydney Strategic Travel Model

The STM, developed and operated by TfNSW, is the primary source for the extraction of region-wide trip patterns and travel demand on the transport network across Sydney, Newcastle and the Illawarra. The STM was used to extract trip matrices for road traffic demand modelling across greater Sydney for more detailed traffic modelling using WRTM. Future year trip matrices were extracted from STM that consider endorsed NSW Government plans and policies as documented in **Section 3.2**, population and employment projections, and transport infrastructure and service operation assumptions.

STM modelling approach

The STM is operated by TfNSW and generates multi-modal travel demand for the Sydney Greater Metropolitan Area and provides the travel demand forecasts that feed into all other strategic transport models used by NSW Government.

STM model scenarios for use in modelling of the project were undertaken using the following process:

- A review of the available model scenarios and their input data was undertaken to identify the appropriate scenario to inform the project
- Base and future population and employment data was sourced from NSW Department of Planning, Industry and Environment to inform the development of the do minimum scenario

- Future network assumptions were reviewed to confirm the inclusion and timing of transport projects that would impact travel patterns and demands in the area surrounding the project
- STM was run using the inputs identified above, producing trip generation, trip distribution, mode choice and trip assignment
- Travel demand matrices for car and truck were extracted from STM for use in more detailed traffic modelling.

Strategic Travel Model (STM)

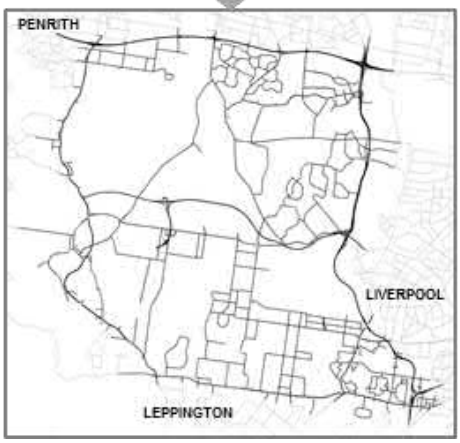
GENERAL DESCRIPTION
Projects travel pattern across Sydney, Newcastle and the Illawarra under proposed land use, multi-modal transport, and pricing scenarios

PROJECT CONTEXT
Provides road traffic demands for more detailed assignment modelling within WRTM.

WestConnex Road Toll Model (WRTM)

GENERAL DESCRIPTION
Strategic road traffic forecasting model used to develop and evaluate Sydney motorway projects.

PROJECT CONTEXT
Inform project definition and evaluation, provide road traffic growth forecasts for input to operational traffic modelling.



Western Sydney Airport Growth Area (WSAGA) Traffic Model

GENERAL DESCRIPTION
More comprehensively evaluates the performance of the road network through simulating more complex traffic operations.

PROJECT CONTEXT
Evaluate the road network performance with and without the project.

Figure 3-5 Overview of transport modelling approach

STM Land use inputs

The key land use assumptions that were adopted for the strategic transport modelling undertaken to inform the assessment of the project include:

Western Sydney Airport

Land use assumptions for the Western Sydney Airport have been provided by WSA Co based on information supplied as part of the Environmental Impact Statement (EIS) for the Western Sydney Airport as well as more recent land use information provided in early 2018 including assumptions relating to traffic generation from the on-site business parks at the airport.

The key features of the Western Sydney Airport that have been included in STM include:

- The EIS for Western Sydney Airport estimates of traffic generated by the operation of Stage 1 of the airport is expected to result in approximately 42,000 vehicles entering and leaving the airport site each day by 2030. This forecast traffic generation has been included within the STM forecast for vehicle trips into and out of Western Sydney Airport, based on linear growth for the 2026 and 2036 horizon years
- In addition to the operation of the terminal, up to 350 hectares of land within the Western Sydney Airport site has been set aside for business development
- Future traffic demand forecasts provided by Roads and Maritime for use in future travel demand development reflect the traffic generation and trip distribution for the terminal and the on-site business parks included in this assessment.

South West Growth Area

Land use assumptions for the South West Growth Area have been based on population and employment projections for this area made by NSW Department of Planning, Industry and Environment (DPIE) as part of LU14 standard land use forecast. The key features of the South West Growth Area that have been included in STM include:

- Comprised of 18 precincts and covers about 17,000 hectares
- It is expected to accommodate about 110,000 new dwellings for 300,000 people (DPE, 2015)
- To date, seven precincts within the South West Growth Area have been rezoned to allow urban development, which have the potential for about 42,560 new homes
- Detailed planning for Stage 1 of Leppington Precinct (south-east of the project area) has recently been finalised. Upon rezoning, it is expected the Leppington Precinct will provide land for approximately 2,500 additional homes

Western Sydney Aerotropolis

Land use assumptions for the Western Sydney Aerotropolis have been based on population and employment projections for this area made by DPIE as part of the LU14 standard land use forecast. The key features of the Western Sydney Aerotropolis that have been included in STM include:

- Identified in ‘A Plan for Growing Sydney’ (NSW Planning and Environment, December 2014)
- It extends from Bringelly Road in the south to the Sydney Water pipeline in the north and from the Ouster Sydney Orbital corridor in the west to the Kemps Creek riparian zone in the east.
- Identifies about 10,000 hectares of currently low intensity rural activity lands to be developed as a diverse employment centre, providing businesses in the region with land for industry and employment, catering for transport and logistics, warehousing and office space
- It is anticipated to provide over 57,000 jobs over the next 30 years, and over 200,000 jobs once it is fully established.

The locations of each of these key land release areas in relation to the project is provided in **Figure 3-6**.

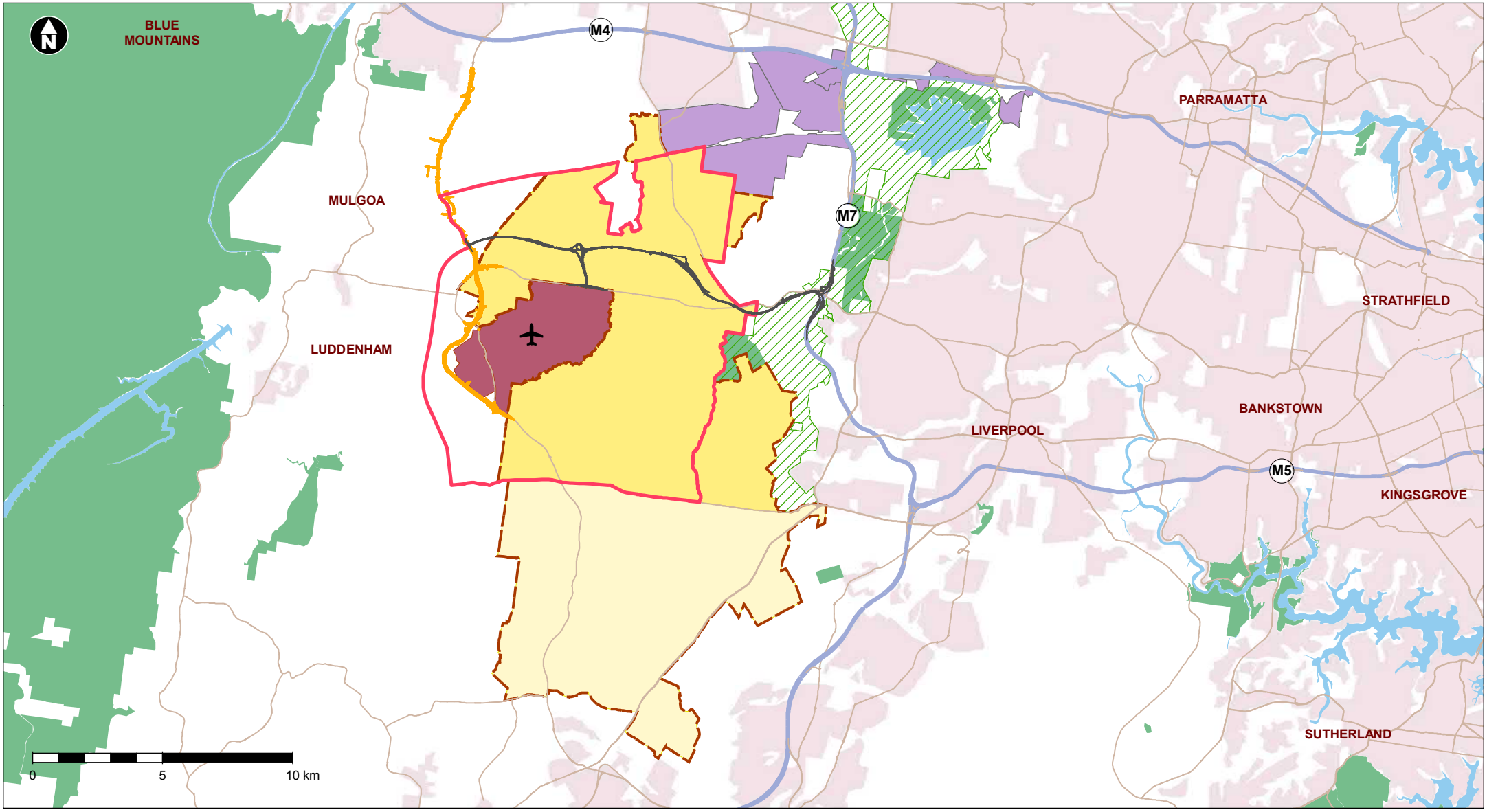


Figure 3-6 Key land release areas affecting the project

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STM transport network assumptions

As the STM is a multimodal model that includes the interaction of public transport, private transport and land use, the impacts of strategic public transport initiatives and projects are accounted for at this level in the transport modelling methodology. The public transport projects that were modelled in STM to inform the assessment of the project are provided in **Table 3-1**. The locations of these projects is provided in **Figure 3-7**. Details of each of these projects is provided in the sections that follow.

Table 3-1 Key transport projects identified within the study area

Project	2017 Base	2026 without M12 Motorway	2026 with M12 Motorway	2036 without M12 Motorway	2036 with M12 Motorway
Sydney Metro Greater West (formerly North-South Rail Line) – St Mary's to Western Sydney Airport	-	✓	✓	✓	✓
Sydney Metro Greater West to Macarthur Station	-	-	-	✓	✓
Western Sydney Freight Line	-	-	-	✓	✓
Rapid bus services linking Liverpool, Penrith and Campbelltown with the Aerotropolis	-	✓	✓	✓	✓
Outer Sydney Orbital	Implementation date unknown				

Sydney Metro Greater West

Sydney Metro Greater West would provide a high-capacity public transport connection to the Western Sydney Airport along the alignment of what was previously the North-South Rail link planned to connect Schofields to Macarthur. The first stage of Sydney Metro Greater West will connect St Marys to the Western Sydney Airport and has been identified as a high priority to coincide with the opening of the airport by 2026.

Corridor preservation for the extension of this line south of Western Sydney Airport through to Macarthur is currently underway to support the long-term transport needs of the South West Growth Area and has been assumed to be open by 2036.

Western Sydney Freight Line

The Western Sydney Freight Line is a proposed freight railway line between the Main Western railway line at Street Marys and the Southern Sydney Freight Line at Villawood. Currently under investigation, it is intended to separate freight from passenger rail and support the growth of freight and the logistics industry in western Sydney. A corridor has been identified between the M7 Motorway and the planned Outer Sydney Orbital's freight rail corridor near Luddenham and has been subject to public consultation by TfNSW.

When completed, the freight line between Port Botany and Western Sydney will support the movement of container and bulk freight by rail across Greater Sydney and serve employment lands and future industries across the Western Sydney Aerotropolis.

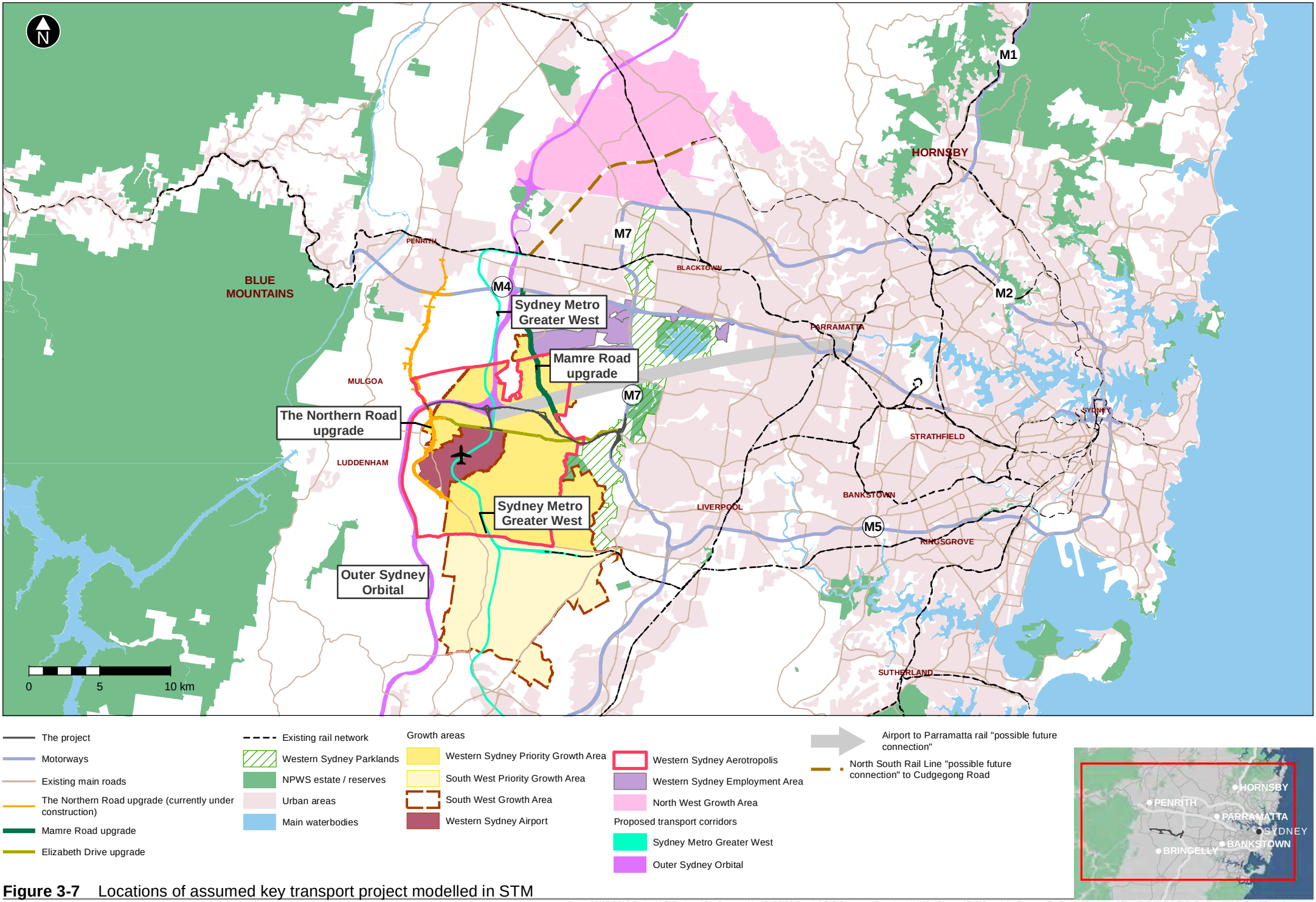

Figure 3-7 Locations of assumed key transport project modelled in STM

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Western Sydney Airport rapid bus services

The NSW Government proposes to provide rapid bus services from the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Airport before it opens in 2026. In addition, transit corridors are being planned along Rickard Road, Jersey Road, Fifteenth Avenue and Western Road with the potential to extend Transitway services via Fifteenth Avenue and Edmondson Avenue. The services associated with these transit corridors have been included in STM.

Outer Sydney Orbital

The Outer Sydney Orbital, currently under investigation by TfNSW, is a long-term plan to connect the Central Coast to Illawarra via Western Sydney Airport and South West Growth Area. The alignment of the Outer Sydney Orbital is currently being planned with the section from Great Western Highway to Western Sydney Airport currently planned to follow the alignment of the project between The Northern Road and Western Sydney Airport access. As the Outer Sydney Orbital is currently in the early stages of planning, it has not been included in the assessment of the project.

3.4.2 Stage 2 - WestConnex Road Toll Model

The WestConnex Road Toll Model (WRTM) was originally developed and operated by Roads and Maritime for the purpose of forecasting toll road demands for the WestConnex programme of works. It provides a platform to understand changes in future weekday traffic patterns under different land use, transport infrastructure and pricing scenarios.

Although 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 new motorway projects under planning and assessment individually and in combination. For the M12 Motorway project, WRTM was used to provide future year traffic demand forecasts for the Western Sydney Airport Growth Area[2] Traffic Model (WSAGA Traffic Model).

WRTM modelling approach

The process undertaken to develop the WRTM and use it to generate future traffic demand for the project involved the following steps:

- 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
- Value of Travel Time Savings (VTTS) surveys of drivers' willingness to pay tolls were undertaken to inform the toll choice modelling
- Car and truck travel demand generated by STM was brought into WRTM for the base and future year scenarios and the resulting growth in travel demand applied to the calibrated base travel demand
- Refinement of the traffic generation and distribution for trips generated by the Western Sydney Airport was undertaken to ensure alignment with traffic generation assumptions provided by WSA Co in early 2018

[2] Note that this area is now referred to as the Western Sydney Aerotropolis

- Existing road infrastructure was reviewed for the base year. A set of future road infrastructure projects anticipated for future years for the modelled Sydney metropolitan area was developed and these projects formed the basis for the future do minimum networks modelled in WRTM
- The WRTM project model was developed and calibrated to current observed travel behaviour, then validated against 2017 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 WRTM comprises separate weekday time period sub-models, with average one-hour peak multi-class traffic assignments run for:
  - AM period: (7am to 9am)
  - Daytime inter-peak: (9am to 3pm)
  - PM period: (3pm to 6pm)
  - Evening off-peak: (6pm to 7am)
- The project 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 future base case scenario. Traffic estimates were produced by the WRTM for the years 2026 and 2036. These traffic estimates were produced by time period for an average school day at each year and vehicle class for toll assessment and include the calculation of induced demand as a result of the project for the project scenarios
- Forecast traffic demand from WRTM for car, truck and heavy truck split by toll-paying and non-toll-paying vehicles was extracted for use in more detailed simulation traffic modelling undertaken using the WSAGA Model.

WRTM land use assumptions

As the WRTM uses growth in travel demand extracted from STM, the WRTM land use assumptions are consistent with STM and reflect the LU14 standard land use assumptions provided by TfNSW. In addition to these land use assumptions, refinement of the traffic generation of the Western Sydney Airport and the on-site business parks to align with information provided by WSA Co in early 2018 was undertaken and incorporated into the WRTM traffic demand assumptions.

WRTM road network assumptions

As the WRTM is primarily a traffic assignment model that includes the impact of road tolls on the motorway network, the impacts of induced demand and road network upgrades on the distribution of traffic at a strategic level as well as the patronage of various toll roads including M5 South Western Motorway and the M7 Motorway are accounted for at this level in the transport modelling methodology. The scenarios that were modelled using WRTM to inform the assessment of the project include the following road network upgrades that are either, committed and planned or under investigation:

- Bringelly Road (under construction)
- The Northern Road (under construction)
- Elizabeth Drive (under investigation)
- Devonshire Road and Mamre Road (under investigation)
- Luddenham Road and Adams Road (under investigation)
- M7 Motorway (under investigation)
- Fifteenth Avenue (under investigation)
- Western Sydney Airport on-site business park accesses.

The details of each upgrade are discussed further below.

Bringelly Road

The Bringelly Road upgrade will include upgrading of Bringelly Road between Camden Valley Way and The Northern Road in Bringelly. It will include an 80 kilometres per hour speed limit, an off-road shared user path and bus priority at signalised intersections and indented bus bays. Stage 1 of the project between Camden Valley Way and King Street is currently under way and due to be completed by late 2018. Stage 2 of the project between King Street and The Northern Road is due to be completed by 2020.

The Northern Road

Roads and Maritime are undertaking a major upgrade to The Northern Road involving addition of a traffic lane in each direction of travel and provision of a central median to allow for widening to six lanes in future. The improvement will include signalisation of nine intersections, a grade separated interchange (underpass) at Bringelly Road, a shared pedestrian/cyclist path on the western side and bus priority lanes at signalised intersections.

Stage 3 of The Northern Road Upgrade between Jamison Road and Glenmore Parkway is due to be completed by 2020. Stages 4 – 6 between Glenmore Parkway and Mersey Road are currently under construction and due to be completed prior to opening of the Western Sydney Airport in 2026.

In addition to these committed road network upgrades, based on land use forecasts for the Western City, it is likely other uncommitted road network upgrades would also be required to support the development forecast for the District. In order to undertake a realistic assessment of the impacts of the project and ensure that traffic modelling of the project is robust, the following additional uncommitted projects have also been assumed, based on an assessment of network performance at the 2026 and 2306 forecast years without the project:

Elizabeth Drive

There is currently no commitment to widen Elizabeth Drive. However, investigations have commenced for widening of Elizabeth Drive to two lanes in each direction between the M7 Motorway and The Northern Road by 2036.

Traffic modelling undertaken for the assessment of M12 Motorway assumes localised upgrade of the following intersections along Elizabeth Drive by 2026:

- Adams Road and Luddenham Road realigned and upgraded with traffic signals
- Western Sydney Airport on-site business park east (converted from Badgerys Creek Road) and west accesses, with traffic signals
- Martin Road upgraded, with traffic signals
- Western Road upgraded, with traffic signals
- Devonshire Road upgraded, with traffic signals
- Duff Road upgraded, with traffic signals
- Cecil Road restricted
- M7 Motorway and Wallgrove Road interchange localised widening and remarking of turning lanes for M7 Motorway exit ramps.

By 2036 it is assumed that Elizabeth Drive would be widened to two lanes in each direction between The Northern Road and M7 Motorway. The intersection of Mamre Road and Elizabeth Drive is located adjacent the proposed M12 Motorway viaduct; it is assumed that this intersection would remain as a roundabout in 2026 but upgraded to incorporate traffic signals by 2036.

As part of The Northern Road upgrade plan, it is proposed to convert the existing roundabout at the intersection of Elizabeth Drive to a signalised intersection. A realignment of Elizabeth Drive and the construction of a new link to Luddenham town centre is included as part of this intersection upgrade. In the longer term when the Outer Sydney Orbital is built, this intersection is likely to be upgraded further.

Devonshire Road and Mamre Road

As part of the investigations for the widening and upgrade of Elizabeth Drive, the realignment of Mamre Road to the current alignment of Devonshire Road is also under investigation. This realignment would rationalise the north-south movement allowing traffic travelling to and from Devonshire Road and Mamre Road to cross Elizabeth Drive at a single intersection. It has been assumed that this realignment would be undertaken at the same time as the widening of Elizabeth Drive and upgrade of the existing roundabout on Elizabeth Drive at Mamre Road and would be completed by 2036.

Luddenham Road and Adams Road

As part of the investigations for the widening and upgrade of Elizabeth Drive, the realignment of Adams Road to the current alignment of Luddenham Road is also under investigation. This realignment would rationalise the north-south movement allowing traffic travelling to and from Adams Road and Luddenham Road to cross Elizabeth Drive at a single intersection. It has been assumed that this realignment would be undertaken at the same time as the widening of Elizabeth Drive and upgrade of the existing roundabout on Elizabeth Drive at Mamre Road and would be completed by 2036.

M7 Motorway

The current M7 Motorway deed allows for widening of the M7 Motorway to provide an additional public transport lane in each direction Widening the M7 Motorway to three lanes in each direction would be required to relieve forecast congestion along this corridor.

For the purposes of this study, it is assumed that widening of the M7 Motorway to three general traffic lanes along its length would occur by 2036, with further localised widening to provide four lanes in each direction between the M4 Motorway and Old Wallgrove Road ramps to reduce delays associated with merging in this section.

Western Sydney Airport business park accesses

Access to Western Sydney Airport is proposed to be primarily via the M12 Motorway. Access to the on-site business parks adjacent to the terminal would be provided by two signalised intersections on Elizabeth Drive east and west of the M12 Motorway Western Sydney Airport access road. An internal interchange within the Western Sydney Airport site would allow traffic to access M12 Motorway from these business park entries and vice versa, however internal local area traffic management would make this unlikely for the majority of trips to and from Western Sydney Airport. If the project was not built, access to the airport terminal would be from Elizabeth Drive via the proposed business park accesses and the internal interchange.

Induced demand

Induced demand results from 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 results in induced traffic demand. The WRTM includes the changes in traffic associated with this induced demand. Induced demand analysis carried out for the project showed that the impacts are local, with the majority of (induced) traffic changes occurring within the core study area and negligible impact in or outside the wider study area. Induced demand equates to about 0.2 per cent additional daily trips in the Sydney metropolitan area in 2036 and represents the change in utility across the network as a result of the project being built.

The WRTM was established in 2012 on announcement by the NSW Government of the (then) proposed WestConnex project. Hence 2012 is referred to as the ‘base year’ for the calibrated WRTM as referred to in this assessment.

3.4.3 Stage 3 - WSAGA mesoscopic traffic model

Stage 3 of the traffic modelling involved mesoscopic simulation modelling to further refine the strategic modelling undertaken at Stage 1 and Stage 2 and to more accurately reflect the impact of capacity constraints on the urban and motorway road network to understand what impacts these constraints would have on the regional road network.

Mesoscopic simulation allows for true dynamic equilibrium assignment where vehicles can select their optimal travel routes based on their previous travel experiences. This provides a confidence that the modelled pattern of traffic represents a realistic response to the delays and capacity constraints that would be experienced by traffic on a day-to-day basis and are not accounted for in the strategic forecasting models.

The Western Sydney Airport Growth Area (WSAGA) Traffic Model originally developed for the DPIE was adopted for the assessment of the M12 Motorway. In order to be fit for the purposes of assessing the project, the model has been further refined to ensure that the operation of motorways in the wider study area has been accurately modelled.

WSAGA mesoscopic traffic modelling approach

Modelled traffic volumes, travel times and intersection performance measures used in the assessment of the project have been taken from the WSAGA mesoscopic traffic model. The process undertaken to develop the WSAGA mesoscopic traffic model and use it to model future traffic conditions with and without the project involved the following steps:

- Development of a calibrated and validated base model that reflects observed traffic conditions of the existing 2017 road network and land use
- Development of do minimum 2026 and 2036 scenarios that reflects the forecast growth in traffic demand from WRTM and proposed road network without the project
- Optimisation of the 2026 and 2036 do minimum scenarios to address road network performance issues that may arise where traffic demand greatly exceeds network capacity
- Development of 2026 and 2036 project scenarios that reflect the forecast growth in traffic demand from WRTM, the do minimum road network and the project
- Reporting of traffic volumes, network statistics, travel times and intersection performance from do minimum and project case scenarios.

Spatial coverage

The WSAGA model covers the road network bounded by the following roads:

- M4 Motorway
- M7 Motorway
- Camden Valley Way and Bringelly Road
- The Northern Road.

Time of day coverage

These WSAGA mesoscopic model boundaries correspond with the wider traffic and transport study area shown in **Figure 1-3**. The following time periods are included in this model:

- Morning peak 6am to 10am
- Evening peak 3pm to 7pm.

All traffic performance measures presented in this assessment have been derived from the WSAGA mesoscopic traffic model, informed by modelling undertaken in both STM and WRTM. The WSAGA mesoscopic traffic model was developed using AIMSUN Version 8.2.0 for both base and forecast years (2026 and 2036).

WSAGA mesoscopic model 2017 existing year model development

The WSAGA mesoscopic traffic model used in the assessment of the project involved building a calibrated and validated 2017 existing model (the 'base model'), prior to producing future year scenarios with and without the project. Detailed documentation of the development, calibration and validation of the WSAGA traffic model is provided in the WSAGA Traffic Model Calibration and Validation Report provided in Annexure A.

The key steps in the development, calibration and validation of this model were:

1. Network coding based on aerial photography and Sydney Coordinated Adaptive Traffic System (SCATS) intersection plots
2. Bus network coding using TfNSW Operational Spatial Database (OSD) data including stop locations, route and stop pattern and schedules services.
3. Traffic signal coding based on phasing, timing and offset data from SCATS
4. Demand estimation based on sub-area travel demand pattern derived from WRTM
5. Calibration of modelled turning movement volumes to observed turning movement volumes collected during traffic surveys
6. Validation of travel times along key routes to observed travel times collected during travel time surveys.

Calibration of the base model was carried out to ensure a match between modelled and observed traffic demands. The results of this calibration and validation process are detailed further in Annexure A.

Note that the WSAGA model does not incorporate traffic volumes associated with the construction of the Western Sydney Airport, which began in 2018.

WSAGA mesoscopic model data sources

Data sources used to calibrate the base year WSAGA Traffic Model include the following:

- Intersection turning movement surveys for 119 sites collected between 2015 and 2017 as shown in **Figure 3-1**
- SCATS (traffic signal system) signal phasing and timing for all 59 signalised intersections located throughout the model area
- Floating-car travel time surveys undertaken in June 2017.

These data sources were reviewed and validated to determine the consistency of the data between intersections and between different survey days. This analysis indicated that there was some variability in the observed traffic flows, particularly in the morning peak period where traffic flows varied by more than 10 per cent between survey days. This is typical for turning movements with low flows.

WSAGA mesoscopic model future growth forecasting

Forecasting of future traffic growth for the 2026 and 2036 horizon years has been undertaken based on the following methodology:

1. Population and employment forecasts for the standard land use scenarios (based on 2016 census data) for greater Sydney are input to STM to produce trip generation and distribution and assignment of these trips across the public transport and road network.
2. Car and truck matrices from STM are input to WRTM, with refinement of the traffic generation and distribution of non-journey-to-work trips associated with Western Sydney Airport, based on information supplied by WSA Co in early 2018. Willingness-to-pay associated with toll roads (to account for the M7

Motorway) is incorporated into the traffic assignment to produce traffic volume forecasts on all roads within the study area for morning and evening peak periods.

3. Car and truck volumes split into toll-paying and non-toll paying are extracted from WRTM and applied to calibrated base traffic volumes to produce detailed traffic demand forecasts for use in WSAGA traffic model.
4. WSAGA Traffic Model is run for the 2026 and 2036 using the same input demand for all scenarios (with and without the project).

WSAGA mesoscopic model future network optimisation

Mesoscopic traffic modelling considers the functioning of the road network at a greater level of detail than the strategic transport modelling outlined in **Sections 3.4.1** and **3.4.2**, treating capacity constraints associated with roads and intersections with a higher level of accuracy. As a result, when modelling traffic growth derived from a strategic travel model on a capacity-constrained mesoscopic traffic model, the forecast growth in traffic demand can exceed the available network capacity, resulting in unrealistic delays and congestion that can obscure the assessment of the impacts of the project.

Many of the roads within the wider study area have limited capacity to support growth in traffic of the scale forecast in the LU14 standard land use scenarios used in this assessment. Modelling this growth in the WSAGA mesoscopic model would result in extreme levels of delay and congestion, and it is unlikely that this growth could be supported without further road upgrades. The majority of the upgrades required in the wider study area have been identified in the course of developing the WRTM network as documented in **Section 3.4.2**.

As a final step in undertaking mesoscopic modelling of the project, the do minimum scenarios have been further optimised to ensure that the mesoscopic traffic model realistically represents future traffic conditions within the wider study area. The following approach has been taken to optimise the final do minimum mesoscopic traffic models prior to modelling and assessing the project:

- Sub-area traffic demand from WRTM identified a large number of trips travelling from south of Bringelly Road in Leppington to South Western Freeway/Hume Motorway via Bernera Road and Cowpasture Road interchanges. Mesoscopic traffic modelling showed that WRTM underestimates the delay these trips would experience and it was determined that these trips would experience lower delays by travelling via Camden Valley Way and Campbelltown Road. These trips were reassigned in the WSAGA mesoscopic model to use this alternative route.
- Forecast traffic demands in the wider study area would exceed the road network capacity at a number of locations in both 2026 and 2036. Traffic signals at these locations were optimised to allow more vehicles to enter the wider study area at these locations, however constraints at these locations still mean that there is a residual amount of traffic unable to enter the wider study area at the following locations by 2036:
  - The Northern Road, Gipps Street and Archbold Road and M7 Motorway north of M4 Motorway
  - M4 Motorway east of the M7 Motorway
  - Horsley Drive, Fifteenth Avenue. And M5 Motorway east of the M7 Motorway
  - Hume Highway east of Campbelltown Road
  - South Western Freeway south of Camden Valley Way
  - Camden Valley Way, Rickard Road, Dickson Road, Allenby Road and The Northern Road south of Bringelly Road.

- Mesoscopic modelling of forecast traffic demands from WRTM indicate that widening and upgrade of Fifteenth Avenue to provide improved access from Austral to Liverpool would be required by 2036 due to increased traffic demand between Austral and Liverpool. For the purposes of this study, it is assumed that Fifteenth Avenue would be widened to 4 lanes between Cowpasture Road and Fourth Avenue by 2036, including upgrade of the following intersection to traffic signals:
  - Second Avenue and Kingsford Smith Avenue
  - Calk Avenue
  - Edmondson Avenue
  - Fourth Avenue
  - Devonshire Road.
  - Cowpasture Road
- Mesoscopic modelling of forecast traffic demands from WRTM indicate that the widening of Cowpasture Road in the vicinity of the M7 Motorway would be required by 2036 due to increased demand along the corridor. For the purposes of this study it is assumed that the corridor would be widened to allow for three through lanes in each direction between M7 Motorway and Camden Valley Way to facilitate planned development in Austral and to minimise the impacts of queues and congestion on the M7 Motorway.

3.5 Construction assessment

Assessment of the potential transport and traffic impacts during construction was undertaken using a similar methodology to the assessment of the operational impacts of the project. In order to determine the operation of the road network in the core study area under construction conditions, the following scenarios were developed within the WSAGA mesoscopic traffic model:

- Future construction year (2024) without construction
- Future construction year (2024) with construction traffic

The year 2024 was modelled as it corresponds to the peak construction year for the project.

Both scenarios include forecast traffic growth to the likely year of peak construction activity (2024), which has been forecast by interpolating between 2017 and 2026 forecast traffic growth and includes changes to the road network within the core study area expected to be complete by 2024. The construction scenario includes the following changes to the traffic network associated with construction:

- Additional heavy vehicles associated with spoil and material haulage
- Additional light vehicles associated with the construction workforce
- Traffic management measures including traffic control, road closures, detours, diversions, worksite traffic control and reduced speed zones to maintain safety for construction traffic
- Additional access points from the public road network to the proposed construction ancillary facilities.

In addition to the changes in performance of the road network associated with construction, the following aspects of the transport network in the core study area have also been assessed for construction:

- On street parking
- Public transport
- Pedestrians and cyclists.

3.6 Modelled scenarios

In order to assess the performance of the road network with and without the project and identify the impacts of the project, both under construction and operation, traffic modelling of the following scenarios has been undertaken:

- **2017 existing situation**: reflects the transport network as it was in 2017 with no new projects or upgrades. 2017 was adopted as the existing year as the majority of traffic counts were undertaken at this time, with other data adjusted to account for any time difference.
- **2024 do minimum**: reflects the forecast transport network and traffic demand without the project in 2024, which includes the completion of The Northern Road upgrade between Mersey Road and Jamison Road and Bringelly Road upgrade between Camden Valley Way and The Northern Road.
- **2024 with project construction**: as per 2024 do minimum but includes construction traffic and traffic management measures to facilitate access for construction vehicles to construction ancillary facilities during the peak period of construction.
- **2026 do minimum**: includes The Northern Road upgrade, Bringelly Road upgrade, Elizabeth Drive upgrade between M7 Motorway and Mamre Road, along with the opening and operation of the Western Sydney Airport and two access intersections along Elizabeth Drive between Adams Road and Taylors Road. Includes forecast traffic growth to 2026 based on the LU14 standard land use scenario as well as the operation of Western Sydney Airport and the on-site business parks.
- **2026 with project**: as per 2026 do minimum, but includes the project complete and open to traffic
- **2036 do minimum**: includes all upgrades assumed in 2026 do minimum, as well as:
  - Upgrade of the M7 Motorway to three lanes in each direction
  - Upgrade of Cowpasture Road between M7 Motorway and Camden Valley Way
  - Realignment and upgrade of Luddenham Road and Dams Road intersection
  - Realignment of Mamre Road and Devonshire Road intersection
  - Upgrade of Elizabeth Drive between The Northern Road and Mamre Road
  - Upgrade of Fifteenth Avenue between Cowpasture Road and Fourth Avenue
  - Forecast traffic growth to 2036 based on the LU14 standard land use scenario as well as the operation of Western Sydney Airport and the on-site business parks within the Western Sydney Airport.
- **2036 with project**: as per 2036 do minimum, but includes the project.

A summary of the scenarios modelled using WSAGA traffic model and the demand and network assumptions in each scenario is provided in **Table 3-2**.

The 2017 Existing Year scenario reflects existing observed traffic conditions and has been calibrated and validated against observed data. Traffic associated with the construction of the Western Sydney Airport is not included as the start of the airport construction works began in 2018.

The do minimum scenario reflects the business-as-usual road network conditions that would occur if the Western Sydney Airport was opened and the project was not built.

Note that the modelling land use data that incorporates future land use associated with the Western Sydney Aerotropolis has not yet been released. The modelling data won't be released until mid-2020, following consultation on Stage 2 of LUIIP. However, traffic demand from the airport and business parks has been included into the M12 Motorway traffic model.

Table 3-2 Summary of modelled scenarios

Scenario	Bringelly Road upgrade	The Northern Road upgrade	Elizabeth Drive upgrade (Intersections only)	Elizabeth Drive upgrade (M7 Motorway to The Northern Road)	Mamre Road and Devonshire Road realignment	Luddenham Road and Adams Road realignment	M7 Motorway upgrade	Cowpasture Road Upgrade	Fifteenth Avenue Upgrade	M12 Motorway (M7 Motorway to Western Sydney Airport)	M12 Motorway (M7 Motorway to The Northern Road)
2017 existing situation	×	×	×	×	×	×	×	×	×	×	×
2024 do minimum	✓	✓	×	×	×	×	×	×	×	×	×
2024 project construction	✓	✓	×	×	×	×	×	×	×	×	×
2026 do minimum	✓	✓	✓	×	×	×	×	×	×	×	×
2026 project	✓	✓	✓	×	×	×	×	×	×	✓	✓
2036 do minimum	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×
2036 project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The purpose of modelling each of these scenarios is to determine the difference in traffic flows and road network performance between the business-as-usual scenario with the opening of Western Sydney Airport and the project scenario to determine the impact of the project on the transport network. As all modelled scenarios include the impacts of other transport related projects in the study area (detailed in **Section 3.4.1** and **Section 3.4.2**), this assessment of the project's transport and traffic impacts represents the cumulative impacts of the project with other projects planned in the study area.

3.7 Assessment criteria

The operational traffic modelling outlined in **Section 3.4.3** has been used as the basis for assessing the performance of the road network both with and without the project. Generally, traffic operational performance can be assessed in several ways, including:

- At a network level, in terms of average speed, total distance travelled, and total time travelled
- At a footprint level, in terms of average travel times on a particular route for private vehicles and buses
- At an intersection level, showing individual performance of these typically constraining elements of urban road networks.

Each of the performance measures listed above has been directly extracted from the WSAGA Traffic Model for each of the modelled scenarios to inform the assessment of the impacts of the project. Due to the scope of the WSAGA Traffic Model, covering the study area and the surrounding regional road network, the assessment of the road network performance accounts for the interaction of all traffic constraints together, recognising that relieving congestion at one location can result in increasing traffic volumes and delays in another, moving congestion through the network without necessarily changing network performance as a whole.

For this reason, performance of the road network is assessed at the level of individual intersections and footprints, but also at the wider network level to understand the regional impacts of changes to the road network.

Further detail regarding the methodology for determining each of the performance measures outlined above, as well as the Standards of Service by which these performance measures are assessed is provided below.

3.7.1 Network-wide statistics

Assessment of the performance of the road network as a whole is based on the following network-wide statistics extracted from the WSAGA Traffic Model for the morning and evening peak periods are as follows:

- Total throughput – vehicles completing their trips through the study area
- Average network travel speed – kilometres per hour
- Latent demand – vehicles waiting outside the study area
- Total vehicle hours travelled in the study area (VHT)
- Total vehicle kilometres travelled across the study area (VKT).

Each of the above statistics has been used to compare the performance of each modelled scenario across the assessment periods and horizon years. VHT and VKT have been treated as secondary measures as they can differ depending on the network arrangements for each scenario. Presenting VHT and VKT in isolation can be misleading when considering them in the context of network performance. For this reason, average network speed (which is the ratio of VKT to VHT) has been used as a primary performance metric.

As a secondary measure, the number of vehicles that are able to complete their trip within the peak period, as well as the number of vehicles that are unable to commence their trip within the peak period (also known as the latent demand) provides a measure of how well the network is able to serve the travel demand that is forecast for that scenario. Ideally, all trips would be able to commence and complete their journeys through the study area. However, in later forecasts, vehicles may remain outside the study area unable to commence or complete their trips due to forecast demand exceeding road network capacity.

Lower latent demands indicate a network that is better suited to serving the forecast demand, while higher latent demands indicate capacity constraints that are stopping vehicles from making or completing their trips within the peak period.

3.7.2 Midblock Level of Service

The assessment of performance of the network is based on criteria defined in the *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (Austroads 2009) and the *Highway Capacity Manual 2010* (Transportation Research Board 2010). The performance of surface roads is defined by the midblock Level of Service which is based on the volume to capacity (V/C) ratio. The Level of Service for freeways and motorways is calculated from vehicle density, which is the traffic volume divided by the average passenger car speed. Density is measured in passenger car units (PCU) per kilometre per lane. The Level of Service criteria for midblock sections is shown in **Table 3-3**.

Table 3-3 Level of Service criteria for midblock sections (based on volume and capacity)

LoS	Definition	Multi-lane roads[1]	Freeways/ motorways[2]
		V/C ratio	Density (PCU/km/lane)
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 in extremely high, and the general level of comfort and convenience provided is excellent.	≤ 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 and convenience 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: Austroads, Guide to Traffic Management – Part 3 Traffic Studies and Analysis, Second Edition 2013

Travel times and travel speeds provide an alternative means of assessing the functional performance of a road under interrupted flow conditions. The criteria for determining the Level of Service based on average travel speeds is defined in *Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis* (2013). The Level of Service criteria for midblock section based on travel speed is shown in **Table 3-4**.

Table 3-4 Level of Service criteria for midblock sections (based on travel speed)

Travel speed as a percentage of free-flow travel speed (%)	Level of Service (volume to capacity <1)	Level of Service (volume to capacity >1)
>85%	A	F
67-85%	B	F
50-67%	C	F
40-50%	D	F
30-40%	E	F
<30%	F	F

3.7.3 Intersection Level of Service

For urban road networks, mid-block capacity is not the governing factor in the road network performance, instead capacity is dictated by the capacity of intersections that limit flow across the network. The assessment of intersection performance is based on criteria outlined in **Table 3-5** and defined in the *Guide to Traffic Generating Developments* (Roads and Traffic Authority 2002). The average delay assessed for signalised intersections is for all movements, and for priority (sign-controlled) intersections is for the worst movement and is expressed in seconds per vehicle.

It is generally accepted that the target Level of Service (LoS) for intersection performance should be D or better. However, when assessing intersection performance for parts of the road network that already experiences substantial congestion over the course of the day or with future demand, achieving Level of Service D or better may not represent good value for money, or not be physically possible within the constraints of the project. In these locations, consideration need to be given to whether achieving Level of Service D is practical within the constraints of the project. If not, a minimum of Level of Service E is set as a performance target for intersections that are within the scope of works of the project.

Many intersections within the wider study area currently operate at a reasonable level of service under existing 2017 conditions during the morning and afternoon peak periods. This is due to the rural nature of the study area with its low population and employment densities that would change in future without the project when the area becomes fully developed.

Table 3-5 Level of Service criteria for intersections

Level of Service	Average delay per vehicle (seconds/vehicle)	Traffic signals and roundabouts	Give way and stop signs
A	14 or less	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 will cause delays	At capacity; requires other control mode
F	Greater than 70	Extra capacity required, Roundabouts require other control mode	At capacity; requires other control mode

Source: Roads and Traffic Authority (2002) Guide to Traffic Generating Developments

4. Existing traffic and transport environment

4.1 Introduction/overview

This section includes a description of the existing transport and traffic environment and has been informed by the desktop investigations and surveys undertaken for the project. All data in this section presents the existing conditions of the base case (2017). The description of the existing transport and traffic environment presented in this chapter includes modes of travel, road network, road network volumes, public transport network, pedestrian and cyclist network and road safety.

For the purpose of assessing the traffic impacts of the project, the description of the transport network in this chapter covers the wider study area bounded by the area between Bringelly Road to the M4 Motorway and from the M7 Motorway to The Northern Road, with particular focus placed on the core study area that covers Elizabeth Drive, The Northern Road and the M7 Motorway.

4.2 Existing road network

Roads and Maritime uses a classification system that designates the road network into a number of categories to define their functions within the road network. The classification is based on a hierarchal system that covers roads from primarily a movement function, with minimal access, to those with predominately access function to local developments carrying low volumes of traffic. The process of classification of roads allows the function of the road to remain generally compatible with surrounding land use and the intended use of the road primarily either for movement or access.

A summary of the function and characteristics of each road classification is provided below:

- Motorways – Fully access-controlled roads with grade separation at intersections along their route. They have divided carriageway with high speed serving inter-region trips used for movement of freight.
- Arterial Roads – High-capacity urban roads that can be divided or undivided carriageways with lower speed limits that connect across regions. They provide access to other roads via signalised or roundabout intersections. They can be used by most classes of freight and commercial vehicles.
- Sub-arterial Roads – Roads that provide connectivity between arterial roads typically carrying traffic between different parts within a region. Sub-arterial roads are generally expected to carry lower traffic volumes in line with their intended function of connecting arterial roads with collector roads.
- Collector Roads – Roads connect the higher-class arterial and sub-arterial roads to local roads and expected to provide connectivity within a locality, connecting local roads with sub-arterial roads.
- Local Roads – Provide direct access to local properties carrying local traffic only.

The functional hierarchy of the existing road network within the study area is presented in **Figure 4-1**.

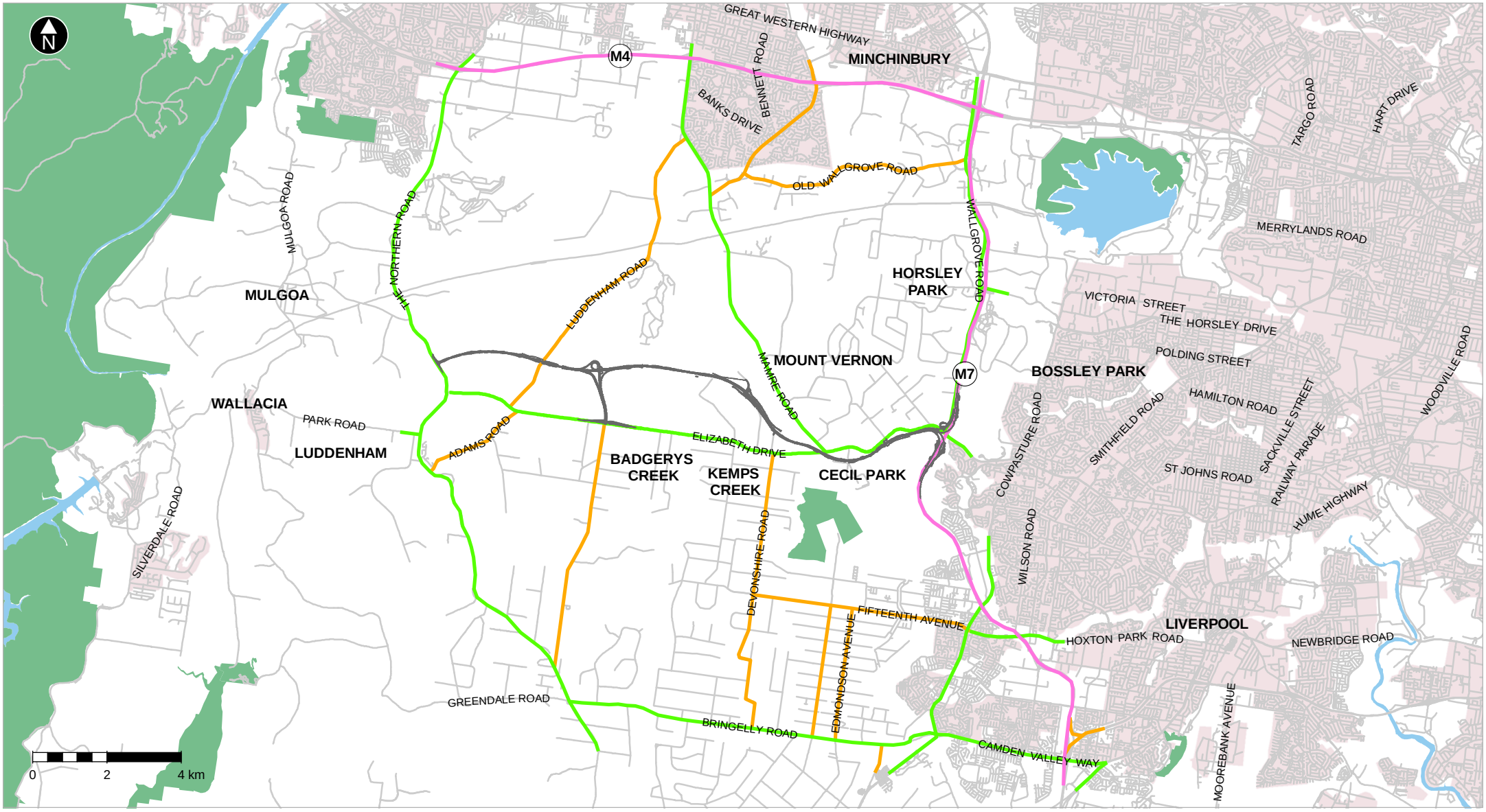


Figure 4-1 Road network hierarchy surrounding M12 Motorway

Date: 21/07/2019 Path: J:\IE\Projects\04_Eastern\IA145100\08 Spatial\GIS\Directory\Templates\MXDs\Figures\EIS\SpecialistReports\TrafficAndTransport\FinalEIS\JAJV_EIS_Traffic_F003_RoadNetwork_r4v1.mxd
Created by : AA | QA by : NS

4.2.1Regional road network

Within the wider study area, the regional road network comprises the strategic motorways and arterial roads. A summary of the key regional roads in the study area is provided below:

- **M7 Motorway** – is part of the Sydney orbital motorway network that runs between the M5 in Liverpool and the M2 in Quakers Hill. The M7 Motorway is a fully electronic toll road that uses a distance-based tolling system to charge passenger cars and freight vehicles for trips of different lengths. It provides two lanes of traffic on a divided carriageway; the original planning for the M7 Motorway allowed for future widening to include an additional bus lane. Within the study area, the M7 Motorway runs parallel to alignment of Wallgrove Road with interchanges at the Horsley Drive, Old Wallgrove Road and the M4 Motorway. The sign-posted speed limit along the M7 Motorway through the study area is 100 kilometres per hour, however during morning and evening peak periods, variable speed zones are used to limit travel speeds to 80 kilometres per hour.
- **M4 Motorway** – is situated north of the study area is the M4 Motorway which is a major six lane motorway that connects the Blue Mountains with Strathfield in Sydney's Inner West. It has a sign-posted speed limit of up to 110 kilometres per hour within the study area and has interchanges with the arterial road network at Mamre Road, Roper Road, Wallgrove Road and the M7 Motorway. There are no tolls in this section of the M4 Motorway for general or freight traffic.
- **Elizabeth Drive** – is an east-west arterial road that connects The Northern Road at its western end to the M7 Motorway at the eastern boundary of the study area. It is a two-lane undivided carriageway of approximately 10 metres width with unsealed shoulders and sign-posted speed limit of 80 kilometres per hour. Elizabeth Drive intersects The Northern Road at a roundabout at its western end. At its eastern end within the study area Elizabeth Drive intersects Wallgrove Road at a signalised intersection, and closely nearby it intersects with the M7 Motorway at a second signalised intersection for accessing the southbound on and off ramps.
- **The Northern Road** – is a north-south arterial road that extends between Narellan in the south-west to the M4 Motorway and Great Western Highway to the north. Currently through the majority of the wider study area, it is a two-lane undivided carriageway with one lane of traffic in each direction. Roads and Maritime has commenced widening of The Northern Road to a four-lane divided road due to the importance of The Northern Road as a key north-south connection to the Western Sydney Airport and to accommodate additional traffic generated by increased population and employment in western Sydney. The Northern Road has a posted speed limit of 80 kilometres per hour and this would be retained after the upgrade is complete.
- **Wallgrove Road** –is a State road that connects Elizabeth Drive with the Great Western Highway to the north. The road is generally designed to rural highway standards with one lane of traffic in each direction and a sign-posted speed limit of 80 kilometres per hour. Wallgrove Road also provides access to the M7 Motorway northbound carriageway from Elizabeth Drive at a priority intersection on Wallgrove Road 550 metres north of Elizabeth Drive.
- **Mamre Road** – connects Elizabeth Drive with the Great Western Highway. It is one lane in each direction with a posted speed limit of 80 kilometres per hour. The northern end of Mamre Road provides access to the M4 Motorway with an interchange that includes both east and west-facing ramps. Roads and Maritime has undertaken initial planning work for a future upgrade of Mamre Road between the M4 Motorway and Kerrs Road to a four-lane divided carriageway to support the economic and residential growth in the area. In the longer-term Mamre Road may be re-aligned and connected to Devonshire Road at Elizabeth Drive to provide a continuous north-south route between the Western Sydney Aerotropolis and the South West Growth Area.

4.2.2 Local road network

Within the core study area, the local road network comprises the sub-arterial, collector and local roads that have a direct interface with the project. A summary of the local road network within the study area is provided below.

- **Badgerys Creek Road** – runs between a priority intersection with Elizabeth Drive and a roundabout on The Northern Road. It is one lane in each direction and is built to rural design standard with a posted speed limit of 80 kilometres per hour. As Badgerys Creek Road is within the boundary of the Western Sydney Airport, Badgerys Creek Road may be gradually closed between Elizabeth Drive and Jagelman Road as the development of the Western Sydney Airport progresses.
- **Devonshire Road** – is a north-south road that runs from a priority intersection with Elizabeth Drive at Kemps Creek in the north, to intersection with Bringelly Road at King Street to the south which is currently un-signalised but will be upgraded to traffic signals as part of Bringelly Road widening by Roads and Maritime in 2019. It currently provides access to the rural farms along its route and has a sign-posted speed limit of 70 kilometres per hour.
- **Luddenham Road** – runs between a priority intersection with Elizabeth Drive, to its intersection with Mamre Road which is also priority controlled. It has a single lane of traffic in each direction and a posted speed limit of 80 kilometres per hour.
- **Adams Road** – is a collector road running between Elizabeth Road and The Northern Road. It provides a single lane of traffic in each direction with a posted speed limit of 70 kilometres per hour.
- **Erskine Park Road** – is situated north of the M12 Motorway footprint linking Mamre Road to Roper Road. Erskine Park Road and Roper Road provide access to the M4 Motorway via east facing ramps as well as access to residential and employment near the M4 Motorway. Erskine Park Road has a sign-posted speed limit of 70 kilometres per hour.

4.2.3 Existing parking

The roads within the core study area are either motorways, arterial or rural roads and while at many locations there is sufficient space, do not have or permit on-street parking along their length these roads is either discouraged or prohibited. Due to the largely rural nature of the surrounding land, there is minimal to or no demand for on-street parking, as the surrounding properties have ample space for off-street parking and are not intensively developed

4.3 Existing traffic volumes and patterns

The roads discussed in this section relate to roads that would be impacted during the construction and operation of the project, including proposed construction access routes. Existing traffic volumes on key roads in the study area provide an understanding of how many vehicles use these roads over the course of an average weekday and during the average morning and afternoon peak hours. The proportion of heavy vehicles that make up this traffic volume provides an understanding of the importance of these roads as heavy vehicle corridors. This is of particular importance for single lane roads such as Elizabeth Drive, as cars are unable to overtake slower heavy vehicles, which can reduce travel speeds.

Surveyed traffic volumes, based on automatic traffic counts undertaken in July 2015 at key locations within the core study area, including the proportions of heavy-vehicles at these locations, are provided in **Table 4-1**. A plot of these count locations is provided in **Figure 3-2**.

Table 4-1 Existing traffic volumes on key roads through the study area (2015)

Road	Location	Direction	AWT Flow		Morning peak (7.30am to 8.30am)		Evening peak (5.30pm to 6.30pm)	
			Vehicles/ day	% Trucks	Vehicles/ hour	% Trucks	Vehicles/ hour	% Trucks
The Northern Road	North of Bradley Street	Northbound	11,542	16%	1,215	11%	924	14%
		Southbound	11,634	13%	672	13%	1,069	8%
	North of Kings Hill Road	Northbound	9,055	13%	862	9%	840	10%
		Southbound	9,486	12%	638	10%	816	8%
	North of Elizabeth Drive	Northbound	8,092	12%	694	9%	844	6%
		Southbound	8,063	14%	606	12%	649	8%
	South of Elizabeth Drive	Northbound	8,383	12%	797	8%	673	8%
		Southbound	8,260	15%	483	15%	834	9%
	North of Adams Road	Northbound	6,977	14%	577	12%	662	10%
		Southbound	6,778	14%	403	13%	575	8%
	North of Dwyer Road	Northbound	6,805	11%	561	10%	632	8%
		Southbound	6,951	19%	410	17%	607	12%
Elizabeth Drive	West of Luddenham	Eastbound	4,633	14%	470	11%	238	7%
		Westbound	4,611	15%	251	16%	570	7%
	East of Western Road	Eastbound	6,268	20%	697	16%	329	9%
		Westbound	6,457	24%	345	25%	783	14%
Adams Road	East of The Northern Road	Northbound	3,312	0%	346	0%	152	0%
		Southbound	3,171	0%	158	0%	389	0%

Note: data sourced from automatic traffic counts undertaken in July 2015
It is noted that the traffic volumes associated with the construction of the Western Sydney Airport is not included in the above as construction began in 2018. The peak construction period according to the WSA EIS is 2021 which is prior to the M12 Motorway commencing construction. In addition, the traffic volume data provided in 15.4.1 of the Western Sydney Airport EIS is not presented in a format that can be incorporated into the M12 Motorway traffic model. To incorporate the data into the model it would need to be broken down into vehicles per volume type per road.

Analysis of the existing traffic volumes on key roads through the core study indicates that current traffic flows on both The Northern Road and Elizabeth Drive are low compared to other urban arterials which generally carry more than 10,000 vehicles per day and 1,000 vehicles per hour in the peak hour, such as Great Western Highway at St Marys (20,000 vehicles per day in each direction) or Hume Highway at Casula (35,000 vehicles per day in each direction) The proportion of heavy vehicles on these roads is relatively high, between 15 per cent and 24 per cent over the day, indicating that these roads are significant heavy vehicles routes.

4.4 Existing modes of travel

An analysis of the Journey to Work data based on the 2011 Census data[3] (Australian Bureau of Statistics) shows that car (driver and passenger) is the dominant mode of travel for people living and working within the study area. Employment trips provide a good indication of the total mode share of the area and are particularly relevant given that the proposed land uses surrounding the Western Sydney Airport would be primarily employment-related.

The Journey to Work travel zones used for this analysis are shown in **Figure 4-2**.

In 2011, there were 3,479 jobs and 15,323 residents within the travel zones identified within the study area over an area of about 14,300 hectares. This represents an average population density of 1,050 persons per square kilometre, which is lower than the urban Sydney average of 2,040 persons per square kilometre. The data in **Table 4-2** indicates that only 14 per cent of trips to work into the study area were made by public transport, which is significantly lower than in urban areas with better access to public transport. This proportion of trips by public transport is lower for residents living in the study area who work outside of the study area with six per cent of these trips using public transport and reflects a general lack of public transport options within the core study area. Car usage remains the dominant mode of travel, with 78 per cent of trips from the study area made by car, either as a driver or passenger of a car.

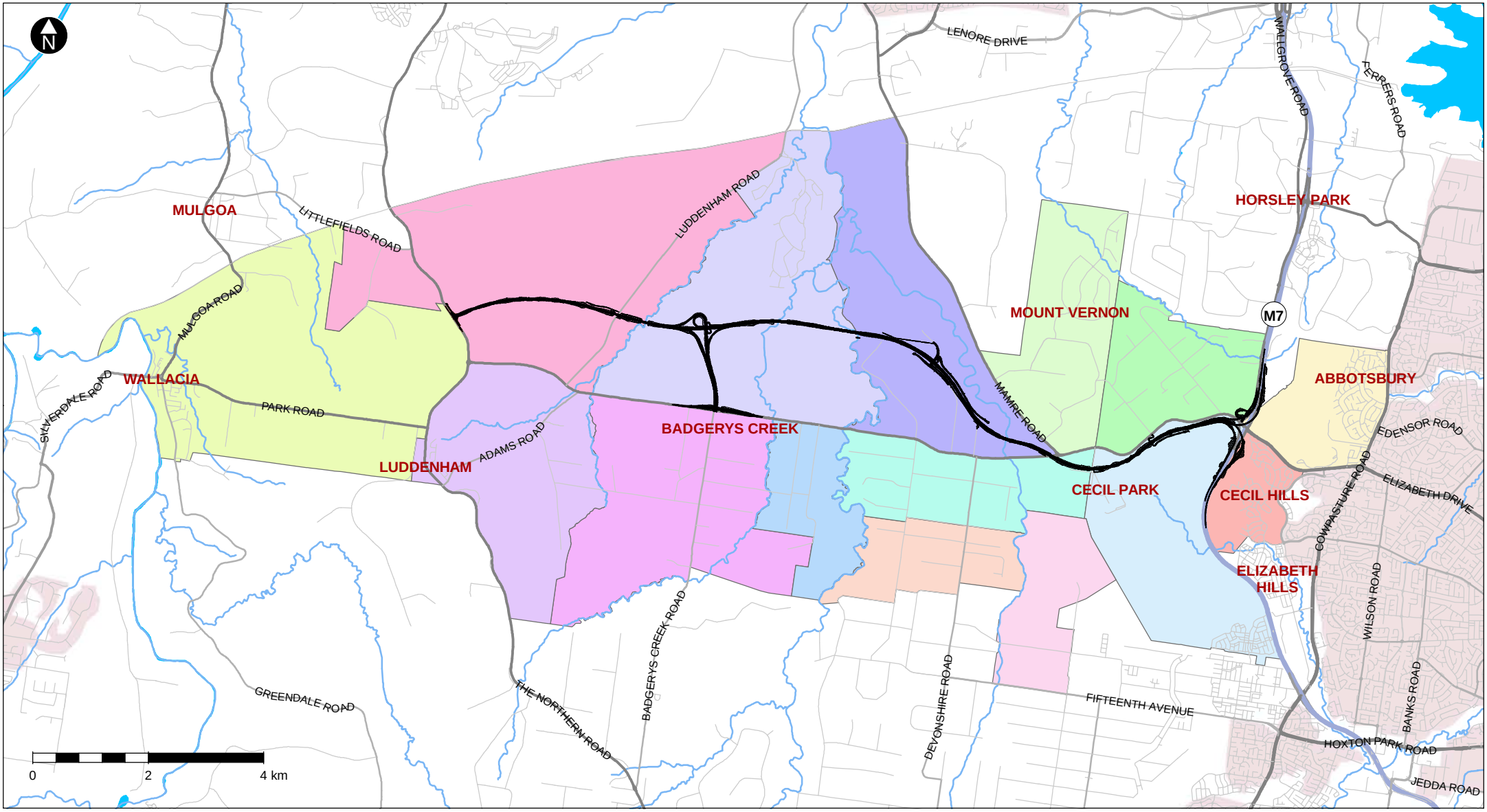
Figure 4-3 and **Figure 4-4** show the mode share data for the study area by origin and destination respectively.

Table 4-2 Journey to Work mode share

Mode	Destination (trips to the study area)	Origin (trips from the study area)
Car driver	35%	72%
Car passenger	3%	6%
Mode not stated	24%	2%
Train	5%	5%
Bus	9%	1%
Walk	3%	1%
Worked at home or did not go to work	10%	12%
Other	11%	1%

Source: TfNSW Journey to Work 2011

[3] 2011 is the latest census year for which Journey To Work data is available from Transport for NSW Bureau of Transport Statistics



The project

Built areas

Travel zones (2011)

- Abbotsbury Shopping Centre
- Badgerys Creek
- Badgerys Creek_Martin Rd and Cuthel St
- Cecil Hills Shopping Centre
- Cecil Park
- Kemps Creek
- Kemps Creek Nature Reserve
- Kemps Creek Shopping Centre
- Kemps Creek_Western Rd and Tavistock Rd
- Luddenham Hall
- Luddenham_Model Park SSME
- Mount Vernon
- Sydney International Shooting Centre
- Twin Creeks Golf Course
- Wallacia

Figure 4-2 Journey to work travel zones

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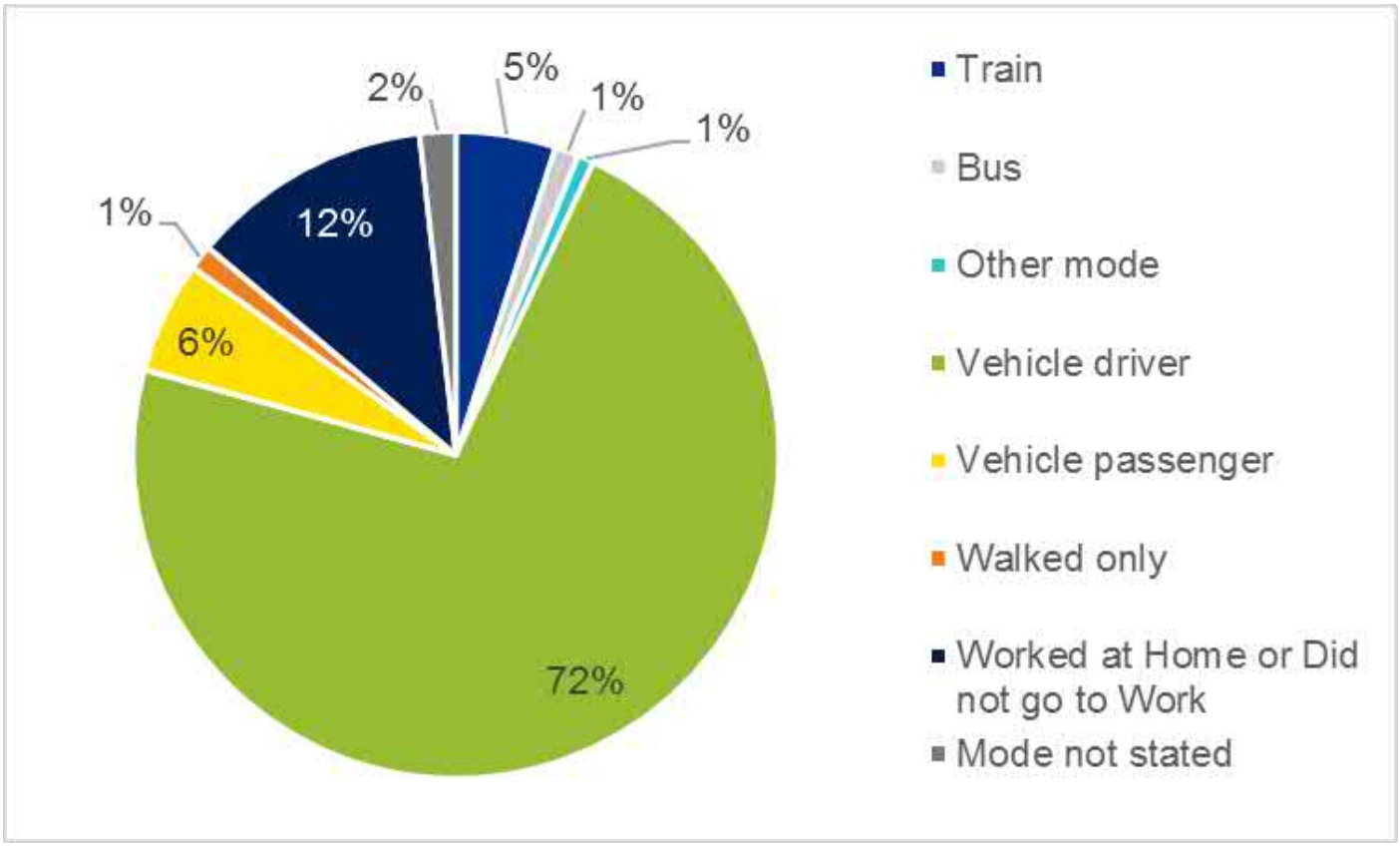

Figure 4-3 Mode share for trips originating in study area (TfNSW 2011 Journey to Work)

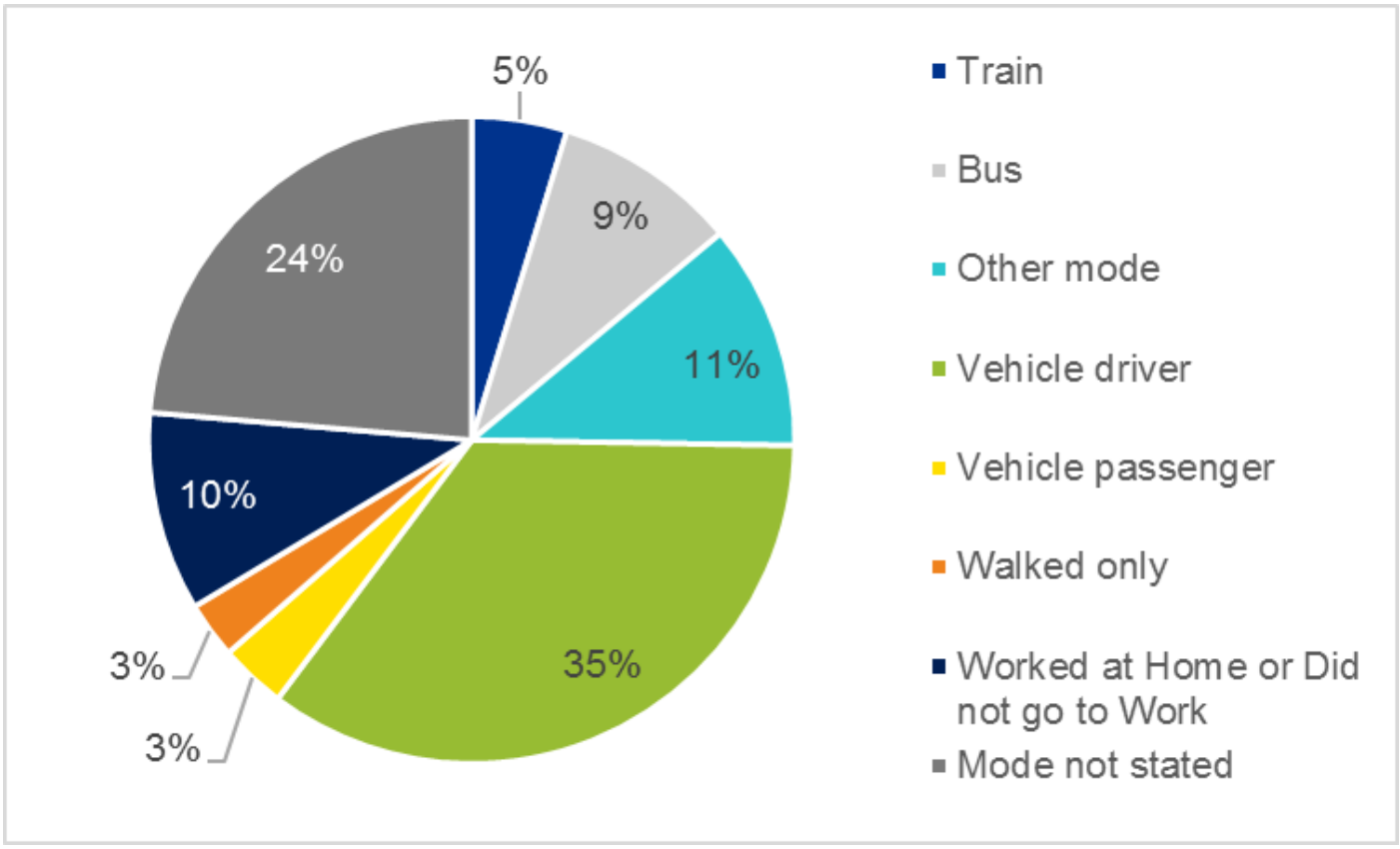

Figure 4-4 Mode share for trips originating outside the study area (TfNSW 2011 Journey to Work)

4.5 Existing public transport network

Public transport in the core study area is currently served by bus services only with very limited coverage and frequency. TransitSystems operates the following routes via Elizabeth Drive:

- Route 813 (Liverpool town centre to Badgerys Creek Road) runs to the east of Mamre Road on Elizabeth Drive. This is a local bus service that operates on weekdays only with 4 services a day in each direction between 9.30 am and 6.20 pm
- Route 801 (Bonnyrigg to Fairfield) travels up to Badgerys Creek Road. There are no bus services or bus facilities west of Badgerys's Creek Road on Elizabeth Drive. This is local bus route that operates on weekdays only with two services in the peak direction in the morning and evening peak

Busways operates the following routes via The Northern Road

- The Northern Road – Route 789 operates along The Northern Road between Penrith and Luddenham. This is a peak hour only service and operates twice a day on weekdays with no services provided on weekends

These routes are shown in **Figure 4-5**. Bus services within the core study area are very poor, with very few services provided at very low frequencies, that operate long and circuitous routes primarily to provide local coverage. This reflects the low population density across the core study area, which generates very little demand for public transport trips.

4.6 Existing active transport network

There is currently limited pedestrian and cycling infrastructure provided in the area, reflecting the predominately greenfield character and low population densities that do not support construction of off-road active transport facilities. The majority of the existing cycleways in the study area are situated within the Western Sydney Parklands for recreational cycling use.

As part of The Northern Road upgrade, Roads and Maritime will provide a shared user path between Narellan and the M4 Motorway expected to be completed by 2019.

An off-road separated shared user path runs adjacent to the M7 Motorway with entry and exit ramp facilities provided at Elizabeth Drive. It connects the M7 Motorway shared user path to the regional path that runs along Elizabeth Drive to the Liverpool town centre as well as providing a pedestrian and cycle bridge over the M7 Motorway south of Elizabeth Drive that connects to the Western Sydney Parklands.

West of the M7 Motorway, a bridge over the M7 Motorway connects the M7 Motorway shared user path to a shared user path into the Western Sydney Parklands. This path connects to an access driveway that allows for access to an existing water tower, ASA radar installation and mobile phone tower from Elizabeth Drive via Gate G to the Western Sydney Parklands.

To the south of Elizabeth Drive, the Wylde mountain bike trail that runs through the Western Sydney Parklands. This is a recreational cyclist facility that does not connect to other cycleways to attract commuter cyclists.

There are no existing footpaths or off-road cycle facilities along Elizabeth Drive to allow safe cycling or to connect the existing M7 Motorway shared user path with the shared user path being constructed along The Northern Road as part of The Northern Road upgrade. **Figure 4-6** shows the existing Sydney cycleways in the study area.

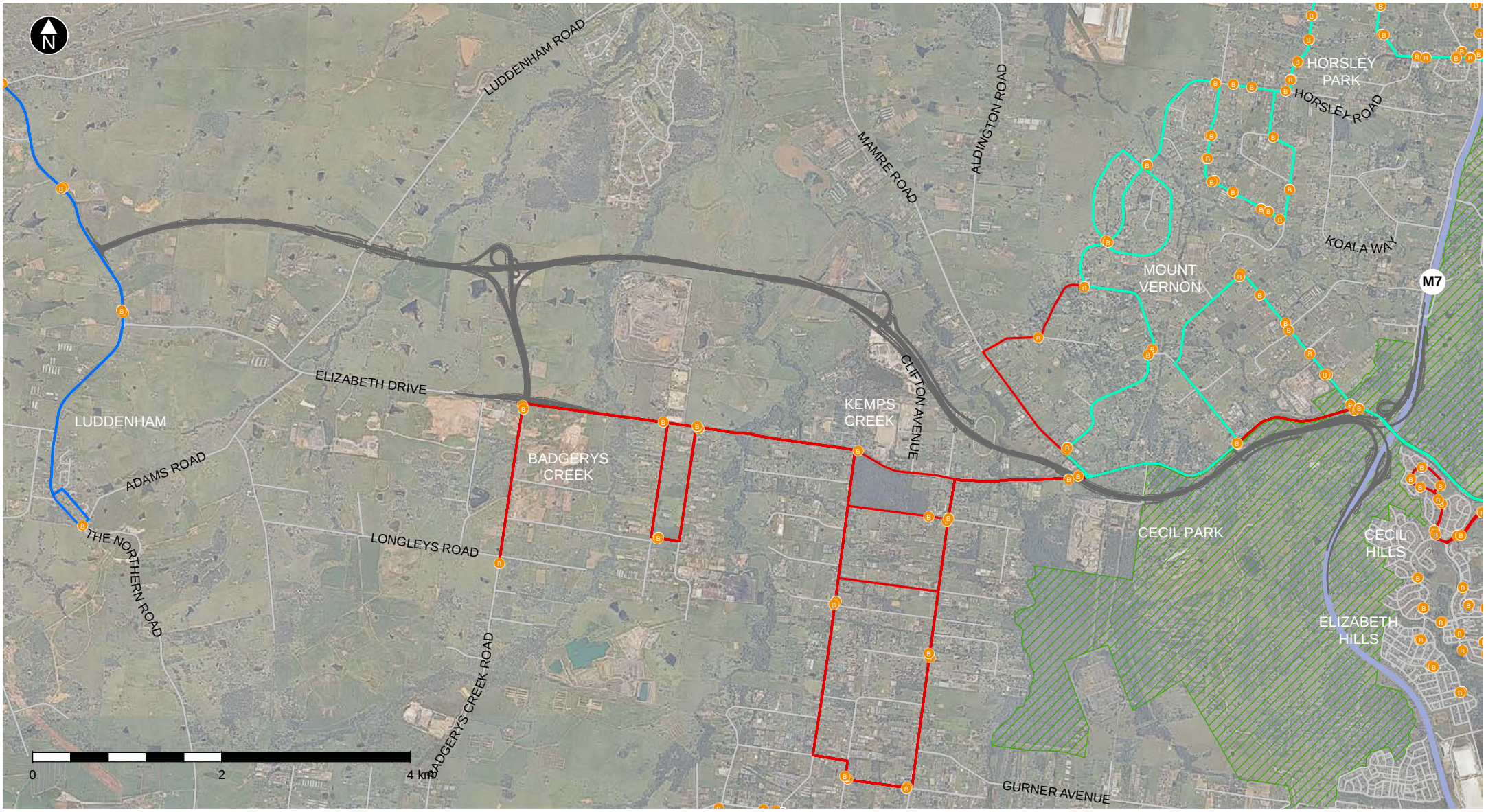

Figure 4-5 Bus routes through the study area

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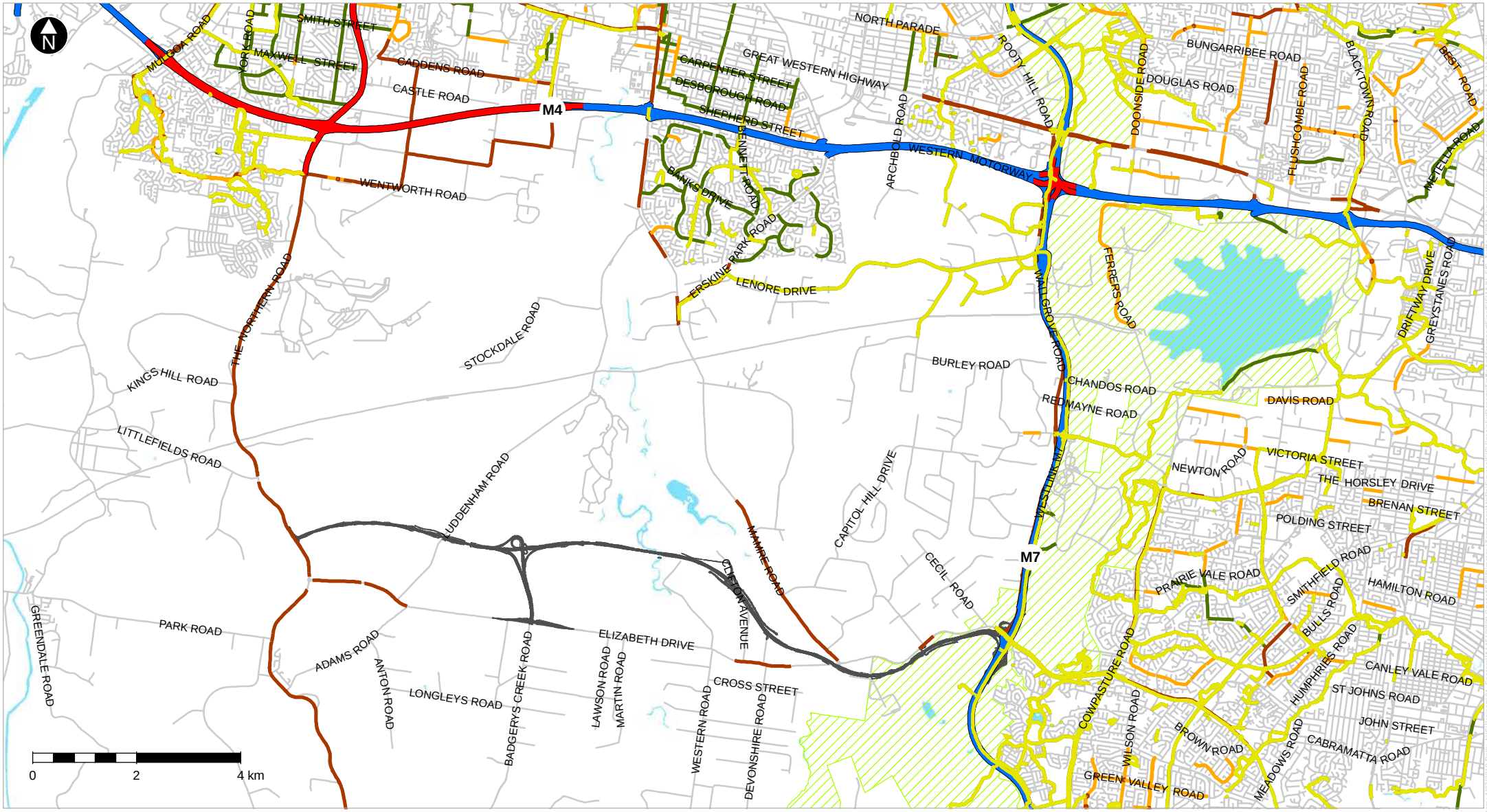

The project
Urban areas

On-road environment
Low difficulty
Medium difficulty
High difficulty

Off-road environment
All paths

No access
No cycling allowed

Freeways/Motorways
High speed roads

Western Sydney Parklands

Figure 4-6 Existing bicycle network through the study area

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Pedestrian and cycle surveys of the M7 Motorway shared user path were undertaken in February 2019 at the locations identified in **Figure 3-4**. These counts were undertaken over 9 days during fair weather and recorded daily and hourly pedestrian and cycle movements along the M7 Motorway shared user path and the shared user bridge across M7 Motorway south of Elizabeth Drive. Daily volumes for pedestrians and cyclists at both sites are provided in **Figure 4-7** and **Figure 4-8**.

Analysis of the pedestrian and cyclist surveys shows the following:

- The overwhelming majority of traffic along the M7 Motorway shared user path is cyclists. Pedestrians represent less than 10 per cent of the travel along this facility
- Weekend volumes are five times higher than weekday volumes, indicating that the majority of cyclists using this facility are recreational rather than commuters
- Of the cyclists that travel along the M7 Motorway shared user path, about 25 per cent use the M7 Motorway shared user bridge to access Western Sydney Parklands on weekends. This drops to about 10 per cent during weekdays.

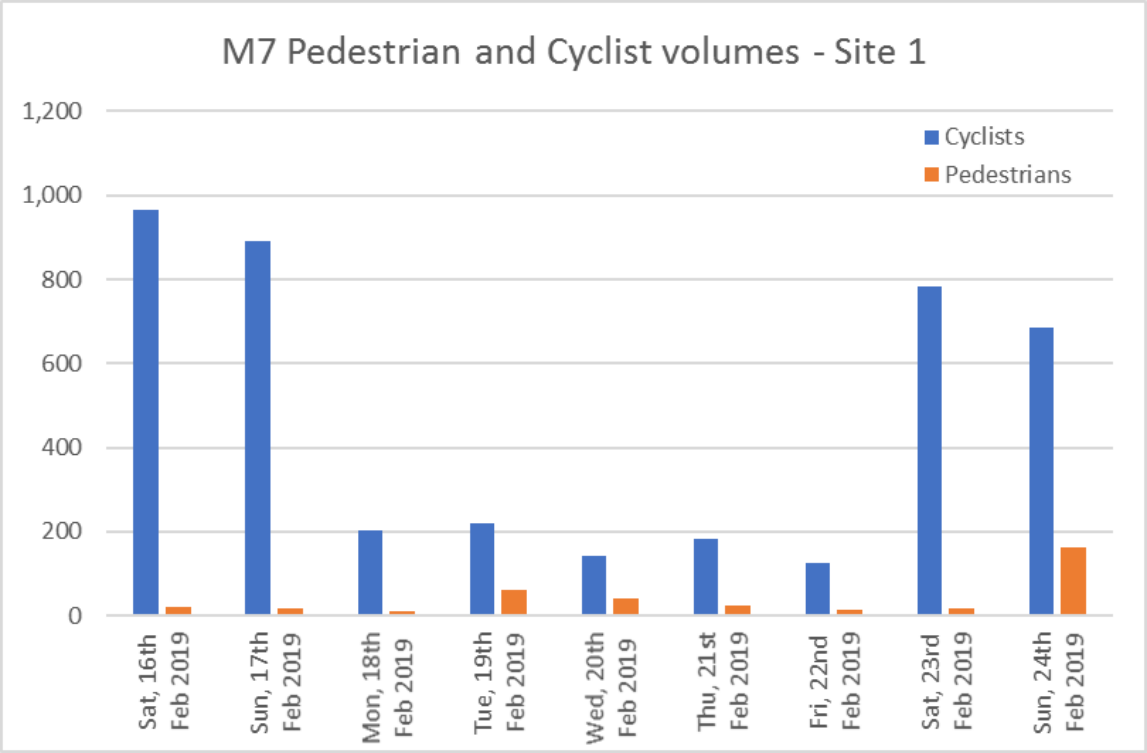

Figure 4-7 Daily pedestrian and cycle volumes at the M7 Motorway shared user bridge

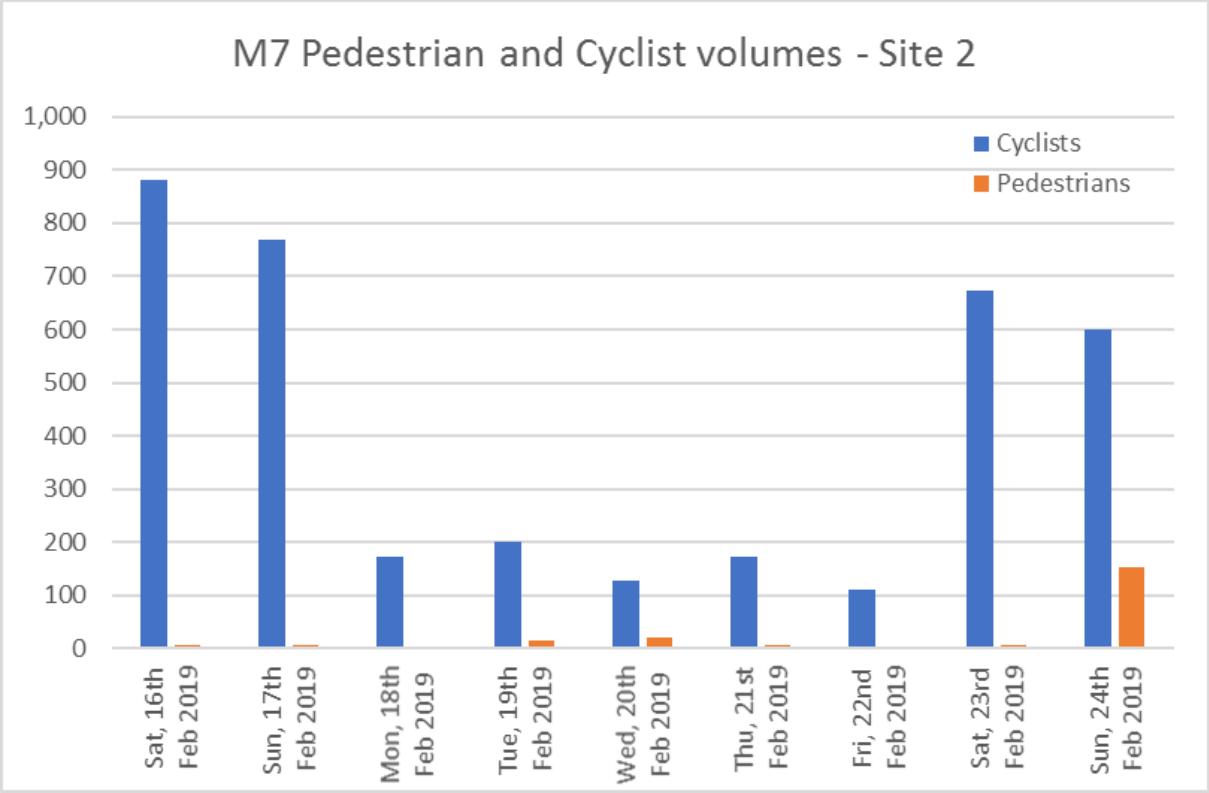

Figure 4-8 Daily pedestrian and cycle volumes at the M7 Motorway shared user path south of Elizabeth Drive

4.7 Existing Freight network

Within the wider study area, the key freight routes that provide transport to key industrial and employment areas in western Sydney are the M7 Motorway and M4 Motorway. These strategically important freight routes are designated national freight routes and allow freight vehicles to travel uninterrupted at high speed between western Sydney, Greater Sydney (including Port Botany) and other regional centres in NSW including Port Kembla. These roads are critical parts of the NSW freight network carry freight trips across the day.

In the core study area, Elizabeth Drive, The Northern Road, Mamre Road, Badgerys Creek Road, Bringelly Road, Devonshire Road and Erskine Park Road are all approved routes for 26 metre B-doubles, which make up a substantial proportion of heavy and long-distance freight travel and are also suitable for use by construction haulage vehicles. **Figure 4-9** shows the approved B-Double routes through the project area. These routes are used to provide access for heavy vehicles to various agricultural and industrial land uses in the core study area including quarries, brickmaking, grazing, poultry farming and waste-processing.

Observed traffic volumes on Elizabeth Drive show heavy vehicle flows to be generally higher east of Mamre Road due to the presence of a number of industrial and commercial businesses that are located along Elizabeth Drive near Mamre Road.

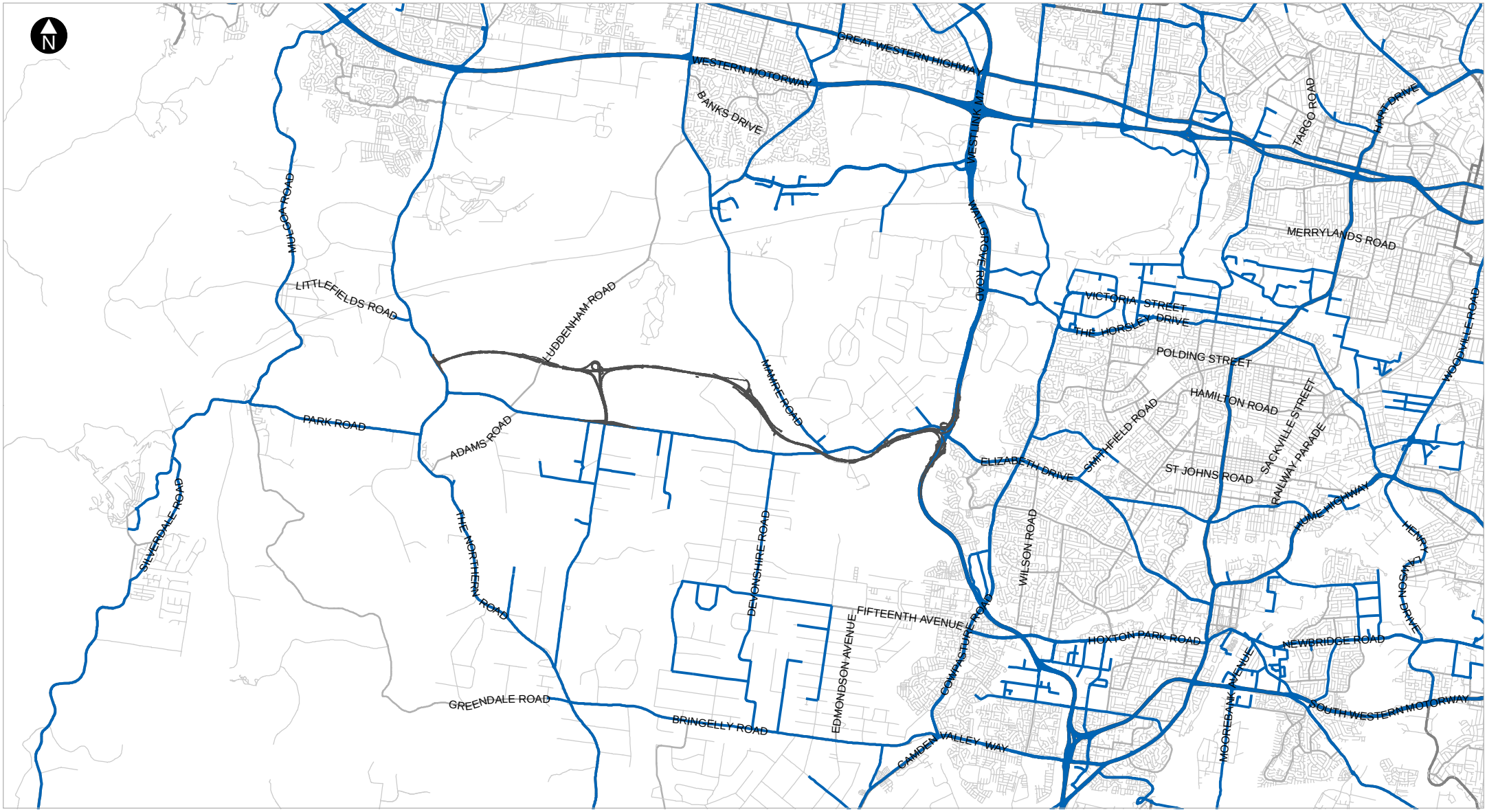

Figure 4-9 Existing designated B-Double routes through the study area

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5. Existing road network performance

5.1 Introduction

This section provides a summary of the performance of key roads within the study area. The assessment of existing operational performance has been focussed on the following performance indicators:

- Individual travel times and travel speeds on key roads
- Intersection delay and Level of Service at key intersections
- Road safety performance and crash history.

5.2 Regional road network conditions

A summary of the existing traffic conditions at key road corridors within the wider study area is provided below:

- **M7 Motorway** – Typically experiences high traffic volumes in the northbound direction between the M5 Motorway and Elizabeth Drive in the morning peak period. In the southbound direction it experiences congestion between the M4 Motorway and the Horsley Drive and at the interchange between M4 Motorway and M7 Motorway in the evening peak. High levels of congestion occur at Bernera Road, Cowpasture Road and Old Wallgrove Road interchanges. This congestion is caused by the high volumes of heavy vehicles that use the M7 Motorway and are affected by uphill grades between the M5 Motorway and Elizabeth Drive.
- **The Northern Road** – Generally, does not experience congestion in the peak periods. The only exception is section of the road between Glenmore Parkway/Wentworth Road and Bradley Street, and near Bringelly Road which experience moderate congestion.
- **Elizabeth Drive** – Elizabeth Drive typically experiences moderate delays around key constraint points at the Elizabeth Drive/Devonshire Road and Elizabeth Drive/Duff Road intersections primarily due to traffic volumes arriving and departing from schools. Congestion during peak periods also occur at its intersection with Wallgrove Road and the M7 Motorway interchange where traffic from Elizabeth Drive enters the M7 Motorway southbound ramp.
- **M4 Motorway** – Congestion along the M4 Motorway is frequently observed eastbound in the morning and westbound in the evening. The primary eastbound constraint is the interchange with the M7 Motorway, where eastbound traffic on the M4 Motorway merges with traffic from both directions on the M7 Motorway. These merges also generate delays on the M7 Motorway, with entry ramp queues frequently extending on to the M7 Motorway northbound in the morning peak and southbound in the evening peak.
- **Bringelly Road** – Bringelly Road typically experiences low congestion in the peak hours, with the exception of its intersections with The Northern Road and Cowpasture Road/Camden Valley Way. Ongoing construction works associated with the upgrade of Bringelly Road has increased delays along Bringelly Road east of King Street.
- **Luddenham Road** – During peak hours, Luddenham Road experiences little to no delay, with the only source of congestion along Luddenham Road being on approach to Twin Creeks Drive where traffic travelling along Luddenham Road is required to give way to traffic turning right into and out of Twin Creeks Drive at this roundabout.
- **Mamre Road** – Moderate congestion occurs on Mamre Road between the M4 Motorway and Bakers Lane. This is due to residents and employees accessing the nearby residential and commercial developments. South of Bakers Lane, there is little to no delay experienced during peak hours.

The travel conditions throughout the study area, particularly on arterial and collector roads indicate that these roads are generally performing adequately.

5.3 Existing travel times and travel speeds

Travel times and travel speeds provide a means of assessing the functional performance of the road network in a way that is consistent with the experience of road users through their day-to -day travel. Of the 2017 surveyed travel times routes identified in **Section 3.3**, the M7 Motorway, Elizabeth Drive and The Northern Road are located within the core study area of the project and hence directly relevant to the project. A summary of 2017 travel times and travel speeds along these routes is provided in **Table 5-1** and **Table 5-2**, along with their level of service based on the performance standards outlined in **Section 3.7.2**.

Analysis of observed average speeds (based on travel time surveys and modelled travel times calibrated to these surveys) along The Northern Road between Glenmore Parkway and Dwyer Road shows that there is a good level of service in both morning and afternoon peak hours. Elizabeth Drive also shows a good level of service with observed travel speeds very close to sign posted speed limits during the weekday morning and afternoon peak periods. This is expected as the area is predominately rural with low population and employment density.

Average travel times along the M7 Motorway during peak periods also show the corridor currently performs at an adequate level of service along its length through the wider study area, however localised delays are observed between Elizabeth Drive and Cowpasture Road, where steep grades cause reductions in travel speed for heavy vehicles. During peak periods in these sections, variable speed zones are used to limit travel speeds to 80 kilometres per hour and reduce the safety risks of trucks travelling at much lower speeds than surrounding traffic.

Table 5-1 2017 travel times and travel speeds on key roads in the core study area (morning peak)

Segment	Direction	Travel Time (mm:ss)	Average Travel Speed (km/hr)	LoS
M7 Motorway between Camden Valley Way and Elizabeth Drive	Northbound	11:46	54	C
	Southbound	07:27	84	B
M7 Motorway between Elizabeth Drive and M4 Motorway	Northbound	07:45	77	B
	Southbound	07:05	85	B
Elizabeth Drive between M7 Motorway and The Northern Road	Eastbound	12:59	64	C
	Westbound	13:49	60	C
The Northern Road between Bringelly Road and Elizabeth Drive	Northbound	09:54	61	C
	Southbound	03:31	56	C
The Northern Road between Elizabeth Drive and M4 Motorway	Northbound	09:34	60	C
	Southbound	15:08	65	C

Table 5-2 2017 travel times and travel speeds on key roads in the study area (evening peak)

Segment	Direction	Travel Time (mm:ss)	Average Travel Speed (km/hr)	LoS
M7 Motorway between Camden Valley Way and Elizabeth Drive	Northbound	07:25	86	A
	Southbound	07:26	85	B
M7 Motorway between Elizabeth Drive and M4 Motorway	Northbound	06:51	87	A
	Southbound	09:06	66	C
Elizabeth Drive between M7 Motorway and The Northern Road	Eastbound	13:12	63	B
	Westbound	13:18	63	B
The Northern Road between Bringelly Road and Elizabeth Drive	Northbound	09:42	62	B
	Southbound	03:34	55	B
The Northern Road between Elizabeth Drive and M4 Motorway	Northbound	09:55	58	B
	Southbound	15:22	64	B

5.4 Existing intersection performance

Intersection Level of Service, based on modelled average delay from the WSAGA Traffic Model, has been extracted for the morning and afternoon peak periods for the following intersections that would be potentially affected by the project within the core study area:

- Elizabeth Drive and Northern Road
- Elizabeth Drive and Luddenham Road
- Elizabeth Drive and Martin Road
- Elizabeth Drive and Western Road
- Elizabeth Drive and Devonshire Road
- Elizabeth Drive and Mamre Road
- Elizabeth Drive and Duff Road
- Elizabeth Drive and Wallgrove Road
- Elizabeth Drive and M7 Motorway
- Wallgrove Road and M7 Motorway.

Modelled intersection Level of Service for the existing situation indicates that the majority of intersections along Elizabeth Drive in the vicinity of the project are operating at a satisfactory Level of Service (D or better).

The western intersection in this interchange at Wallgrove Road is currently close to capacity and is operating and Level of Service D in the evening peak. Delays at this location are caused by the conflict between vehicles travelling east-west on Elizabeth Drive and those turning right onto the M7 Motorway northbound and southbound. The interchange also has existing traffic constraints on Elizabeth Drive that include:

- Double-point interchange configuration that limits the capacity of the interchange for right-turn demand from the M7 Motorway
- Steep gradients on the approach to Elizabeth Drive/Wallgrove Road from the M7 Motorway exit ramps, which affects heavy vehicle speeds resulting in queues that extend from the exit ramps into the M7 Motorway through-lanes with increased heavy vehicle volumes.

Table 5-3 Modelling intersection performance within the study area – 2017 morning and evening peak hour

Key intersection	2017 Morning peak		2017 Evening peak	
	Average Delay (sec)	LoS	Average Delay (sec)	LoS
Elizabeth Drive/Northern Road	12	A	11	A
Elizabeth Drive/Luddenham Road	13	A	18	B
Elizabeth Drive/Martin Road	9	A	12	A
Elizabeth Drive/Western Road	14	A	9	A
Elizabeth Drive/Devonshire Road	13	A	12	A
Elizabeth Drive/Mamre Road	14	A	14	A
Elizabeth Drive/Duff Road	12	A	9	A
Elizabeth Drive/Wallgrove Road	31	C	48	D
Elizabeth Drive/M7 Motorway	20	B	17	B
Wallgrove Road/M7 Motorway	2	A	10	A

5.5 Existing road safety performance

An analysis of crash history data has been carried out for key roads in the core study area using data collected by Roads and Maritime between July 2012 and June 2017. Crash statistics recorded by Roads and Maritime are confined to those crashes that conform to the national guidelines for reporting and classifying road vehicle crashes. The main criteria are:

- The crash was reported to the police
- The crash occurred on a road open to the public
- The crash involved at least one moving vehicle
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Minor crashes where drivers exchange details are not required to be recorded and are not included in the crash data used for this assessment.

A summary of casualty crashes for a five-year period between July 2012 and June 2017 on key roads within the core study area is presented in **Table 5-4**. Key road safety issues roads in the study area are:

- Relatively high crash rates are observed on Elizabeth Drive (56 crashes per 100 million Vehicle Kilometres Travelled (VKT)), and The Northern Road (35 crashes per 100 million VKT)
- Casualty crash rates on Elizabeth Drive, the M7 Motorway and The Northern Road are below the Sydney metropolitan average for their respective similar type of road.

A summary of all crash data provided by Roads and Maritime for the five-year period between July 2012 and June 2017 on roads within the study area is presented in **Table 5-5**.

Key crash statistics for key roads in the study area are:

- Sixty per cent of crashes where at least one injury occurred or a tow-away was required (137 crashes)
- Four crashes resulted in a fatality within the analysed time period; two on Elizabeth Drive and two on The Northern Road
- Fifty-two per cent of crashes (124 crashes) involved a heavy vehicle, with the majority occurring on Elizabeth Drive
- One per cent of crashes (two crashes) involved a cyclist or pedestrian
- The three most common crash types involved a rear end collision (22 per cent), vehicles turning left off the carriageway into an object or a parked vehicle (12 per cent), a head on collision (eight per cent) and a rear end collision from a right turn (eight per cent)
- Sixty-one per cent of crashes occurred at a midblock, while 39 per cent of crashes occurred at an intersection.

Table 5-4 Summary of crash rates

Road segment	Length (km)	AADT	Crashes per 100M VKT	Casualty crashes per kilometres per year	Casualty crashes (Sydney Metropolitan average)
Elizabeth Drive (M7 Motorway - The Northern Road)	14	8,706	56	1.4	3.0*
M7 Motorway (The Horsley Drive- Cowpasture Road)	2	89,610	11	1.5	2.6**
The Northern Road (Glenmore Parkway-Adams Road)	3	15,513	30	1.13	3.0*

*Sydney metropolitan average for arterial roads

**Sydney metropolitan average for motorways

Table 5-5 Summary of crash history

Road segment	Number of crashes by severity				Top 3 crash types	Number of crashes involving pedestrians and cyclists	Number of crashes involving heavy vehicles	percentage of intersection and midblock crashes
	Fatality	Injury	Non-casualty	Total				
Elizabeth Drive (M7 Motorway - The Northern Road)	2	94	54	150	Rear end collision (18%) Left off carriageway into object/parked vehicle (12%) Right rear collision (13%)	None	84	96% intersection, 4% midblock
M7 Motorway (The Horsley Drive-Cowpasture Road)	0	15	21	36	Rear end collision (21%) Right off carriageway into object/parked vehicle (17%) Lane change left (8%)	None	19	0% intersection, 100% midblock
The Northern Road (Glenmore Parkway-Adams Road)	2	28	14	44	Head on collision (20%) Left off carriageway into object/parked vehicle (12%) Off carriageway left on right bend into object/parked vehicle (12%)	None	11	88% intersection, 12% midblock
Total	4	137	89	230	Rear end collision (39%) Left off carriageway into object/parked vehicle (12%) Head on collision (8%) Right rear collision (8%)	2 cyclist crashes	124	39% intersection, 61% midblock

6. Assessment of potential impacts

6.1 Construction impacts

This chapter provides an assessment of the potential transport and traffic impacts of construction of the project and addresses the following issues:

- Summary of construction activities
- Location of construction ancillary facilities and work sites
- Impacts of changed conditions and additional traffic the road network performance, public transport, pedestrians and cyclists as a result of construction activities
- Cumulative impacts of construction that may result from interaction with other construction activities in the core study area, including concurrent construction of Western Sydney Airport and Sydney Metro Greater West.

6.1.1 Construction overview

Construction activities

Construction of the project would be primarily on undeveloped rural grazing land, and would consist primarily of the following activities:

- Establishment of ancillary facilities and early works: clearing land and establishing accesses to ancillary facilities
- Property access: adjustments to access and within properties that would be affected by construction
- Utilities relocation: relocation of utilities including water, sewerage, gas, telecommunications and power
- Fencing: erection of fences to secure work sites
- Demolition/clearing: removal of vegetation and man-made structures in the work sites
- Bulk earthworks: construction of cuts and fill embankments and the associated movement of material between different areas along the alignment
- Bridge works: construction of bridge piers and placement of deck elements
- Drainage: construction of drainage pipes and detention basins
- Pavements: laying of pavement surfaces over earth and bridge structures
- Barriers: casting and placement of kerbs, medians and safety barriers
- Landscaping: finishing of earth structures and planting of vegetation
- ITS: installation of Intelligent Transport Systems (ITS) including variable messaging systems, emergency communications and in-road sensors
- Lighting: installation and electrification of lighting
- Signage: installation of signage
- Decommission ancillary sites: removal of construction materials, equipment and temporary structures and rehabilitation of construction compounds and work sites.

A detailed description of the proposed construction methods and schedule is provided in EIS Chapter 5. Based on these activities, it is likely that the peak period of construction would occur during the bulk earthworks and pavement activities, as these periods would generate the most construction traffic for deliveries of spoil to build reinforced earth structures and pavement materials.

As many of the reinforced earth and bridge structures as well as paving could be built independently along the length of the project, the intensity of construction would be dictated by the number of worksites being constructed at any one time by the construction contractor.

Generally speaking, the more worksites that can be constructed at the same time, the faster the project would be built, but the more construction traffic would be generated by spoil and paving materials haulage. The use of internal haul roads to transport materials as the project is being completed, would minimise the volumes of traffic that would use public roads.

Construction stages and program

Key stages and an indicative program for the construction of the M12 Motorway, based on the construction activities detailed above is shown in **Table 6-1**.

Table 6-1 Construction stages and indicative timing

Construction activity	Indicative construction program				
	2022	2023	2024	2025	2026
Mobilisation/ancillary facilities/early works					
Property access					
Utilities relocation					
Fencing					
Demolition/clearing					
Bulk earthworks					
Bridge works					
Drainage					
Pavements					
Barriers					
Landscaping					
ITS					
Lighting					
Signage					
Decommission ancillary sites					

Construction would commence in 2022 with completion by the middle of 2026. Peak construction activity would occur in 2024. The majority of the alignment of the M12 Motorway is located in greenfield areas. As a result, the project would seek approval to undertake construction activities during extended hours of the day and on weekends.

Closer to residential land uses and other noise-sensitive sites, it is expected that the majority of the work would take place in accordance with the recommended standard hours for construction work, which are:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturday
- No works on Sunday or public holidays.

The project may also apply for extension to these working hours if they would be required at certain times to minimise impacts on road traffic and for safety reasons. Any extended working hours would be subject to approval by the NSW Environmental Protection Agency (EPA). Previous projects undertaken by Roads and Maritime have extended working hours on weekdays (from 6am to 7pm), Saturdays (from 8am to 6pm) and allowed for working on Sundays (from 8am to 5pm).

Construction footprint

The total area required to facilitate the construction of the project is referred to as the construction footprint. The construction footprint consists of construction ancillary facilities (generally those sites that would include a compound and site offices etc.) and construction sites where the work is taking place.

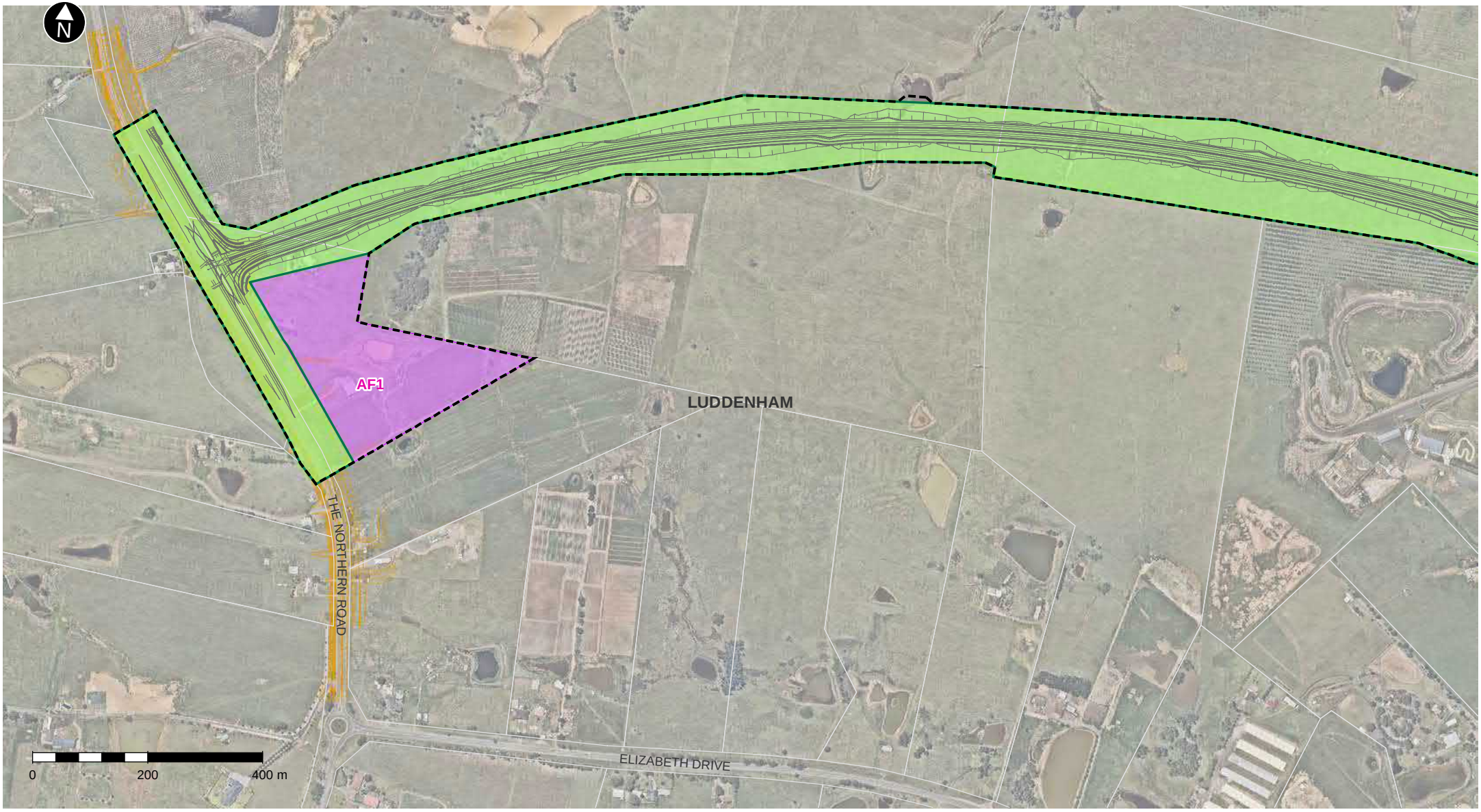
The primary construction ancillary facilities would be AF1, AF2/3, AF4 and AF5, where parking and site offices would be located. The other construction ancillary facilities are smaller sites that would be in operation for shorter periods, with workers travelling to them from the main construction ancillary facilities and would not have significant parking demand or parking provision.

An overview of the construction footprint is shown in **Figure 6-1** to **Figure 6-10**.

To facilitate construction of the M12 Motorway, nine construction ancillary facilities would be required. These sites are summarised in **Table 6-2**.

Table 6-2 Summary of construction ancillary facilities

Site no.	Construction ancillary facility facilities/uses							Peak heavy vehicle movements per hour
	Main office	Secondary office	Car park	Amenities	Stockpile and laydown area	Concrete/ asphalt batching plant	Plant servicing workshop	
AF1		X	X	X	X			28
AF2	X		X	X	X		X	22
AF3		X	X	X	X	X	X	22
AF4		X	X	X	X		X	14
AF5		X	X	X	X		X	16
Range Road		X			X		X	22
AF6		X			X		X	22
AF9		X		X	X			16
Wallgrove Road		X		X	X			16



The project

Part of The Northern Road upgrade project

Cadastre

Construction footprint

The project construction footprint

Ancillary facilities

Operational footprint

The project operational footprint

RMS road reserve

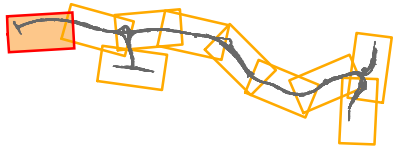


Figure 6-1 Construction footprint (The Northern Road)

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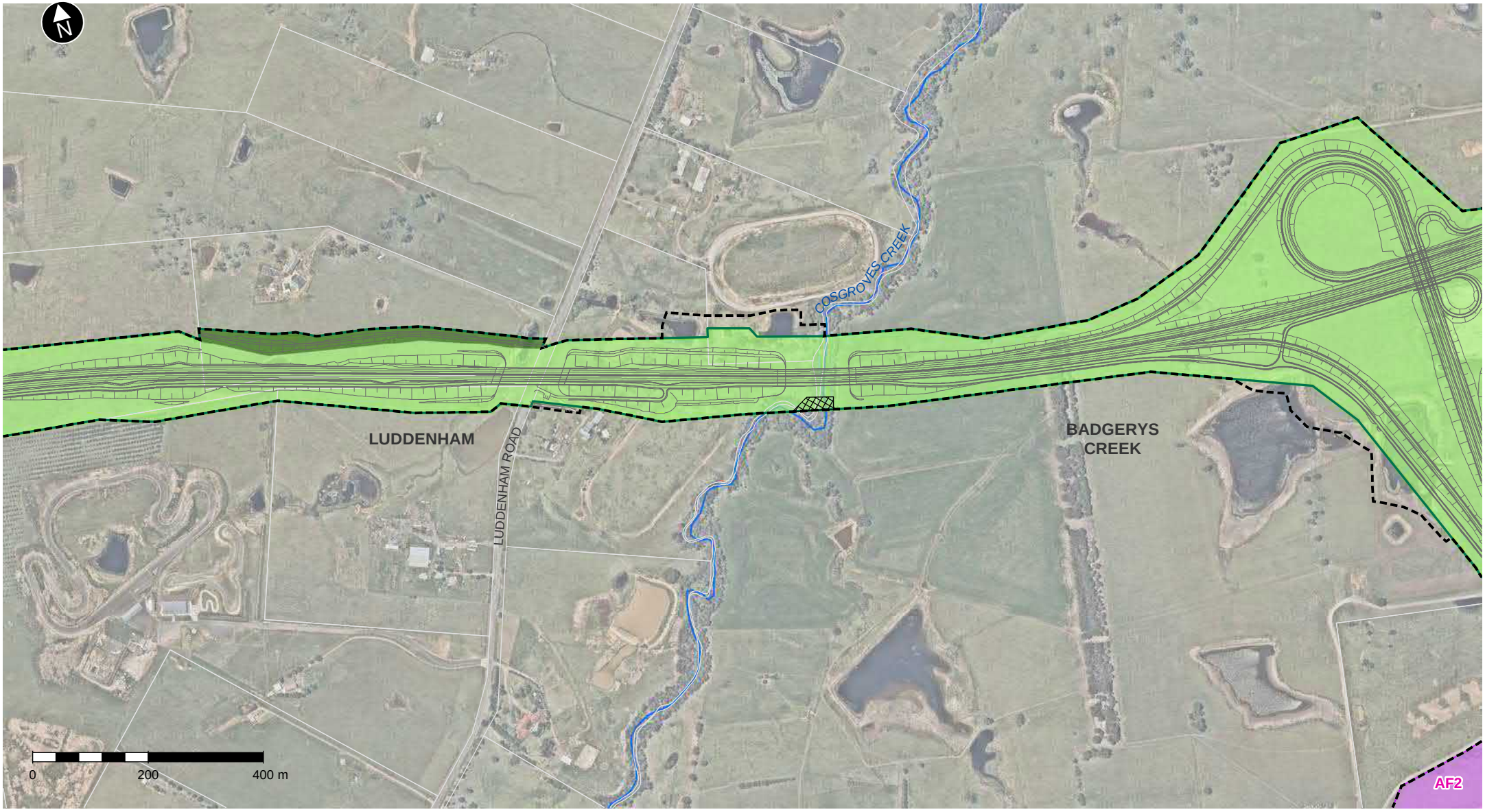


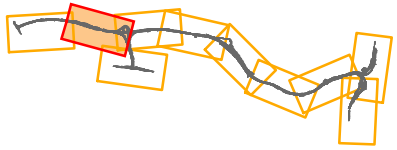
The project
Waterways
Cadastre

Construction footprint

The project construction footprint
Ancillary facilities
Exclusion zones

Operational footprint

The project operational footprint
RMS road reserve
Proposed permanent work areas



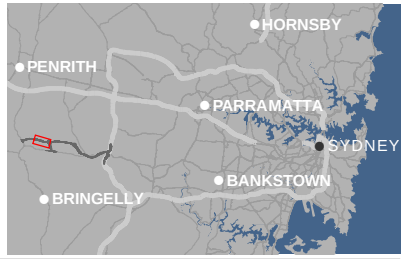


Figure 6-2 Construction footprint (Luddenham Road)

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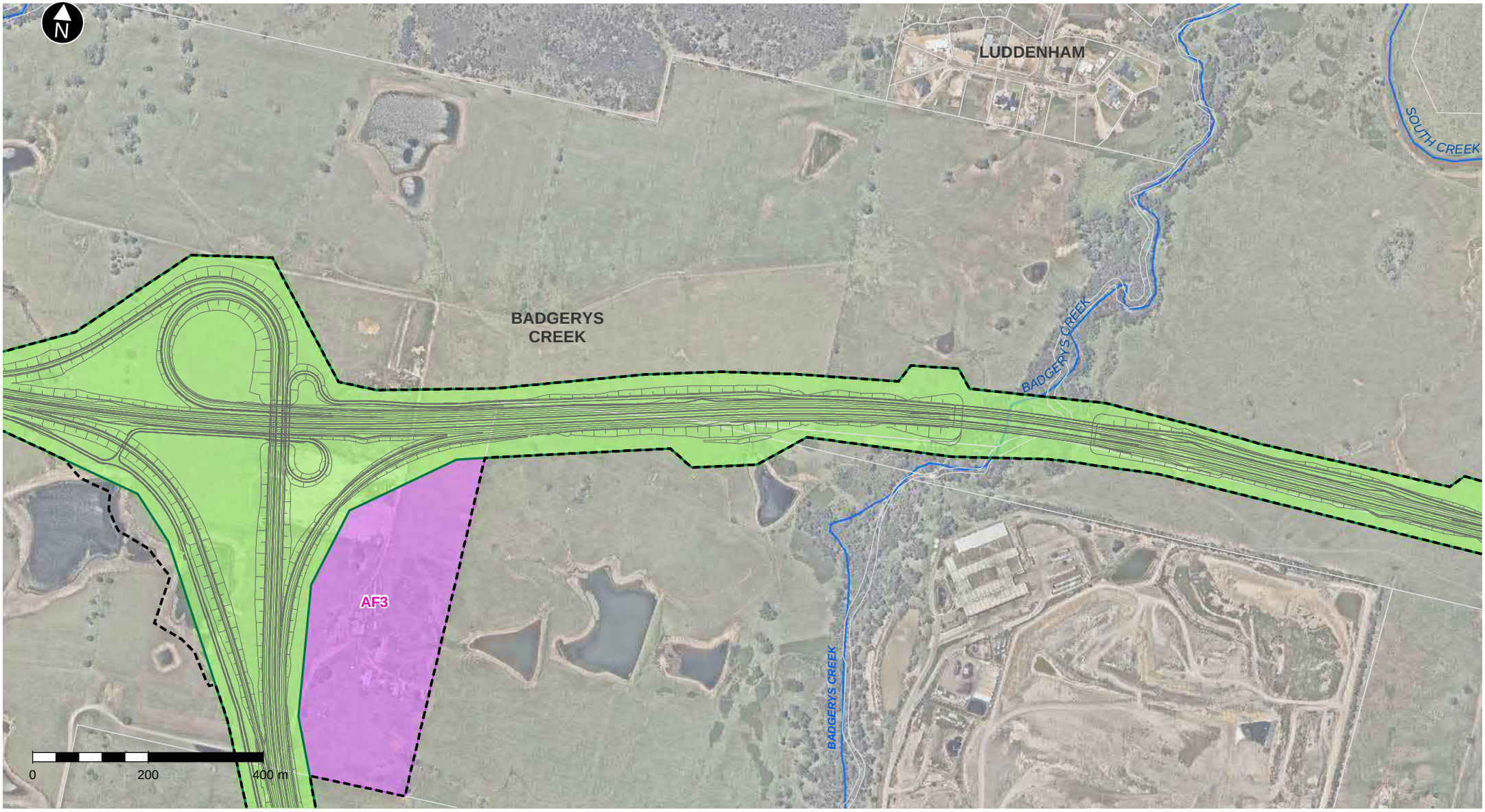

Figure 6-3 Construction footprint (Western Sydney Airport Access)

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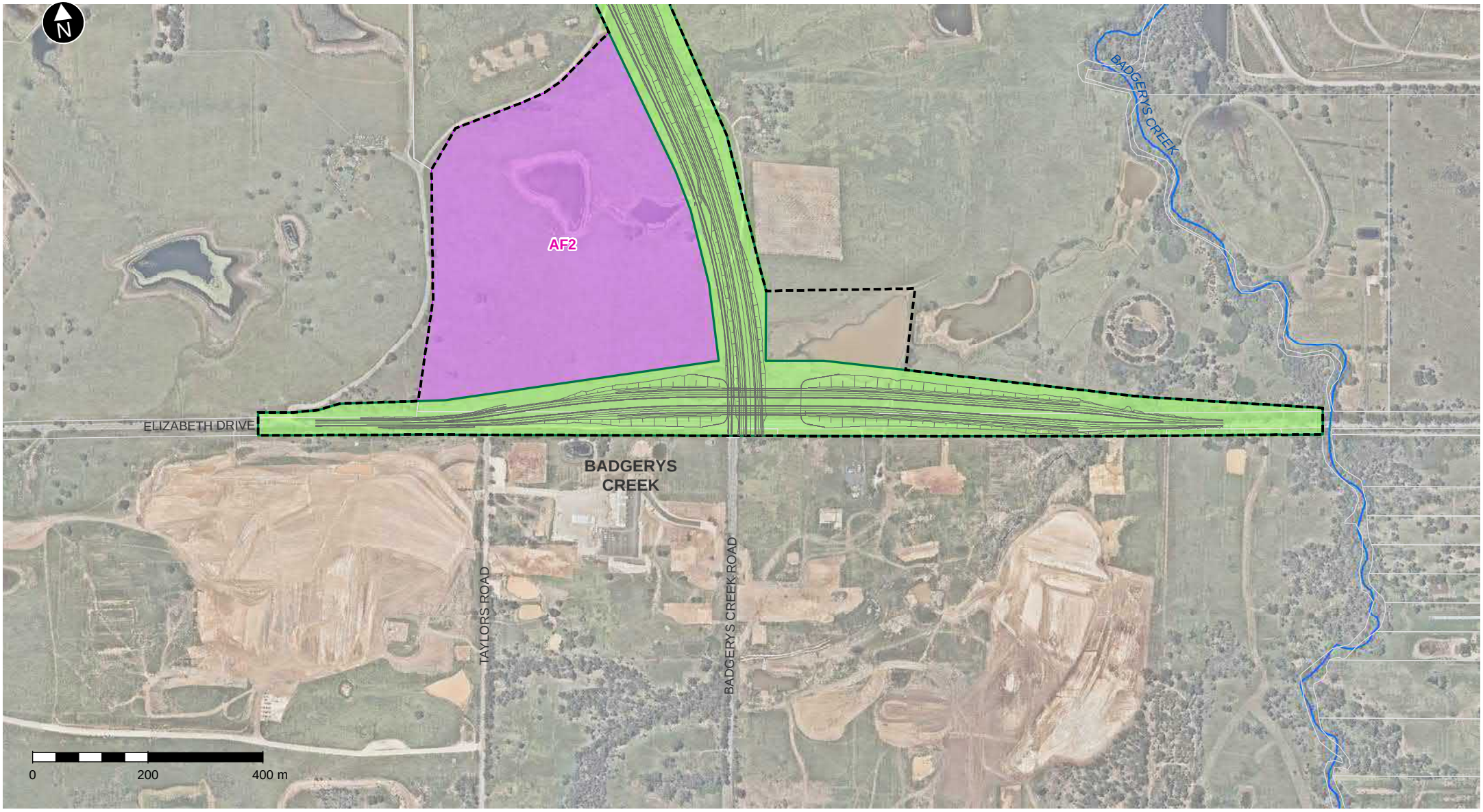

Figure 6-4 Construction footprint (Western Sydney Airport Access at Elizabeth Drive)

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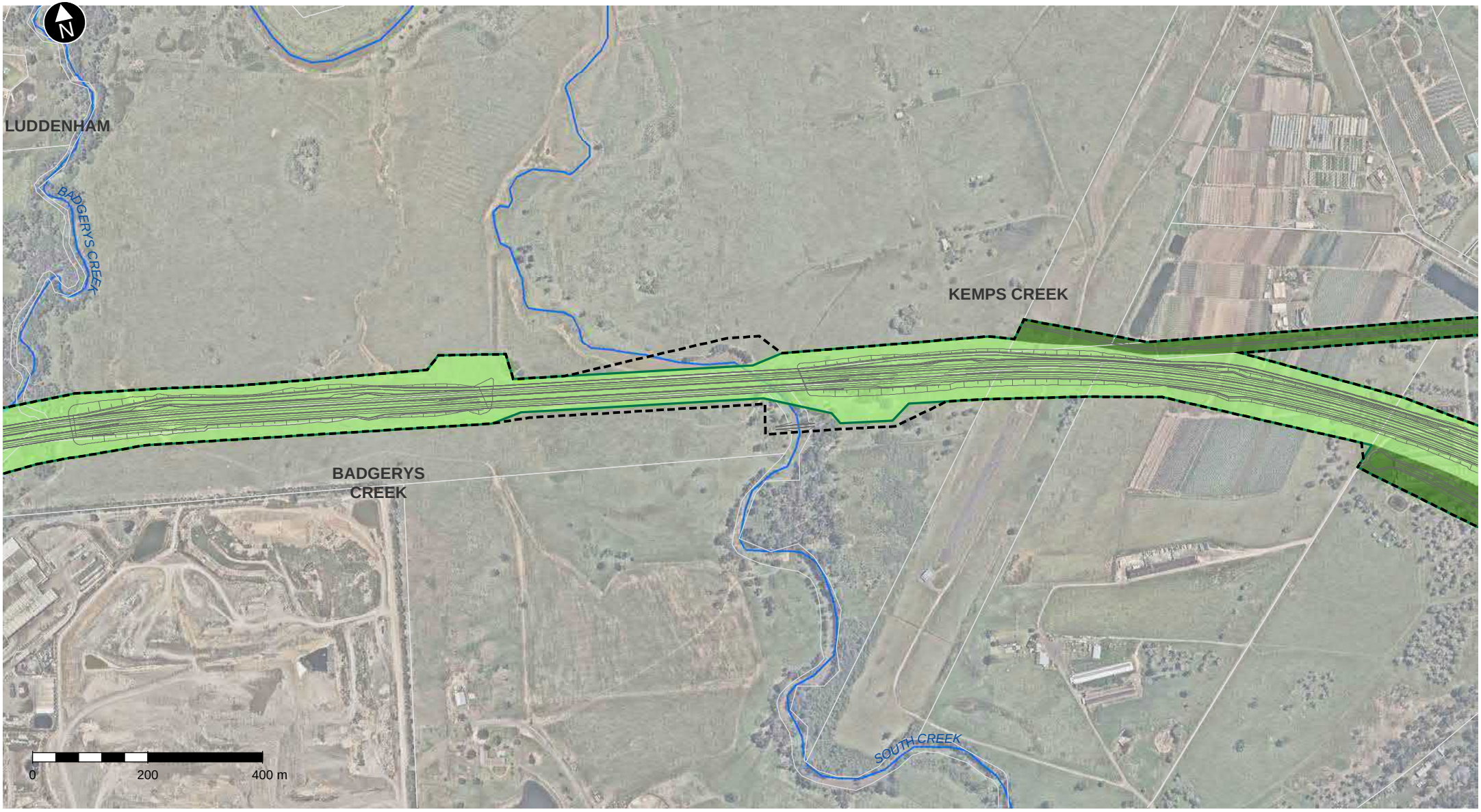

The project
Waterways
Cadastre

Construction footprint

The project construction footprint
Ancillary facilities

Operational footprint

The project operational footprint
RMS road reserve
Proposed permanent work areas

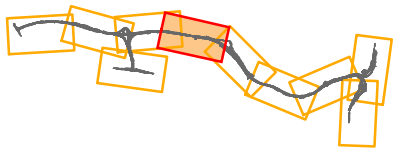

Figure 6-5 Construction footprint (South Creek)

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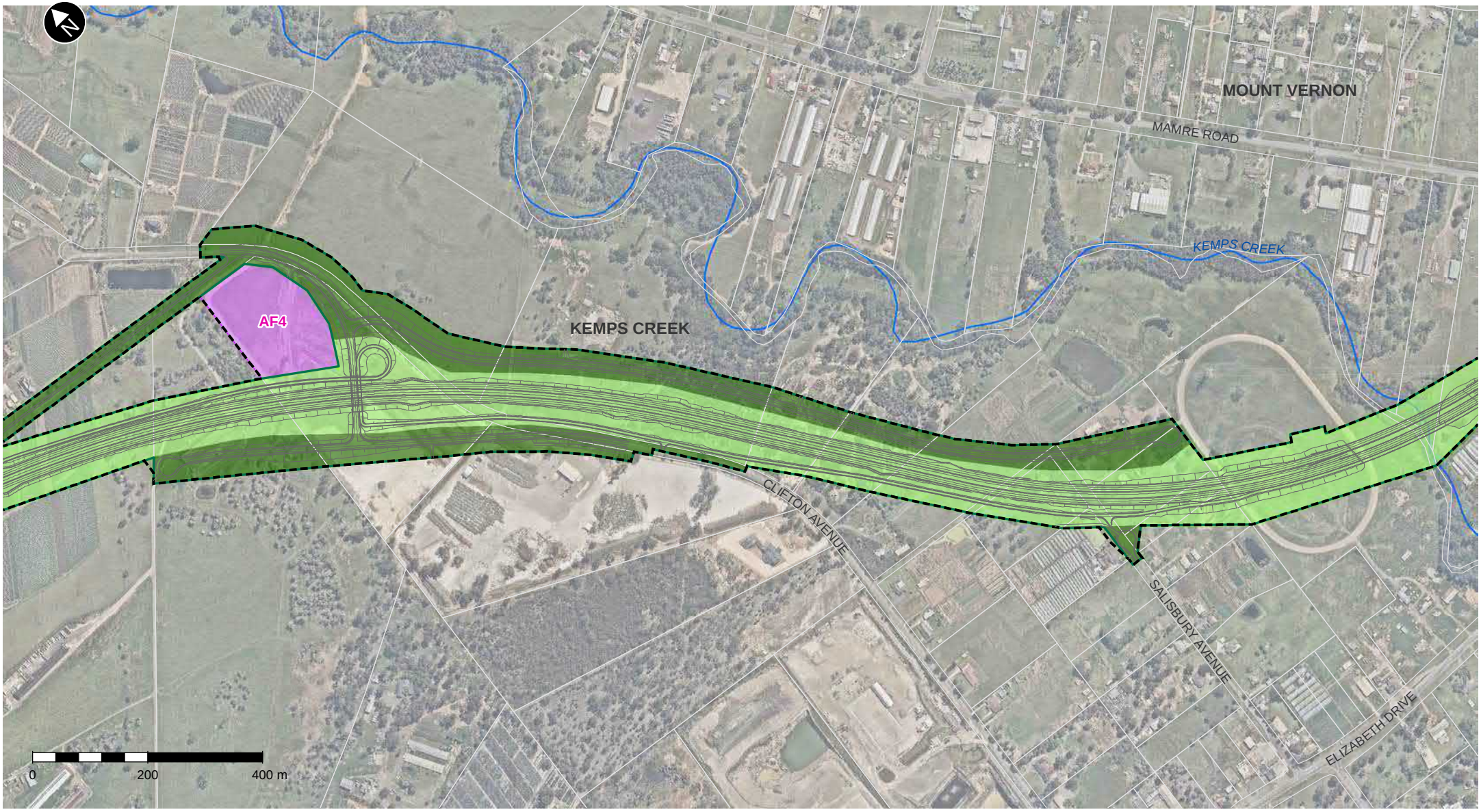

Figure 6-6 Construction footprint (Clifton Avenue)

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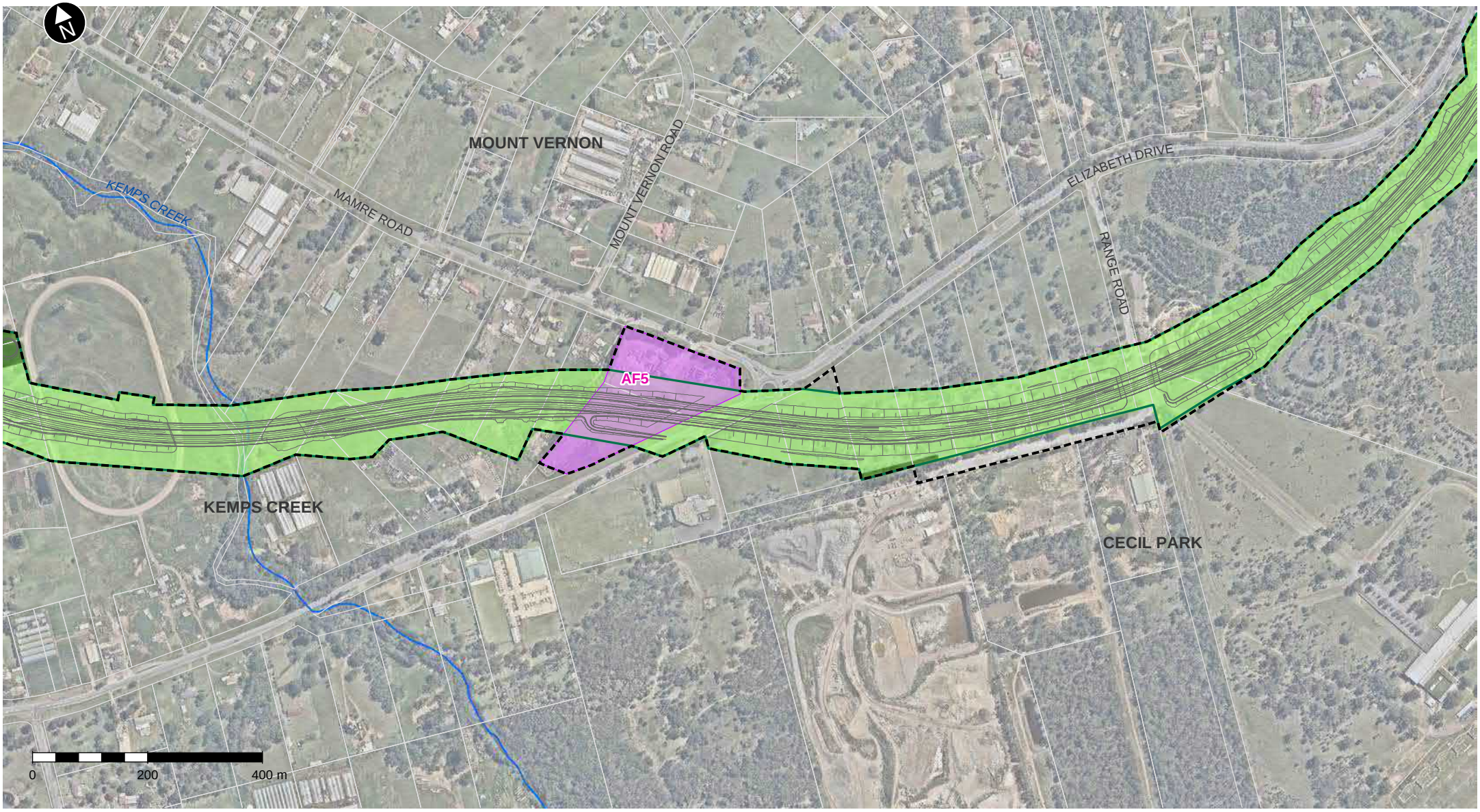


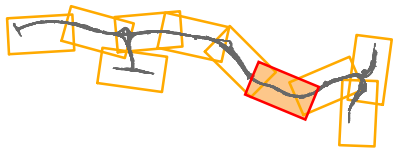
The project
Waterways
Cadastre

Construction footprint

The project construction footprint
Ancillary facilities

Operational footprint

The project operational footprint
RMS road reserve
Proposed permanent work areas



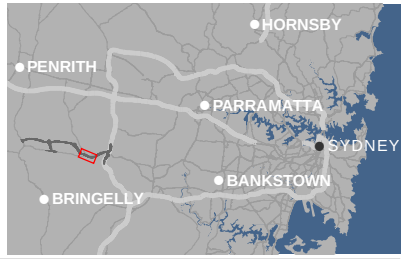


Figure 6-7 Construction footprint (Mamre Road)

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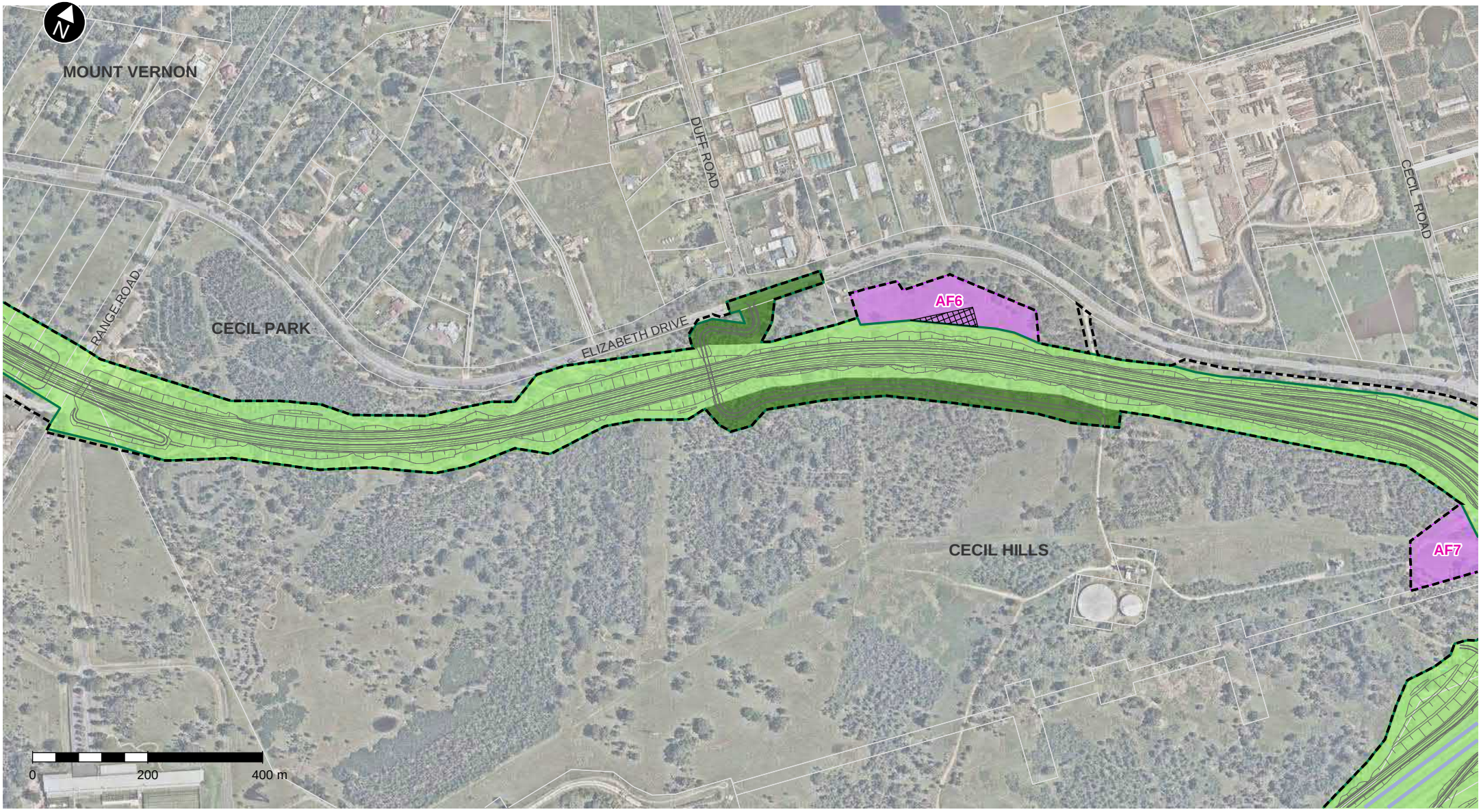

The project
Cadastre

Construction footprint
The project construction footprint
Ancillary facilities
Exclusion zones

Operational footprint
The project operational footprint
RMS road reserve
Proposed permanent work areas

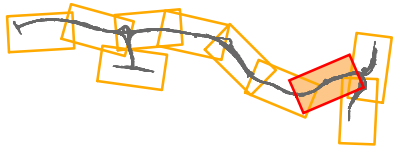

Figure 6-8 Construction footprint (Duff Road)

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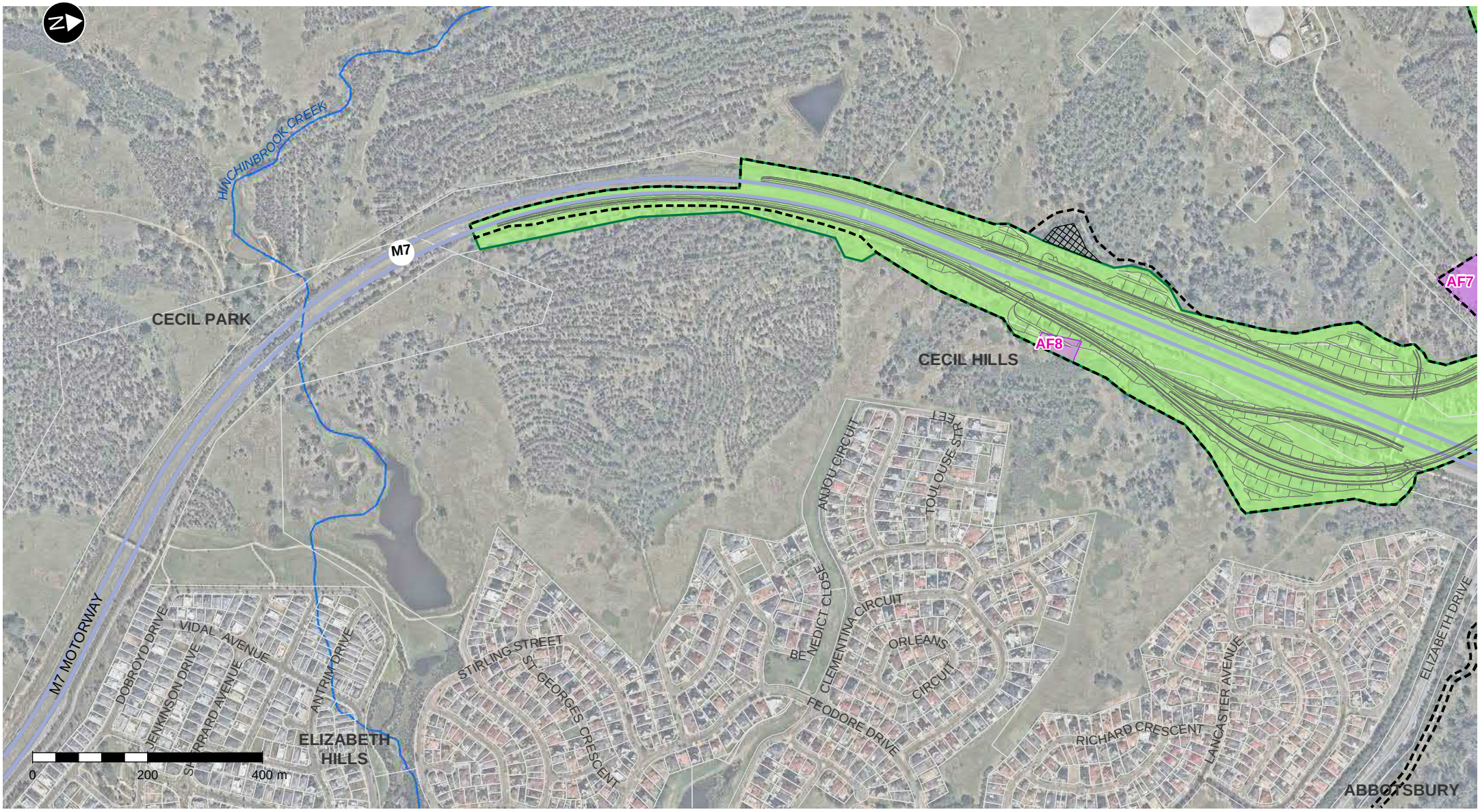
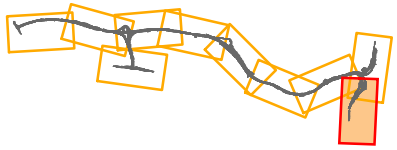


The project
Waterways
Cadastre

Construction footprint
The project construction footprint
Ancillary facilities
Exclusion zones

Operational footprint
The project operational footprint
RMS road reserve



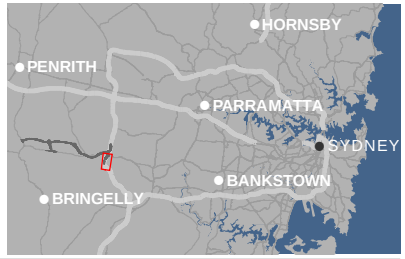


Figure 6-9 Construction footprint (M7 Motorway south)

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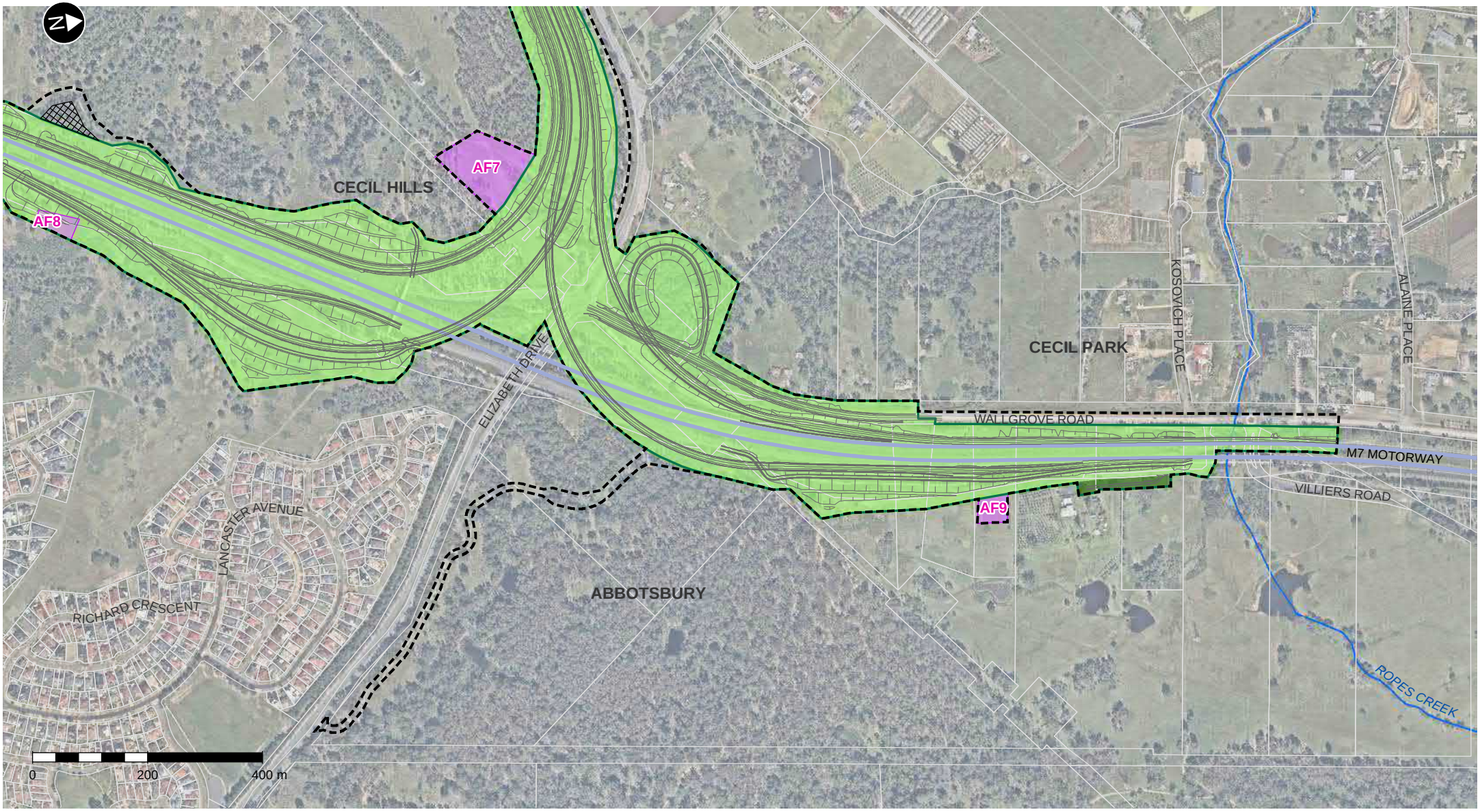


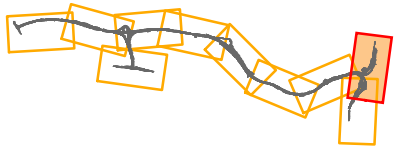
The project
Waterways
Cadastre

Construction footprint

The project construction footprint
Ancillary facilities
Exclusion zones

Operational footprint

The project operational footprint
RMS road reserve
Proposed permanent work areas



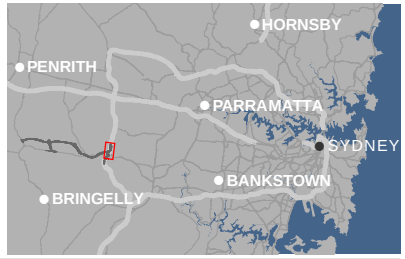


Figure 6-10 Construction footprint (M7 Motorway north)

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Haulage routes

Analysis of construction traffic movements during the peak construction period in 2024 shows the primary constraint to facilitating the large amount of spoil haulage during the bulk earthworks stage would be capacity and delays at the Elizabeth Drive/M7 Motorway/Wallgrove Road interchange. The interchange has existing traffic constraints that include:

- Double-point interchange configuration that limits the capacity of the interchange for right-turn demand from the M7 Motorway
- Steep gradients on the approach to Elizabeth Drive/Wallgrove Road from the M7 Motorway exit ramps, which affects heavy vehicle speeds resulting in queues that extend from the exit ramps into the M7 Motorway through lanes with increased heavy vehicle volumes.

In order to determine a haulage plan that would consider the nature of existing traffic on construction access routes as well as the number and size of construction related vehicles, the following approach has been undertaken:

- The heavy vehicle generation for each construction ancillary facility and work site has been identified (detailed below)
- The safest and most direct access to each construction ancillary facility and work site has been identified, as well as the movements that would be allowed onto and off the public road network (detailed below)
- The locations in greater Sydney from which construction materials and spoil would potentially be delivered from was identified. For this project, it is possible (subject to timing) that spoil would be delivered from other large construction projects with spoil surplus east of the project. Similarly, it is expected that the majority of construction materials would be delivered from locations east of the project. These trips are likely to be distributed equally to the north and south of Elizabeth Drive.
- The higher order road network constraints were identified, in this case the critical constraint is the Elizabeth Drive M7 Motorway interchange. Alternative routes would be via M4 Motorway and The Northern Road from the north and Bringelly Road and The Northern Road from the south. By the time of construction, The Northern Road and Bringelly Road upgrades would be completed to facilitate spoil haulage and earthworks for the Western Sydney Airport and would have enough capacity to accommodate additional spoil haulage.
- Preliminary traffic modelling of the haulage routes was undertaken to determine how many sites could be accessed from M7 motorway without generating substantial additional delays on M7 Motorway in the year of construction. This was undertaken by reassigning haulage routes from M7 Motorway to The Northern Road until acceptable levels of delay were forecast for Elizabeth Drive and M7 Motorway.

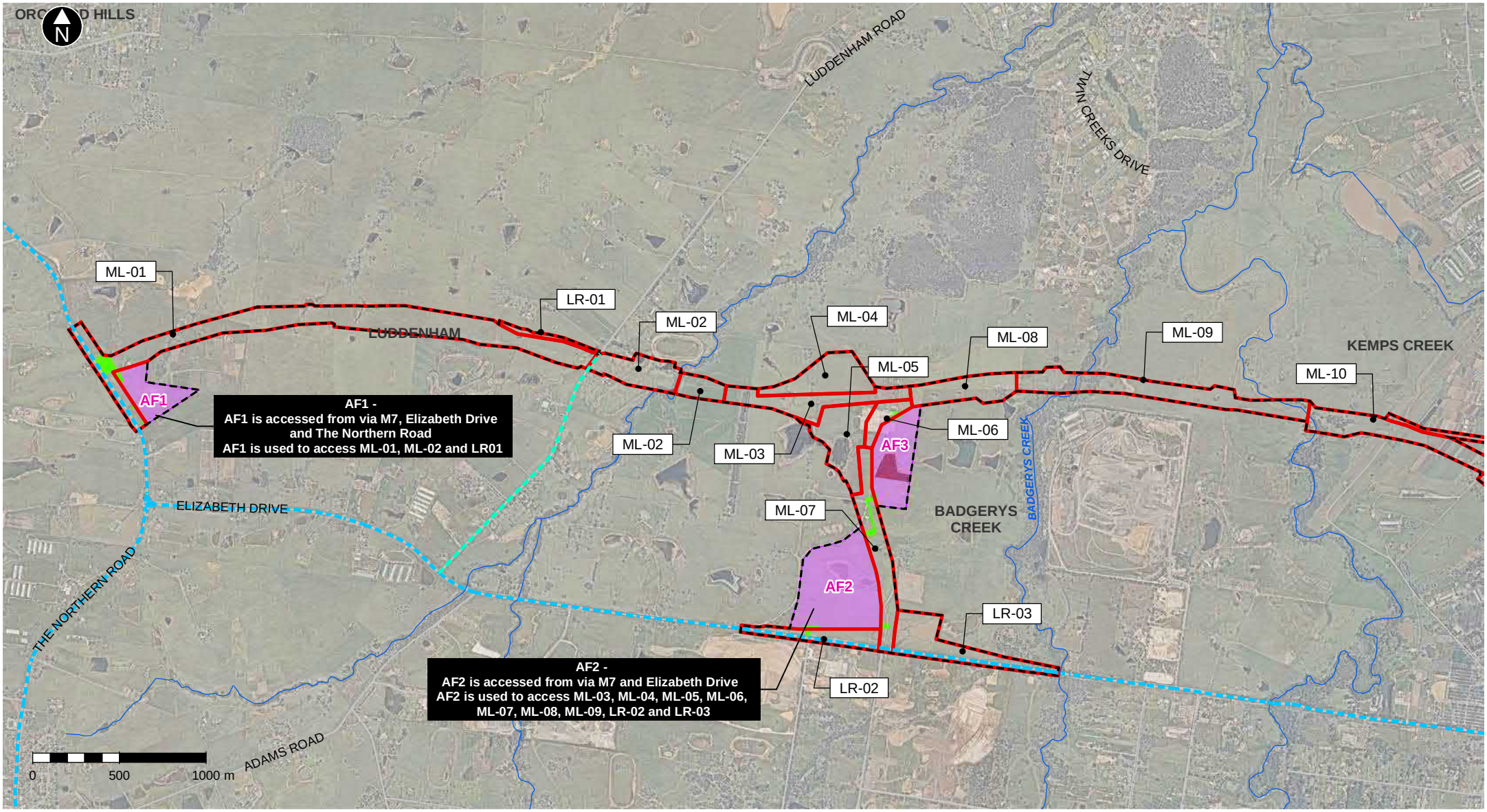
As a result of the analysis, the development of haulage routes on public roads has been based on minimising impacts to the Elizabeth Drive/M7 Motorway/Wallgrove Road interchange. Various configurations for access to the project for construction purposes were modelled. The haulage routes described in **Section 4.7** produced traffic performance results with the least impact on the Elizabeth Drive/M7 Motorway/Wallgrove Road interchange. The use of that interchange is unavoidable, as it provides access to the surrounding motorway network.

The haulage routes are as follows:

- AF1, AF2/AF3 and AF4 would be accessed via The Northern Road, Elizabeth Drive
- AF5 would be accessed via The Northern Road, Elizabeth Drive and Mamre Road
- Range Road, AF6, Wallgrove Road and AF9 would be accessed via the M7 Motorway and Elizabeth Drive.

It is noted that haulage from construction ancillary facilities to the work site would take place within the project footprint. These construction traffic movements would not be travelling on public roads and would

have no impact on the surrounding road network. A plot of the proposed haulage routes on public roads is shown in **Figure 6-11** and **Figure 6-12**.



Waterways
The project construction footprint
Ancillary facilities
Exclusion zones
Haulage routes
Temporary haulage route for bridge construction
Work zones
Vehicular access to ancillary facilities

ML - Main line
LR - Local road

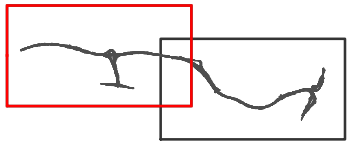


Figure 6-11 Proposed heavy vehicle haulage routes on public roads (western construction ancillary facilities)

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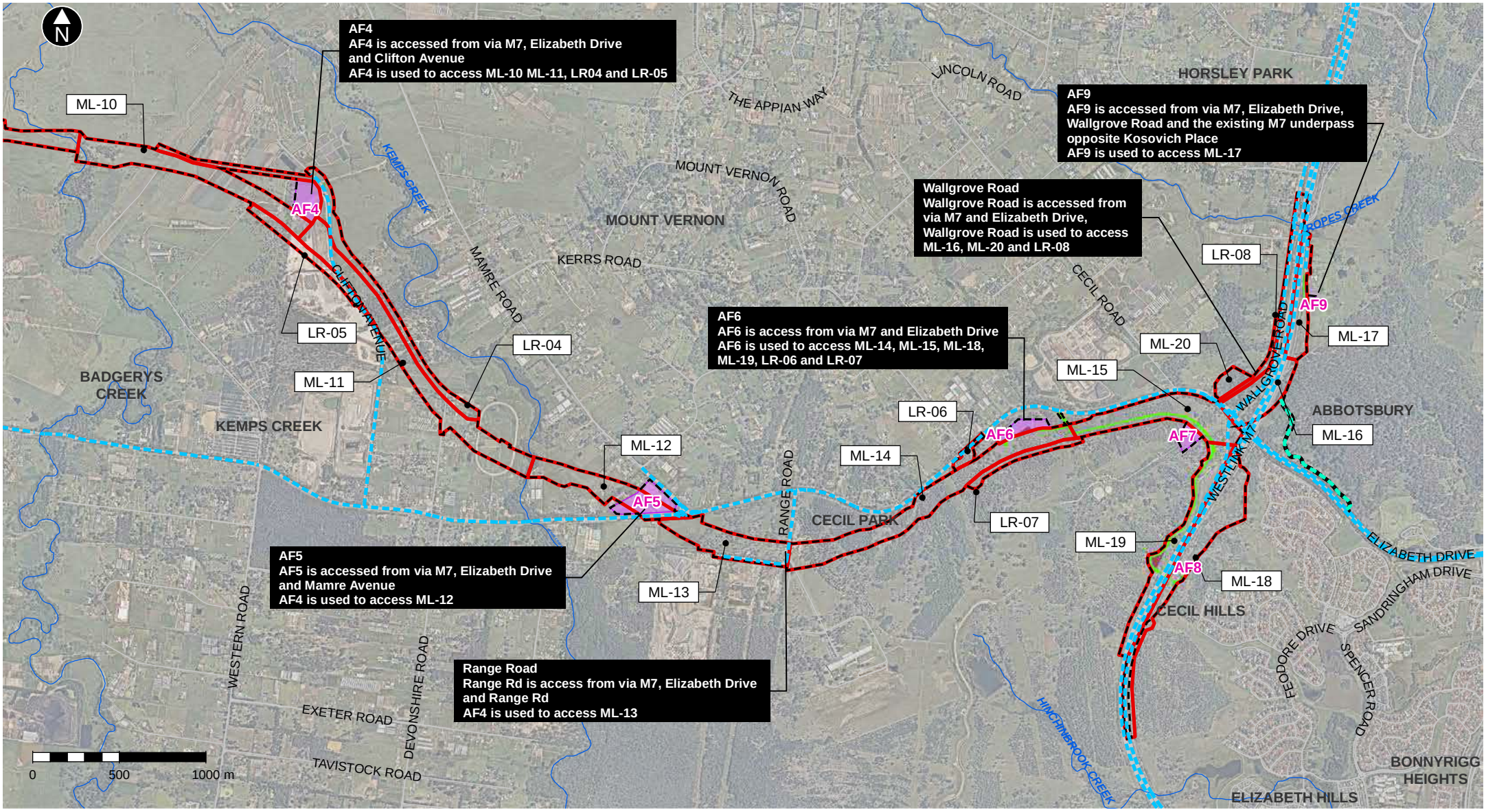

Waterways
The project construction footprint
Ancillary facilities
Exclusion zones
Haulage routes
Temporary haulage route for bridge construction
Work zones
Vehicular access to ancillary facilities

ML - Main line
LR - Local road

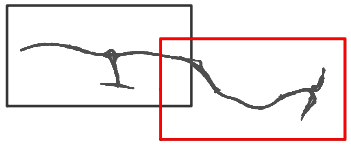

Figure 6-12 Proposed heavy vehicle haulage routes on public roads (eastern construction ancillary facilities)

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As identified in Table 5-20 of the EIS, temporary creek crossings would be established across Cosgroves Creek, Badgerys Creek, South Creek and Kemps Creek. These would be used to haul material along the construction footprint and enable construction of the bridges spanning these creeks. The impacts of these temporary creek crossings are assessed in Section 7.1.4. and Section 7.8.4 of the EIS. In summary, temporary creek crossings are not anticipated to result in significant biodiversity, flooding or groundwater impacts.

Work site and construction ancillary facility traffic generation

Light and heavy vehicle traffic generation from each of the work sites and construction ancillary facilities is provided in **Table 6-3**. Light vehicle traffic generation in the morning peak would not affect morning peak traffic conditions, as the construction workers would generally be expected to arrive at the site before the start of the morning peak traffic period. Light vehicle traffic would be generated by workers and personnel.

Construction hours would commence at 7am, with any pre-start meetings to be carried out before this time. As a result, construction workers would generally be expected to arrive at the site before 7am, which is early in the peak period of 6am to 9am.

Spoil haulage vehicles are assumed to use truck-and-dog trailer configurations (17 metres in length) and have been modelled as fully-loaded travelling to the project (40 tonnes) and empty leaving the project (24 tonnes).

Table 6-3 Construction traffic generation (inbound and outbound)

Site	Daily heavy vehicle generation	Morning peak light vehicle generation	Morning peak heavy vehicle generation	Evening peak light vehicle generation	Evening peak heavy vehicle generation
AF1	280	208	28	208	28
AF2/3	220	208	22	208	22
AF4	140	208	14	208	14
AF5	160	208	16	208	16
Range Rd	220	-	22	-	22
AF6	220	-	22	-	22
AF9	160	-	16	-	16
Wallgrove Rd	160	-	16	-	16
Total	**1,560**	**832**	**156**	**832**	**156**

Work site and construction ancillary facility access assumptions

For work site and construction ancillary facilities, the following principles have been assumed:

- For routes turning left into a construction ancillary facility, it is assumed that a short (50 metres) deceleration lane would be built.
- Worksites that would have direct access to Elizabeth Drive and The Northern Road would require traffic management to ensure safe entry and exit to the worksites. For these sites, traffic controllers would be required to allow traffic to enter and exit work sites. The speed limit on Elizabeth Drive may be reduced to 60 kilometres per hour in the vicinity of the site accesses while traffic control is in place.
- All routes turning right across Elizabeth Drive and Wallgrove Road would do so under traffic control, which may require the speed limit around this control to be reduced to 60 kilometres per hour.

- For routes turning right on to or off The Northern Road, these routes would be required to use turn-back facilities to the north and south of Elizabeth Drive, as the section of The Northern Road where the proposed work site access would be located would be a divided carriageway with a median along its length.

Road closures, detours and other temporary traffic management

To allow for safe construction adjacent or over live traffic, the following short-term traffic management measures would be in place during critical construction activities.

Elizabeth Drive and M7 Motorway bridge installation

The construction of bridges over Elizabeth Drive and new ramps connecting with the M7 Motorway would involve construction activities near existing traffic lanes and bridge works over live traffic. Full road closures requiring detours would be in place when works over live traffic are required; this would generally apply when work is undertaken on ramps and would be undertaken outside of peak periods to minimise impacts of road closures on traffic. These works would not involve full closure of the M7 Motorway, but may require lane closures to ensure that works are conducted safely.

During the installation of these bridges, the following detours may be in place:

- Northbound trips on M7 Motorway would exit at Elizabeth Drive exit ramp and renter via Wallgrove Road entry ramp
- Southbound trips on M7 Motorway would exit at The Horsley Drive, used The Horsley Drive and Cowpasture Road to re-enter M7 Motorway at the Cowpasture Road Interchange
- Eastbound trips on Elizabeth Drive would travel to the north via Mamre Road, Lenore Drive and Old Wallgrove Road
- Eastbound trips Elizabeth Drive would travel east via Devonshire Road, Fifteenth Avenue, and Cowpasture Road
- Westbound trips on Elizabeth Drive would travel west via Cowpasture Road, Fifteenth Avenue and Devonshire Road

These potential detour routes are shown in **Figure 6-13**.

The Northern Road tie-in

The M12 Motorway would intersect with The Northern Road at a new signalised intersection and would involve adding new left and right turning lanes on The Northern Road. Temporary traffic barriers would be installed along the shoulder of The Northern Road and also along the median side to facilitate construction of the left and right turning lanes on The Northern Road. Existing capacity would be maintained throughout construction. Any traffic switches or temporary lane closures would occur outside of peak periods. There may be periods when vehicles would be required to travel on temporary pavement. Traffic speeds would be maintained as much as possible, with any reduction in speed limited to outside of peak periods.

Luddenham Road bridge installation

The installation of a bridge over Luddenham Road would involve construction activities near existing traffic lanes and bridge works over live traffic. Full road closures requiring detours would be in place when works over live traffic are considered unsafe and would be undertaken outside of peak periods to minimise impacts. During installation of this bridge, the following detours would be in place:

- Northbound and southbound trips travelling along Luddenham Road would use Mamre Road and Elizabeth Drive

This proposed detour is shown in **Figure 6-13**.

Clifton Avenue realignment

Construction of the new motorway formation and a bridge over Clifton Avenue would require its realignment. A new road would be built to the west of the existing road, connecting to the new bridge over the M12 Motorway and a new service road to the east of the existing alignment of Clifton Avenue. This would maintain north-south connectivity for properties along both sides of Clifton Avenue. The new road would be built offline, and open prior to the construction of the motorway formation.

Temporary traffic management

The majority of construction activities would occur on greenfield land, however at the tie-in locations work would need to be undertaken adjacent to live traffic. At these locations, temporary traffic management would be required to ensure that traffic travelling adjacent to workers are doing so at an appropriate speed and with sufficient separation. This may require reduced speed limits and temporary realignments around tie-in locations.

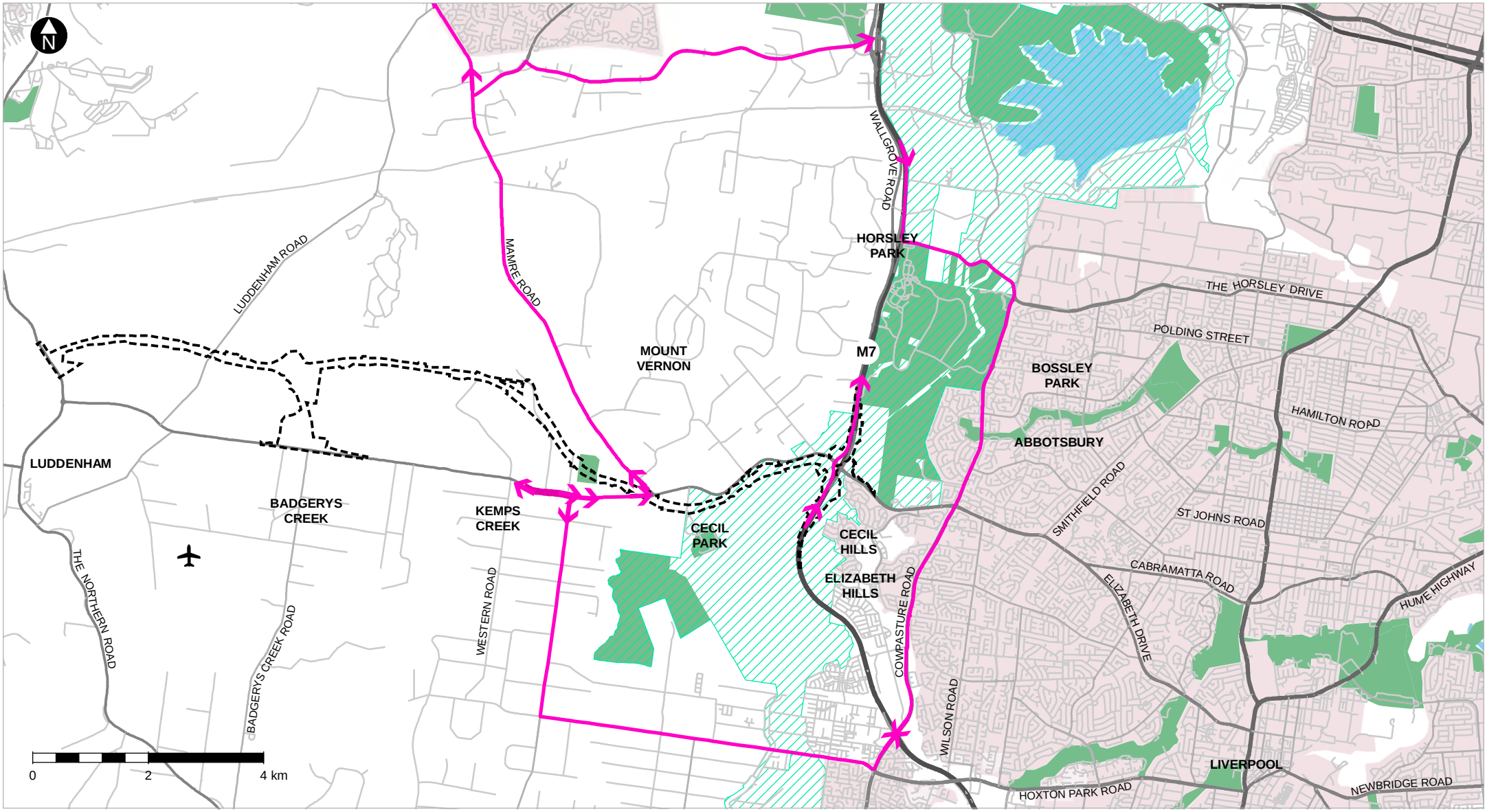

Figure 6-13 Proposed vehicle detours around construction road closures

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6.1.2 Construction impact assessment

This section presents the results of traffic modelling undertaken for the peak construction year of 2024 with and without construction of the project.

Background traffic volumes and patterns

As the peak construction traffic generation for the project would occur in 2024, a 2024 do minimum scenario has been developed that includes traffic growth from 2017 to 2024, based on the forecast linear growth rate between 2017 and 2026.

The following projects within the core study area would also be completed by 2024 and have been included as part of the road network assumptions for construction scenario:

- The Northern Road upgrade including realignment of the western end of Elizabeth Drive and upgrade of the existing roundabout at The Northern Road and Elizabeth Drive to traffic signals

A summary of the forecast background traffic growth on key roads within the core study area is provided in **Table 6-4**.

Table 6-4 Traffic growth on key roads in the core study area by 2024

Road location	Direction	Morning peak (7.30am to 8.30am)			Evening peak (5.30am to 6.30pm)		
		2017 base	2024	% Change	2017 base	2024	% Change
The Northern Road north of Elizabeth Drive	Northbound	685	1,467	114%	801	2,111	164%
	Southbound	761	1,205	58%	673	747	11%
The Northern Road south of Elizabeth Drive	Northbound	866	679	-22%	659	1,151	75%
	Southbound	522	654	25%	933	381	-59%
Elizabeth Drive west of Adams Road	Eastbound	611	948	55%	297	622	109%
	Westbound	305	857	181%	642	1,318	105%
Elizabeth Drive west of Devonshire Road	Eastbound	1,199	1,223	2%	511	626	23%
	Westbound	516	728	41%	833	1,257	51%
Elizabeth Drive east of Mamre Road	Eastbound	1,407	1,306	-7%	718	895	25%
	Westbound	852	1,063	25%	1,153	1,532	33%
Elizabeth Drive East of Wallgrove Road	Eastbound	1,426	1,493	5%	1,236	1,962	59%
	Westbound	1,273	1,512	19%	1,180	1,410	19%
Mamre Road north of Wallgrove Road	Northbound	752	1,064	41%	729	1013	39%
	Southbound	502	644	28%	642	975	52%
Wallgrove Road north of Elizabeth Drive	Northbound	1,191	1,178	-1%	592	596	1%
	Southbound	299	201	-33%	690	864	25%

Intersection performance

Traffic modelling has been undertaken in the WSAGA mesoscopic model (for the core study area only) to determine the relative impacts of construction traffic at key intersections when compared to conditions without construction of the project. This was undertaken by adding heavy vehicle and light vehicle construction traffic generation to each of the construction ancillary facilities and work sites during the morning and evening peak hours.

Intersection performance for the 2024 base case scenario with and without construction traffic is summarised in **Table 6-5** and **Table 6-6** for the morning and evening peak hours respectively.

Intersection performance without construction

The following intersections would exceed Level of Service D in 2024 without construction traffic:

- Elizabeth Drive/Devonshire Road (morning and evening peak)
- Elizabeth Drive/M7 Motorway northbound ramp/Wallgrove Road (evening peak)
- Elizabeth Drive/M7 Motorway southbound ramps (evening peak).

The intersection of Elizabeth Drive/Devonshire Road would exceed Level of Service D due to high delays for vehicles turning into and out of Devonshire Road, which is priority controlled. Level of Service at priority intersections is reported for the worst movement hence the poor intersection performance reflects high delays for traffic turning out of Devonshire Road during both the morning and evening peak periods.

The unsatisfactory performance of the M7 Motorway/Elizabeth Drive interchange and Wallgrove Road would result from the conflict between right turning traffic from Elizabeth Drive to the M7 Motorway and eastbound and westbound traffic on Elizabeth Drive.

Intersection performance with construction

With construction traffic added to the road network, the performance of the following intersections would operate at Level of Service D or worse as a result:

- Elizabeth Drive/Cecil Road (evening peak) – would change from Level of Service A to Level of Service F
- Elizabeth Drive/M7 Motorway northbound ramp/Wallgrove Road (morning peak) – Would change from Level of Service C to Level of Service D
- Elizabeth Drive/M7 Motorway southbound ramps (evening peak) – Would change from Level of Service D to Level of Service F
- Elizabeth Drive/Luddenham Road (evening peak) – Would change from Level of Service B to Level of Service F.

These increases in delay are generally due to the addition of construction heavy vehicle traffic, that would experience additional delays because of the following:

- Additional delays in accelerating up steep grades while fully-loaded. This is generally the case when exiting M7 Motorway to Elizabeth Drive from the south, which is a steep uphill grade.
- Additional delays in waiting for a gap in traffic when turning right or left. Due to their length, construction heavy vehicles require longer gaps in traffic to safely turn from minor roads at priority intersections. Increased construction traffic volumes along Elizabeth Drive would also increase delays at priority intersections including Luddenham Road southbound and from Elizabeth Drive into Adams Road southbound.

Table 6-5 Construction scenario morning peak modelled intersection performance

Intersection	2024 no construction		2024 construction	
	Av Delay (s)	LoS	Av Delay (s)	LoS
Elizabeth Drive/M7 Motorway southbound ramps	26	B	28	B
Elizabeth Drive/M7 Motorway northbound ramps/Wallgrove Road	43	C	48	D
Elizabeth Drive/Cecil Road	9	A	15	A
Elizabeth Drive/Duff Road	20	B	29	C
Elizabeth Drive/Mamre Road	28	B	34	C
Elizabeth Drive/Range Road	8	A	13	A
Elizabeth Drive/Devonshire Road	> 100	F	> 100	F
Elizabeth Drive/Clifton Avenue	12	A	15	B
Elizabeth Drive/Western Road	16	B	20	B
Elizabeth Drive/Martin Road	8	A	9	A
Elizabeth Drive/Lawson Road	7	A	9	A
Elizabeth Drive/Badgerys Creek Road	61	E	63	E
Elizabeth Drive/Adams Road	9	A	9	A
Elizabeth Drive/Luddenham Road	15	A	16	B
Elizabeth Drive/The Northern Road	37	C	38	C

Table 6-6 Construction scenario evening peak modelled intersection performance

Intersection	2024 no construction		2024 construction	
	Av Delay (s)	LoS	Av Delay (s)	LoS
Elizabeth Drive/M7 Motorway southbound ramps	49	D	81	F
Elizabeth Drive/M7 Motorway northbound ramps/Wallgrove Road	> 100	F	> 100	F
Elizabeth Drive/Cecil Road	9	A	> 100	F
Elizabeth Drive/Duff Road	13	A	77	F
Elizabeth Drive/Mamre Road	16	B	30	C
Elizabeth Drive/Range Road	13	A	33	C
Elizabeth Drive/Devonshire Road	> 100	F	> 100	F
Elizabeth Drive/Clifton Avenue	4	A	49	D
Elizabeth Drive/Western Road	19	B	26	B
Elizabeth Drive/Martin Road	13	A	15	A

Intersection	2024 no construction		2024 construction	
	Av Delay (s)	LoS	Av Delay (s)	LoS
Elizabeth Drive/Lawson Road	9	A	14	A
Elizabeth Drive/Badgerys Creek Road	31	C	55	D
Elizabeth Drive/Adams Road	11	A	23	B
Elizabeth Drive/Luddenham Road	29	B	> 100	F
Elizabeth Drive/The Northern Road	41	C	43	C

Construction worker parking and impacts on on-street parking

Parking for construction personnel would be provided at all ancillary facilities. It is not expected that surplus parking demand from construction activities would reduce the availability of surrounding public parking as there is currently limited or no on-street parking in the core study area.

Impacts on public transport

Bus routes 801 and 813 operate along Elizabeth Drive between the M7 Motorway and Badgerys Creek Road. Route 789 operates on The Northern Road. During construction of the project the following impacts to buses and bus customers are likely:

- Reductions in speed when travelling through construction activity areas, resulting in longer travel times
- Temporary relocation of stops away from construction zones requiring some passenger to walk further, while other passenger may have a shorter distance to walk to their desired bus stop

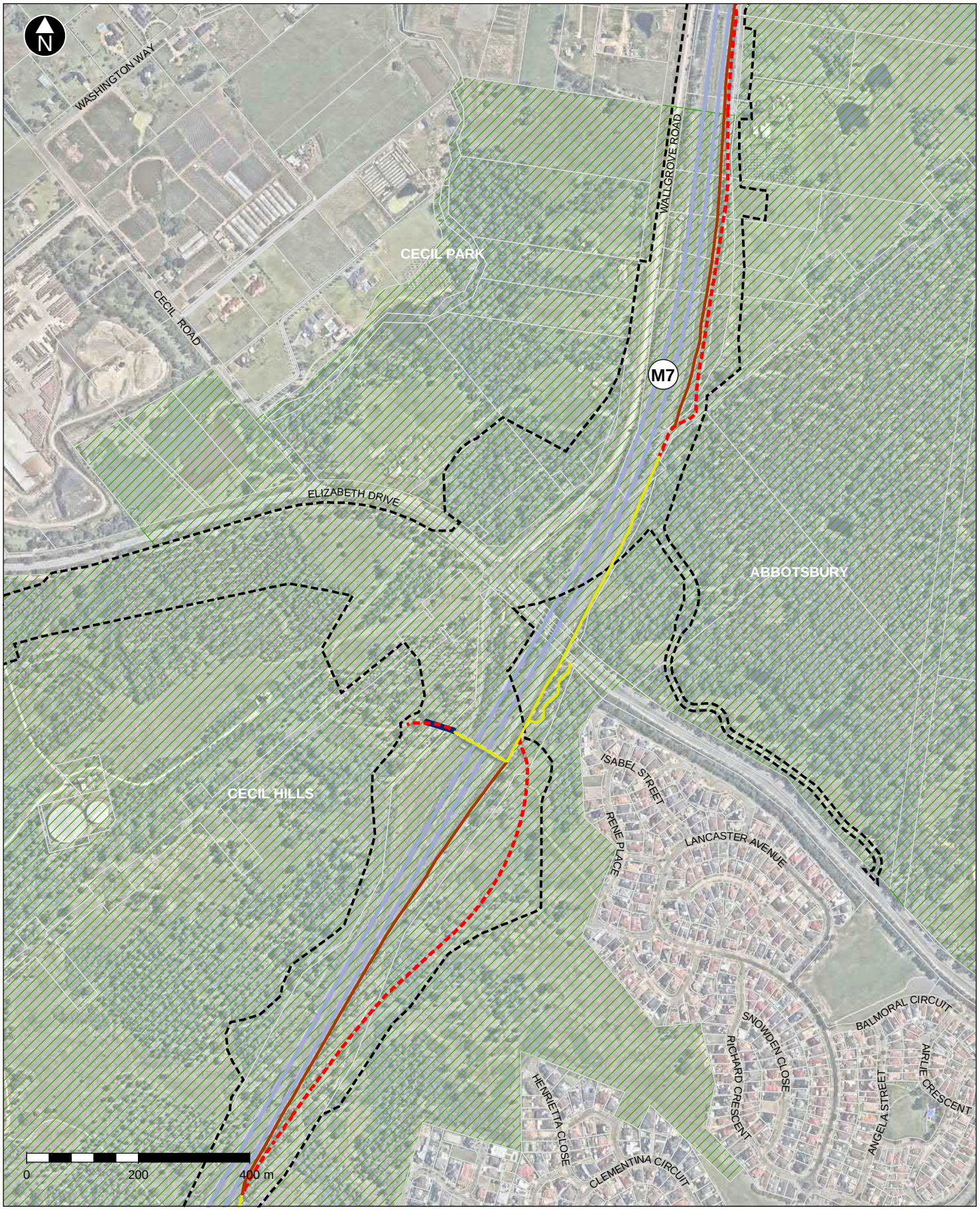
Alternative access to relocated bus stops may need to be provided, in some cases requiring passengers to walk further to reach their desired bus stop in the event that bus stops are temporarily relocated.

Impacts on pedestrians and cyclists

The existing off-road shared user path along the M7 Motorway would require relocation to the east for about two kilometres between Villiers Road and south of Elizabeth Drive to accommodate the new off-load and on-load ramps between the M7 Motorway and M12 Motorway. The realignment would tie-in to the existing shared user path north and south of Elizabeth Drive. The extent of the proposed realignment is shown in **Figure 6-14**.

The realigned path would be constructed and opened to sensitive road users prior to decommissioning the existing path to maintain access along the length of the facility. Safety barriers would separate users from the construction zone during construction of the new path and the decommissioning of the old path to provide safe passage during the realignment works. At tie in locations any potential temporary disruptions (eg with final surfacing) would be managed to ensure users would be able to continue their journey.

Based on the surveys of sensitive road users (pedestrians and cyclists) that currently use the M7 Motorway shared user path and the shared user path into Western Sydney Parklands, this is likely to affect up to 1,000 people per day on weekends and up to 250 people per day during weekdays.



The project construction footprint

Western Sydney Parklands

Motorway

New bridge

Existing shared user path to be removed

Existing shared user path to be retained

New shared user path

Figure 6-14 Proposed shared user path realignment

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Other impacts of construction

The volume of spoil haulage vehicles required to support the proposed earthworks would result in some dilapidation of the pavement along M7 on and off-ramps, Elizabeth Drive, Mamre Road and The Northern Road. The pavement on The Northern Road would be new at the time of construction, as The Northern Road Upgrade would have been recently completed. Other roads would likely suffer some dilapidation as a consequence of the project and would have already been degraded to some degree by construction traffic from prior projects completed in the area including The Northern Road Upgrade and Western Sydney Airport.

6.2 Operational impacts

6.2.1 Assessment of impacts without the project

Overview

This chapter provides a summary of the changes to the transport network for the 2026 and 2036 forecast year if the project was not built (the do minimum scenario). This reflects the main features of the transport network and the operation of the road network under the assumption that the M12 Motorway is not built and represents a business-as-usual do minimum when the Western Sydney Airport is operational, with access provided directly from Elizabeth Drive. Assessment of the future road network performance is based on the following performance measures:

- Regional road network performance, examining the growth in traffic volumes on strategic roads in the study area
- Network performance based on vehicle hours of travel (VHT), vehicle kilometres of travel (VKT) and average network speed
- Intersection performance based on intersection Level of Service
- General traffic travel times for key corridors.

Changes to the road network

The network changes documented in **Table 3-1** and **Table 3-2** have been identified as being in place for the do minimum scenario either by 2026 or 2036, however some of these projects are still under investigation or in planning. The following road projects have been assumed to be in place for 2026:

- Bringelly Road upgrade: under construction
- The Northern Road upgrade: under construction
- Elizabeth Drive upgrade (intersection upgrades only): under investigation

The following road projects are assumed to be in place by 2036:

- Elizabeth Drive upgrade (M7 Motorway to The Northern Road): under investigation
- Mamre Road and Devonshire Road realignment: under investigation
- Luddenham Road and Adams Road realignment: under investigation
- M7 Motorway upgrade: identified through traffic modelling as required to meet forecast demands
- Cowpasture Road Upgrade: under investigation
- Fifteenth Avenue Upgrade: under investigation.

Changes to the public transport network

The primary assumed change to the public transport network by 2026 is the construction of the Sydney Metro Greater West line between Western Sydney Airport and St Marys. By 2036, it is assumed that this would be extended to Macarthur.

There are no proposed changes to bus operation assumed within the wider study area as part of the do minimum scenario for the project. It is noted that as part of The Northern Road upgrade, there would be some relocation of bus stops from the approach side to the nearest departure side of the upgraded signalised intersections between Elizabeth Drive and Glenmore Parkway, as detailed in The Northern Road Upgrade Environmental Assessment (NSW Roads and Maritime, 2017).

Changes to the pedestrian and cycle network

The following changes to the pedestrian and cycle network have been assumed as part of the do minimum scenario:

- Shared user path adjacent to The Northern Road as part of The Northern Road upgrade from Narellan to Penrith
- Shared user path adjacent to Bringelly Road as part of the Bringelly Road upgrade project between Camden Valley Way and The Northern Road.

Changes to parking and access

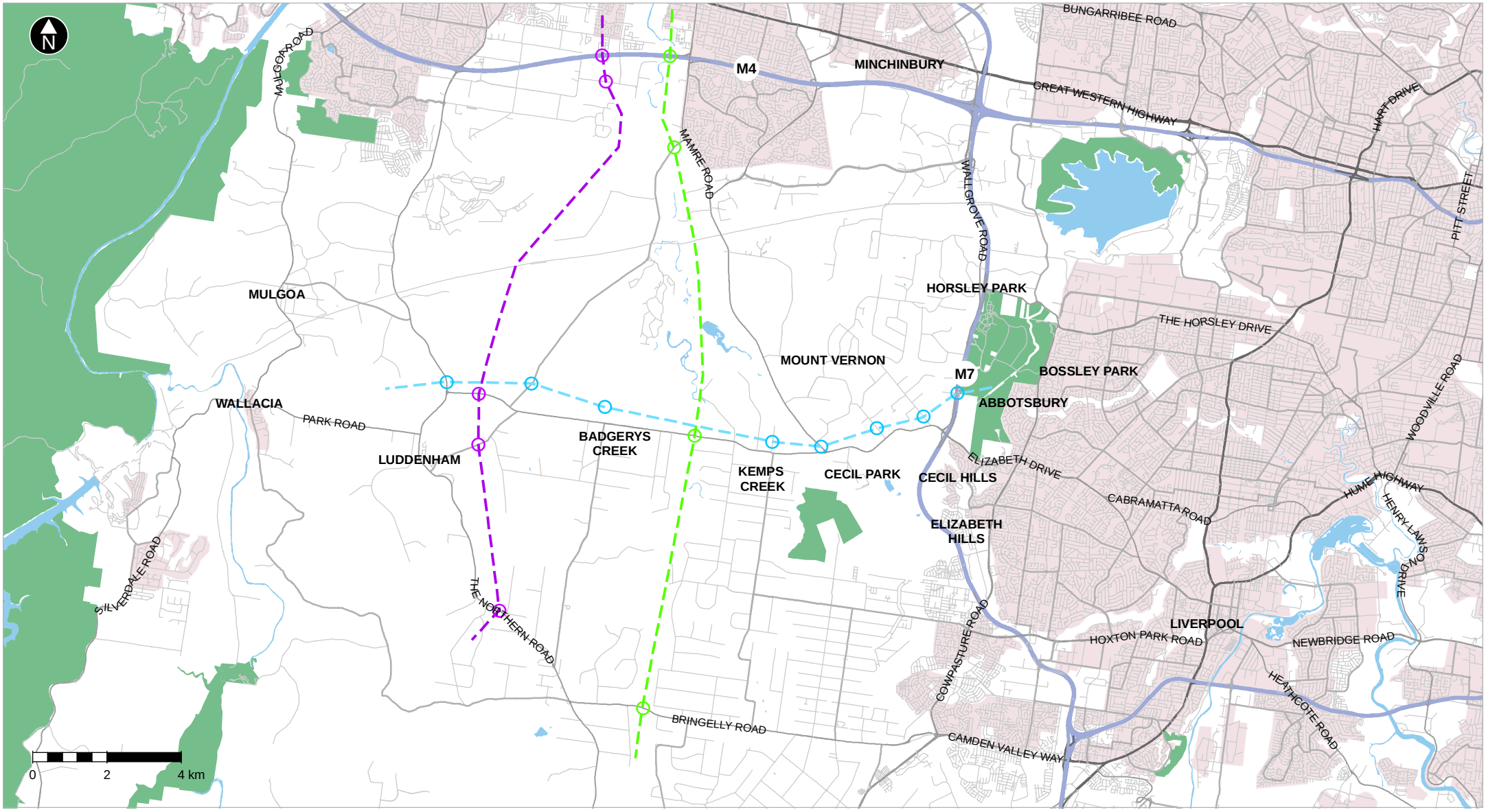
There are no proposed changes to parking assumed as part of the do minimum scenario for the project.

Separate to the project, it is noted that both The Northern Road upgrade and the Bringelly Road upgrade would introduce divided carriageway along the length of these roads through the wider study area, limiting access for properties that front onto these roads. The construction of a central median along both corridors would restrict right turns into and out of these frontages and would require these trips to use turn-back facilities provided as part of the design for these upgrades.

The assumed upgrade of Elizabeth Drive to four-lanes between The Northern Road and M7 Motorway would also be likely to provide a central median along Elizabeth Drive as part of the Elizabeth Drive upgrade project.

Changes to regional road network volumes

Traffic volumes forecasts for key strategic roads in the wider study area are provided in **Table 6-7** and **Table 6-9** for the locations shown in **Figure 6-15**. Taken as groups, these locations define three major ‘screen lines’ that can be used to compare the changes in directional and two-way demands across the study area at a strategic level. Plots of the screen lines connecting these counts are also provided in **Figure 6-15**.



East-West Screen Line
Eastern North-South Screen Line
Western North-South Screen Line
NPWS estate / reserves
Major waterbodies

Figure 6-15 M12 Motorway footprint screen line locations

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Table 6-7 to **Table 6-10** present a summary of traffic demand at these key screen line locations for the 2017 base year and the 2026 and 2036 do minimum scenarios for morning and evening peak respectively, based on the forecasting methodology outlined in **Section 3.4**. Analysis of the modelled do minimum traffic volumes across each of the screen lines indicates the following:

- North-south traffic volumes across the study area are forecast to increase substantially in the future, almost doubling between 2017 and 2036. The majority of this growth in north-south traffic would occur on the M7 Motorway, Mamre Road and The Northern Road, which are the primary north-south arterial roads through the study area. This reflects the substantial increase in forecast land use in and around the study area, including the Western Sydney Aerotropolis and the South West Growth Area.
- The assumed widening of the M7 Motorway to three lanes in each direction would substantially reduce traffic volumes on Mamre Road west of the proposed Devonshire Street connection. As a result of this realignment, the north-south traffic that currently travels between Devonshire Road and Mamre Road would travel directly north south along the extension of Devonshire Road at a new intersection with Elizabeth Drive.
- Traffic volumes along Luddenham Road would increase substantially by 2036, reflective of the increased traffic from Western Sydney Airport and also due to the realignment and connection of Luddenham Road to Adams Road and through to The Northern Road. This creates an alternative route to The Northern Road for trips travelling to the M4 Motorway via Mamre Road and the Great Western Highway.
- East-west traffic volumes are also forecast to increase by up to 260 per cent by 2036. Most of this growth in east-west traffic would occur on the M4 Motorway, Luddenham Road, Elizabeth Drive and Bringelly Road.
- Increased traffic volumes along Elizabeth Drive are primarily a result of the Western Sydney Airport and the on-site business parks within the Western Sydney Airport.

Table 6-7 Morning peak screen line volume summary (east-west screen line)

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
East-West Screen Line (southbound)							
M7 Motorway Mainline	N of Elizabeth Drive	2,666	2,624	3,092	3,043	4,343	4,041
Wallgrove Road	N of Elizabeth Drive	327	333	184	241	228	160
Cecil Road	N of Elizabeth Drive	231	236	178	174	204	33
Duff Road	N of Elizabeth Drive	52	51	65	57	72	103
Mamre Road	N of Elizabeth Drive	574	532	1,248	1,239	513	525
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	868	936
Luddenham Road	N of Elizabeth Drive	118	143	263	385	518	804
The Northern Road	N of Elizabeth Drive	804	660	1,792	1,708	1,828	1,659
Total		4,772	4,579	6,822	6,847	8,574	8,261
East-West Screen Line (northbound)							
M7 Motorway Mainline	N of Elizabeth Drive	3,291	3,378	3,367	3,683	4,556	4,292
Wallgrove Road	N of Elizabeth Drive	645	592	823	679	941	782
Cecil Road	N of Elizabeth Drive	113	112	39	31	50	36
Duff Road	N of Elizabeth Drive	89	65	173	175	142	153
Mamre Road	N of Elizabeth Drive	547	671	1,070	1,154	303	277
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	1,084	1,332
Luddenham Road	N of Elizabeth Drive	271	263	763	1,237	842	915
The Northern Road	N of Elizabeth Drive	758	744	1,088	1,271	1,086	1,159
Total		**5,714**	**5,825**	**7,323**	**8,230**	**9,004**	**8,946**

Table 6-8 Morning peak screen line volume summary (north-south screen line)

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
Eastern North-South Screen Line (eastbound)							
M4 Motorway	W of Mamre Road	4,057	3,830	4,014	4,368	4,588	3,194
Luddenham Road	W of Mamre Road	431	364	956	1,229	1,152	1,080
Elizabeth Drive	W of Western Road	950	879	1,088	918	1,479	1,637
Bringelly Road	W of Masterfield Street	647	572	1,320	1,381	2,381	1,980
Total		6,085	5,645	7,378	7,896	9,600	7,891
Eastern North-South Screen Line (westbound)							
M4 Motorway	W of Mamre Road	2,229	2,752	3,223	3,728	3,205	3,703
Luddenham Road	W of Mamre Road	178	232	387	459	677	865
Elizabeth Drive	W of Western Road	555	418	1,079	1,206	2,123	2,152
Bringelly Road	W of Masterfield Street	233	294	956	1,082	1,030	1,051
Total		3,195	3,696	5,645	6,475	7,035	7,771
Western North-South Screen Line (eastbound)							
M4 Motorway	W of Kent Road	3,501	3,306	3,339	3,566	3,793	2,801
Lansdowne Road	W of Kent Road	102	114	169	429	324	533
Elizabeth Drive	W of Luddenham Road	697	546	1,452	1,450	1,935	1,974
Adams Road	E of The Northern Road	70	74	132	181	149	180
The Northern Road	W of Mersey Road	567	439	741	709	896	915
Total		**4,937**	**4,479**	**5,833**	**6,335**	**7,097**	**6,403**

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
Western North-South Screen Line (westbound)							
M4 Motorway	W of Kent Road	1,949	2,422	2,676	3,086	2,687	3,043
Lansdowne Road	W of Kent Road	37	46	136	180	197	190
Elizabeth Drive	W of Luddenham Road	310	355	224	390	347	650
Adams Road	E of The Northern Road	8	24	191	269	535	457
The Northern Road	W of Mersey Road	672	485	935	978	1,015	961
Total		**2,976**	**3,332**	**4,162**	**4,903**	**4,781**	**5,301**

Table 6-9 Evening peak screen line volume summary (east-west screen line)

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
East-West Screen Line (southbound)							
M7 Motorway Mainline	N of Elizabeth Drive	3,078	2,577	3,933	3,781	4,961	4,398
Wallgrove Road	N of Elizabeth Drive	929	924	845	865	843	917
Cecil Road	N of Elizabeth Drive	189	131	21	230	17	22
Duff Road	N of Elizabeth Drive	33	28	203	281	227	239
Mamre Road	N of Elizabeth Drive	869	682	1,974	1,877	1,004	877
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	872	946
Luddenham Road	N of Elizabeth Drive	270	299	670	675	1,055	1,019
The Northern Road	N of Elizabeth Drive	791	723	1,052	948	1,718	1,767
Total		6,159	5,364	8,698	8,657	10,697	10,185
East-West Screen Line (northbound)							
M7 Motorway Mainline	N of Elizabeth Drive	3,088	2,631	2,923	2,496	3,976	4,128
Wallgrove Road	N of Elizabeth Drive	344	421	500	676	340	323
Cecil Road	N of Elizabeth Drive	153	137	88	92	42	1
Duff Road	N of Elizabeth Drive	120	97	187	119	208	193
Mamre Road	N of Elizabeth Drive	632	543	1,091	1,152	407	396
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	1,316	1,724
Luddenham Road	N of Elizabeth Drive	162	184	726	802	934	563
The Northern Road	N of Elizabeth Drive	983	829	2,053	2,108	1,992	2,302
Total		**5,482**	**4,842**	**7,568**	**7,445**	**9,215**	**9,630**

Table 6-10 Evening peak screen line volume summary (north-south screen line)

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
Eastern North-South Screen Line (eastbound)							
M4 Motorway	W of Mamre Road	2,787	2,633	4,307	4,018	5,217	5,041
Luddenham Road	W of Mamre Road	201	172	1,077	1,011	1,227	625
Elizabeth Drive	W of Western Road	408	351	607	480	1,793	2,258
Bringelly Road	W of Masterfield Street	373	401	1,700	1,776	1,774	1,893
Total		3,769	3,557	7,691	7,285	10,011	9,817
Eastern North-South Screen Line (westbound)							
M4 Motorway	W of Mamre Road	4,163	4,512	5,193	5,593	5,570	6,083
Luddenham Road	W of Mamre Road	415	448	940	914	1,169	848
Elizabeth Drive	W of Western Road	931	790	1,281	1,112	2,286	2,272
Bringelly Road	W of Masterfield Street	675	762	1,851	2,225	1,409	1,563
Total		6,184	6,512	9,265	9,844	10,434	10,766
Western North-South Screen Line (eastbound)							
M4 Motorway	W of Kent Road	2,405	2,271	3,165	3,113	3,796	3,808
Lansdowne Road	W of Kent Road	74	85	458	408	637	631
Elizabeth Drive	W of Luddenham Road	235	322	369	447	1,096	1,349
Adams Road	E of The Northern Road	42	26	77	188	199	230
The Northern Road	W of Mersey Road	655	698	896	829	1,543	1,544
Total		**3,411**	**3,402**	**4,965**	**4,985**	**7,271**	**7,562**

Road	Location	2017 (vehicles)		2026 (vehicles)		2036 (vehicles)	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
Western North-South Screen Line (westbound)							
M4 Motorway	W of Kent Road	3,686	3,974	4,309	4,594	4,723	5,080
Lansdowne Road	W of Kent Road	124	142	196	247	275	303
Elizabeth Drive	W of Luddenham Road	560	535	1,012	1,032	1,669	1,873
Adams Road	E of The Northern Road	59	111	140	156	722	911
The Northern Road	W of Mersey Road	689	650	1,543	1,638	996	1,145
Total		**5,118**	**5,412**	**7,200**	**7,667**	**8,385**	**9,312**

Traffic volumes across the study area show that the proposed traffic growth associated with the Western Sydney Airport and the on-site business parks within the Western Sydney Airport as well as development further afield in both the Western Sydney Aerotropolis and the South West Growth Area would result in traffic demands on many key arterials through the corridor that are in excess of the capacity that is currently provided by roads that are currently single lane rural roads. Traffic volumes on these roads, particularly Elizabeth Drive, Luddenham Road and Devonshire Road generally exceed capacity during morning and evening peak hours.

Changes to heavy vehicle volumes

The Western Sydney Airport will be a significant attractor of heavy vehicle traffic, generating new freight movements between air and road freight modes. Elizabeth Drive, The Northern Road and M7 Motorway all carry high proportions of heavy vehicles, with heavy vehicles making up between 15 and 20 per cent of daily traffic volumes on these roads. More broadly, freight volumes are likely to increase from general economic growth in the western Sydney area and the greater Sydney metropolitan area, as described in the Greater Sydney Region Plan. Additional freight demand forecasts have been included throughout the traffic modelling.

Heavy vehicles typically avoid travelling during commuter peak periods and tend to travel outside of peaks during the day. For this reason, daily heavy vehicle volumes are a more representative measure of the heavy vehicle traffic demand through the core study area. **Table 6-11** presents a summary of the forecast heavy vehicle volumes on key roads within the core study area.

Modelled daily heavy vehicle forecasts from WRTM indicate substantial growth in heavy vehicle volume by 2036, with daily volumes along sections of Elizabeth Drive in the core study area to increase by up to 250 per cent. Many of these heavy vehicles will be generated by the Western Sydney Airport itself (up to 200 heavy vehicles per day) as well as by the surrounding employment lands forecast to develop on the adjacent lands.

Table 6-11 Daily heavy vehicle forecasts on key roads in the core study area

Road location	Direction	2012* base	2026	% Change from 2012	2036	% Change from 2012
The Northern Road north of Elizabeth Drive	Northbound	600	1,430	138%	1,370	128%
	Southbound	810	1,600	98%	610	-25%
The Northern Road south of Elizabeth Drive	Northbound	620	1,120	81%	1,290	108%
	Southbound	890	1,560	75%	560	-37%
Elizabeth Drive west of Adams Road	Eastbound	180	130	-28%	630	250%
	Westbound	240	430	79%	600	150%
Elizabeth Drive west of Devonshire Road	Eastbound	590	610	3%	1,540	161%
	Westbound	920	1,110	21%	1,450	58%
Elizabeth Drive east of Mamre Road	Eastbound	840	1,290	54%	2,390	185%
	Westbound	1,460	1,610	10%	2,420	66%
Elizabeth Drive East of Wallgrove Road	Eastbound	1,040	1,650	59%	2,770	166%
	Westbound	1,660	1,930	16%	2,790	68%
	Northbound	390	1,080	177%	2,070	431%

Road location	Direction	2012* base	2026	% Change from 2012	2036	% Change from 2012
Mamre Road north of Wallgrove Road	Southbound	220	1270	477%	1720	682%
Wallgrove Road north of Elizabeth Drive	Northbound	430	1050	144%	810	88%
	Southbound	740	1500	103%	1270	72%

*WRTM calibrated base year is 2012

Changes to network performance

A summary of the future network performance statistics for the wider study area under the do minimum scenario is provided in **Table 6-12** and **Table 6-13** for morning and evening peak respectively. Analysis of the network performance without the project indicates the following:

- Traffic demand for the study area is forecast to increase by up to 104 per cent during afternoon peak from 2017 to 2036 (from 223,148 vehicles to 455,336 vehicles). This is reflective of the large increase in residential land that is planned for release as part of the Western Sydney Aerotropolis and the South West Growth Area, as well as employment land associated with Western Sydney Airport.
- Total travel distance through the wider study area would increase by up to 74 per cent during afternoon peak from 2017 to 2036 (from 1,828,324 kilometres to 3,185,503 kilometres), while total travel time through the wider study area would increase by up to 300 per cent during afternoon peak from 2017 to 2036 (from 31,893 hours to 96,743 hours), which would result in average speeds across the network (ie wider study area) reducing by up to 42 per cent during afternoon peak by 2036 (from 57 kilometres per hour to 33 kilometres per hour).
- Up to 18 per cent (80,179 out of 455,336 trips) of the forecast demand over the four-hour peak periods is unable to enter the network by 2036, with the majority of this unreleased traffic distributed at the periphery of the study area in the following locations:
  - South of Bringelly Road between The Northern Road and Camden Valley Way
  - Hoxton Park Road east of the M7 Motorway
  - Elizabeth Drive east of the M7 Motorway
  - Horsley Drive east of the M7 Motorway
  - M4 Motorway east of the M7 Motorway
  - Wallgrove Road north of the M4 Motorway
  - Archbold Road north of the M4 Motorway
  - Western Sydney Airport on-site business park accesses.

This indicates that the future road network at these locations would have insufficient capacity to carry the traffic that would be generated by the land use surrounding and within the wider study area and that many roads surrounding the study area would be at or near capacity in the future, including:

- M7 Motorway northbound and southbound between Hoxton Park Road and the M4 Motorway
- Elizabeth Drive east and west of the M7 Motorway interchange
- Wallgrove Road in the vicinity of the M7 Motorway, the Horsley Drive and Elizabeth Drive
- Cowpasture Road between the M7 Motorway and Hoxton Park Road.

Table 6-12 Modelled do minimum morning peak network performance

Network measure	2017	2026 do minimum	2036 do minimum
Network statistics for all vehicles			
Total traffic demand (vehicles)	193,949	276,206	344,333
Total vehicle kilometres travelled through network	1,667,587	2,350,227	2,673,216
Total vehicle travel time through the network (hours)	28,699	60,008	74,249
Average network speed (kilometres per hour)	58	39	36
Total vehicles entering the network	196,113	268,058	305,541
Unreleased traffic			
Total unreleased trips	204	10,383	37,133
percentage of demand unreleased	0%	4%	11%

Table 6-13 Modelled do minimum evening peak network performance

Network measure	2017	2026 do minimum	2036 do minimum
Network statistics for all vehicles			
Total traffic demand (vehicles)	223,148	345,296	455,336
Total vehicle kilometres travelled through network	1,828,324	2,802,008	3,185,503
Total vehicle travel time through the network (hours)	31,893	78,157	96,743
Average network speed (kilometres/hr)	57	36	33
Total vehicles entering the network	227,661	332,230	376,363
Unreleased traffic			
Total unreleased trips	807	23,351	80,179
percentage of demand unreleased	0%	7%	18%

Induced demand

Induced demand accounts for the potential new trips that would not be undertaken if the project was not built. This induced demand is calculated at the Sydney-wide level in the traffic model as a result of the project, and represents the change in utility across the network as a result of the project being built. As discussed previously, the WRTM considers the changes in traffic associated with this induced demand. This equates to about 0.2 per cent additional daily trips in the Sydney metropolitan area in 2036 and represents the change in utility across the network as a result of the project being built.

It is not expected that the induced demand more locally to the project would exceed this figure accounted for by the WRTM, since the project is primarily providing improved access to new development.

Intersection performance

Modelled future intersection performance for key intersections within the core study area under the do minimum scenario are provided in **Table 6-13** and **Table 6-14** for the morning and evening peak respectively. Modelled intersection performance indicates that the following:

- Many intersections along Elizabeth Drive would operate at an unsatisfactory Level of Service of E or worse by 2026, reflecting forecast traffic demands that exceed available capacity at most of these intersections, even after upgrades. The intersections that would operate at an unsatisfactory Level of Service by 2026 include:
  - Elizabeth Drive and The Northern Road (from A to F)
  - Elizabeth Drive and Luddenham Road (from A to E)
  - Elizabeth Drive and Martin Road (from A to D)
  - Elizabeth Drive and Western Road (from A to F)
  - Elizabeth Drive and Devonshire Road (from A to F)
  - Elizabeth Drive and Mamre Road (from A to F)
  - Elizabeth Drive and Duff Road (from A to F)
  - Elizabeth Drive, Wallgrove Road and the M7 Motorway (from B to F)
- The assumed widening of Elizabeth Drive to two lanes in each direction between Mamre Road and the M7 Motorway, as well as the proposed upgrade of the Elizabeth Drive and Mamre Road roundabout to traffic signals would improve intersection performance along this section, however capacity limitations at the M7 Motorway interchange would still result in unsatisfactory performance of intersections on the eastern end of Elizabeth Drive in the vicinity of the M7 Motorway.
- The proposed eastern and western business park accesses would have sufficient capacity to serve the forecast demand into and out of Western Sydney Airport in 2026, however by 2036 these accesses would be operating at unsatisfactory levels of service and would be unable to support the level of growth forecast for Western Sydney Airport.

Overall intersection performance under the do minimum scenario indicates that even with assumed upgrades along Elizabeth Drive, the corridor would have insufficient capacity to carry forecast traffic demand that is expected to accompany Western Sydney Airport and its associated land uses.

Table 6-14 Morning peak intersection Levels of Service without the project

Intersection	2017 Base		2026 do minimum		2036 do minimum	
	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS
Elizabeth Drive/Northern Road	12	A	67	E	>100	F
Elizabeth Drive/Luddenham Road	13	A	77	F	41	C
Elizabeth Drive/Business Park East	N/A	N/A	30	C	33	C
Elizabeth Drive/Business Park West	N/A	N/A	25	B	>100	F
Elizabeth Drive/Martin Road	9	A	36	C	44	D
Elizabeth Drive/Western Road	14	A	61	E	42	C
Elizabeth Drive/Devonshire Road	13	A	>100	F	80	F
Elizabeth Drive/Mamre Road	14	A	>100	F	36	C
Elizabeth Drive/Duff Road	12	A	17	B	23	B
Elizabeth Drive/Wallgrove Road	31	C	45	D	74	F

Intersection	2017 Base		2026 do minimum		2036 do minimum	
	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS
Elizabeth Drive/M7 Motorway	20	B	>100	F	>100	F
Wallgrove Road/M7 Motorway	2	A	20	B	13	A

Table 6-15 Evening peak intersection Levels of Service without the project

Intersection	2017 Base		2026 do minimum		2036 do minimum	
	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS
Elizabeth Drive/Northern Road	11	A	51	D	64	E
Elizabeth Drive/Luddenham Road	18	B	>100	F	66	E
Elizabeth Drive/Business Park East	N/A	N/A	33	C	34	C
Elizabeth Drive/Business Park West	N/A	N/A	31	C	31	C
Elizabeth Drive/Martin Road	12	A	85	F	48	D
Elizabeth Drive/Western Road	9	A	>100	F	45	D
Elizabeth Drive/Devonshire Road	12	A	>100	F	73	F
Elizabeth Drive/Mamre Road	14	A	56	D	38	C
Elizabeth Drive/Duff Road	9	A	>100	F	26	B
Elizabeth Drive/Wallgrove Road	48	D	>100	F	>100	F
Elizabeth Drive/M7 Motorway	17	B	>100	F	>100	F
Wallgrove Road/M7 Motorway	10	A	80	F	>100	F

General traffic travel times

Modelled general traffic travel times on key routes through the core study area under the do minimum scenario are presented in **Figure 6-16** to **Figure 6-21**. Analysis of the modelled travel times under the do minimum scenario indicates:

- Travel times on the M7 Motorway, particularly in the vicinity of Elizabeth Drive would increase substantially by 2026. This is a result of the existing capacity issues that are currently observed on the M7 Motorway between Hoxton Park Road and Elizabeth Drive, where steep grades, particularly northbound on approach to Elizabeth Drive, cause heavy vehicles to slow down. As traffic volumes increase along the M7 Motorway in these locations, increased delays are expected even under the existing reduced speed zones that operate in this area.
- The assumed widening of the M7 Motorway by 2036 would relieve delays associated with heavy vehicle speeds, allowing trucks to remain in the kerbside lane and provide sufficient passing capacity for general traffic. By 2036, assumed widening of the M7 Motorway would reduce delays and facilitate travel times along this motorway that are in line with existing performance.
- Eastbound and westbound travel times on Elizabeth Drive would increase substantially, even with localised intersection upgrades in 2026 and widening to four lanes in 2036. These delays are a result of the capacity constraints at the Elizabeth Drive/M7 Motorway interchange, where limited work is possible to increase the capacity of the already constrained double-point interchange. Traffic turning right onto

the M7 Motorway from Elizabeth Drive conflicts with through traffic eastbound and westbound on Elizabeth Drive, resulting in queues that would extend as far as Duff Road by 2036.

- Travel times on The Northern Road would increase in 2026 and 2036, however this would largely be limited to the approaches to Elizabeth Drive, which would be the primary access route to the Western Sydney Airport from Penrith.

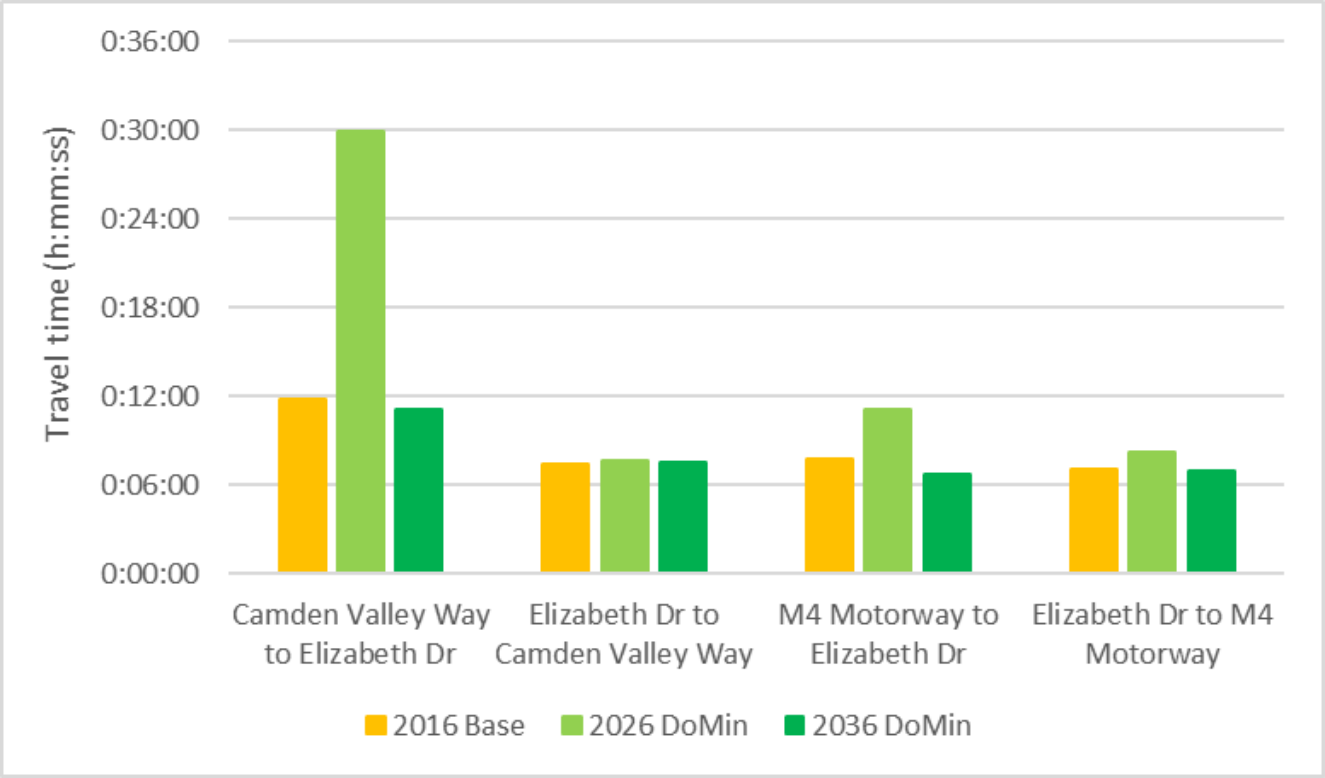

Figure 6-16 M7 Motorway morning peak travel times (8am to 9am)

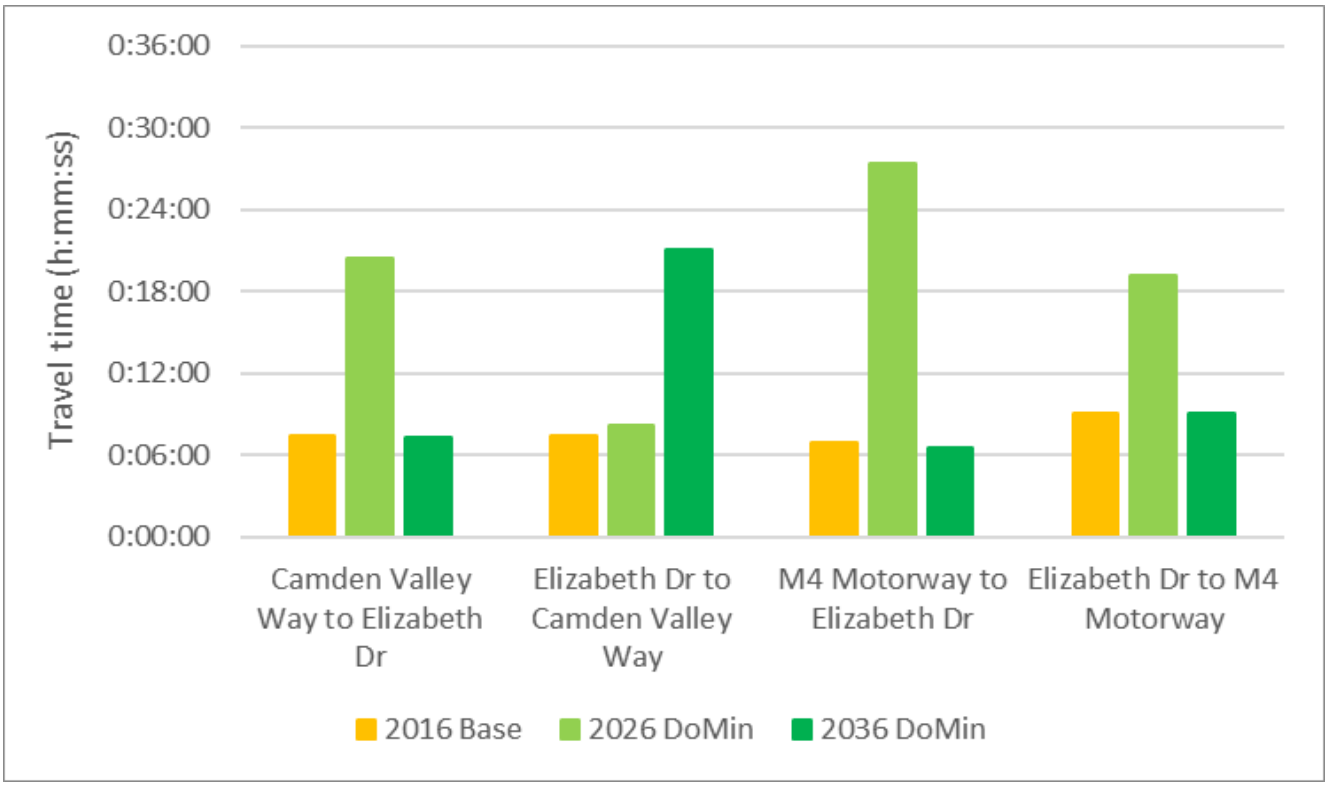

Figure 6-17 M7 Motorway evening peak travel times (5pm to 6pm)

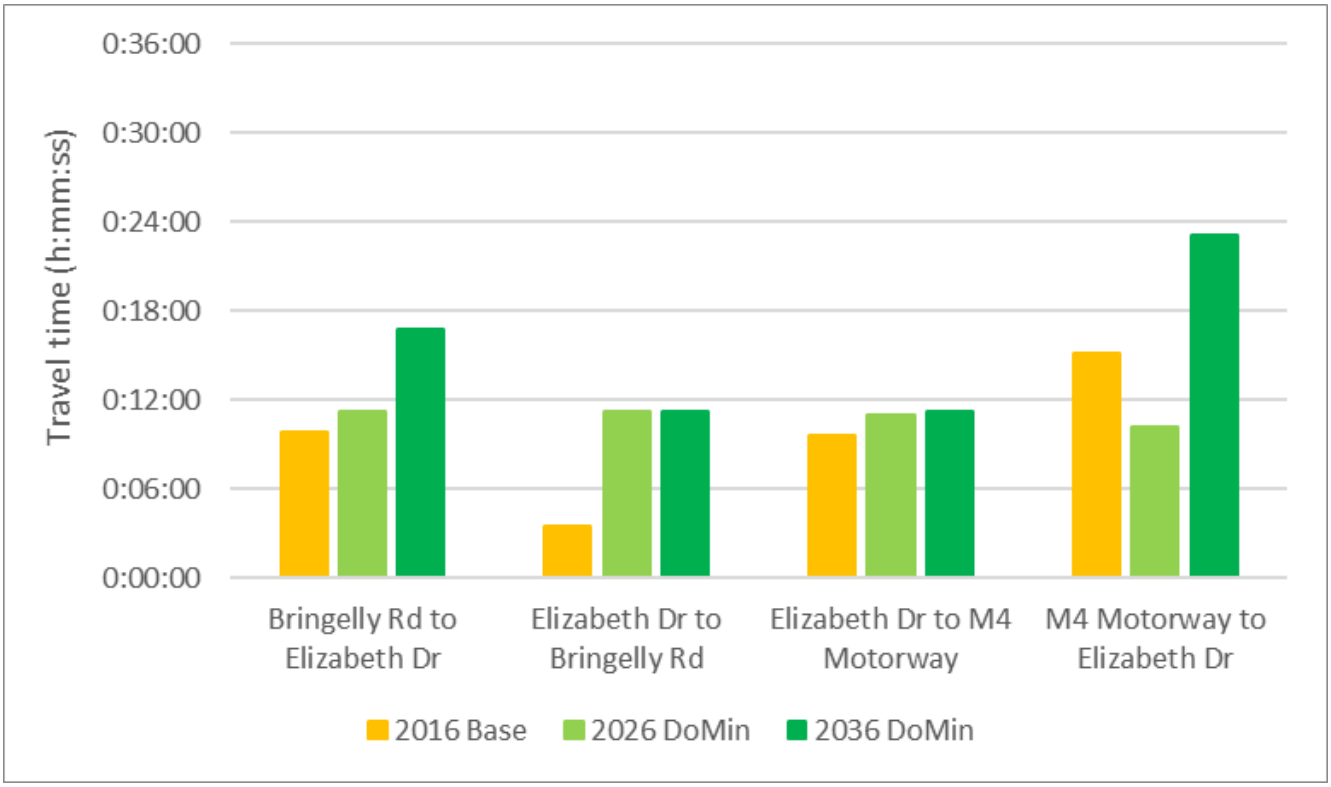

Figure 6-18 The Northern Road morning peak travel times (8am to 9am)

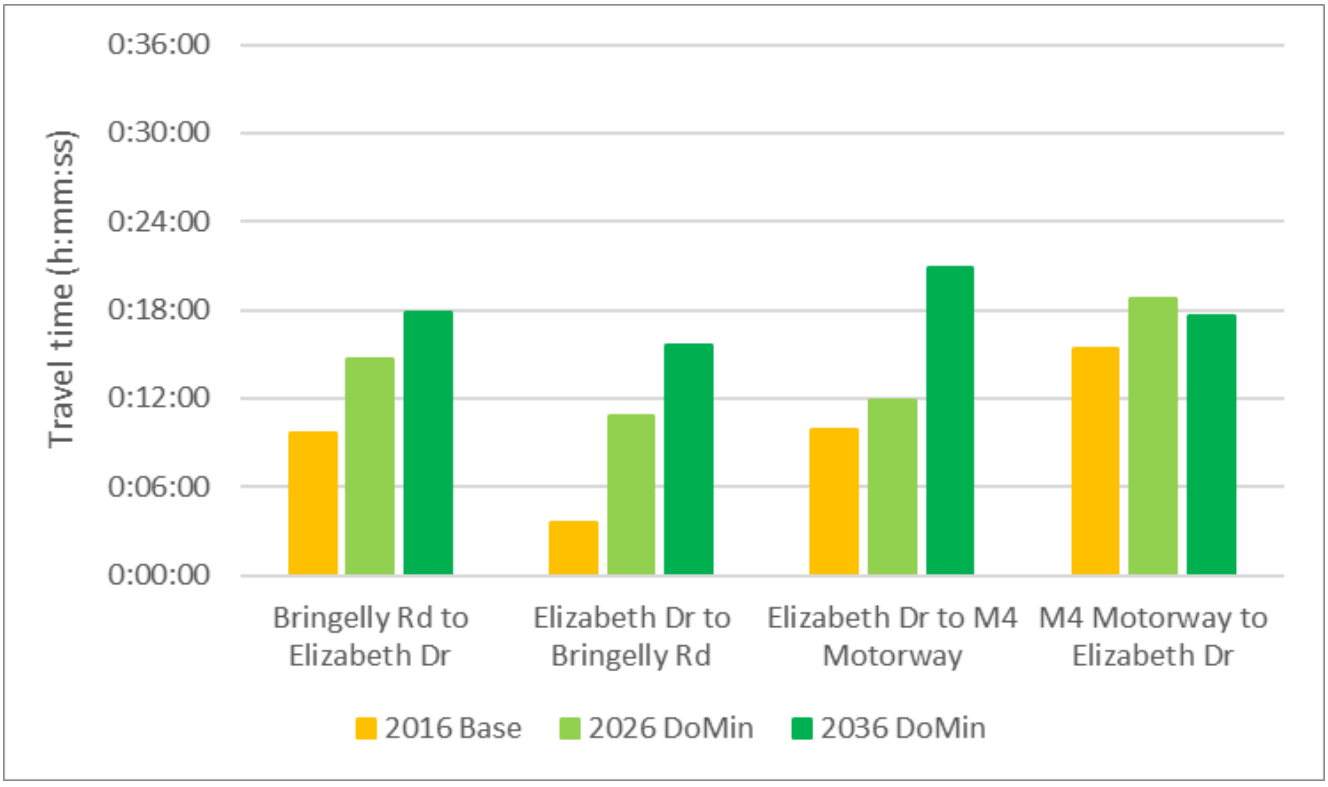

Figure 6-19 The Northern Road evening peak travel times (5pm to 6pm)

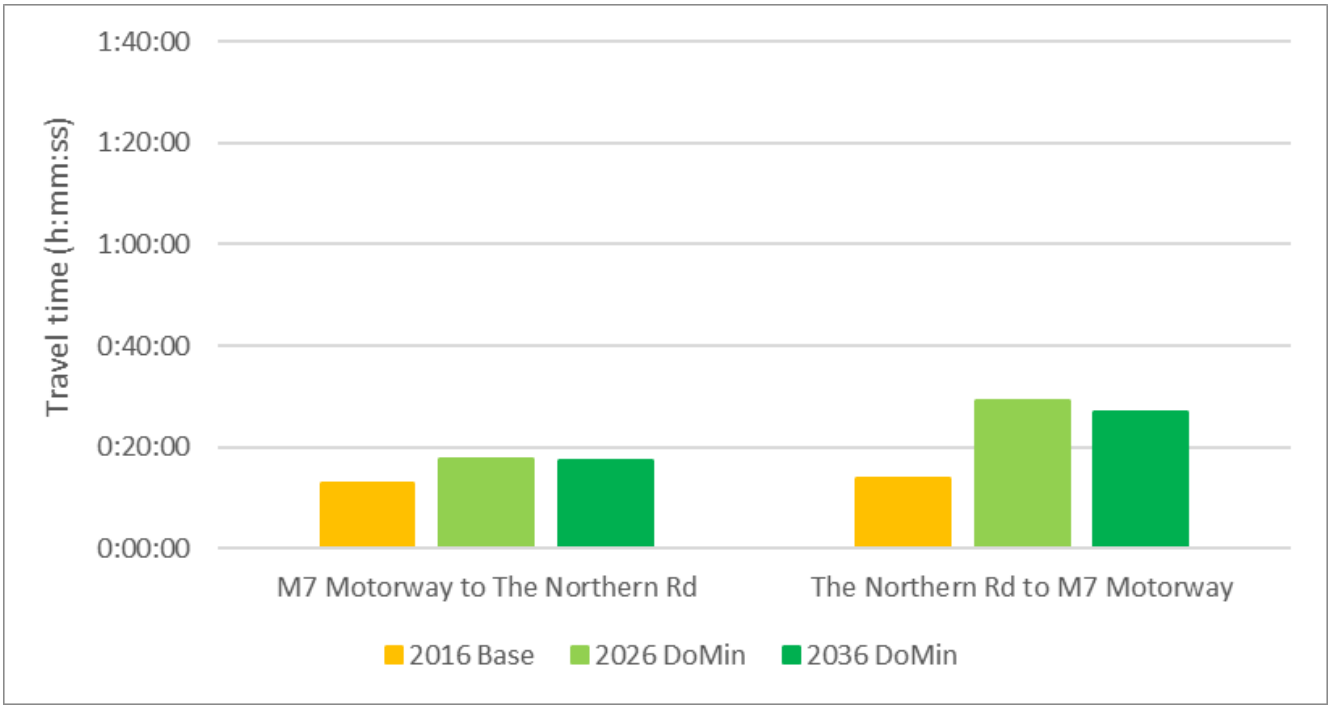

Figure 6-20 Elizabeth Drive morning peak travel times (8am to 9am)

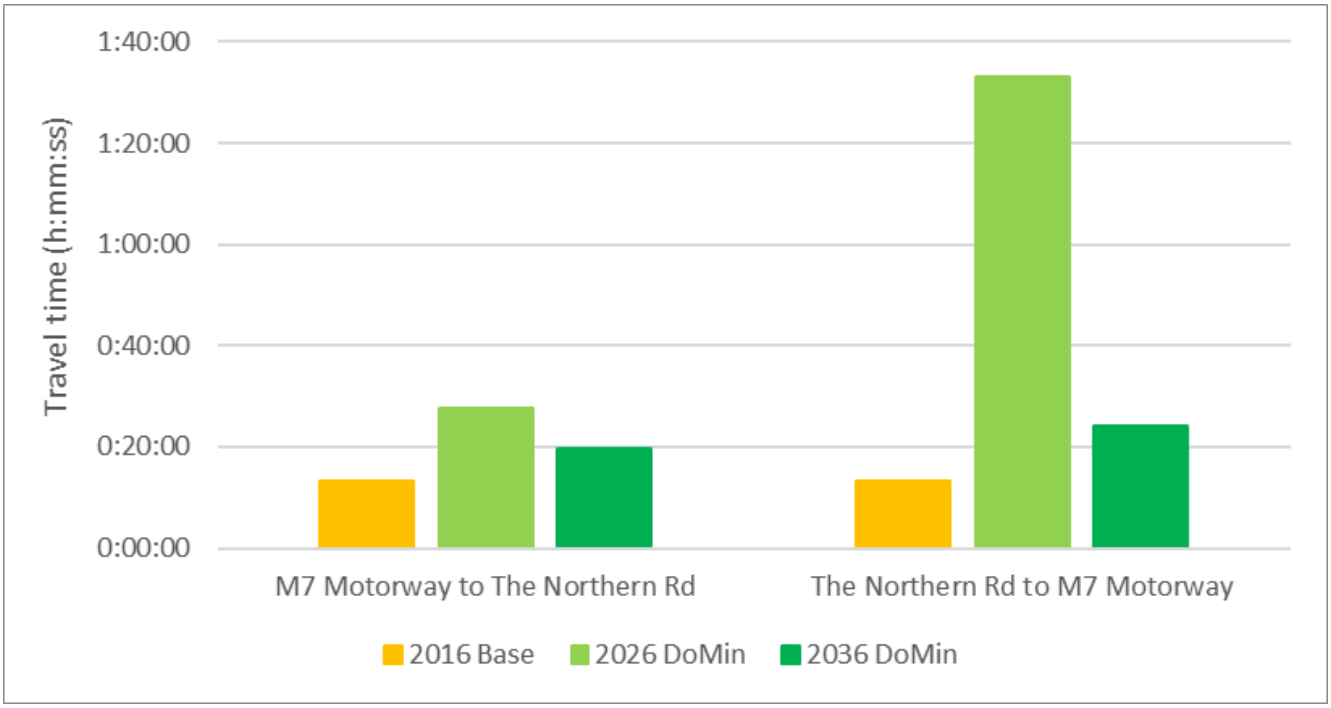

Figure 6-21 Elizabeth Drive evening peak travel times (5pm to 6pm)

Summary

Assessment of the future performance of the transport network in the wider study area without the project indicates the following key issues:

- Traffic volumes on key roads the wider study area are forecast to increase substantially, almost doubling by 2036 from 2017 volumes. This is indicative of the large planned land releases occurring in the Western Sydney Aerotropolis, Western Sydney Employment Area and the South West Growth Area.
- The majority of arterial and motorway corridors surrounding the study area would experience high delays at critical constraints in the network, including:
  - M7 Motorway northbound and southbound between Hoxton Park Road and M4 Motorway
  - Elizabeth Drive east and west of the M7 Motorway interchange
  - Wallgrove Road in the vicinity of the M7 Motorway, the Horsley Drive and Elizabeth Drive
  - Cowpasture Road between M7 Motorway and Hoxton Park Road.
- Proposed intersection upgrades along Elizabeth Drive in 2026 and full widening of the corridor to four lanes in 2036 would still result in high delays in 2026 and 2036 because of the high volume of traffic forecast for the corridor. Further, despite these corridor upgrades, there is limited scope to add capacity at the Elizabeth Drive/M7 Motorway interchange, where conflicting demand between Elizabeth Drive and the M7 Motorway traffic would result in high delays by 2036
- The assumed widening of the M7 Motorway in 2036 would reduce mainline delays caused by heavy vehicles, particularly northbound on approach to Elizabeth Drive and reduce travel times, however many of the interchanges along the M7 Motorway have limited capacity and would experience congestion on the arterial road network at locations including Camden Valley Way, Cowpasture Road, Bernera Road, The Horsley Drive and Elizabeth Drive.

6.2.2 Assessment of impacts with the project

Overview

This section provides a summary of the road network performance in 2026 and 2036 with the project (the project scenario). This assessment has been based on a comparison of the do minimum scenario (see **Section 6.2.1**) with the project scenario for the following performance measures:

- Regional road network performance, examining the growth in traffic volumes on strategic roads in the study area
- Network performance based on vehicle hours of travel (VHT), vehicle kilometres of travel (VKT) and average network speed
- Intersection performance based on intersection Level of Service
- General traffic travel times for key corridors.

Regional road network volumes

Traffic volumes forecasts for key strategic roads through the wider study area are provided in **Table 6-16** and **Table 6-19** for the locations shown in **Figure 6-22**. Taken as groups, these locations define three major “screen lines” that can be used to compare the changes in directional and two-way demands across the study area at a strategic level. Plots of the screen lines connecting these counts is also provided in **Figure 6-22**.

Table 6-16 to **Table 6-21** presents a summary of traffic demand at these key screen line locations for the 2026 and 2036 do minimum and project scenarios for morning and evening peak respectively.

Table 6-16 Morning peak project screen line volume summary (east-west screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
East-West Screen Line (southbound)									
M7 Motorway Mainline	N of Elizabeth Drive	3,092	3,043	3,153	2,881	4,343	4,041	4,130	3,811
Wallgrove Road	N of Elizabeth Drive	184	241	162	204	228	160	164	182
Cecil Road	N of Elizabeth Drive	178	174	225	271	204	33	251	327
Duff Road	N of Elizabeth Drive	65	57	92	71	72	103	120	83
Mamre Road	N of Elizabeth Drive	1,248	1,239	1,103	1,118	513	525	545	521
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	868	936	608	621
M12 Motorway	N of Elizabeth Drive	N/A	N/A	579	568	N/A	N/A	1,438	1,574
Luddenham Road	N of Elizabeth Drive	263	385	261	386	518	804	629	797
The Northern Road	N of Elizabeth Drive	1,792	1,708	1,129	1,083	1,828	1,659	1,529	1,625
Total		**6,822**	**6,847**	**6,704**	**6,582**	**8,574**	**8,261**	**9,414**	**9,541**

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
East-West Screen Line (northbound)									
M7 Motorway Mainline	N of Elizabeth Drive	3,367	3,683	2,722	3,824	4,556	4,292	4,971	4,473
Wallgrove Road	N of Elizabeth Drive	823	679	935	729	941	782	883	919
Cecil Road	N of Elizabeth Drive	39	31	24	22	50	36	33	60
Duff Road	N of Elizabeth Drive	173	175	184	187	142	153	145	164
Mamre Road	N of Elizabeth Drive	1,070	1,154	1,244	1,232	303	277	341	298
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	1,084	1,332	1,172	1,340
M12 Motorway	N of Elizabeth Drive	N/A	N/A	237	326	N/A	N/A	1,074	1,008
Luddenham Road	N of Elizabeth Drive	763	1,237	1,023	1,214	842	915	840	982
The Northern Road	N of Elizabeth Drive	1,088	1,271	1,179	1,432	1,086	1,159	1,170	1,257
Total		**7,323**	**8,230**	**7,548**	**8,966**	**9,004**	**8,946**	**10,629**	**10,501**

Table 6-17 Morning peak project screen line volume summary (eastern north-south screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
Eastern North-South Screen Line (eastbound)									
M4 Motorway	W of Mamre Road	4,014	4,368	4,487	4,052	4,588	3,194	4,189	3,730
Luddenham Road	W of Mamre Road	956	1,229	1,035	1,246	1,152	1,080	1,059	1,059
M12 Motorway	W of Mamre Road	N/A	N/A	960	1,356	N/A	N/A	1,881	1,921
Elizabeth Drive	W of Western Road	1,088	918	704	790	1,479	1,637	1,339	1,538
Bringelly Road	W of Masterfield Street	1,320	1,381	1,205	1,182	2,381	1,980	2,054	1,808
Total		**7,378**	**7,896**	**8,391**	**8,626**	**9,600**	**7,891**	**10,522**	**10,056**
Eastern North-South Screen Line (westbound)									
M4 Motorway	W of Mamre Road	3,223	3,728	3,147	3,680	3,205	3,703	3,354	3,727
Luddenham Road	W of Mamre Road	387	459	344	448	677	865	725	812
M12 Motorway	W of Mamre Road	N/A	N/A	474	468	N/A	N/A	1,092	1,174
Elizabeth Drive	W of Western Road	1,079	1,206	918	986	2,123	2,152	1,211	1,431
Bringelly Road	W of Masterfield Street	956	1,082	929	1,116	1,030	1,051	917	1,072
Total		**5,645**	**6,475**	**5,812**	**6,698**	**7,035**	**7,771**	**7,299**	**8,216**

Table 6-18 Morning peak project screen line volume summary (western north-south screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am	7am to 8am	8am to 9am
Western North-South Screen Line (eastbound)									
M4 Motorway	W of Kent Road	3,339	3,566	3,673	3,437	3,793	2,801	3,360	3,123
Lansdowne Road	W of Kent Road	169	429	167	396	324	533	274	413
M12 Motorway	W of Luddenham Road	N/A	N/A	1,050	1,345	N/A	N/A	1,696	1,798
Elizabeth Drive	W of Luddenham Road	1,452	1,450	886	819	1,935	1,974	1,472	1,728
Adams Road	E of The Northern Road	132	181	188	208	149	180	184	192
The Northern Road	W of Mersey Road	741	709	678	654	896	915	832	1,009
Total		**5,833**	**6,335**	**6,642**	**6,859**	**7,097**	**6,403**	**7,818**	**8,263**
Western North-South Screen Line (westbound)									
M4 Motorway	W of Kent Road	2,676	3,086	2,609	3,049	2,687	3,043	2,791	3,072
Lansdowne Road	W of Kent Road	136	180	136	182	197	190	190	217
M12 Motorway	W of Luddenham Road	N/A	N/A	196	207	N/A	N/A	497	495
Elizabeth Drive	W of Luddenham Road	224	390	367	333	347	650	351	373
Adams Road	E of The Northern Road	191	269	59	204	535	457	336	651
The Northern Road	W of Mersey Road	935	978	999	1,228	1,015	961	947	1,075
Total		**4,162**	**4,903**	**4,366**	**5,203**	**4,781**	**5,301**	**5,112**	**5,883**

Table 6-19 Evening peak Project screen line volume summary (east-west screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
East-West Screen Line (southbound)									
M7 Motorway Mainline	N of Elizabeth Drive	3,933	3,781	3,865	3,842	4,961	4,398	4,925	4,372
Wallgrove Road	N of Elizabeth Drive	845	865	649	785	843	917	777	797
Cecil Road	N of Elizabeth Drive	21	230	77	71	17	22	13	50
Duff Road	N of Elizabeth Drive	203	281	143	122	227	239	205	211
Mamre Road	N of Elizabeth Drive	1,974	1,877	1,889	2,015	1,004	877	1,042	912
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	872	946	821	861
M12 Motorway	N of Elizabeth Drive	N/A	N/A	300	333	N/A	N/A	793	857
Luddenham Road	N of Elizabeth Drive	670	675	714	730	1,055	1,019	938	905
The Northern Road	N of Elizabeth Drive	1,052	948	918	849	1,718	1,767	1,843	1,809
Total		**8,698**	**8,657**	**8,555**	**8,747**	**10,697**	**10,185**	**11,357**	**10,774**

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
East-West Screen Line (northbound)									
M7 Motorway Mainline	N of Elizabeth Drive	2,923	2,496	3,460	2,921	3,976	4,128	4,697	4,540
Wallgrove Road	N of Elizabeth Drive	500	676	464	455	340	323	439	540
Cecil Road	N of Elizabeth Drive	88	92	25	27	42	1	45	25
Duff Road	N of Elizabeth Drive	187	119	184	193	208	193	278	212
Mamre Road	N of Elizabeth Drive	1,091	1,152	1,239	1,249	407	396	246	317
Devonshire Road	N of Elizabeth Drive	N/A	N/A	N/A	N/A	1,316	1,724	1,222	1,297
M12 Motorway	N of Elizabeth Drive	N/A	N/A	491	427	N/A	N/A	1,844	1,797
Luddenham Road	N of Elizabeth Drive	726	802	720	757	934	563	671	738
The Northern Road	N of Elizabeth Drive	2,053	2,108	2,174	2,040	1,992	2,302	2,193	1,844
Total		**7,568**	**7,445**	**8,757**	**8,069**	**9,215**	**9,630**	**11,635**	**11,310**

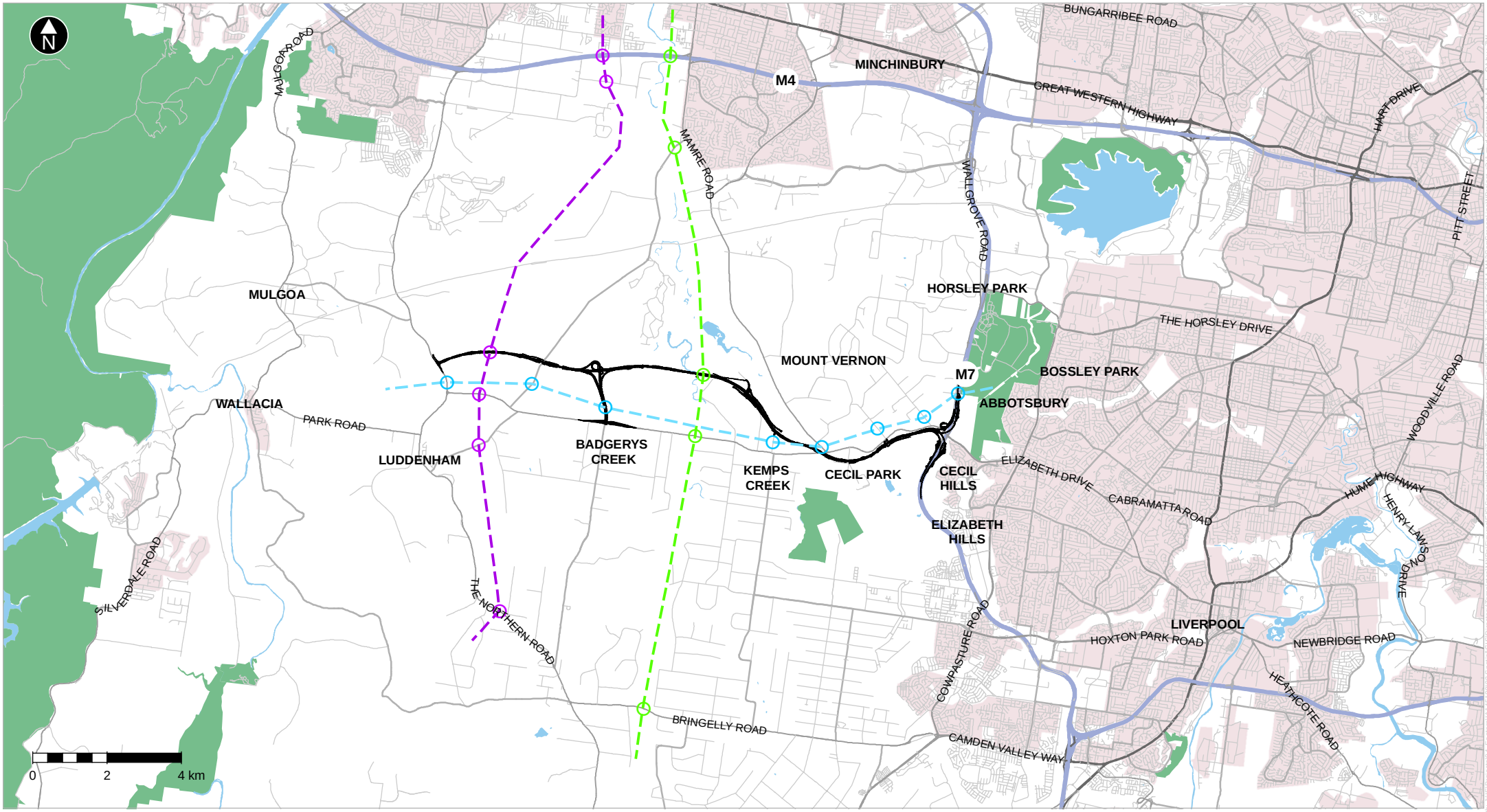

Figure 6-22 M12 Motorway footprint screen line locations (with project)

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Table 6-20 Evening peak project screen line volume summary (eastern north-south screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
Eastern North-South Screen Line (eastbound)									
M4 Motorway	W of Mamre Road	4,307	4,018	4,054	4,076	5,217	5,041	5,178	4,877
Luddenham Road	W of Mamre Road	1,077	1,011	953	942	1,227	625	967	760
M12 Motorway	W of Mamre Road	N/A	N/A	1,014	802	N/A	N/A	2,236	1,997
Elizabeth Drive	W of Western Road	607	480	618	534	1,793	2,258	1,321	1,470
Bringelly Road	W of Masterfield Street	1,700	1,776	1,487	1,597	1,774	1,893	2,018	1,435
Total		**7,691**	**7,285**	**8,126**	**7,951**	**10,011**	**9,817**	**11,720**	**10,539**
Eastern North-South Screen Line (westbound)									
M4 Motorway	W of Mamre Road	5,193	5,593	5,357	5,602	5,570	6,083	5,654	5,898
Luddenham Road	W of Mamre Road	940	914	851	923	1,169	848	1,016	857
M12 Motorway	W of Mamre Road	N/A	N/A	582	751	N/A	N/A	1,203	1,322
Elizabeth Drive	W of Western Road	1,281	1,112	1,066	1,152	2,286	2,272	1,778	1,777
Bringelly Road	W of Masterfield Street	1,851	2,225	1,852	1,867	1,409	1,563	1,551	1,323
Total		**9,265**	**9,844**	**9,708**	**10,295**	**10,434**	**10,766**	**11,202**	**11,177**

Table 6-21 Evening peak project screen line volume summary (western north-south screen line)

Road	Location	2026 do minimum		2026 project		2036 do minimum		2036 project	
		4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm	4pm to 5pm	5pm to 6pm
Western North-South Screen Line (eastbound)									
M4 Motorway	W of Kent Road	3,165	3,113	3,253	3,219	3,796	3,808	3,856	3,581
Lansdowne Road	W of Kent Road	458	408	402	387	637	631	589	569
M12 Motorway	W of Luddenham Road	N/A	N/A	586	477	N/A	N/A	1,161	1,055
Elizabeth Drive	W of Luddenham Road	369	447	370	390	1,096	1,349	727	821
Adams Road	E of The Northern Road	77	188	62	71	199	230	257	201
The Northern Road	W of Mersey Road	896	829	716	716	1,543	1,544	1,499	1,513
Total		**4,965**	**4,985**	**5,389**	**5,260**	**7,271**	**7,562**	**8,089**	**7,740**
Western North-South Screen Line (westbound)									
M4 Motorway	W of Kent Road	4,309	4,594	4,509	4,602	4,723	5,080	4,753	4,922
Lansdowne Road	W of Kent Road	196	247	231	233	275	303	298	284
M12 Motorway	W of Luddenham Road	N/A	N/A	354	511	N/A	N/A	1,243	1,271
Elizabeth Drive	W of Luddenham Road	1,012	1,032	1,095	1,095	1,669	1,873	1,463	1,417
Adams Road	E of The Northern Road	140	156	80	170	722	911	553	746
The Northern Road	W of Mersey Road	1,543	1,638	1,327	1,272	996	1,145	1,172	590
Total		**7,200**	**7,667**	**7,596**	**7,883**	**8,385**	**9,312**	**9,482**	**9,230**

Overall, at a regional scale the project would not substantially impact traffic volumes on surrounding higher-order roads. The changes in traffic volumes associated with the project would be a more localised level, resulting in a redistribution of traffic primarily along the Elizabeth Drive corridor by shifting traffic from Elizabeth Drive and onto M12 Motorway, with minimal changes to other regional roads in the study area. This redistribution would also benefit the M7 Motorway by reducing the volume of traffic that would need to travel through the existing Elizabeth Drive interchange which is a significant capacity constraint in the core study area.

More detailed analysis of the of the modelled traffic volumes on a screen line basis with the project indicates the following:

- The project would result in increased flows southbound across the study area in the morning peak and northbound in the evening peak. The introduction of the M12 Motorway interchange at the M7 Motorway would allow for free-flow movement for traffic travelling to and from the Western Sydney Airport via the M12 Motorway instead of through the existing Elizabeth Drive interchange, which would reach capacity (without the project) by 2026. By 2036, this would allow a much greater volume of traffic to travel along M7 Motorway in the peak direction unimpeded by the existing capacity constraints at Elizabeth Drive.
- Eastbound and westbound volumes across the study area in the peak periods would increase as a result of the project, in both morning and evening peak periods. The majority of this additional traffic would be along the Elizabeth Drive and M12 Motorway corridor. Approximately 50 per cent of the traffic volumes that would travel along Elizabeth Drive in the do minimum scenario would transfer to M12 Motorway, freeing up capacity along Elizabeth Drive for trips that would otherwise be unable to enter the wider study area either at the Western Sydney Airport Access or on Elizabeth Drive to the east of the M7 Motorway during the peak period. By freeing up capacity in these locations, the project would facilitate more travel that would otherwise not be made during the peak period, although this demand would still exist with or without the project.
- The transfer of traffic from Elizabeth Drive to M12 Motorway would reduce right turning traffic travelling from the Elizabeth Drive to the M7 Motorway at the existing M7 Motorway interchange. This would allow for more traffic to travel east-west along Elizabeth Drive at the M7 Motorway interchange from the east than would be possible without the project.
- The transfer of traffic from Elizabeth Drive to M12 Motorway, combined with additional traffic that would be able to enter the study area at Western Sydney Airport and on Elizabeth Drive east of the M7 Motorway would result in reduced traffic volumes along Elizabeth Drive of up to 43 per cent by 2036.

Network performance statistics

A summary of the future network performance statistics for the wider study area under the project scenario is provided in **Table 6-22** and **Table 6-23**. Analysis of the modelled network statistics shows the following:

- The project would result in increased average network speed by 2036, in the morning peak by 3 per cent and in the evening peak by 8 per cent
- The project would not substantially change the amount of traffic that would be unable to enter the wider study area by the end of the peak period, as much of this traffic is south of Bringelly Road and at a wide remove from the project.
- The total distance travelled through the network would increase with the project by 7 per cent in the morning peak and evening peak, due to the additional distance along the alignment of the M12 Motorway, however this would be at a much higher travel speed than Elizabeth Drive, resulting in lower total hours of travel.

Overall, the network performance statistics show that the project would substantially improve traffic conditions in the study area, particularly in the evening peak, leading to lower delays and higher average speeds across the network.

Table 6-22 Modelled project morning peak network performance

Network measure	2026 do minimum	2026 project	2036 do minimum	2036 project
Network statistics for all vehicles				
Total traffic demand (vehicles)	276,206	269,769	344,333	338,577
Total vehicle kilometres travelled through network	2,350,227	2,414,354	2,673,216	2,845,037
Total vehicle travel time through the network (hours)	60,008	61,348	74,249	75,995
Average network speed (kilometres per hour)	39	39	36	37
Total vehicles entering the network	268,058	269,648	305,541	307,046
Unreleased traffic				
Total unreleased trips	10,383	10,207	37,133	39,182
Percentage of demand unreleased	4%	4%	11%	12%

Table 6-23 Modelled project evening peak network performance

Network measure	2026 do minimum	2026 project	2036 do minimum	2036 project
Network statistics for all vehicles				
Total traffic demand (vehicles)	345,296	338,126	455,336	449,659
Total vehicle kilometres travelled through network	2,802,008	2,875,652	3,185,503	3,411,466
Total vehicle travel time through the network (hours)	78,157	70,063	96,743	95,691
Average network speed (kilometres per hour)	36	41	33	36
Total vehicles entering the network	332,230	328,467	376,363	378,351
Unreleased traffic				
Total unreleased trips	23,351	21,866	80,179	81,972
Percentage of demand unreleased	7%	6%	18%	18%

Intersection performance

Modelled future intersection performance for key intersections within the core study area under the project scenario as well as comparison against the performance under the do minimum scenario is presented in **Table 6-24** and **Table 6-25** for morning and evening peak respectively.

Modelled intersection performance under the project scenario indicates the following:

- The project would reduce traffic volumes and delays along Elizabeth Drive, particularly in the westbound direction. Under the 2026 scenario, this makes Devonshire Road, Elizabeth Drive and Luddenham Road a more attractive toll-free alternative to M7 Motorway, which would have substantial increases in delay under the 2026 forecast years. This would create more demand for the right turn from Elizabeth Drive to Luddenham Road northbound, increasing delays at this location.
- Reduced flows along Elizabeth Drive because of the project would improve the performance of most intersections along Elizabeth Drive, including the intersections of Elizabeth Drive with:
  - The Northern Road
  - Luddenham Road
  - Eastern and Western Business Park Accesses
  - Western Road
  - Devonshire Road
  - Wallgrove Road
- The M7 Motorway/Elizabeth Drive interchange would continue to perform poorly in the morning and evening peak period. While the project would reduce demand for traffic travelling between Western Sydney Airport and the M7 Motorway through this interchange, the remaining demand for this intersection, which would exist with or without the project would still exceed its capacity.
- The intersection of Mamre Road and Elizabeth Drive would perform worse under the project scenario due to the conflict of additional right turning traffic that would use Elizabeth Drive and Mamre Road as a toll-free alternative to the M7 Motorway to travel from east to north through the study area. Without the project, this traffic would be held back on Elizabeth Drive to the east of the M7 Motorway. However, reduced traffic between Elizabeth Drive and M7 Motorway through this interchange would allow more traffic to travel west along Elizabeth Drive and would conflict with eastbound traffic at this roundabout, causing increased eastbound delays, effectively transferring delay from outside the wider study area to inside the wider study area.
- The inclusion of a loop ramp providing access to the M7 Motorway from Elizabeth Drive would remove the existing priority intersection that provides access to the M7 Motorway from Wallgrove Road. This would effectively remove any delays associated with this movement, allowing for a free-flow access to the M7 Motorway from Elizabeth Drive and substantially reducing delays for this movement.

In summary, morning peak intersection performance would be either unchanged or improved in all cases, except for the Elizabeth Drive/Wallgrove Road intersection. The performance of this intersection would decrease from a D to an F in 2026 but would be improved back to a D by 2036. This is not considered to be a major impact.

Evening peak intersection performance would be either static or unchanged, with the exception of the Elizabeth Drive/The Northern Road intersection and the Elizabeth Drive/Mamre Road intersection. The performance of the Elizabeth Drive/Mamre Road intersection would decrease from a D to an F in 2026, but would be improved to a C by 2036. The performance of the Elizabeth Drive/The Northern Road intersection would decrease to an F by 2036 As this is the only material decrease in intersection performance, this is not considered to be a major impact to the overall network.

Overall, modelled intersection performance in the study area shows that the project would result in improved intersection performance along the Elizabeth Drive corridor between The Northern Road and Mamre Road. For intersections east of Mamre Road, trips using this section of Elizabeth Drive would not have access to M12 Motorway as alternative route, so although there would be some improvement in intersection performance in this section, it would be lesser than for intersections further west on Elizabeth Drive.

Table 6-24 Morning peak project intersection Levels of Service

Intersection	2026 do minimum		2026 project		2036 do minimum		2036 project	
	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS
Elizabeth Drive/The Northern Road	67	E	59	E	183	F	75	F
Elizabeth Drive/Luddenham Road	77	F	>100	F	41	C	52	D
Elizabeth Drive/Business Park East	30	C	37	C	33	C	30	C
Elizabeth Drive/Business Park West	25	B	21	B	120	F	19	B
Elizabeth Drive/Martin Road	36	C	39	C	44	D	34	C
Elizabeth Drive/Western Road	61	E	35	C	42	C	42	C
Elizabeth Drive/Devonshire Road	>100	F	>100	F	80	F	73	F
Elizabeth Drive/Mamre Road	>100	F	>100	F	36	C	38	C
Elizabeth Drive/Duff Road	17	B	16	B	23	B	24	B
Elizabeth Drive/Wallgrove Road	45	D	84	F	74	F	49	D
Elizabeth Drive/M7 Motorway	>100	F	>100	F	>100	F	>100	F
The Northern Road/M12 Motorway	-	-	44	D	-	-	27	B

Table 6-25 Evening peak project intersection Levels of Service

Intersection	2026 do minimum		2026 project		2036 do minimum		2036 project	
	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS	Av Delay	LoS
Elizabeth Drive/The Northern Road	51	D	65	E	64	E	71	F
Elizabeth Drive/Luddenham Road	>100	F	63	E	66	E	49	D
Elizabeth Drive/Business Park East	33	C	36	C	34	C	39	C
Elizabeth Drive/Business Park West	31	C	22	B	31	C	19	B
Elizabeth Drive/Martin Road	85	F	37	C	48	D	44	D
Elizabeth Drive/Western Road	>100	F	32	C	45	D	45	D
Elizabeth Drive/Devonshire Road	>100	F	26	B	73	F	88	F
Elizabeth Drive/Mamre Road	56	D	>100	F	38	C	43	C
Elizabeth Drive/Duff Road	>100	F	49	D	26	B	26	B
Elizabeth Drive/Wallgrove Road	>100	F	66	E	>100	F	73	F
Elizabeth Drive/M7 Motorway	>100	F	>100	F	>100	F	97	F
The Northern Road/M12 Motorway	-	-	46	D	-	-	34	C

General traffic travel times

Modelled general traffic travel times for key routes through the study area are presented in **Figure 6-23** to **Figure 6-30**. Analysis of the modelled travel times shows the following:

- Travel times along the M7 Motorway would generally increase in the project scenario when compared to the do minimum scenario in the 2026 morning peak. These generally small increases in travel time would be due to additional merging of traffic at the locations where the M12 Motorway interfaces with the M7 Motorway. This merging would generate additional delay, particularly in the northbound direction, however most of these delays would be reduced following the assumed widening of the M7 Motorway in the 2036 scenario, which reduces the conflict between merging traffic and traffic on the mainline.
- Travel times on The Northern Road northbound between Elizabeth Drive and the M4 Motorway in the evening peak would increase with the project, due to the changes in access to the Western Sydney Airport. Without the project, some traffic from the Western Sydney Airport would travel north to the M4 Motorway via Luddenham Road, as this route is more direct, and Luddenham Road is generally free flow, while The Northern Road would have several signalised intersections along its length once The Northern Road Upgrade project is complete. With the project, access to The Northern Road via the M12 Motorway would make The Northern Road a more attractive alternative to Luddenham Road.
- Travel time on the M12 Motorway would increase between 2026 and 2036, reflecting the forecast growth traffic volumes associated with the Western Sydney Airport, particularly eastbound to the M7 Motorway, where the increased volumes of heavy vehicle travelling to the M7 Motorway would experience increased delays due to the steep grade between Mamre Road and Cecil Road. Although travel times on the M12 would increase over time as traffic demand grows, the change is small (less than 5 minutes along the length of the M12 motorway) and demonstrates that the project has sufficient capacity to perform acceptable with forecast 2036 traffic volumes.
- Travel times on Elizabeth Drive between The Northern Road and the M7 Motorway would decrease substantially, except for the 2026 scenario during the morning peak. This increase in travel times along Elizabeth Drive in the 2026 morning peak is due to the increased volumes of traffic travelling west along Elizabeth Drive and turning right from Elizabeth Drive into Mamre Road. As noted in **Section 7.4**, this increased right turn volume would delay opposing eastbound traffic, however upgrade of this intersection to traffic signals would eliminate this eastbound delay by 2036.

Figure 6-23 shows that travel times along the M7 Motorway would generally increase in the project scenario when compared to the 'do minimum' scenario in the 2026 morning peak. These generally small increases in travel time would be due to additional merging of traffic at the locations where the M12 Motorway interfaces with the M7 Motorway. This merging would generate additional delay, particularly in the northbound direction. However, most of these delays would be reduced following the assumed widening of the M7 Motorway in the 2036 scenario, which would reduce the conflict between merging traffic and traffic on the main line. The exception is from the M4 Motorway to Elizabeth Drive. This is due to the project creating an alternative route to the Northern Road for trips travelling to the M4 Motorway via Mamre Road and the Great Western Highway

During the evening peak along the M7 Motorway (see **Figure 6-24**), travel times are generally less with the project in 2026, with the exception of from Elizabeth Drive to Camden Valley Way where localised intersection upgrades would be occurring in 2026. The travel times in 2036 would be less with the project between Elizabeth Drive and Camden Valley Way as Elizabeth Drive would be widened to four-lanes. Travel times will increase with the project in 2036 from M4 Motorway to Elizabeth Drive. As per the changes in morning peak time, the increase during the 2036 scenario is due to the project creating an alternative route to the Northern Road for trips travelling to the M4 Motorway via Mamre Road and the Great Western Highway

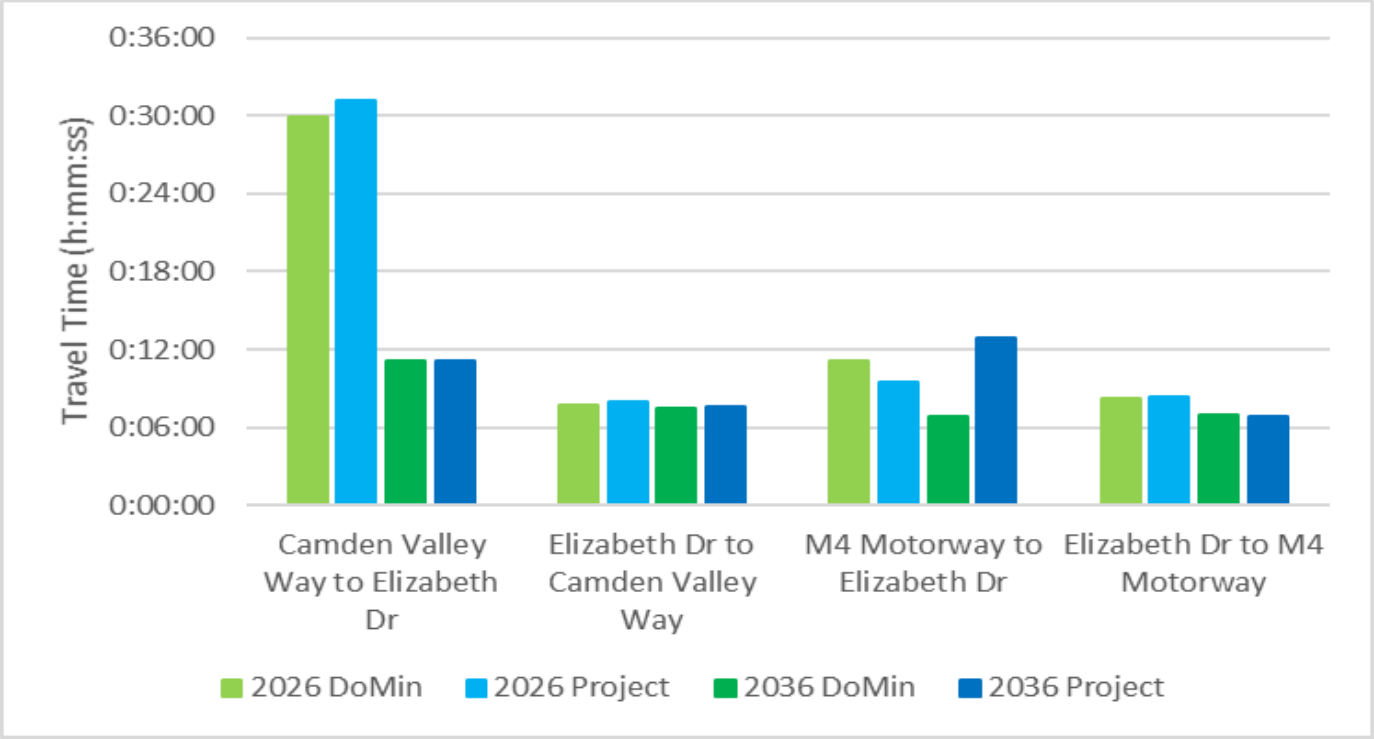


Figure 6-23 M7 Motorway morning peak travel times (8am to 9am)

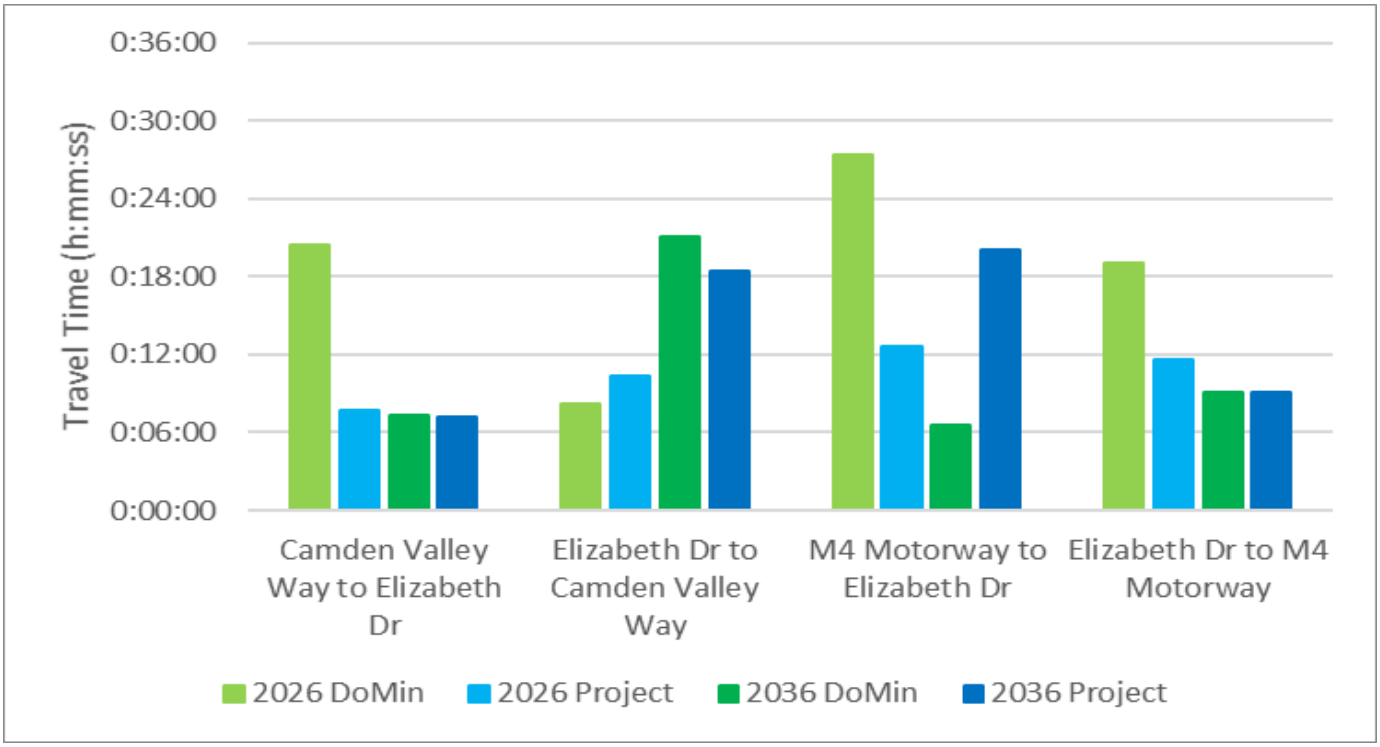


Figure 6-24 M7 Motorway evening peak travel times (5pm to 6pm)

Figure 6-25 shows that travel times on The Northern Road northbound between Elizabeth Drive and the M4 Motorway in the morning peak would generally decrease with the project. There will be slight increases in travel times with the project, however, in 2026 between Elizabeth Drive and the M4 Motorway and in 2036 from Bringelly Road to Elizabeth Drive. This increase in travel times along Elizabeth Drive in the 2026 morning peak is due to the increased volumes of traffic travelling west along Elizabeth Drive and turning right from Elizabeth Drive into Mamre Road.

Figure 6-26 shows that travel times on The Northern Road northbound between Elizabeth Drive and the M4 Motorway in the evening peak would increase with the project), due to the changes in access to the Western Sydney Airport. Without the project, some traffic from the Western Sydney Airport would travel north to the M4 Motorway via Luddenham Road, as this route would be more direct, and Luddenham Road would be generally free flow, while The Northern Road would have several signalised intersections along its length once The Northern Road upgrade project is complete. With the project, access to The Northern Road via the M12 Motorway would make The Northern Road a more attractive alternative to Luddenham Road.

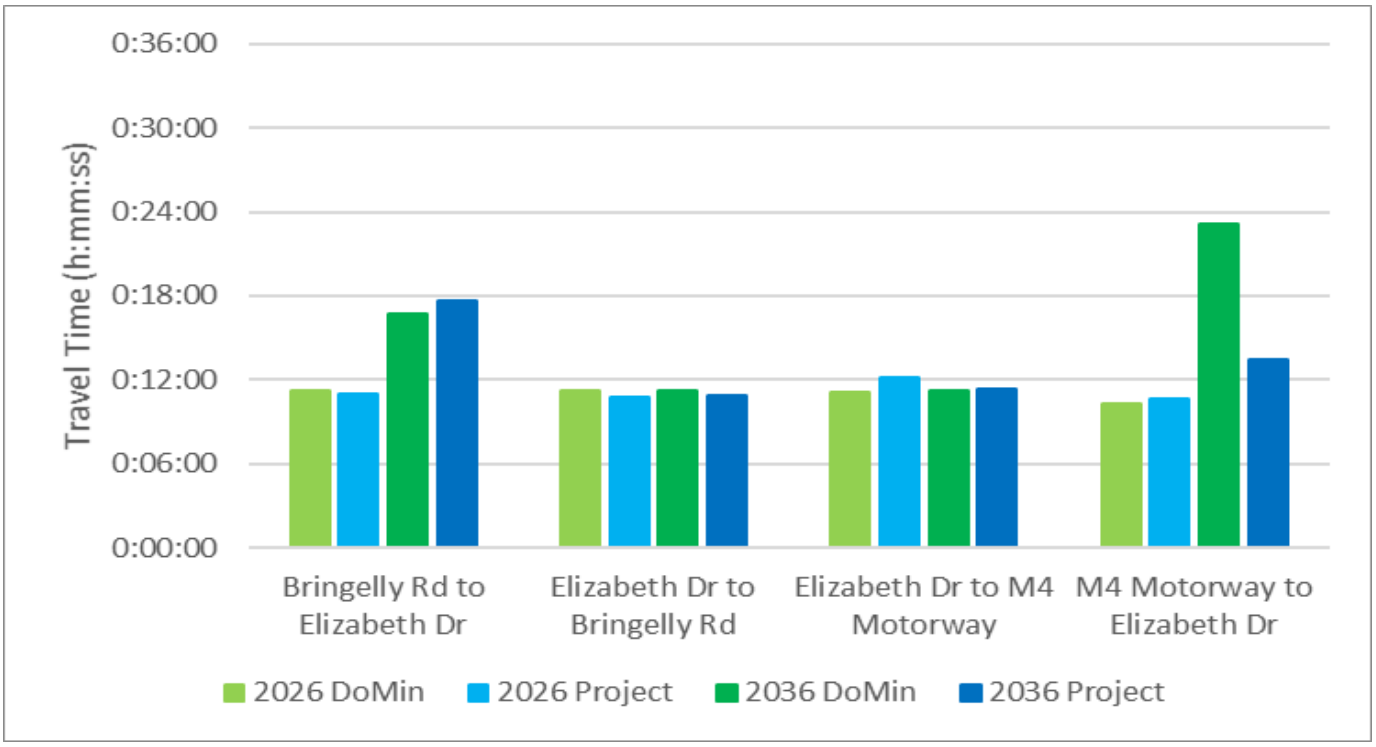


Figure 6-25 The Northern Road morning peak travel times (8am to 9am)

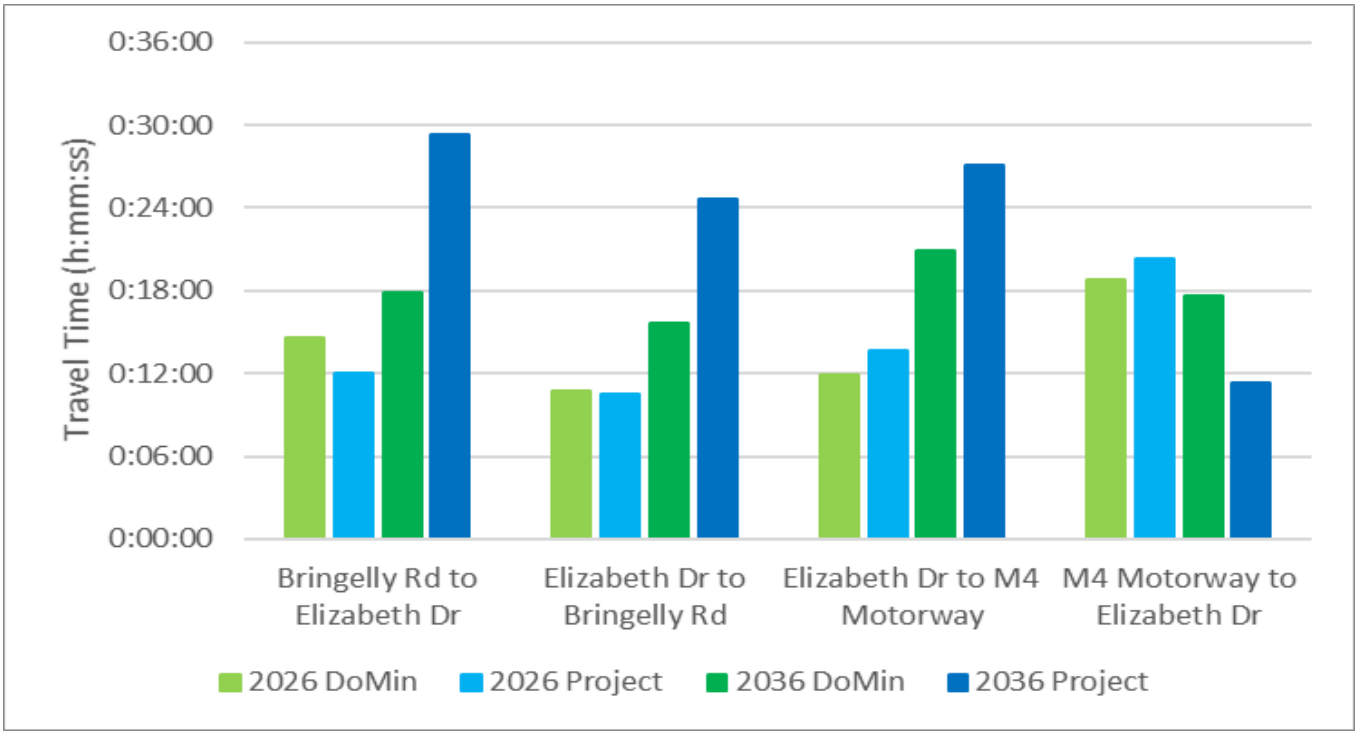


Figure 6-26 The Northern Road evening peak travel times (5pm to 6pm)

Figure 6-27 and **Figure 6-28** show that:

- Travel times on Elizabeth Drive between the M7 Motorway and The Northern Road would increase in 2026 and decrease in 2036. This slight increase is due to proposed intersection upgrades along Elizabeth Drive in 2026 and full widening of the corridor to four lanes in 2036
- Travel times on Elizabeth Drive between The Northern Road and the M7 Motorway would decrease substantially, except for the 2026 scenario during the morning peak. This increase in travel times along Elizabeth Drive in the 2026 morning peak would be due to the increased volumes of traffic travelling west along Elizabeth Drive and turning right from Elizabeth Drive into Mamre Road. This increased right turn volume would delay opposing eastbound traffic However, upgrading this intersection to traffic signals would eliminate this eastbound delay by 2036.

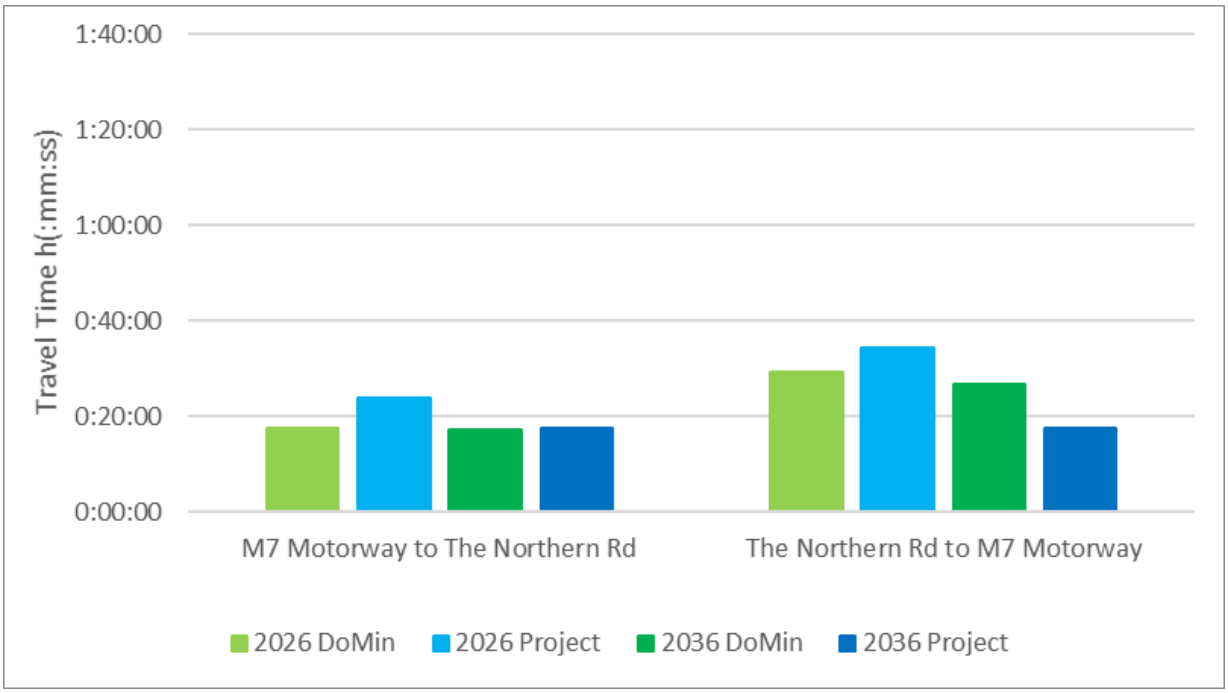


Figure 6-27 Elizabeth Drive morning peak travel times (8am to 9am)

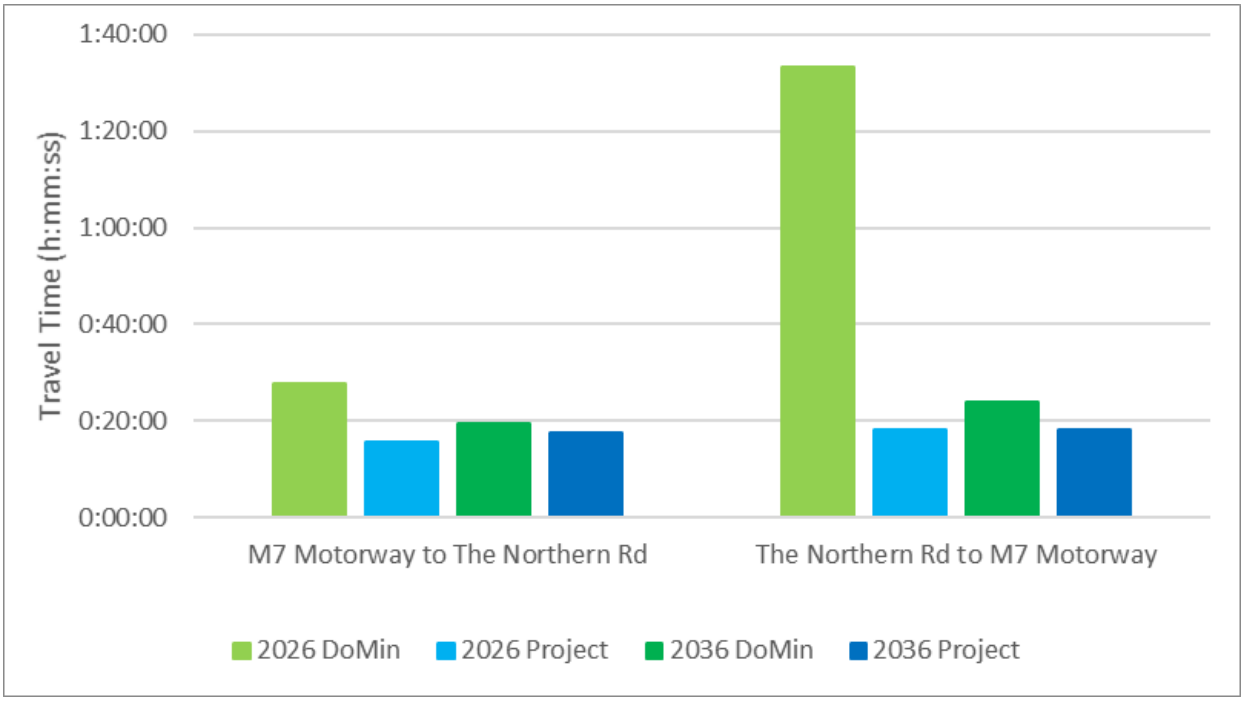


Figure 6-28 Elizabeth Drive evening peak travel times (5pm to 6pm)

Travel time on the M12 Motorway would increase between 2026 and 2036 for both morning (see **Figure 6-29**) and evening (see **Figure 6-30**) peaks. This, reflects the forecast growth in traffic volumes associated with the Western Sydney Airport, particularly eastbound to the M7 Motorway, where the increased volumes of heavy vehicles travelling to the M7 Motorway would experience increased delays due to the steep grade between Mamre Road and Cecil Road. Although travel times on the M12 Motorway would increase over time as traffic demand grows, the change would be small (less than five minutes along the length of the motorway) and demonstrates that the project has sufficient capacity to perform acceptably with forecast 2036 traffic volumes.

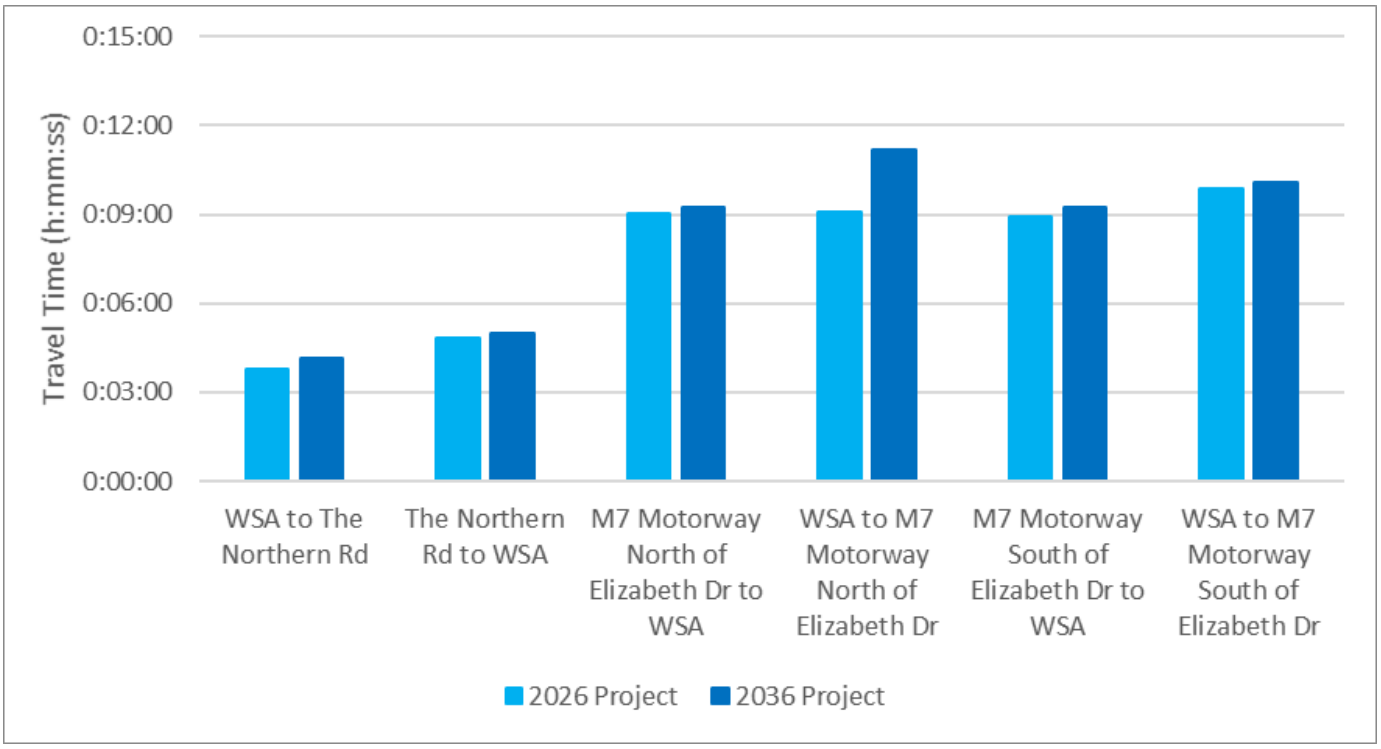


Figure 6-29 M12 Motorway morning peak travel times (8am to 9am)

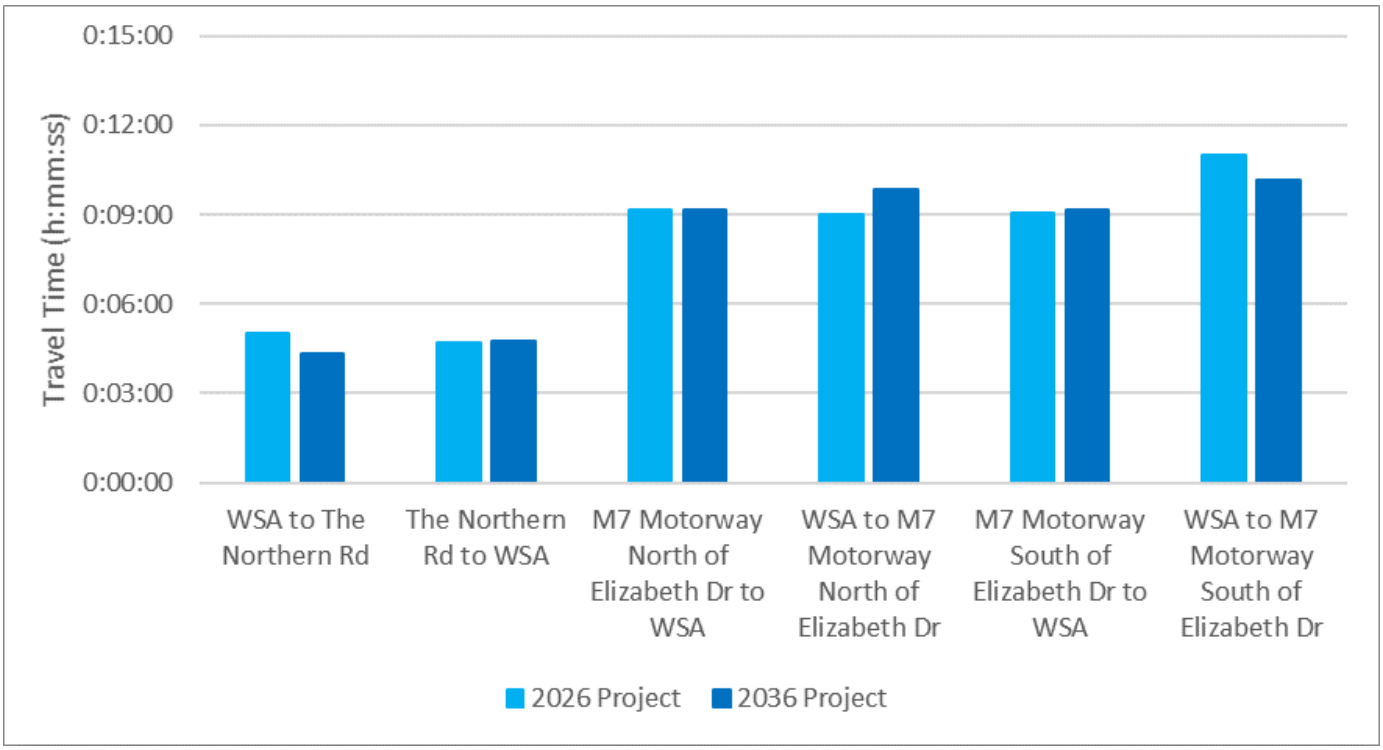


Figure 6-30 M12 Motorway evening peak travel times (5pm to 6pm)

Impacts on freight transport

As identified above, the project is expected to improve reliability and travel times for all traffic, including freight traffic that would be travelling to and from the Western Sydney Airport. It would achieve this by providing additional traffic capacity and motorway standard access to Western Sydney Airport, minimising travel times and reducing wear and tear on trucks.

The project would also reduce travel time and improve reliability and speed for trucks travelling between The Northern Road and the M7 Motorway. Currently, trucks use the Elizabeth Drive which is single lane in each direction and is capacity-constrained at its intersections with the M7 Motorway. With the upgrade of The Northern Road to a primary north-south freight route from the emerging South West Growth Area and other growth areas within the Western Parkland City, freight traffic travelling between The Northern Road and the M7 Motorway is expected to increase. The M12 Motorway would provide a safe and reliable route between major roads and to the airport. This would improve the reliability of freight shipments transferring between air and road modes.

Table 6-26 provides a summary of the forecast daily heavy vehicle volumes for key roads in the core study area. These forecast volumes show that the primary impact of the project on heavy vehicle volumes would be a reduction of up to 40 per cent in heavy vehicle trips along Elizabeth Drive, with most of these trips transferring to M12 Motorway to travel between The Northern Road and M7 Motorway.

Impacts on public transport

Operation of the M12 Motorway would have no impact on existing bus routes and bus stops through the study area. The NSW government proposes to establish rapid bus services from the metropolitan centres of Penrith, Liverpool and Campbelltown to the Western Sydney Aerotropolis and to Western Sydney Airport before it opens. The service frequencies for these buses would be determined based on the demand for travel to the proposed airport; the design of the project does not preclude the operation of these buses along the M12 motorway.

It is likely that some of these buses that offer direct service to and from Western Sydney Airport would use the M12 Motorway for access into and out of the airport site.

Operation of the M12 Motorway would have no impact on existing rail services and has been planned to integrate with the planned Sydney Metro Greater West line, which would be grade separated as it passes south within the M12 footprint and under the proposed realignment of Elizabeth Drive.

It is not feasible to accurately forecast travel demand for the public transport network at this stage of the project.

Table 6-26 Forecast daily heavy vehicle volumes on key roads in the core study area

Road location	Direction	2026 do minimum	2026 project	% Change	2036 do minimum	2036 project	% Change
The Northern Road north of Elizabeth Drive	Northbound	1,430	880	-38%	1,370	1,400	2%
	Southbound	1,600	1,400	-13%	610	750	23%
The Northern Road south of Elizabeth Drive	Northbound	1,120	650	-42%	1,290	1,150	-11%
	Southbound	1,560	1,360	-13%	560	610	9%
Elizabeth Drive west of Adams Road	Eastbound	130	120	-8%	630	360	-43%
	Westbound	430	320	-26%	600	440	-27%
Elizabeth Drive west of Devonshire Road	Eastbound	610	670	10%	1,540	1,310	-15%
	Westbound	1,110	1,160	5%	1,450	1,270	-12%
Elizabeth Drive east of Mamre Road	Eastbound	1,290	1,410	9%	2,390	2,590	8%
	Westbound	1,610	1,730	7%	2,420	2,000	-17%
Elizabeth Drive East of Wallgrove Road	Eastbound	1,650	1,840	12%	2,770	3,240	17%
	Westbound	1,930	2,040	6%	2,790	2,420	-13%
Mamre Road north of Wallgrove Road	Northbound	1,080	990	-8%	2,070	1,660	-20%
	Southbound	1,270	1,210	-5%	1,720	1,890	10%
Wallgrove Road north of Elizabeth Drive	Northbound	1,050	1,280	22%	810	1,240	53%
	Southbound	1,500	1,530	2%	1,270	1,360	7%
M12 Motorway Western Sydney Airport Access	Northbound	N/A	180	N/A	N/A	60	N/A
	Southbound	N/A	110	N/A	N/A	50	N/A
M12 Motorway west of Western Sydney Airport	Eastbound	N/A	1,340	N/A	N/A	2,310	N/A
	Westbound	N/A	1,690	N/A	N/A	2,360	N/A
M12 Motorway east of Western Sydney Airport	Eastbound	N/A	1,520	N/A	N/A	2,360	N/A
	Westbound	N/A	1,790	N/A	N/A	2,410	N/A

Impacts on active transport

A shared pedestrian/cycle path about four metres wide would be provided along the M12 Motorway, from The Northern Road at the western end of the project up to Range Road, in the Western Sydney Parklands. Ultimately, the shared pedestrian/cycle path would extend through the parklands to connect to the existing shared pedestrian/cycle path along the M7 Motorway. The shared user path would complete a connection between the existing M7 Motorway shared user path and the shared user path adjacent to The Northern Road that will be built as part of The Northern Road upgrade.

The shared user path would be grade separated at all road crossings and floodplains and would underpass the airport access road. It would run adjacent to the M12 Motorway from The Northern Road to the Western Sydney Airport interchange, separated by a barrier.

Between The Northern Road and the Western Sydney Airport interchange the shared user path would be located on the southern side of the M12 Motorway. It would then cross under the airport to M12 westbound

entry ramp before overpassing the M12 Motorway at the Western Sydney Airport interchange and continuing along the northern side of the M12 Motorway as far as Clifton Avenue. At Clifton Avenue, the shared user path would again cross the M12 motorway along the proposed Clifton Avenue bridge. The shared user path would then continue along the southern side of the M12 Motorway to Range Road.

The two existing pedestrian bridges crossing the M7 Motorway south of Elizabeth Drive, Cecil Hills, would be retained, with the northernmost of these two bridges being lengthened to span across the M7 Motorway northbound exit ramp.

The section of the shared user path through the Western Sydney Parklands does not form part of this project and would be implemented by the Western Sydney Parklands Trust in accordance with the Trust's broader strategic plans for the Western Sydney Parklands. Roads and Maritime is liaising with the Western Sydney Parklands Trust through the development of the shared user path location.

The shared pedestrian/cycle path would extend along the western side of the airport access road up to the boundary of the Western Sydney Airport and would tie into Elizabeth Drive. Connections to local roads and places of interest would be provided as part of the shared user path facility including a connection to Clifton Avenue in Kemps Creek.

Connecting two major regional cycling facilities some 14 kilometres apart, the project would substantially improve cycling and walking connectivity through the wider study area. In addition to connecting these two major cycling facilities, the project would also provide access from this adjacent shared user path to the following roads:

- Range Road and Wylde Mountain Bike Trail
- Elizabeth Drive at Mamre Road
- Salisbury Avenue
- Clifton Avenue
- Elizabeth Drive at Western Sydney Airport
- Luddenham Road
- The Northern Road.

This level of pedestrian and cycle connectivity would be a transformative addition to the regional active transport network in the wider study area, allowing pedestrians and cyclists to access currently very poorly accessible streets and properties on Elizabeth Drive and its adjacent cross-streets. In addition to the connectivity benefits, shared user facility would also substantially improve safety for cyclists and pedestrians, by providing an off-road active transport corridor separated from vehicles, removing conflicts on-road and at crossing points.

It is not feasible to accurately forecast travel demand for the cycle network at this stage of the project.

Impacts on road safety

The M12 Motorway would reduce the volume of future traffic travelling on Elizabeth Drive. Trips travelling to and from the Western Sydney Airport would use the M12 Motorway to connect to the M7 Motorway and the rest of the Sydney motorway network and would benefit from travelling on a higher standard of road instead of arterial roads. Motorways are generally safer than arterial roads due to:

- Higher design speed and wider curve geometry
- Wider lanes
- Higher quality pavement
- Fewer intersections and less stop-start-traffic
- Better lighting and intelligent transport systems
- Separation of sensitive road users from the vehicular traffic on the roads.

This has the potential to impact on safety in that it may reduce the number of crashes on roads on which traffic volumes would be expected to decrease (primarily Elizabeth Drive) when the M12 Motorway becomes operational.

A summary of the change in vehicle kilometres of travel (VKT) from arterial standard to motorway standard roads as a result of the project is presented in **Table 6-27**. The change in arterial and motorway VKT, when combined with the associated average crash rates for arterial roads in the study area and the M7 Motorway indicate that overall crashes across the core study area could decrease by up to 217 crashes per year by 2036 as a result with the project.

Table 6-27 Forecast crash reduction due to M12 Motorway by 2036

M12 Motorway Forecast Annual VKT	Arterial crash rate (crashes per million VKT)	Motorway Crash Rate (crashes per million VKT)	Reduction in Annual Crashes
323,532,229	78	11	217

In addition to these likely road safety benefits associated with a reduction in the number of crashes, the project is expected to result in the following improvements to road safety:

- Reduce the number of heavy vehicles that would need to use Elizabeth Drive for access to the Western Sydney Airport or for travelling between the M7 Motorway and The Northern Road. This would improve road safety by reducing overtaking of heavy vehicles and the associated risk of head-on crashes
- Provide cyclists with a safe off-road facility and remove the risks associated with cycling on road adjacent to general traffic on Elizabeth Drive
- Reduced congestion at the M7 Motorway/Elizabeth Drive Interchange is expected to reduce the likelihood of vehicle crashes, especially rear-end type crashes.

Sensitive road user safety is also described in Section 8.3.4 of the EIS. In summary, the project is expected to positively impact road safety and the improve access and safety for pedestrians and cyclists.

The project would provide safer access for pedestrians and cyclists by the provision of a shared user path. The shared user path has been designed to accommodate the expected increase in number of sensitive road users as a result of the proposed future land use and infrastructure. This would create a safe pedestrian and cyclist facility for the wider western Sydney area.

Impacts on local roads and access

The project would impact property access either because it would pass through a property and block an existing internal access to a part of that property, or because it would close or block access to an existing access to the public road network. The properties affected by access changes as well as the nature of the access impact to these properties are provided in **Table 6-28** . These affected properties would have their access reinstated as part of the project in consultation with the property owner, unless property acquisition or amalgamation would make this unnecessary.

Table 6-28 Properties affected by M12 Motorway access changes

Affected Property	Impacted access description
2594-2776 The Northern Road, Luddenham	Access points not impacted by the M12 Motorway. M12 Motorway divides the land parcel.
2778-2828 The Northern Road, Luddenham	The M12 Motorway impacts one property access point at the tie into The Northern Road.
777-819 Luddenham Road, Luddenham	Property access on Luddenham Road is impacted.
752-810 Luddenham Road, Luddenham	Property access via Luddenham Road is impacted. Land Parcel divided by the M12 Motorway
146b Clifton Avenue, Kemps Creek 2178	Property Access maintained via a private road intersecting Elizabeth Drive. M12 Motorway divides land parcel. Adjoining land, DP Lot 2/587135, owned by the same corporation
146-196 Clifton Avenue, Kemps Creek	The realignment of Clifton Avenue to overpass the M12 Motorway impacts the property access point. The land parcel is divided by the M12 Motorway
364-372 Clifton Avenue, Kemps Creek 2178	Property access impacted. Land parcel divided by the M12.
90 Clifton Avenue, Kemps Creek 2178	Northern property access temporarily impacted during construction
258 Clifton Avenue, Kemps Creek	Property accesses impacted on Clifton Avenue. Northern access impacted during construction only. Southern access impacted
373-381 Clifton Avenue, Kemps Creek 2178	Property access impacted on Clifton Avenue. Land parcel divided by the M12 Motorway.
316 Clifton Avenue, Kemps Creek 2178	Property access fronting Clifton Avenue is impacted. Land parcel divided by M12 Motorway.
382-393 Clifton Avenue, Kemps Creek 2178	Property access maintained fronting Clifton Avenue. Land parcel divided by M12 Motorway.
12-20 Salisbury Avenue, Kemps Creek 2178	Property access on Salisbury Avenue impacted. M12 Motorway alignment over majority of land parcel and local road over the remainder
2-10 Salisbury Avenue, Kemps Creek 2178	Property access fronting Salisbury Avenue is impacted. Northern access road parallel to the M12 Motorway bisects plot. No access to be reinstated along Salisbury Avenue due to land being split from Salisbury Avenue.
3 Salisbury Avenue, Kemps Creek 2178	Property access fronting Salisbury Avenue impacted.

Affected Property	Impacted access description
Western Sydney Parklands Trust	Public entry and exit to the Sydney International Shooting Centre impacted, Entry Gate B to the Wylde Mountain Bike Trail carpark impacted Gate D on Elizabeth Drive impacted Gate E/G is impacted and not reinstated.
1400 Elizabeth Drive, Cecil Park 2178	Property access fronting Range Road not impacted. Property Owner owns adjacent lots 2/1054778, 3/1054778, 4/1054778, 5/1054778, 6/1054778, 7/1054778, 8/1054778 and 9/1054778. This is a single access point for all lots, with the exception to lot 8/1054778. Property Access fronting Elizabeth Drive located in property lot 8/1054778 is impacted. Combined land parcel divided by the M12 Motorway.
1297-1305 Elizabeth Drive, Kemps Creek 2178	Property accesses on Mamre Road not impacted. M12 Motorway alignment located over property access on Elizabeth Drive, which will not be reinstated.
1307-1337 Elizabeth Drive, Kemps Creek 2178	Property access on Elizabeth Drive impacted. M12 Motorway alignment over majority of land parcel.
1953-2109 Elizabeth Drive, Badgerys Creek 2555	Property access on Elizabeth Drive is not impacted. The land parcel is divided by the M12 Motorway.
1793-1951 Elizabeth Drive, Badgerys Creek 2555	DP lots 3/164242, 62/1087838 and 63/1087838 are owned by the same land owner (The University of Sydney), property access fronts Elizabeth Drive from lot DP 63/1087838. Property access on Elizabeth Drive is impacted The land parcel is divided by the airport access road.
1383-1411 Elizabeth Drive Kemps Creek	Property access points fronting on Elizabeth Drive not impacted. M12 Motorway mainline and bridge over Kemps creek divides the land parcel.
1293-1297 Mamre Road, Kemps Creek 2178	Property access on Mamre Road not impacted. Land parcel divided by the M12 Motorway alignment.
885a Mamre Road, Kemps Creek	Property access is impacted by the M12 Motorway. Access to this lot is via DP 741/810111. The private bridge crossing South Creek and linking land parcels DP 21/258414, 1/88836 to 1/74574 would be demolished for the M12 Motorway.
949a Mamre Road, Kemps Creek	Property Access maintained via a private road intersecting Elizabeth Drive. M12 Motorway divides land parcel. Property access also maintained via a private bridge crossing Kemps Creek
37-73 Wallgrove Road Cecil Park	Property access is impacted by the realignment of Wallgrove Road.
112-128 Wallgrove Road Cecil Park	Property access is impacted by the M7 Motorway Southbound entry ramp to the M12 Motorway.

The M12 Motorway footprint is generally located on undeveloped land and limits its impact on access to the surrounding properties. Design standards for motorways require that cross-traffic must be grade-separated, and intersections permitted only at interchanges via on and off ramps, consequently access to the M12 Motorway would only be provided at limited locations, as described in **Section 1.2**.

The design has also been developed to ensure that a possible connection from Devonshire Road and Mamre Road via an interchange could be built in the future. The crossings of the M12 Motorway with Luddenham Road, Mamre Road and a possible future extension of Devonshire Road would be grade-separated and traffic would be able to continue using both roads uninterrupted. The current design also allows sufficient space for the upgrade of the intersection of Mamre Road and Elizabeth Drive to traffic signals in the future (assumed for the purposes of this study to be built by 2036).

Impacts on parking

Due to the location of the M12 Motorway, which would be built on primary undeveloped land, there would be no impacts on existing parking in the study area. Arterial and motorway roads generally do not permit on-street parking and there is currently no parking permitted on Elizabeth Drive or The Northern Road in the study area.

Summary

Assessment of the future performance of the transport network in the study area with the project indicates the following key impacts:

- Reduced delays and higher travel speeds for vehicles travelling to Western Sydney Airport and between The Northern Road and the M7 Motorway providing improved safety for vehicles that would otherwise use Elizabeth Drive
- Reduced road crashes along the Elizabeth Drive corridor
- Improved pedestrian/cyclist safety due to the provision of a separated shared user path providing an alternative to Elizabeth Drive, where pedestrians and cyclist would otherwise be required to use the shoulder.
- Improved regional connectivity for pedestrians and cyclists by connecting the existing M7 Motorway shared user path with the shared-user path being constructed as part of The Northern Road upgrade
- Reduced number of heavy vehicles, including B-Doubles along Elizabeth Drive which would increase safety for drivers, cyclists and pedestrians
- Improved performance for intersections along Elizabeth Drive between the M7 Motorway and The Northern Road, as well as replacement of the existing priority intersection providing access to the M7 Motorway northbound from Wallgrove Road with an uninterrupted g-loop arrangement.

7. Cumulative impacts

Cumulative transport and traffic impacts may arise from the interaction of construction and operation activities of the project and other approved or proposed projects in the area. When considered in isolation, specific project impacts may be considered minor, but when considered with the impact of multiple projects, they may be considered more substantial. As such, the transport and traffic impacts discussed in **Section 6**, above, were assessed in consideration of the following recently completed, ongoing and proposed projects:

- Western Sydney Airport
- Sydney Metro Greater West
- The Northern Road Upgrade
  - Stage 5 (Littlefields Road to Glenmore Park)
  - Stage 6 (Littlefields Road to Eaton Road)
- Other existing road network upgrades and potential road projects, including:
  - Elizabeth Drive Upgrade
  - Mamre Road Upgrade
  - Outer Sydney Orbital
- Major land releases, including:
  - Western Sydney Aerotropolis
  - South West Growth Area
  - Western Sydney Employment Area.

The above projects are in varying stages of delivery and planning. This chapter provides an assessment of cumulative transport and traffic impacts based on the most current and publicly available information on the above. In many instances this is a high-level qualitative assessment. The assessment of cumulative impacts per project is discussed in the sections that follow.

7.1 Western Sydney Airport

The Australian Government is currently constructing the Western Sydney Airport on the 1,780-hectare Commonwealth-owned land at Badgerys Creek. The airport will service both domestic and international markets and development will be staged in response to ongoing growth in aviation demand. Stage 1 includes the establishment of the following to provide operational capacity for about 10 million passengers per year and freight traffic:

- A single 3,700 metre runway in the north-western portion of the site
- A terminal
- Other support facilities
- Foundation for further expansion.

It is anticipated that the demand in relation to this airport would reach about 82 million passengers a year by 2063. To cater for this, a second parallel runway would be constructed at a later stage.

The EIS for the Western Sydney Airport was placed on display in October 2015 and finalised on 15 September 2016 with a Revised Draft Airport Plan. The assessment found that the airport would result in some adverse impacts on the environment and community, particularly in relation to the following:

- Air quality
- Biodiversity
- Health
- Noise
- Water quality.

Mitigation measures were proposed to reduce these potential impacts during construction.

7.1.1 Construction cumulative impacts

Construction of Western Sydney Airport is under way and the airport is set to open in 2026. Construction activities for Stage 1 involve three major work phases:

- Site preparation works, including:
  - Securing the construction impact zone
  - Establishing site services and construction facilities
  - Clearing vegetation
  - Undertaking major earthworks
- Aviation infrastructure works, including construction of the:
  - Runway, taxiways and apron areas
  - Internal road network
  - Terminal complex
  - Air traffic control tower
  - Freight, cargo and maintenance facilities
  - Fuel farm
- Site commissioning activities at the completion of the aviation infrastructure works
  - involves testing and commissioning of all facilities in readiness for the operation.

Peak construction for the Western Sydney Airport, associated with the bulk earthworks required to prepare the runway and terminal pads is expected to be undertaken prior to the peak construction period for M12 Motorway. Consequently, there is expected to some overlap in construction traffic generation between the two projects. The bulk earthworks for the Western Sydney Airport would need to be completed prior to the commencement of terminal works. These bulk earthworks would overlap with the early phases of the M12 construction which would not be during the peak construction period for either project.

There would be minor cumulative heavy vehicle impacts associated with the construction of the project and the Western Sydney Airport. This would be associated with the overlap in construction traffic generated by the two projects. This overlap is not anticipated to be during the peak construction period for either the Western Sydney Airport or the M12 Motorway.

The Northern Road would carry the bulk of heavy vehicles expected for construction works. In its upgraded state, The Northern Road will have ample capacity to accommodate any crossover between traffic generated by both projects. As such, the combined construction traffic would not substantially impact capacities along The Northern Road, but would result in a longer period of higher than normal heavy vehicle activity along The Northern Road.

7.1.2Operation cumulative impacts

The Western Sydney Airport and the project would be operational at the same time. As a result, M12 Motorway would carry most of the traffic into the Western Sydney Airport, and this is one of the key design considerations for the project. As this is a fundamental component of the assessment of the transport and traffic impacts of the project, the operation of the Western Sydney Airport, along with the traffic that is generated by it is included in the impact assessment of the project.

The cumulative impacts on transport and traffic associated with the operation of the project and the Western Sydney Airport are already included in the assessment presented in **Section 6**.

7.2 Sydney Metro Greater West

TfNSW recently identified recommended corridors for a rail option to provide a major transport link between the North West Growth Area, Western Sydney Airport, and the South West and Greater MacArthur Growth Area. This rail option would connect the existing Main South Line (T8) near Macarthur Station to the existing Main Western Line (T1) near St Marys Station, via the Western Sydney Airport. This new passenger rail line would run adjacent to the M12 airport access road and pass under Elizabeth Drive at the same location.

This railway servicing the new Western Sydney Airport will be developed and delivered by Sydney Metro. It is referred to as the Sydney Metro Greater West. Planning for this project is currently underway and as such, environmental assessment results are not yet available.

7.2.1 Construction cumulative impacts

Construction timeframes for the Sydney Metro Greater West would have significant overlap with the construction of the project. During any timeframes where construction activities are concurrent, increased construction heavy vehicle impacts may be likely. This would be dependent on the specific construction locations and the different construction activities. At the time of preparing this assessment, the details of construction for Sydney Metro Greater West are not available however the current planning for this line to be complete at about the same time and the M12 Motorway means that it is very likely that there would be a substantial overlap of the two project, particularly in the vicinity of Western Sydney Airport where the two projects would be under construction concurrently.

There would be moderate cumulative construction heavy vehicle impacts associated with the construction of the project and the Sydney Metro Greater West, particularly where there is overlap between the proposed metro alignment and the project where both would enter the Western Sydney Airport site, however as this project is currently in early planning, the details of these impacts are not available for a quantitative assessment.

Based on the scope of works for Sydney Metro Greater West, construction heavy vehicle traffic would be distributed along the alignment, potentially between St Marys and Macarthur, but due to the limited options for haulage routes in western Sydney, the key impacts of cumulative construction traffic would be along The Northern Road and Elizabeth Drive. While The Northern Road will be upgraded to a higher capacity to accommodate these additional heavy vehicles, increased delays and travel times along Elizabeth Drive would be expected under a cumulative construction scenario.

7.2.2 Operation cumulative impacts

The Sydney Metro Greater West and the project would both be operational in the longer term (ie opening of the Metro may occur after the opening of the project). The public transport mode share for trips travelling to

and from Western Sydney Airport via Sydney Metro Greater West have been included within the traffic generation inputs to the traffic modelling documented in **Section 2.1**.

The cumulative impacts of the operation of the project and the Sydney Metro Greater West are already included in the impact assessment presented in Section 6.

7.3 The Northern Road Upgrade

An upgrade of The Northern Road was approved in May 2018 as part of the Western Sydney Infrastructure Plan. The upgrade will improve the capacity of the existing road and create about eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham to realign the section of The Northern Road that currently runs through the Western Sydney Airport site. Once the upgrade is complete, The Northern Road will connect the project with the M4 Motorway and improve connectivity with the Western Sydney Airport (Roads and Maritime Services, 2017). The upgrade is being carried out in six stages:

- Stage 1 – between The Old Northern Road, Narellan and Peter Brock Drive, Oran Park
  - Completed
- Stage 2 – between Peter Brock Drive, Oran Park and Mersey Road, Bringelly
  - Under construction
- Stage 3 – between Glenmore Parkway, Glenmore Park and Jamison Road, South Penrith
  - Under construction
- Stage 4 – between Mersey Road, Bringelly and Eaton Road, Luddenham
  - Under construction
- Stage 5 – between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park
  - Construction to start early 2019
- Stage 6 – between Eaton Road, Luddenham and Littlefields Road, Luddenham
  - Construction to start mid-2019.

7.3.1 Construction cumulative impacts

Stages 1 through 4 of The Northern Road upgrade will be completed by the time construction of the project commences. The construction for Stage 5 is scheduled for early 2019 to end of 2022. The construction for Stage 6 is scheduled for mid-2019 to end of 2021. Construction activities associated with these two stages may overlap with the project construction. Both these stages are near the project.

As the peak construction period for the project is likely to be in 2024, the selection and assessment of construction and heavy vehicle haulage routes for the project has assumed that The Northern Road upgrade will be complete by 2024 to enable heavy vehicle routes to use The Northern Road as an alternative to the M7 Motorway interchange at Elizabeth Drive.

Consequently, construction activities for The Northern Road upgrade should be completed prior to the peak construction period for the project, resulting in minimal overlap between the two projects. If the completion of Stages 5 and 6 are delayed, this would mean that more construction heavy vehicles would be required to travel via M7 Motorway and Elizabeth Drive during the early stages of the project's construction, however construction heavy vehicle generation in the early stages of the project would be substantially lower than the peak period, minimising impacts to the M7 Motorway during this period.

There would be minor cumulative construction heavy vehicle impacts associated with the construction of the project and The Northern Road Upgrade Stages 5 and 6. The scale of the impacts would be dependent on the timing and location of concurrent construction activities for both projects. Based on the construction

program provided in **Table 6-1**, there is likely to be no overlap with peak construction activities and the only construction activity likely to overlap between the two projects would be mobilisation and early works relating to the establishment of construction ancillary facilities and property access adjustment. The cumulative impacts of construction of the project with other projects would be minor.

7.3.2 Operation cumulative impacts

The Northern Road upgrade is a fundamental component of the strategic road network in western Sydney and will be required to support the development of the Western Sydney Aerotropolis and the South West Growth Centre. As The Northern Road upgrade is currently under construction and due to be completed prior to opening of the project, it has been included as an assumption in all traffic modelling documented in **Section 2.1**

The cumulative impacts of the operation of the project and The Northern Road Upgrade Stages 5 and 6 are already included in the impact assessment presented in **Section 6**.

7.4 Other road network upgrades

There are several other planned and potential road upgrade projects in the western Sydney area that may contribute to cumulative transport and traffic impacts. These potential projects include:

- Elizabeth Drive upgrade – Roads and Maritime has started site investigations, including preliminary engineering, preliminary/strategic designs, environmental field investigations, and strategic modelling. These investigations are expected to be completed by mid-2019
- Mamre Road upgrade – the NSW Government has started early planning for a future upgrade of a 10-kilometre section of Mamre Road, between the M4 Motorway and Kerrs Road to support economic and residential growth in the area
- Outer Sydney Orbital – a future north-south motorway and freight rail line in Sydney's West to support the growth of western Sydney and the distribution of freight across Sydney and regional NSW (TfNSW, 2018b). While the Outer Sydney Orbital is in early stages of planning, it would provide connections to the Western Sydney Airport via the airport interchange constructed as a part of this project.

In addition, the M7 Motorway was planned and constructed with enough width in the median to allow future widening to six lanes. While there are no plans yet to carry out this upgrade and the current deed only allows for widening of The M7 Motorway to accommodate public transport lanes, it is noted that traffic forecasts show that the M7 Motorway would exceed its current capacity by 2026 and would likely need to be widened to accommodate forecast 2036 traffic volumes.

These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available.

7.4.1 Construction cumulative impacts

The timing for construction of the above projects has not yet been announced. However, there is potential for overlaps in construction timing between the project and some of these road upgrade works. Should this occur the cumulative impacts would likely be minimal as much of the work would be geographically distant from the project, and would be dependent on the timing, type and location of simultaneous construction activities. As the details of the construction of these projects are not currently available, it would fall within the scope of the environmental assessment for those projects, if they proceed, to assess their cumulative construction impact with M12 Motorway if there is any.

There would be moderate cumulative construction heavy vehicle impacts associated with the construction of the project and other road projects. In addition to the localised impacts of cumulative construction on road network capacity and travel times resulting from the combined construction traffic generation of the projects identified in this section, prolonged concurrent construction activity is also likely to result on construction fatigue for drivers that use the affected road network on a day-to-day basis.

Construction fatigue for drivers can occur when drivers change their driving behaviour as a result of frustration or complacency. Under fatigue, drivers may not obey temporary speed reductions through construction areas or otherwise be less alert when driving through areas affected by construction activities. This may result in reduced driver safety and increased risk of crashes.

7.4.2 Operation cumulative impacts

Upgrade of Elizabeth Drive and Mamre Road are fundamental components of the strategic road network in western Sydney and would be required to support the development of the Western Sydney Aerotropolis and the South West Growth Centre. As preliminary optimisation of the road network within the wider study area documented in **Section 3.4.3**, they have been included as assumptions in all traffic modelling documented in **Section 3**

The cumulative impacts of the operation of the Elizabeth Drive and Mamre Road upgrades are already included in the impact assessment presented in **Section 6**.

7.5 Growth areas

Western Sydney is the focus of several plans and policies to promote changes in land use and to increase employment opportunities, in particular within the following defined areas:

- Western Sydney Aerotropolis – The area surrounding the Western Sydney Airport (see **Figure 1-1)**. The Aerotropolis would establish a new high-skill jobs hub across aerospace and defence, manufacturing, healthcare, freight and logistics, agribusiness, education and research industries, and is expected to contribute to establishing 200,000 new jobs for western Sydney (DPE, 2018).
- South West Growth Area – The broader area surrounding the Western Sydney Airport (see **Figure 1-1**). This will guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area. The NSW Government is currently at the early stages of investigations.
- Western Sydney Employment Area – The area north-east of the Western Sydney Aerotropolis (see **Figure 1-1**). Established by the NSW Government to be a new employment space, providing opportunities for local people to work closer to home.
- South West Growth Area – The area to the south of Bringelly Road as well as the Austral land release north of Bringelly Road (shown in **Figure 1-1**), this is one of the two major residential land releases in Sydney. Precincts including Oran Park, Turner Road, East Leppington, Austral, Catherine Fields and South Creek West have been rezoned, with rezoning currently underway for Lowes Creek Maryland precinct.

The land within the areas above would be developed by individual developers at varying timeframes. Each would be subject to their own environmental assessments, based on the scale and potential impact of each project. There are currently no defined plans available for the individual developments within these growth areas.

The project would traverse the Western Sydney Aerotropolis and service the Western Sydney Aerotropolis, and indirectly, the Western Sydney Employment Area. The project would serve and facilitate the growth by providing increased road capacity and reducing congestion and travel times in the area.

7.5.1 Construction cumulative impacts

The timing for the construction of developments within the above-mentioned growth areas has not yet been announced. There is potential of overlaps in construction timing between some developments and the project. Should this occur, the cumulative impacts would likely be minimal and dependent on the timing, type and location of simultaneous construction activities.

It is likely that there would be substantial cumulative construction heavy vehicle impacts associated with the construction of the project and the development associated with the nearby growth areas should construction programs overlap. Based on the development currently taking place in these areas, construction activity is likely to be fragmented and take place over 10 to 20 years area as individual precincts are rezoned and constructed; the primary impact of this overlap in construction activities would be construction fatigue up to the opening of the project.

7.5.2 Operation cumulative impacts

The development associated with the Western Sydney Aerotropolis, Western Sydney Aerotropolis, Western Sydney Employment Area and South West Growth Area are critical design considerations for the project. As the transport and traffic demand generated by these land use changes are fundamental to the assessment of the transport and traffic impacts of the project, the travel demand generated by these land release areas is already included in the operational traffic impact assessment of the project presented in **Section 6**.

7.6 Conclusion

Overall, the cumulative impacts of the project under construction are difficult to quantify as the details of the other projects that may be under construction at the same time are not generally available, however a qualitative assessment of the overlap in project indicates that the key cumulative impacts would likely result from the construction of the project with:

- Western Sydney Airport bulk earthworks and terminal construction
- Sydney Metro Greater West
- Other road network upgrades under investigation but not approved including Elizabeth Drive and the M7 Motorway widening.

These projects would have substantial cumulative transport and traffic impacts associated with construction traffic generation, changes to road network conditions and driver construction fatigue, especially where the construction schedules of those projects overlaps with that of the project.

The cumulative transport and traffic impacts associated with operation of the project and the other ongoing and planned developments in the area have been assessed as part of this report and are presented in **Section 6**.

8. Environmental management measures

This section provides a summary of the environmental management measures that would be required to minimise, avoid or mitigate the impacts of the project on transport and traffic in the study area.

Due to the nature of the project, the majority of operational impacts associated with design constraints, maintaining access and integration with the existing transport network have been addressed in the design. The remaining impacts that require mitigation are primarily impacts of construction.

8.1 Management of construction impacts

The majority of project impacts have been addressed and mitigated through the development of the concept design but there would still be impacts to transport and traffic as a result of construction of the project. Environmental management measures would be required to minimise the impacts of construction of the project on transport and traffic. Measures to avoid, minimise or manage transport and traffic impacts as a result of construction of the project are detailed in **Table 8-1**.

The key environmental management measure required to address the impacts of construction on transport and traffic would be site-specific Construction Traffic Management Plans (CTMPs) prepared as part of the Construction Environmental Management Plan (CEMP) for the whole project. These plans would be prepared by the construction contractor and would be required to outline the guidelines, general requirements and specific procedures to be used for any works that may have an impact on traffic operation. Each CTMP would need to be reviewed by Council, Sydney Coordination Office and Roads and Maritime and would be required to:

- Identify individual traffic management requirements at each phase of construction
- Outline the general principles and procedures for the development of specific CTMPs, taking into consideration where possible other construction works utilising similar haulage and access routes
- Ensure safe and continuous traffic movement for construction workers and the general public
- Maintain the capacity of existing roads where possible
- Identify the requirements for temporary speed restrictions where traffic may pose a safety risk to workers, particularly at the locations where access to construction sites is provided directly off Elizabeth Drive and The Northern Road
- Maintain continuity of access to local roads and properties, particularly along the existing alignment of Elizabeth Drive and Mamre Road
- Provide temporary traffic control access to worksites directly accessed from Elizabeth Drive and The Northern Road
- Identify requirements and placement of traffic barriers
- Provide appropriate warning and signage for traffic in the vicinity of work areas and worksite accesses
- Include methods to minimise road user delays such as undertaking works around live traffic including tie-in and bridge work outside of peak periods
- Undertake construction activities outside the existing road-corridor where possible to minimise the requirement to operate temporary traffic control and reduced speed zones
- Minimise the impact that heavy vehicles would have on the operation of the Elizabeth Drive/M7 Motorway interchange and ensure that construction traffic does affect mainline-traffic flows on M7 Motorway
- Outline processes to advise local residents and businesses of any changes to traffic conditions during construction.

Table 8-1 Construction environment management measures (transport and traffic)

Impact	Reference	Environmental management measure	Responsibility	Timing
Construction transport and traffic	TT01	A Construction Transport and Traffic Management Plan (CTTMP) will be prepared as part of the CEMP in consultation with relevant local Councils, and in accordance with relevant guidelines. The CTTMP will outline: • Staging and planning of works to minimise the need to occupy roads where practicable, including identification of haulage routes • Safe alternate routes for pedestrians and cyclists in accordance with relevant safety and accessibility standards. • The requirements for traffic control plans to be prepared for each work area which will include details of site access and specific traffic control measures (including signage) to manage traffic movements • Road safety audit requirements • Parking arrangements for construction staff • Identification of access arrangements at construction sites detailing vehicle access movements • Measures to minimise changes to the existing road network, property access, bus stops and pedestrian/cyclist facilities where feasible • Measures to communicate and notify of any changes in traffic conditions on roads or paths to road users, emergency services, public transport operators, and other relevant stakeholders • Measures to manage construction traffic interfaces and access arrangements with Western Sydney Airport and Sydney Metro Greater West • Requirements for appropriate warning and signage for traffic and other road users such as cyclists and pedestrians in the vicinity of work areas and worksite access, and road diversions.	Contractor	Prior to construction and during construction
	TT02	Changes to bus stops will be implemented in consultation with TfNSW, relevant councils, and relevant bus operators. Alternate temporary bus stops will be provided with appropriate signage to direct commuters. Safe access will be provided in accordance with relevant safety and accessibility standards.	Contractor	Prior to construction, during construction and after construction
	TT03	Movements of haulage vehicles will be planned to minimise movements on the road network during the AM and PM peak periods where practicable.	Contractor	Prior to construction and during Construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Impacts to M7 Motorway traffic and shared user path users	TT04	Consultation will be undertaken with the operators of the M7 Motorway to develop measures to manage the potential impacts of construction within the operating M7 Motorway corridor.	Roads and Maritime/Contractor	Detailed design, prior to construction, and during construction
	TT05	Roads and Maritime will continue to work with Western Sydney Parklands Trust to support the delivery of a shared user path within Western Sydney Parklands to connect from Range Road to the existing M7 Motorway shared user path. If it is determined during consultation that the shared user path connection through the Western Sydney Parklands will not be delivered, Roads and Maritime will provide an alternate alignment for the shared user path in this section via either Elizabeth Drive, or alongside the M12 Motorway from Range Road to the M7 shared user path network.	Roads and Maritime	Detailed design, during construction
Damage or impacts to local road infrastructure	TT06	A road dilapidation report will be prepared before impacts on local roads in consultation with relevant councils and other relevant stakeholders. The report will document the existing conditions of local roads and outline measures to repair damage to roads from heavy vehicle movements associated with the project.	Contractor	Prior to construction
Impacts to property access	TT07	Existing property access would be maintained at all times. Any changes to access arrangements or alternative access that are necessary during construction will be done with consultation with the landowner. Any changes to access will provide the same equivalent pre-existing level of access unless agreed to by the land owner Property access that is physically affected by the project will be reinstated to at least an equivalent standard, in consultation with the landowner.	Roads and Maritime/ Contractor	Detailed design, prior to construction, and during construction
Impacts on businesses	TT08	A signage strategy will be prepared as part of the CTTMP to provide for appropriate signage for businesses where existing signage is obscured/no longer visible or where customers are required to use alternate access to reach the businesses during construction.	Contractor	Prior to construction

8.2 Management of operational impacts

The majority of operational impacts of the project have been addressed through the concept design and include the following:

- Maintenance of access to existing roads and properties, addressed through the access strategy and detailed in **Table 8-2**.
- Management of traffic capacity constraints, addressed through the design of gradients, ramps and merge areas at motorway interfaces
- Provision of active transport facilities, addressed through the design by provision of a shared user path along the length of the M12 Motorway, connecting with existing cycle and pedestrian facilities on the M7 Motorway and The Northern Road.

In addition, consultation with the Traffic Management Centre and Northwest Roads will continue regarding the management of potential operational traffic impacts. Northwest Roads is the operator of the M7 Motorway. Northwest Roads would review construction traffic management plans to ensure impacts to traffic using the M7 Motorway are minimised. They would also place conditions on Roads and Maritime relating to hours of work and lane closures. The Traffic Management Centre has a similar role for all State roads, as well as the M7 Motorway.

Table 8-2 Proposed property access measures

Affected Property	Impact of the project	Proposed Access Mitigation
2594-2776 The Northern Road, Luddenham	Access points not impacted by the M12 Motorway. M12 Motorway divides the land parcel.	Provide property access point fronting The Northern Road and traversing DP 1/200435.
2778-2828 The Northern Road, Luddenham	The M12 Motorway impacts one property access point at the tie into The Northern Road.	Property access points are affected by The Northern Road upgrade and are to be reinstated as part of this project.
777-819 Luddenham Road, Luddenham	Property access on Luddenham Road is impacted.	Reinstate property access on Luddenham Road with the access path passing through DP 25/604586
752-810 Luddenham Road, Luddenham	Property access via Luddenham Road is impacted. Land Parcel divided by the M12 Motorway	Relocate and reinstate property access point on northern portion of land parcel
146b Clifton Avenue, Kemps Creek 2178	Property Access maintained via a private road intersecting Elizabeth Drive. M12 Motorway divides land parcel. Adjoining land, DP Lot 2/587135, owned by the same corporation	Relocate and reinstate property access point on northern portion of land parcel via local road which traverses DP 47/734584, 2/587135 and 1/587135. Divided southern parcel of land new access via the southern local cul de sac road off the realigned Clifton Avenue.
146-196 Clifton Avenue, Kemps Creek	The realignment of Clifton Avenue to overpass the M12 Motorway impacts the property access point. The land parcel is divided by the M12 Motorway	Relocate and reinstate property access point on northern portion of land parcel via the realigned Clifton Avenue – north of the M12 motorway alignment. The southern land parcel will be maintained via a new access point on the Clifton Avenue realignment – south of the M12 motorway alignment.
364-372 Clifton Avenue, Kemps Creek 2178	Property access impacted. Land parcel divided by the M12.	Relocation existing access to the northern parcel of land via the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951,

Affected Property	Impact of the project	Proposed Access Mitigation
		41/734584, 4/812284, 5/812284, 6/812284, 7/812284
90 Clifton Avenue, Kemps Creek 2178	Northern property access temporarily impacted during construction	Reinstate northern property access point
258 Clifton Avenue, Kemps Creek	Property accesses impacted on Clifton Avenue. Northern access impacted during construction only. Southern access impacted	Relocate southern access and reinstate northern property access point on northern portion of land parcel
373-381 Clifton Avenue, Kemps Creek 2178	Property access impacted on Clifton Avenue. Land parcel divided by the M12 Motorway.	Relocate and reinstate property access point on northern portion of land parcel via the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951, 41/734584, 4/812284, 5/812284, 6/812284, 7/812284
316 Clifton Avenue, Kemps Creek 2178	Property access fronting Clifton Avenue is impacted. Land parcel divided by M12 Motorway.	Provide access to the property via the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951, 41/734584, 4/812284, 5/812284, 6/812284, 7/812284
382-393 Clifton Avenue, Kemps Creek 2178	Property access maintained fronting Clifton Avenue. Land parcel divided by M12 Motorway.	Provide access to the property via the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951, 41/734584, 4/812284, 5/812284, 6/812284, 7/812284
12-20 Salisbury Avenue, Kemps Creek 2178	Property access on Salisbury Avenue impacted. M12 Motorway alignment over majority of land parcel and local road over the remainder	The property access would not be reinstated
2-10 Salisbury Avenue, Kemps Creek 2178	Property access fronting Salisbury Avenue is impacted. Northern access road parallel to the M12 Motorway bisects plot. No access to be reinstated along Salisbury Avenue due to land being split from Salisbury Avenue.	Property access point provided on the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951, 41/734584, 4/812284, 5/812284, 6/812284, 7/812284 to be reinstated
3 Salisbury Avenue, Kemps Creek 2178	Property access fronting Salisbury Avenue impacted.	New access provided through adjacent property (Lot 1 DP 981720). There is also potential to provide property access off Clifton Avenue, via an undeveloped paper road corridor adjacent to Lot 41 DP734584 and Lot 24 DP2566.
Western Sydney Parklands Trust	Public entry and exit to the Sydney International Shooting Centre impacted, Entry Gate B to the Wylde Mountain Bike Trail carpark impacted Gate D on Elizabeth Drive impacted Gate E/G is impacted and not reinstated.	Access point to Shooting Centre impacted by the shared user path ramp down to Range Road reinstated. Entry Gate B will be relocated to the north into the existing carpark. Gate D will be relocated to new access point at the intersection of Duff Road and Elizabeth Drive. This will cross the M12 over a new one-way access bridge. Gate E/G not reinstated due to M12 dividing land parcel. Gate E/G near proposed gate for Gate D and new access bridge. Access can be provided of new access road. Location of gate

Affected Property	Impact of the project	Proposed Access Mitigation
		to be determined in consultation with Western Sydney Parklands Trust.
1400 Elizabeth Drive, Cecil Park 2178	Property access fronting Range Road not impacted. Property Owner owns adjacent lots 2/1054778, 3/1054778, 4/1054778, 5/1054778, 6/1054778, 7/1054778, 8/1054778 and 9/1054778. This is a single access point for all lots, with the exception to lot 8/1054778. Property Access fronting Elizabeth Drive located in property lot 8/1054778 is impacted. Combined land parcel divided by the M12 Motorway.	Property access impacted has had the Land parcels divided by the M12. Due to land size of the property access on Elizabeth Drive, the lane parcel facing Elizabeth Drive has not had the property access reinstated. Divided land parcel with access, has had the access reinstated at the back via Range Road.
1297-1305 Elizabeth Drive, Kemps Creek 2178	Property accesses on Mamre Road not impacted. M12 Motorway alignment located over property access on Elizabeth Drive, which will not be reinstated.	None
1307-1337 Elizabeth Drive, Kemps Creek 2178	Property access on Elizabeth Drive impacted. M12 Motorway alignment over majority of land parcel.	Access to be reinstated to the lot for access to the transmissions tower.
1953-2109 Elizabeth Drive, Badgerys Creek 2555	Property access on Elizabeth Drive is not impacted. The land parcel is divided by the M12 Motorway.	Provide property access path beneath BR02 to divided portion of land
1793-1951 Elizabeth Drive, Badgerys Creek 2555	DP lots 3/164242, 62/1087838 and 63/1087838 are owned by the same land owner (The University of Sydney), property access fronts Elizabeth Drive from lot DP 63/1087838. Property access on Elizabeth Drive is impacted The land parcel is divided by the airport access road.	Reinstate access points fronting Elizabeth Drive
1383-1411 Elizabeth Drive Kemps Creek	Property access points fronting on Elizabeth Drive not impacted. M12 Motorway mainline and bridge over Kemps creek divides the land parcel.	Property access to be provided to the northern portion of the land via the realignment of Clifton Avenue to overpass the M12 Motorway and a local road traversing DP lots 1/736951, 41/734584, 4/812284, 5/812284, 6/812284, 7/812284
1293-1297 Mamre Road, Kemps Creek 2178	Property access on Mamre Road not impacted. Land parcel divided by the M12 Motorway alignment.	Access along Elizabeth Drive will been provided
885a Mamre Road, Kemps Creek	Property access is impacted by the M12 Motorway. Access to this lot is via DP 741/810111. The private bridge crossing South Creek and linking land parcels DP 21/258414, 1/88836 to 1/74574 would be demolished for the M12 Motorway.	Replacement bridge to be built from DP 1/74574 to DP 1/88836, adjacent to the M12 Motorway South Creek bridge. Property access to DP 21/258414 would traverse DP 1/88836"
949a Mamre Road, Kemps Creek	Property Access maintained via a private road intersecting Elizabeth Drive. M12 Motorway divides land parcel.	Provide access to the northern portion of the land parcel by local road which lies within a undeveloped road easement intersecting Clifton Avenue north of the M12 Motorway.

Affected Property	Impact of the project	Proposed Access Mitigation
	Property access also maintained via a private bridge crossing Kemps Creek	
37-73 Wallgrove Road Cecil Park	Property access is impacted by the realignment of Wallgrove Road.	Property access reinstated along Wallgrove Road realignment.
112-128 Wallgrove Road Cecil Park	Property access is impacted by the M7 Motorway Southbound entry ramp to the M12 Motorway.	Property access to Wallgrove Road maintained under M7 bridge over Ropes Creek. New access provided by private road realignment through Lot 14 DP1021940.

9. Conclusion

9.1 Overview

Traffic modelling of the proposed M12 Motorway has been undertaken using the Western Sydney Priority Growth Area traffic model. The traffic model allows for detailed simulation of interactions between vehicles and is informed by traffic volume forecasts that incorporate land use forecasts for Western Sydney Aerotropolis, South West Growth Area and the Western Sydney Airport and its on-site business park developments.

9.2 Key findings

Overall, analysis of the road network performance under the 2026 and 2036 future horizon years shows that the M12 Motorway is required to allow forecast traffic volumes to access Western Sydney Airport. The M12 Motorway would improve access to Western Sydney Airport, providing a motorway standard access directly from the Sydney strategic motorway network and reduce travel times and delays on Elizabeth Drive by providing a high-speed alternative to Elizabeth Drive between The Northern Road and the M7 Motorway.

The project would generate the following potential positive benefits to transport and traffic:

- Reduced delays and higher travel speeds for vehicles travelling to Western Sydney Airport and between The Northern Road and the M7 Motorway providing improved safety for vehicles that would otherwise use Elizabeth Drive
- Reduced road crashes along the Elizabeth Drive corridor
- Provision of a strategically important off-road pedestrian and cycle connection between M7 Motorway and The Northern Road, completing a significant gap in the existing pedestrian and cycle network
- Improved pedestrian/cyclist safety due to the provision of a separated shared user path providing an alternative to Elizabeth Drive, where pedestrians and cyclists would otherwise be required to use the shoulder or the verge
- Reduced number of heavy vehicles, including B-Doubles along Elizabeth Drive which would increase safety for drivers, cyclists and pedestrians
- Improved performance for intersections along Elizabeth Drive between the M7 Motorway and The Northern Road, as well as removal of the existing priority intersection providing access to the M7 Motorway northbound from Wallgrove Road.

The project would result in the following potential impacts to transport and traffic:

- Reduced speeds and increased delays for vehicles travelling along Elizabeth Drive, the M7 Motorway and other local roads within the core study area during construction
- Changes to access for properties whose access would be affected by the project particularly those properties accessed via Clifton Avenue
- Travel time increases and delays to bus operations during construction
- Diversion of pedestrians and cyclists along the M7 shared user path to a relocated path to the east for about two kilometres between Villiers Road and Elizabeth Drive to accommodate the construction of new motorway ramps
- Temporary closure of the existing shared user path bridge over the M7 Motorway south of Elizabeth Drive that provides access from Cecil Hills to the Western Sydney Parklands. During this closure, pedestrians and cyclists using this bridge would be required to travel along Elizabeth Drive.

9.3 Recommendations

Transport and traffic impacts associated with construction of the project would need to be mitigated through environmental management measures. These measures would include the development and implementation of Construction Traffic Management Plans (CTMPs) prepared as part of the Construction Environment Management Plan (CEMP). These plans would be prepared by the construction contractor and would be required to outline the guidelines, general requirements and specific procedures to be used for any works that may have an impact on traffic operation.

10. References

Austroads (2014) *Cycling Aspects of Austroads Guides,* Austroads Ltd, Sydney NSW

Austroads (2013) *Guide to Traffic Management – Part 3 Traffic Studies and Analysis*, Austroads Ltd, Sydney NSW

Commonwealth of Australia and NSW Government (2018), *Western Sydney City Deal*, Commonwealth of Australia, Canberra ACT

Commonwealth of Australia and NSW Government (2014), *Western Sydney Infrastructure Plan*, Commonwealth of Australia, Canberra ACT

Department of Infrastructure, Planning and Natural Resources (2004) *Planning Guidelines for Walking and Cycling*, Department of Infrastructure, Planning and Natural Resources, Sydney NSW

Greater Sydney Commission (2018) *A Metropolis of Three Cities – the Greater Sydney Region Plan*, Greater Sydney Commission, Parramatta NSW

Infrastructure NSW (2018) *State Infrastructure Strategy 2018-2038*, Infrastructure NSW, Sydney NSW

Liverpool City Council (2011), *Growing Liverpool 2021*, Liverpool City Council, Liverpool NSW

NSW Government (2018) *Future Transport Strategy 2056*, Transport for NSW, Chippendale NSW

NSW Roads and Traffic Authority (2005) *NSW Bicycle Guidelines Version 1.2*, NSW Roads and Traffic Authority, Sydney NSW

NSW Roads and Traffic Authority (2002) *Guide to Traffic Generating Developments Version 2.2*, NSW Roads and Traffic Authority, Sydney NSW

Roads and Maritime Services (2018) M12 Motorway Access Strategy*,* available online: https://v2.communityanalytics.com.au/assets/media/rms/m12/M12_Access_Strategy.pdf

Roads and Maritime Services (2019) *Cycleway Finder,* available online: http://www.rms.nsw.gov.au/maps/cycleway_finder

Roads and Maritime Services (2019) *NSW Combined Higher Mass Limits (HML) and Restricted Access Vehicle (RAV) Map*, available online: https://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/restricted-access-vehicles-map/map/index.html

Roads and Maritime Services (2013) *Traffic Modelling Guideline*s, Roads and Maritime Services, Sydney NSW

Transport for NSW (2017b) *Journey to Work 2011*, available online: https://opendata.transport.nsw.gov.au/dataset/journey-work-jtw-2011

Transport for NSW (2018) *Outer Sydney Orbital Corridor Identification*, available online: https://www.transport.nsw.gov.au/corridors/oso

Transport for NSW (2013f) *NSW Sustainable Design Guidelines Version 3.0*, Transport for NSW, Chippendale NSW

Transportation Research Board (2010) *Highway Capacity Manual 2010*, Transportation Research Board, USA

Annexure 1

WSAGA Calibration and Validation Report

ARCADIS Design & Consultancy for natural and built assets

JACOBS

ROADS AND MARITIME SERVICES

M12 MOTORWAY CONCEPT DESIGN AND ENVIRONMENTAL IMPACT STATEMENT

Wider Area Traffic Modelling Base Model Development

Contents

1. Introduction

Jacobs Arcadis Join Venture (JAJV) has been appointed by Roads and Maritime Services (Roads and Maritime) to undertake Concept Design and Environmental Impact Statement (EIS) for M12 Motorway between M7 and The Northern Road in Western Sydney.

M12 Motorway is proposed to provide a crucial transport link to the future development and growth in Western Sydney, particularly for the new Western Sydney Airport located between the Northern Road and the Badgerys Creek Road south of Elizabeth Drive.

To inform a Preliminary Business Case (PBC) and develop the concepts for the M12 Motorway in this project, hybrid microscopic and mesoscopic simulation traffic modelling (using Aimsun) has been used to investigate traffic operation, impact and performance. This report has been prepared to provide a brief summary of the development of the design assessment traffic model including the modelling approach, model construction process, parameters and settings, demand development, survey data, traffic signals as well as the model calibration and validation.

1.1 Background

The M12 Motorway project is the development and construction of a 16km dual carriageway motorway between the Westlink M7 motorway, Cecil Park and The Northern Road, Luddenham. The motorway proposal includes grade separated interchanges at the M7 motorway and Western Sydney Airport, an at-grade signalised interchange with The Northern Road, and design provision for a future service interchange at Devonshire and Mamre Road.

In April 2014 the M12 Motorway was announced as part of the Western Sydney Infrastructure Plan. Roads and Maritime carried out a route options assessment and strategic design process for the M12 Motorway once the Federal Government approved Badgerys Creek as the site for Western Sydney Airport. The motorway is required to cater for the increased traffic volumes. The Strategic Route Options Assessment defined and confirmed a preferred corridor for the motorway which was publicly announced in 2016. The preferred corridor is referred to as the “modified orange” option and is 300 metres wide.

The key benefits of the proposed M12 Motorway are to:

- Provide direct access from the Westlink M7 Motorway to the planned Western Sydney Airport at Badgerys Creek, and from the M4 Western Motorway via the upgraded The Northern Road;
- Improve access to the Western Sydney Airport Growth Area and the South West Priority Land Release Area;
- Increase road capacity for future growth and development;
- Improve traffic safety for road users;
- Provide new pedestrian and cyclist infrastructure;
- Improve freight movement to key commercial centres; and
- Reduce the cost of congestion impact on the community and businesses by providing more capacity.

This stage of the project will involve the preparation of a concept design and an Environmental Impact Statement (EIS) and includes the public display of both.

1.2 Project Objectives

The purpose of the M12 Motorway project is to support the opening of the proposed Western Sydney Airport at Badgerys Creek by connecting Sydney's motorway network to the airport. The project aims to address short and long term transport needs; the M12 Motorway is required to cater for the increased traffic volumes from future development in the Western Sydney Airport Growth Area (WSAGA). Roads and Maritime also places a high priority on achieving quality project outcomes from a safety, environmental and community perspective. The M12 Motorway specific project objectives are listed and described in Table 1-1. These specific objectives relate to the function of the project.

Table 1-1 Project Objectives

Project Objectives	Description
Provide sufficient road capacity to meet traffic demand generated by the planned Western Sydney urban development	Two lane dual carriageway motorway with a wide central median for future upgrade to three lanes in each direction. Bridges and structures to be designed and built for the ultimate six lane configuration and line marked for four lanes.
Provide a high standard connection to the airport with capacity to meet future freight and passenger needs	Motorway will be mostly greenfield construction with multiple bridge structures over existing and future local roads, waterways, including but not limited to Kemps Creek, South Creek, Badgerys Creek, Cosgrove Creek and their associated floodplains M12 Motorway will be a SMART Motorway allowing for improved traffic flow and management.
Provide a road which supports and integrates with the broader transport network	Motorway to include grade separated interchanges including associated ramps, with · Westlink M7 Motorway · Mamre Road/Devonshire Road · Spur road to the planned western Sydney airport at Badgerys Creek · Northern Road
Support the provision of an integrated regional and local public transport system	A critical component of the M12 Motorway design is not to preclude rail access options to WSA. Several rail options are being considered by TfNSW and the Federal Government. The M12 Motorway design will accommodate the kinetic envelope for a range of rail options, including High Speed Rail, within the corridor whilst ensuring future works are safe, constructible and cost-effective.
Preserve the access function of Elizabeth Drive	The Airport Spur Road will go under Elizabeth Drive which will require Elizabeth Drive to be raised in the vicinity of the Western Sydney Airport
Provide active local transport within the east-west corridor	Shared user path along the length of the M12 Motorway including connections to existing and future shared user path networks
Make provision for connection to the future Outer Sydney Orbital	Signalised intersection with The Northern Road with provision for grade separation in the future for the continuation of the motorway to the future Outer Sydney Orbital

The traffic and transport objectives of the project are to provide a high quality traffic and transport assessment to form part of the EIS, and to achieve the requirements of the Environmental Planning and Assessment Act 1979 (EP&A Act) and the Secretary's Environmental Assessment Requirements (SEARs). The traffic and transport assessment needs to evaluate future traffic impact and road performance for both the existing road network and the future road network.

1.3 Scope of Work

The scope of the work for JAJV is to undertake Concept Design and EIS for M12 Motorway for Roads and Maritime. The scope of the work undertaken for this Base Model Development report was to:

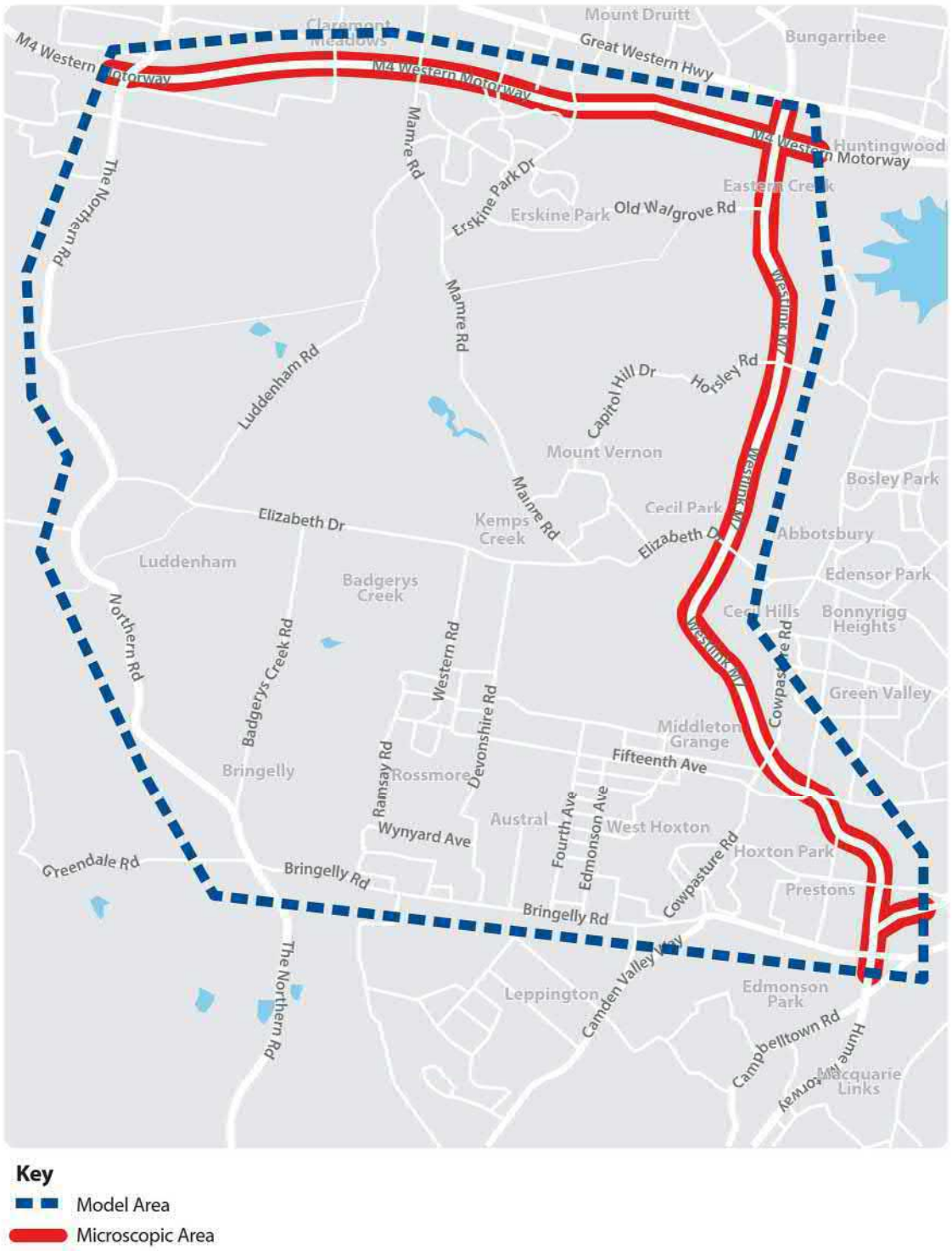
- Develop a hybrid microscopic/mesoscopic simulation traffic model of the area of impact of the M12 for the purposes of civil design; and
- Calibrate and validate the hybrid simulation traffic model to reflect existing traffic conditions.

1.4 Study Area

A plot of the model extents is provided in Figure 1-1. The model covers a region bordered by the following:

- M4 to the North;
- M7 to the East;
- Camden Valley Way and Bringelly Road to the South; and
- The Northern Road to the West.

Figure 1-1 Mesoscopic and microscopic simulation area



1.5 Report Outline

This report has been prepared in accordance with Roads and Maritime's Technical Direction (TTD 2017/001, 17 May 2017), and is structured as follow:

- Chapter 1 – Introduction;
- Chapter 2 – Existing Conditions;
- Chapter 3 – Model Assumptions;
- Chapter 4 – Model Calibration and Validation;
- Chapter 5 – Model Limitations; and
- Chapter 6 – Conclusion.

2. Existing Conditions

2.1 Traffic Surveys

Traffic surveys were undertaken for this modelling exercise in order to capture the existing traffic conditions in the Model Area as detailed below.

2.1.1 Traffic Volume Data

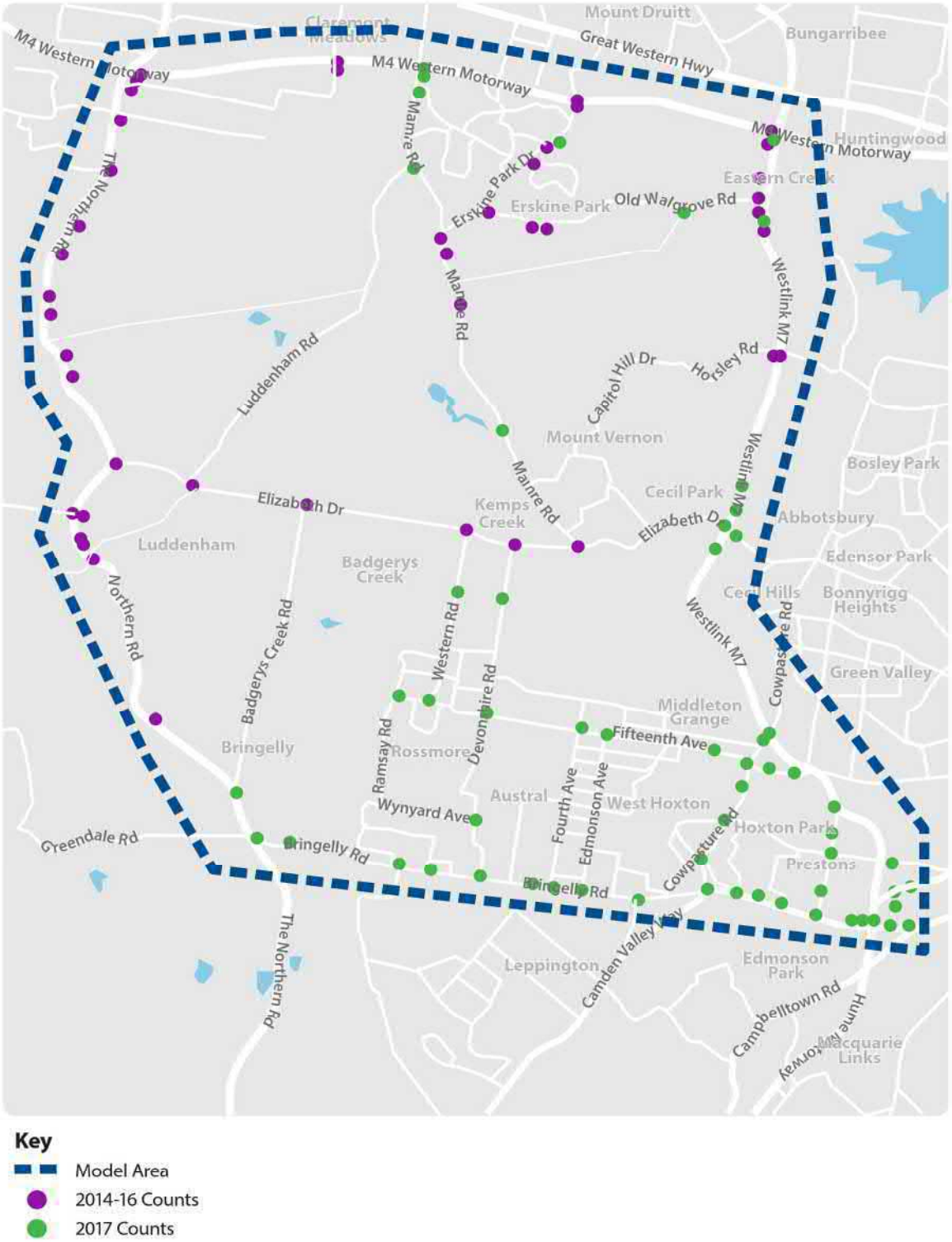
Classified turning movement surveys for 119 intersections were collected at 15-minute intervals during the morning and evening peak and do not identify rigid and articulated heavy vehicles separately. Survey data was collected from various sources spread over the following years:

- 11th June 2015 – 19 intersections along Mamre Road, Erskine Park Road, Lenore Road, Wallgrove Road, the M4 and the M7;
- 23rd July 2015 – 17 intersections along The Northern Road;
- 30th July 2015 – 8 intersections along Elizabeth Drive;
- 17th June 2017 – 61 intersections between The Northern Road to the west, Bringelly Road / Camden Valley Way to the south, M7 to the east, and Elizabeth Drive to the north, as well as along Mamre Road, Wallgrove Road, Erskine Park Road and Lenore Road;
- 18th July 2017 – 2 intersections on Kent Road; and
- 14th December 2017 – 2 intersections on Elizabeth Drive and 10 mid-block counts on the M7 motorway.

Overall, 44 intersections were surveyed in 2015, and 75 intersections were surveyed in 2017.

The location of these data are shown in Figure 2-1.

Figure 2-1 Intersections Count Locations



A number of significant mismatches in flow were observed, particularly between intersections counted in different years. Substantial differences between inflow and outflow for adjacent intersections counted in different years that could not be accounted for by surrounding land use occurred in a number of areas, including but not limited to:

- Mamre Road;
- Erskine Park Road;
- Lenore Drive;
- Luddenham Road; and
- Elizabeth Drive.

A process of correcting these mismatches and ensuring continuity of flow between adjacent intersections was undertaken, generally assuming that the most recently collected counts were more correct.

To provide a sound basis for calibration and demand adjustment, especially in view of the range of types and dates covered by the surveys, the counts have been checked and adjusted for consistency. This also provides an additional check that the 890 counts have been processed and imported into the model correctly.

For each time interval, traffic counts have been propagated through the network to identify section volumes based on both upstream and downstream sources, and the turn or midblock counts which contribute to each. In most cases, approach flows either upstream or downstream of the most reliable count required adjustment either up or down. This was undertaken by factoring total approach flows so that individual turns retain their proportions of the overall approach flow.

Where a discrepancy is found between the propagated upstream and downstream sources, the contributing counts are adjusted according to a priority level depending on the count type as follows:

1) The intersection counts collected in 2017 have the highest priority, as these are the most recent, detailed, and conducted on the same day; and
2) Intersection counts undertaken prior to 2017, or in locations where significant road works have occurred after these counts were taken, were given lower priority.

Discrepancies have been adjusted for in cases where the GEH is greater than two or the flow difference is greater than 100 veh/hr between adjacent intersections. As quoted in the Roads and Maritime Traffic Modelling Guidelines version 1.0, Transport for London (TfL) suggests that the accuracy of observed counts must be within +/- 100 pcu /hr or within a GEH of two. Adopting this method ensures that the larger counts remain within this range while providing good consistency between the lower volume counts.

In some cases, large differences between observed counts were better explained by land use or accesses that exist between the two counts, in which case the counts were not adjusted and some subdivision of centroids was undertaken.

2.1.2 Travel Time Surveys

General traffic travel time data was collected on 27th June 2017 for eight key routes in the study area using floating car travel time surveys:

- Route 1: M7 Motorway;
- Route 2: M4 Motorway;
- Route 3: The Northern Road;
- Route 4: Mamre Road;
- Route 5: Luddenham Road;
- Route 6: Elizabeth Drive;
- Route 7: Bringelly Road/Camden Valley Way; and
- Route 8: Cowpasture Road.

The travel time survey for Route 3 The Northern Road was collected on 27th June 2017 between Bringelly Road and Mersey Road. Between Mersey Road and the M4, the travel time survey was carried out on the 13th and 20th October 2015. Counts were taken at the intersection of The Northern Road and Dwyer Road on 23rd July 2015, and on the intersection of The Northern Road and Badgerys Creek Road on 27th June 2017. The difference in traffic volumes between these two nearby intersections along The Northern Road is a total of 400 combined in the northbound and southbound direction for both the AM and the PM peak 4-hour periods. The older travel time survey is assumed to be an accurate representation of current travel time as very little land use change has occurred in the intervening period, as evidenced by the small change in traffic volumes over the intervening period.

The locations of surveyed travel time routes are shown Figure 2-3.

Review of the floating car travel time data collected for the M4 route showed substantial increases in observed westbound travel times between Roper Road on-ramp and Mamre Road off-ramp between 5pm and 6pm. This observed delay is not consistent with the observed pattern of delays reported by Google traffic and is inconsistent with travel speeds collected by Roads and Maritime in November 2014 at detectors on the M4 Motorway between Roper Road and Mamre Road. A summary of westbound observed speeds on the M4 Motorway westbound is provided in Figure 2-2, and shows that no substantial delays were observed in the evening peak at the location noted by the travel time surveys. This data indicates that the delays along the M4 westbound on the survey date were likely a result of an incident either at or east of the Mamre Road off-ramp, and that the high travel time in this section is not typical of day-to-day operation of the M4 in this location.

Figure 2-2 Observed travel speed on the M4 motorway, 2014 (M7 to Mamre Road)

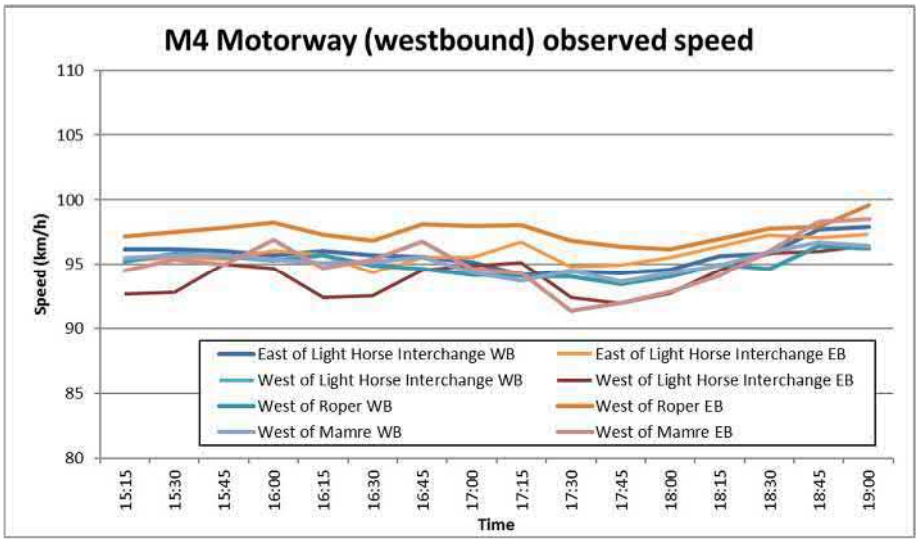


Figure 2-3 Travel time validation corridors

2.2 Site Visit

A site visit was conducted on Thursday 6th April 2017 to observe the current traffic operation and conditions in the study area especially along Elizabeth Drive. The site visit identified that Elizabeth Drive is primarily a two-lane two-way corridor which currently carries a mix of local industrial, commercial and residential traffic across the region. Minimal traffic congestion is observed along Elizabeth Drive during peak periods, with some congestion observed during the morning peak heading eastbound on approach to the M7 Motorway.

2.3 Congestion Locations

Based on site observations and analysis of survey data, traffic congestion generally occurs at the Elizabeth Drive / M7 interchange heading eastbound along Elizabeth Drive in the morning peak, reflecting high demands from the South West Priority Growth Area to Fairfield and Liverpool. No significant congestion was identified in other parts of the road network within the immediate Elizabeth Drive study area.

Based on site observations and analysis of survey data, traffic congestion generally occurs in several locations in the wider study area. In the morning peak, congestion is observed in the following locations:

- **M4 Motorway** – eastbound, between Mamre Road and the M7;
- **M7 Motorway** – northbound, between the Horsley Drive and the M4;
- **Wallgrove Road** – northbound, between the Horsley Drive and the M4, and southbound between Mini Link Road and Wonderland Drive;
- **The Horsley Drive –** eastbound, at the intersection with Wallgrove Road;
- **Elizabeth Drive** – eastbound, at the intersection with the M7;
- **Camden Valley Way** – eastbound, between Cowpasture Road and Campbelltown Road;
- **Cowpasture Road** – northbound, between Greenway Road and the M7; and
- **Beech Road** – southbound, at the intersection with Camden Valley Way.

In the evening peak, congestion is observed in the following locations:

- **M4 Motorway** – westbound, between the M7 and Mamre Road;
- **M7 Motorway** – southbound, between the M4 and Horsley Drive;
- **Wallgrove Road** – northbound, between the Old Wallgrove Road and the M4;
- **The Horsley Drive –** westbound, at the intersection with Wallgrove Road;
- **Camden Valley Way** – eastbound, between Cowpasture Road and Campbelltown Road, and westbound between Campbelltown Road and Gellibrand Road;
- **Cowpasture Road** – northbound, between Greenway Road and the M7, and southbound, between the M7 and Kurrajong Road; and
- **Beech Road** – southbound, at the intersection with Camden Valley Way, and northbound, at the intersection with Kurrajong Road.

2.4 Existing Conditions Analysis

A summary of the existing traffic conditions observed in key locations throughout the study area are provided below:

- **M4 Motorway**: congestion along the M4 Motorway is frequently observed eastbound in the morning and westbound in the evening. The primary eastbound constraint is the interchange with the M7 Motorway, where eastbound traffic on the M4 merges with traffic from both directions on the M7. Delays are also experienced on the M7 and traffic from the north and south merge on the on-ramp to the M4;
- **M7 Motorway**: high traffic volumes on the M7 Motorway occur northbound between the M5 and Elizabeth Drive and southbound between the M4 and the Horsley Drive in the morning and evening peak respectively. High congestion occurs at key constraints at the Bernera Road, Cowpasture Road and Old Wallgrove Road interchanges;
- **The Northern Road**: with the exception of the road between Glenmore Parkway / Wentworth Road and Bradley Street, and near Bringelly Road which experience moderate congestion, the Northern Road typically has low congestion during peak hours;
- **Elizabeth Drive**: Elizabeth Drive typically experiences no to moderate delays, with constraints occurring at the Elizabeth Drive / Devonshire Road and Elizabeth Drive / Duff Road intersections. This is primarily due to traffic volumes arriving and departing from schools at these locations;
- **Camden Valley Way**: moderate to high congestion levels occur on multiple sections of Camden Valley Way, including near Oran Park Drive / Gregory Hills Drive and between the Hume Highway and Cowpasture Road. According to 2017 RMS traffic volume counts, 32,879 vehicles travel in both directions on Camden Valley Way near Heath Road, with 99% being light vehicles and 1% being heavy vehicles;
- **Bringelly Road**: with the exception of the intersections with The Northern Road and Cowpasture Road/Camden Valley Way, Bringelly Road typically experiences low congestion during peak hours;
- **Luddenham Road**: during peak hours, Luddenham Road experiences little to no delay. This can be attributed to a low number of developments fronting Luddenham Road; and
- **Mamre Road:** moderate congestion occurs on Mamre Road between the M4 and Bakers Lane, primarily due to residents and employees accessing nearby residential and commercial developments. South of Bakers Lane, no delays are experienced during peak hours.

3. Model Assumptions

3.1 Modelling Platform

The *Western Sydney Airport Growth Base Traffic Model (WSAGA Base Traffic Model)* has been developed using the AIMSUN (version 8.2.0) traffic modelling platform. AIMSUN allows for the development of static and dynamic traffic models within a unified platform, performing traditional static macroscopic modelling using volume delay functions as well as more detailed dynamic mesoscopic and microscopic modelling. Dynamic traffic models are useful in modelling congested or capacity-constrained conditions where traffic demand exceeds available capacity and traffic diverts to seek less congested alternative routes. These conditions result in queuing that builds up and dissipates over time and dynamic routing of traffic that is responsive to this build-up of delays.

The model is based on an initial road network and traffic demand supplied by Transport for NSW, converted from the Roads and Maritime Strategic Highway Assignment Model and refined for the study area. This model has been built within Jacob's Greater Metropolitan Sydney network, which includes detail in coding from other projects within Sydney including the M4 Motorway and a large area of Western Sydney, and has used many of the existing volume delay functions and node delay functions that have been developed as a result of this work.

The *WSAGA Base Traffic Model* is a hybrid mesoscopic-microscopic traffic simulation model.

Mesoscopic modelling provides sufficient detail to determine the performance of the road network under proposed future land use scenarios and provides guidance on the need for further road infrastructure requirements. In addition, mesoscopic simulation allows for true dynamic equilibrium assignment where vehicles can select their optimal travel routes based on their previous travel experiences. This provides a confidence that the modelled pattern of traffic represents a realistic response to the delays and capacity constraints that would be experienced by traffic on a day-to-day basis.

Additionally, the model includes a microscopic simulation area covering the M4 and M7 motorways to better reflect detailed behaviour such as lane changing and weaving which is best modelled using microscopic simulation.

As the *WSAGA Base Traffic Model* has been developed using AIMSUN **Version 8.2.0**, all future scenario modelling works should be undertaken using the same version. Otherwise, re-calibration and re-validation of the model would be required.

3.2 Time Period

The *WSAGA Base Traffic Model* covers the morning and evening peak periods from 6-10am and 3-7pm respectively. In addition to these simulation periods, a "warm-up" demand of one additional hour has been specified to generate sufficient congestion on the network at the start of each analysis period. Results from the warm-up hour are not included in the reported model statistics.

Traffic demand has been defined in 15-minute matrices, while signal control plans have been defined per hour. Signal times were averaged per hour as minimal phase time variance within the hour was observed for the majority of intersections within the modelled area. The accuracy that would be provided by the use of separate 15-minute signal plans would be minimal, particularly when considering traffic count data and traffic signal data are not from the same day (in some cases from different years).

3.3 Assignment Type

The assignment used in the *WSAGA Base Traffic Model* is based on a Gradient Based Dynamic User Equilibrium (DUE) at the hybrid mesoscopic and microscopic simulation level, using initial path assignment results from a static traffic assignment of the same period.

3.4 Vehicle Type

The three vehicle types were defined and utilised in the *WSAGA Base Traffic Model* including:

- Car – from 3.35m to 5.35m (Vehicle Type 'Car');
- Rigid – from 8m to 15m (Vehicle Type 'Truck'); and
- Semi-Trailer & B-Double – from 17m to 25m (Vehicle Type 'Heavy Truck').

The proportions of the vehicles in the *WSAGA Base Traffic Model* are estimated based on the traffic survey data as follows:

- Car – 92% for morning peak and 95% for evening peak;
- Rigid Truck – 6% for morning peak and 4% for evening peak; and
- Semi-Trailer – 2% for morning peak and 1% for evening peak.

3.5 Traffic Zones and Input

The Greater Sydney AIMSUN model, developed for the Sydney GMA, has a base centroid configuration that corresponds to the Transport Performance Analytics (TPA) Travel Zones for 2011 (TZ11) configuration.

The model area covers some 82 TZ11 Travel Zones. These travel zones have been subdivided in the model in order to increase the resolution of the model in the study area and provide a more detailed distribution of traffic loading onto major corridors to meet observed flows. This disaggregation process resulted in an additional 101 travel zones created within the study area.

Disaggregation of the PTPM travel zones was undertaken to account for the following:

- Large traffic generators or attractors between count locations such as driveways and carparks;
- Areas of differing land use within an existing travel zone, such as residential and industrial land; and
- Areas where land use type or distribution of land use types is likely to change within an existing travel zone.

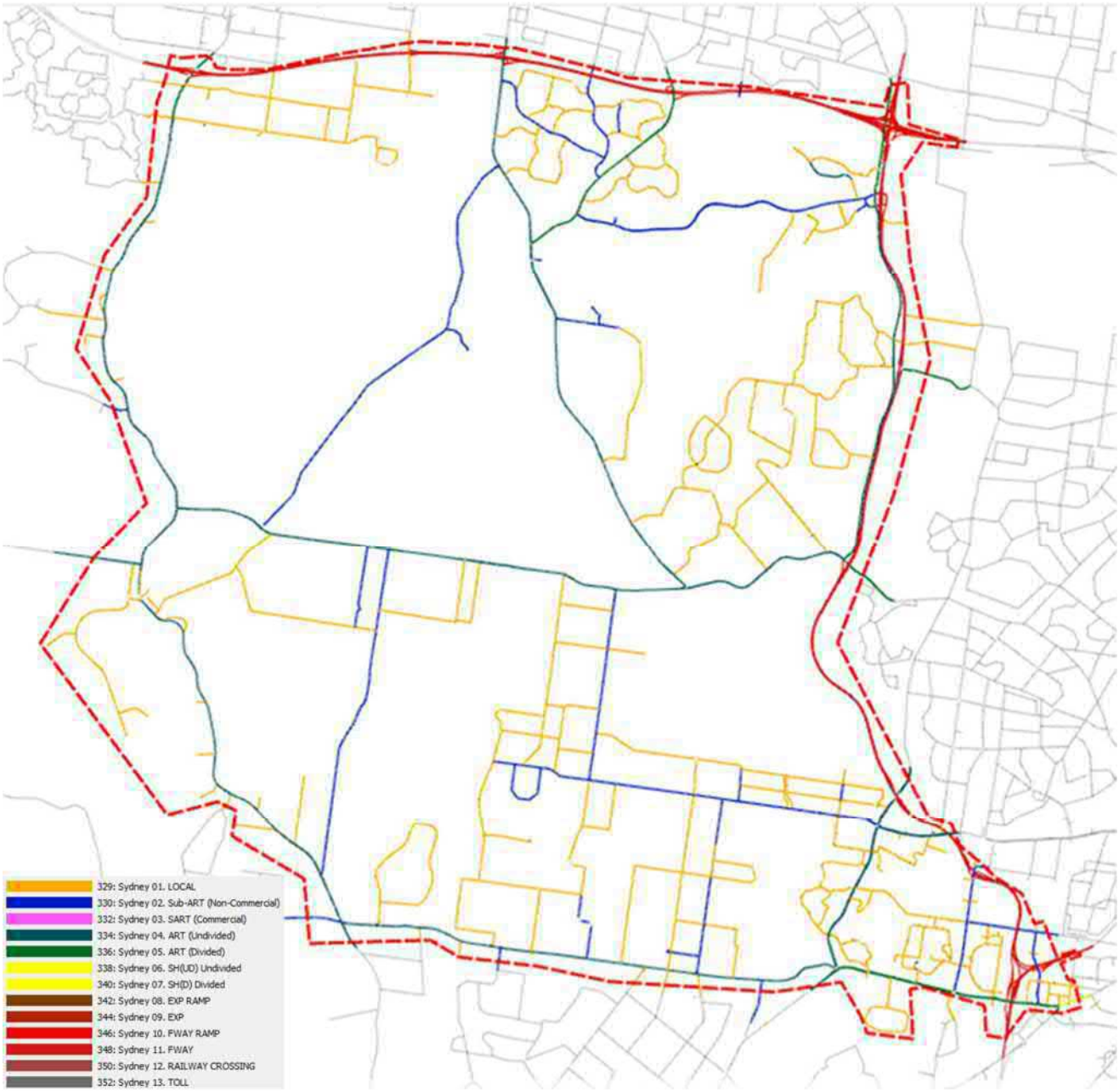
Demand associated with subdivided travel zones was also split, generally according to one of the following:

- Approximate number of dwelling for residential area;
- Approximate developable land area for industrial and commercial land; and
- Approximate number of car spaces for retail land.

3.6 Road Types

The road types and hierarchy adopted in the *WSAGA Base Traffic Model* is presented in Figure 3-1. These road types are based on the road types defined in WRTM for the study for Freeway, Freeway Ramp, Arterial Road (Divided and Undivided), Sub-Arterial Road (Divided and Undivided) and Local Road.

Figure 3-1 Road Types and Hierarchy

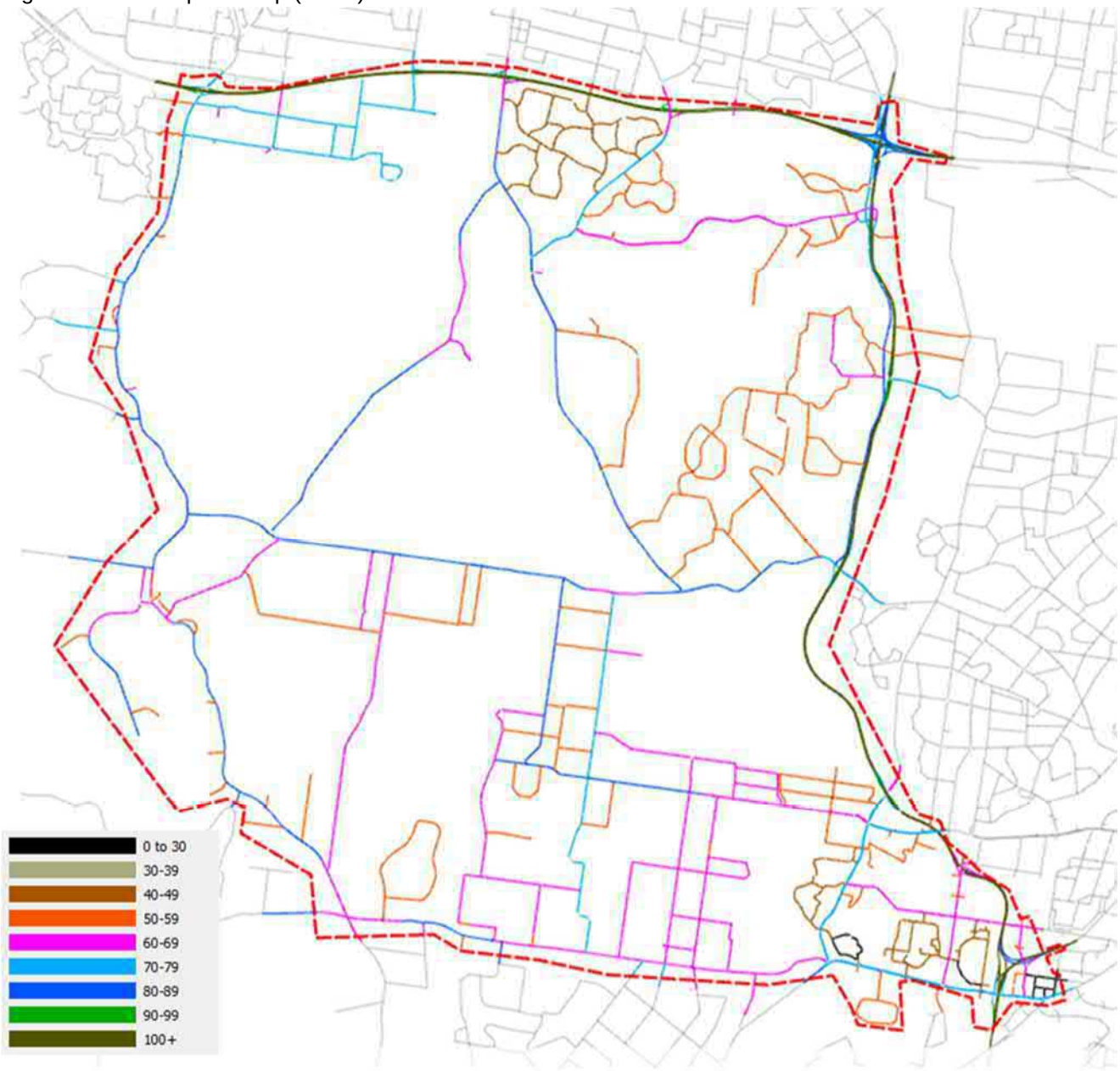


3.7 Speed Profiles

The road section speeds in the *WSAGA Base Traffic Model* are presented in Figure 3-2 and were coded according to the existing posted speed limits in the study area.

Posted speed limits in the area vary from 50 km/h on local roads to 110 km/h on the M7.

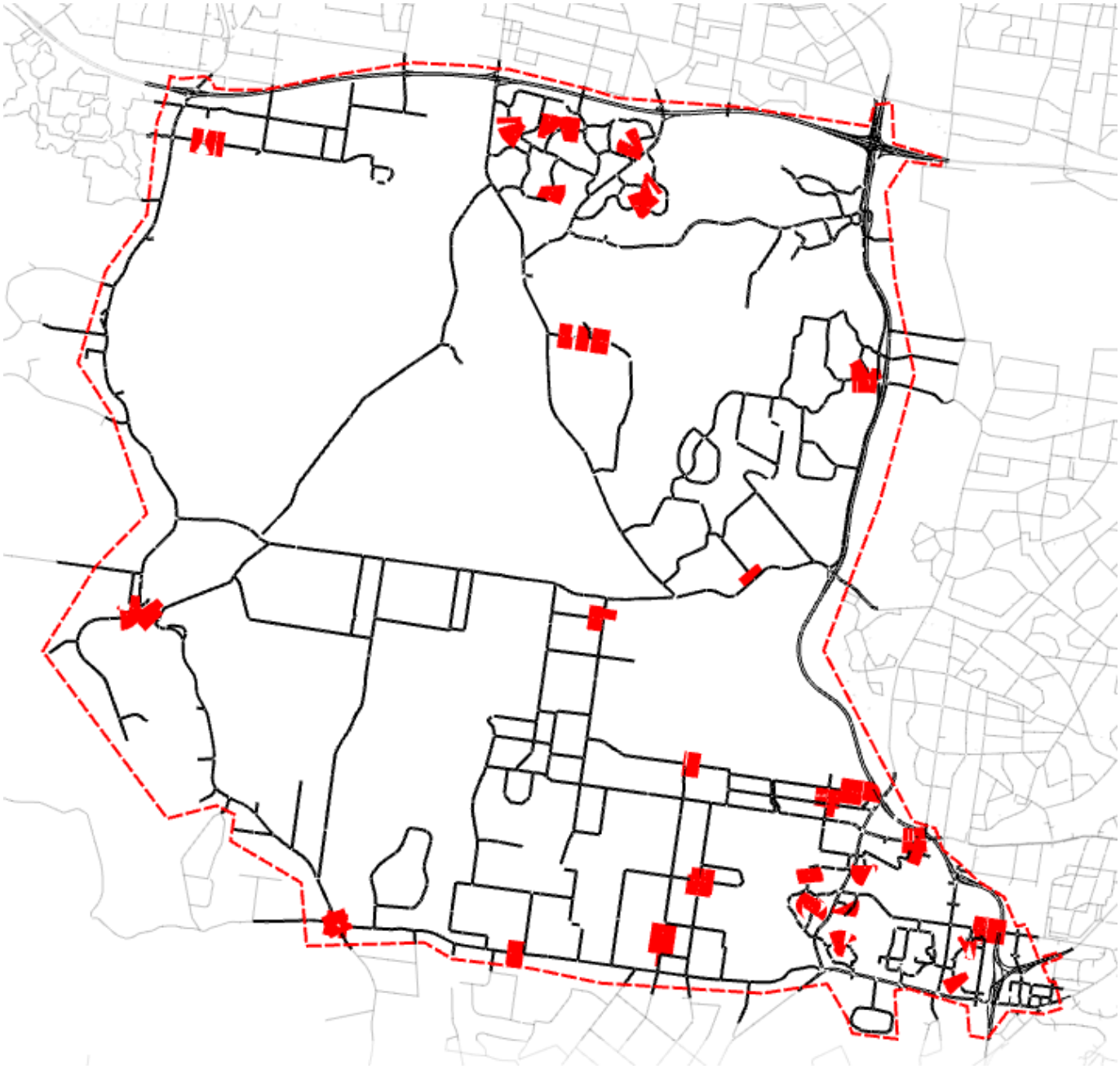
Figure 3-2 Road Speed Map (km/hr)



3.8 School Zones

Numerous school zones exist throughout the model area. Variable speed zones were modelled on all sections located within a school zone using traffic management to apply a 40km/h speed limit from 8-9.30am and 2.30-4pm during school hours, and 60km/h outside these school hours. Figure 3-3 shows the locations of all school zones in the model.

Figure 3-3 School Zone Locations



3.9 Traffic Signals

The *WSAGA Base Traffic Model* has 59 signalised intersections located throughout the model.

The signal phases and timings of the intersections were based on the historical data of the Sydney Coordinated Adaptive Traffic System (SCATS) provided by Roads and Maritime Services.

The traffic signal times have been derived from SCATS History file data which records the times for individual phases across the peak period. These phase times have been aggregated and imported into the models and manually adjusted to reflect a realistic representation of phase and cycle timings.

A limitation of the SCATS History files is that they do not record gap-out behaviour for diamond overlap phases. This behaviour occurs when there is an imbalance in right turns during a diamond phase, causing SCATS to call a short alternative phase to allow a leading right turn and through movement to run before the main through movement phase. The model flows and operation were observed and where it was determined that this gap-out feature was required to meet observed flows, a leading right turn phase was coded taking time from the recorded diamond phase. For intersections with highly variable demand for this gap-out feature, actuated traffic signal logic was used to allow phase times to vary from cycle to cycle.

The traffic signal times have been imported from SCATS History file data which records the phase splits for individual phases across the peak period. These phase splits have been aggregated and imported into the models and manually adjusted to reflect a realistic representation of an adaptive signal operation in fixed-time.

The importation of SCATS History data into AIMSUN has a number of limitations; specifically, the import process does not provide the following data:

- Phase order (when it deviates from the standard phase progression);
- Offsets;
- Gap-out of conditional overlap phases;
- Intergreen times (based on user input); and
- Late-start or pedestrian delays.

As the majority of the model area is currently limited to mesoscopic simulation, which has inherent limitations including instantaneous acceleration and limited lane changing behaviour, signal coordination generally does not have a substantial impact on modelled capacity.

Late starts for left turns, either due to pedestrian protection or direct conflict between pedestrians and left-turning vehicles, has not been accounted for in traffic signal settings, primarily due to a lack of data at locations where pedestrians conflict with traffic. For the majority of arterial roads in the model area, the volume of pedestrians is unlikely to be high enough to have a significant impact on capacity at traffic signals, however these changes can be made to the model if this data is made available and may result in small improvement in observed delays at some key intersections.

Actuated traffic signal logic was used at the following intersections:

- Camden Valley Way and Beech Road

3.10 Public Transport

Coding of the public transport network was undertaken based on bus stop, bus route and bus timetable data from the Transport for NSW Operational Spatial Database (OSD). This database provides the location of bus stops, bus routes and stopping patterns as well as timetabled arrival times at each stop along each route.

A subset of the OSD was extracted that detailed the stops and routes for all public and school buses passing through the study area during the morning and evening peak periods. These bus stops were imported and bus routes created based on linking stops according to the shortest path between stops. Review and correction of imported routes was also undertaken to ensure that stops were imported in the correct locations and that routes operated along the correct roads.

3.11 Demand Assumptions and Adjustment

Traffic demand estimation was undertaken using the Departure Adjustment method available in AIMSUN. The following stages were used in the development of base traffic demand:

- Assignment of the Sydney GMA model and generation of morning and evening peak hour sub-area traversal matrices using static assignment;
- Expansion of the single hour traversal matrices in the strategic model zone system to four hour total matrices in the higher-resolution zone system;
- Static adjustment using departure adjustment methodology within AIMSUN to create 15-minute matrices based on modelled static assignment travel times and paths;
- Manual adjustment of 15-minute matrices to account for differences in static and dynamic assignment; and
- Split of 15-minute matrices into toll and non-toll classes.

Each of these stages is described in further detail below.

3.11.1 Departure adjustment and time-slicing

The aim of the departure adjustment and time-slicing process is to adjust and slice an origin-destination matrix that considers static assignment travel times to allocate trips on the correct departure matrix in order to reach the desired location at the observed time under dynamic simulations. This resolves the time shift of long trips by considering static travel times in the adjustment. This process uses static travel time, and hence dynamic factors such as congestion at signalised intersections are not considered.

The following are the parameters used in this project:

- Interval duration: 900 seconds (15 minutes); and
- Matrix weight: 0.95.

The interval duration is the general time duration used for the slicing calculation. The matrix weight provides a limit on the degree to which the original demand matrices can be adjusted, with ‘one’ corresponding to no allowed change and ‘zero’ corresponding to complete liberty to change the original matrices.

3.11.2 Manual demand adjustment

Following the departure adjustment procedure, further edits were made to the 15-minute demand matrices either to account for limitations in the static demand adjustment or to account for differences between the static and dynamic assignment. Issues that were resolved through manual adjustment of the demand matrices included:

- Inflation of short trips where the demand adjustment procedure has generated a large increase in trips between zones that are very close together; and
- Pathing and inflation of trips through capacity constraints with no control count.

Demand adjustment was undertaken on the basis of turning movement counts at the hourly level. 15-minute demand matrices for each peak period were adjusted to observed counts on the basis of dynamic traffic assignment. Following the departure adjustment, further manual edits were made to the matrices, primarily to correct the following issues:

- Reducing the number of short trips (generally between adjacent zones with the same land use e.g. residential to residential) generated by the departure adjustment procedure and replacing them with longer, more sensible trips;
- Accounting for correction in the connection of travel zones at the time when the departure adjustment was undertaken, such as travel zones connecting to both sides of a divided carriageway or directly into an intersection; and
- Accounting for correction of turn bans that were missing at the time when the departure adjustment was undertaken.

3.11.3 Toll split

A substantial proportion of traffic through the *WSAGA Base Traffic Model* area has the option to travel along the Westlink M7 Motorway or the various toll-free alternatives such as Wallgrove Road and Cowpasture Road. Implementation of a flat user-defined cost was found to be insufficient to replicate the observed traffic volumes in the vicinity of the M7. In order to more accurately match the observed traffic volumes on the eastern half of the model area, the base year traffic demand was subdivided into the following toll classes:

- **Toll eligible**: vehicles willing to pay a toll; and
- **Toll non-eligible**: vehicles not willing to pay a toll.

Tolled roads (in this case, Westlink M7) were made exclusive to toll eligible vehicles only, with non-toll vehicles forced to use other routes.

Origin-destination matrices from WestConnex Road Toll Model (WRTM) split into toll and non-toll vehicles was used as the basis for the initial split of the base year matrices, with further adjustments undertaken to toll and non-toll demand to meet the final calibration targets.

3.12 Trip Length Distribution and Through Traffic Changes

Trip length analysis has been undertaken for the total traffic between the initial traffic demand from the WRTM and the traffic demand adjusted based on the traffic survey data. The purpose of the trip length analysis is to understand if the adjusted traffic demand retains a similar traffic pattern as well as make sure inappropriate short trips have not been added during the demand adjustment process.

Figure 3-4 and Figure 3-5 below demonstrate the comparison of the trip lengths between the initial traffic demand and the adjusted traffic demand. It shows the adjusted traffic demand generally has a similar trip length pattern in both peak periods. In the morning peak there is an increase in trips at 4km and 23-24km, and a reduction at 35-40km. In the evening peak there is an increase at 1-4km and 17km, and a reduction at 30-40km. The overall trip length distribution is considered appropriate for the final adjusted traffic demand.

Figure 3-4 Morning Peak Trip Length Distribution

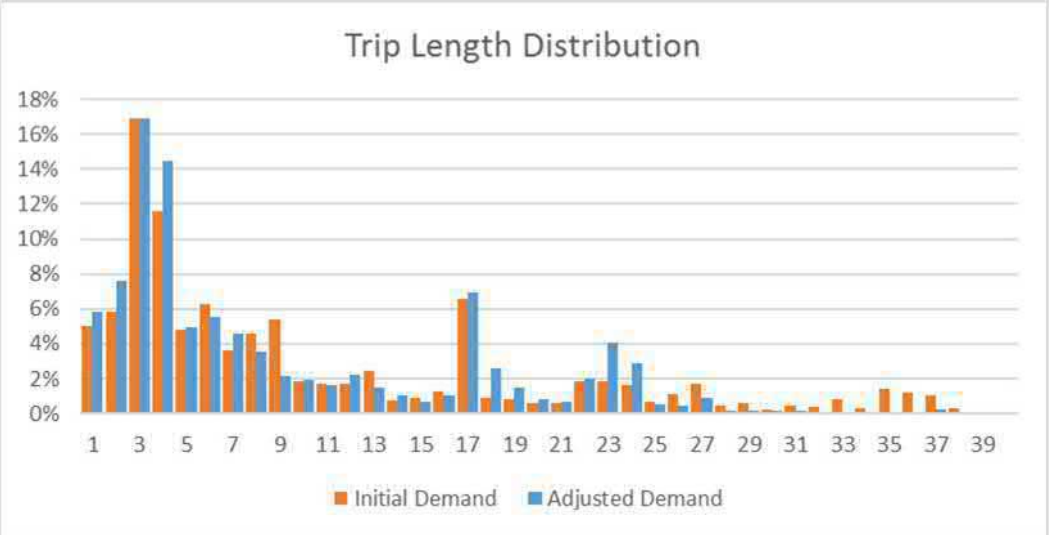
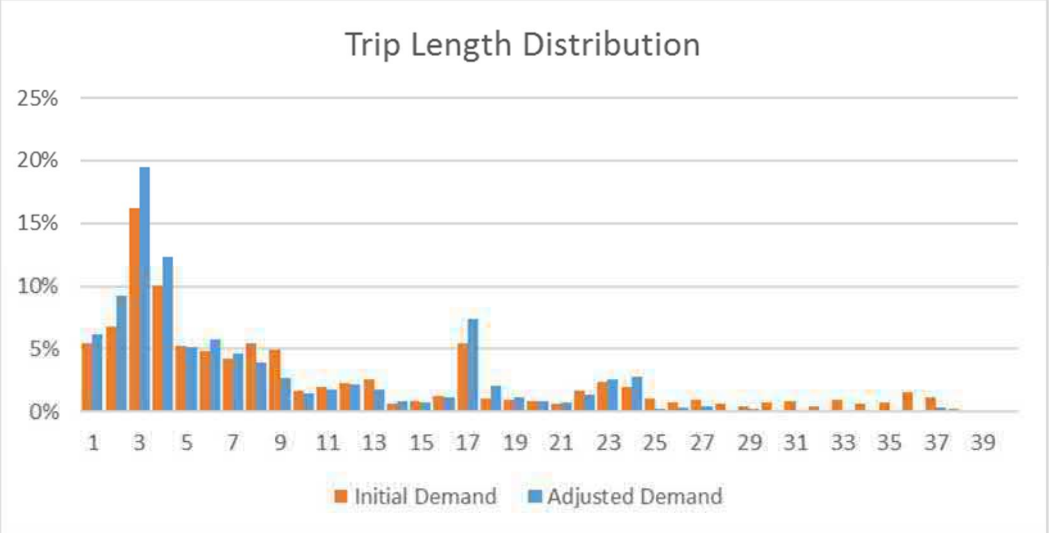


Figure 3-5 Evening Peak Trip Length Distribution



3.13 Pedestrians and Cyclists

No pedestrian or cyclists have been included in the *WSAGA Base Traffic Model*. The impact of pedestrians and cyclists is considered to be minimal for the study area.

3.14 Traffic Profile

A traffic profile with 15-minute intervals for each peak period was developed in the *WSAGA Base Traffic Model* according to the traffic survey data. Vehicles are released based on the profile in the model to reflect the traffic flow changes in the network. Figure 3-6 and Figure 3-7 illustrate the vehicle release profile for each 15-minute in both the morning and evening peak periods.

Figure 3-6 Traffic Profile Morning Peak Periods (no. of vehicles over time)

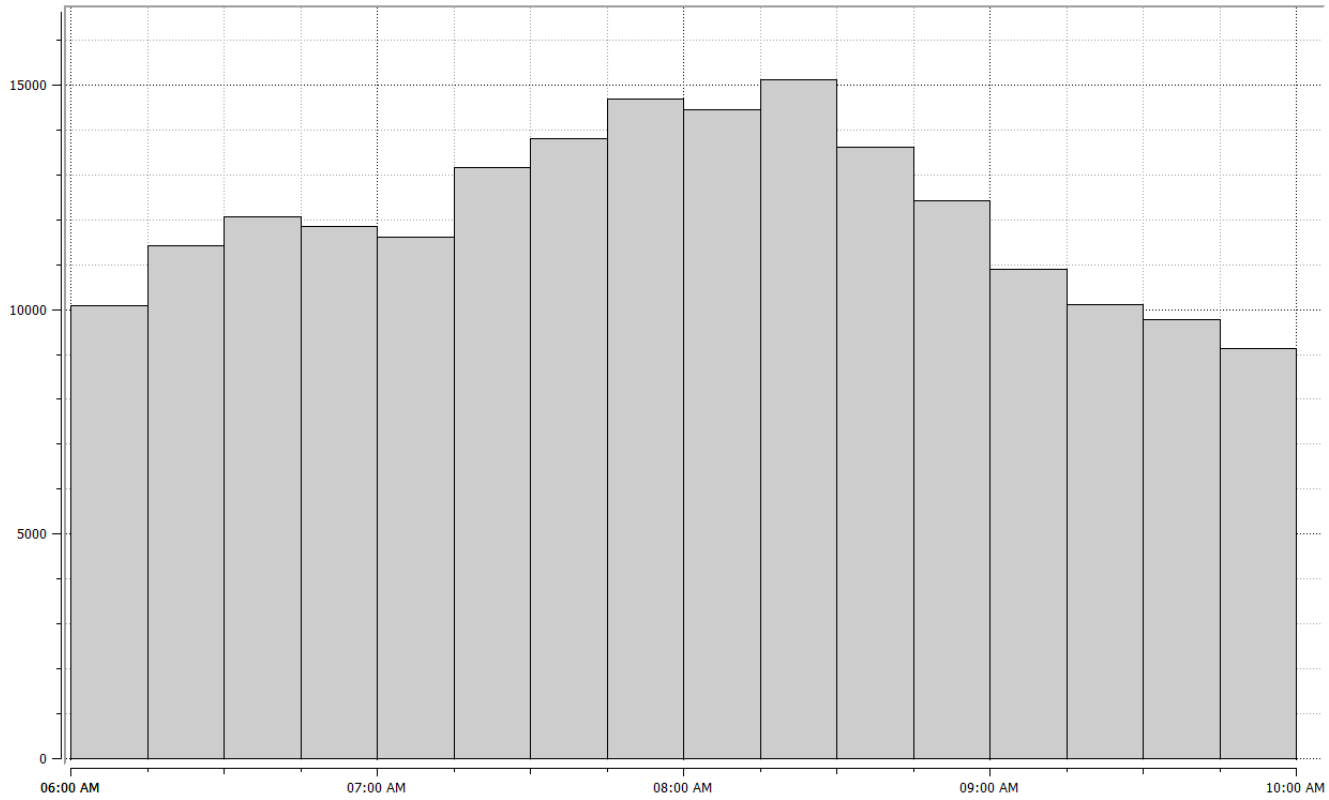
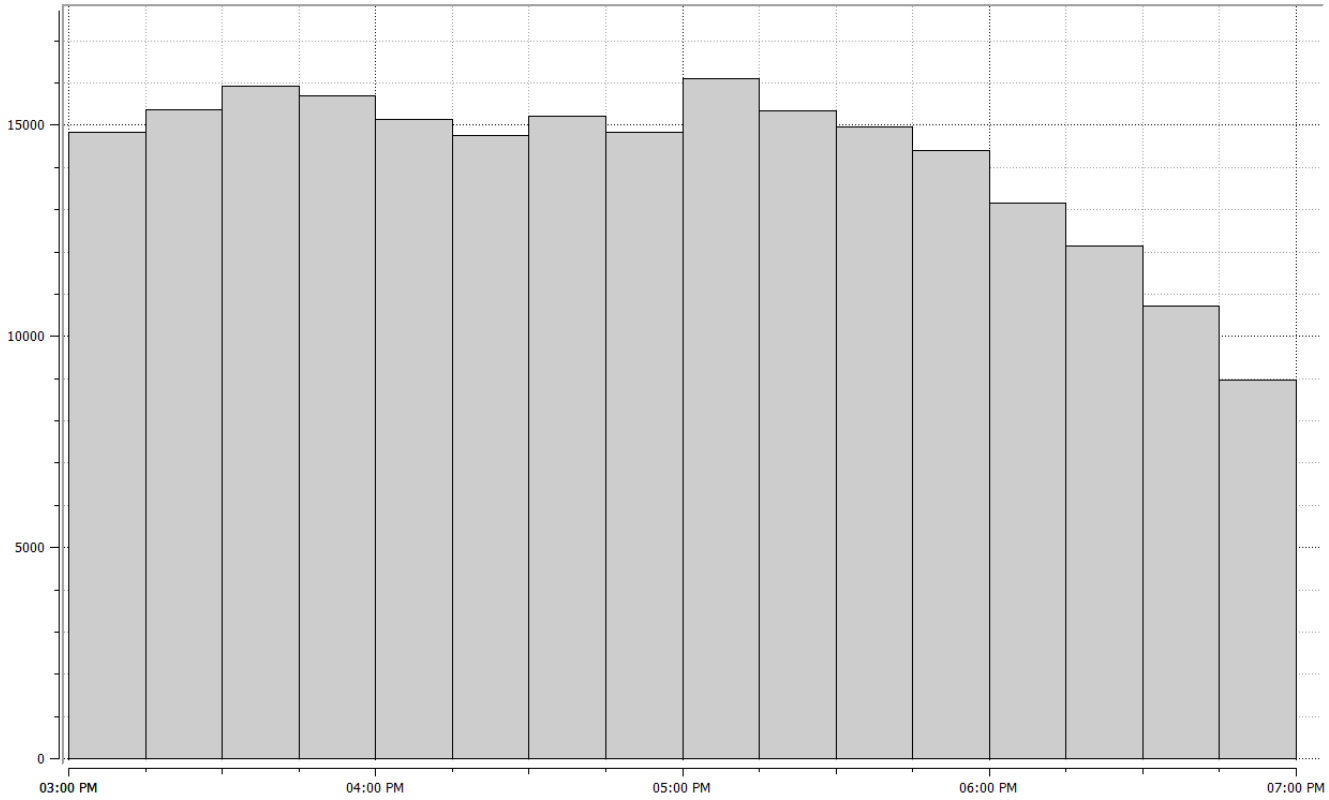


Figure 3-7 Traffic Profile Evening Peak Periods (no. of vehicles over time)



3.15 Behaviour Parameters

The original driving behaviour parameters have been largely kept the same where possible, except for modification of the parameters for ‘Distance Zone 1’ and ‘Distance Zone 2’. This modification is considered as the common practice for correcting and refining lane usage and queuing propagation at intersections.

3.16 General Assumptions

Assumptions and estimation have been made to the traffic survey data due to its limitations and gaps identified during the analysis of the traffic survey data. The traffic survey data was collected from different days and years and inconsistencies between data sets were identified. The data was validated and corrected via common excise and based on the data from adjacent locations.

3.17 Calibration and Validation Assumptions and Targets

The calibration and validation targets adopted are based on the traffic survey data available and the Roads and Maritime Traffic Modelling Guidelines 2013, including:

- Turn Target Calibration / Validation Criteria (Table 11.1 and Table 11.2); and
- Travel Time Target Validation Criteria (Table 11.5).

4. Model Calibration and Validation

4.1 Turn Count Calibration Results

The calibration of the *WSAGA Base Traffic Model* has been undertaken with a view to meeting the targets for calibration provided by Transport for NSW modified from the Roads and Maritime Traffic Modelling Guideline (2013), adapted for mesoscopic simulation where possible. The calibration has been undertaken based on hourly turning movement counts over the four-hour morning (6-10am) and evening (3-7pm) peak periods.

Base model calibration has been undertaken in two stages:

- Calibration of the static assignment parameters iteratively alongside demand adjustment to ensure that the adjustment is undertaken using valid static assignment routing; and
- Calibration of the traffic signals, mesoscopic simulation and DUE assignment parameters were undertaken after static adjustment was completed.

Although the static assignment and adjustment processes use separate network parameters to the mesoscopic simulation, some additional parameters accounting for model delay were also calibrated in the static assignment model on the basis of signal timings derived from the mesoscopic simulation.

4.1.1 Calibration targets

The GEH statistic is used in the calibration of traffic models to compare the differences between modelled and observed traffic flows. The GEH statistic is defined as follows:

$$GEH = \sqrt{\frac{(V_{observed} - V_{modelled})^2}{(0.5 \times (V_{observed} + V_{modelled}))}}$$

Based on the calibration and validation guidelines presented in the Roads and Maritime Traffic Modelling Guidelines (2013), a calibrated microsimulation model should conform to the following requirements:

- 100% of turn and link flow comparisons with GEH less than 10; and
- At least 85% of flow comparisons with GEH less than 5.

Due to the nature of DUE assignment, being iterative and incorporating a simplified mesoscopic simulation in areas, the target requirements below have been adopted for the model:

- 95% of turn and link flow comparisons with GEH less than 10; and
- 80% of turn and link comparisons with GEH less than 5.

Due to the size of the model, additional focus has been placed on the core area, defined as the Elizabeth Drive corridor and associated intersections between The Northern Road and M7 Motorway. More refined target requirements have been set for the core area to reflect the higher level of calibration required for this region in order to test the localised impacts of the proposed M12 Motorway in this region. The core area calibration targets are as follows:

- 100% of turn and link flow comparisons with GEH less than 10; and
- 85% of turn and link comparisons with GEH less than 5.

In addition to GEH comparisons, regression analysis of observed versus modelled flows was also undertaken. The following criteria for regression analysis were adopted:

- R^2 greater than 0.95; and
- Slope between 1.05 and 0.95.

The R^2 generally represents the closeness of fit of the observed data points to modelled data points and the slope of the trend line gives an indication of whether the model is general over-assigning (greater than one) or under-assigning (less than one) traffic across the network.

4.1.2 Convergence

The *WSAGA Base Traffic Model* has been developed using mesoscopic dynamic user equilibrium (DUE) assignment. As the dynamic user equilibrium assignment is an iterative process, the relative gap between iterations is a measure of how close the assignment to the 'optimal' network equilibrium.

Unlike static models, AIMSUN's dynamic user equilibrium measures the relative gap in the path costs for each path assignment cycle period (in this case 15 minutes) in the simulation. As later periods are dependent on the convergence of earlier time periods, later time periods are generally less stable and thus require more iterations to converge. The relative gap reported for the convergence of the model is the mean relative gap for all time periods.

The DUE assignment was run using initial paths derived from the static equilibrium assignment. A summary of the morning and evening peak mesoscopic DUE convergence are shown in Figure 4-1and Figure 4-2.

Figure 4-1 Morning peak hybrid model DUE convergence (6-10am)

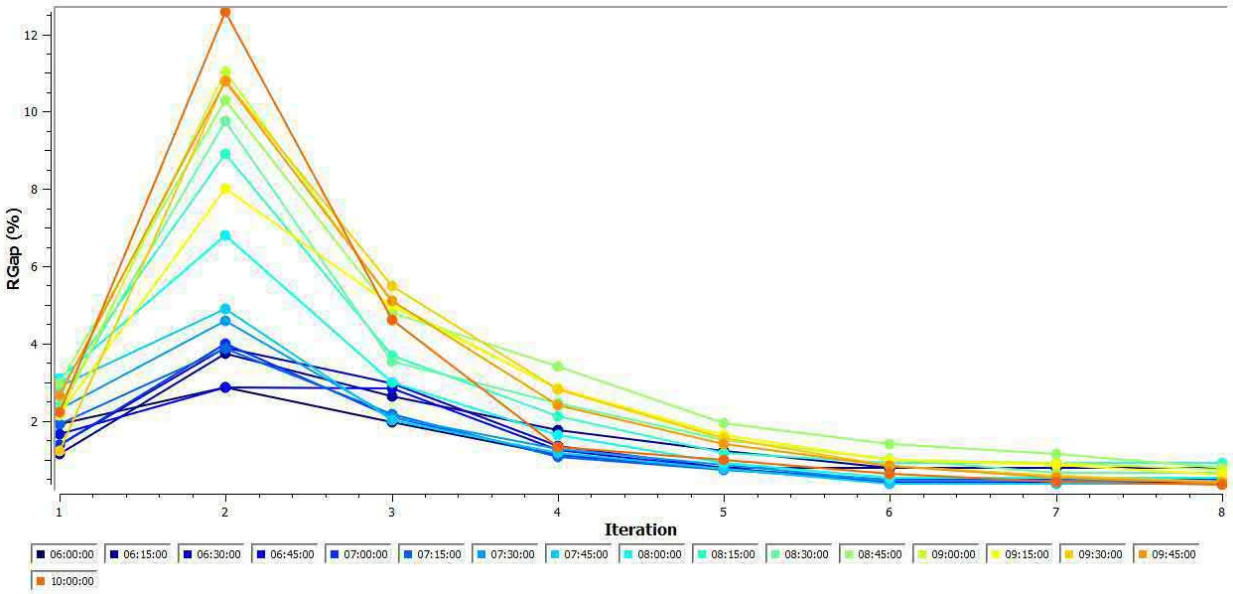
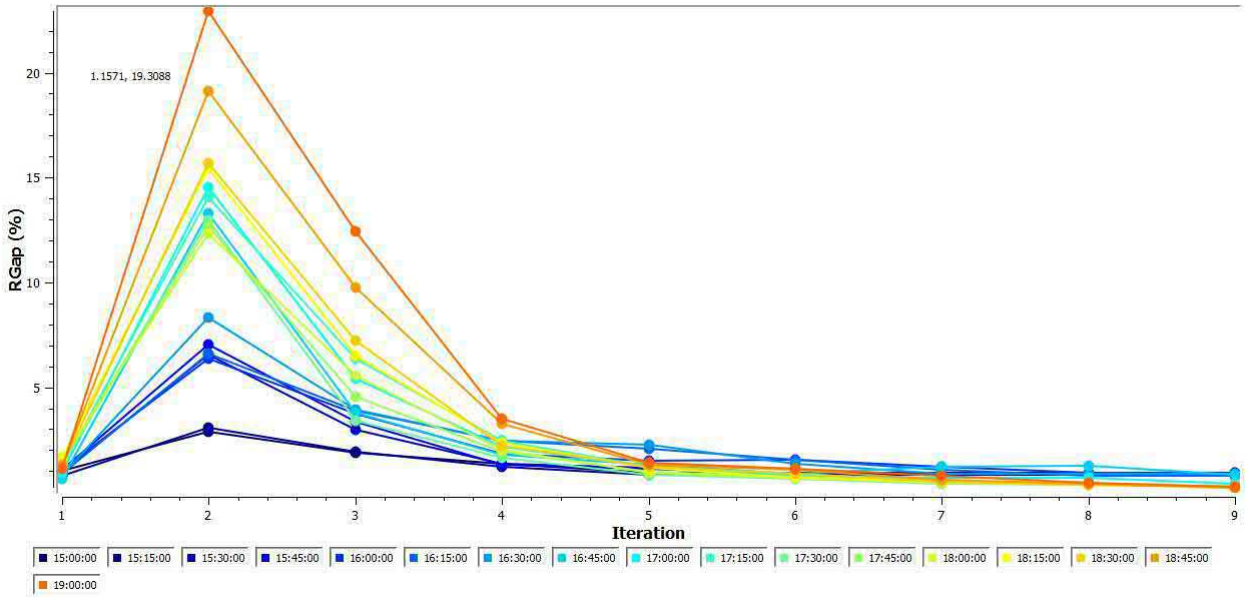


Figure 4-2 Evening peak hybrid model DUE convergence (3-7pm)



The DUE convergence shows that the model terminated at a mean relative gap of 1% after 8 and 9 iterations for the morning and evening peak respectively, well within the maximum of 20 iterations used in the run specification. Overall, the convergence graphs for the model indicate that the model arrives at a relatively stable assignment after around 5 iterations, indicating that the path assignment is generally stable.

4.1.3 Calibration results

A summary of the target count comparison statistics for the hybrid DUE assignment is provided in the following section.

4.1.3.1 Regression Analysis

The following section summarises the regression analysis. Observed traffic flows to modelled traffic flows for the full morning and evening period are plotted in Figure 4-3 and Figure 4-4. Plots of the regression analysis by hour are presented in Appendix A.

Table 4-1 provides a summary of the regression analysis statistics for the morning and evening peak by hour.

The regression analysis highlights the following outliers in the morning peak period:

- **Beech Road and Kurrajong Road**: due to high modelled delays at the intersection of Beech Road and Camden Valley Way, modelled traffic volumes turning right from M5 to Beech Road and then left into Kurrajong Road are higher than observed. These delays exist in reality, however in the field, vehicles tend not to use Kurrajong Road as an alternative to travel west instead of Camden Valley Way. This is in the south western corner of the model and has a limited impact on the study area;
- **Camden Valley Way**: modelled volumes travelling eastbound along Camden Valley Way between Beech Road and Ash Road are lower than observed. This is due to northbound traffic from Prestons entering the M7 from Bernera road instead of Camden Valley Way. This is in the south western corner of the model and has a limited impact on the study area; and
- **The Horsley Drive and Wallgrove Road**: modelled traffic volumes turning left from Wallgrove Road to The Horsley Drive are lower than observed. This is on the eastern edge of the model and has a limited impact on the study area.

The regression analysis highlights the following outliers in the evening peak period:

- **Wallgrove Road and The Horsley Drive**: modelled traffic volumes turning right from The Horsley Drive to Wallgrove Road are lower than observed. This is on the eastern edge of the model and has a limited impact on the study area;
- **Cowpasture Road**: modelled volumes travelling westbound on Cowpasture Road at the intersection of Cowpasture Road and the M7 are lower than observed. This is on the eastern edge of the model and has a limited impact on the study area; and
- **Beech Road and Kurrajong Road**: modelled traffic volumes turning right from M5 to Beech Road and then left into Kurrajong Road and higher than observed. This is due to high modelled delays at the intersection of Beech Road and Camden Valley Way. These delays exist in reality however in the field vehicles tend not to use Kurrajong Road as an alternative to travel west instead of Camden Valley Way. This is in the south western corner of the model and has a limited impact on the study area.

Figure 4-3 Morning peak turn count regression (6-10am)

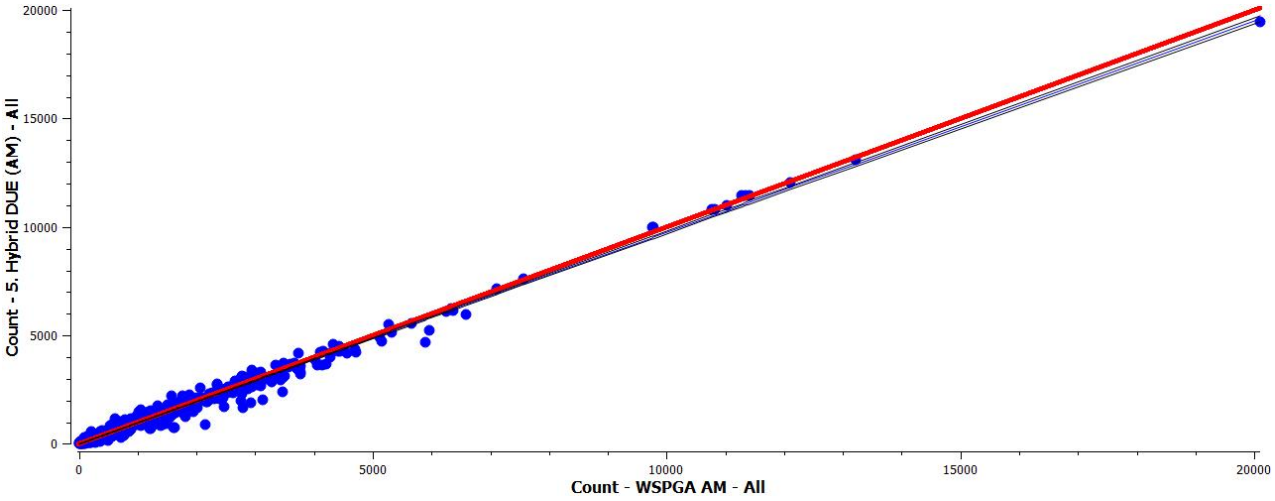


Figure 4-4 Evening peak turn count regression (3-7pm)

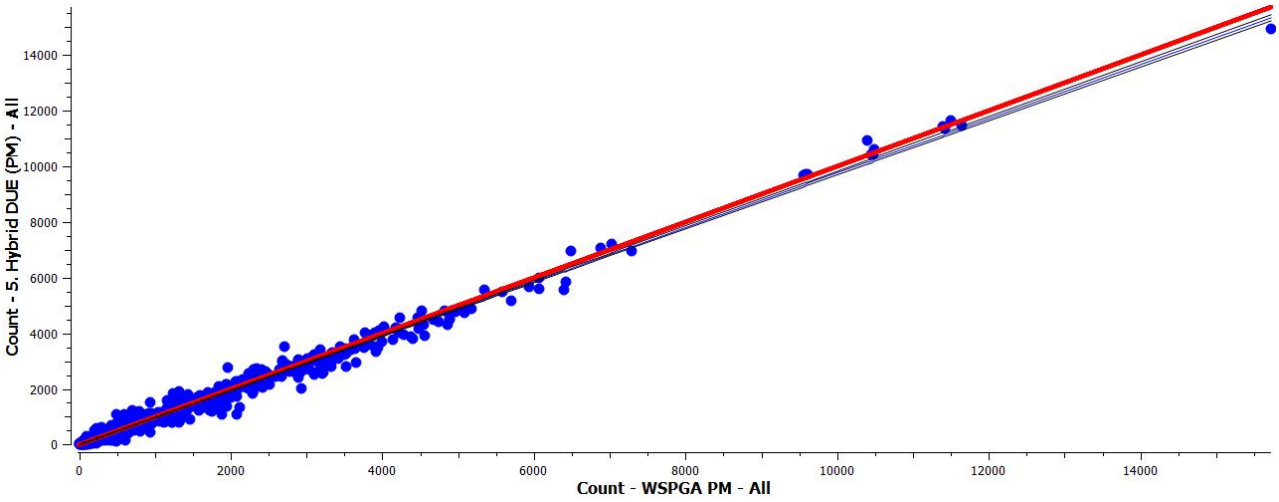


Table 4-1 Model calibration summary – general

Time period	R^2	Slope
6:00 AM to 7:00 AM	0.983	0.95
7:00 AM to 8:00 AM	0.983	0.96
8:00 AM to 9:00 AM	0.980	0.97
9:00 AM to 10:00 AM	0.981	1.02
Total morning peak – all hourly volumes	**0.989**	**0.976**
3:00 PM to 4:00 PM	0.983	0.96
4:00 PM to 5:00 PM	0.980	0.97
5:00 PM to 6:00 PM	0.984	0.96
6:00 PM to 7:00 PM	0.971	1.0
Total evening peak – all hourly volumes	**0.988**	**0.98**

Analysis of the regression parameters show that the regression targets of R^2 greater than 0.95 and slope between 0.95 and 1.05 are met in each hour.

4.1.3.2 GEH Statistics

Table 4-2 and Table 4-3 present a summary of the turn comparison between observed and modelled by GEH statistic. The results show all calibration criteria listed in Section 4.1 have been met.

Table 4-2 Model calibration summary – general traffic morning peak GEH analysis

Criteria and Measures	Target	Hour starting			
		6:00am	7:00am	8:00am	9:00am
GEH statistic < 5.0 for individual turn volumes	>80% of cases	84%	86%	84%	86%
GEH statistic < 10.0 for individual turn volumes	>95% of cases	99%	99%	98%	99%

Table 4-3 Model calibration summary – general traffic evening peak GEH analysis

Criteria and Measures	Target	Hour starting			
		3:00pm	4:00pm	5:00pm	6:00pm
GEH statistic < 5.0 for individual turn volumes	>80% of cases	86%	83%	84%	88%
GEH statistic < 10.0 for individual turn volumes	>95% of cases	98%	98%	98%	99%

4.1.3.3 Core Area Statistics

Table 4-4 and Table 4-5 present a summary of the turn comparison between observed and modelled data by GEH statistic along Elizabeth Drive. The results show all calibration criteria listed in Section 4.1 have been met.

Table 4-4 Model calibration summary – general traffic morning peak GEH analysis

Criteria and Measures	Target	Hour starting			
		6:00am	7:00am	8:00am	9:00am
GEH statistic < 5.0 for individual turn volumes	>85% of cases	91%	91%	91%	91%
GEH statistic < 10.0 for individual turn volumes	100% of cases	100%	100%	100%	100%

Table 4-5 Model calibration summary – general traffic evening peak GEH analysis

Criteria and Measures	Target	Hour starting			
		3:00pm	4:00pm	5:00pm	6:00pm
GEH statistic < 5.0 for individual turn volumes	>85% of cases	91%	91%	93%	95%
GEH statistic < 10.0 for individual turn volumes	100% of cases	100%	100%	100%	100%

4.1.3.4 Heavy vehicle calibration

Due to the high volumes of heavy vehicles through some parts of the study area, spot checks of heavy vehicles have been undertaken at the following locations:

- M4 Motorway and The Northern Road;
- M4 Motorway and Mamre Road;
- M4 Motorway and Roper Road/Erskine Park Road;
- M4 Motorway and Wallgrove Road;
- Wallgrove Road and Old Wallgrove Road;
- Wallgrove Road and Elizabeth Drive;
- M7 Motorway and The Horsley Drive;
- M7 Motorway and Camden Valley Way;
- M7 Motorway and Elizabeth Drive;
- Camden Valley Way, Hume Highway and Campbelltown Road;
- Bringelly Road, Camden Valley Way and Cowpasture Road; and
- Greendale Road, Bringelly Road and The Northern Road.

A summary GEH comparisons for heavy vehicle flows on turns at these locations is provided in Table 4-6 and Table 4-7.

Table 4-6 Model calibration summary –heavy vehicles morning peak GEH analysis

Criteria and Measures	Target	Hour starting			
		6:00am	7:00am	8:00am	9:00am
GEH statistic < 5.0 for individual turn volumes	>85% of cases	86%	88%	86%	87%
GEH statistic < 10.0 for individual turn volumes	100% of cases	100%	100%	100%	100%

Table 4-7 Model calibration summary – heavy vehicles evening peak GEH analysis

Criteria and Measures	Target	Hour starting			
		3:00pm	4:00pm	5:00pm	6:00pm
GEH statistic < 5.0 for individual turn volumes	>85% of cases	86%	88%	87%	91%
GEH statistic < 10.0 for individual turn volumes	100% of cases	100%	100%	100%	100%

Analysis of modelled and observed heavy vehicle volumes shows that all calibration criteria listen in Section 4.1 have been met and that the model is replicating heavy vehicle flows well in all locations where heavy vehicles are a significant proportion of traffic.

4.1.3.5 Calibration Summary

The model is considered to be satisfactorily calibrated against observed flows for the purpose of the *Western Sydney Airport Growth Area* project. The calibration targets for general traffic and heavy vehicles in selected locations have either been met or are very close and the model has been calibrated in accordance with calibration targets.

4.1.4 Travel Time Validation

Validation of the *WSAGA Base Traffic Model* has been undertaken primarily on the basis of travel time comparisons for general traffic along key corridors within the study area. Additional qualitative confirmation of queueing and congestion in key areas of the model area has also been undertaken.

Travel time validation has been undertaken on the basis of floating car travel time surveys along the following key routes through the model area:

- Route 1 - M7 Motorway;
- Route 2 - M4 Motorway;
- Route 3 - The Northern Road;
- Route 4 - Mamre Road;
- Route 5 - Luddenham Road;
- Route 6 - Elizabeth Drive;
- Route 7 - Bringelly Road/Camden Valley Way; and
- Route 8 - Cowpasture Road.

As recommended by the Roads and Maritime Traffic Modelling Guide (2013), travel time can be considered to match well when observed and modelled travel times are within 15% or one minute of one another (whichever is larger). In addition to overall route travel times, attention should also be paid to the distribution of delay along a route to distinguish where travel times are consistently outside this range for the whole route or only within a section of the route.

Observed and modelled cumulative travel times for the peak two-hour morning and evening periods are presented in Table 4-8 to Table 4-11. Corridors outside the 15% bounds have been highlighted in orange. Cumulative travel time graphs are provided in Appendix B

Table 4-8 General traffic travel time comparison summary (7-8am)

Route	Direction	Modelled	Surveyed	Surveyed -15%	Surveyed +15%
Route 1 – M7	Northbound	0:19:11	0:19:55	0:16:56	0:22:54
	Southbound	0:14:34	0:13:54	0:11:49	0:15:59
Route 2 – M4	Eastbound	0:09:23	0:11:56	0:10:09	0:13:44
	Westbound	0:09:09	0:08:32	0:07:15	0:09:49
Route 3 – The Northern Road	Northbound	0:19:28	0:18:19	0:15:35	0:21:04
	Southbound	0:18:32	0:18:28	0:15:41	0:21:14
Route 4 – Mamre Road	Northbound	0:11:08	0:10:43	0:09:07	0:12:20
	Southbound	0:11:16	0:11:04	0:09:25	0:12:44
Route 5 – Luddenham Road	Northbound	0:08:45	0:08:00	0:06:48	0:09:12
	Southbound	0:08:17	0:08:08	0:06:55	0:09:21
Route 6 – Elizabeth Drive	Westbound	0:13:06	0:12:18	0:10:27	0:14:09
	Eastbound	0:13:41	0:14:48	0:12:35	0:17:02
Route 7 – Bringelly Road / Camden Valley Way	Westbound	0:20:18	0:18:42	0:15:54	0:21:31
	Eastbound	0:20:22	0:20:20	0:17:17	0:23:22
Route 8 – Cowpasture Road	Northbound	0:06:04	0:05:17	0:04:30	0:06:05
	Southbound	0:06:51	0:06:08	0:05:13	0:07:03

Table 4-9 General traffic travel time comparison summary (8-9am)

Route	Direction	Modelled	Surveyed	Surveyed - 15%	Surveyed +15%
Route 1 – M7	Northbound	0:19:35	0:20:52	0:17:44	0:24:00
	Southbound	0:14:41	0:13:33	0:11:31	0:15:35
Route 2 – M4	Eastbound	0:10:54	0:09:01	0:07:40	0:10:23
	Westbound	0:09:44	0:08:21	0:07:06	0:09:36
Route 3 – The Northern Road	Northbound	0:19:24	0:21:33	0:18:19	0:24:47
	Southbound	0:18:33	0:19:00	0:16:09	0:21:51
Route 4 – Mamre Road	Northbound	0:11:26	0:12:00	0:10:12	0:13:48
	Southbound	0:11:45	0:12:15	0:10:25	0:14:05
Route 5 – Luddenham Road	Northbound	0:08:43	0:08:15	0:07:01	0:09:29
	Southbound	0:08:21	0:07:49	0:06:39	0:08:59
Route 6 – Elizabeth Drive	Westbound	0:12:57	0:12:36	0:10:42	0:14:29
	Eastbound	0:13:51	0:13:59	0:11:53	0:16:05
Route 7 – Bringelly Road / Camden Valley Way	Westbound	0:20:20	0:19:41	0:16:43	0:22:38
	Eastbound	0:21:17	0:18:47	0:15:58	0:21:36
Route 8 – Cowpasture Road	Northbound	0:06:28	0:07:30	0:06:23	0:08:38
	Southbound	0:06:48	0:07:00	0:05:57	0:08:03

Table 4-10 General traffic travel time comparison summary (4-5pm)

Route	Direction	Modelled	Surveyed	Surveyed - 15%	Surveyed +15%
Route 1 – M7	Northbound	0:14:31	0:12:50	0:10:55	0:14:46
	Southbound	0:16:57	0:17:13	0:14:38	0:19:48
Route 2 – M4	Eastbound	0:09:02	0:08:41	0:07:23	0:09:59
	Westbound	0:09:46	0:10:21	0:08:48	0:11:55
Route 3 – The Northern Road	Northbound	0:19:33	0:18:14	0:15:30	0:20:58
	Southbound	0:18:54	0:19:15	0:16:22	0:22:08
Route 4 – Mamre Road	Northbound	0:11:29	0:11:19	0:09:37	0:13:00
	Southbound	0:11:45	0:11:21	0:09:39	0:13:03
Route 5 – Luddenham Road	Northbound	0:08:24	0:09:30	0:08:05	0:10:56
	Southbound	0:08:44	0:08:12	0:06:58	0:09:26
Route 6 – Elizabeth Drive	Westbound	0:13:25	0:14:04	0:11:57	0:16:10
	Eastbound	0:12:59	0:12:47	0:10:52	0:14:42
Route 7 – Bringelly Road / Camden Valley Way	Westbound	0:22:32	0:19:57	0:16:58	0:22:57
	Eastbound	0:20:20	0:18:54	0:16:04	0:21:44
Route 8 – Cowpasture Road	Northbound	0:06:29	0:05:50	0:04:58	0:06:43
	Southbound	0:08:20	0:05:49	0:04:57	0:06:41

Table 4-11 General traffic travel time comparison summary (5-6pm)

Route	Direction	Modelled	Surveyed	Surveyed - 15%	Surveyed +15%
Route 1 – M7	Northbound	0:14:11	0:12:45	0:10:50	0:14:40
	Southbound	0:16:29	0:17:34	0:14:56	0:20:12
Route 2 – M4	Eastbound	0:09:01	0:08:55	0:07:34	0:10:15
	Westbound	0:09:51	0:21:55	0:18:37	0:25:12
Route 3 – The Northern Road	Northbound	0:19:36	0:19:15	0:16:22	0:22:08
	Southbound	0:18:54	0:20:04	0:17:03	0:23:04
Route 4 – Mamre Road	Northbound	0:11:12	0:12:02	0:10:14	0:13:51
	Southbound	0:11:34	0:11:43	0:09:58	0:13:29
Route 5 – Luddenham Road	Northbound	0:08:24	0:08:52	0:07:32	0:10:11
	Southbound	0:08:39	0:08:09	0:06:55	0:09:22
Route 6 – Elizabeth Drive	Westbound	0:13:12	0:12:55	0:10:59	0:14:51
	Eastbound	0:13:10	0:13:08	0:11:10	0:15:06
Route 7 – Bringelly Road / Camden Valley Way	Westbound	0:22:13	0:17:45	0:15:05	0:20:25
	Eastbound	0:20:19	0:19:37	0:16:40	0:22:33
Route 8 – Cowpasture Road	Northbound	0:06:39	0:06:41	0:05:41	0:07:41
	Southbound	0:06:51	0:05:39	0:04:48	0:06:30

Inspection of travel time comparisons on routes through the model present a number of locations where modelled and observed travel times do not match within the 15% bounds:

- **M4 Motorway**: modelled westbound travel times are generally lower that observed during the 5-6pm period. As noted in Section 2.1.2, this is likely due to an incident that occurred during the survey period at or east of the Mamre Road off-ramp. Observed travel times at this location during this period are likely not reflective of typical conditions at this location. This is supported by Google traffic data and detector speeds recorded at the same location, which do not show these delays; and
- **Cowpasture Road**: modelled travel times westbound along Cowpasture Road are marginally outside of the 15% bound in the evening peak period, however it is noted that construction was undertaken along this corridor at the time of undertaking both travel time and intersection turning count surveys which is likely to have resulted in less-reliable observed travel times.

Notwithstanding these variances, cumulative travel time graphs show that modelled patterns of delay along the validation routes match observed conditions very closely, indicating that the model is well-validated along the key routes through the model.

4.1.5 Congestion hotspot validation

A qualitative assessment of queuing and congestion within the study area has been undertaken to determine whether the model is replicating observed congestion in locations where there are known pre-existing traffic issues.

4.1.5.1 Beech Road, Cowpasture Road and Camden Valley Way

Congestion is observed in both directions on Beech Road, Cowpasture Road and Camden Valley Way, and to a lesser extent on Kurrajong Road and Bernera Road, in both directions during both the morning and the

afternoon peak hours. This congestion is accurately reflected in the model. Congestion also occurs in the northbound direction on the Westlink M7 during the morning peak. This congestion is not reflected in the model to the same extent due to the reduced speed zones implemented by Westlink M7, the data for which was not available at the time of preparing this report.

Figure 4-5 Modelled congestion at Beech Road/Cowpasture Road/Camden Valley Way (morning peak 8-9am)

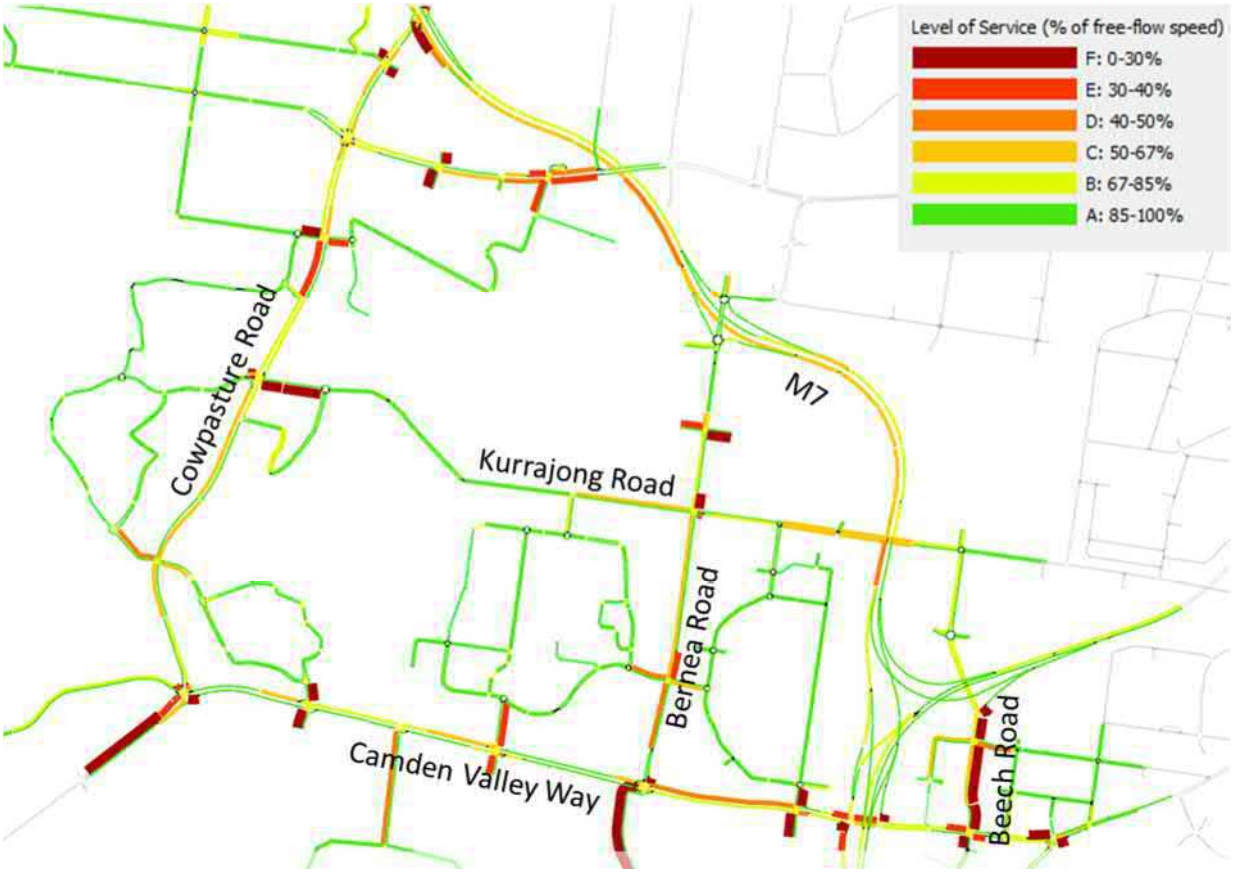
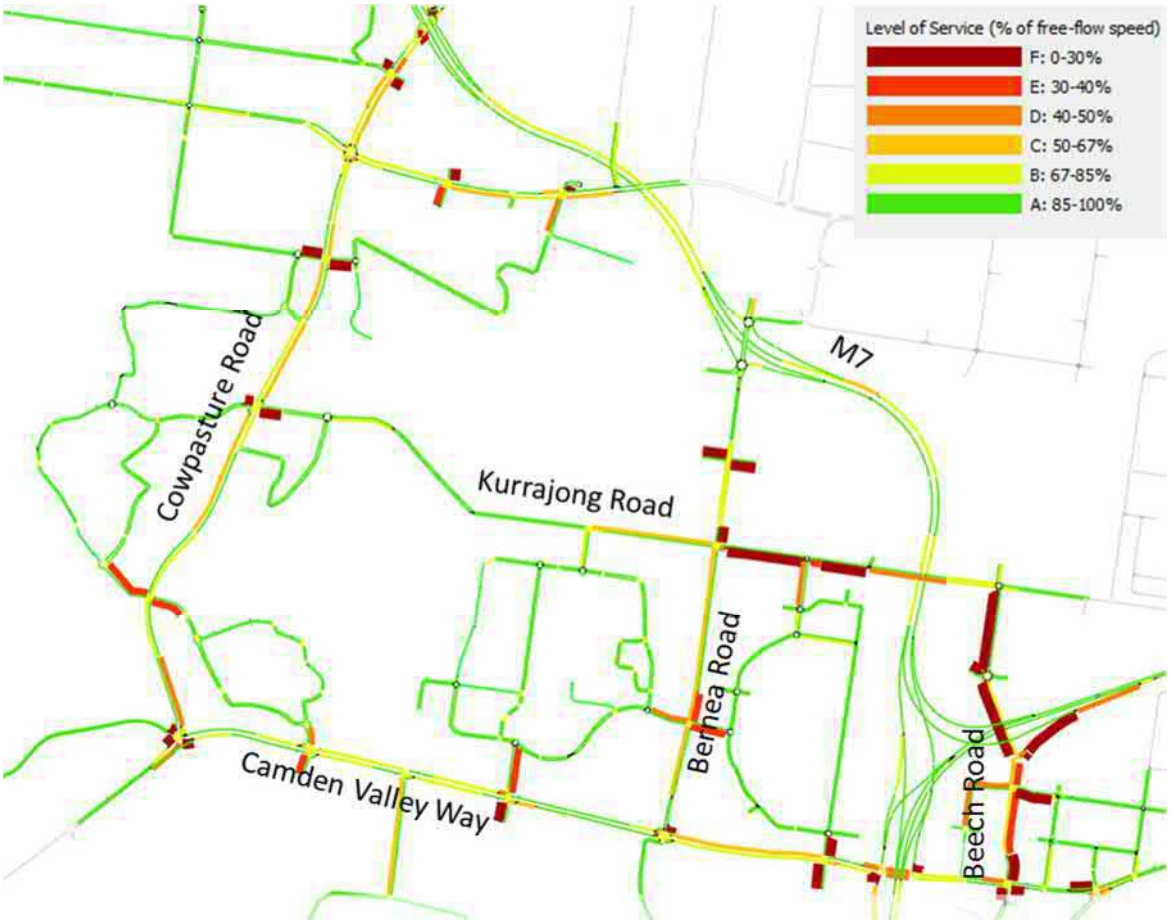


Figure 4-6 Modelled congestion at Beech Road/Cowpasture Road/Camden Valley Way (afternoon peak 5-6pm)



4.1.5.2 Elizabeth Drive

Congestion occurs on Wallgrove Road and the Westlink M7 exit ramp at their intersections with Elizabeth Drive during both the morning and evening peak hours. Congestion also occurs on Elizabeth Drive in the eastbound direction during the morning peak hour. This is reflected in the model. In the model, congestion is also observed in the westbound direction during the morning peak. This occurs due to the modelled flows being slightly higher than the observed flows during the peak two hours.

Figure 4-7 Modelled congestion at Elizabeth Drive (morning peak 8-9am)

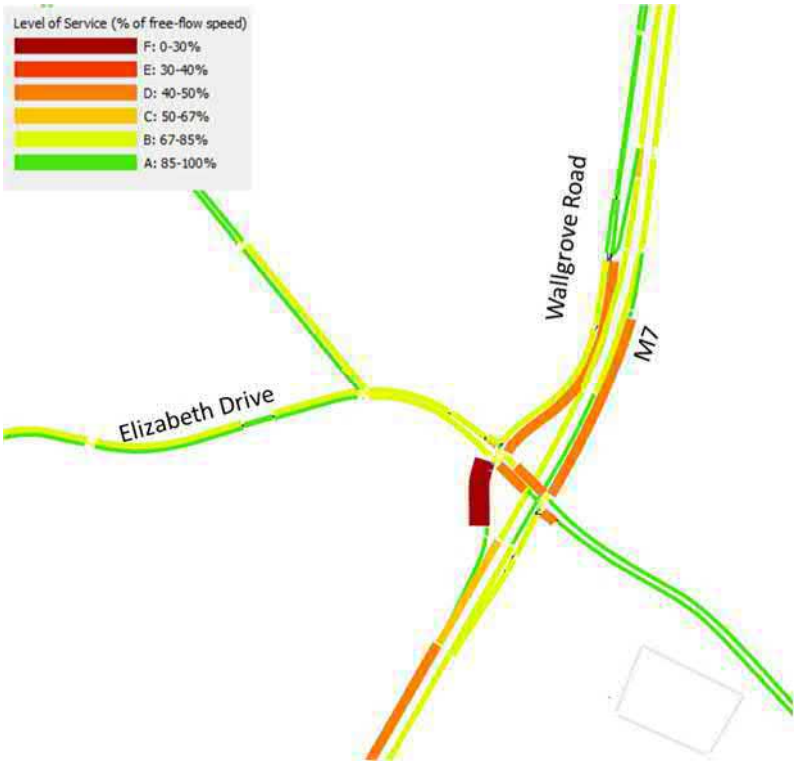


Figure 4-8 Modelled congestion at Elizabeth Drive (afternoon peak 5-6pm)

4.1.5.3 The Horsley Drive

Congestion is observed on the Westlink M7 exit and entry ramps, Wallgrove Road and the Horsley Drive in the eastbound direction during both the morning and evening peak hours and is accurately reflected in the model. In the model, congestion on The Horsley Drive in the westbound direction during the afternoon peak is observed to a larger degree than what occurs.

Figure 4-9 Modelled congestion at The Horsley Drive (morning peak 8-9am)

Figure 4-10 Modelled congestion at The Horsley Drive (afternoon peak 5-6pm)

4.1.5.4 Wallgrove Road

Congestion is observed along Wallgrove Road and the Westlink M7 at the intersection with the Old Wallgrove Road and the exit/entry ramps to/from Westlink M7, and is accurately reflected in the model.

Figure 4-11 Modelled congestion along Wallgrove Road (morning peak 8-9am)

Figure 4-12 Modelled congestion along Wallgrove Road (afternoon peak 5-6pm)

4.1.5.5 M4 at M7

Congestion occurs along the M4 in the eastbound direction during the morning peak and the westbound direction in the afternoon peak, and the entry ramps to the M4 eastbound in the morning peak and the M4 westbound in the afternoon peak. Wallgrove road exhibits congestion in both directions during both the morning and afternoon peaks. The modelled congestion on the ramps is lower than what occurs.

Figure 4-13 Modelled congestion on M4/M7 (morning peak 8-9am)

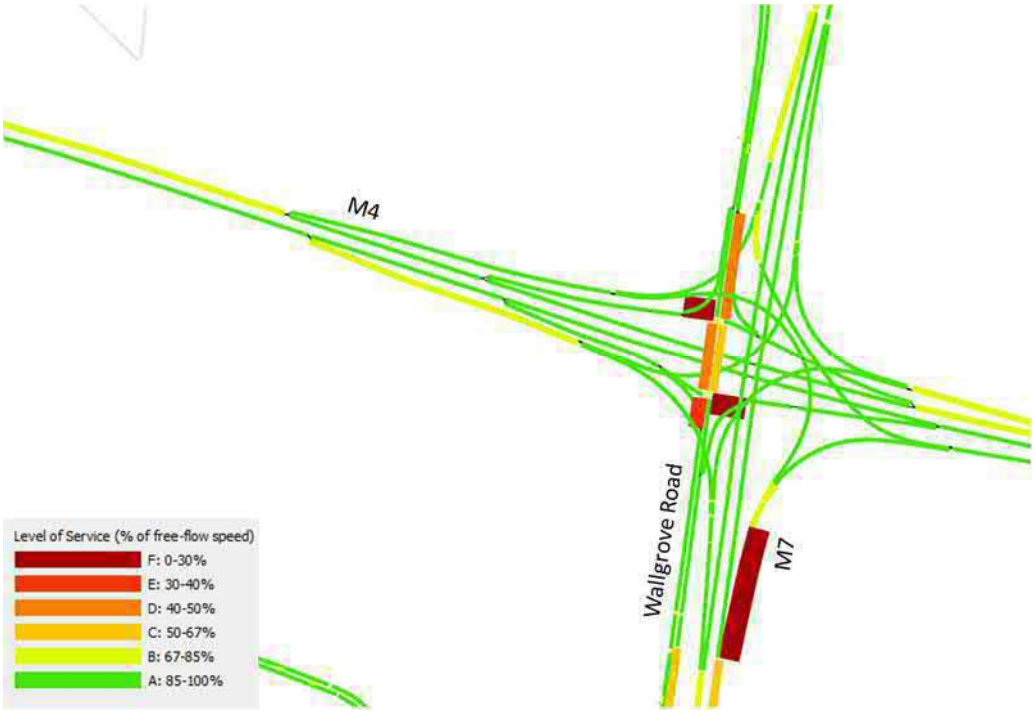


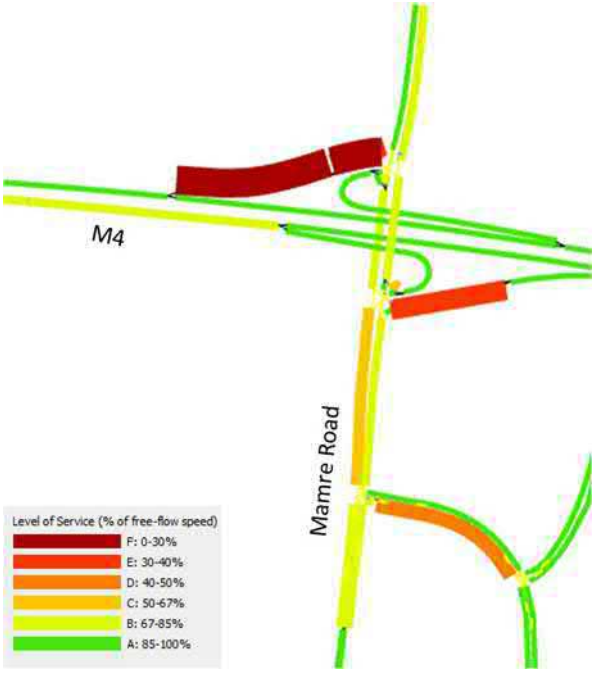
Figure 4-14 Modelled congestion on M4/M7 (afternoon peak 5-6pm)

4.1.5.6 Mamre Road

Congestion occurs on the ramps exiting from the M4 onto Mamre Road in both directions during both the morning and afternoon peaks. Congestion also occurs on the M4 in the eastbound direction during the morning peak. The modelled congestion on the M4 in the eastbound direction east of Mamre Rd is lower than what occurs.

Figure 4-15 Modelled congestion at Mamre Road (morning peak 8-9am)

Figure 4-16 Modelled congestion at Mamre Road (afternoon peak 5-6pm)



4.1.5.7 M4 at The Northern Road

Congestion is observed on the ramps exiting the M4 onto The Old Northern Road in both directions during both the morning and evening peaks. Congestion also occurs on the M4 in the westbound direction prior to the exit ramp and is accurately reflected in the model.

Figure 4-17 Modelled congestion at The Northern Road (morning peak 8-9am)

Figure 4-18 Modelled congestion at The Old Northern Road (afternoon peak 5-6pm)

5. Model Limitations

The AIMSUN *WSAGA Base Traffic Model* has been specifically prepared for the purpose of the Core Area modelling for the Concept Design and Environmental Impact Statement (EIS) for M12 Motorway between M7 and The Northern Road in Western Sydney. The model may not be suitable for a different project intent or work scope.

The AIMSUN *WSAGA Base Traffic Model* was developed based on the traffic data and information provided and to reflect the traffic conditions observed from traffic surveys. Estimation, assumptions and rectification have been made to the data due to its limitations and gaps including:

- the survey data collected from different dates and years for turn counts and travel times which resulted in inconsistent traffic conditions; and
- incorrect turn count data identified from the traffic survey at the Elizabeth Drive / M7 SB On-Ramp intersection. Assumptions and adjustment were made to this the turn count data based on the data from the adjacent intersection.

The model was developed in AIMSUN **Version 8.2.0**, and may require re-calibration and re-validation if a different software version is to be used.

The model will therefore need to be used with consideration and caution of the above limitations for any future works.

6. Conclusions

An AIMSUN hybrid model has been developed and calibrated to reflect the 2015 traffic conditions for the morning peak period (6-10am) and the evening peak period (3-7pm). The *WSAGA Base Traffic Model* operates in a stable manner and shows a good correlation with the traffic conditions reflected in the traffic survey.

Comparisons have been made between the observed data and the model data against the Roads and Maritime Traffic Modelling Guidelines 2013 for:

- Turn count; and
- Travel times.

The model calibration and validation results along with observation of the model operation show that the *WSAGA Base Traffic Model* has been adequately calibrated and validated to represent the existing road conditions based on the data available. Further improvements to simulated travel times along M7 between Cowpasture Road and Elizabeth Drive could be achieved by implementing reduced speed zones through this section consistent with those implemented on the day of the travel time survey, however data regarding the time and nature of these reduced speeds zones is not currently available.

The AIMSUN *WSAGA Base Traffic Model* is therefore considered fit to be used to undertake future scenario modelling and assessments of PBC and the proposed concept designs.

Appendix A. Regression analysis by hour

Figure 6-1 : Whole model area (6-7am)

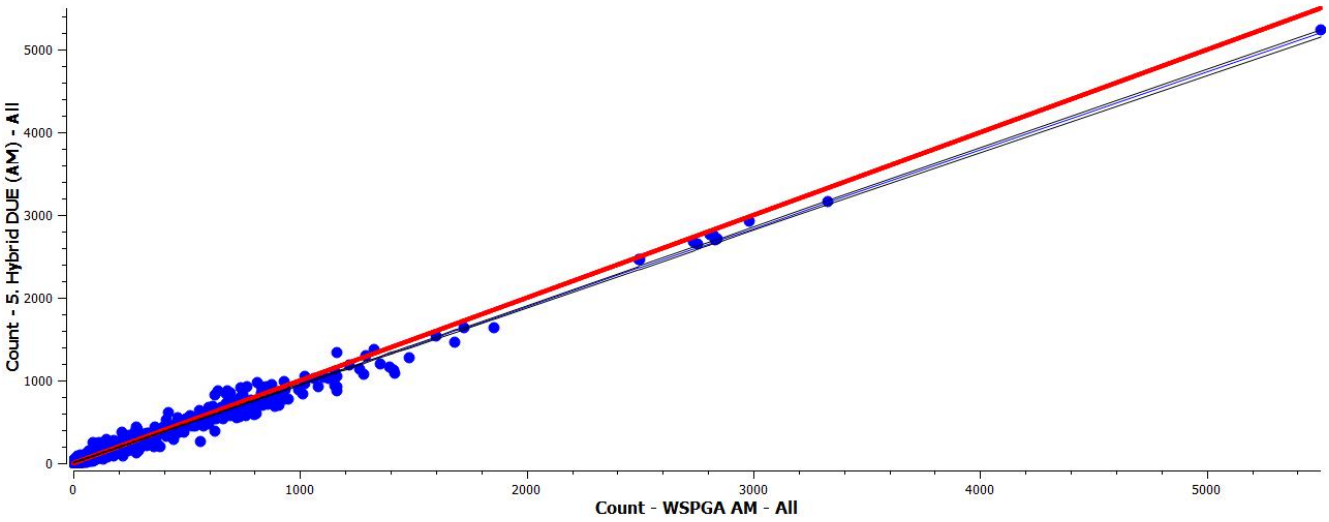


Figure 6-2 : Whole model area (7-8am)

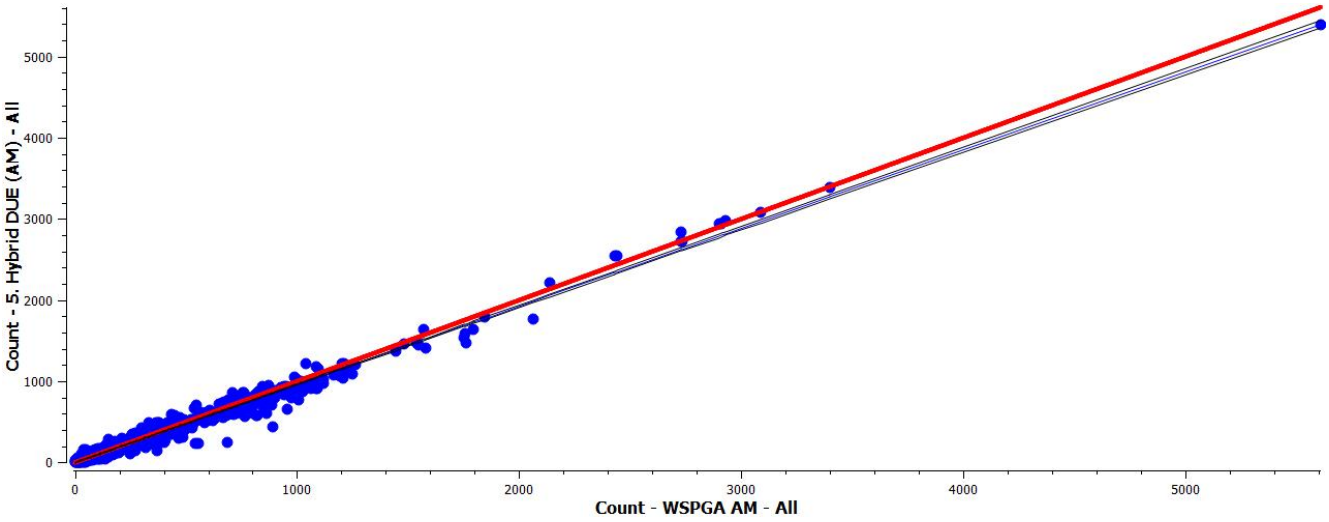


Figure 6-3 : Whole model area (8-9am)

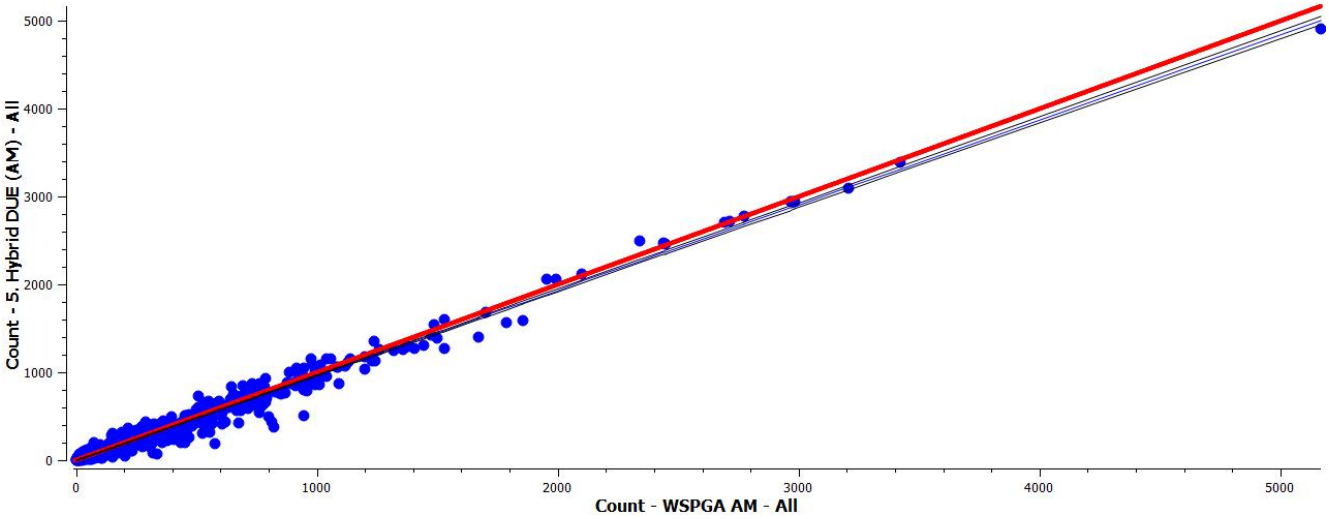


Figure 6-4 : Whole model area (9-10am)

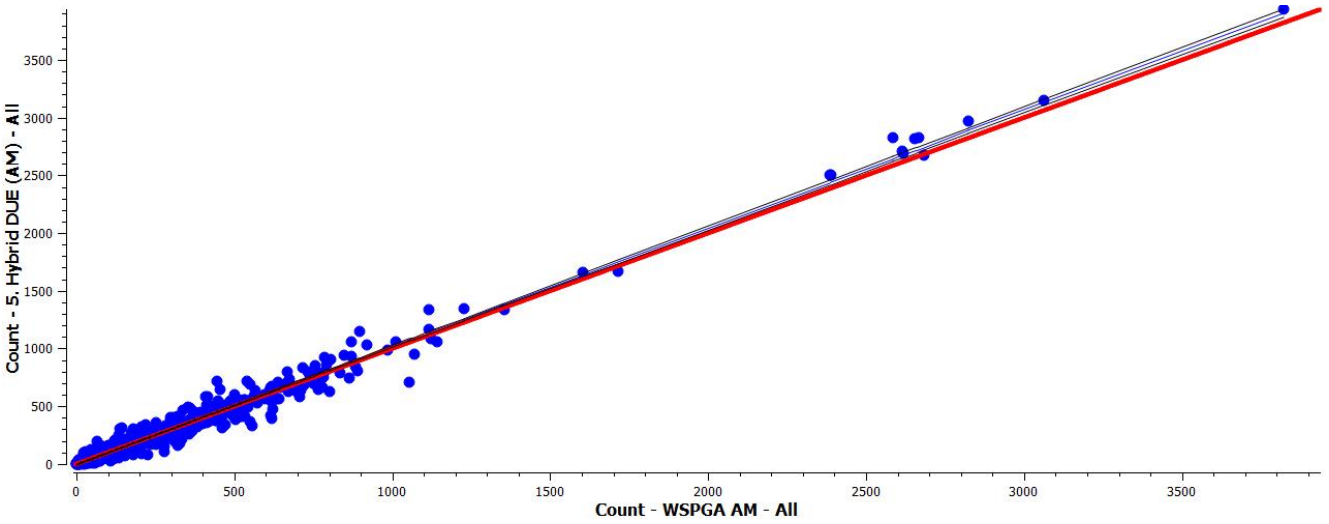


Figure 6-5 : Whole model area (3-4pm)

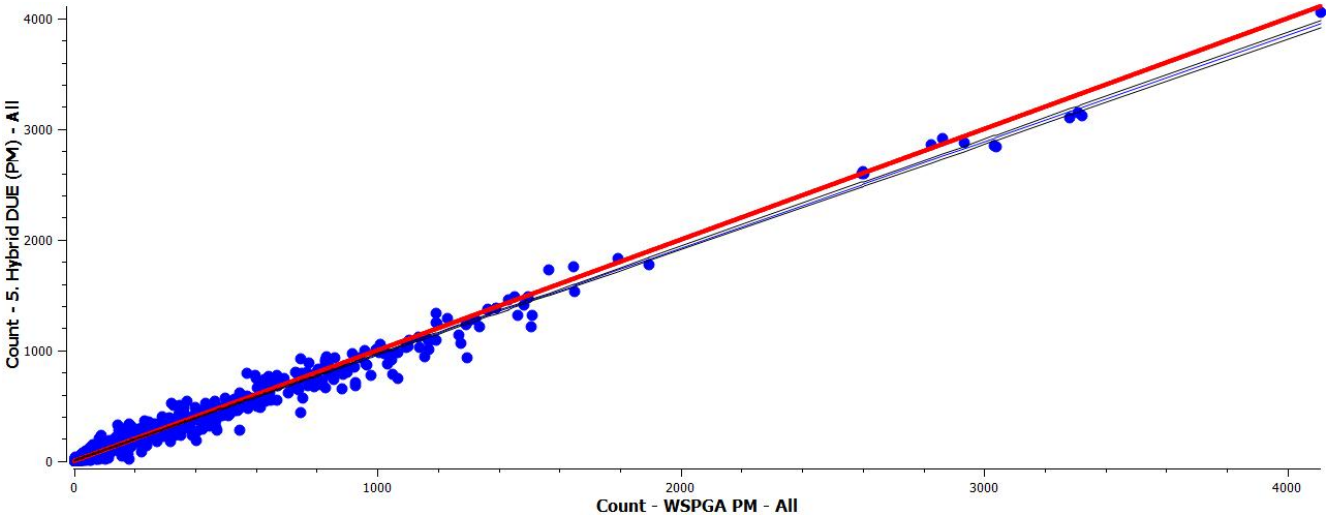


Figure 6-6 : Whole model area (4-5pm)

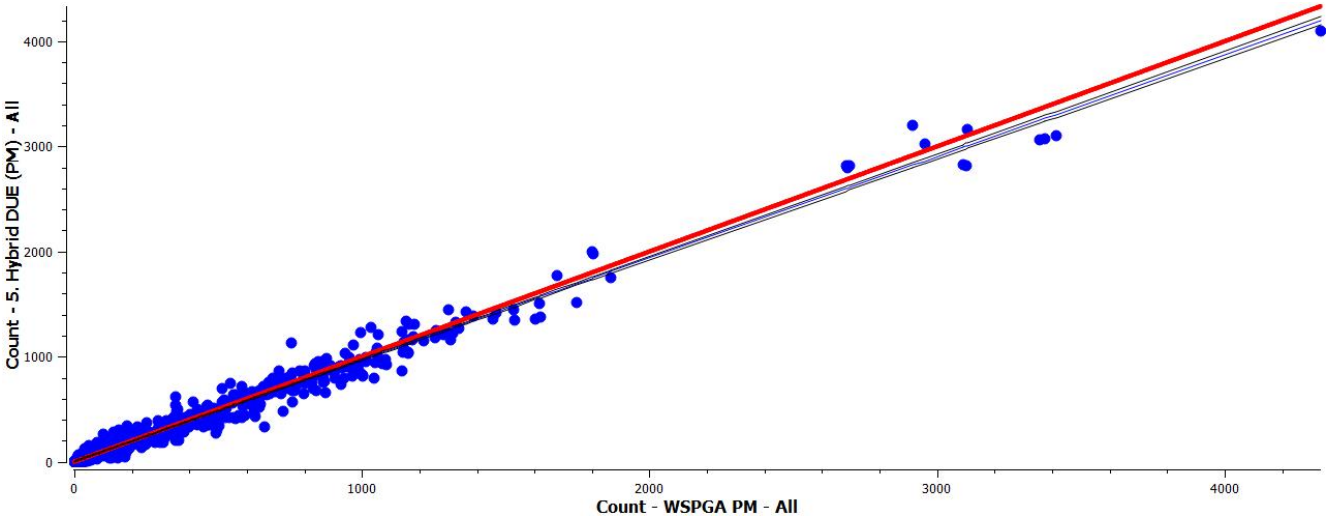


Figure 6-7 : Whole model area (5-6pm)

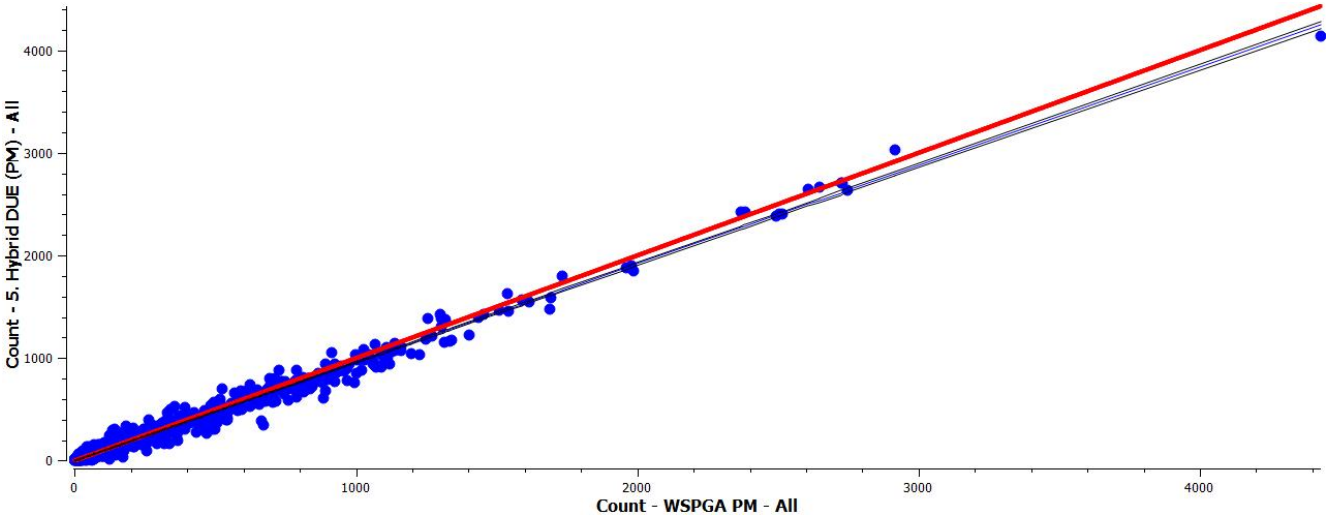
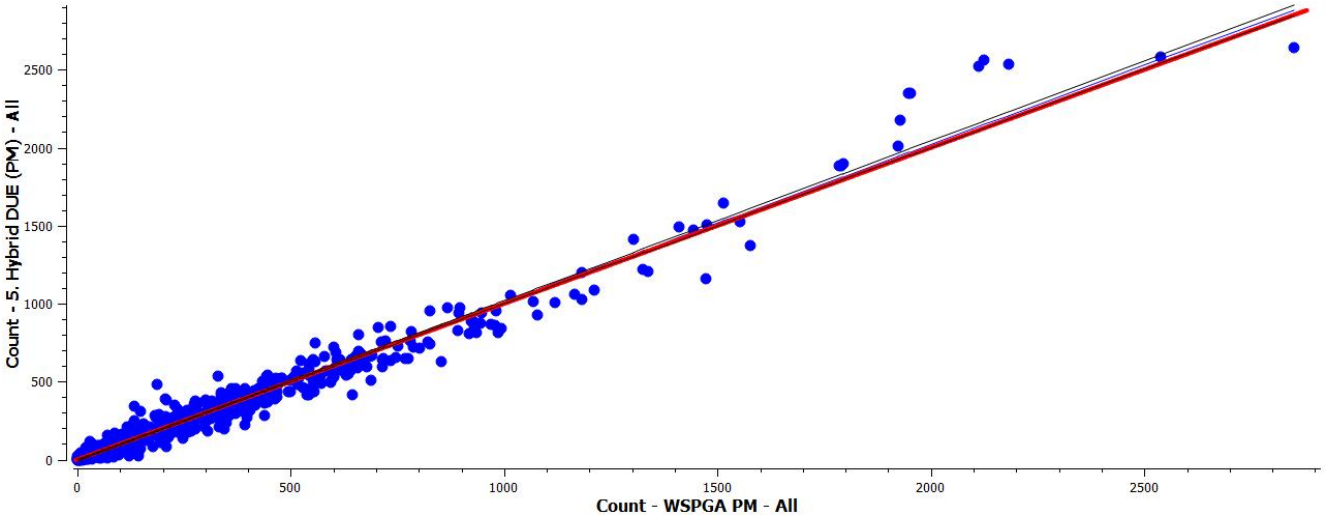
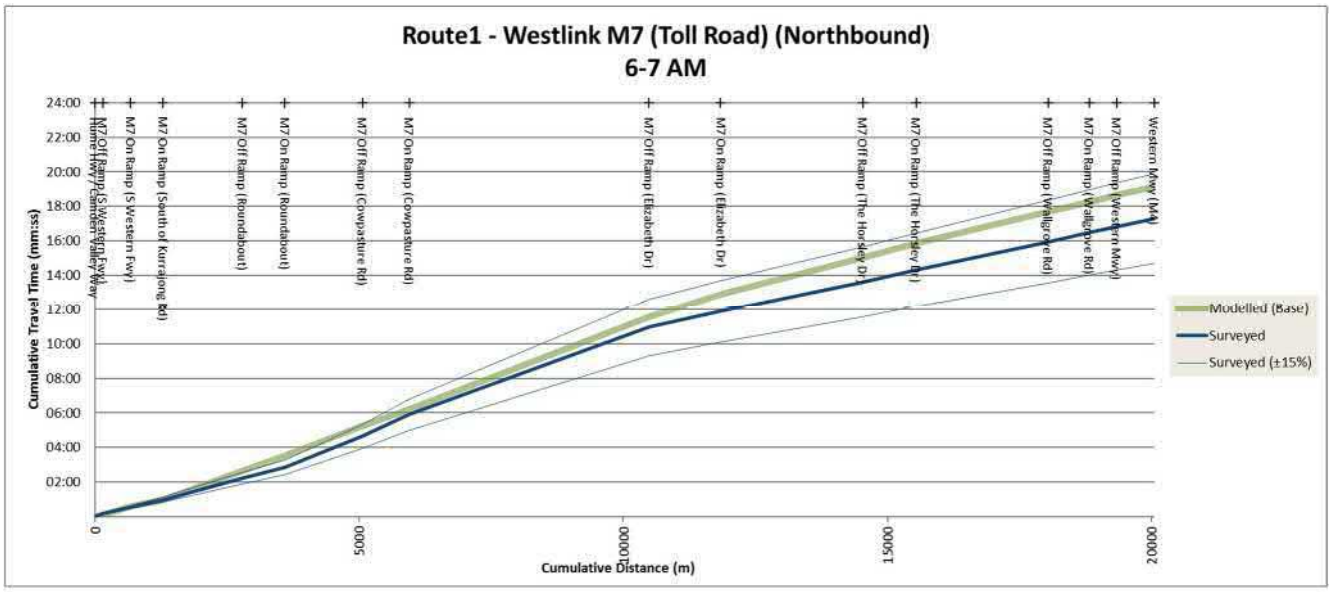


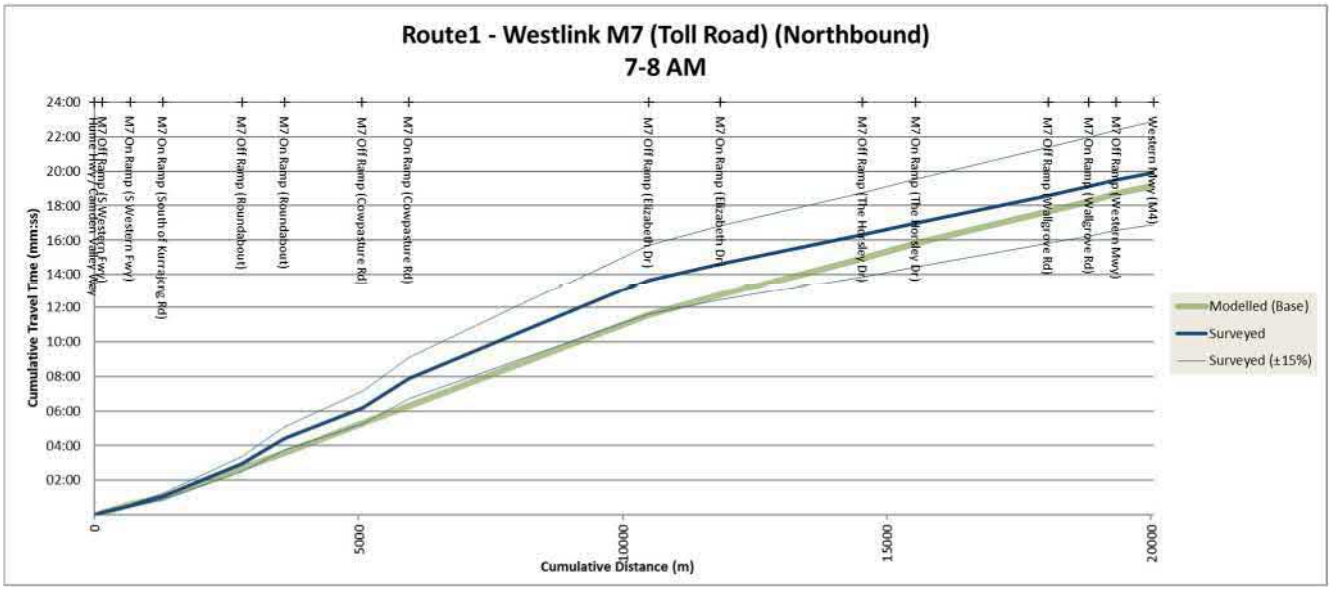
Figure 6-8 : Whole model area (6-7pm)

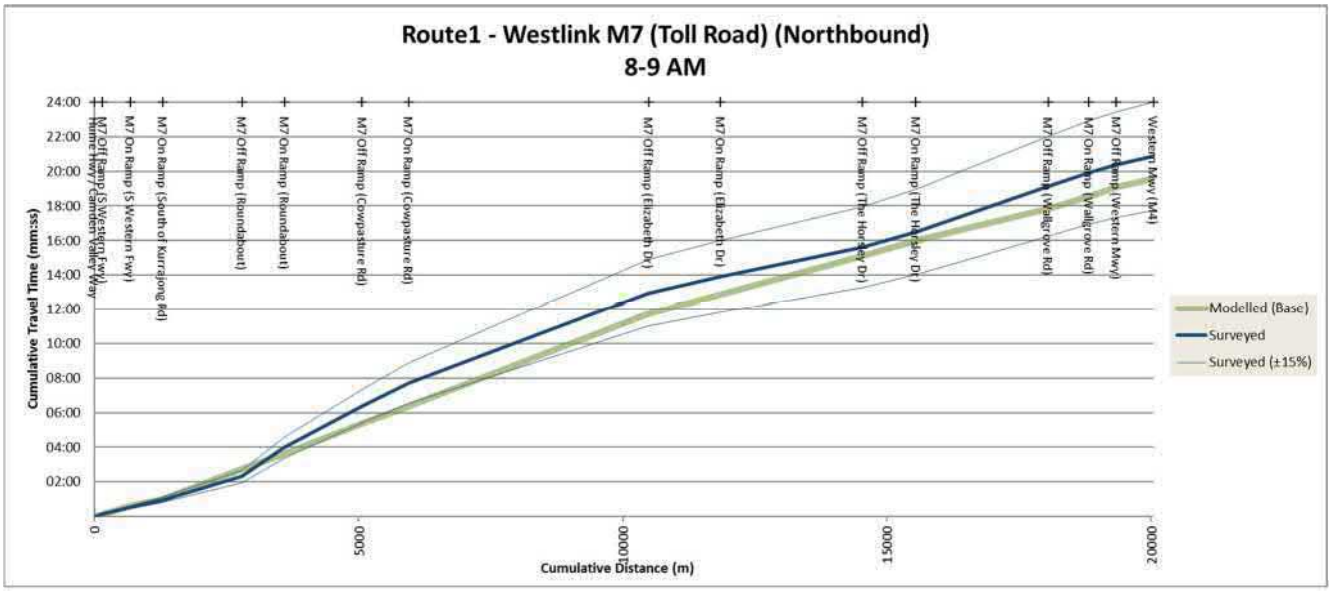


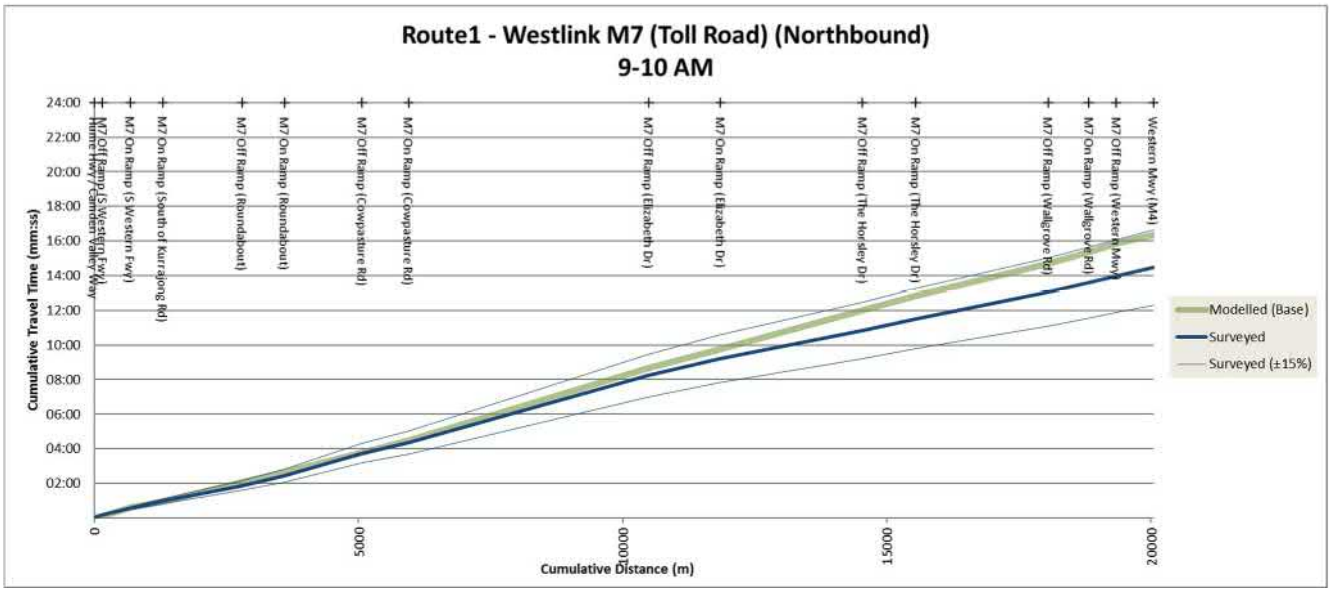
Appendix B. Detailed general traffic travel time validation

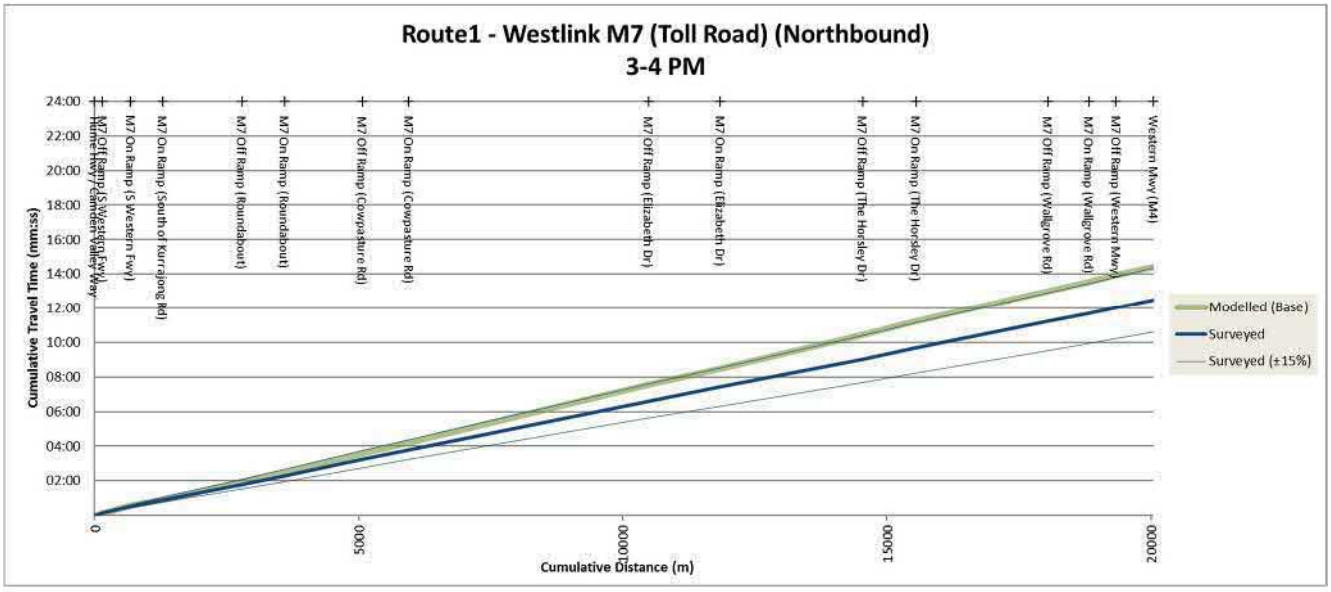
B.1 Route 1 - M7 Motorway

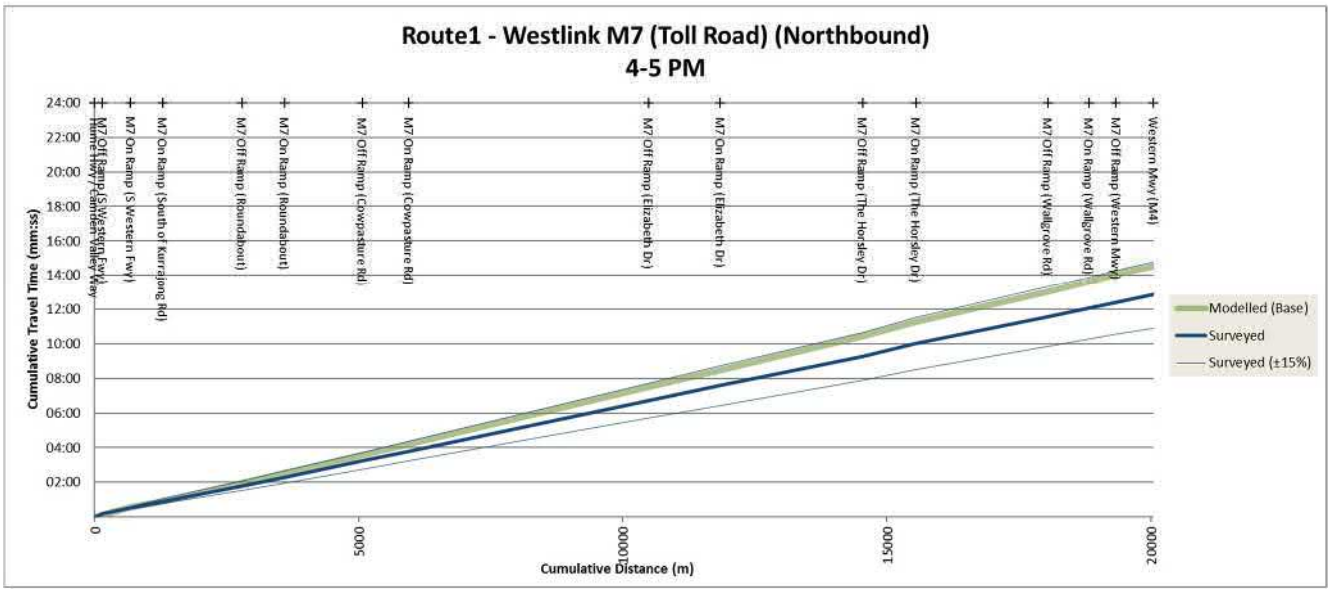


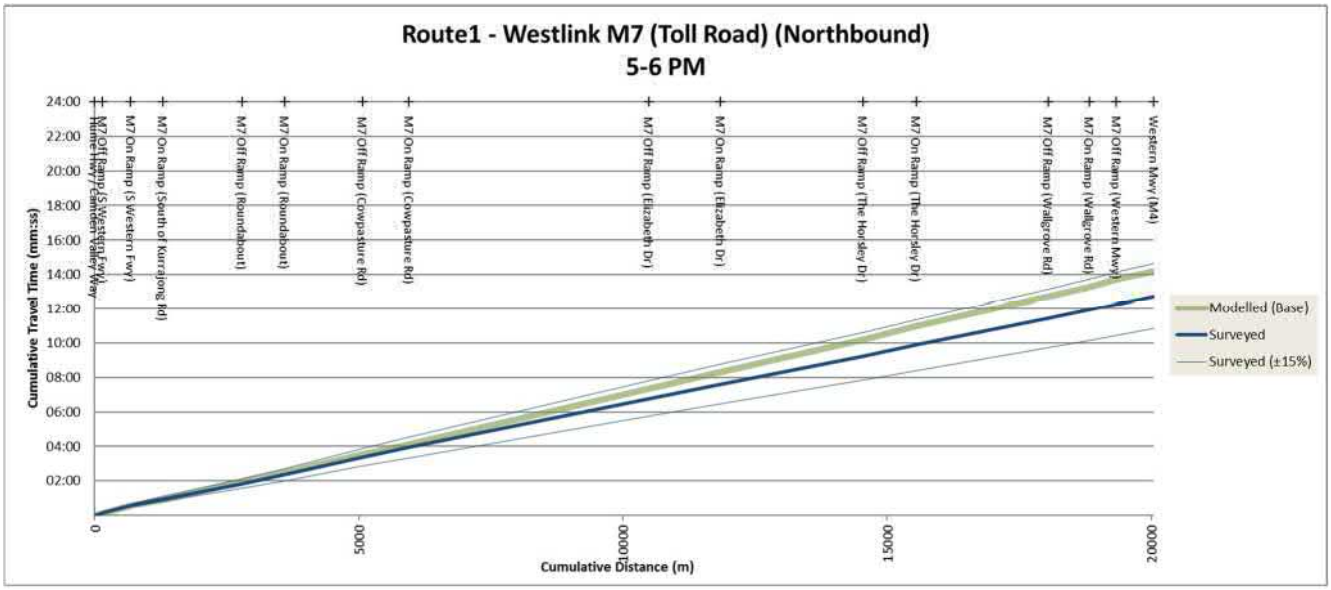


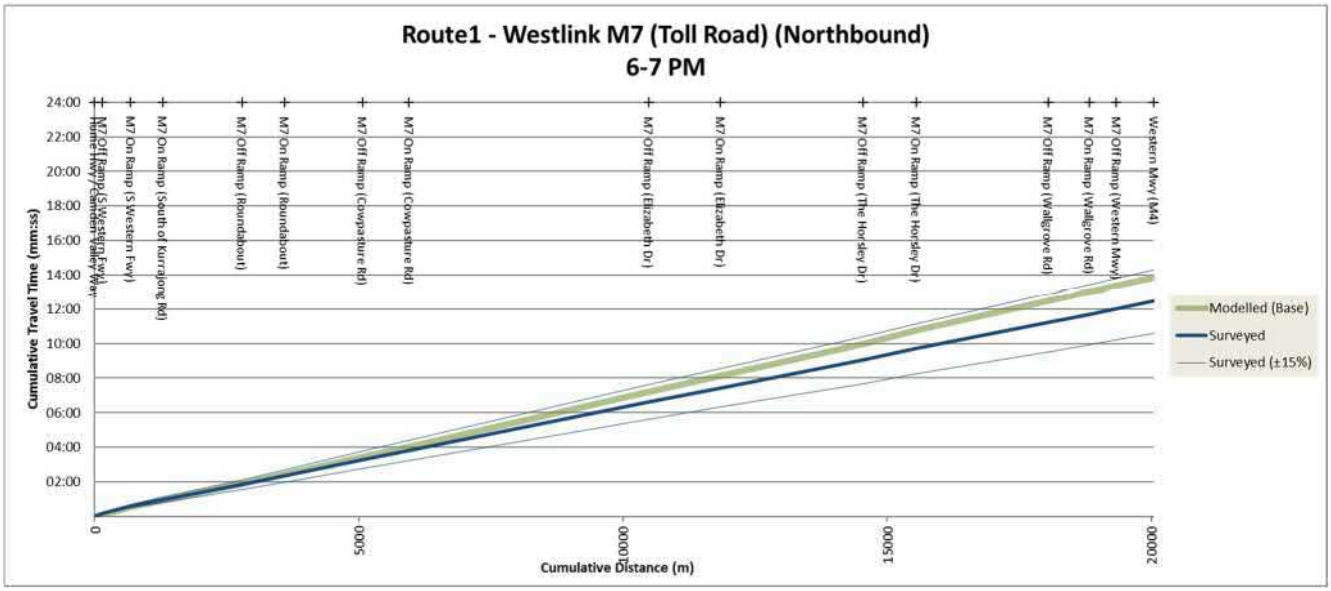

Route1 - Westlink M7 (Toll Road) (Northbound)
8-9 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
0
5000
10000
15000
20000
Cumulative Distance (m)
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
Hume Hwy / Camden Valley Way
Modelled (Base)
Surveyed
Surveyed (±15%)

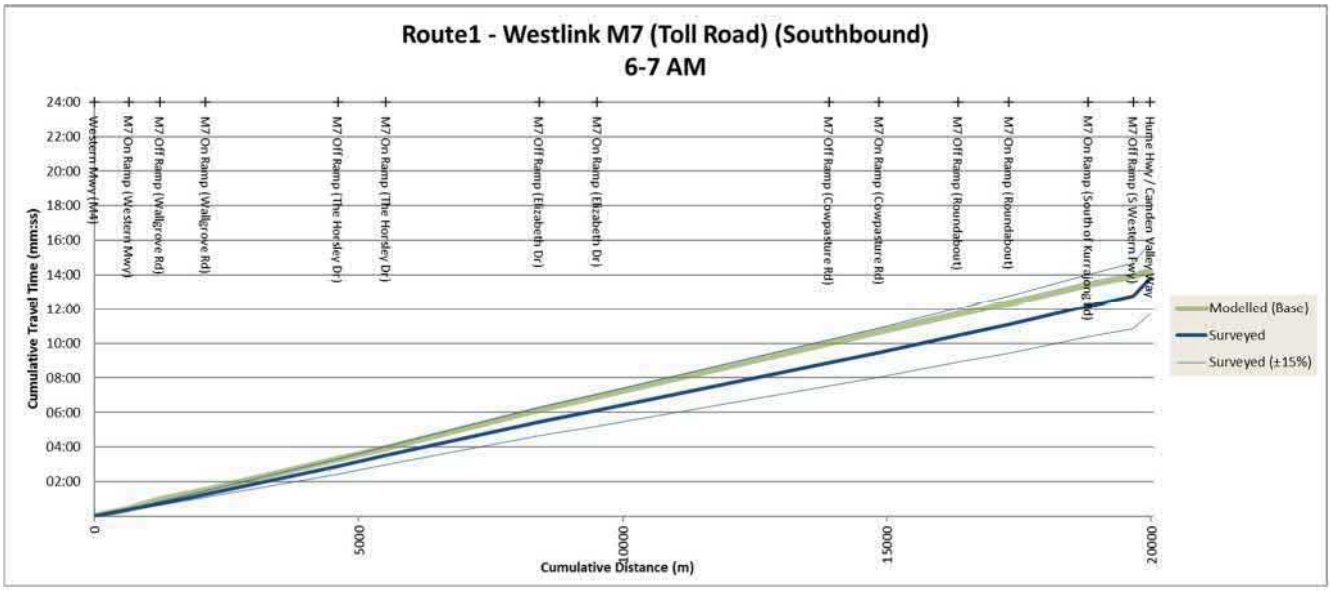

Route1 - Westlink M7 (Toll Road) (Northbound)
9-10 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
0
5000
10000
15000
20000
Cumulative Distance (m)
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
Hume Hwy / Camden Valley Way
Modelled (Base)
Surveyed
Surveyed (±15%)

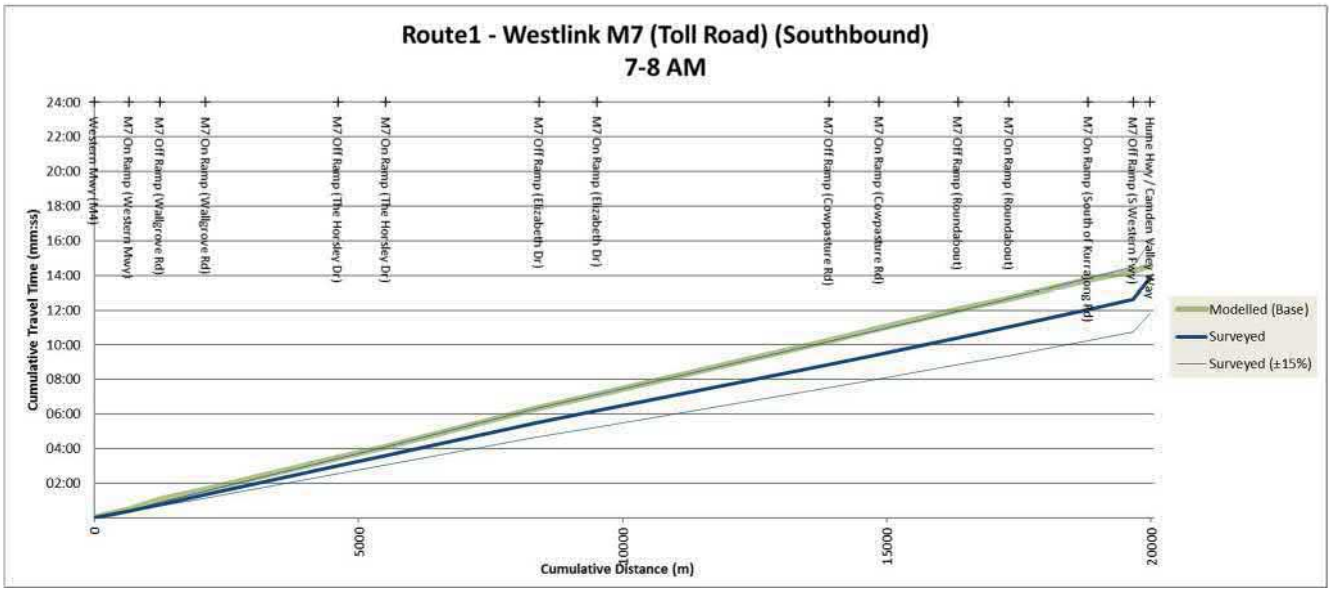

Route1 - Westlink M7 (Toll Road) (Northbound)
3-4 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

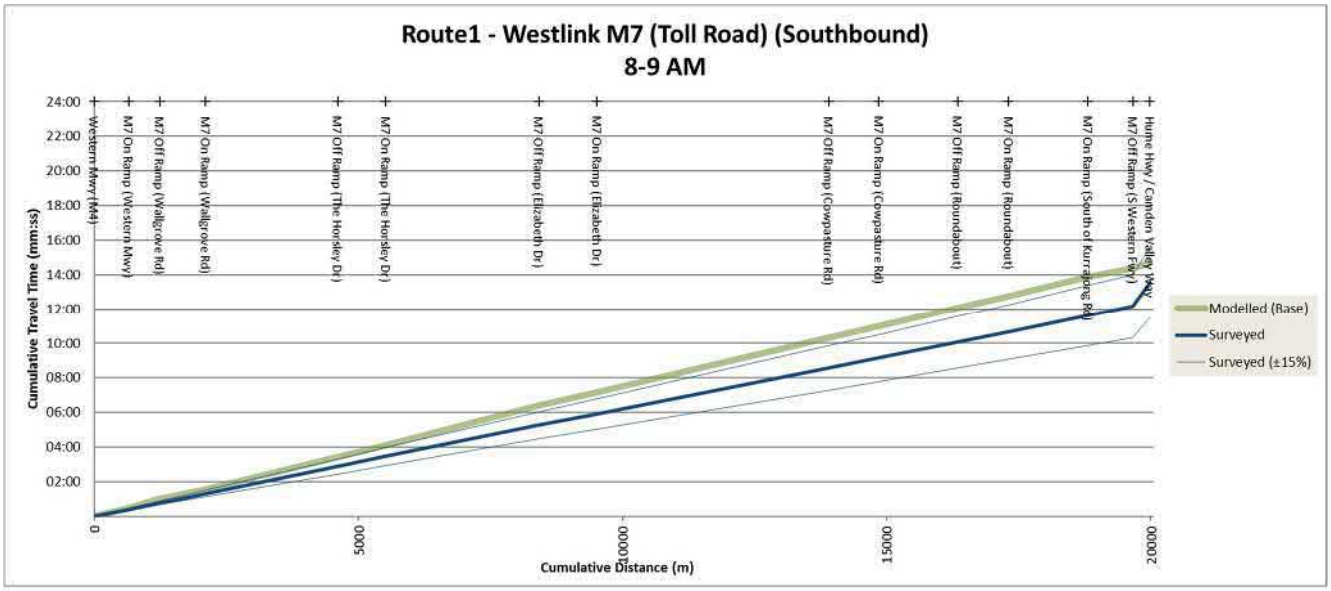

Route1 - Westlink M7 (Toll Road) (Northbound)
4-5 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

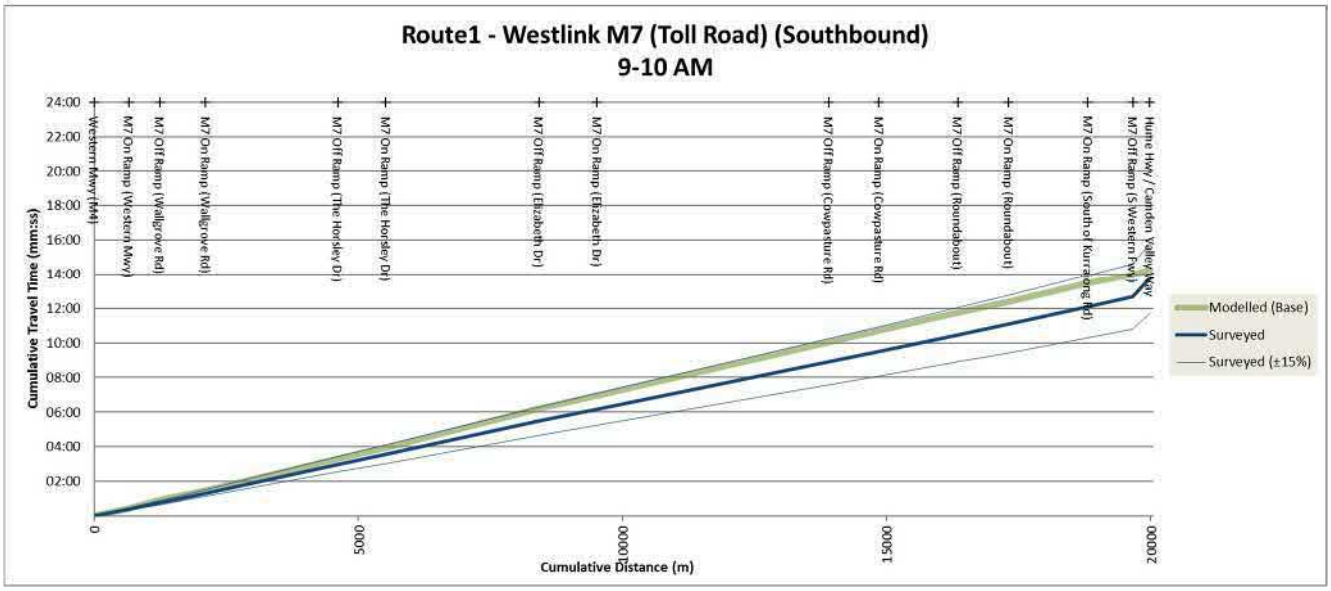

Route1 - Westlink M7 (Toll Road) (Northbound)
5-6 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

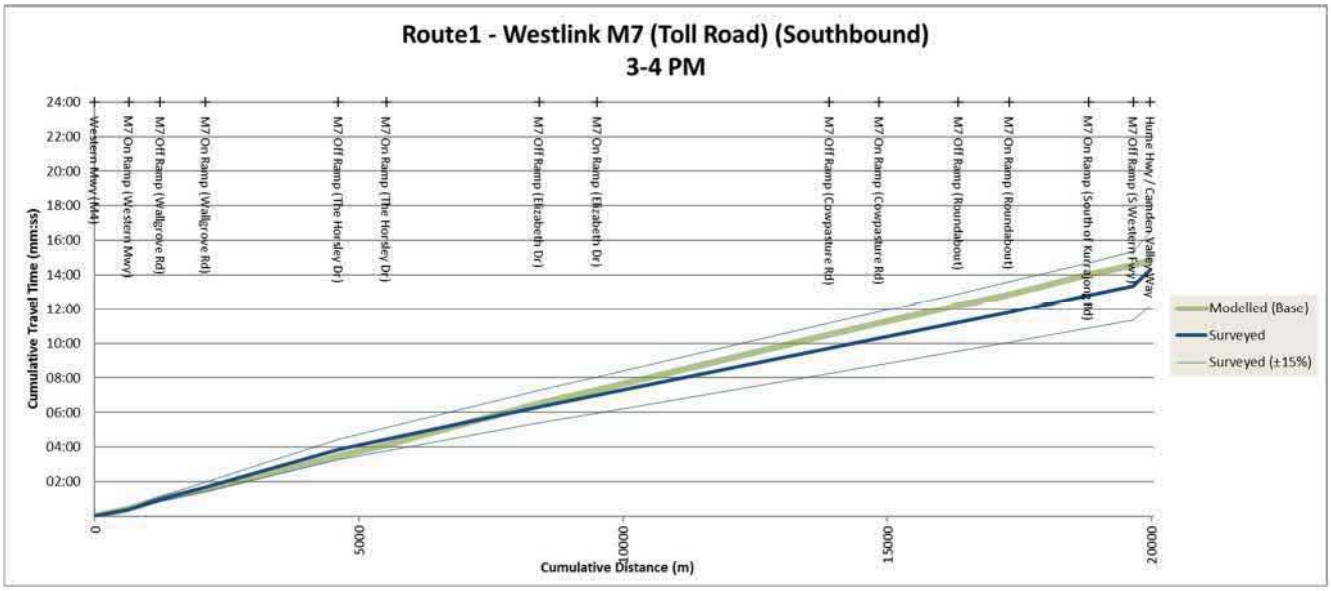

Route1 - Westlink M7 (Toll Road) (Northbound)
6-7 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
M7 Off Ramp (S Western Fwy)
M7 On Ramp (S Western Fwy)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (Western Mwy)
Western Mwy (M4)
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

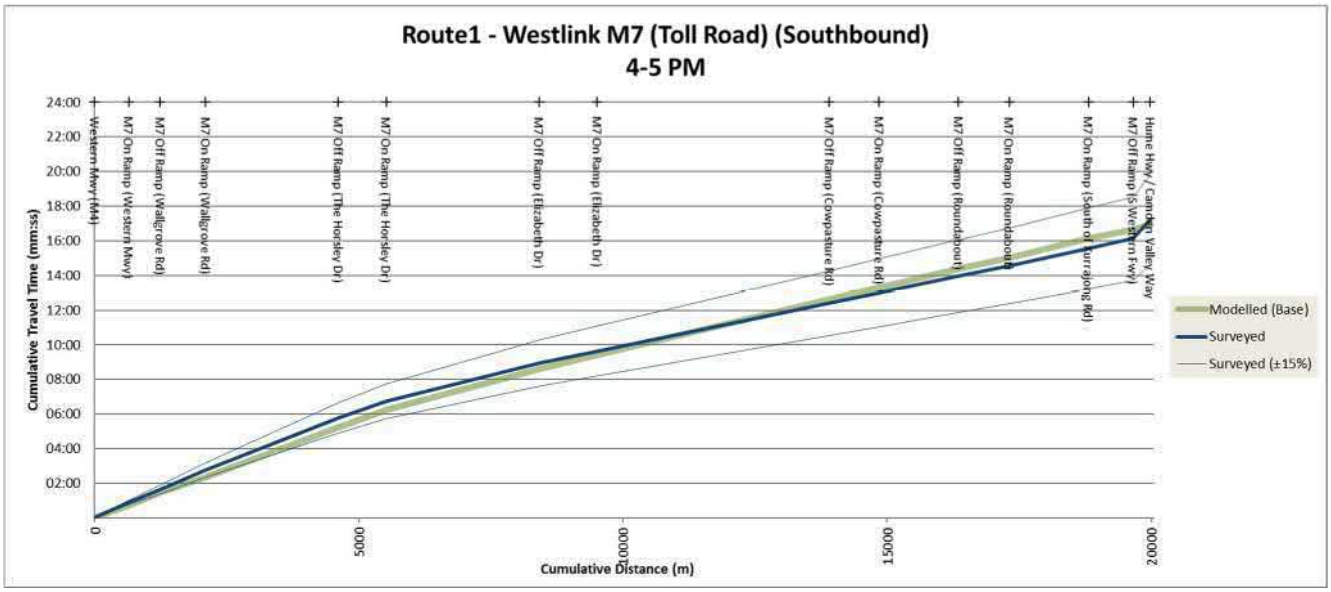

Route1 - Westlink M7 (Toll Road) (Southbound)
6-7 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

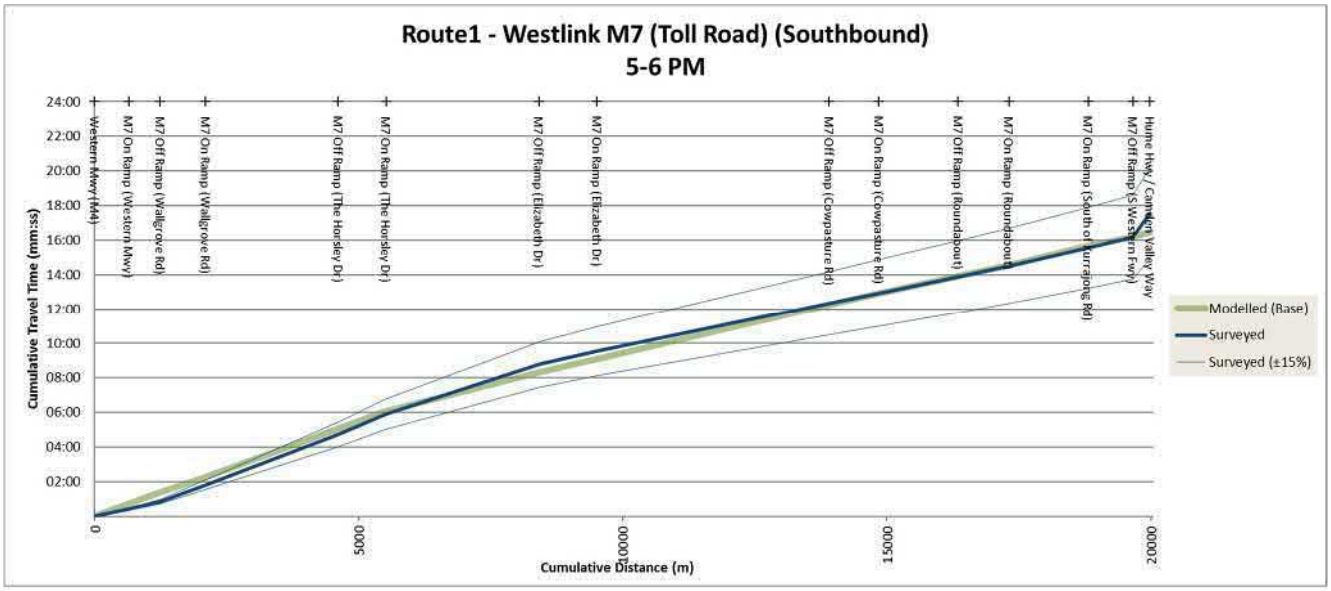

Route1 - Westlink M7 (Toll Road) (Southbound)
7-8 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

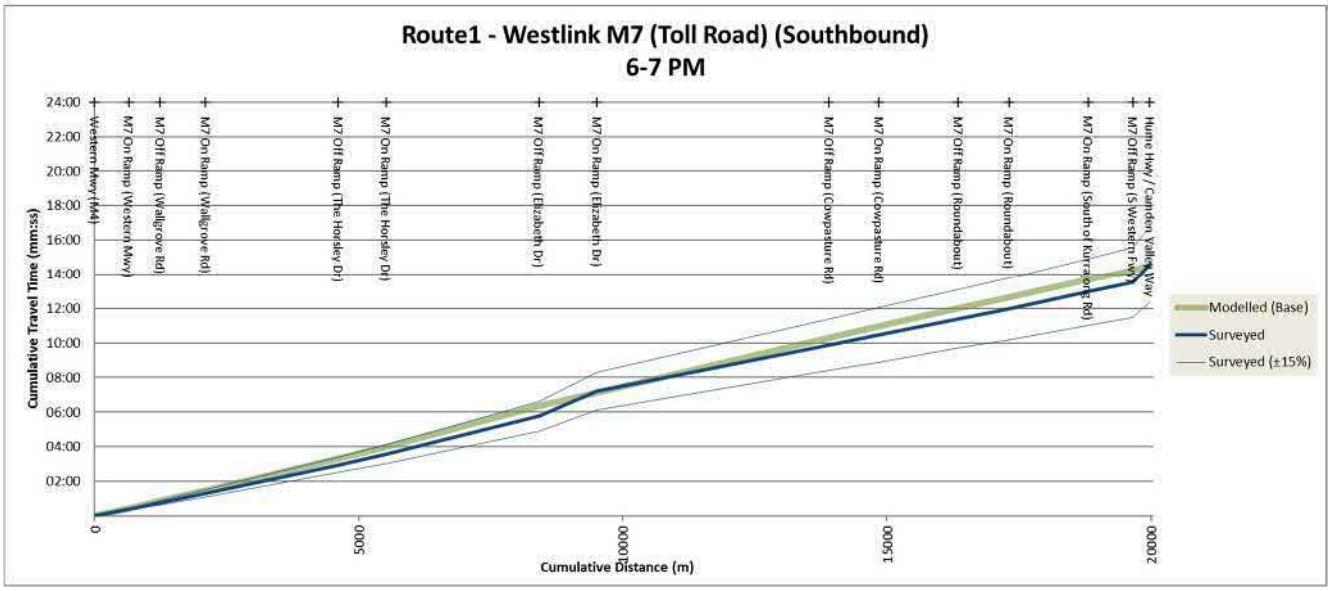

Route1 - Westlink M7 (Toll Road) (Southbound)
8-9 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route1 - Westlink M7 (Toll Road) (Southbound)
9-10 AM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

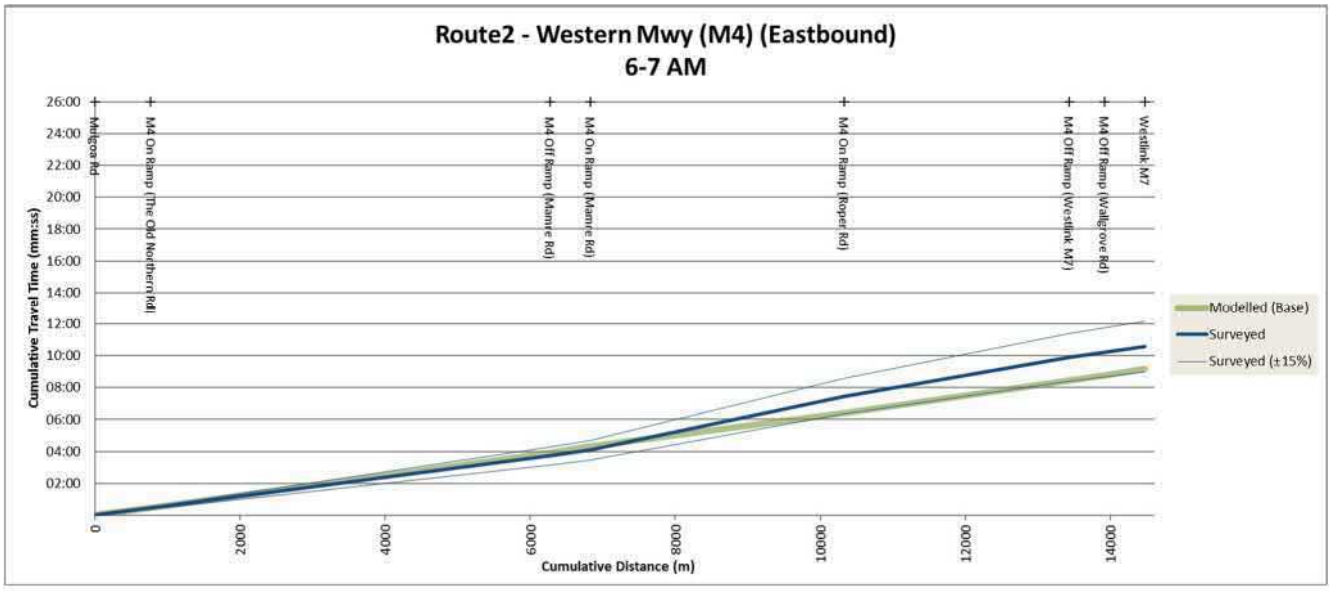

Route1 - Westlink M7 (Toll Road) (Southbound)
3-4 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

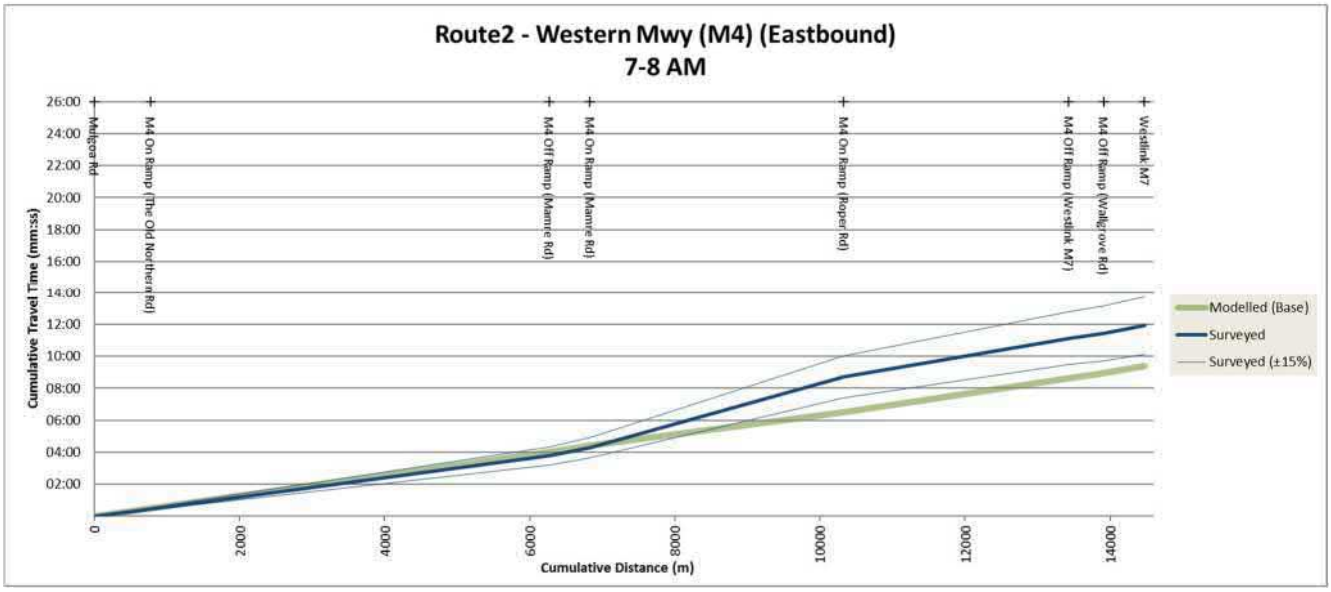

Route1 - Westlink M7 (Toll Road) (Southbound)
4-5 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

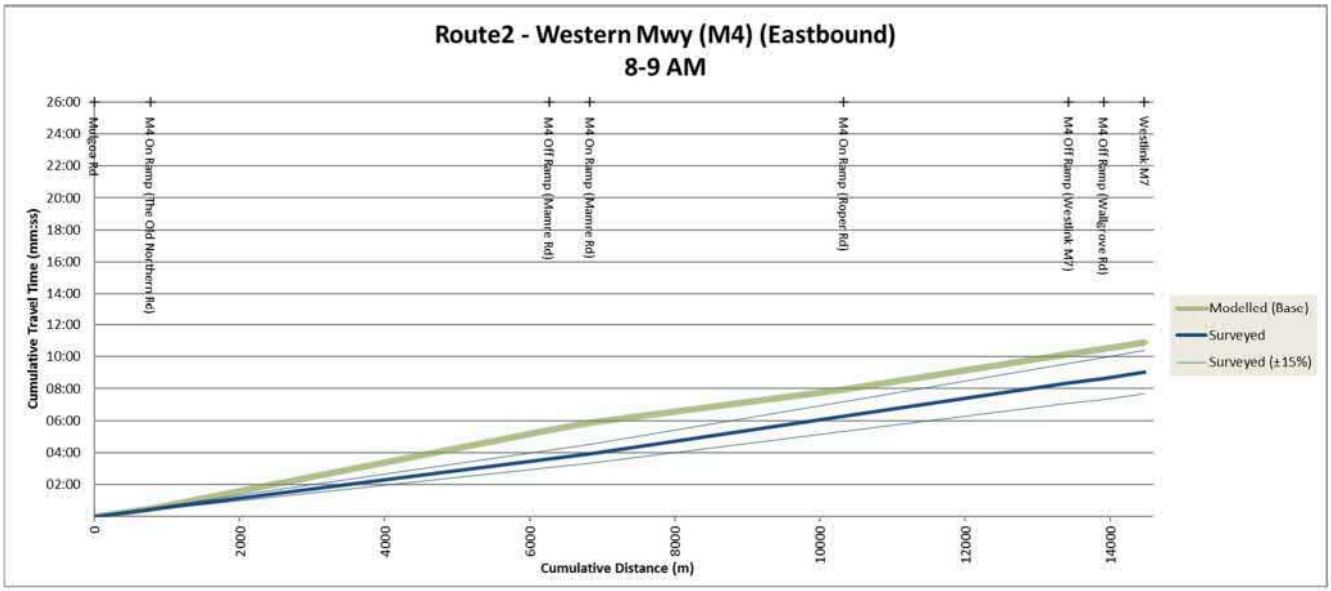

Route1 - Westlink M7 (Toll Road) (Southbound)
5-6 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

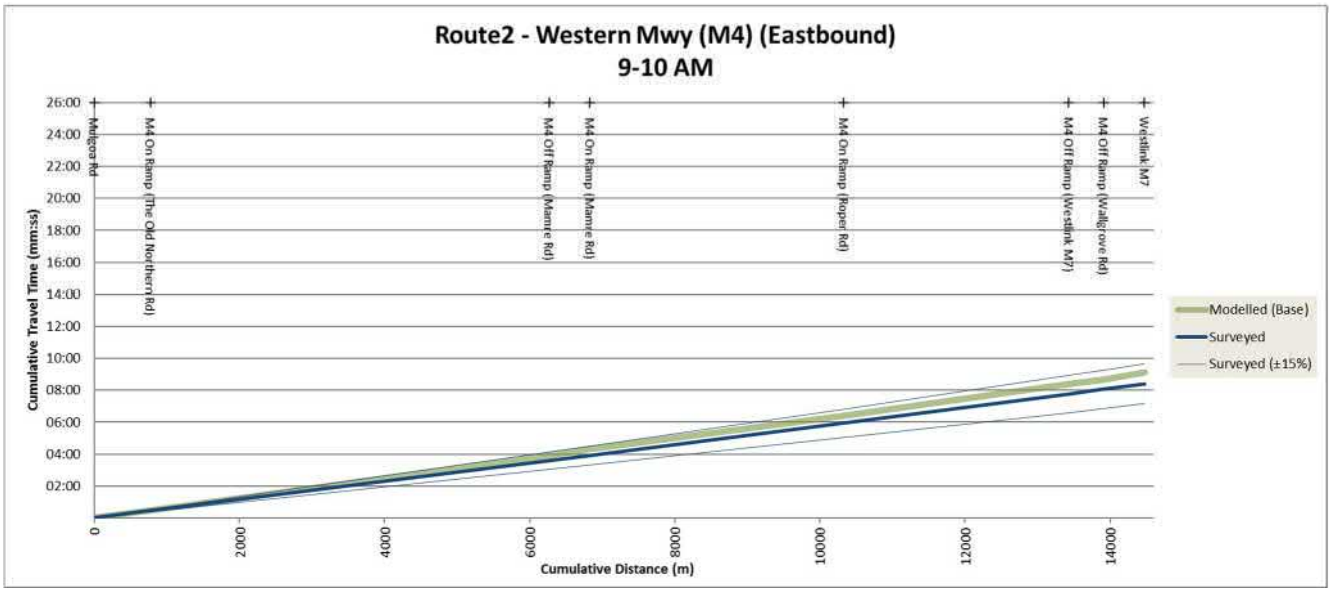

Route1 - Westlink M7 (Toll Road) (Southbound)
6-7 PM
Cumulative Travel Time (mm:ss)
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4)
M7 On Ramp (Western Mwy)
M7 Off Ramp (Wallgrove Rd)
M7 On Ramp (Wallgrove Rd)
M7 Off Ramp (The Horsley Dr)
M7 On Ramp (The Horsley Dr)
M7 Off Ramp (Elizabeth Dr)
M7 On Ramp (Elizabeth Dr)
M7 Off Ramp (Cowpasture Rd)
M7 On Ramp (Cowpasture Rd)
M7 Off Ramp (Roundabout)
M7 On Ramp (Roundabout)
M7 On Ramp (South of Kurrajong Rd)
M7 Off Ramp (S Western Fwy)
Hume Hwy / Camden Valley Way
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

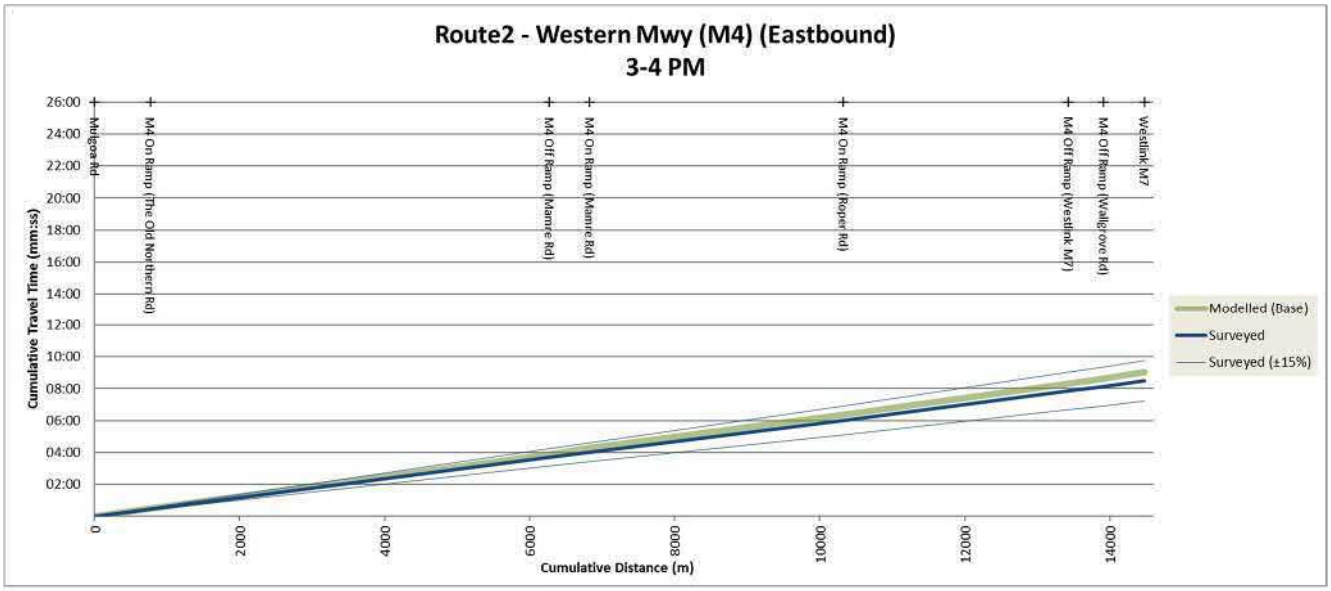
B.2 Route 2 - M4 Motorway

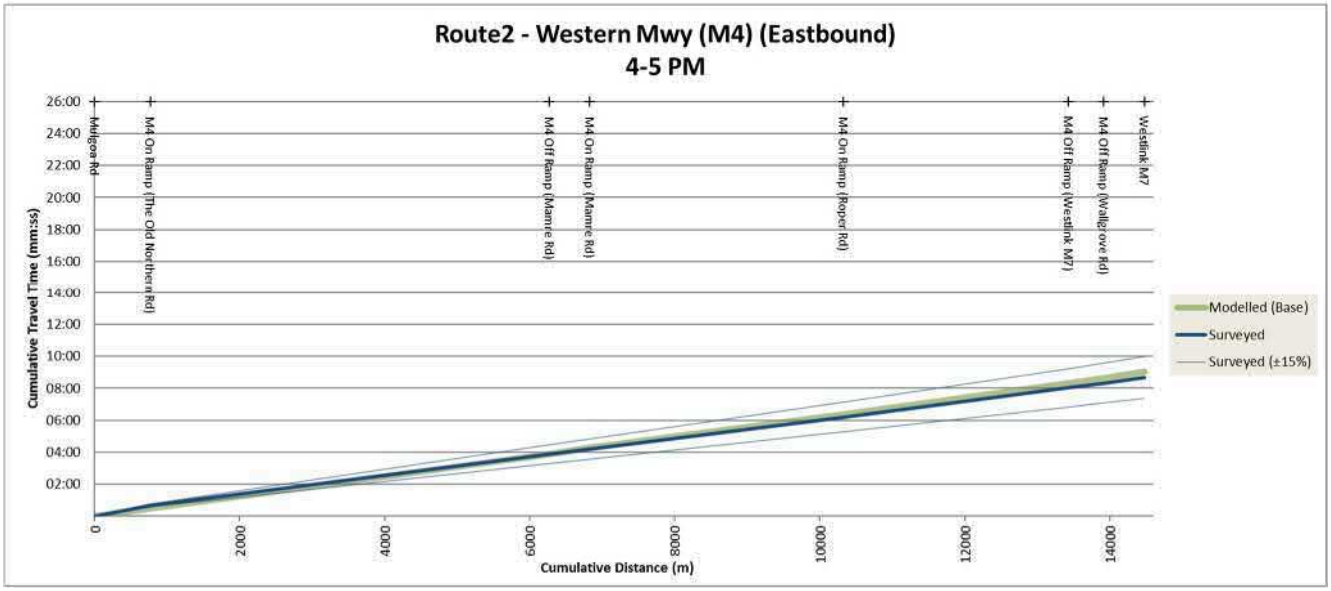


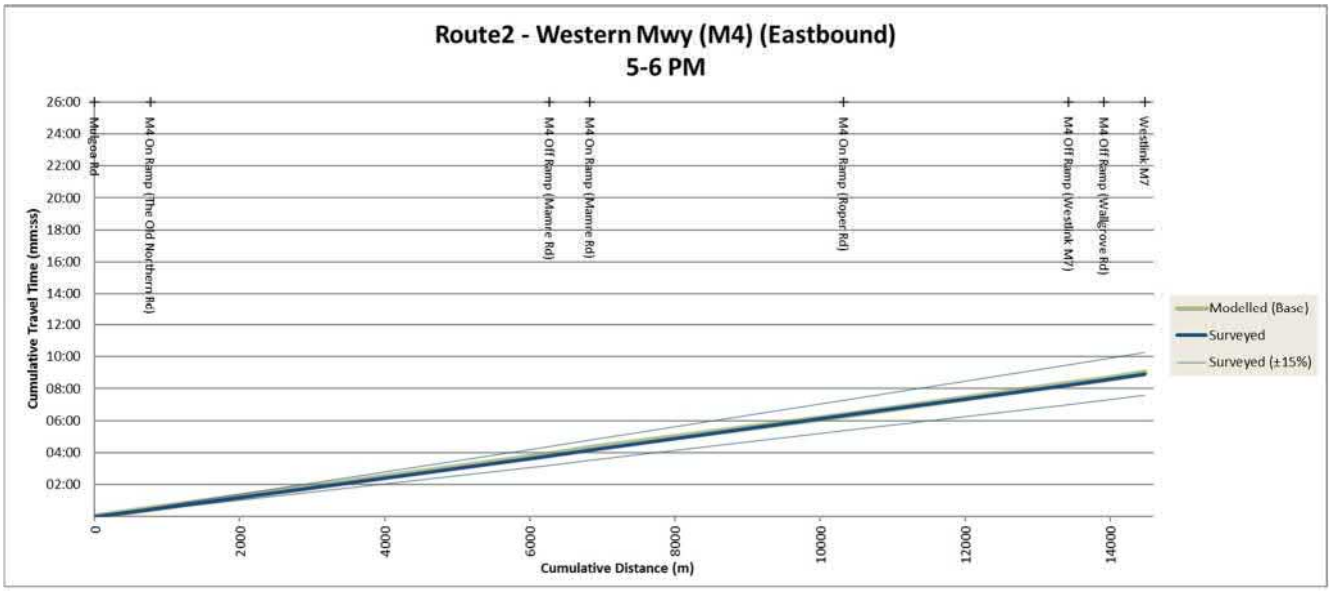


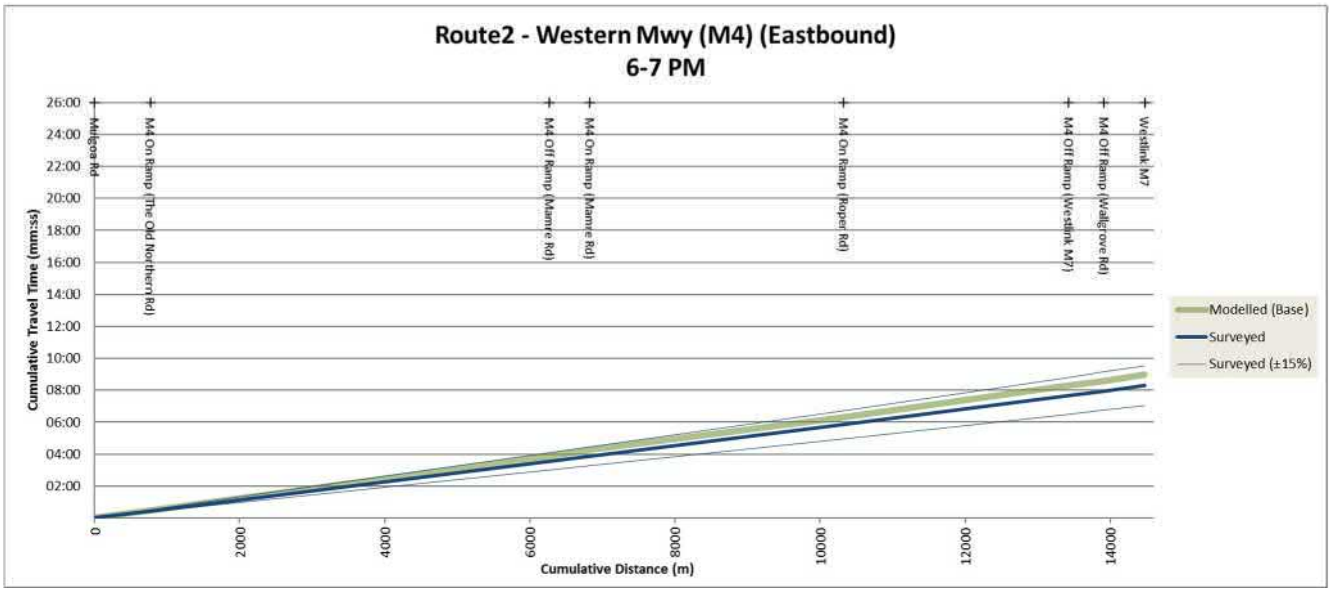

Route2 - Western Mwy (M4) (Eastbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Mulgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

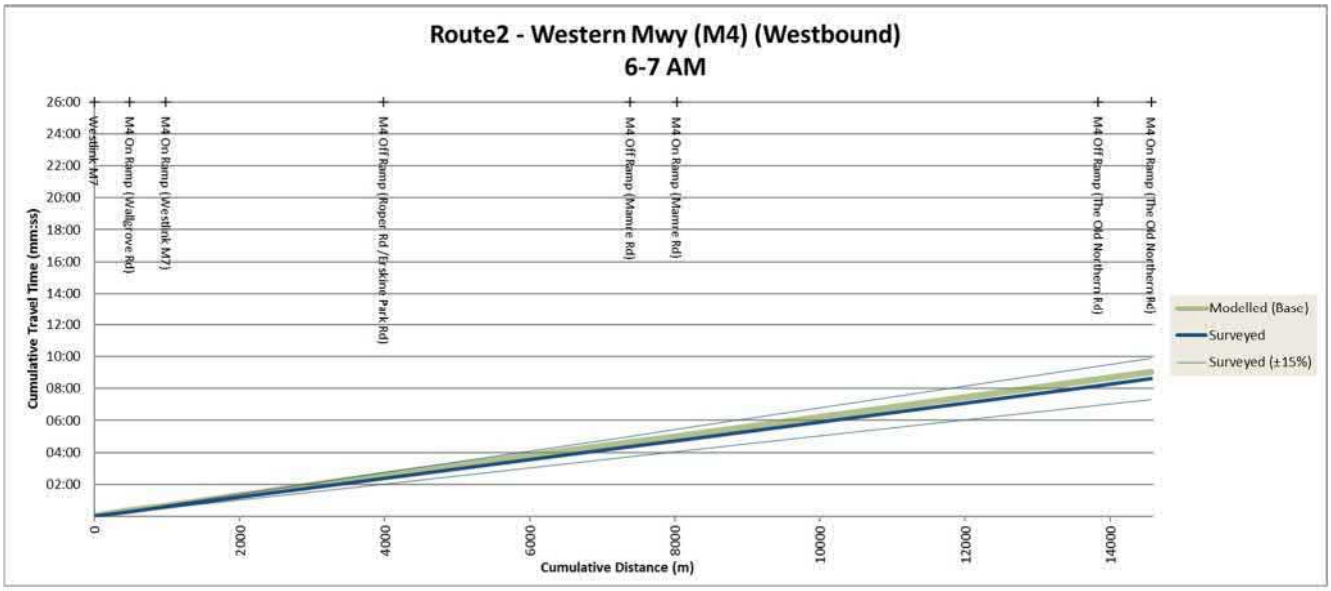

Route2 - Western Mwy (M4) (Eastbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Mulgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

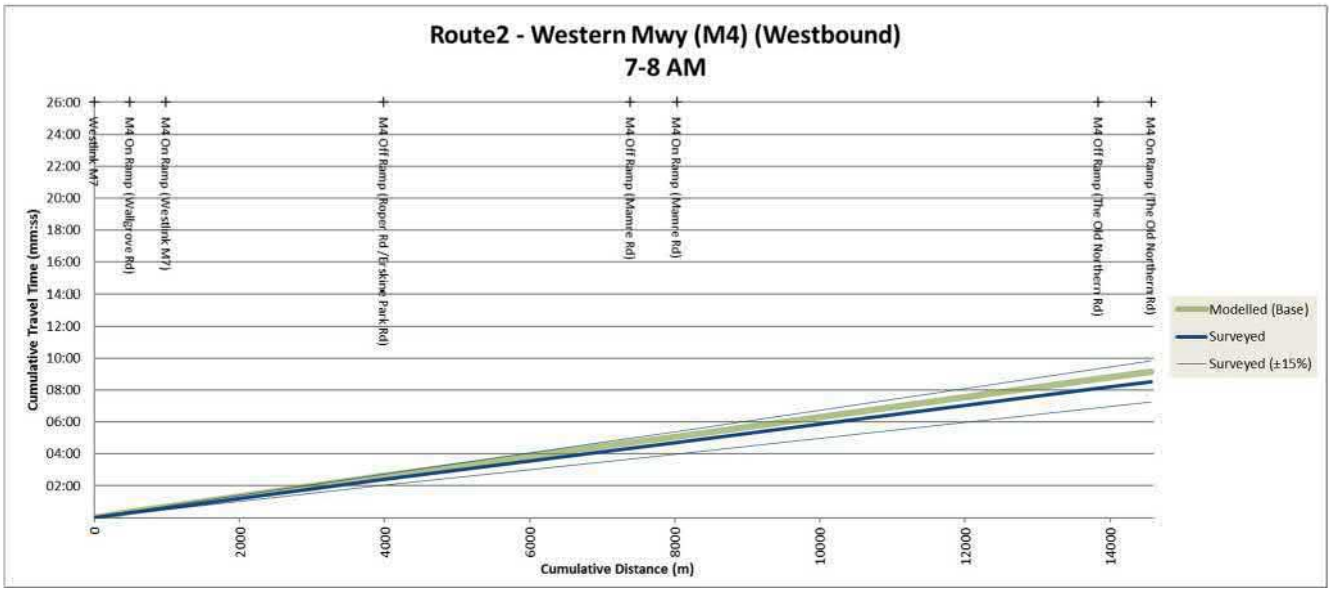

Route2 - Western Mwy (M4) (Eastbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Mulgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

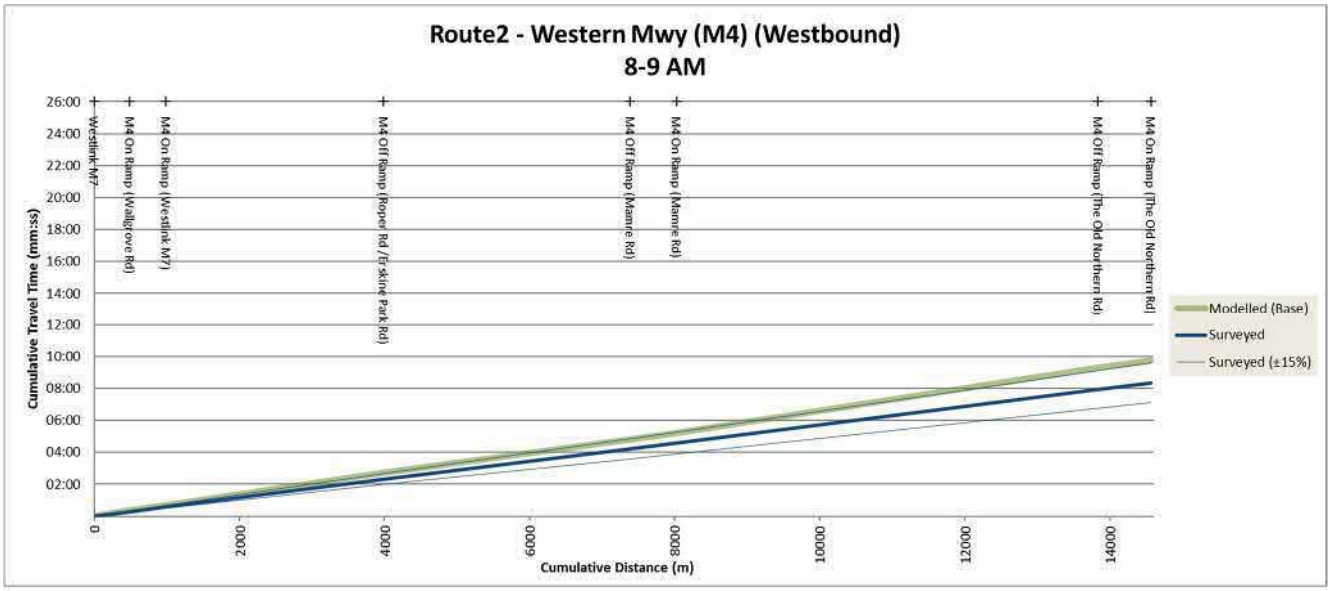

Route2 - Western Mwy (M4) (Eastbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Mulgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

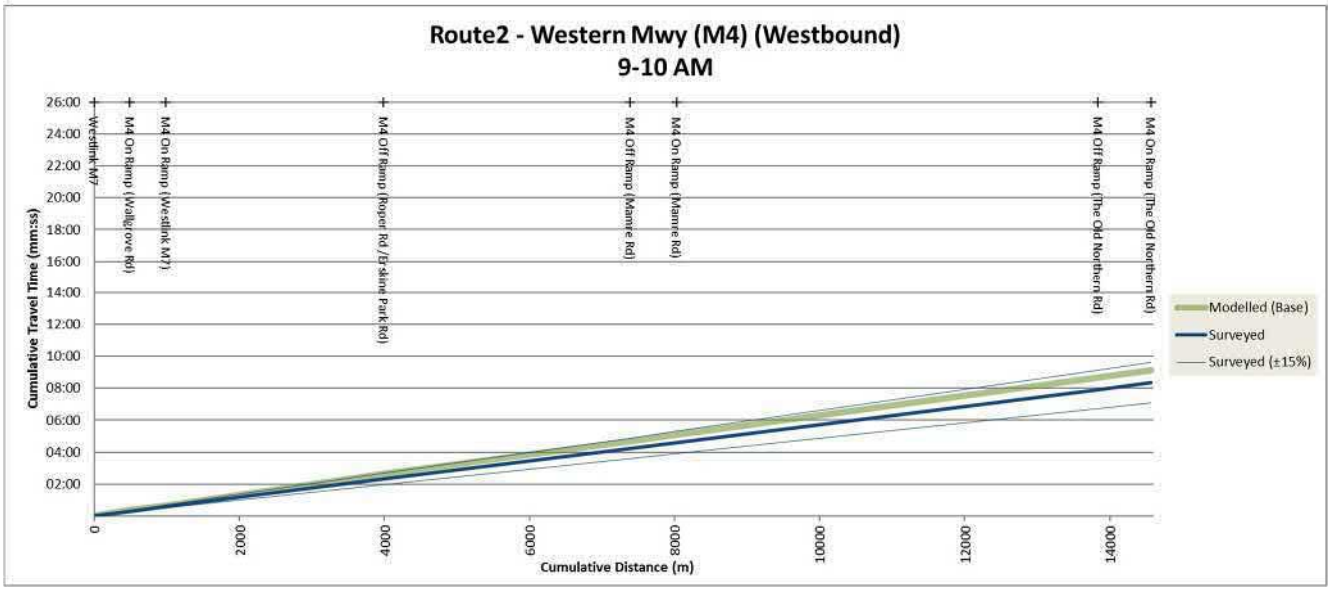

Route2 - Western Mwy (M4) (Eastbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Milgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

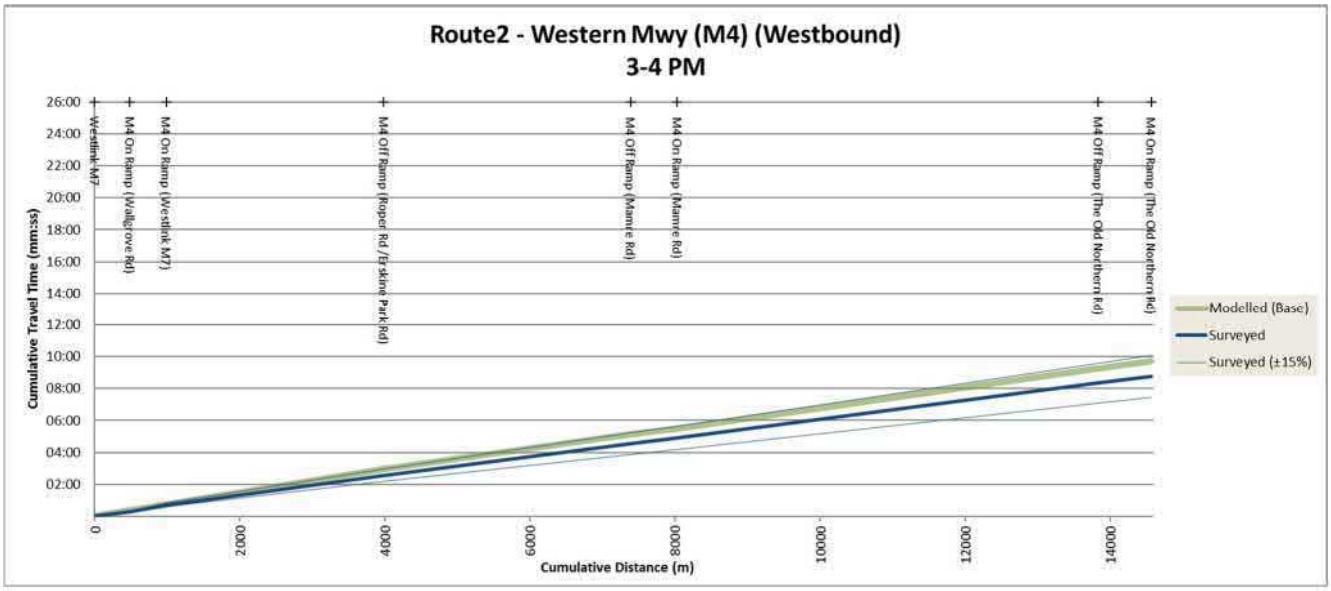

Route2 - Western Mwy (M4) (Eastbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Milgoa Rd
M4 On Ramp (The Old Northern Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 On Ramp (Roper Rd)
M4 Off Ramp (Westlink M7)
M4 Off Ramp (Wallgrove Rd)
Westlink M7
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

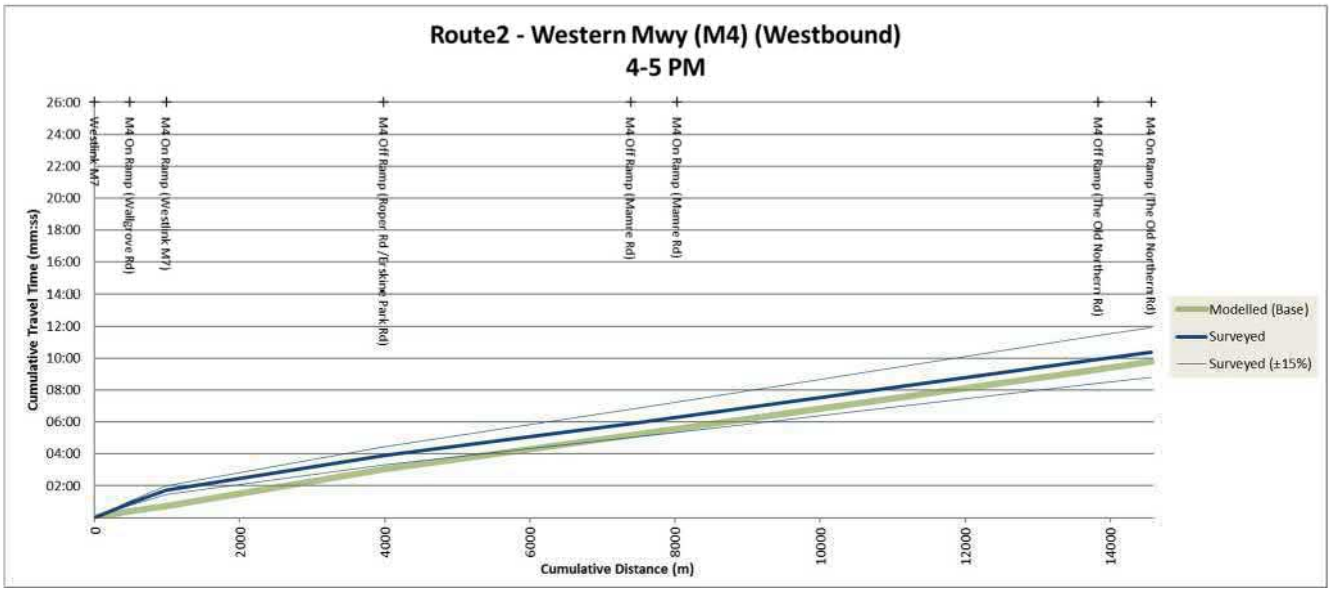

Route2 - Western Mwy (M4) (Westbound)
6-7 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd /Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

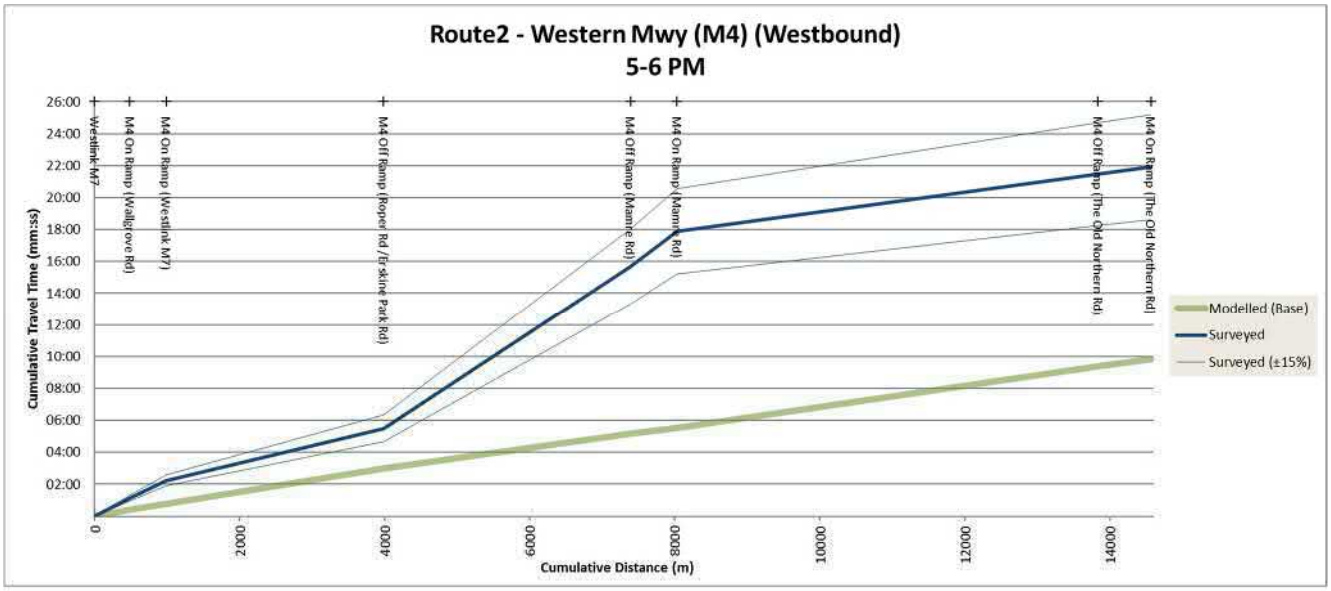

Route2 - Western Mwy (M4) (Westbound)
7-8 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd /Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

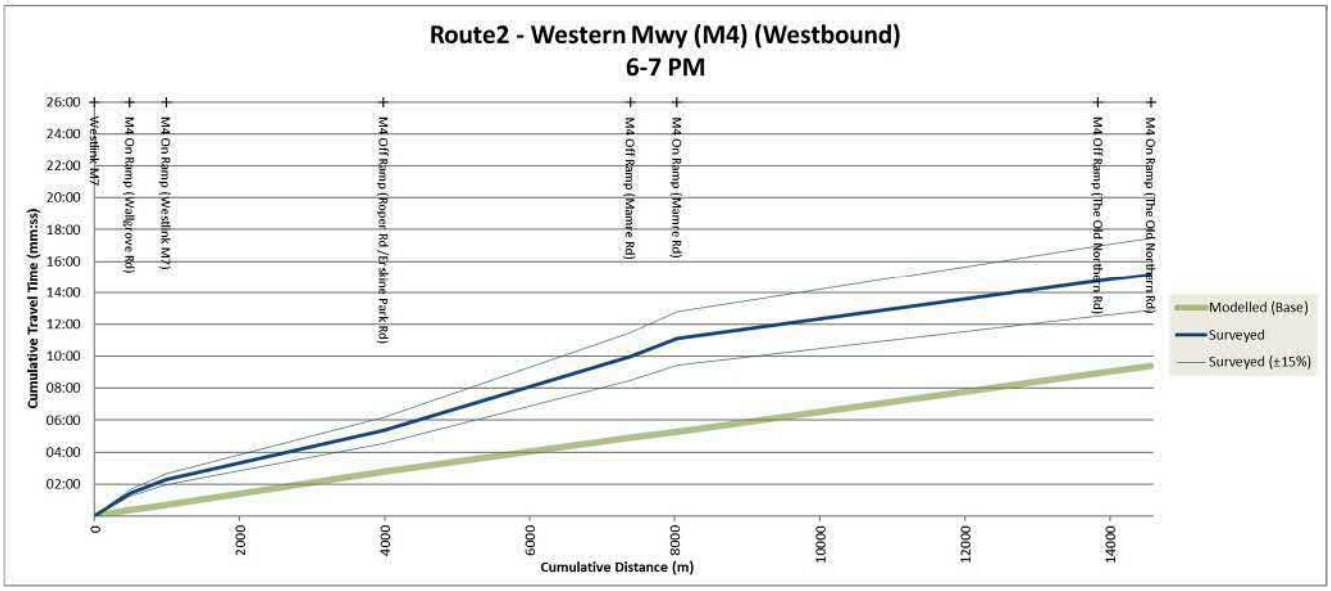

Route2 - Western Mwy (M4) (Westbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roger Rd / Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route2 - Western Mwy (M4) (Westbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roger Rd / Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

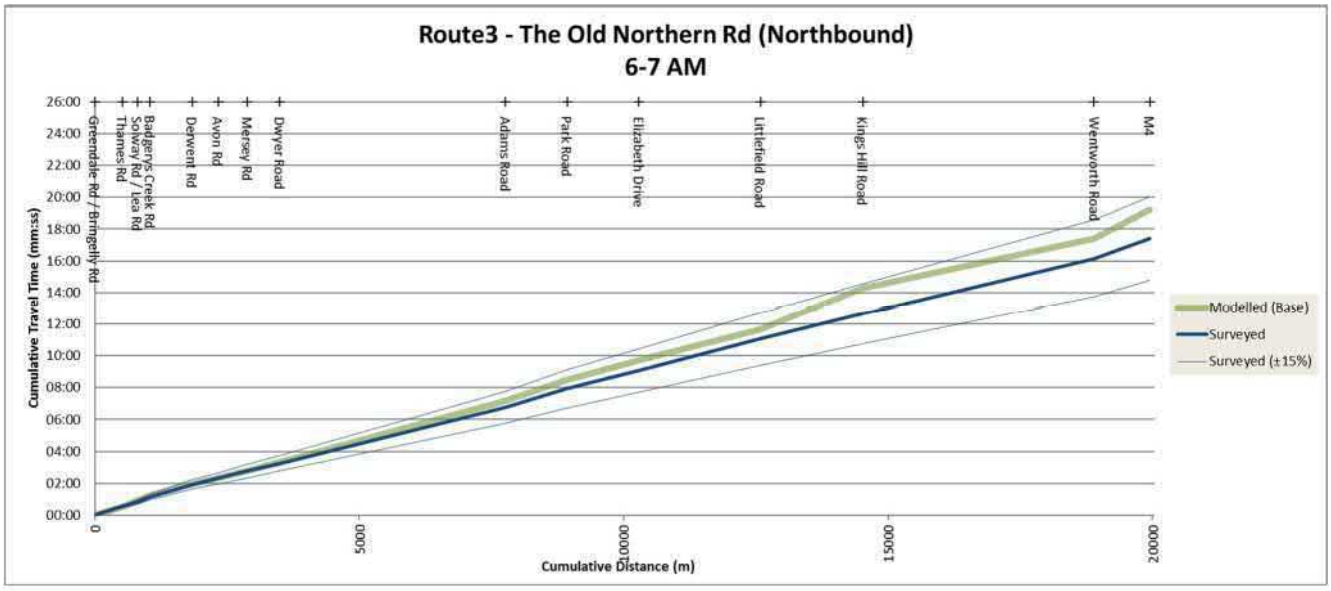

Route2 - Western Mwy (M4) (Westbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd /Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

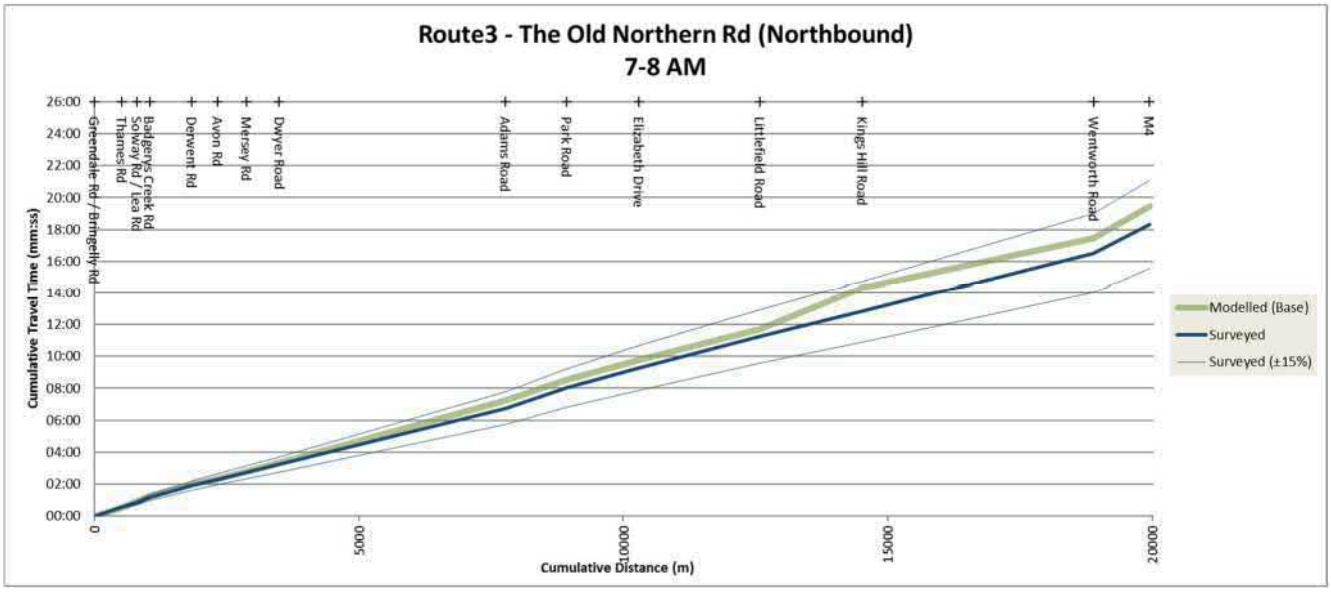

Route2 - Western Mwy (M4) (Westbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd /Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

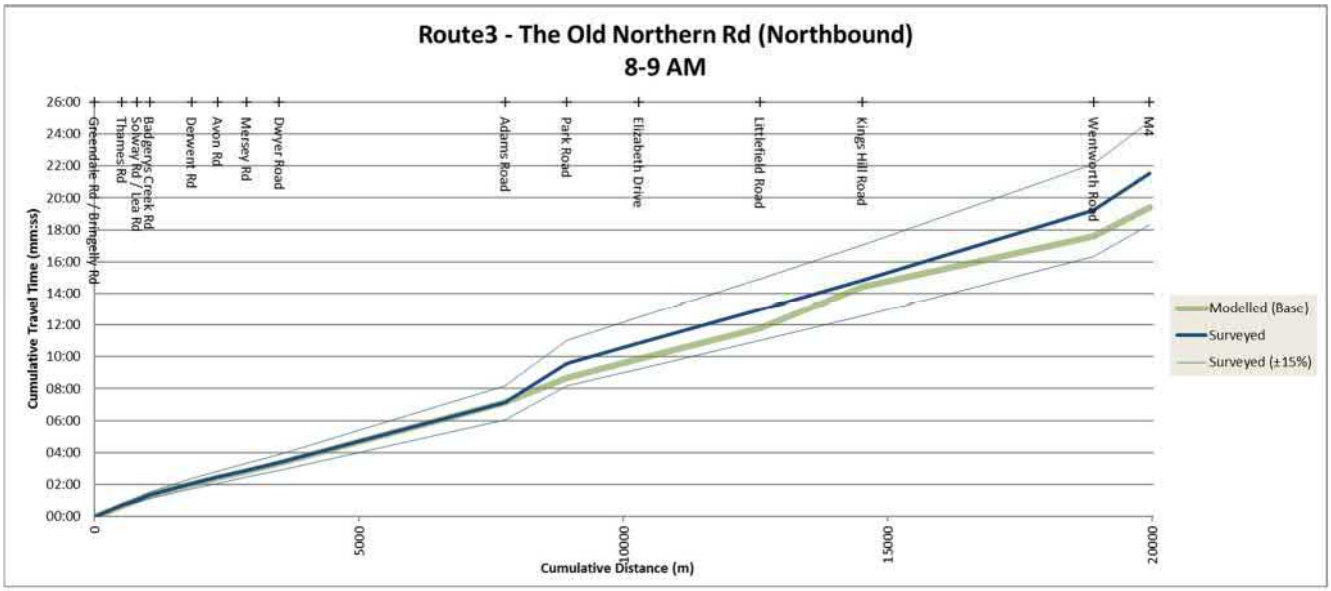

Route2 - Western Mwy (M4) (Westbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd / Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

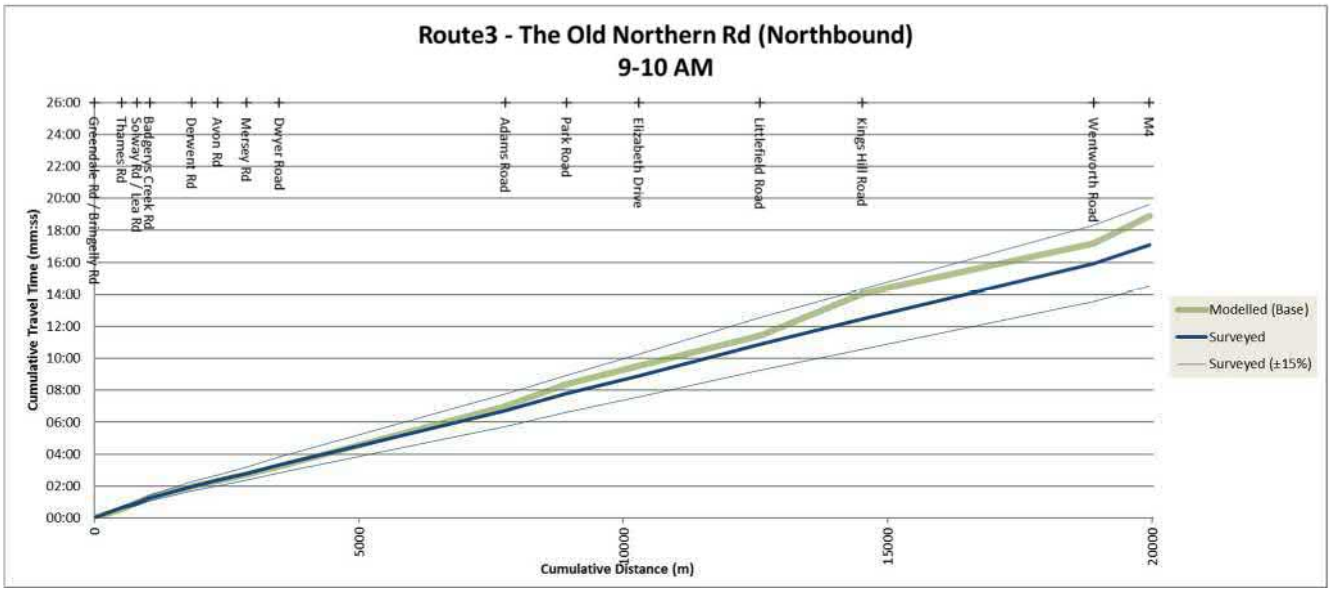

Route2 - Western Mwy (M4) (Westbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Westlink M7
M4 On Ramp (Wallgrove Rd)
M4 On Ramp (Westlink M7)
M4 Off Ramp (Roper Rd / Erskine Park Rd)
M4 Off Ramp (Mamre Rd)
M4 On Ramp (Mamre Rd)
M4 Off Ramp (The Old Northern Rd)
M4 On Ramp (The Old Northern Rd)
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

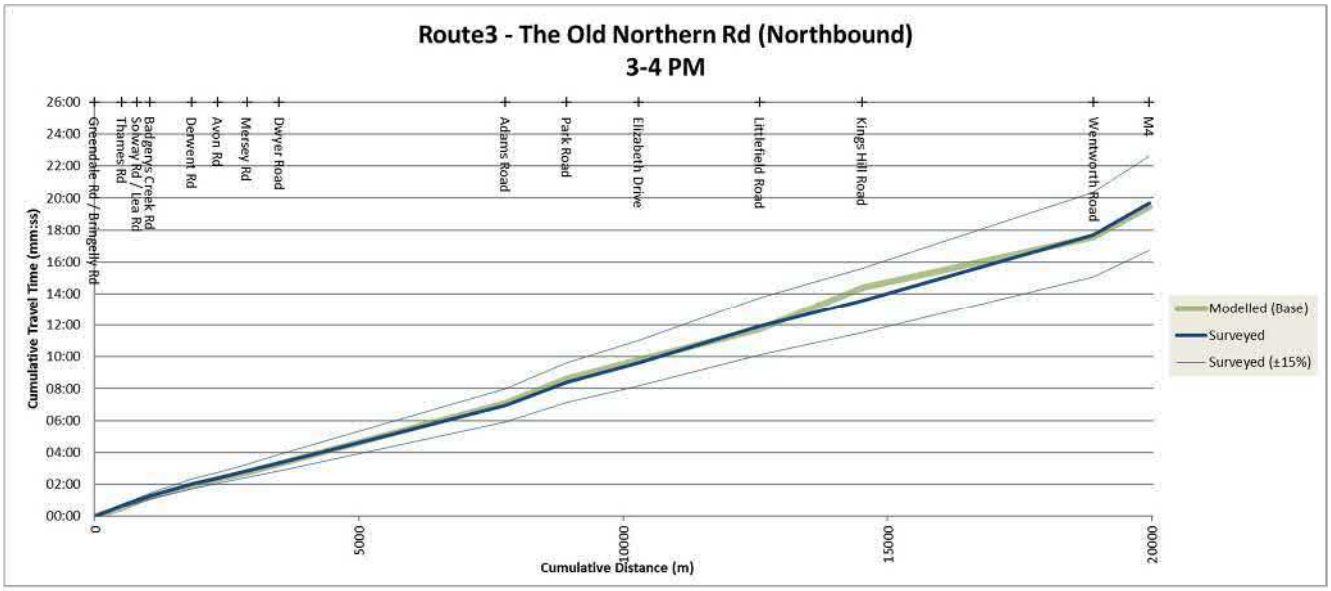
B.3 Route 3 – The Northern Road

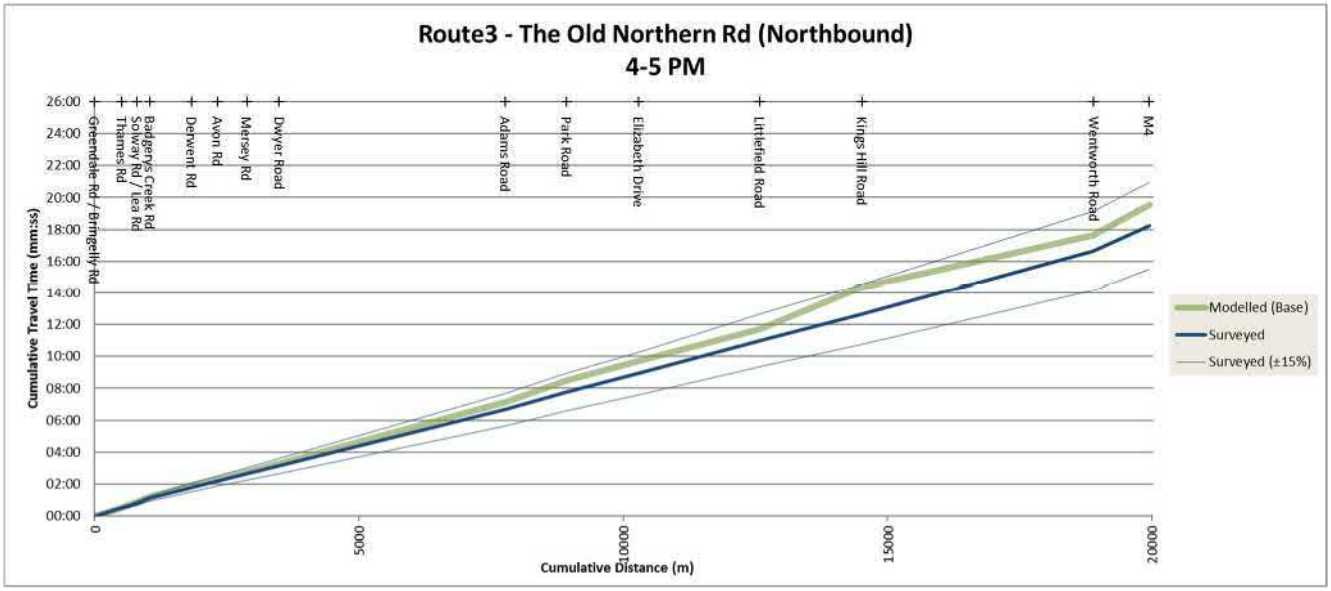


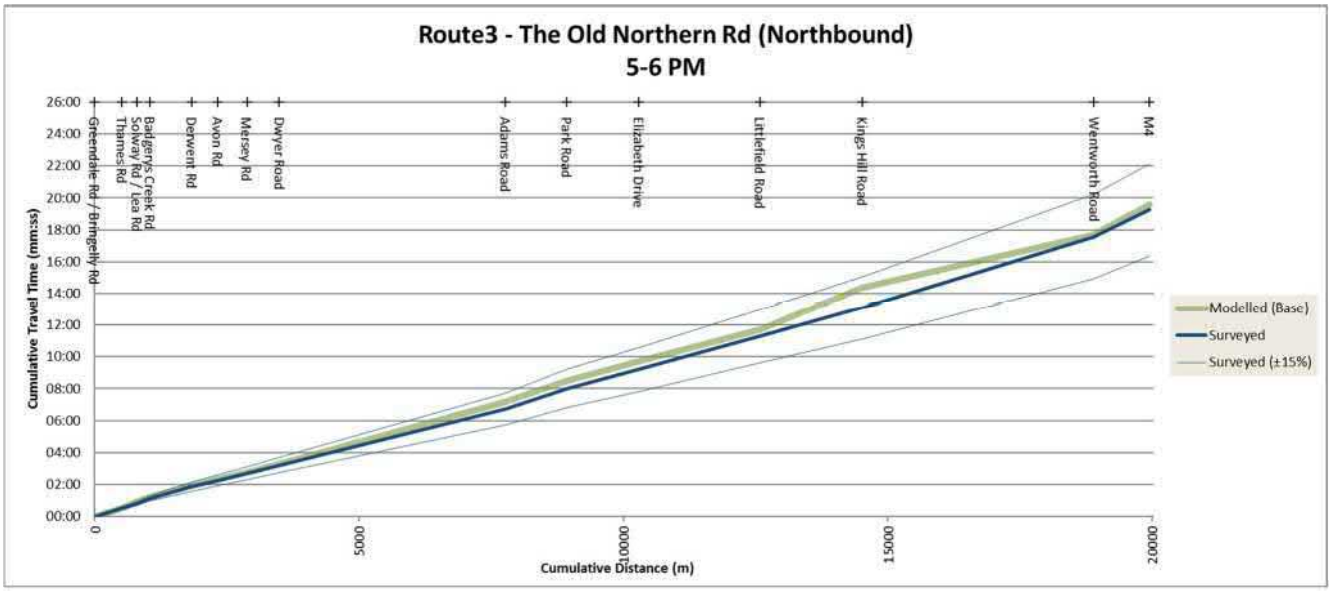


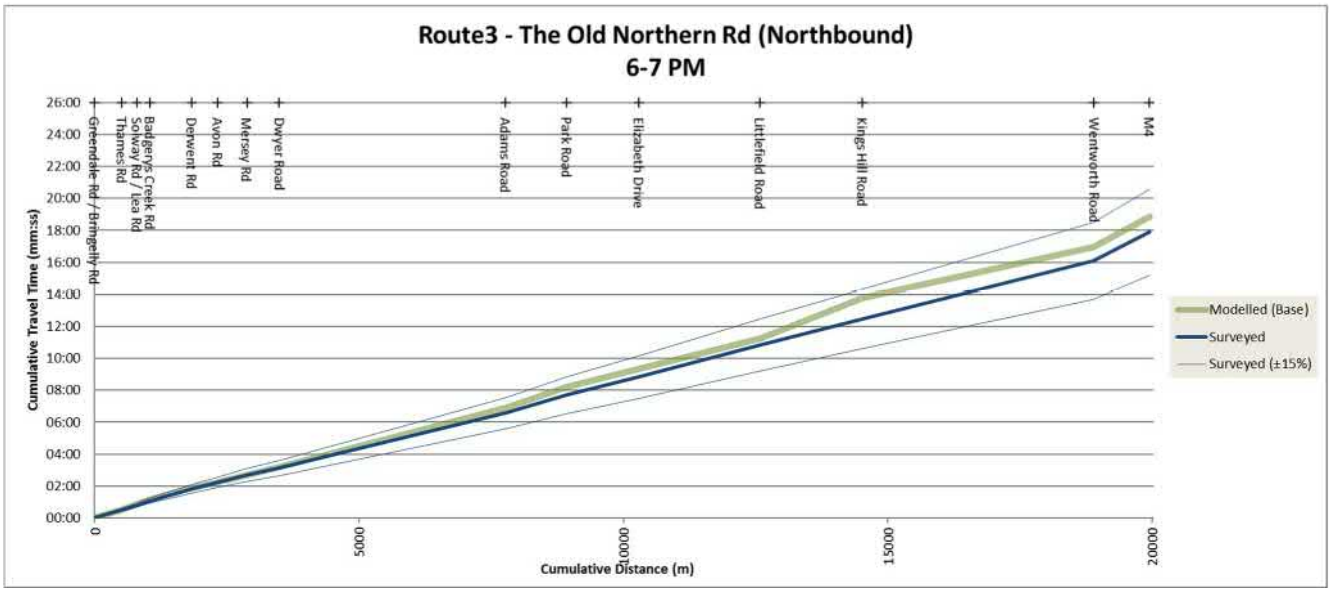

Route3 - The Old Northern Rd (Northbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

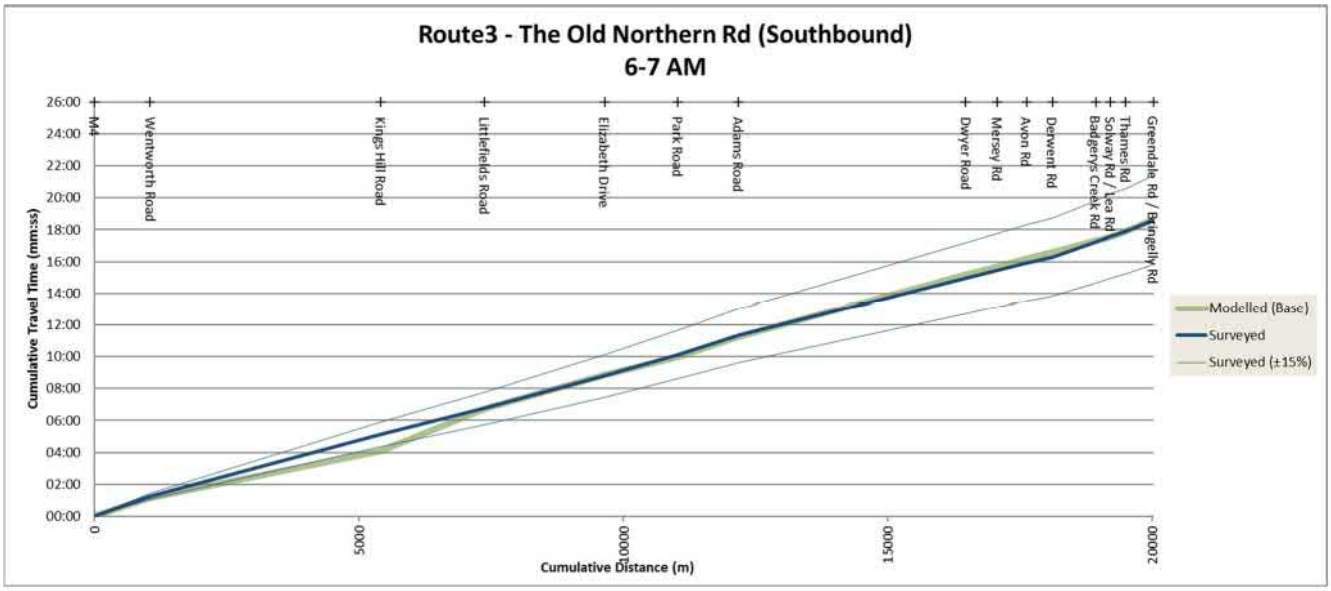

Route3 - The Old Northern Rd (Northbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

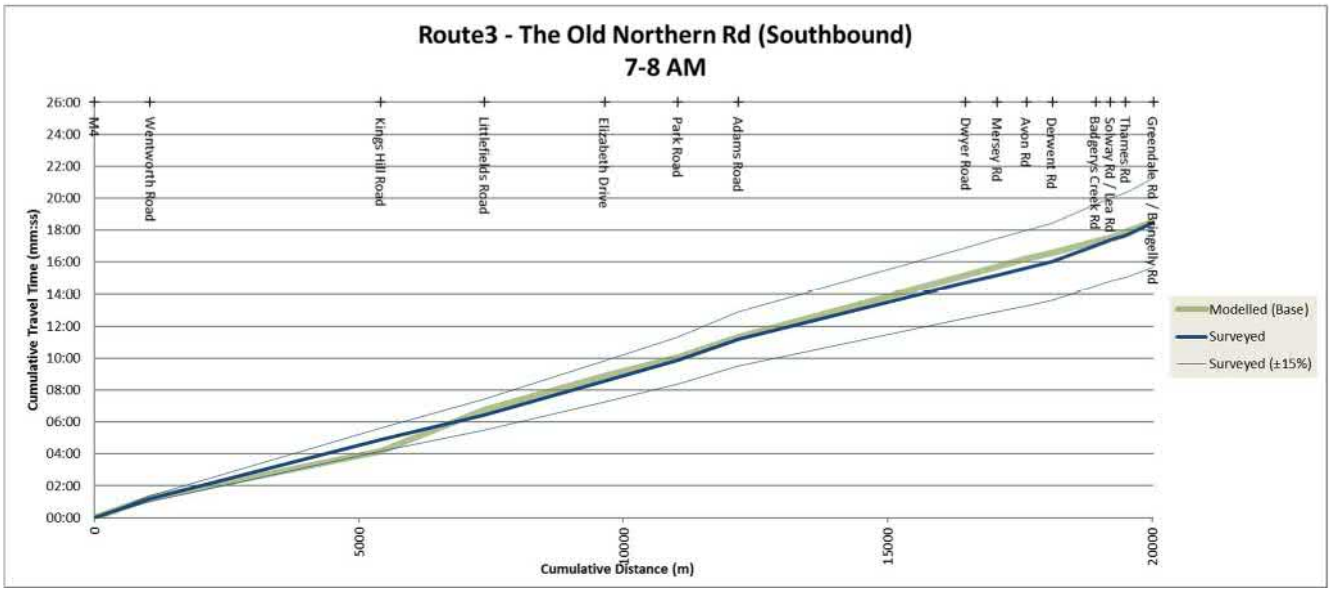

Route3 - The Old Northern Rd (Northbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

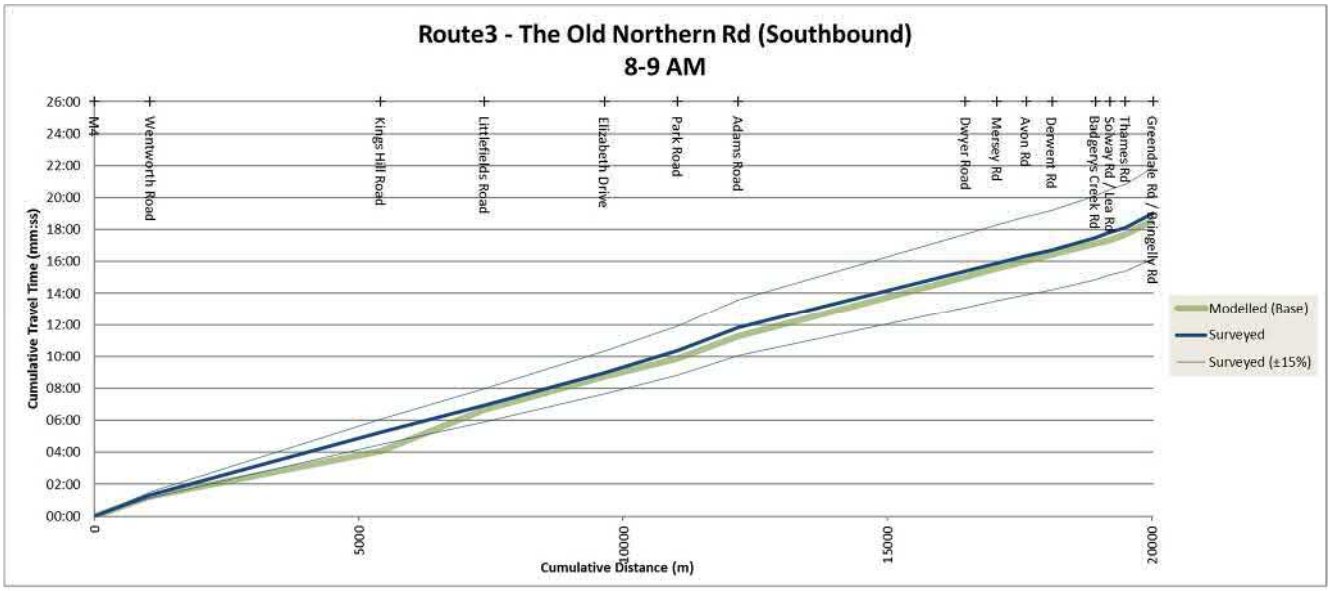

Route3 - The Old Northern Rd (Northbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

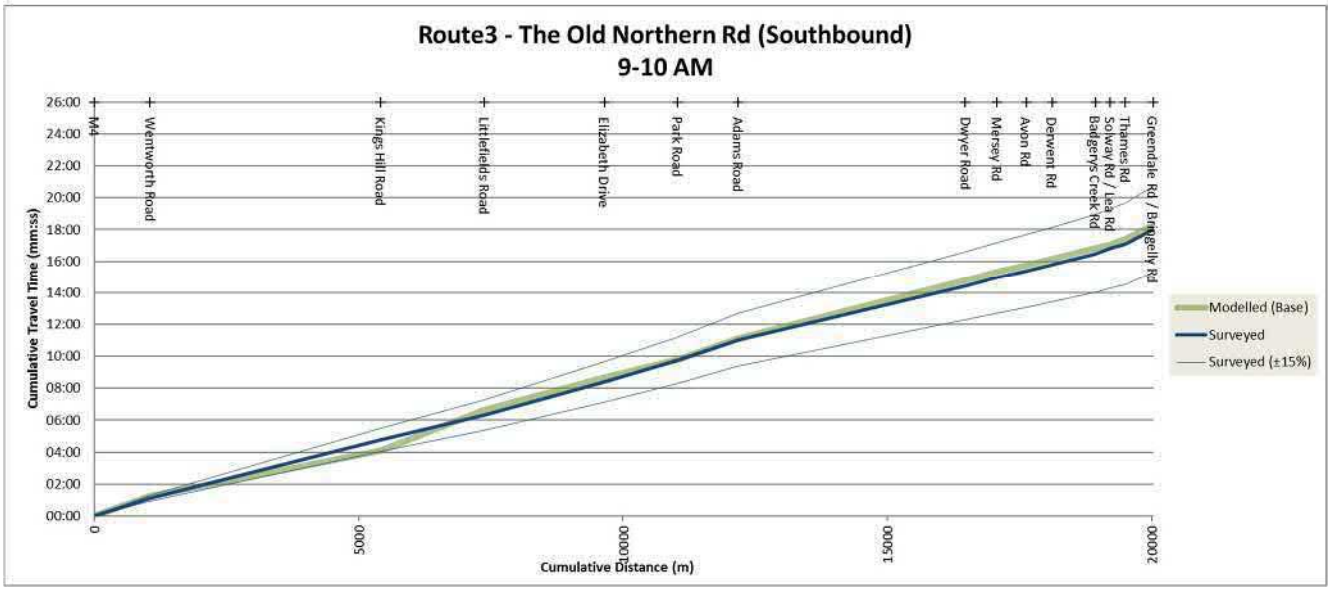

Route3 - The Old Northern Rd (Northbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

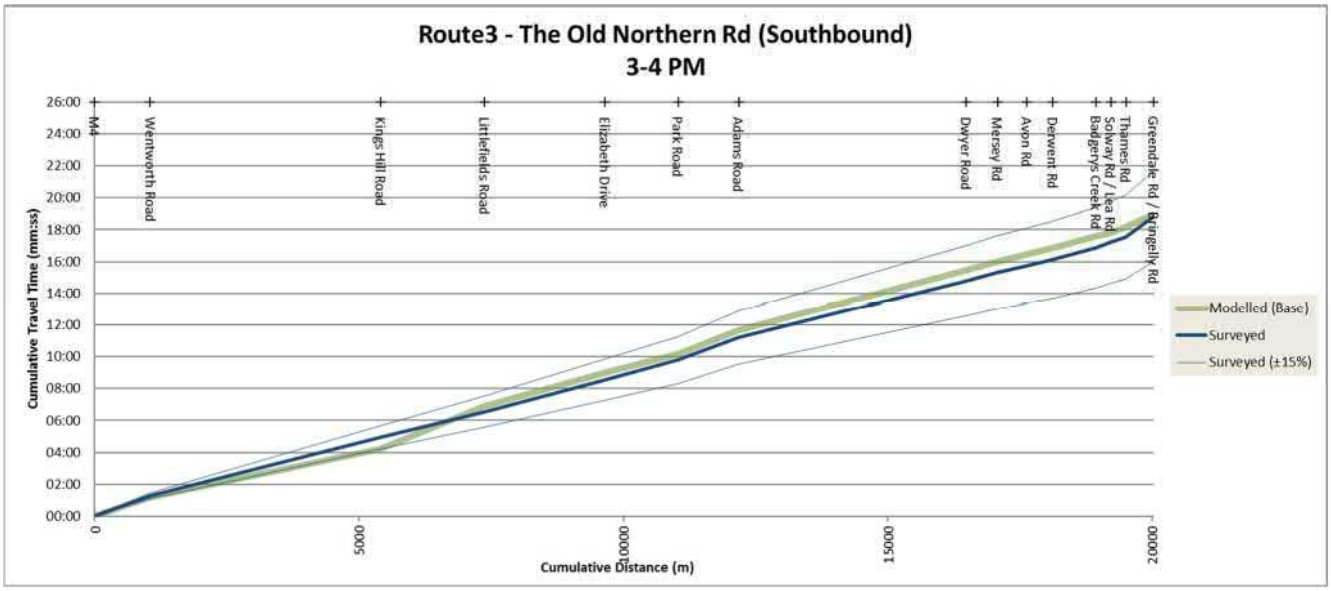

Route3 - The Old Northern Rd (Northbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Greendale Rd / Bringelly Rd
Thames Rd
Solway Rd / Lea Rd
Badgerys Creek Rd
Derwent Rd
Avon Rd
Mersey Rd
Dwyer Road
Adams Road
Park Road
Elizabeth Drive
Littlefield Road
Kings Hill Road
Wentworth Road
M4
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

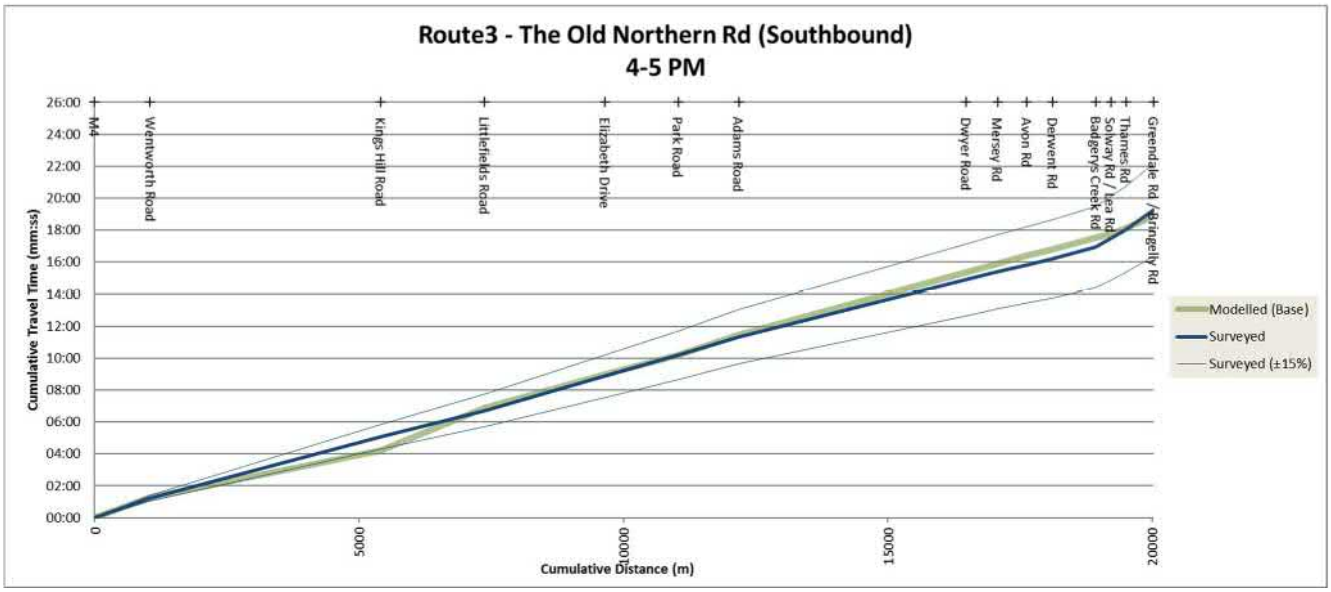

Route3 - The Old Northern Rd (Southbound)
6-7 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

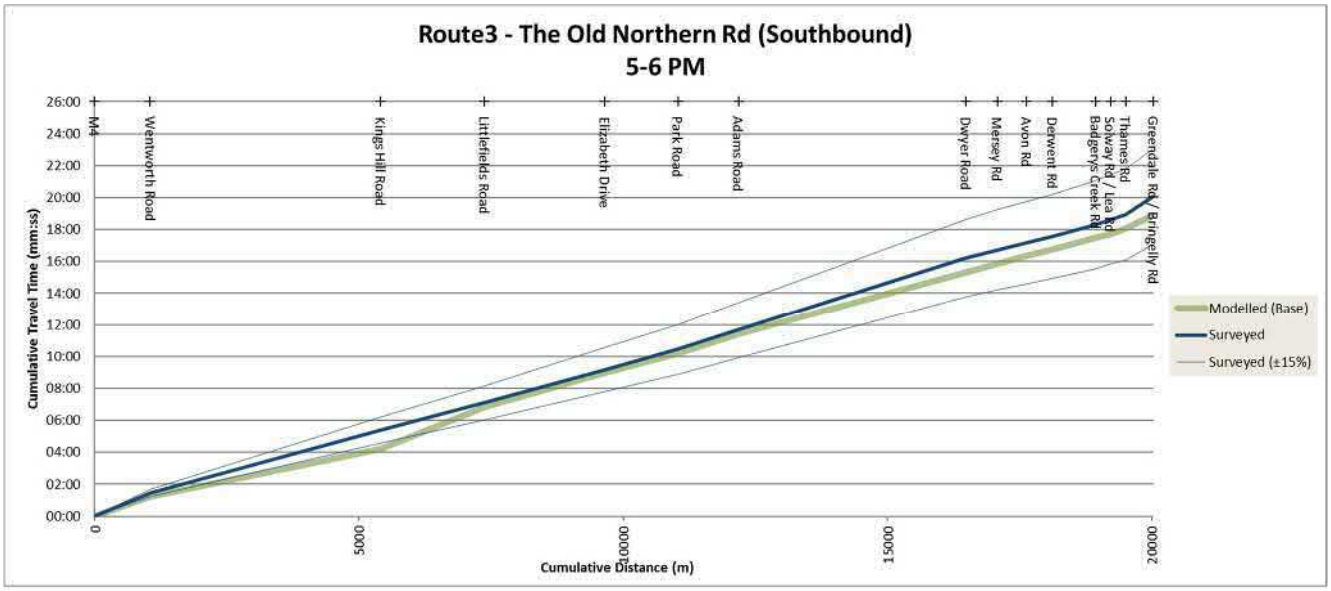

Route3 - The Old Northern Rd (Southbound)
7-8 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

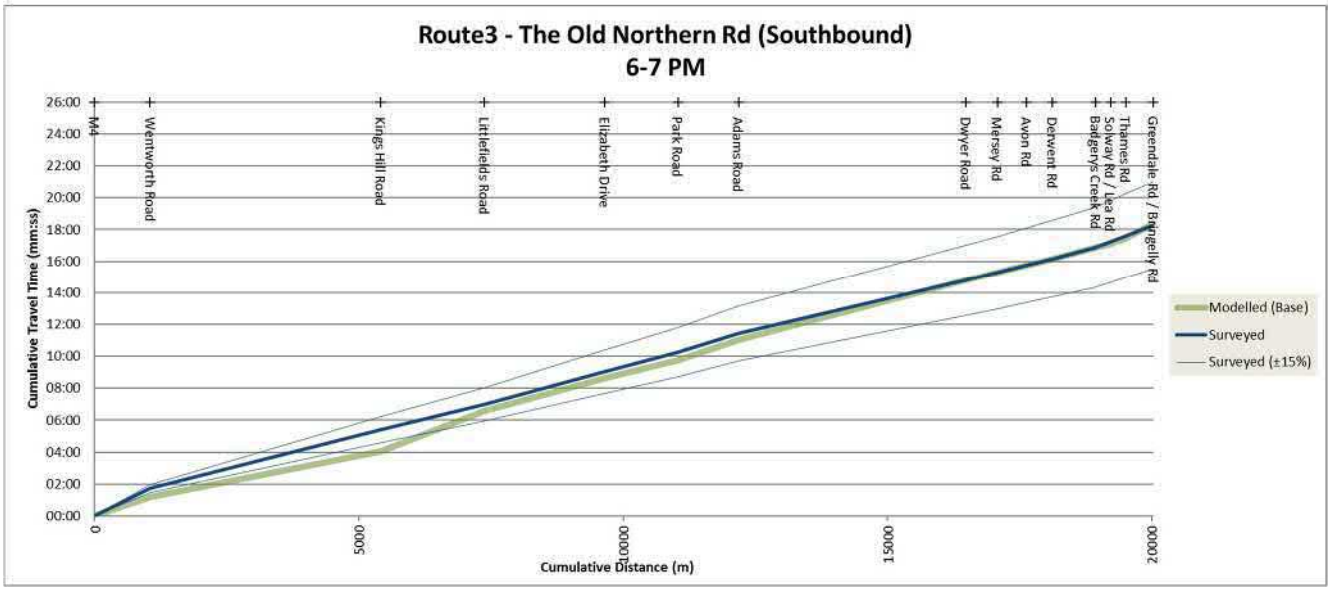

Route3 - The Old Northern Rd (Southbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route3 - The Old Northern Rd (Southbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

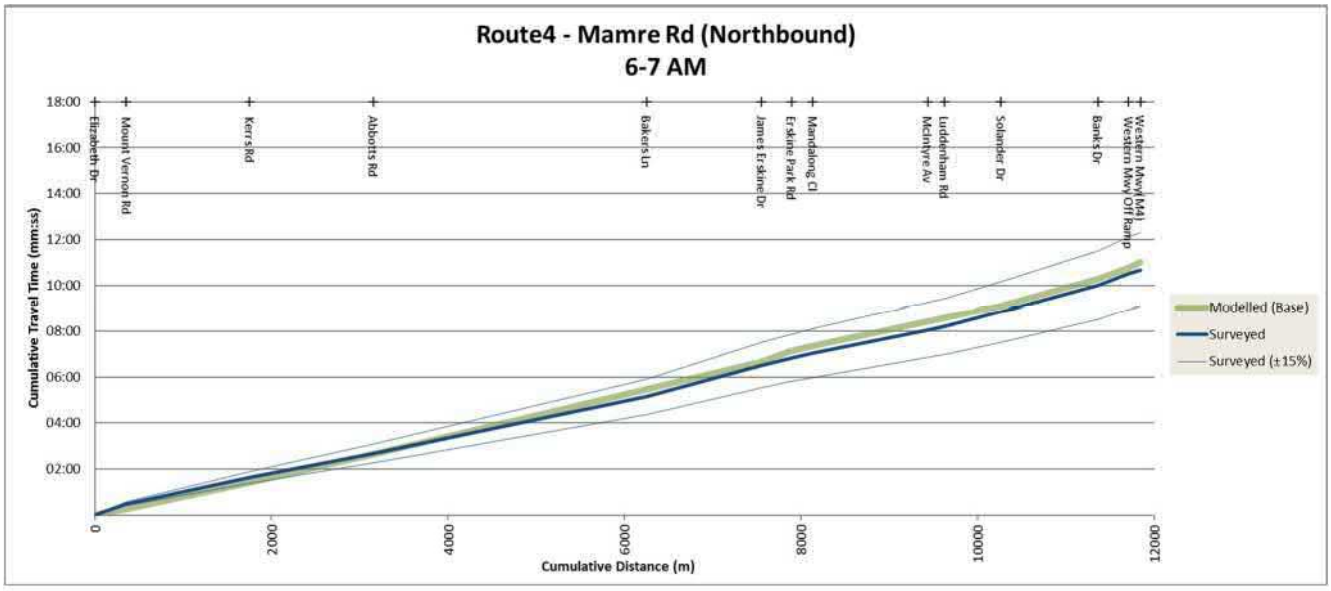

Route3 - The Old Northern Rd (Southbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

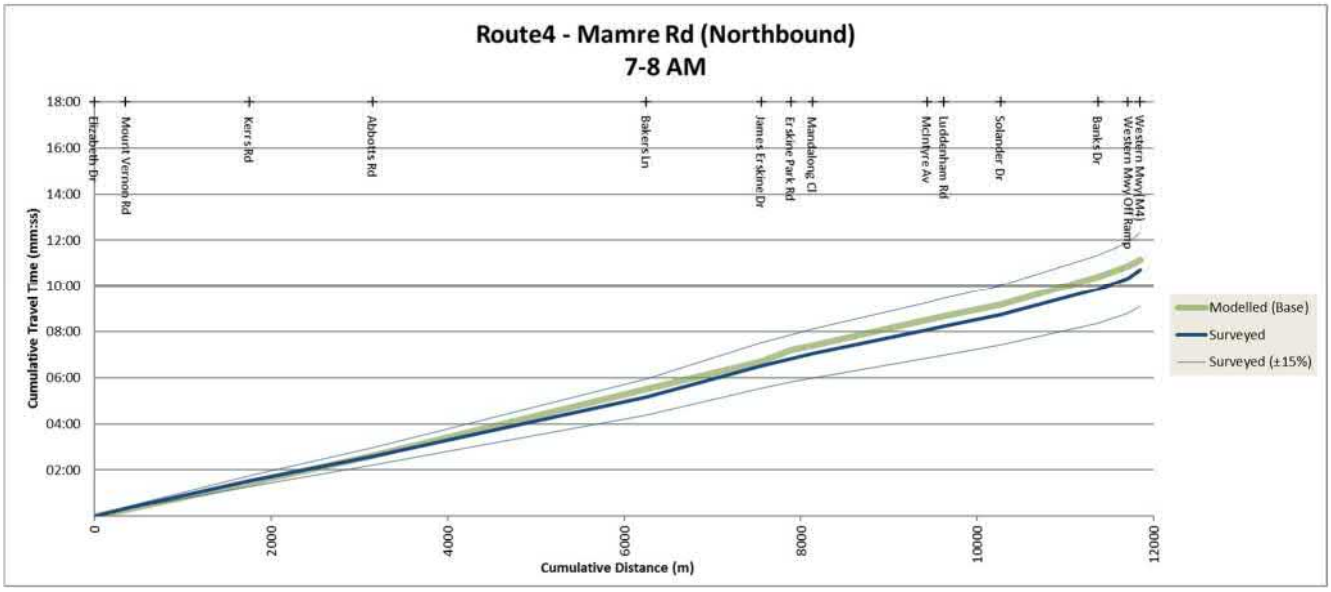

Route3 - The Old Northern Rd (Southbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

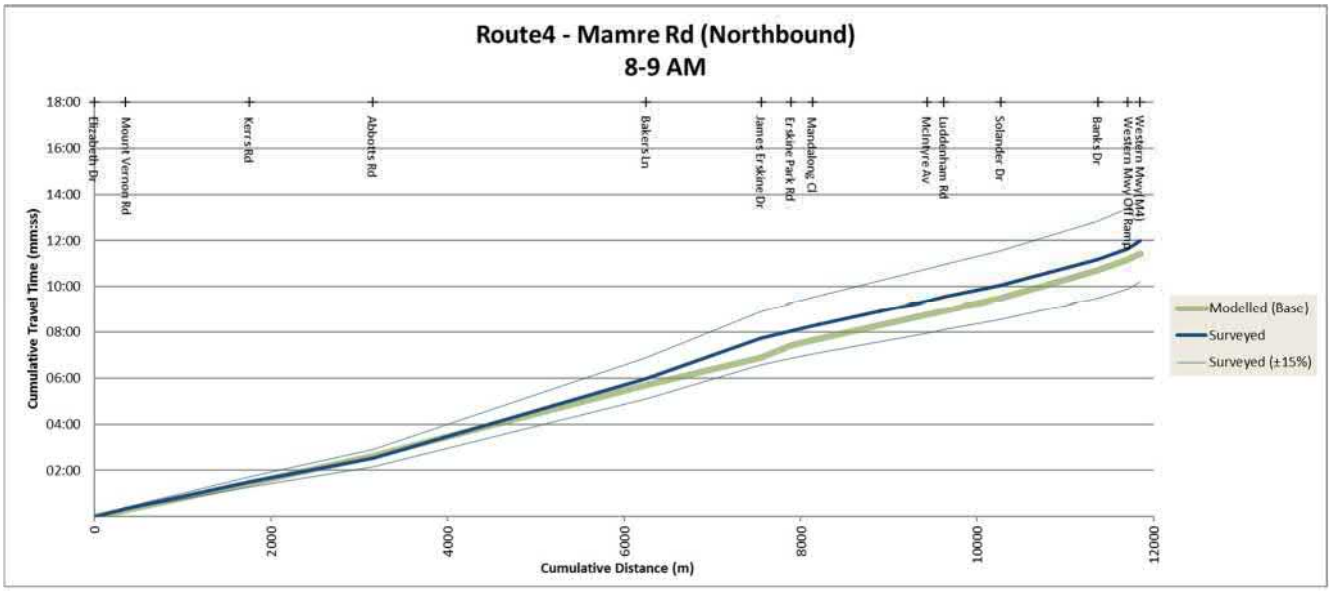

Route3 - The Old Northern Rd (Southbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

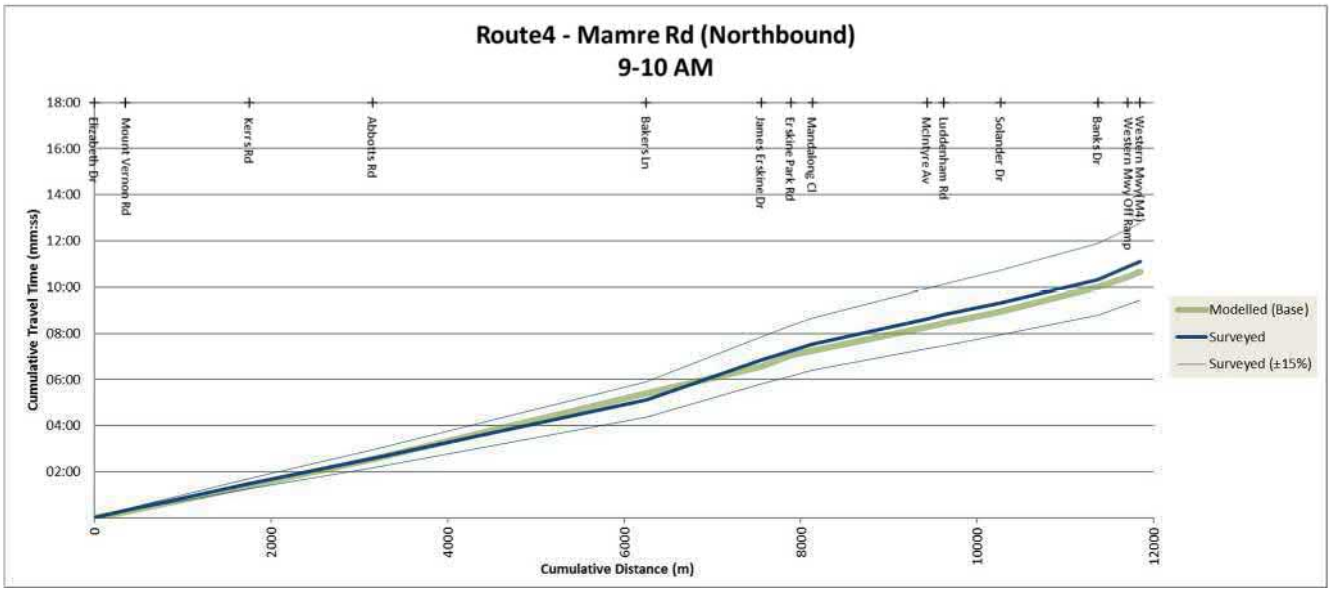

Route3 - The Old Northern Rd (Southbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
00:00
M4
Wentworth Road
Kings Hill Road
Littlefields Road
Elizabeth Drive
Park Road
Adams Road
Dwyer Road
Mersey Rd
Avon Rd
Derwent Rd
Badgerys Creek Rd
Solway Rd / Lea Rd
Thames Rd
Greendale Rd / Bringelly Rd
0
5000
10000
15000
20000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

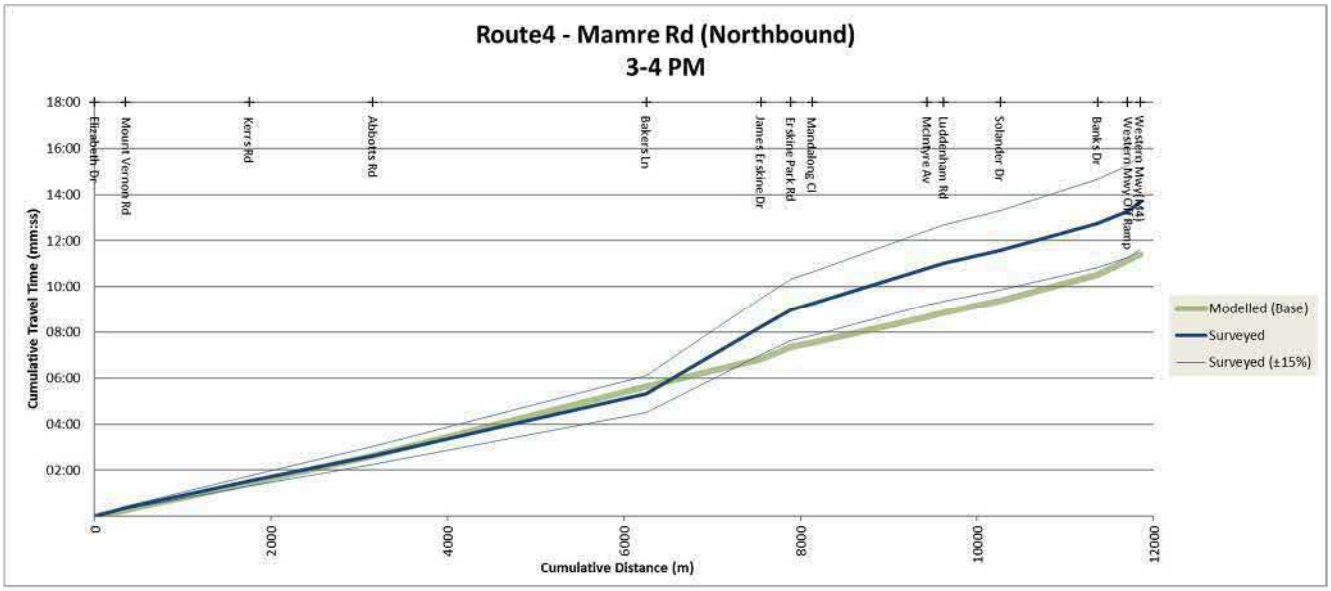
B.4 Route 4 – Mamre Road

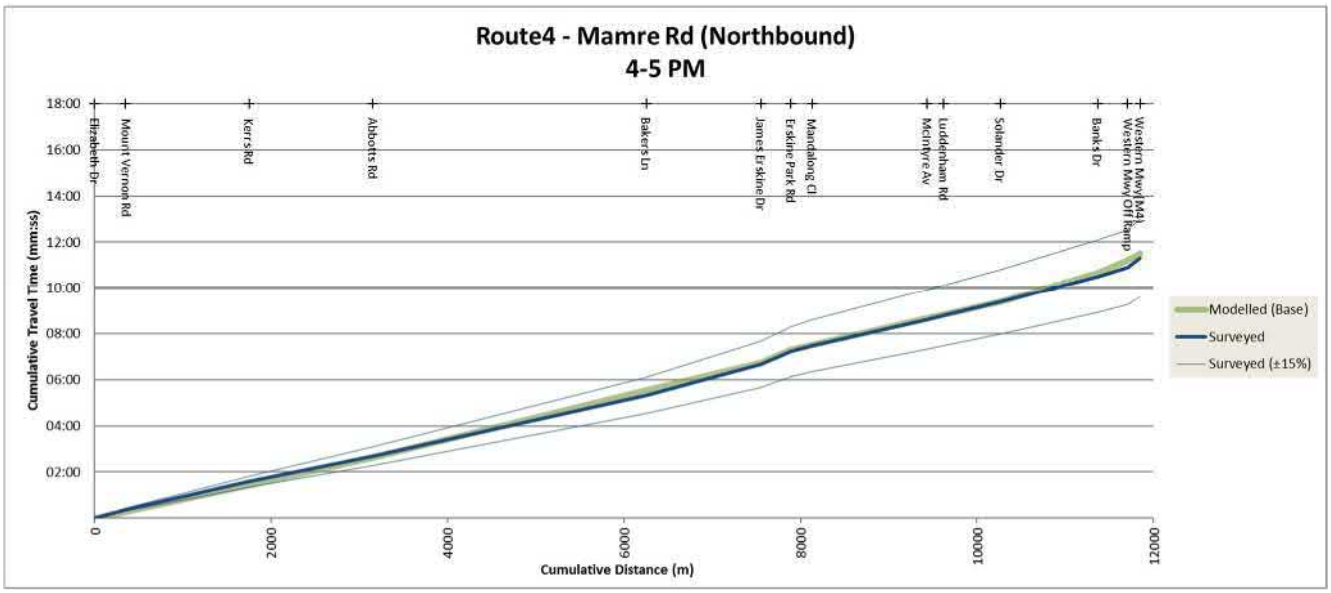


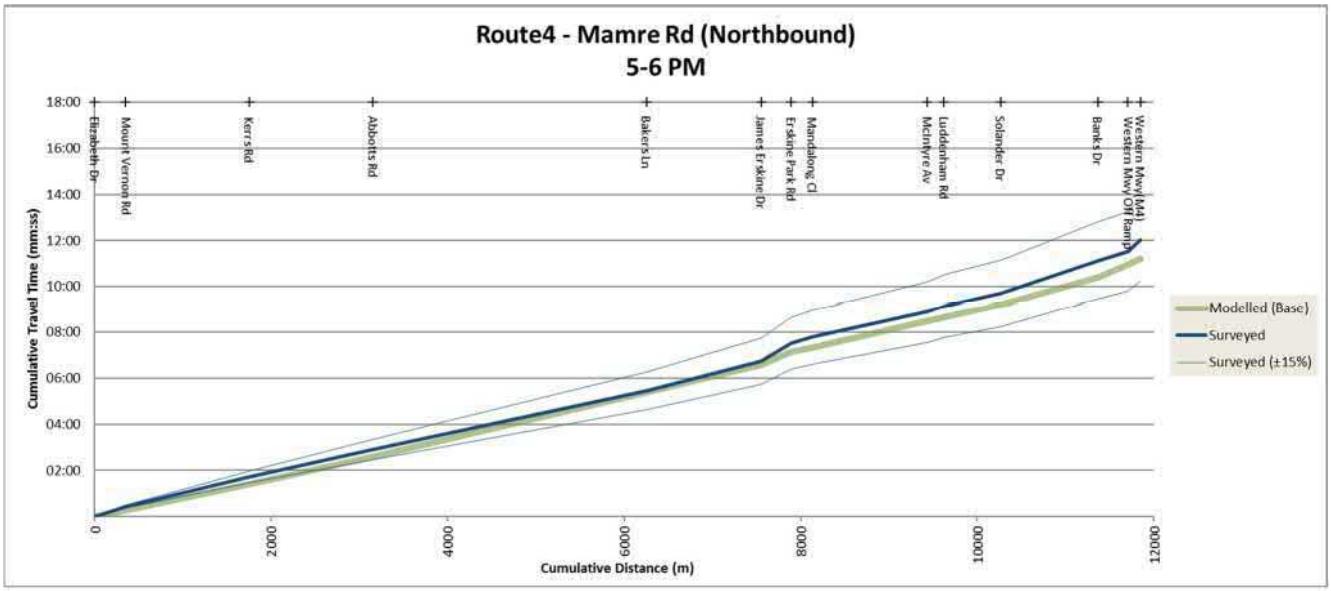


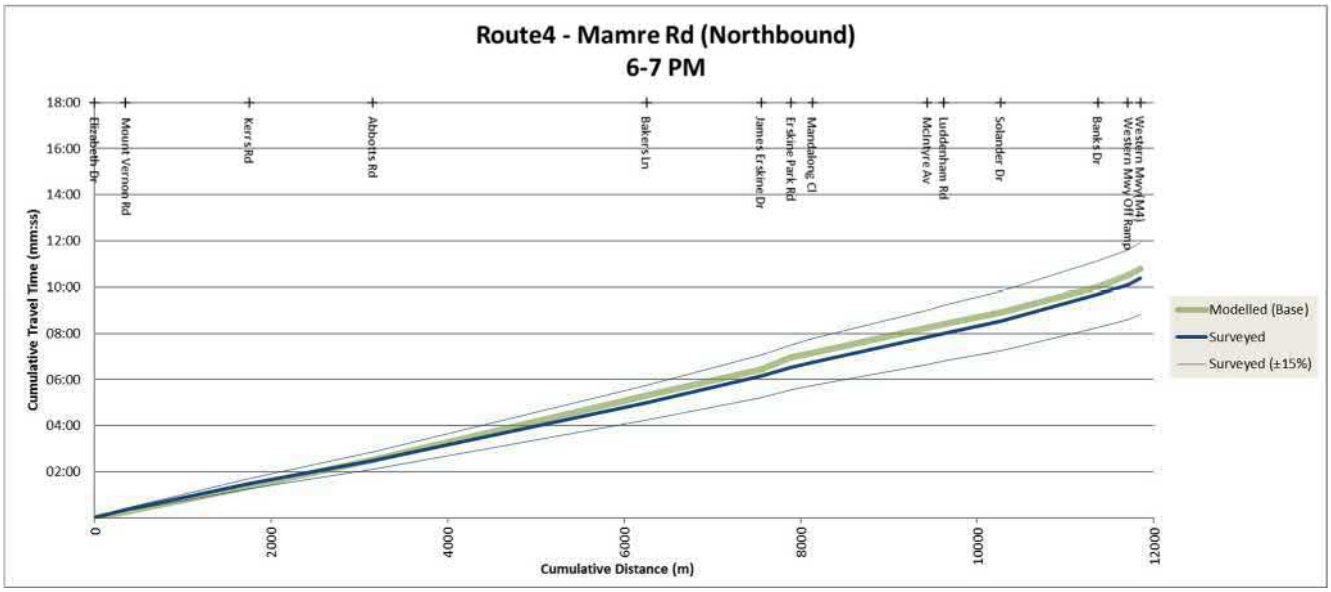

Route4 - Mamre Rd (Northbound)
8-9 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Mandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

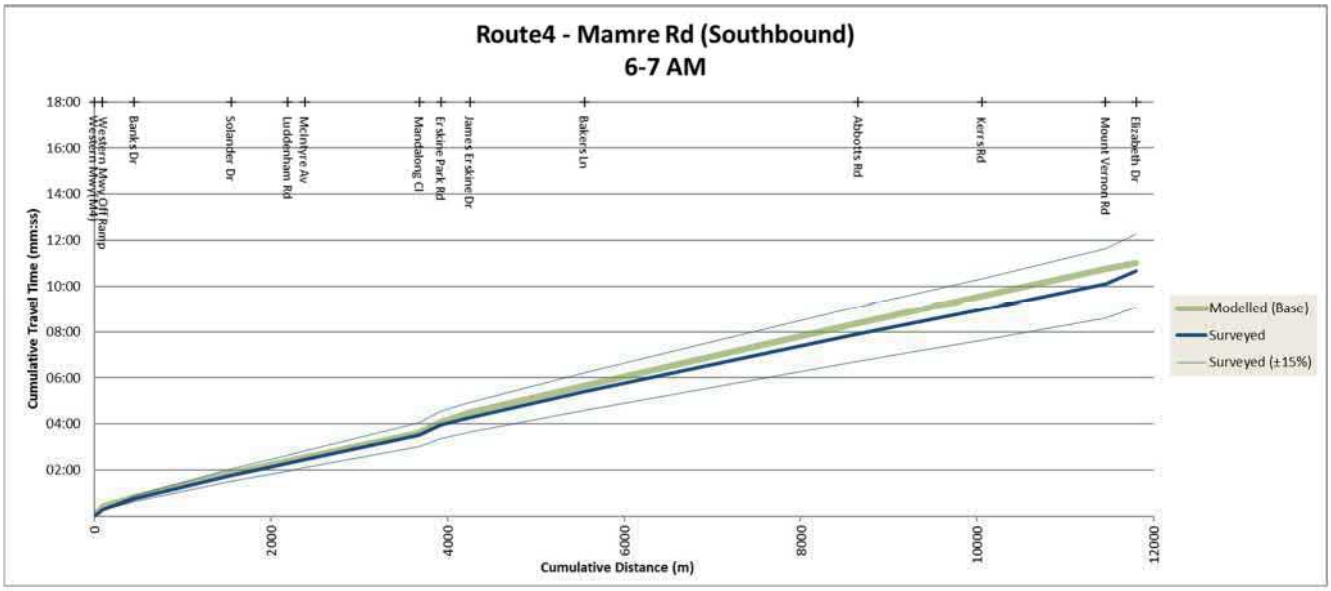

Route4 - Mamre Rd (Northbound)
9-10 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Mandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

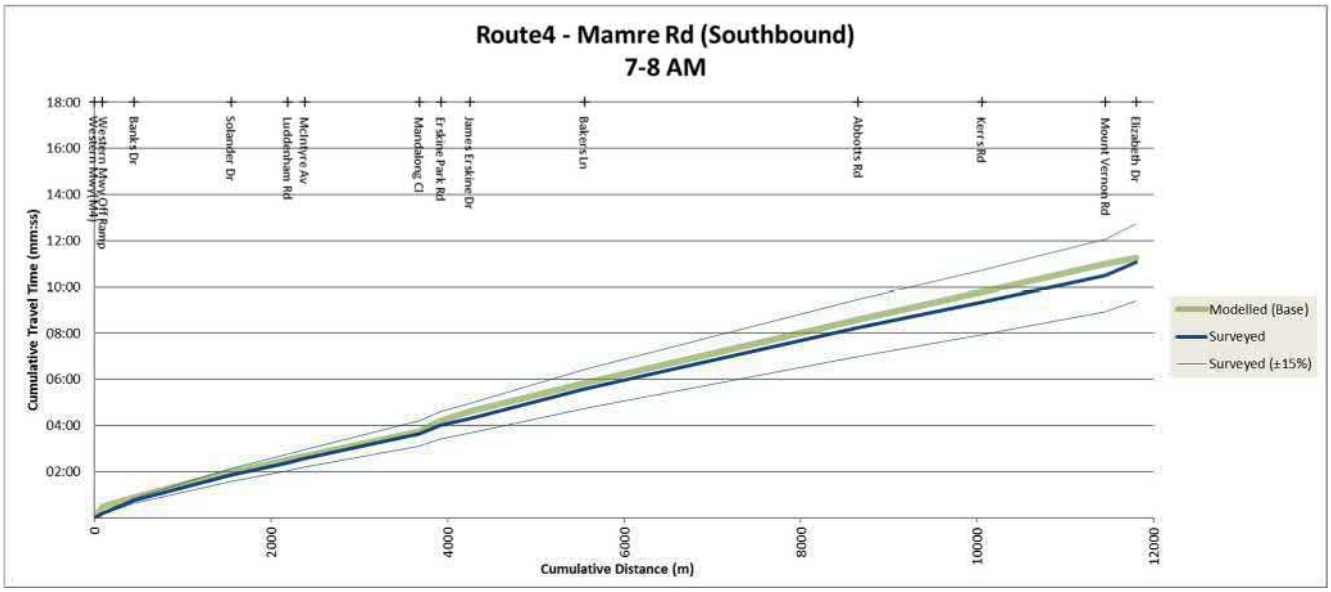

Route4 - Mamre Rd (Northbound)
3-4 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Maandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

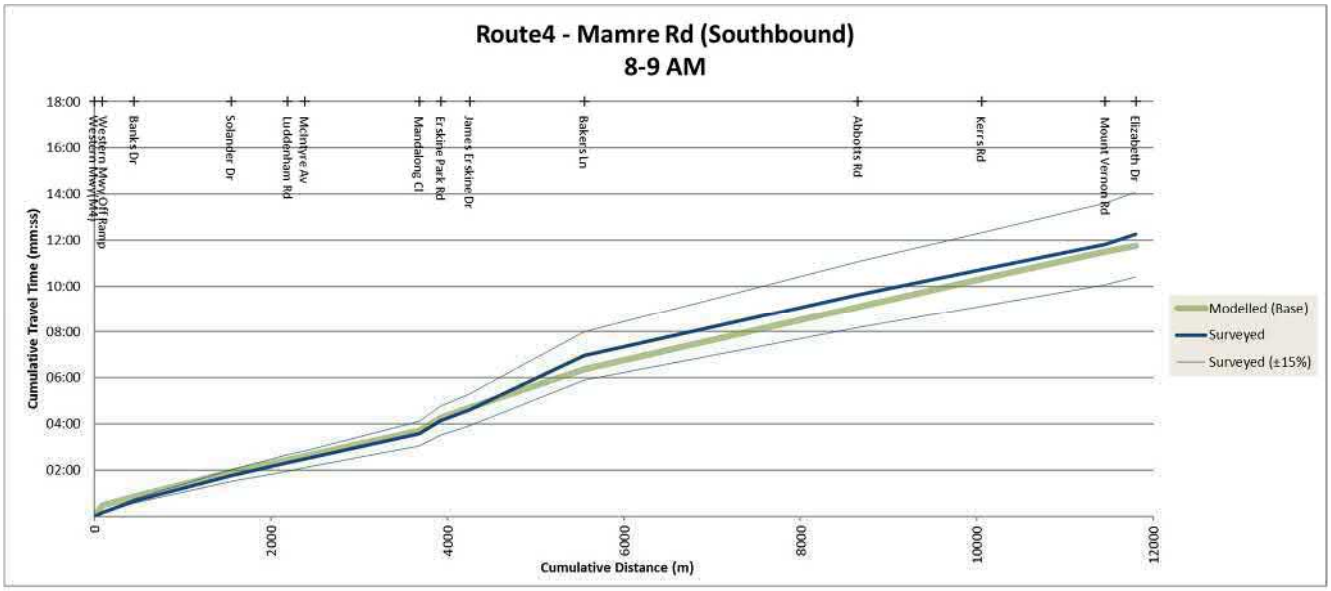

Route4 - Mamre Rd (Northbound)
4-5 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Maandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

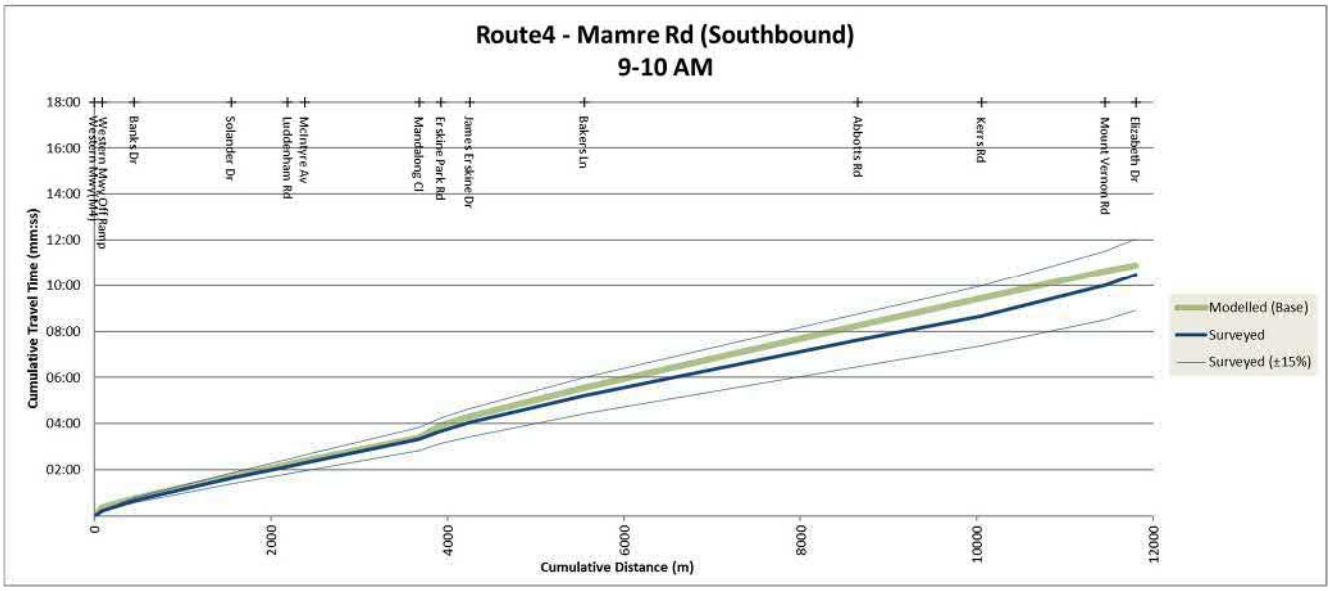

Route4 - Mamre Rd (Northbound)
5-6 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Mandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

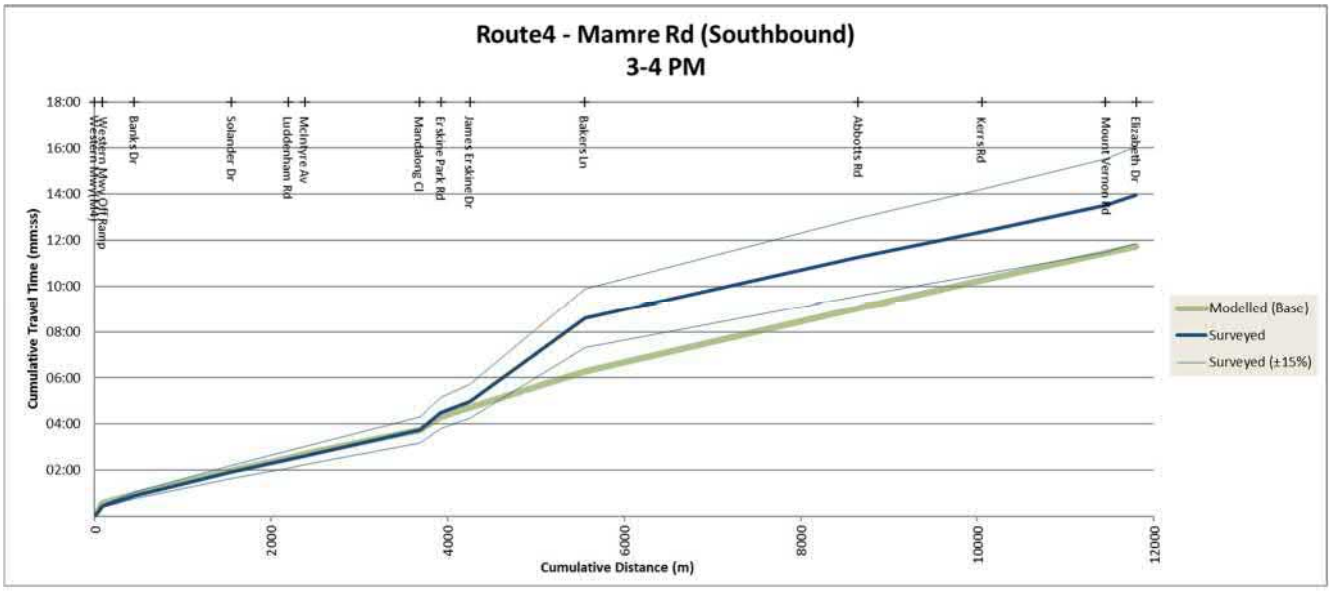

Route4 - Mamre Rd (Northbound)
6-7 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Elizabeth Dr
Mount Vernon Rd
Kerrs Rd
Abbotts Rd
Bakers Ln
James Erskine Dr
Erskine Park Rd
Mandalong Cl
McIntyre Av
Luddenham Rd
Solander Dr
Banks Dr
Western Mwy (M4)
Western Mwy Off Ramp
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

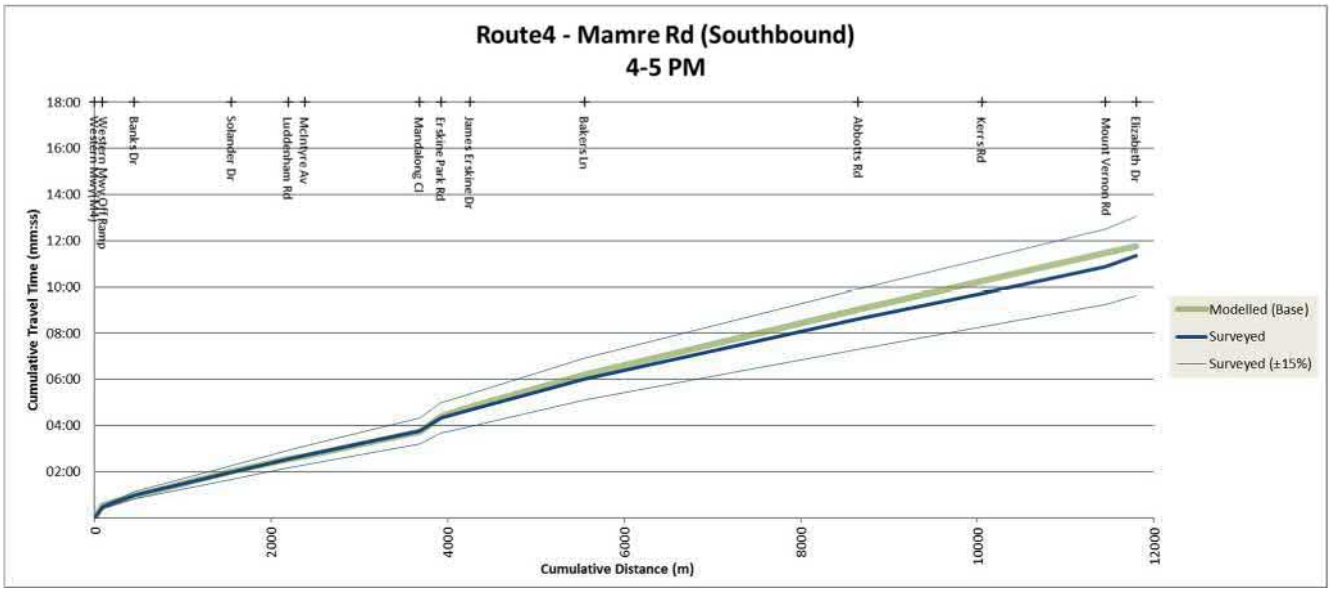

Route4 - Mamre Rd (Southbound)
6-7 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (NM)
Western Mwy Off Ramp
Bank St Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

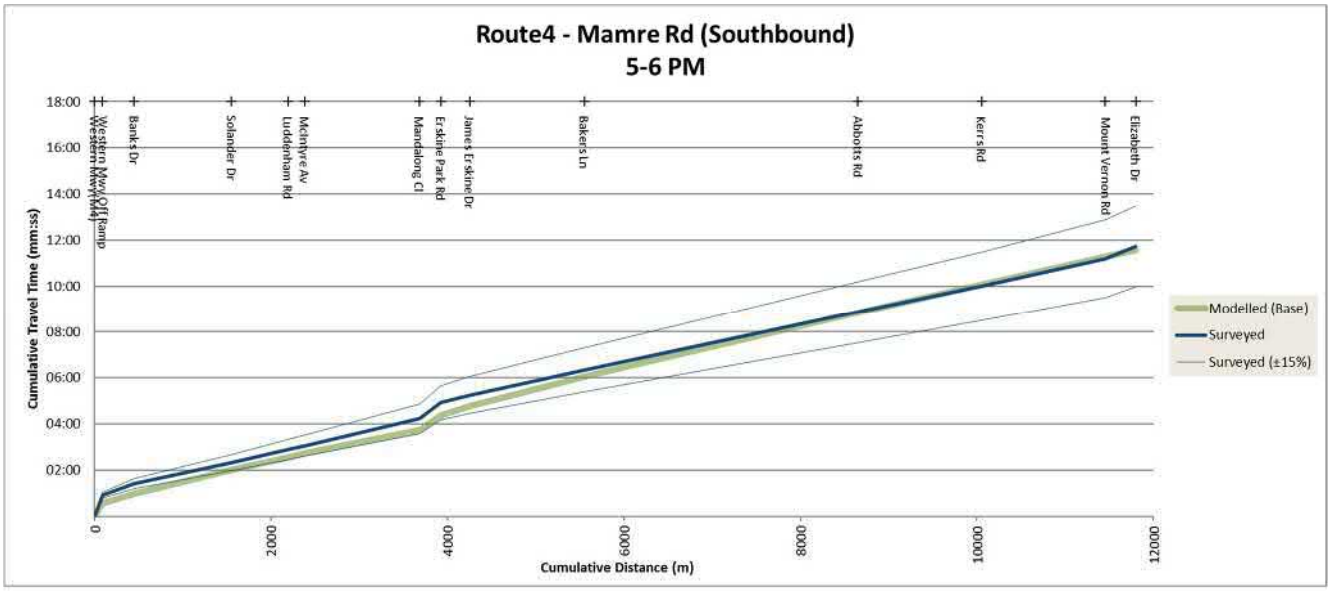

Route4 - Mamre Rd (Southbound)
7-8 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (NM)
Western Mwy Off Ramp
Bank St Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

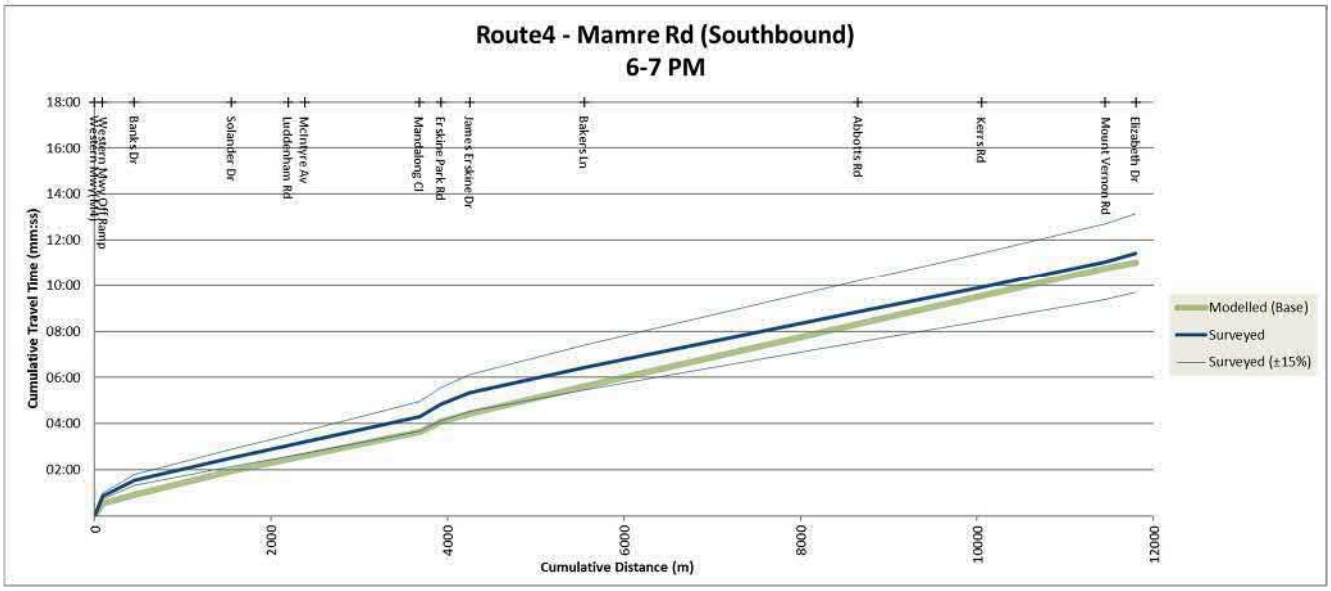

Route4 - Mamre Rd (Southbound)
8-9 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy Off Ramp
Western Mwy (NH)
Banks Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route4 - Mamre Rd (Southbound)
9-10 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy Off Ramp
Western Mwy (NH)
Banks Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

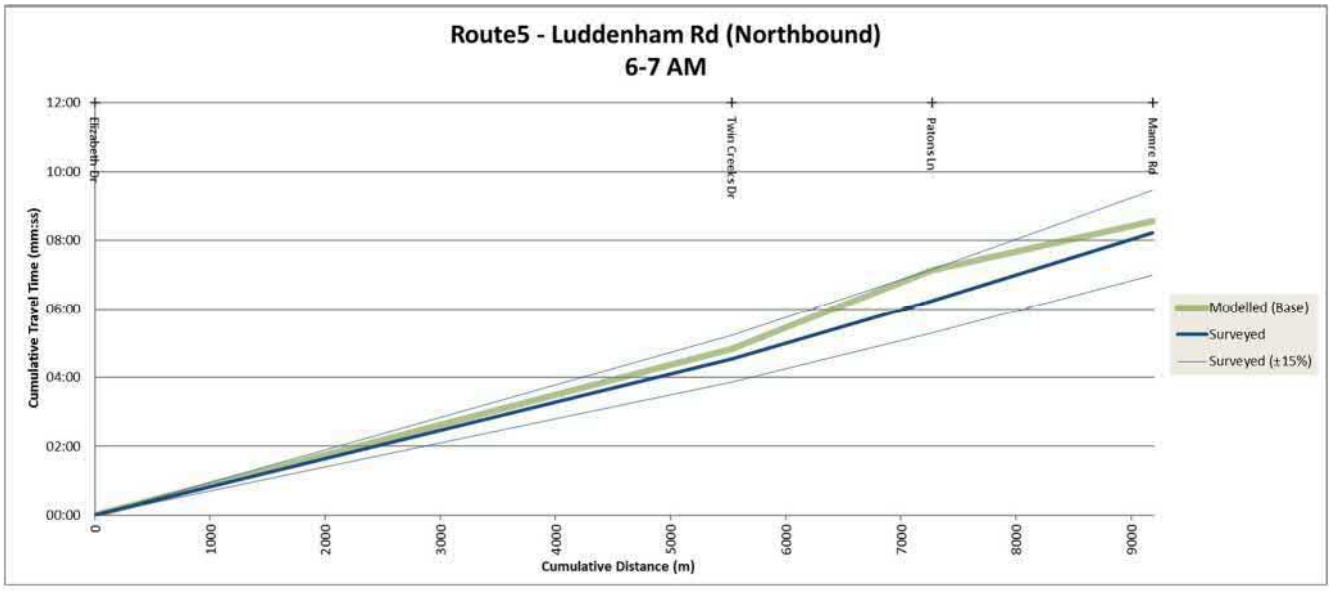

Route4 - Mamre Rd (Southbound)
3-4 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4) Off Ramp
Bank St Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

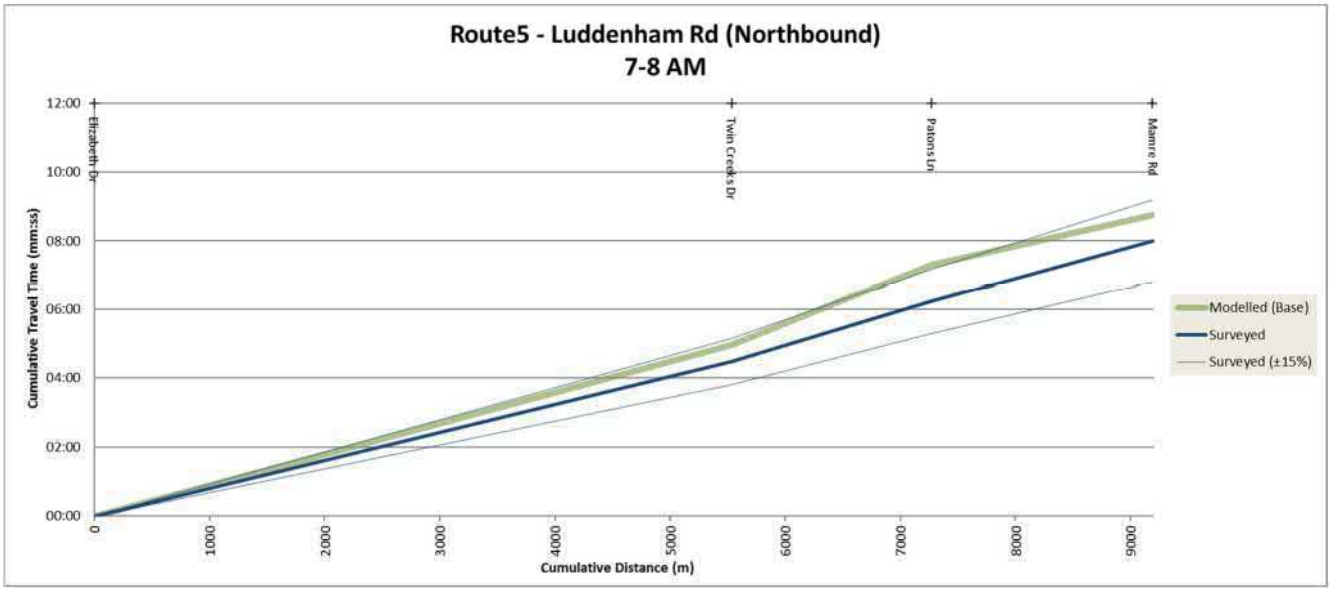

Route4 - Mamre Rd (Southbound)
4-5 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy (M4) Off Ramp
Bank St Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

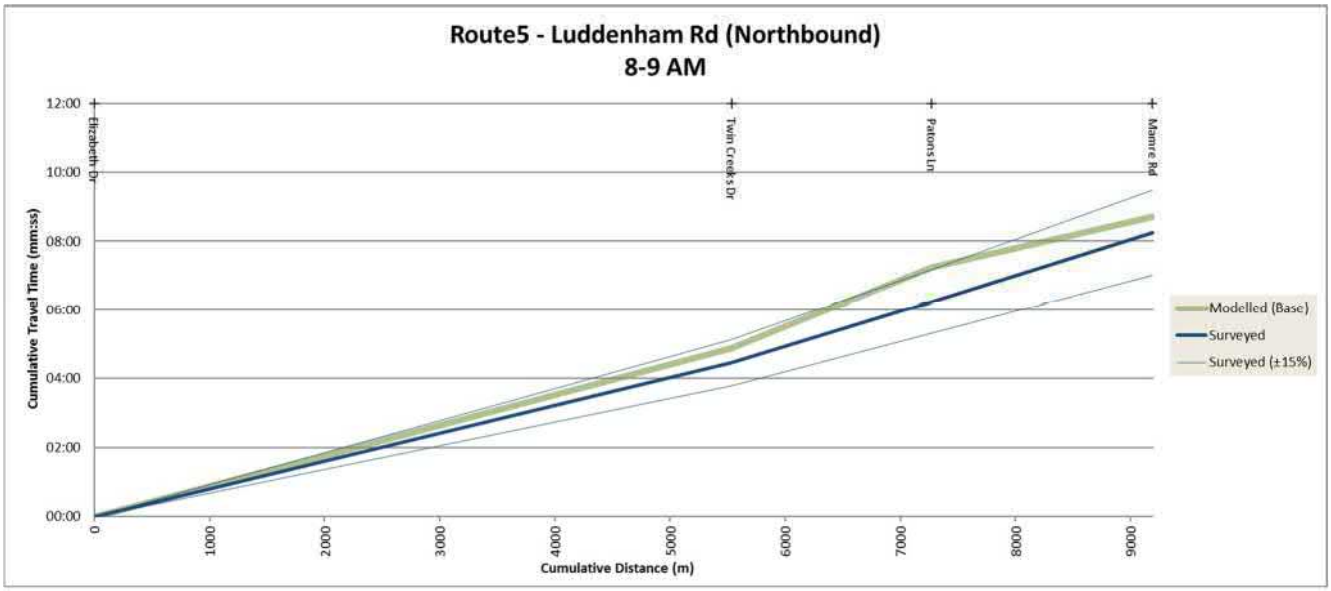

Route4 - Mamre Rd (Southbound)
5-6 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy Off Ramp
Western Mwy On Ramp
Banks Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

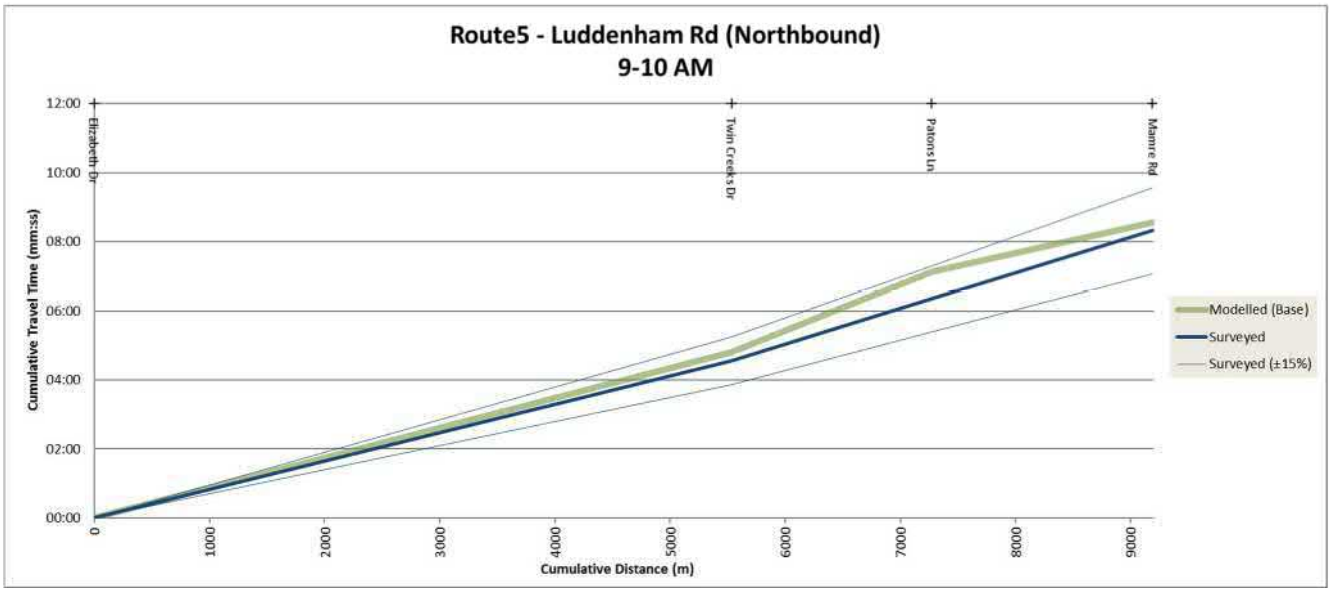

Route4 - Mamre Rd (Southbound)
6-7 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Western Mwy Off Ramp
Western Mwy On Ramp
Banks Dr
Solander Dr
McIntyre Av
Luddenham Rd
Mandalong Cl
Erskine Park Rd
James Erskine Dr
Bakers Ln
Abbotts Rd
Kerrs Rd
Mount Vernon Rd
Elizabeth Dr
0
2000
4000
6000
8000
10000
12000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

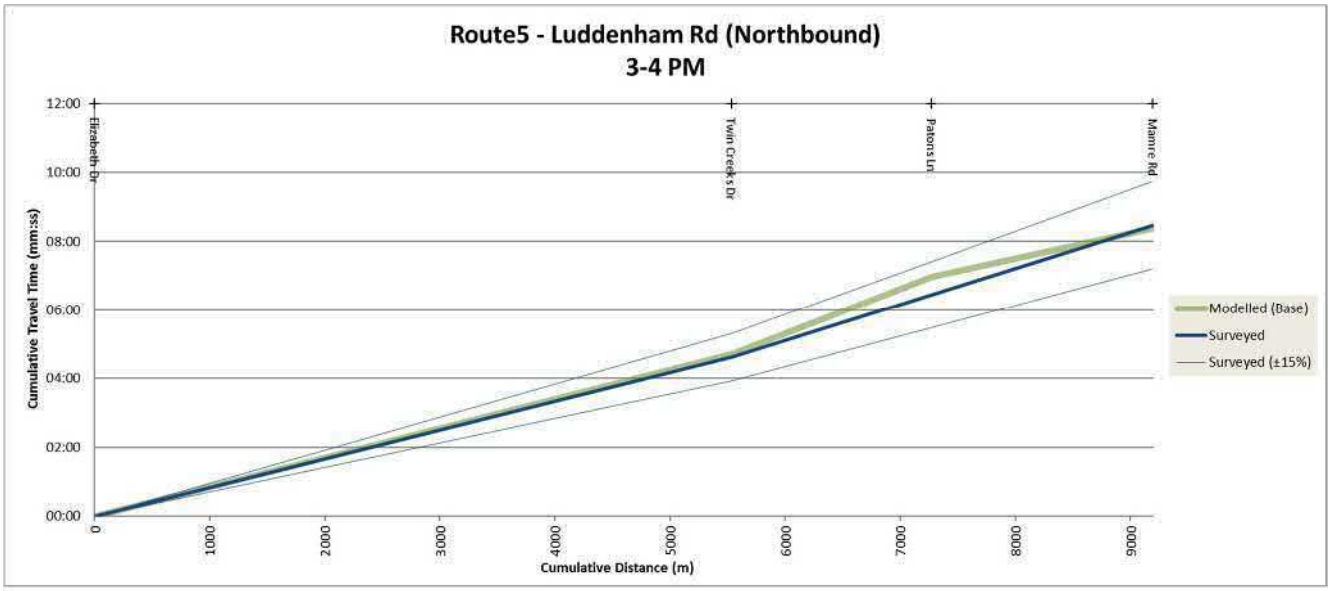
B.5 Route 5 – Luddenham Road

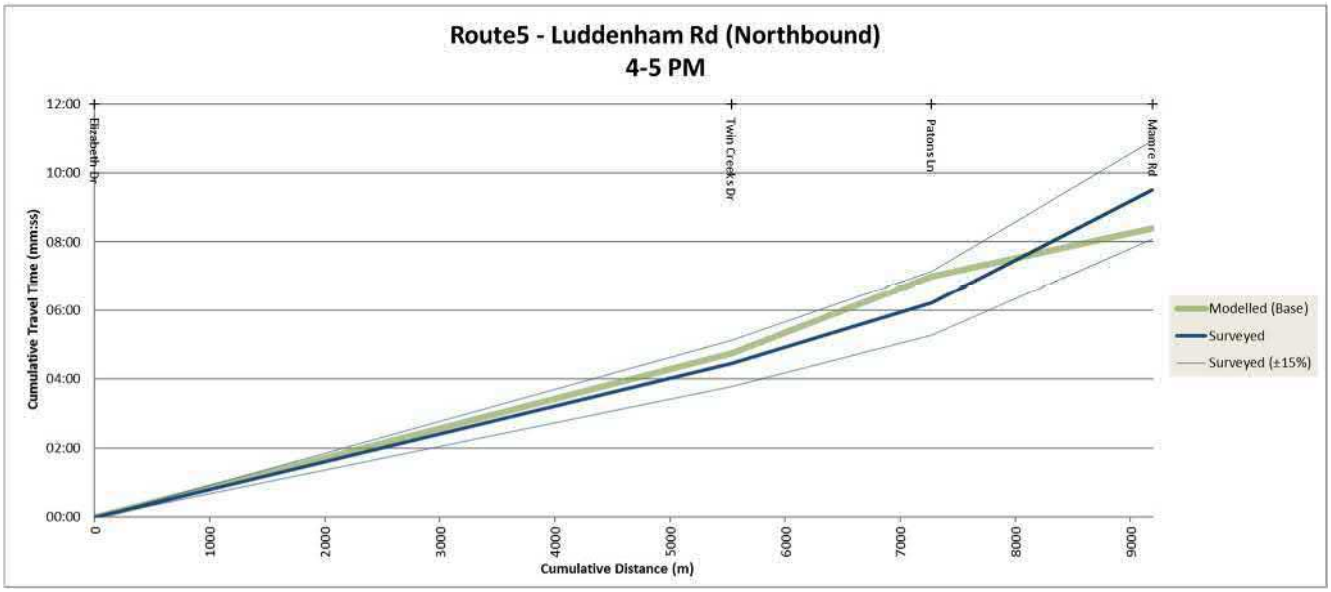


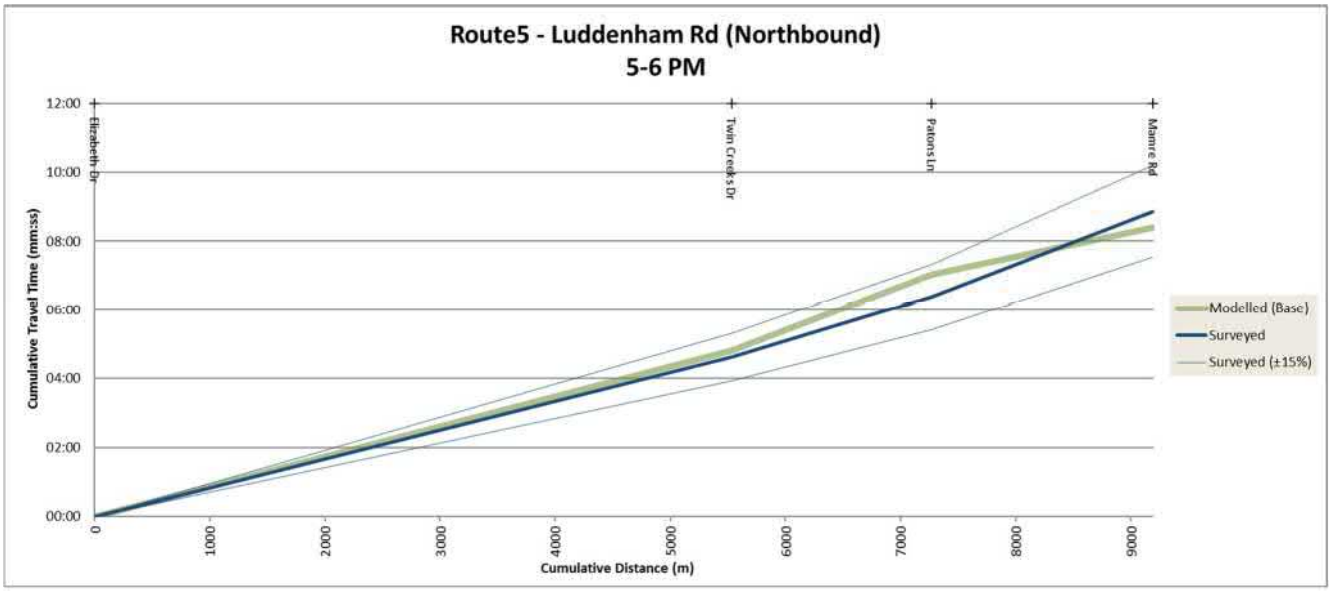


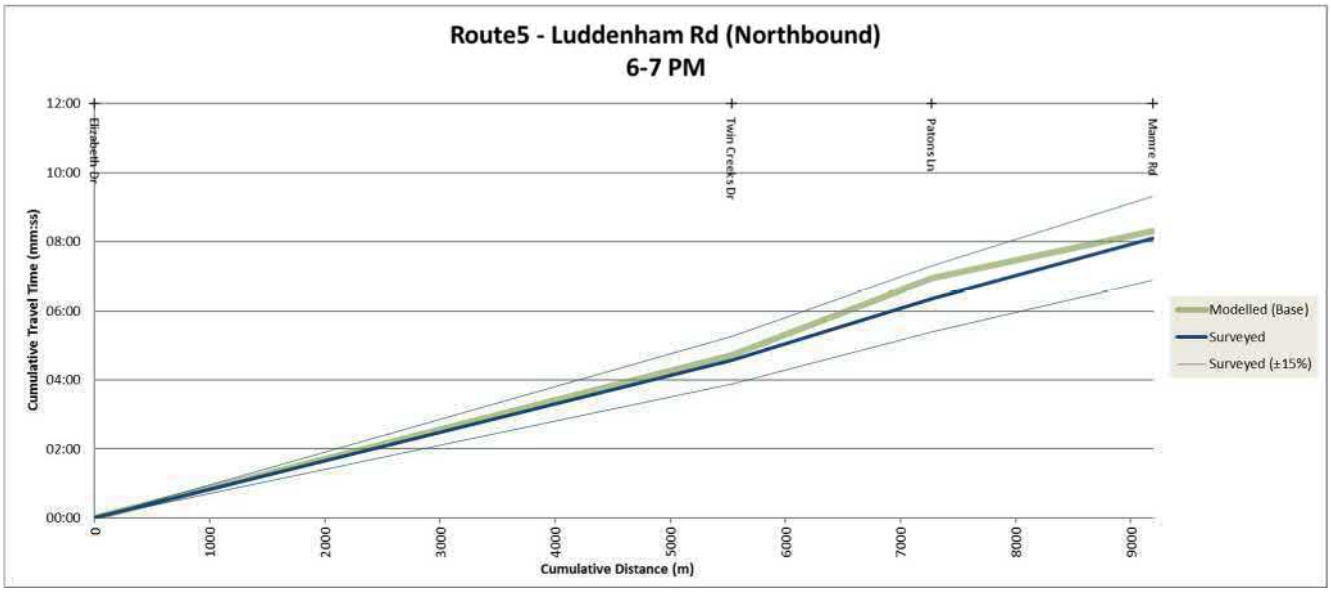

Route5 - Luddenham Rd (Northbound)
8-9 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Manre Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

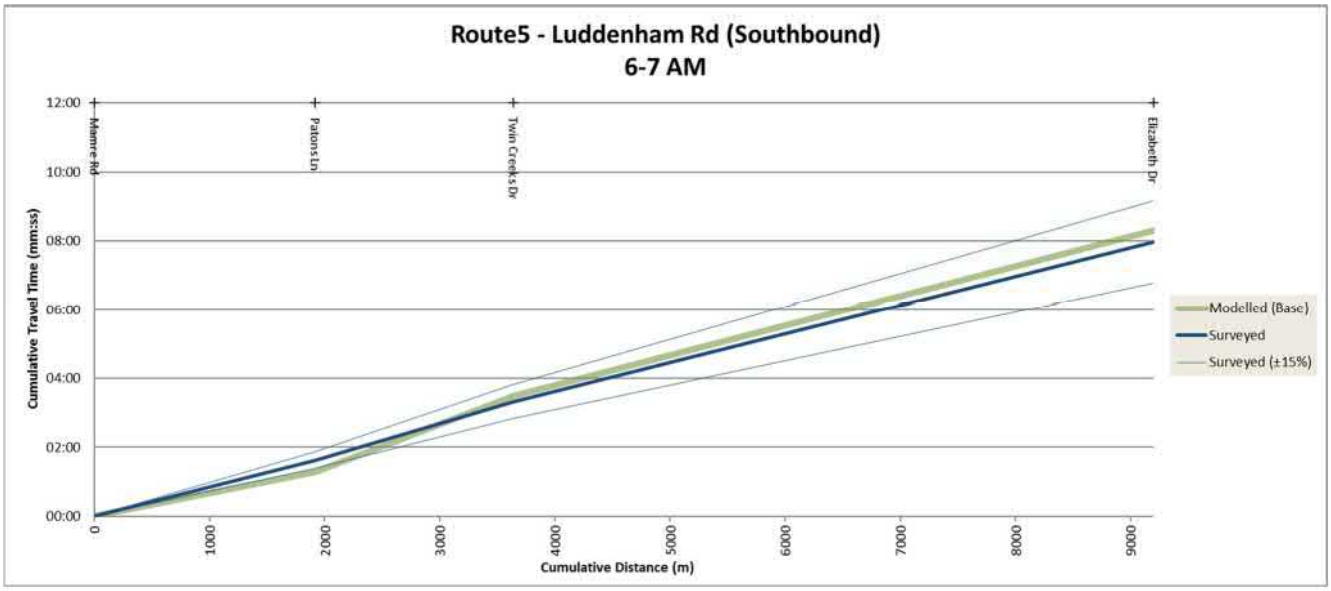

Route5 - Luddenham Rd (Northbound)
9-10 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Manre Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

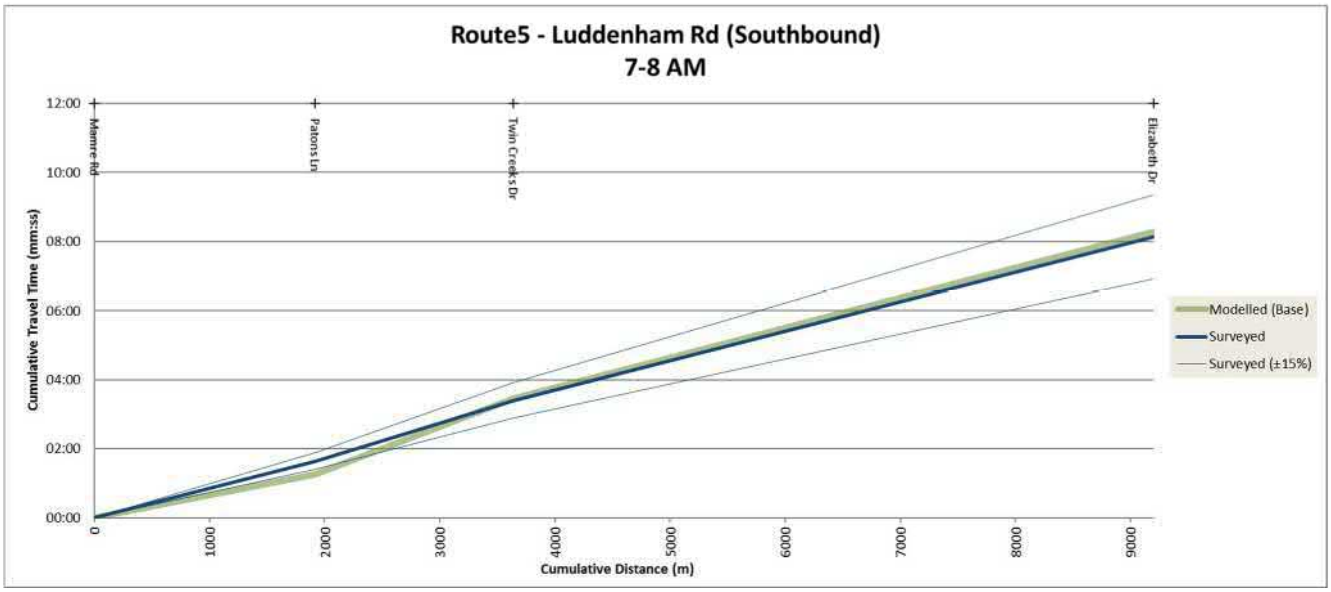

Route5 - Luddenham Rd (Northbound)
3-4 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Manore Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

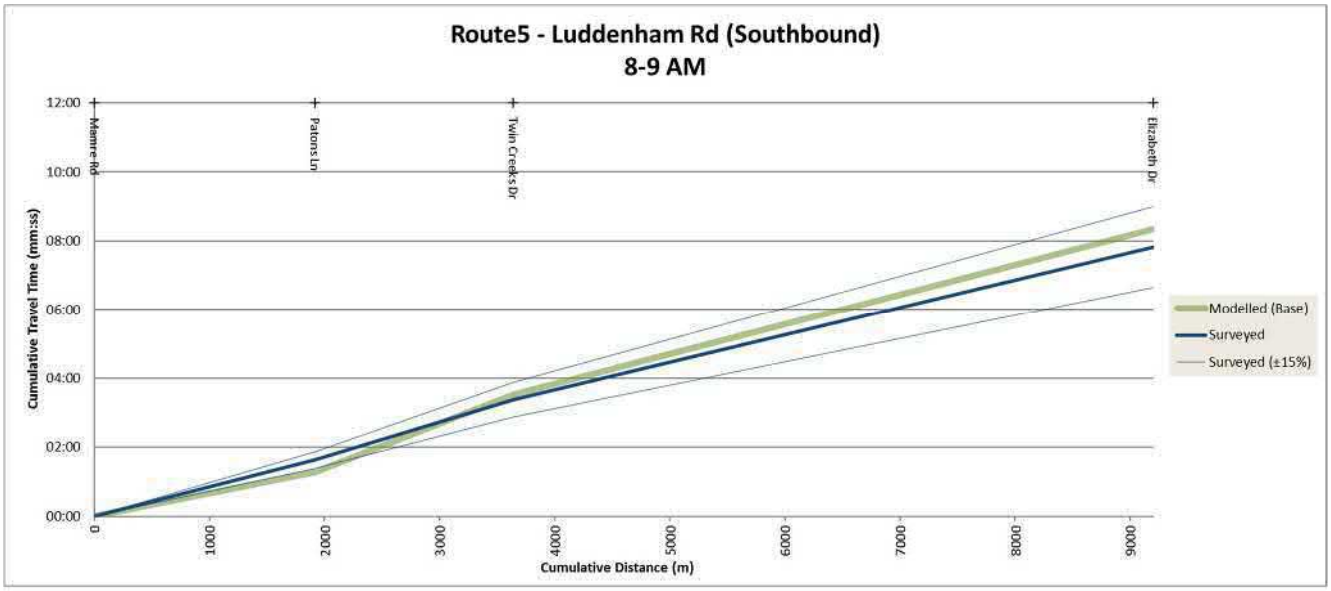

Route5 - Luddenham Rd (Northbound)
4-5 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Manore Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

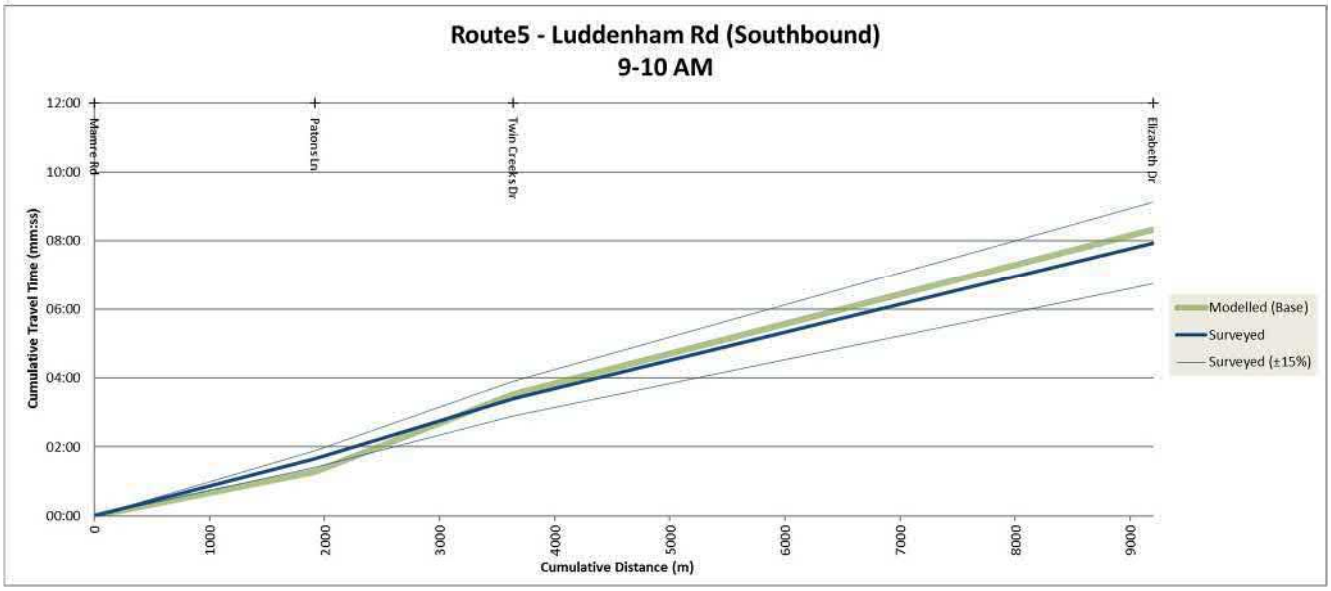

Route5 - Luddenham Rd (Northbound)
5-6 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Mamre Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

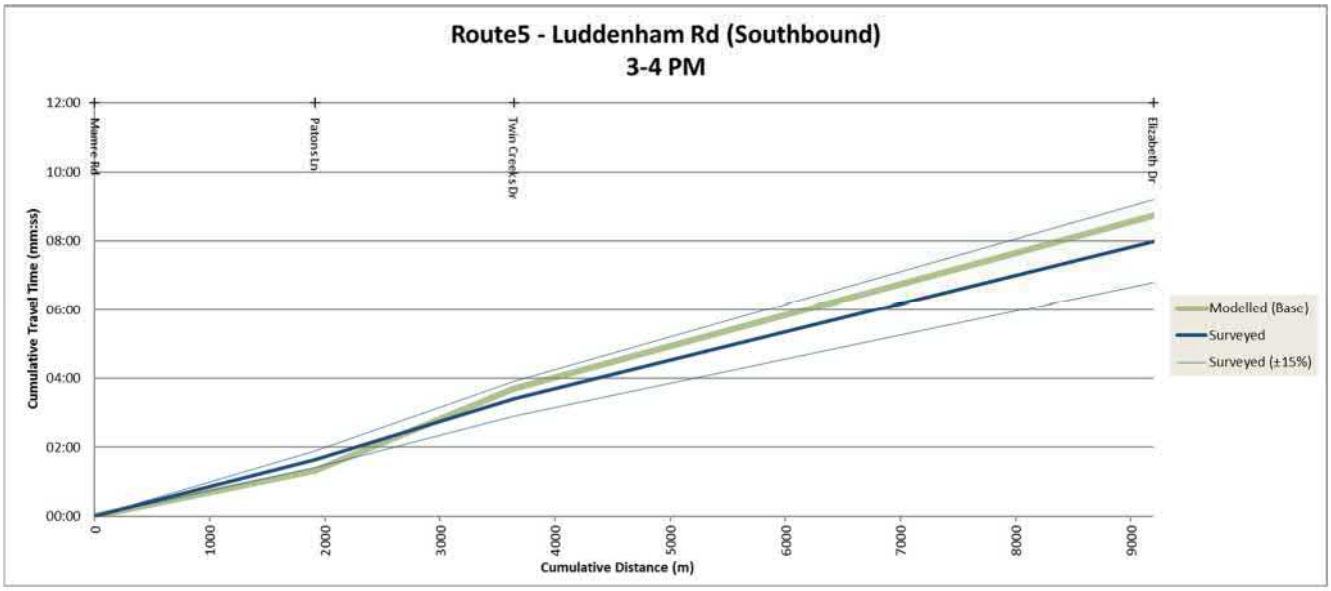

Route5 - Luddenham Rd (Northbound)
6-7 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Elizabeth Dr
Twin Creeks Dr
Patons Ln
Mamre Rd
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

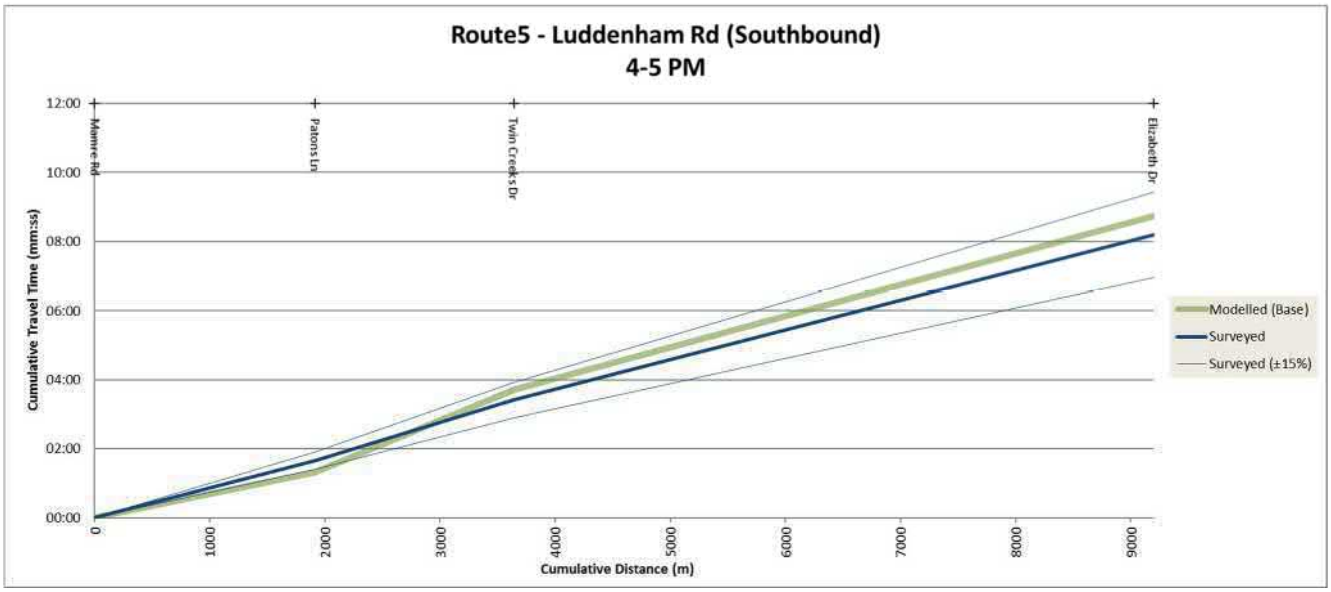

Route5 - Luddenham Rd (Southbound)
6-7 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

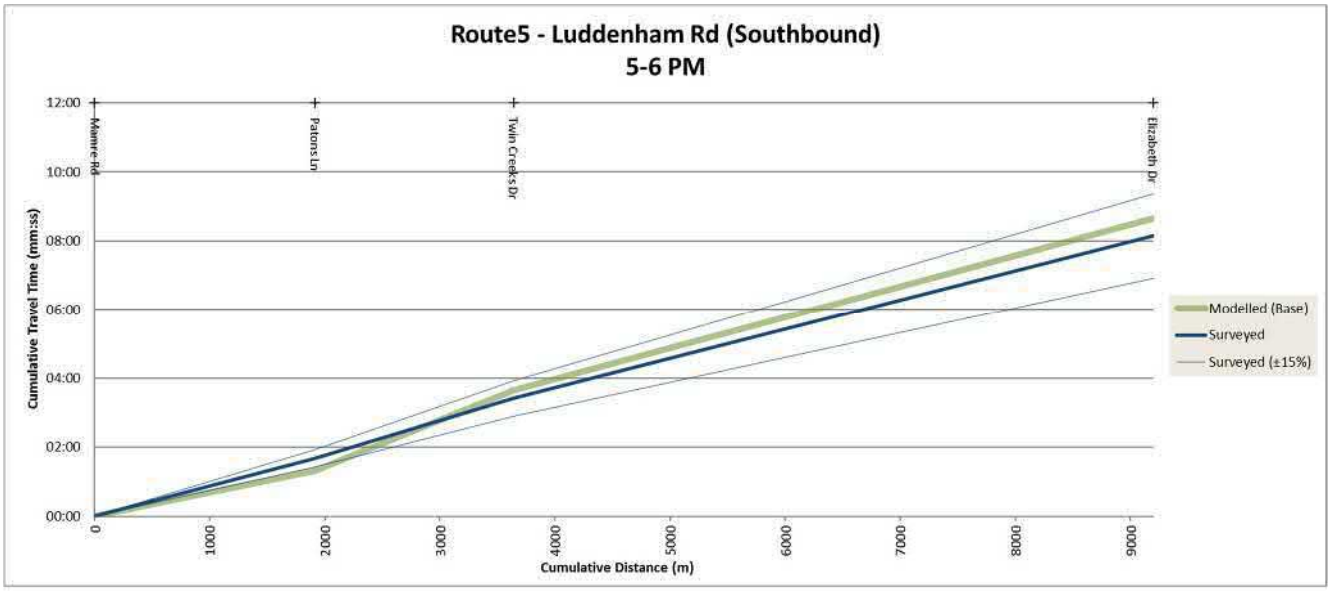

Route5 - Luddenham Rd (Southbound)
7-8 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

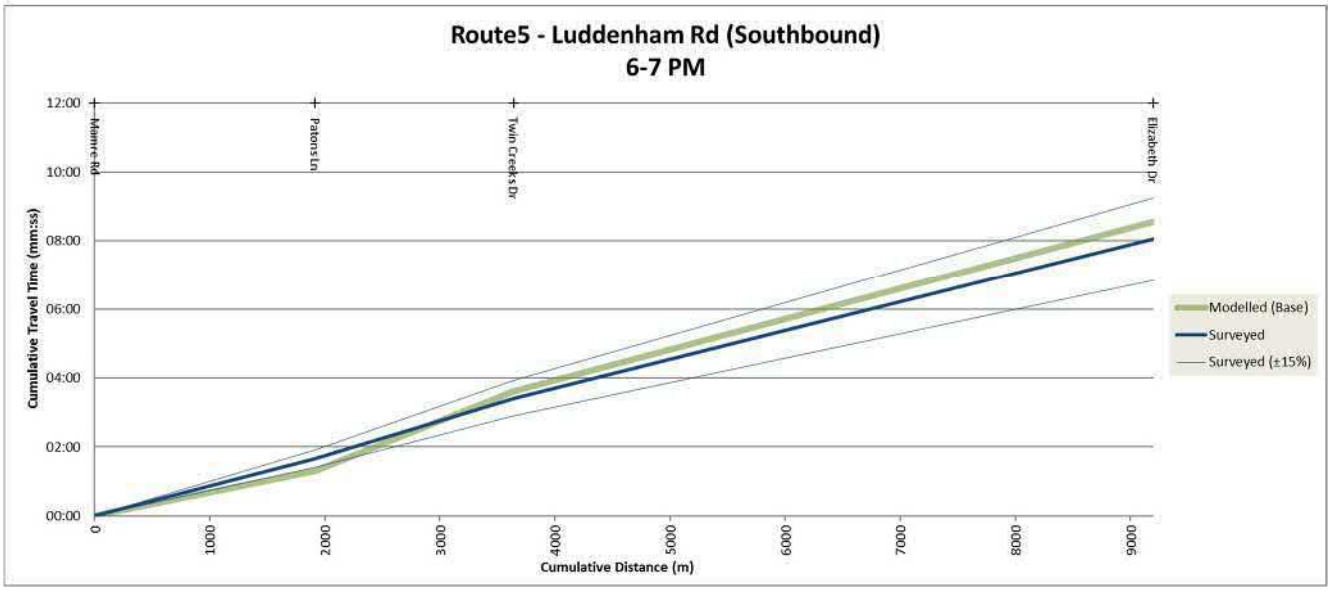

Route5 - Luddenham Rd (Southbound)
8-9 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route5 - Luddenham Rd (Southbound)
9-10 AM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

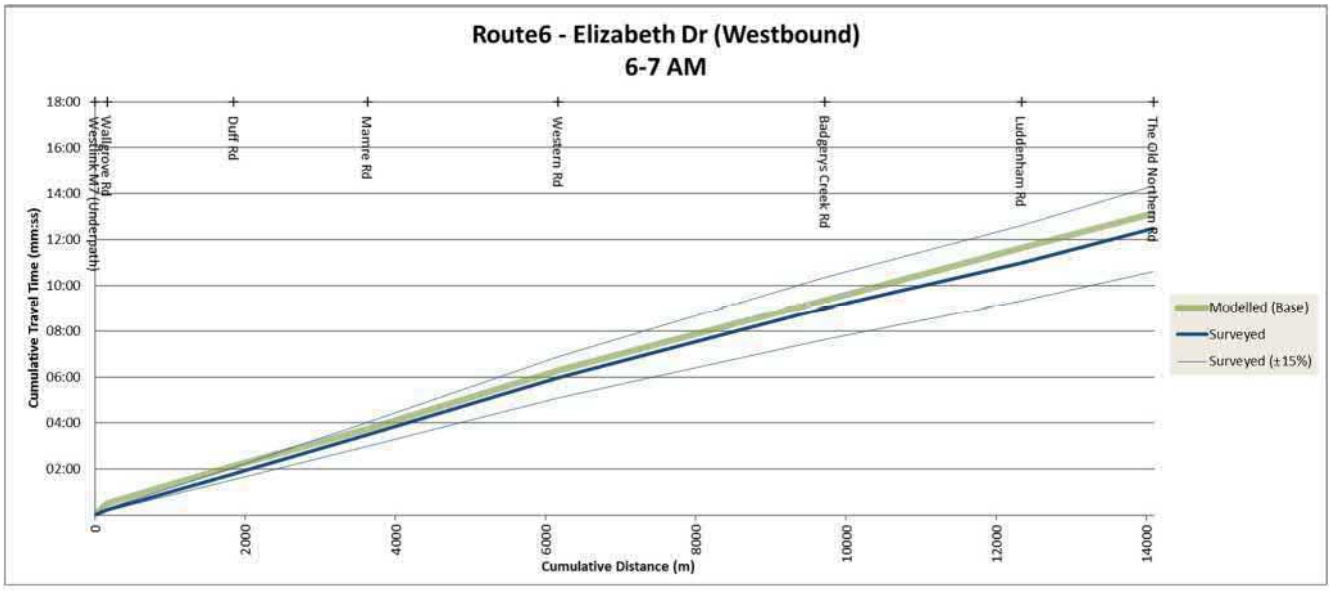

Route5 - Luddenham Rd (Southbound)
3-4 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Munro Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

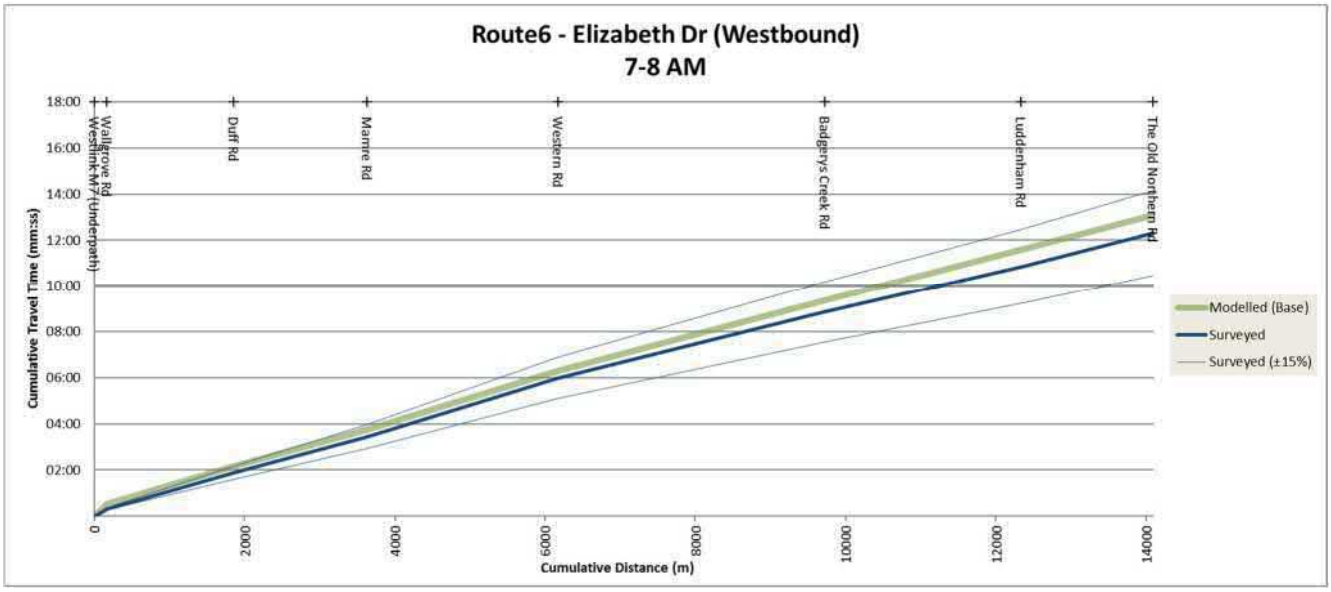

Route5 - Luddenham Rd (Southbound)
4-5 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Munro Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

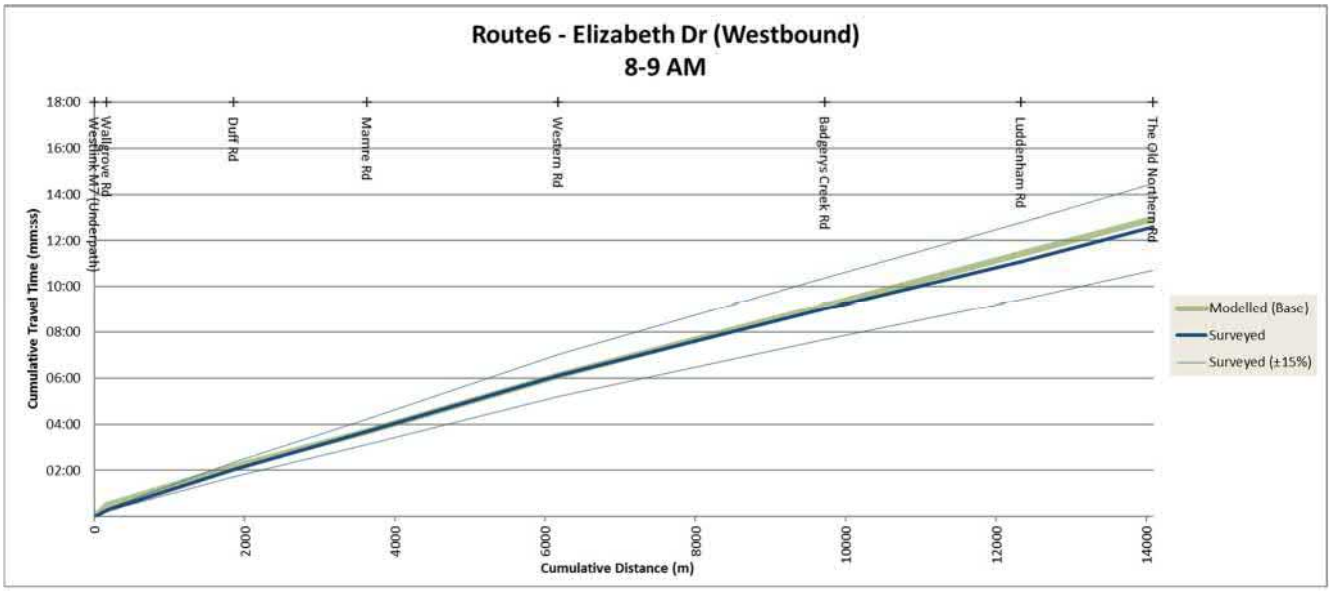

Route5 - Luddenham Rd (Southbound)
5-6 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

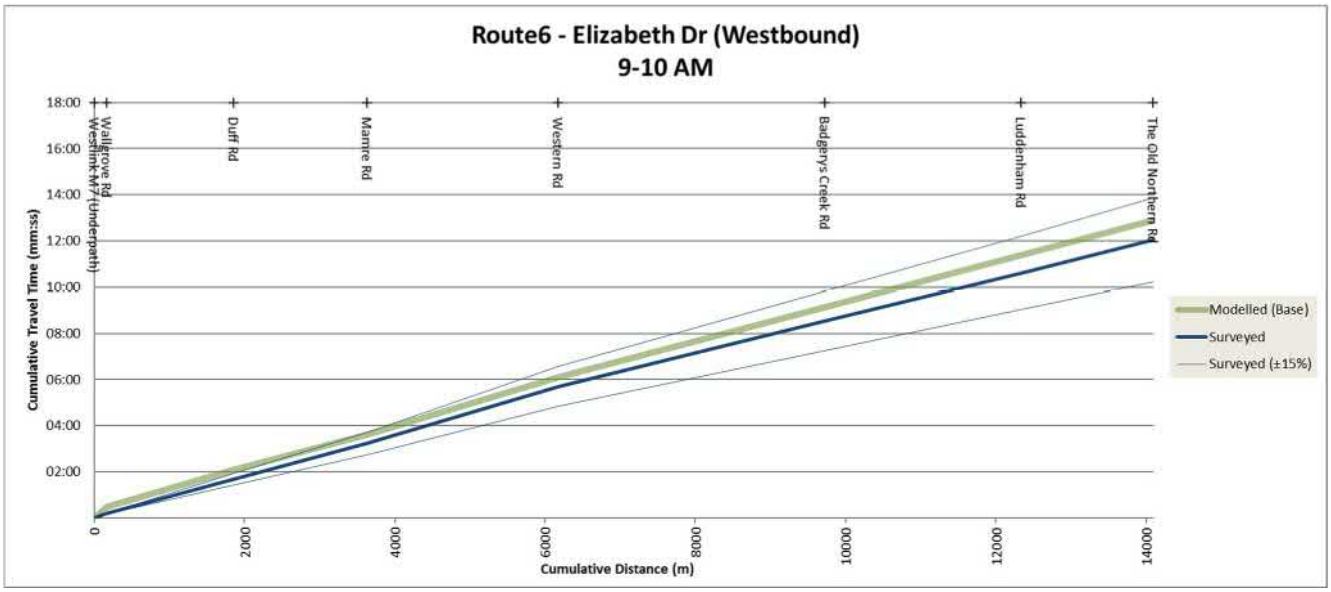

Route5 - Luddenham Rd (Southbound)
6-7 PM
Cumulative Travel Time (mm:ss)
12:00
10:00
08:00
06:00
04:00
02:00
00:00
Mamre Rd
Patons Ln
Twin Creeks Dr
Elizabeth Dr
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

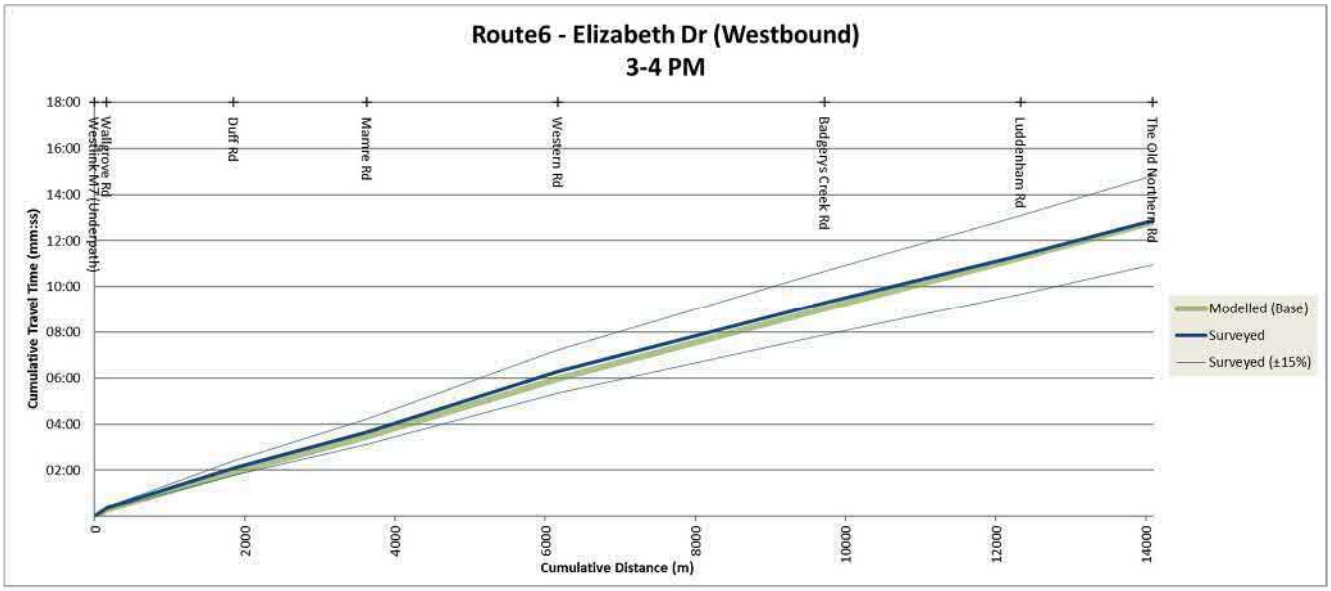
B.6 Route 6 – Elizabeth Drive

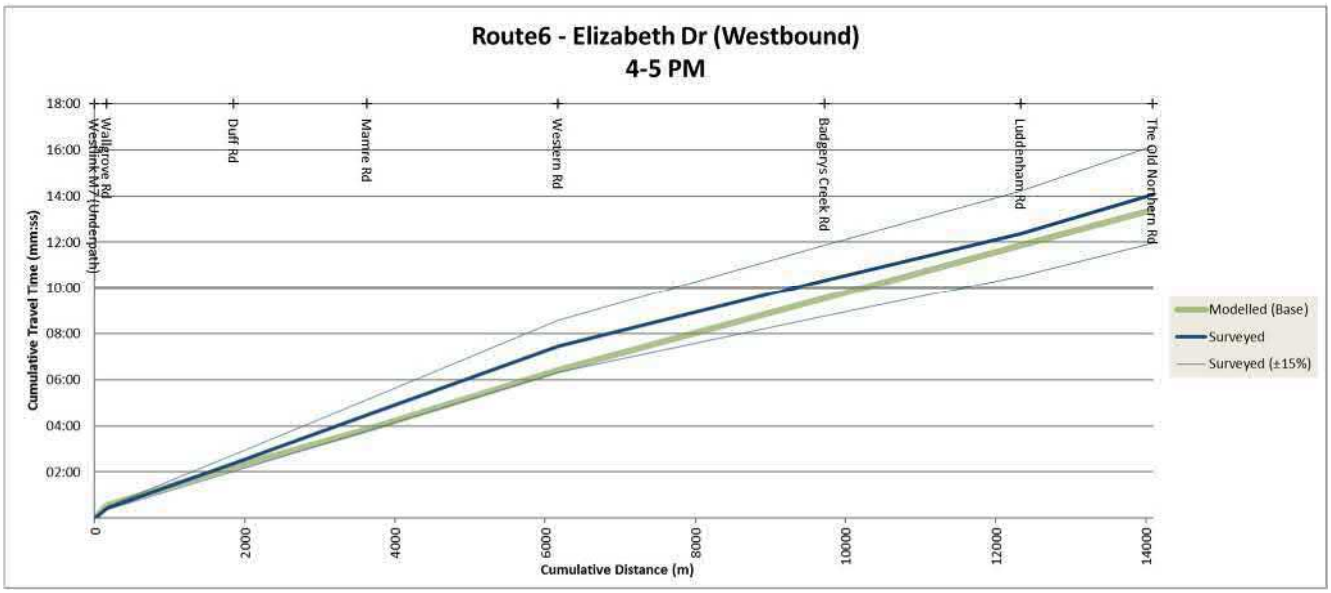


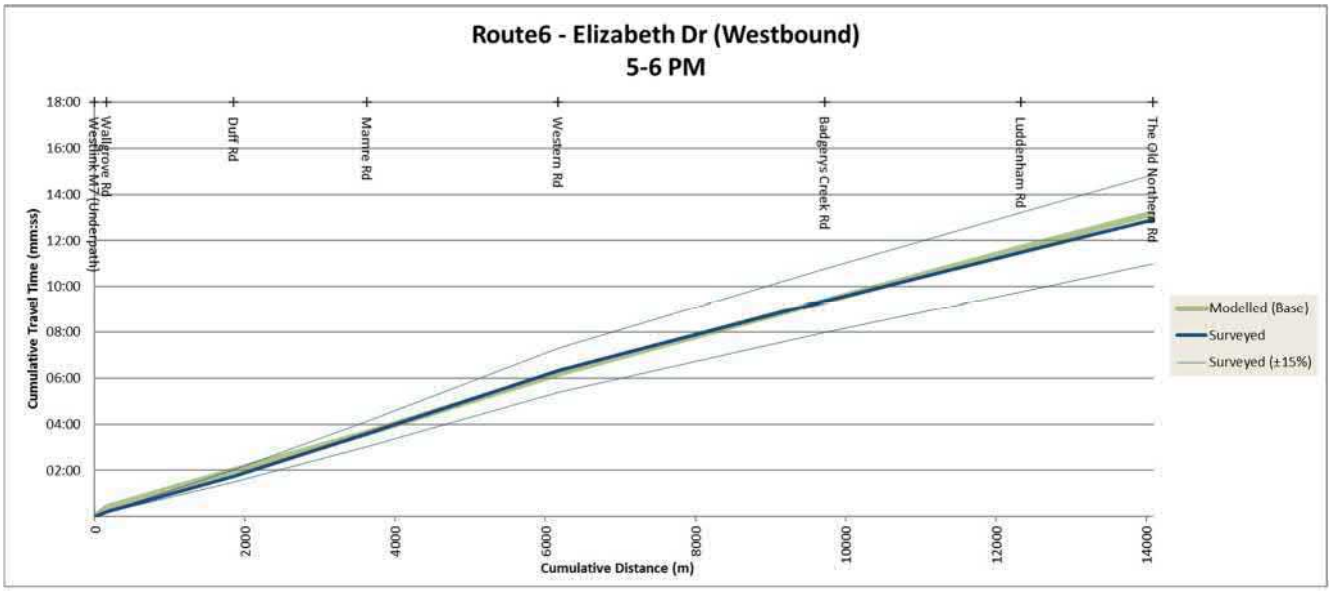


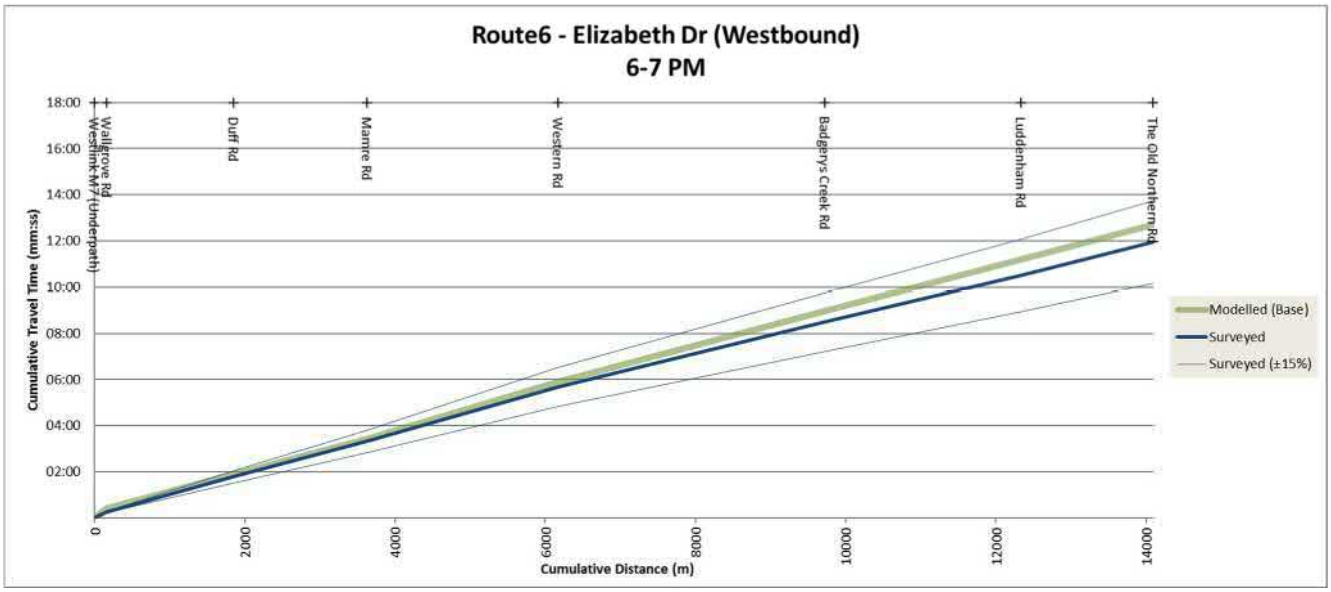

Route6 - Elizabeth Dr (Westbound)
8-9 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

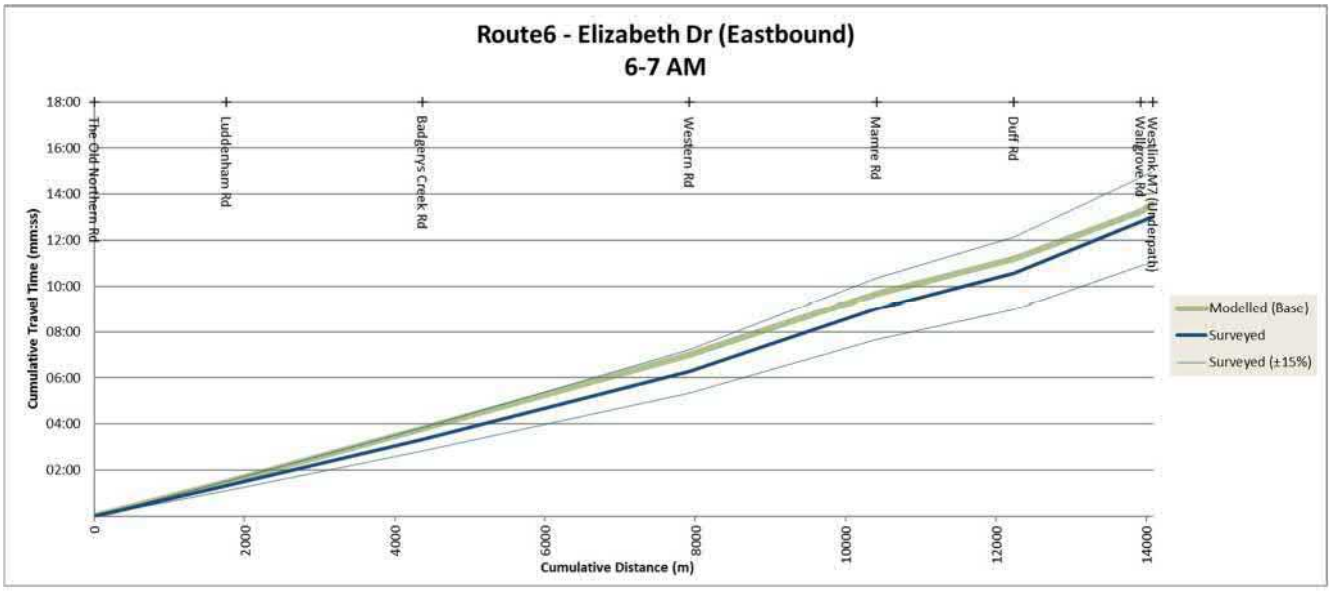

Route6 - Elizabeth Dr (Westbound)
9-10 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

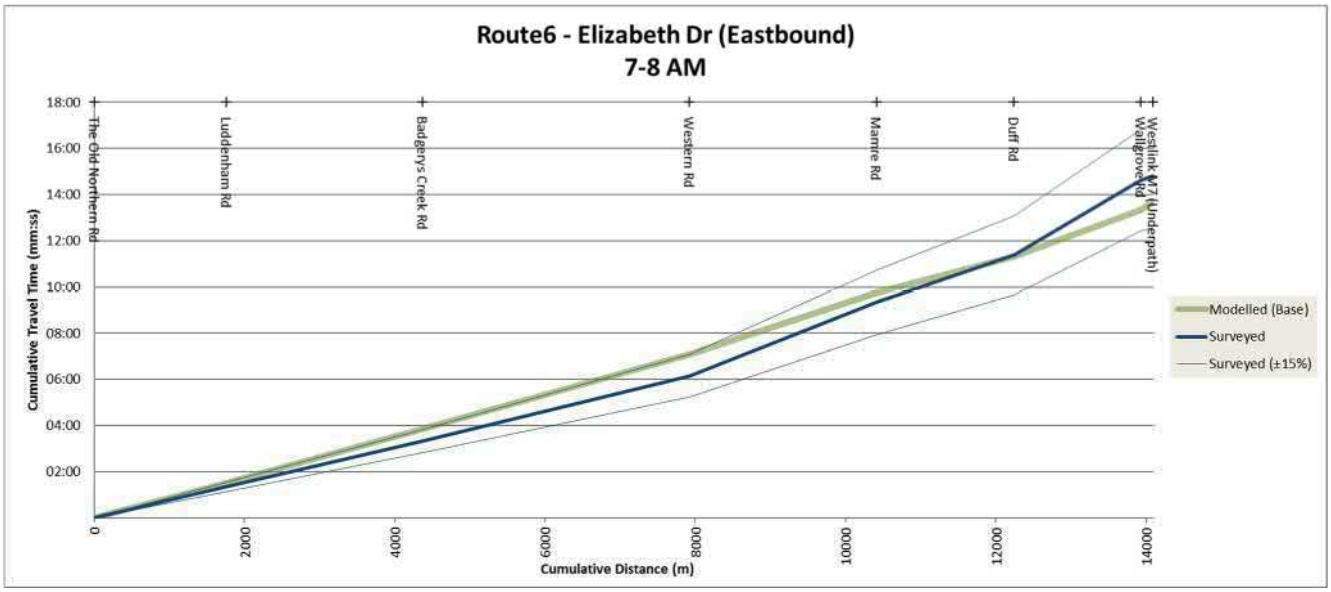

Route6 - Elizabeth Dr (Westbound)
3-4 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

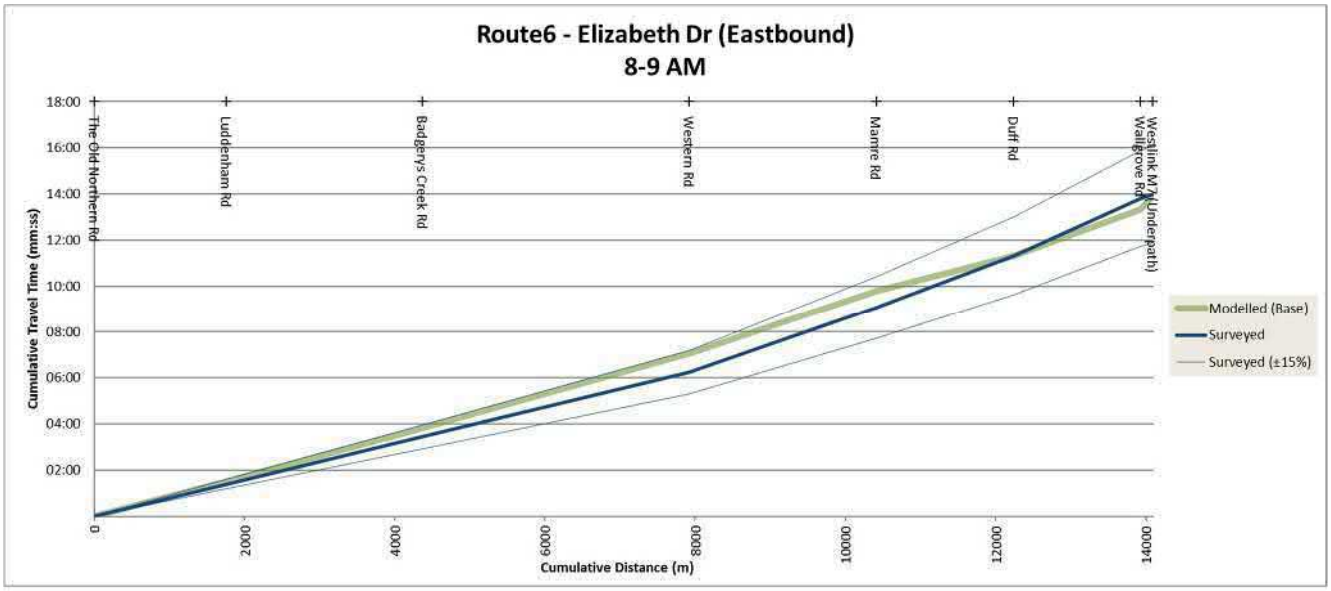

Route6 - Elizabeth Dr (Westbound)
4-5 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

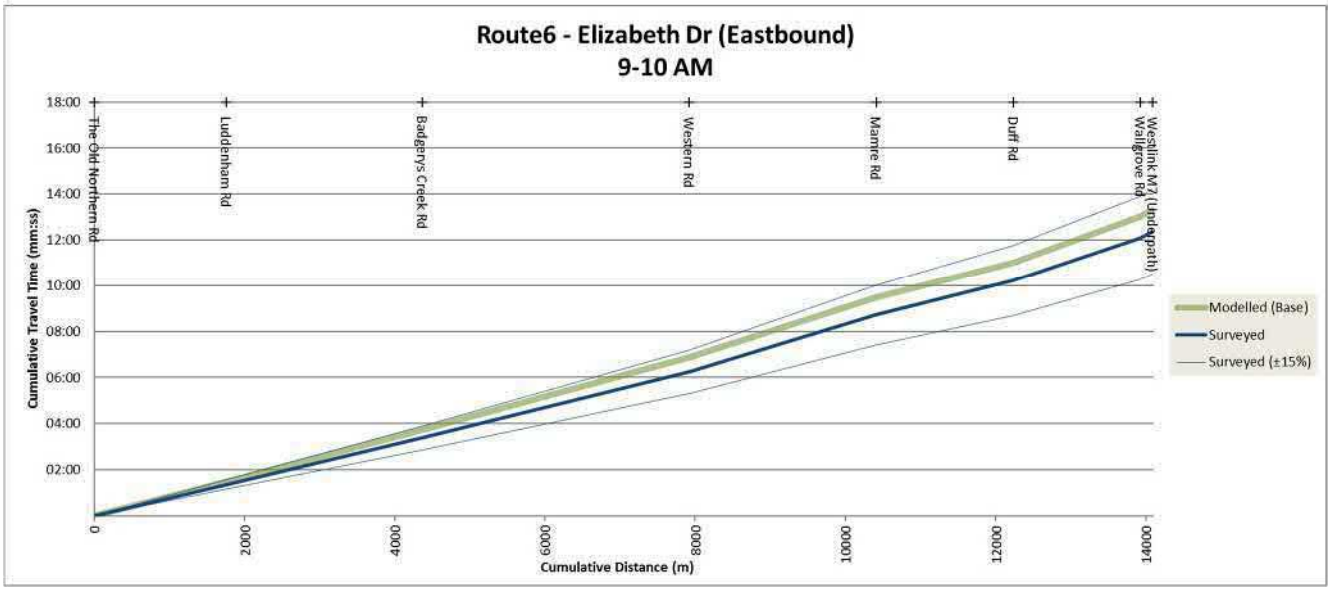

Route6 - Elizabeth Dr (Westbound)
5-6 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

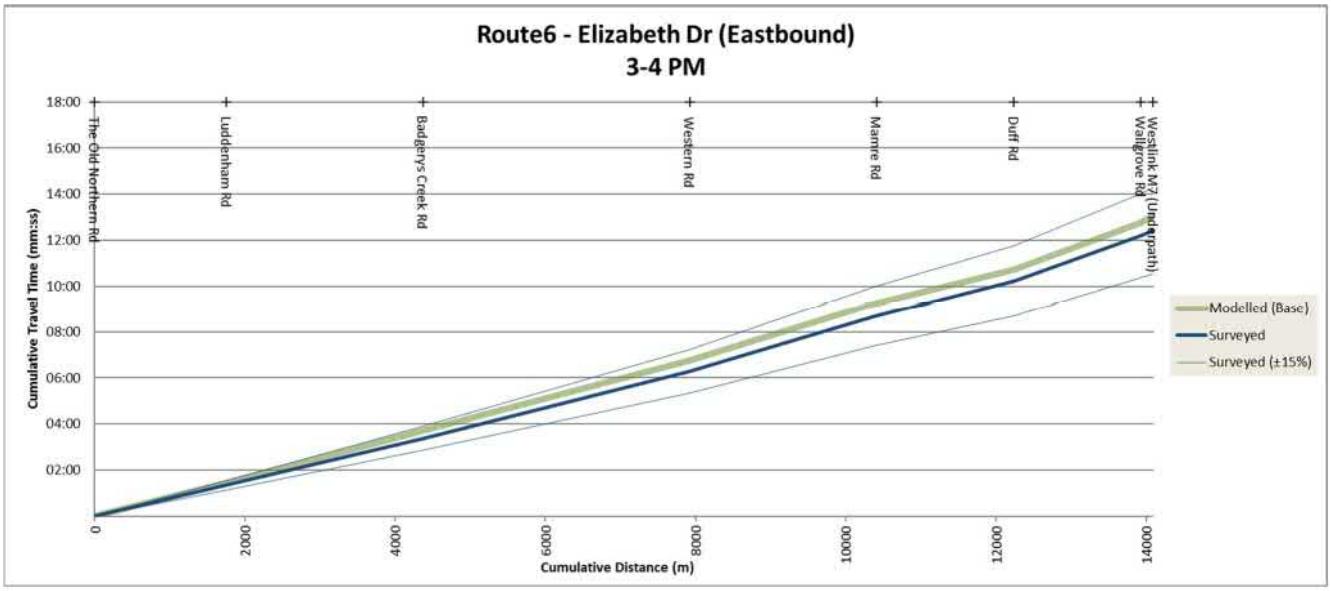

Route6 - Elizabeth Dr (Westbound)
6-7 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Wallgrove Rd
Westlink M7 (Underpath)
Duff Rd
Marrie Rd
Western Rd
Badgerys Creek Rd
Luddenham Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

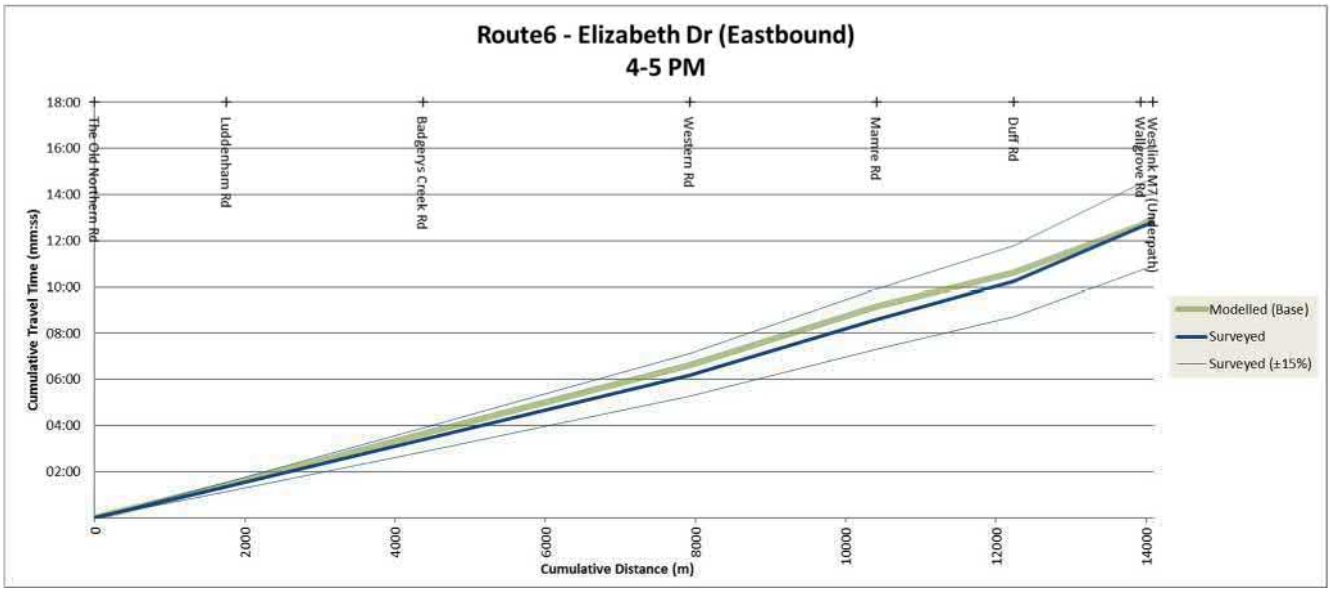

Route6 - Elizabeth Dr (Eastbound)
6-7 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

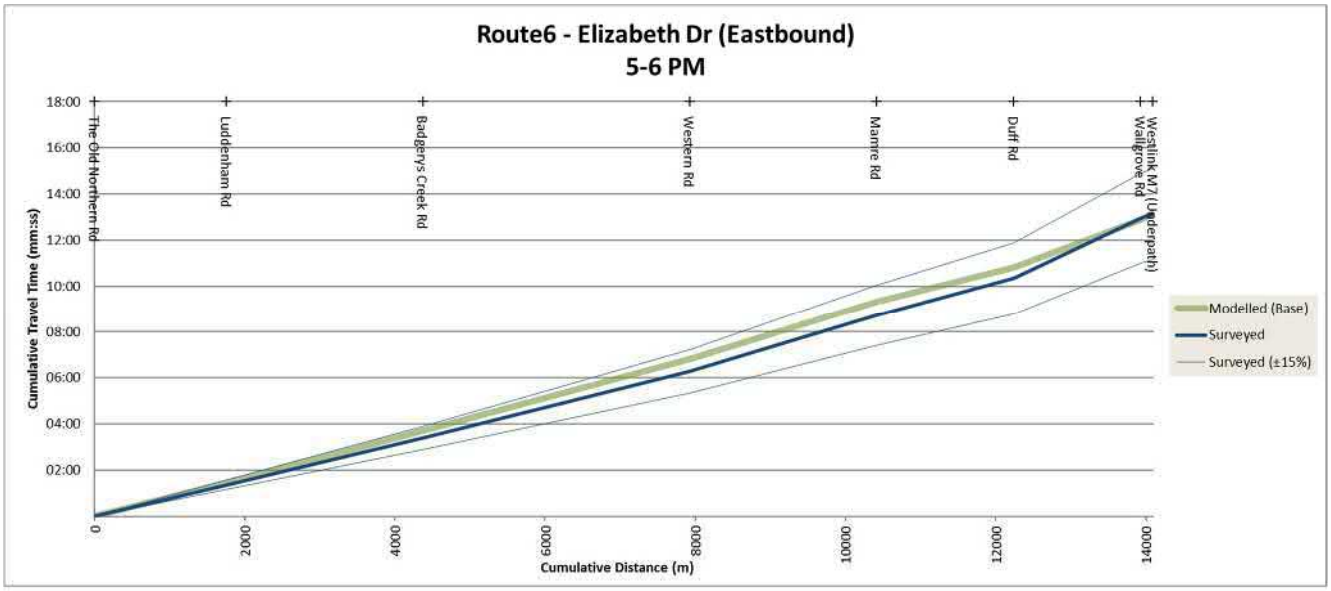

Route6 - Elizabeth Dr (Eastbound)
7-8 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

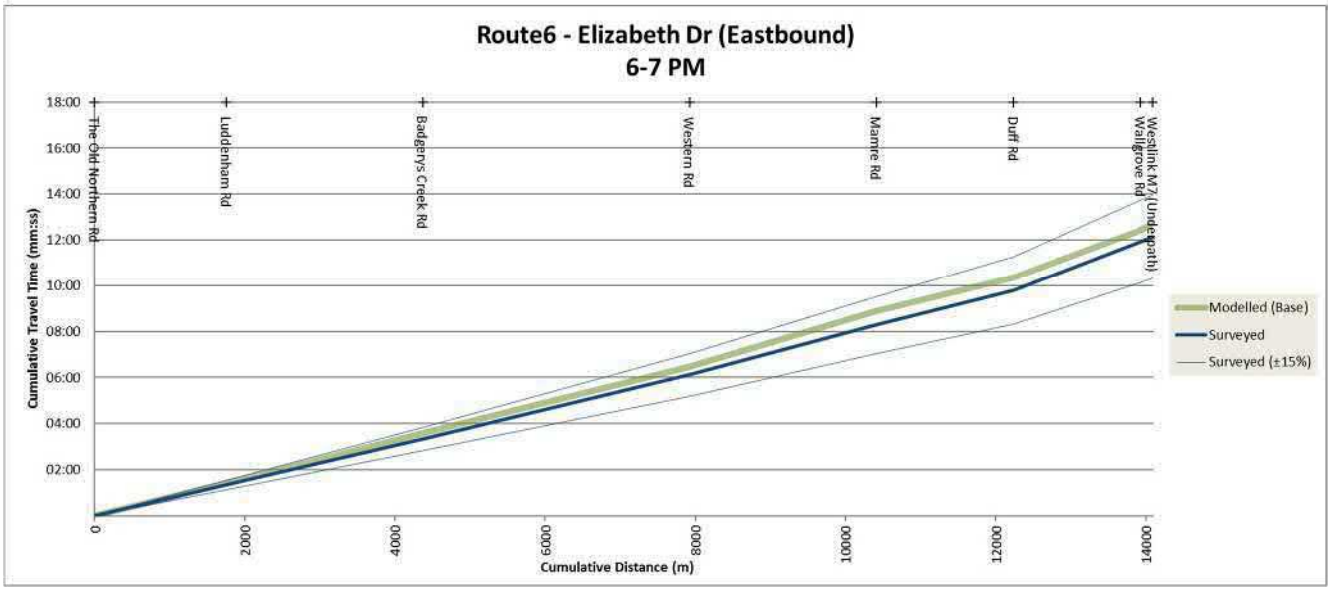

Route6 - Elizabeth Dr (Eastbound)
8-9 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route6 - Elizabeth Dr (Eastbound)
9-10 AM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

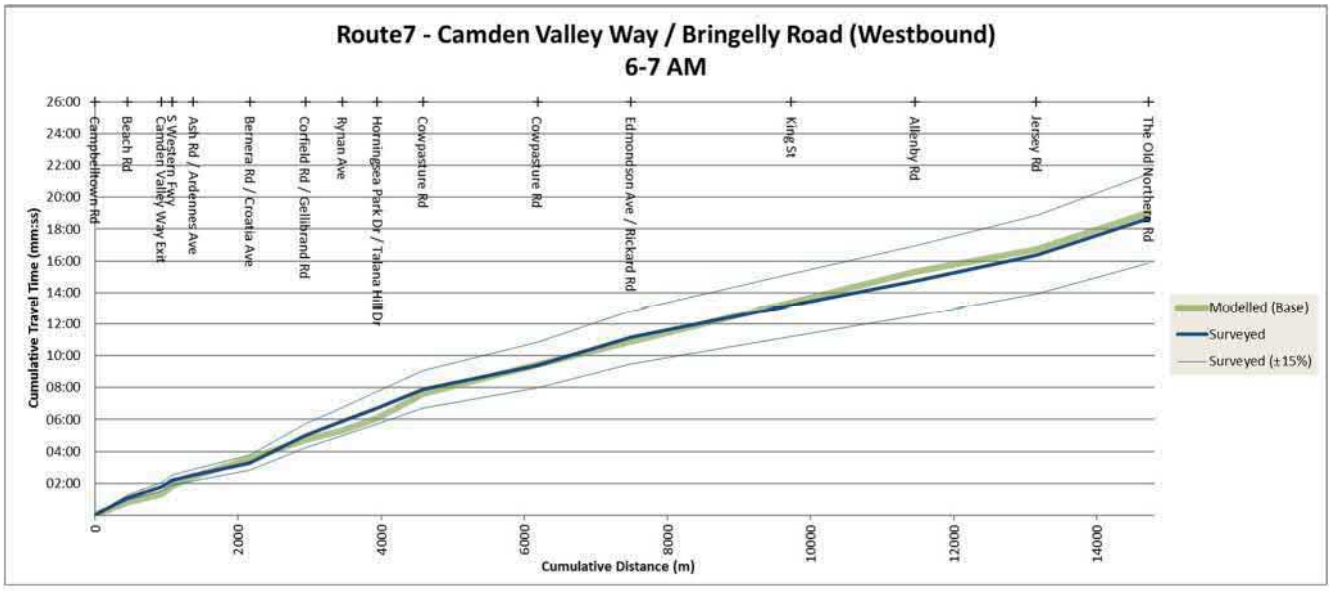

Route6 - Elizabeth Dr (Eastbound)
3-4 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

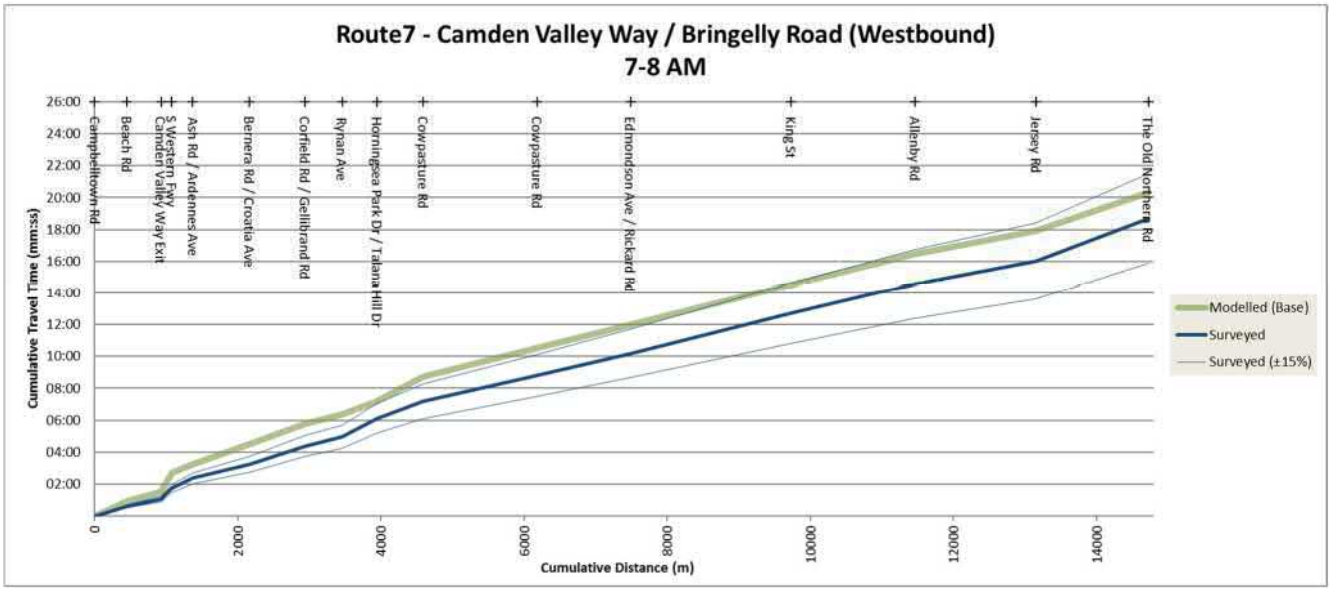

Route6 - Elizabeth Dr (Eastbound)
4-5 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

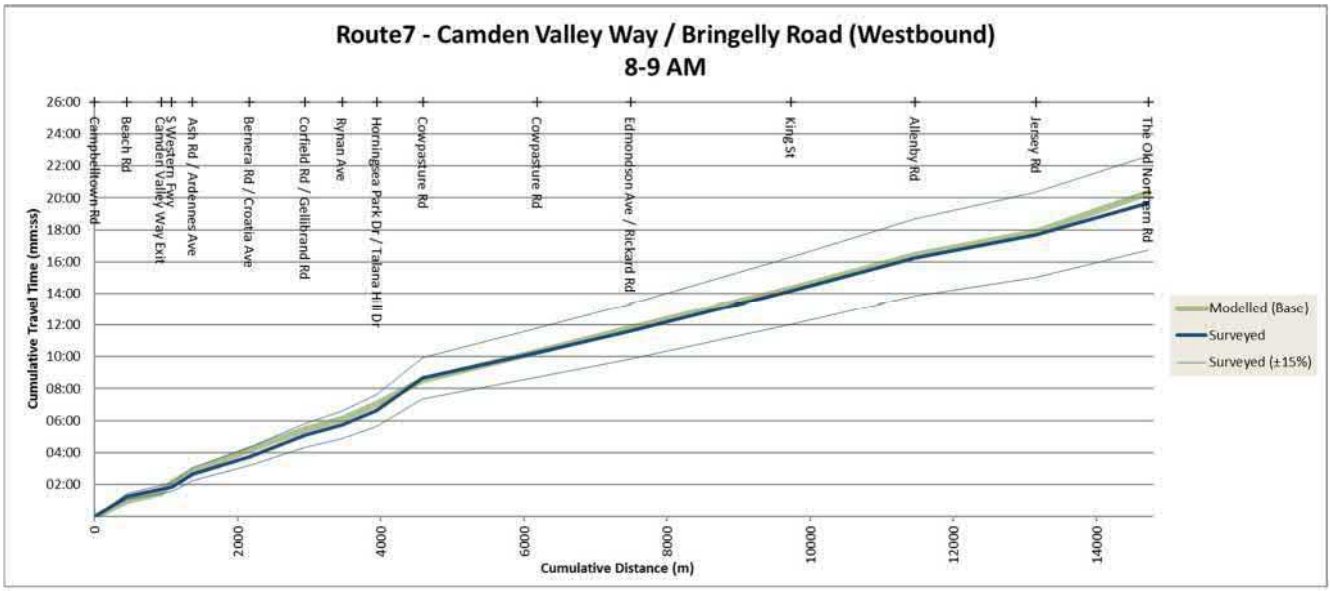

Route6 - Elizabeth Dr (Eastbound)
5-6 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

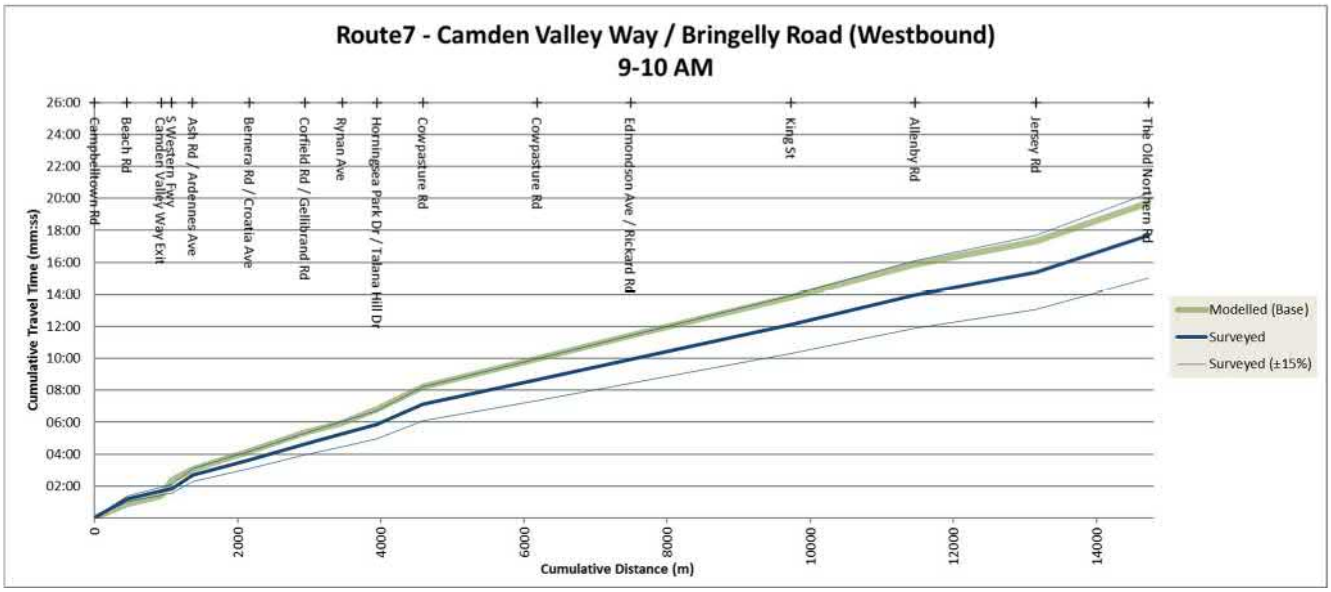

Route6 - Elizabeth Dr (Eastbound)
6-7 PM
Cumulative Travel Time (mm:ss)
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Luddenham Rd
Badgerys Creek Rd
Western Rd
Mamre Rd
Duff Rd
Westlink M7 (Underpath)
Wallgrove Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

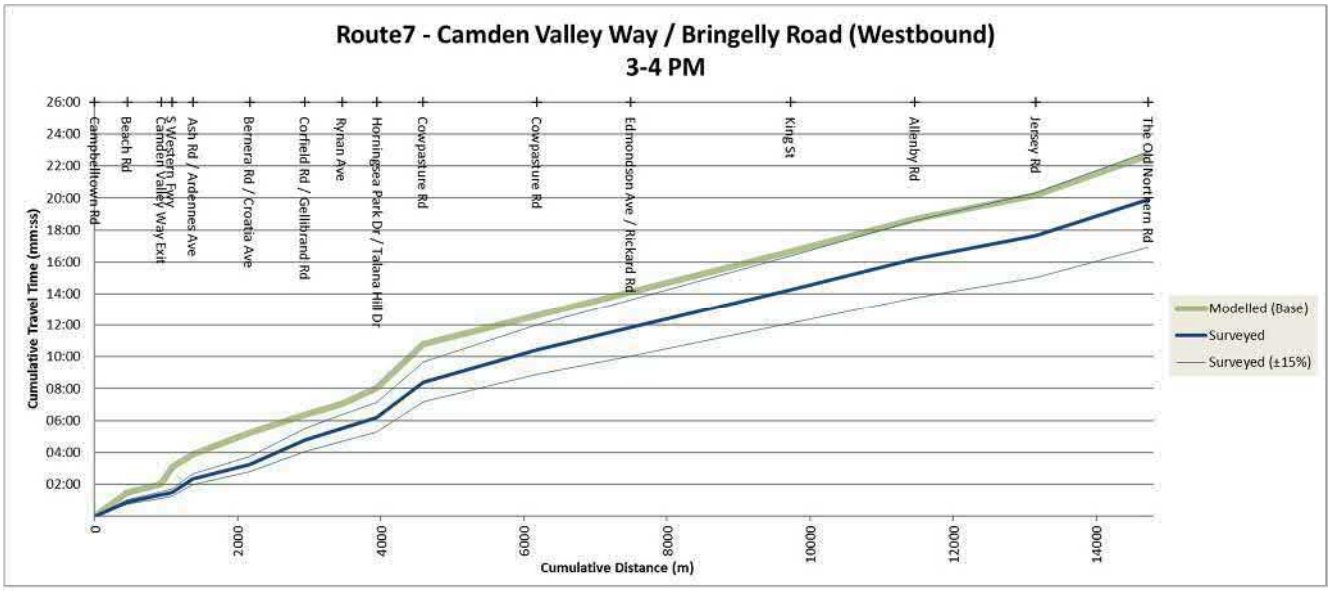
B.7 Route 7 – Camden Valley Way and Bringelly Road

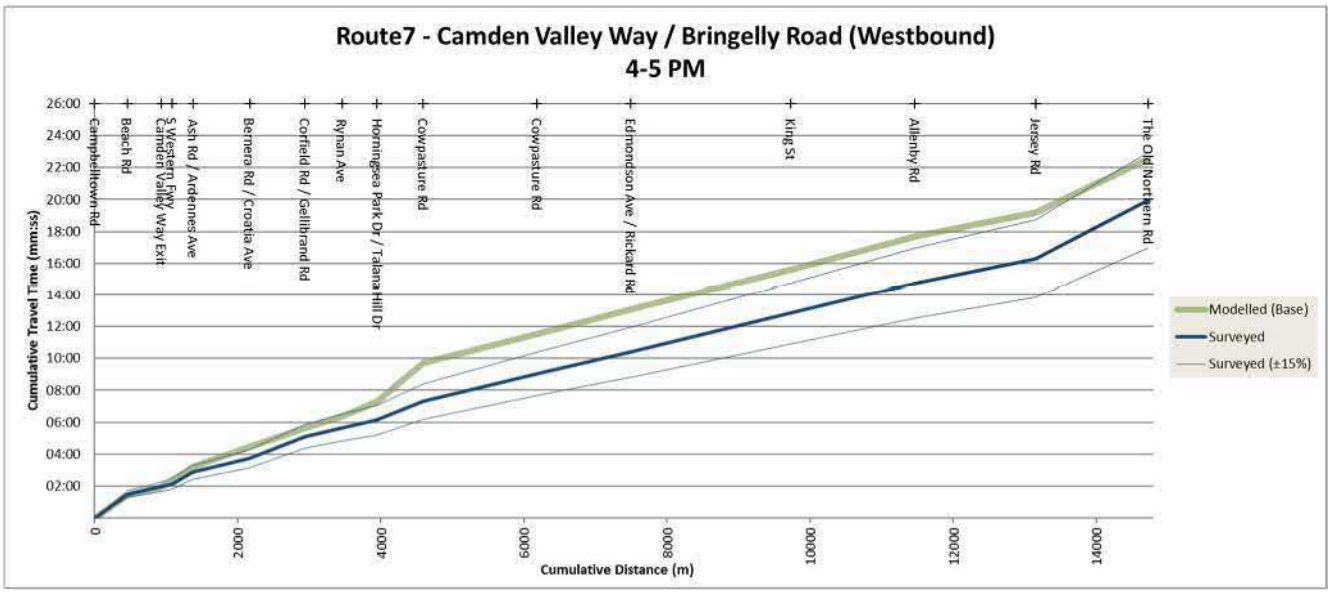


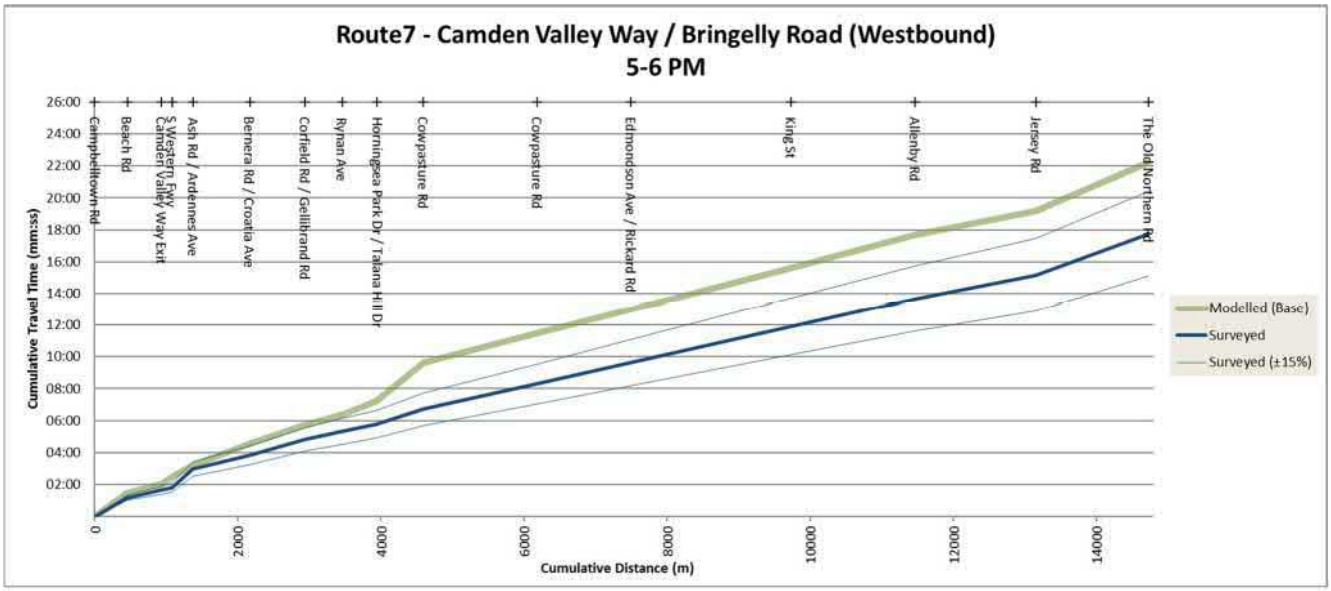


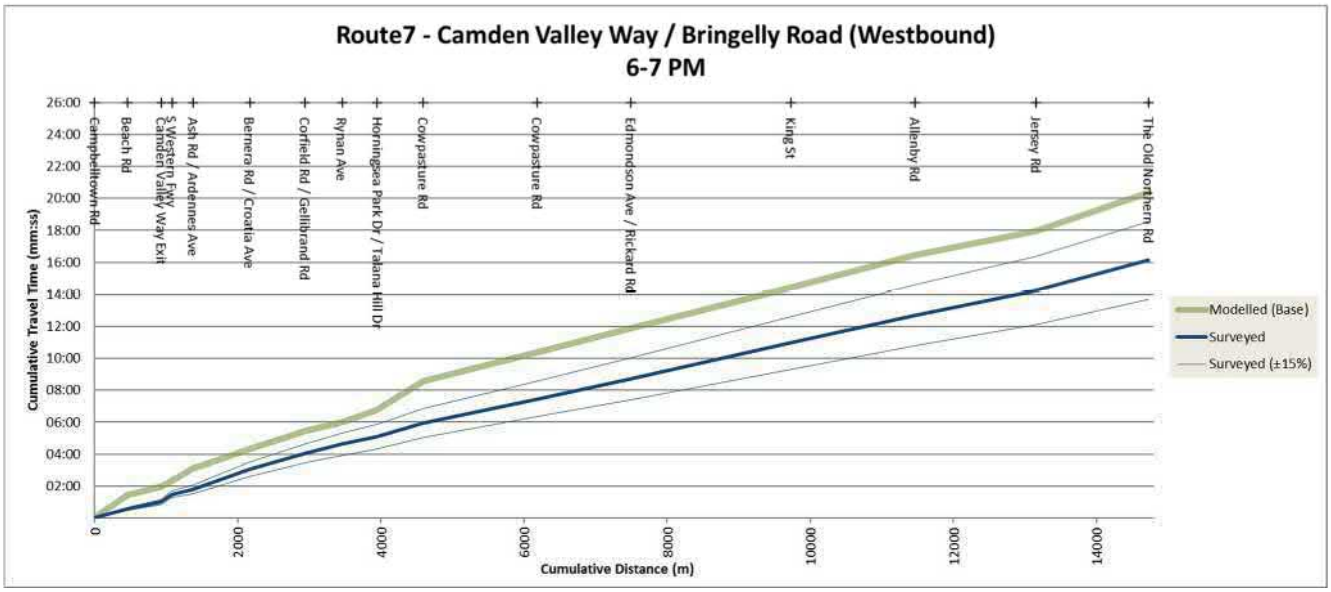

Route7 - Camden Valley Way / Bringelly Road (Westbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Berneria Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Horningsea Park Dr / Tallana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

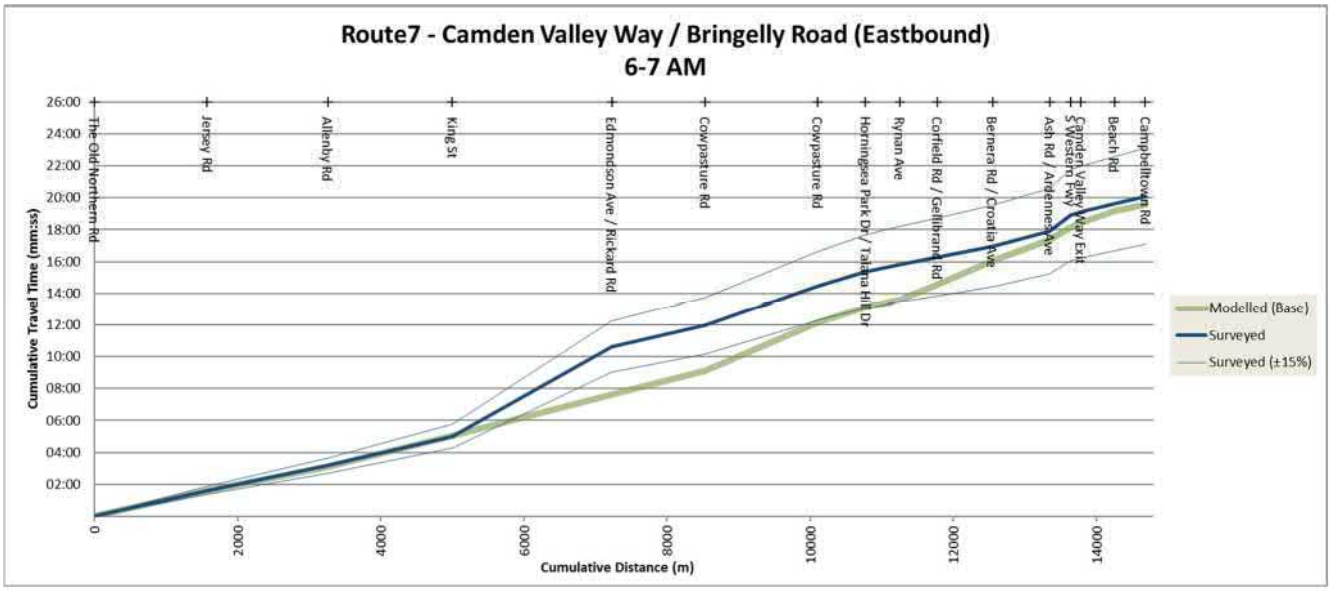

Route7 - Camden Valley Way / Bringelly Road (Westbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Berneria Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Horningsea Park Dr / Tallana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

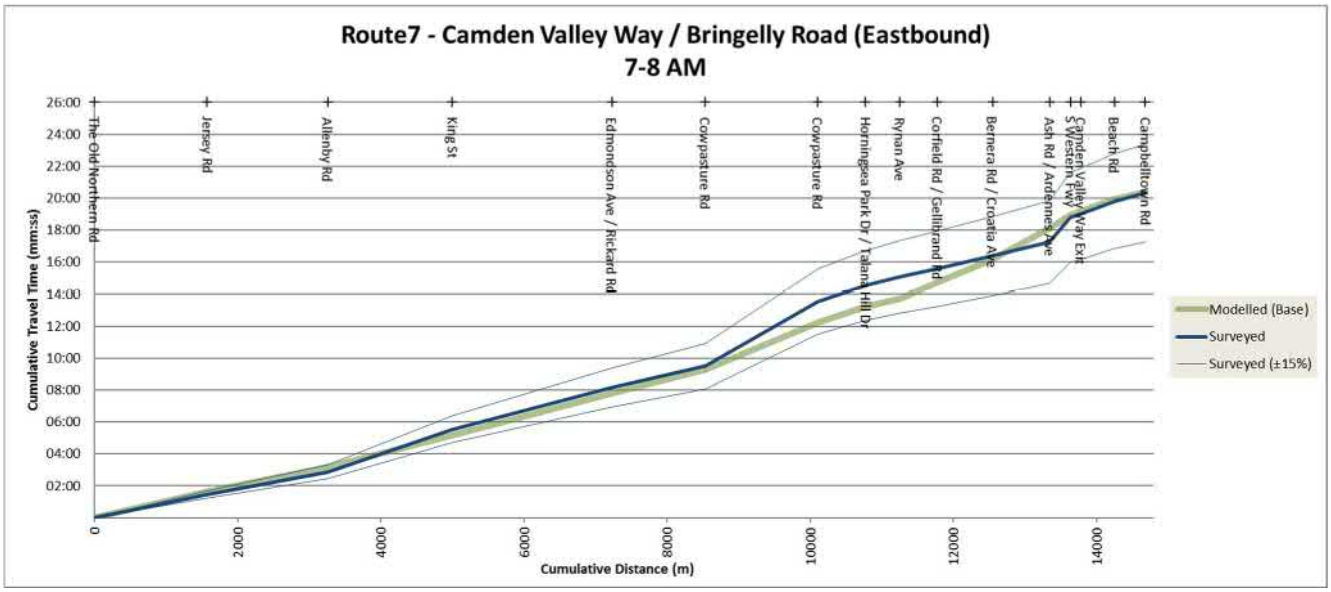

Route7 - Camden Valley Way / Bringelly Road (Westbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Berneria Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Hornings ea Park Dr / Talana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

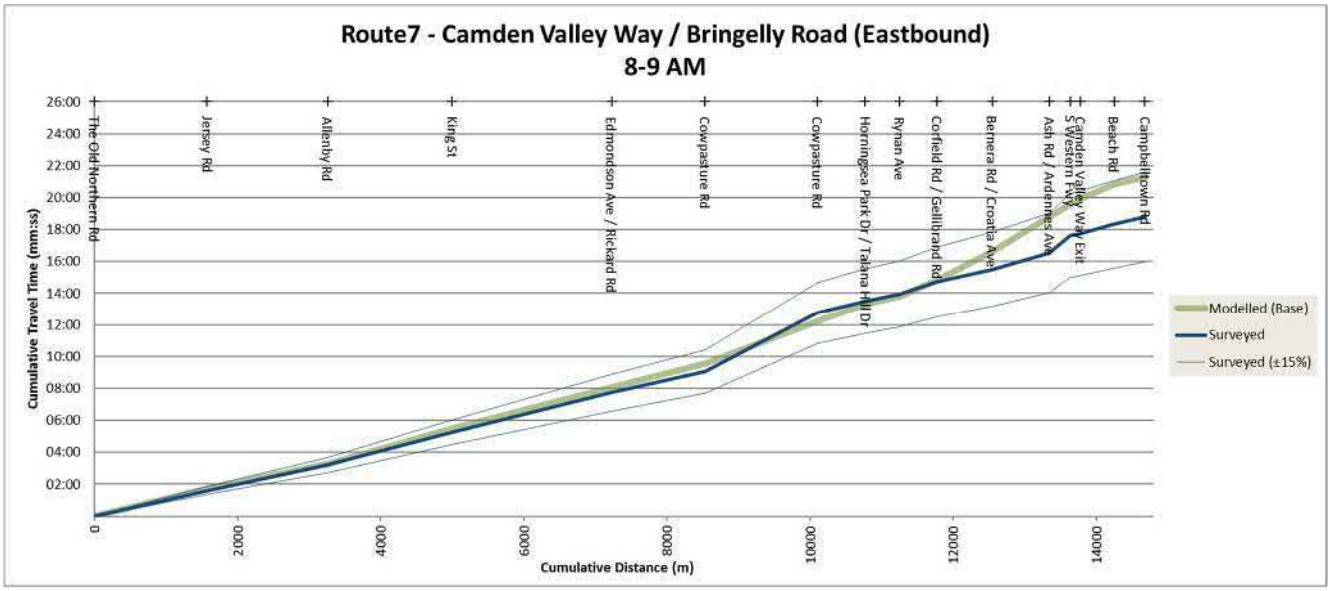

Route7 - Camden Valley Way / Bringelly Road (Westbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Berneria Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Hornings ea Park Dr / Talana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

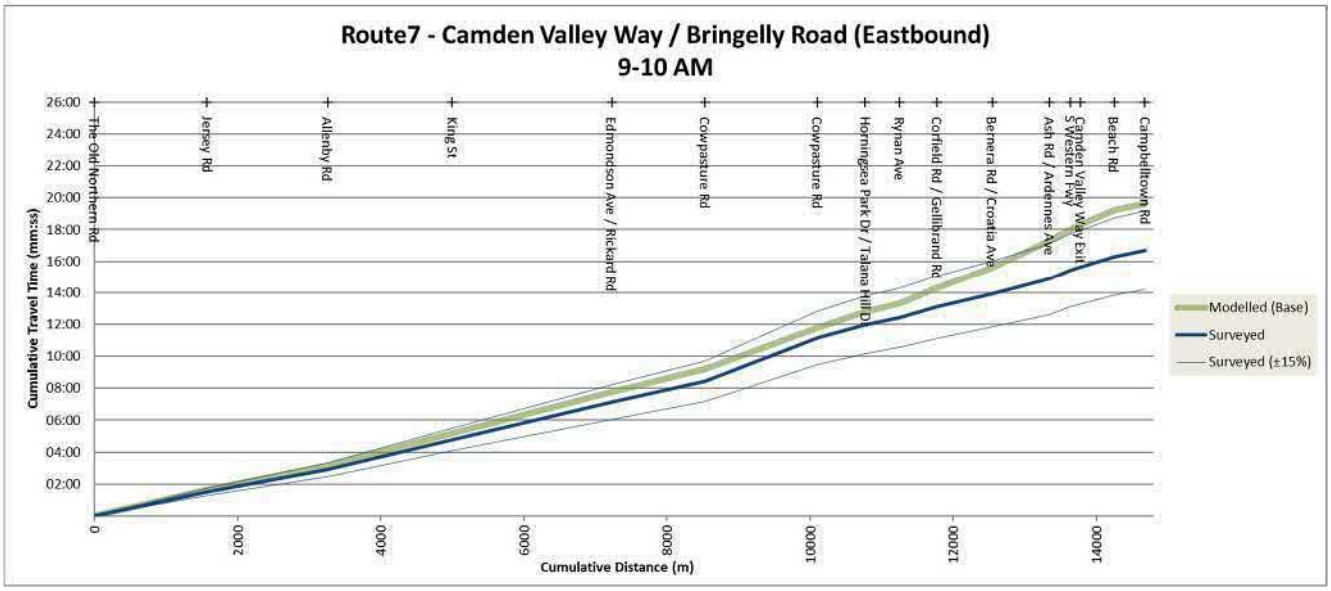

Route7 - Camden Valley Way / Bringelly Road (Westbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Bernera Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Horningsea Park Dr / Tallana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

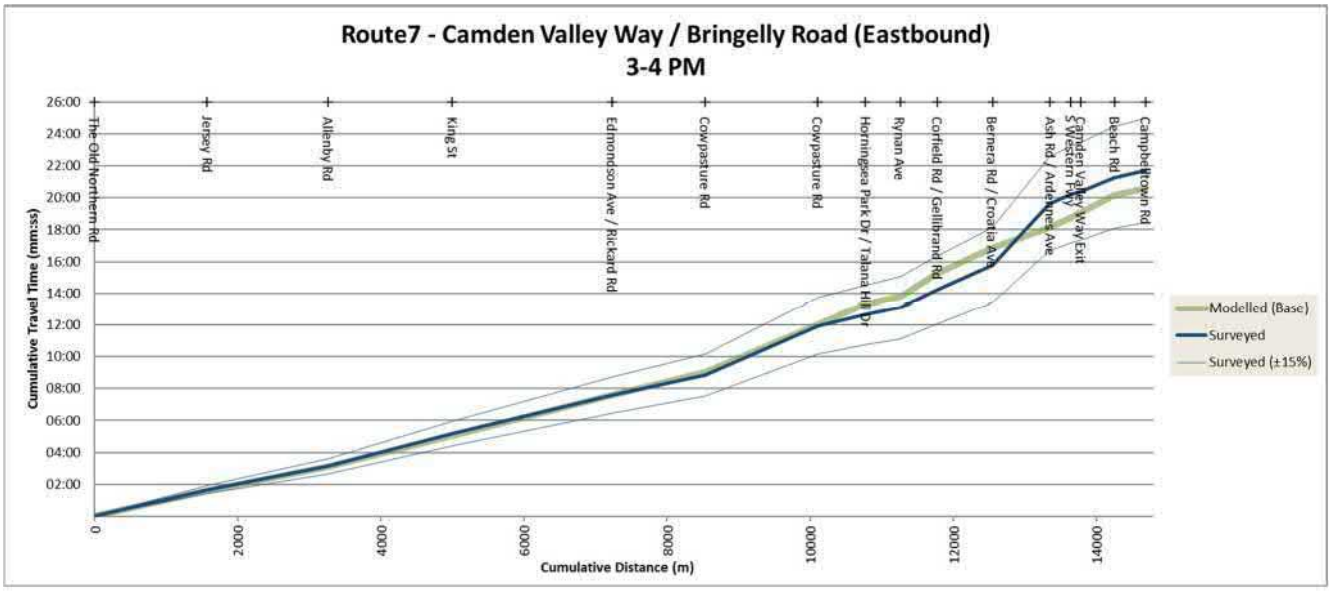

Route7 - Camden Valley Way / Bringelly Road (Westbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
Campbelltown Rd
Beach Rd
S Western Fwy
Camden Valley Way Exit
Ash Rd / Ardennes Ave
Bernera Rd / Croatia Ave
Corfield Rd / Gellibrand Rd
Ryhan Ave
Horningsea Park Dr / Tallana Hill Dr
Cowpasture Rd
Cowpasture Rd
Edmondson Ave / Rickard Rd
King St
Allenby Rd
Jersey Rd
The Old Northern Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

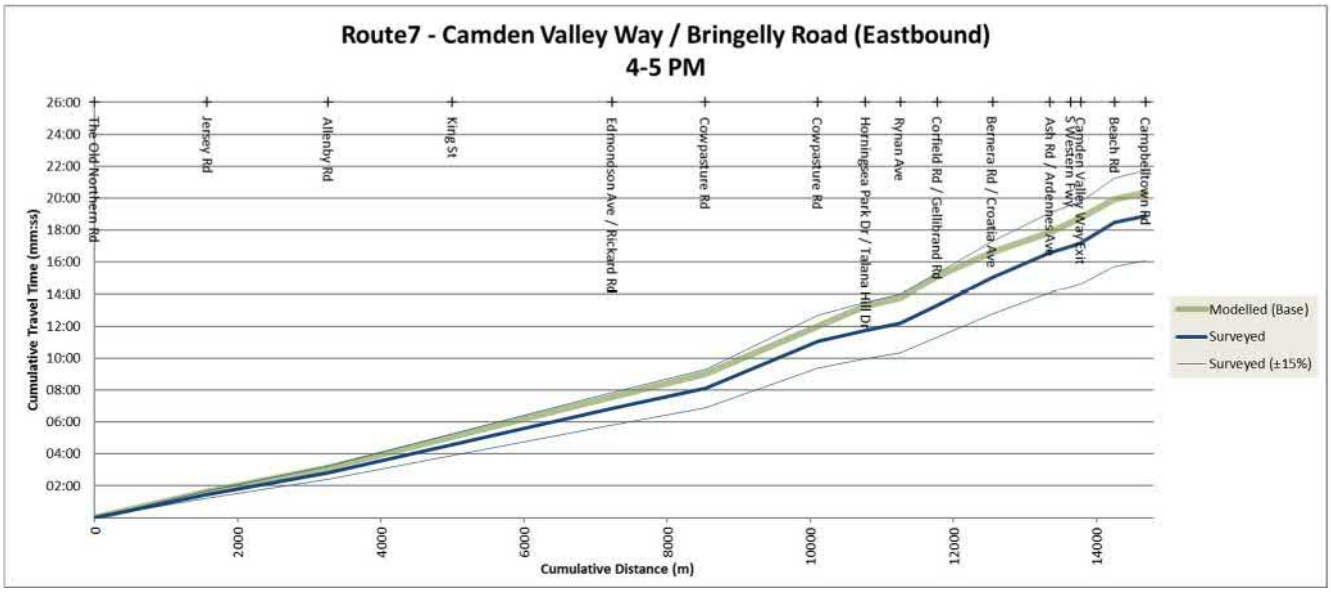

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
6-7 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornindsea Park Dr / Talara Hill Dr
Rynan Ave
Corfield Rd / Gellibrand Rd
Berneria Rd / Croatia Ave
Ash Rd / Ardennes Ave
S Western Fwy
Camden Valley Way Exit
Beach Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

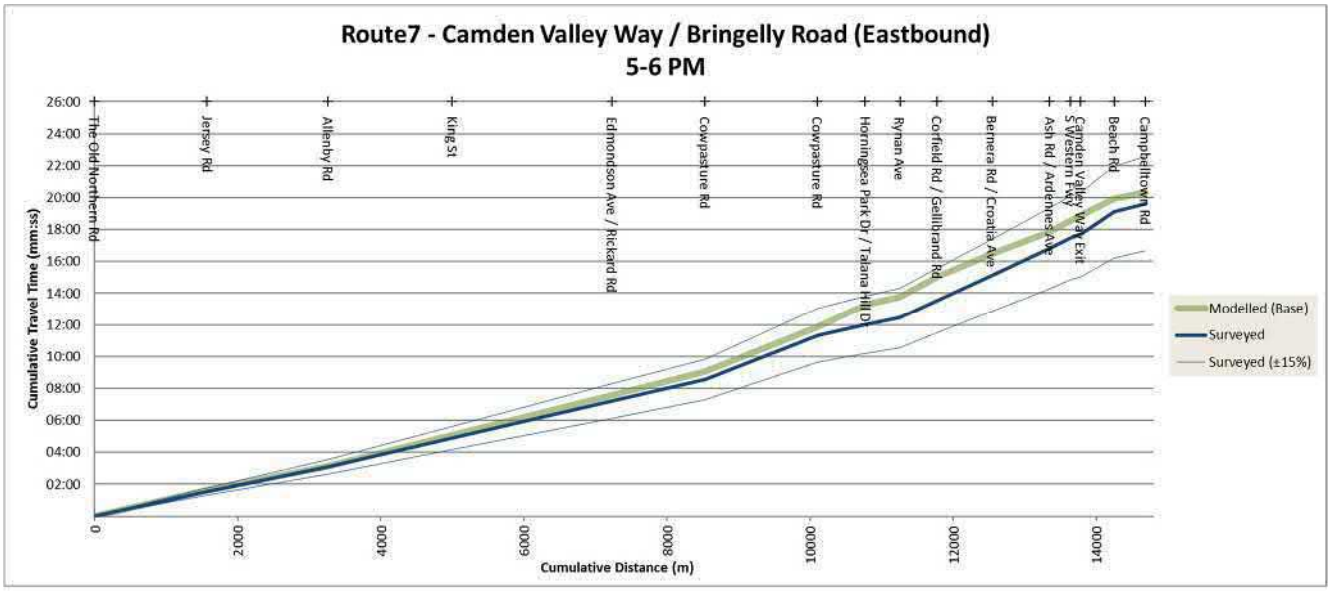

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
7-8 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornindsea Park Dr / Talara Hill Dr
Rynan Ave
Corfield Rd / Gellibrand Rd
Berneria Rd / Croatia Ave
Ash Rd / Ardennes Ave
S Western Fwy
Camden Valley Way Exit
Beach Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

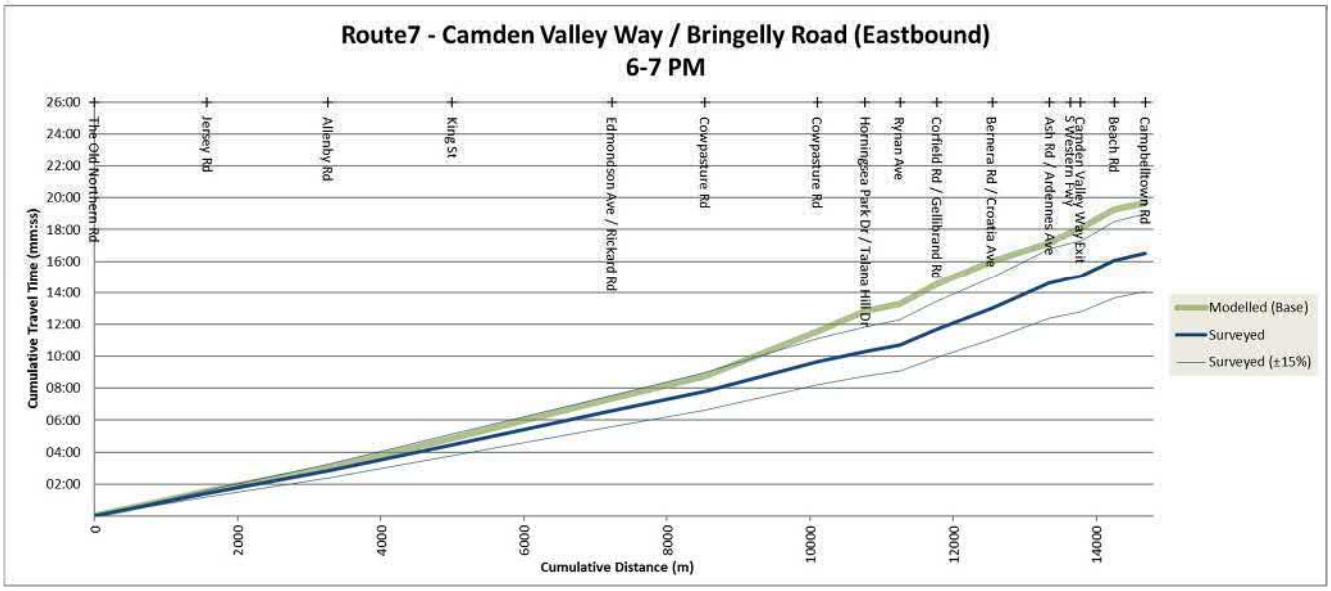

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
8-9 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornings ea Park Dr / Talana Hill Dr
Ryman Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit S Western Fwy
Beech Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route7 - Camden Valley Way / Bringelly Road (Eastbound)
9-10 AM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornings ea Park Dr / Talana Hill Dr
Ryman Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit S Western Fwy
Beech Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

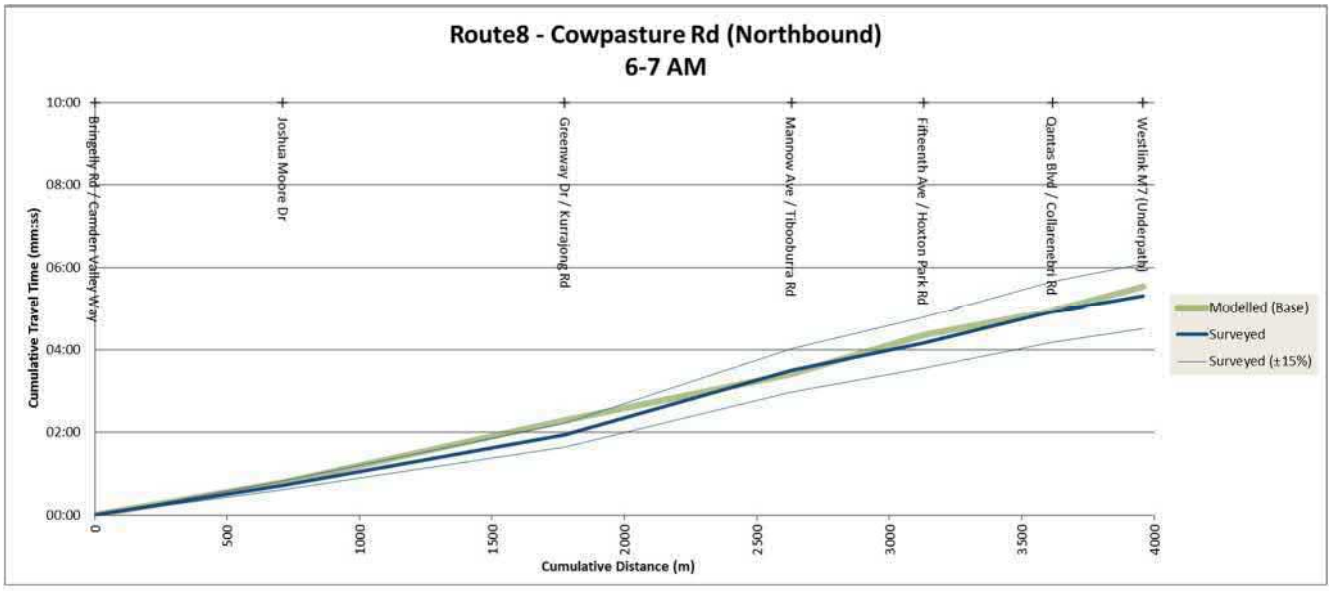

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
3-4 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornindsea Park Dr / Talana Hill Dr
Rynan Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit
S Western Fwy
Beach Rd
Campbelltown Rd
Modelled (Base)
Surveyed
Surveyed (±15%)

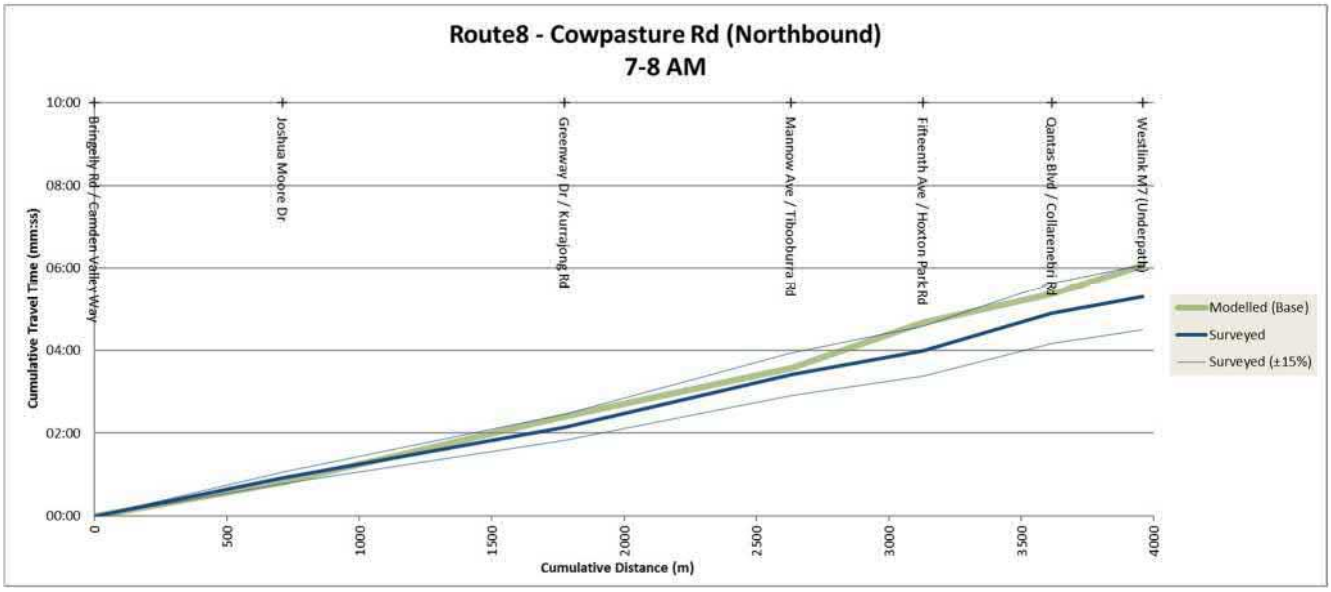

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
4-5 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornindsea Park Dr / Talana Hill Dr
Rynan Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit
S Western Fwy
Beach Rd
Campbelltown Rd
Modelled (Base)
Surveyed
Surveyed (±15%)

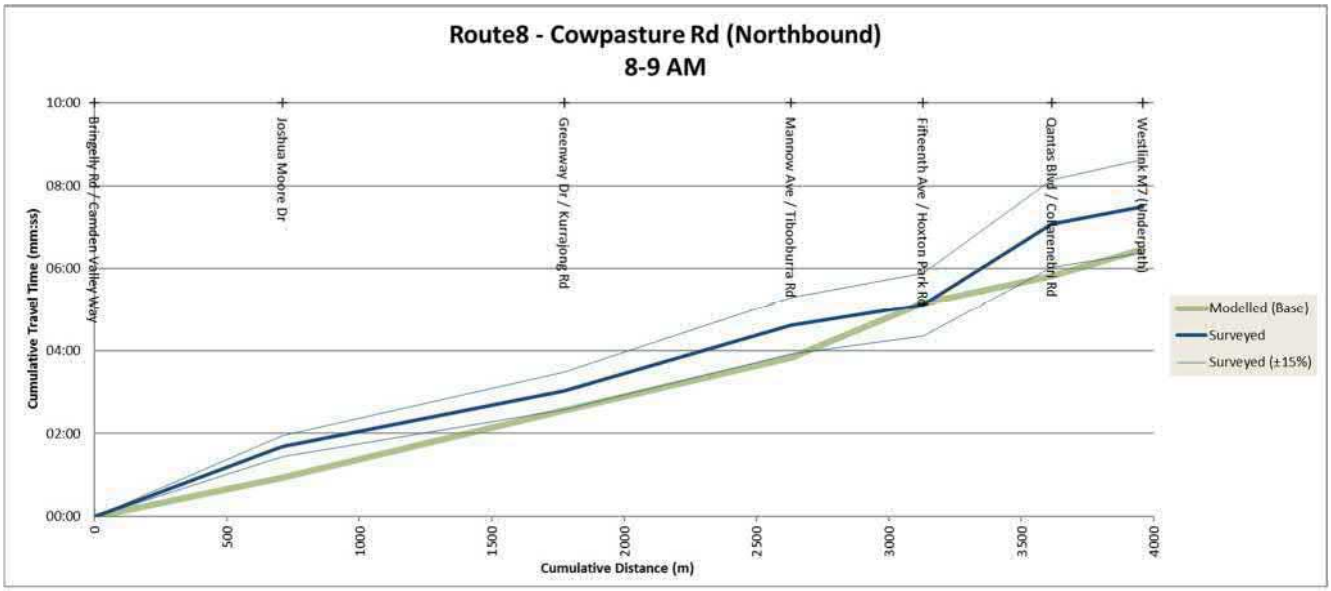

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
5-6 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornings ea Park Dr / Talana Hill Dr
Ryman Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit S Western Fwy
Beach Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

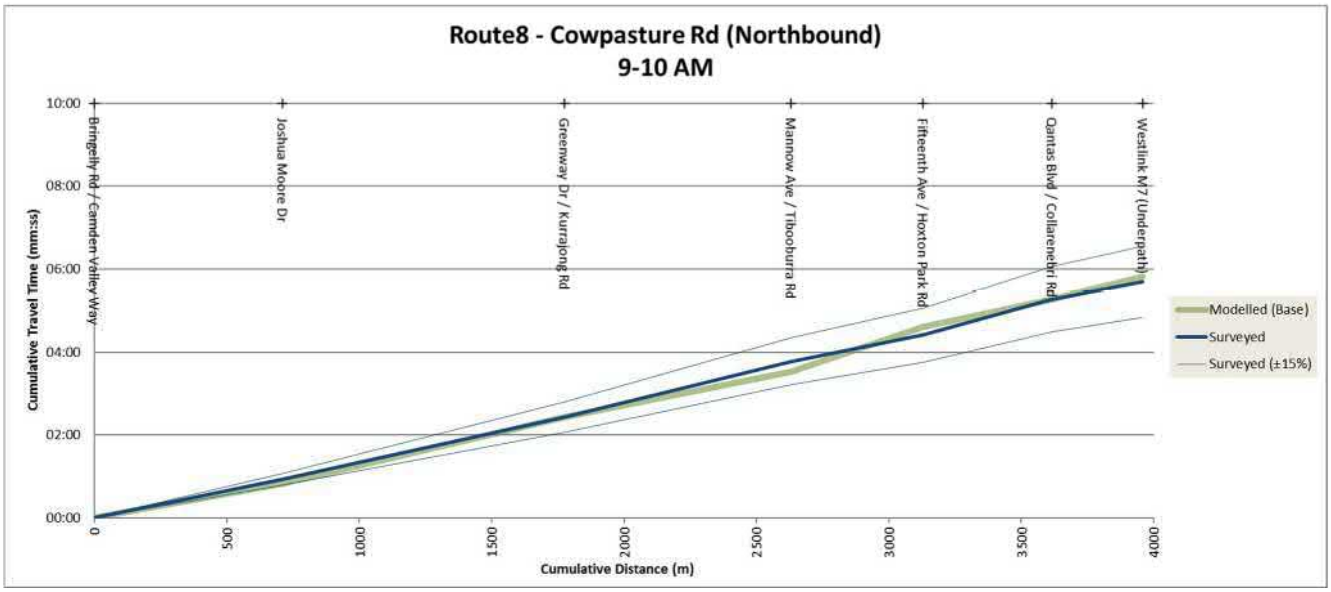

Route7 - Camden Valley Way / Bringelly Road (Eastbound)
6-7 PM
Cumulative Travel Time (mm:ss)
26:00
24:00
22:00
20:00
18:00
16:00
14:00
12:00
10:00
08:00
06:00
04:00
02:00
The Old Northern Rd
Jersey Rd
Allenby Rd
King St
Edmondson Ave / Rickard Rd
Cowpasture Rd
Cowpasture Rd
Hornings ea Park Dr / Talana Hill Dr
Ryman Ave
Corfield Rd / Gellibrand Rd
Bernera Rd / Croatia Ave
Ash Rd / Ardennes Ave
Camden Valley Way Exit S Western Fwy
Beach Rd
Campbelltown Rd
0
2000
4000
6000
8000
10000
12000
14000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

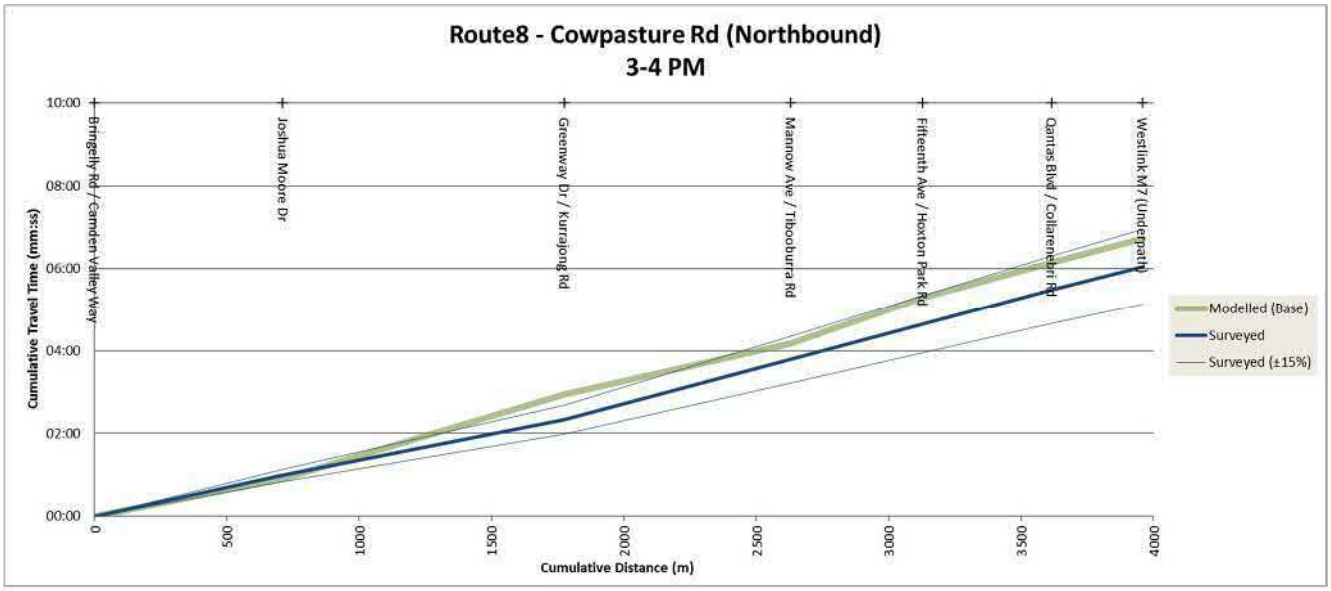
B.8 Route 8 – Cowpasture Road

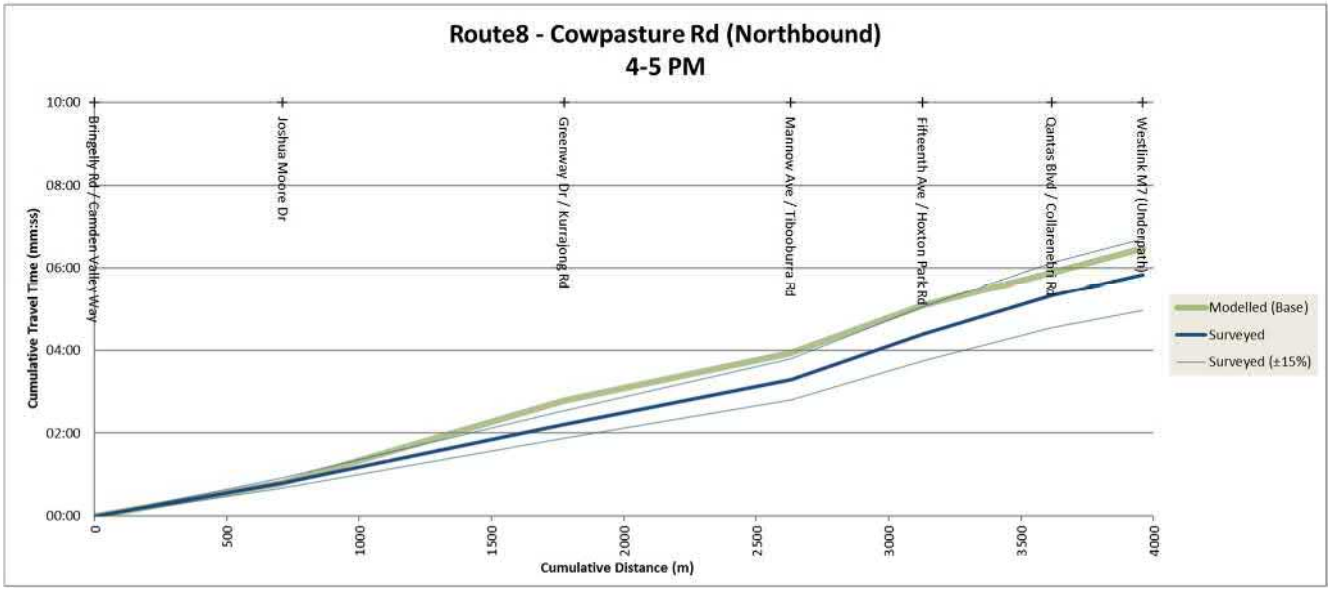


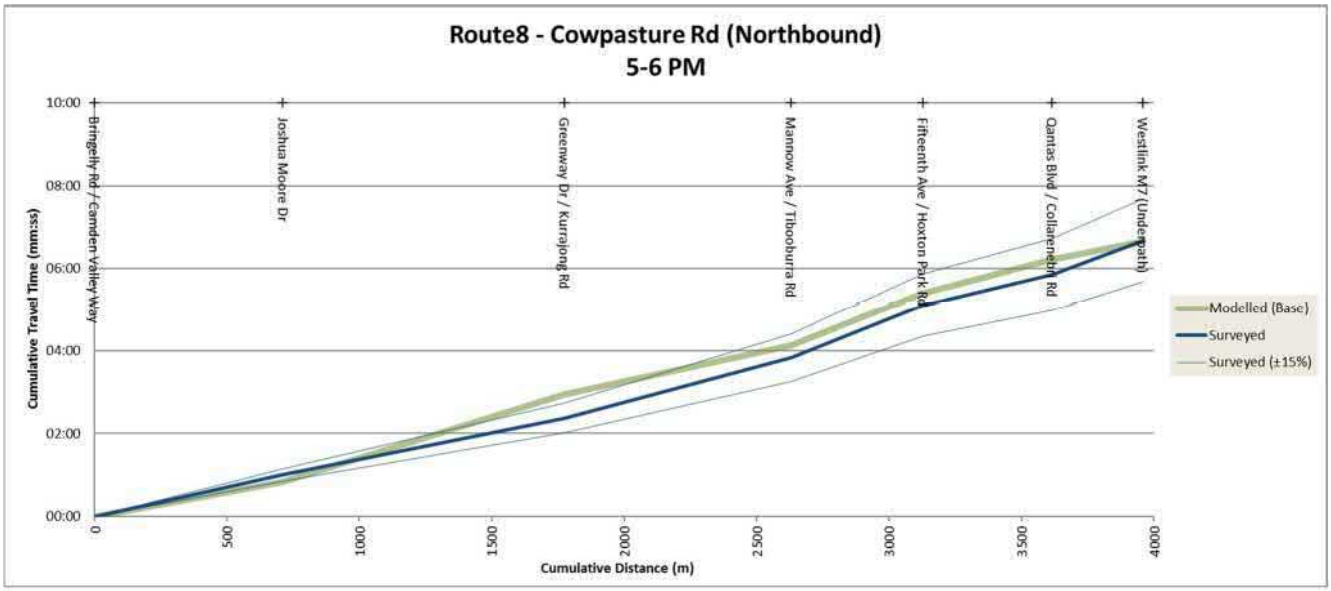


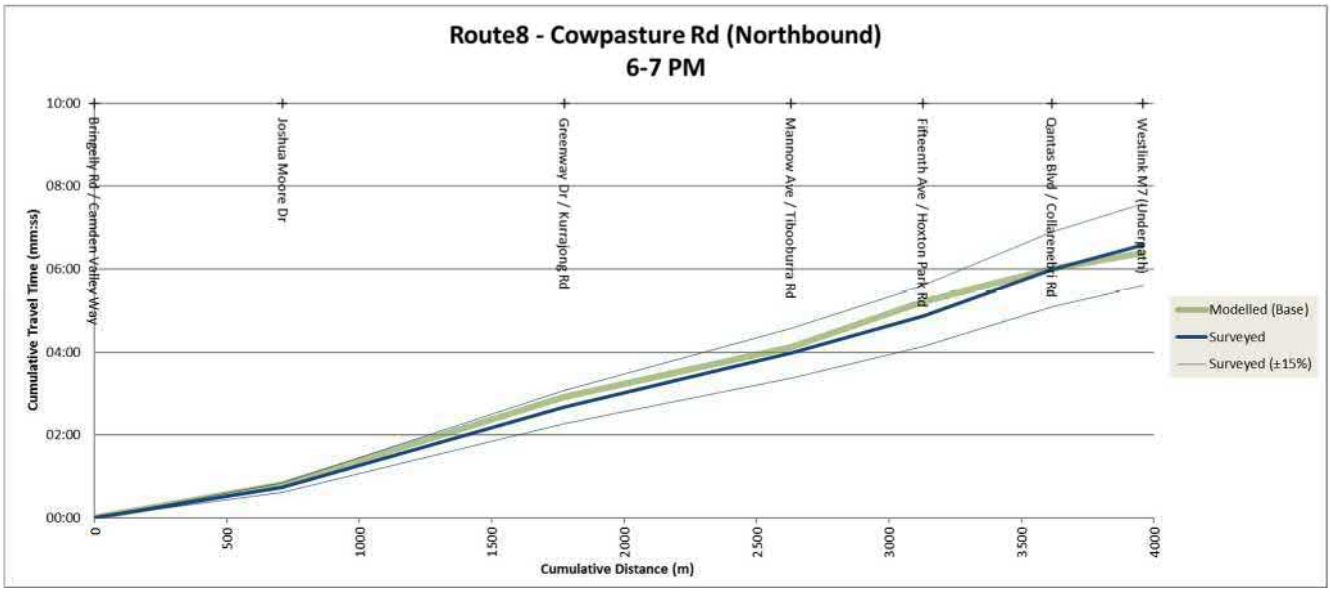

Route8 - Cowpasture Rd (Northbound)
8-9 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboobura Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

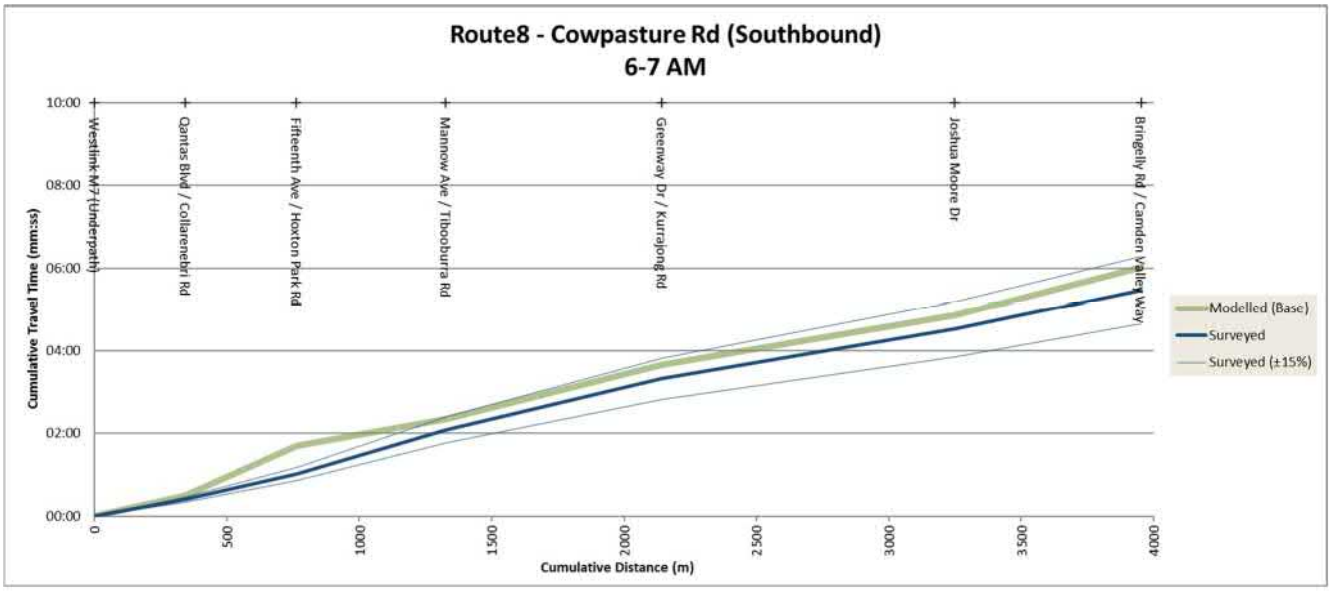

Route8 - Cowpasture Rd (Northbound)
9-10 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboobura Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

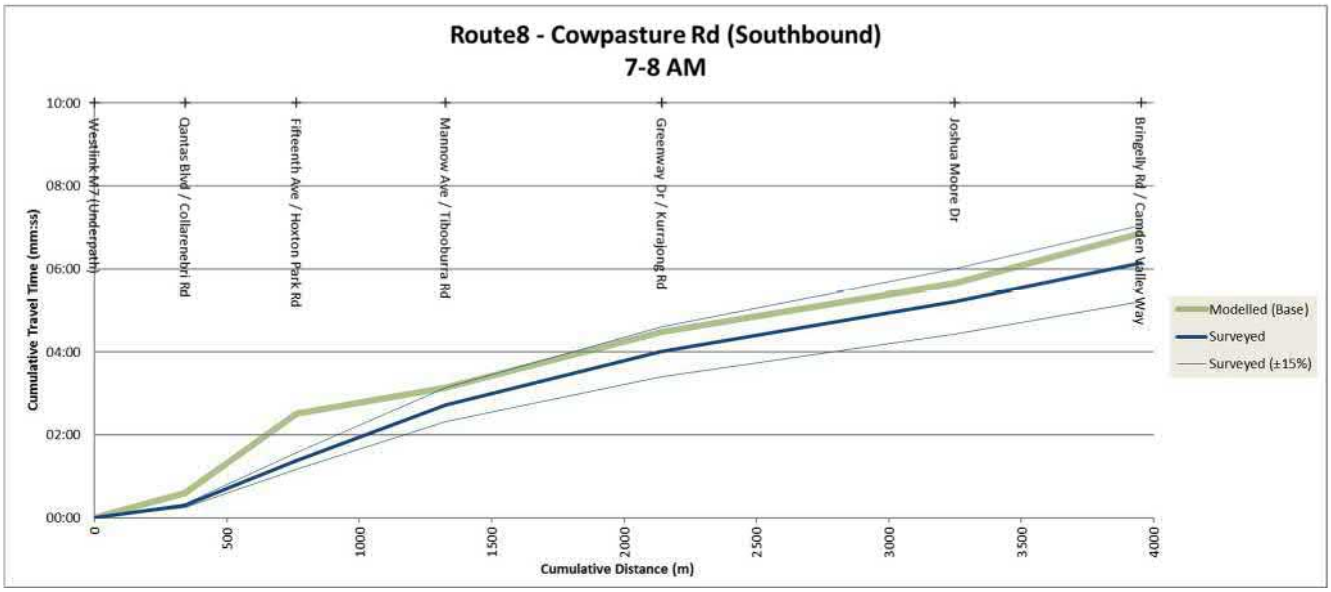

Route8 - Cowpasture Rd (Northbound)
3-4 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboburra Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

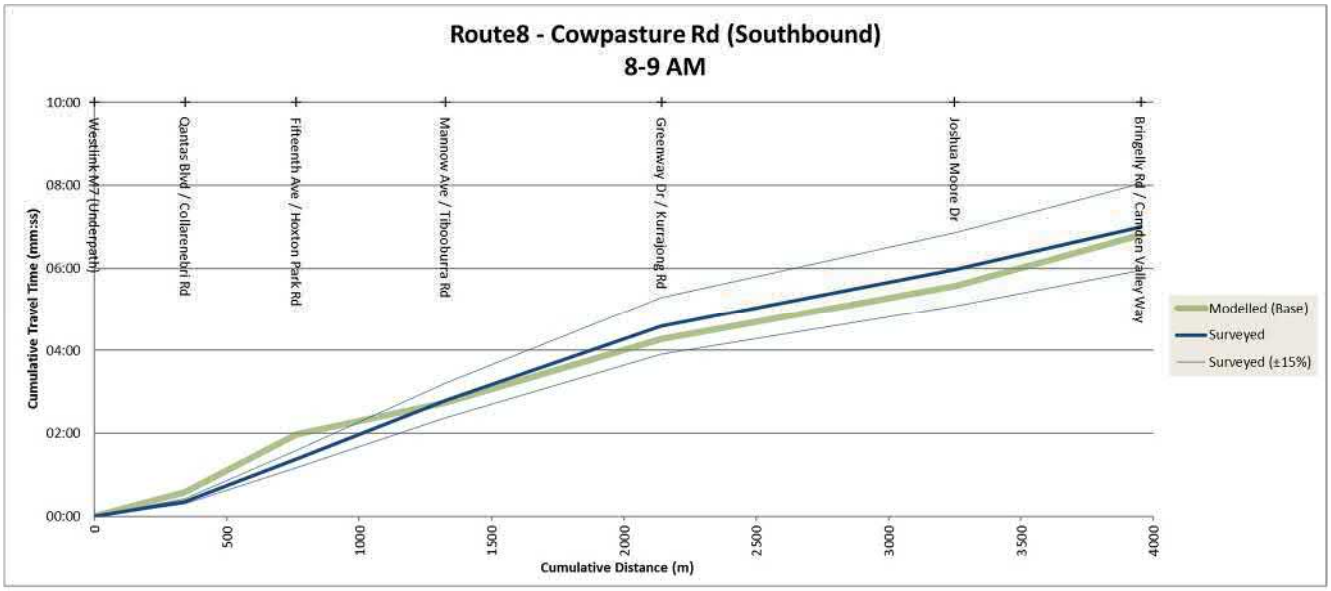

Route8 - Cowpasture Rd (Northbound)
4-5 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboburra Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

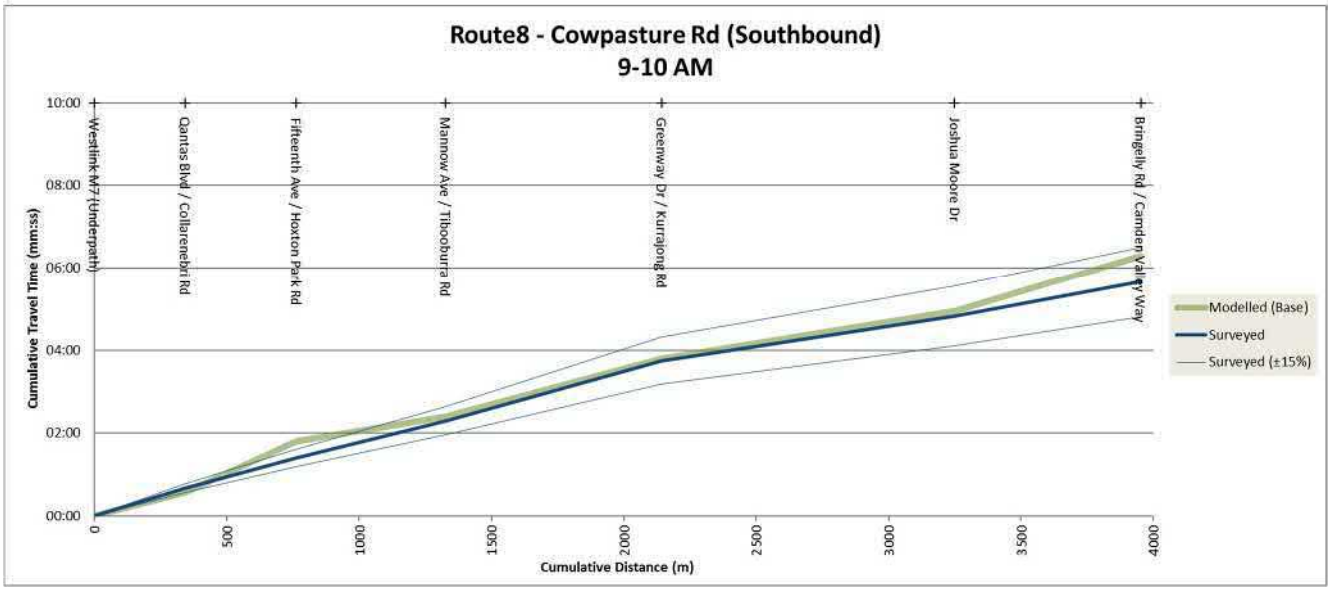

Route8 - Cowpasture Rd (Northbound)
5-6 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboobura Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

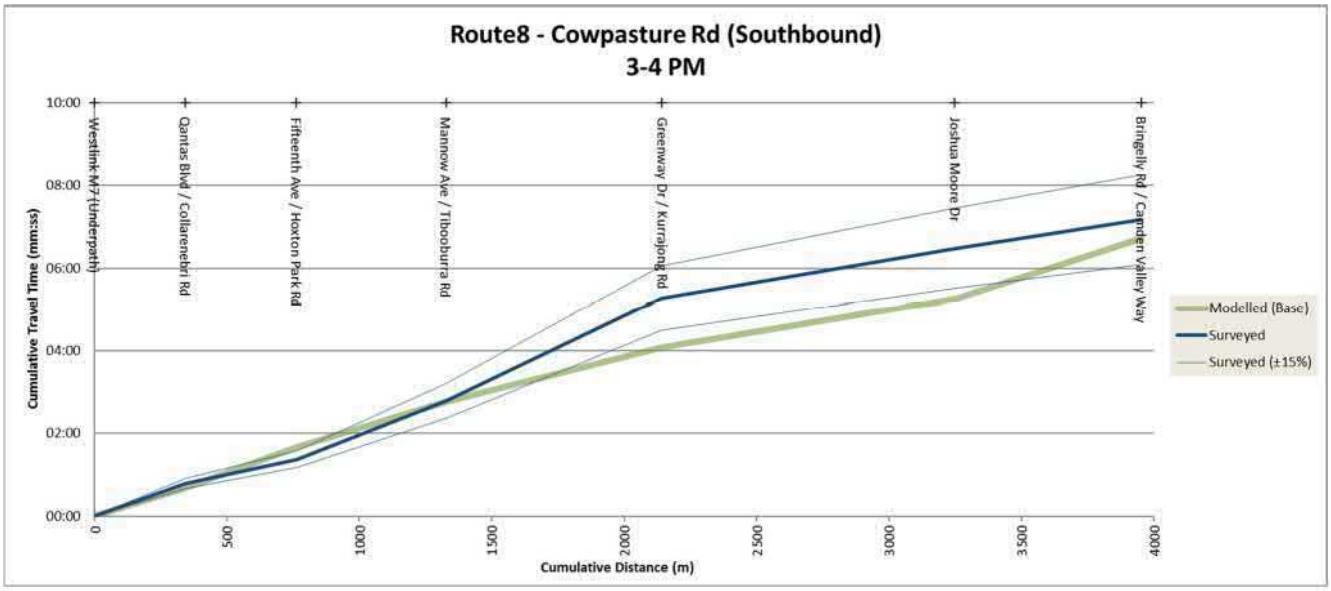

Route8 - Cowpasture Rd (Northbound)
6-7 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Bringelly Rd / Camden Valley Way
Joshua Moore Dr
Greenway Dr / Kurrajong Rd
Mannow Ave / Tiboobura Rd
Fifteenth Ave / Hoxton Park Rd
Qantas Blvd / Collarenebri Rd
Westlink M7 (Underpath)
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

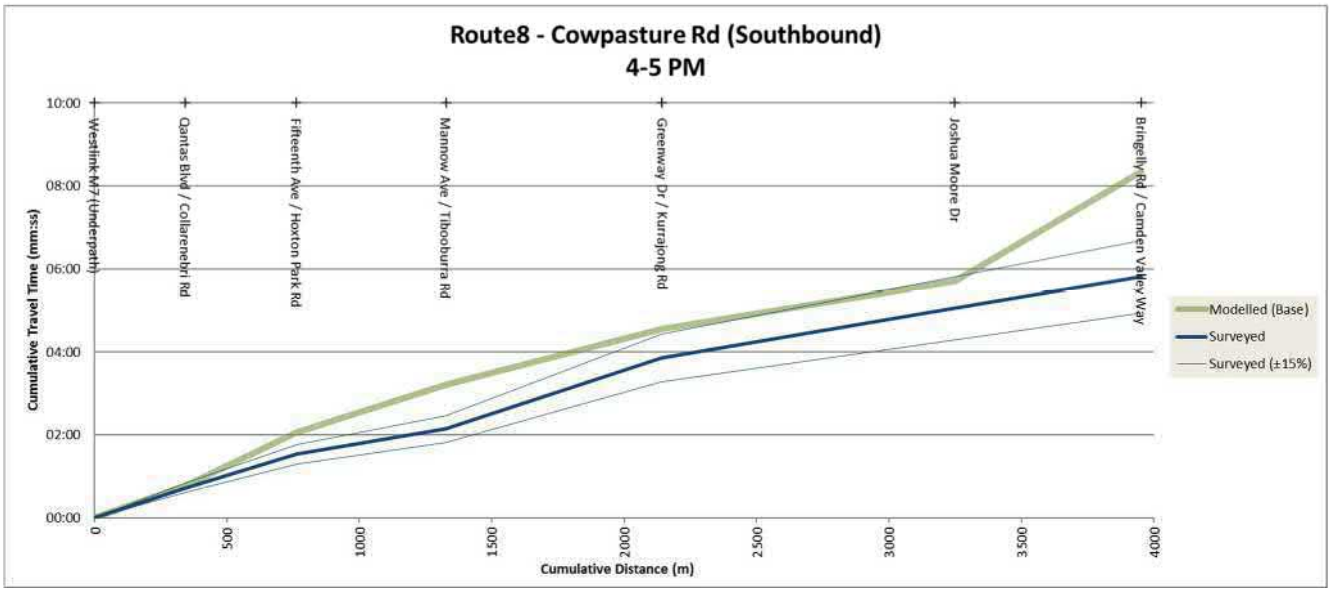

Route8 - Cowpasture Rd (Southbound)
6-7 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tibooburra Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

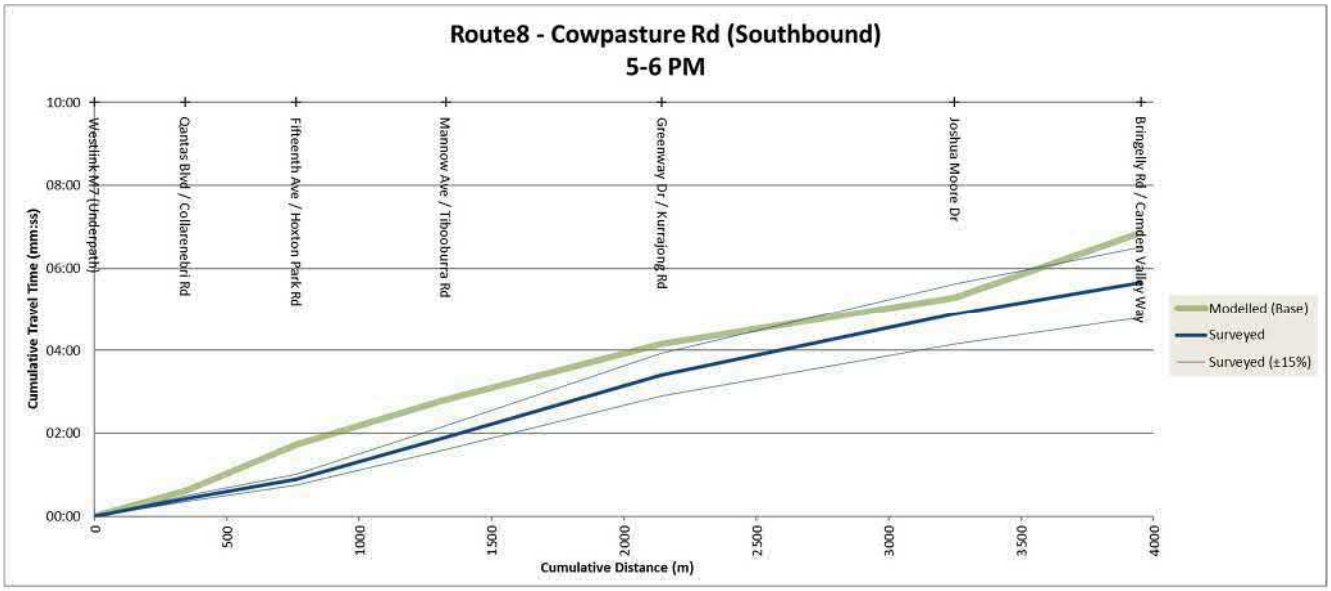

Route8 - Cowpasture Rd (Southbound)
7-8 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tibooburra Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

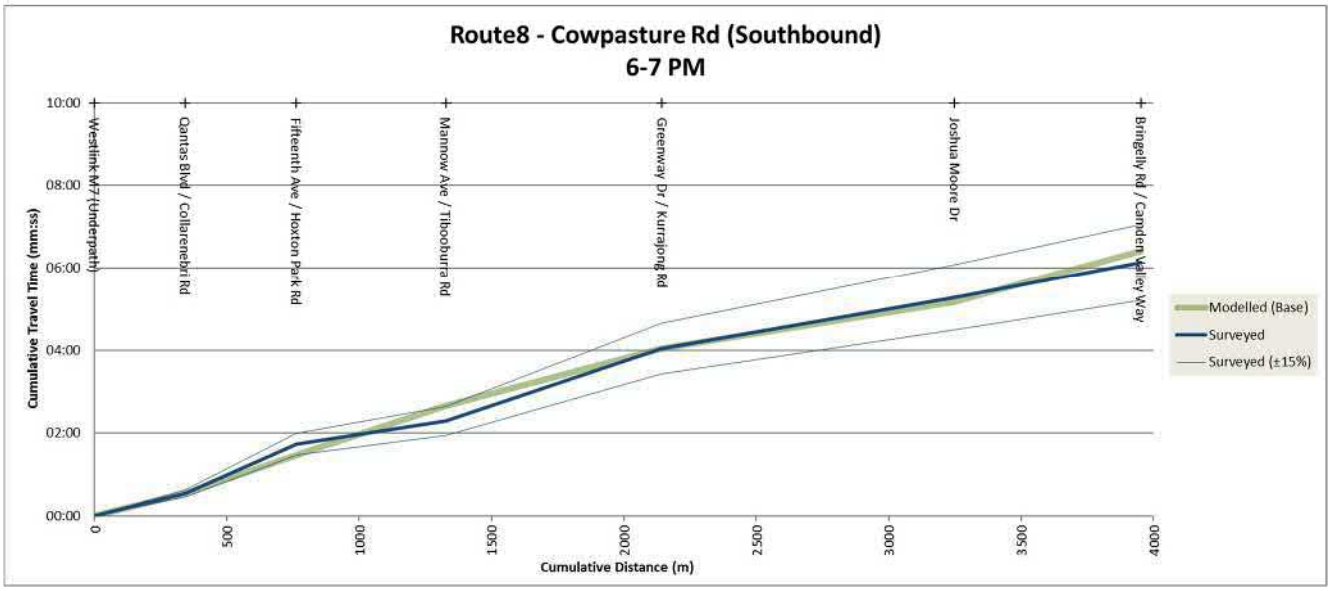

Route8 - Cowpasture Rd (Southbound)
8-9 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tibooburra Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route8 - Cowpasture Rd (Southbound)
9-10 AM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tibooburra Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route8 - Cowpasture Rd (Southbound)
3-4 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tiboobura Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route8 - Cowpasture Rd (Southbound)
4-5 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tiboobura Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route8 - Cowpasture Rd (Southbound)
5-6 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tiboobura Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)


Route8 - Cowpasture Rd (Southbound)
6-7 PM
Cumulative Travel Time (mm:ss)
10:00
08:00
06:00
04:00
02:00
00:00
Westlink M7 (Underpath)
Qantas Blvd / Collarenebri Rd
Fifteenth Ave / Hoxton Park Rd
Mannow Ave / Tiboobura Rd
Greenway Dr / Kurrajong Rd
Joshua Moore Dr
Bringelly Rd / Camden Valley Way
0
500
1000
1500
2000
2500
3000
3500
4000
Cumulative Distance (m)
Modelled (Base)
Surveyed
Surveyed (±15%)

www.rms.nsw.gov.au/m12
m12motorway@rms.nsw.gov.au

1800 517 155

Roads and Maritime Services
PO Box 973
Parramatta NSW 2124

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