

Technical Paper 2 – Supplementary Traffic and Transport Assessment

Newcastle Inner City Bypass
Rankin Park to Jesmond

April 2018



Document control record

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Document control						aurecon
Report title		Technical Paper 2 Supplementary Traffic and Transport Assessment				
Document ID		RP2J-TP2 SUP	Project number	245321		
File path		pw:\\designshare.au.aurecon.info:PW_PROD_AU\Documents\Projects\24xxxx\245321 - Rankin Park to Jesmond\3 Project Delivery\Environmental\EIS\EIS document\Technical papers\Traffic Technical Assessment\				
Client		Roads and Maritime Services	Client contact	Matthew Mate		
Rev	Date	Revision details/status	Author	Verifier	Approver	
CRV01	19 April 2018	Final report	SL/SC/NE	SP	CM	
Current revision		CRV01				

Approval			
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Newcastle Inner City Bypass Rankin Park to Jesmond

Date 19 April 2018
Reference 245321
Revision CRV01

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Executive summary

Roads and Maritime Services (Roads and Maritime) is seeking approval to construct the fifth section of the Newcastle Inner City Bypass between Rankin Park and Jesmond (the project). The approval is sought under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs, an environmental impact statement (EIS) was prepared by Roads and Maritime in November 2016 (*Newcastle Inner City Bypass – Rankin Park to Jesmond Environmental Impact Statement* (Roads and Maritime Services 2016)) to assess the potential impacts of the project. The EIS was exhibited by the Department of Planning and Environment (DP&E) for 30 days from 16 November 2016 to 16 December 2016.

The *Newcastle Inner City Bypass – Rankin Park to Jesmond Environmental Impact Statement Technical Paper 2 – Traffic and Transport* (Aurecon 2016) (herein referred to as the Traffic and Transport Assessment) was prepared in support of the EIS for the project. The purpose of the assessment was to assess potential traffic and transport impacts from the project operation and construction, and where required, identify mitigation measures. The assessment was also prepared to address the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs issued by DP&E for the project.

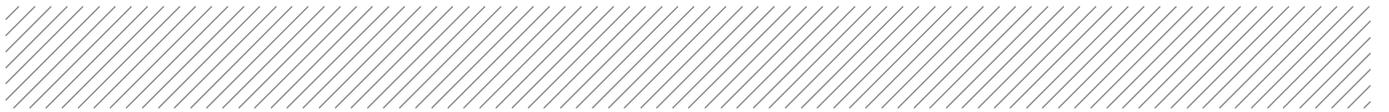
Following exhibition of the EIS, receipt of submissions and further consultation with stakeholders a number of refinements have been made to the project. The main design refinements are:

- The hospital Interchange would now be a full interchange with both north and south facing ramps
- Improved pedestrian and cyclist facilities including grade separation of the Jesmond Park shared path and refinement to the shared path connections to the shared path bridge over Newcastle Road
- Construction work:
 - New/adjusted construction compounds including access and utility connections
 - Refinement of the proposed extended construction hours to limit construction activities carried out during the morning.

This supplementary traffic and transport assessment report has been prepared in accordance with the SEARs to assess the potential impacts of the design refinements made to the project following public exhibition of the EIS.

The following points summarise the findings of this supplementary assessment:

- The project would provide major benefits for motorists using the Newcastle Inner City Bypass with substantial reductions in travel time for both northbound and southbound journeys.
- The project would improve travel times for north-south trips on the existing route and for east-west trips on Newcastle Road.
- The project would generally improve intersection performance at key existing intersections in 2020 and 2030 in both the morning and afternoon peaks.
- The project would improve connections to the existing shared paths in the study area and enhance options for walking and cycling. This would improve safety for pedestrians and cyclists.
- The majority of construction traffic movements are expected to be contained within the project's construction boundary with the exception of deliveries to site, disposal of waste and staff travel.



- During construction, the project would result in small increases of traffic volumes on the existing road network of up to 1.5 per cent of average weekday daily traffic volumes and 1.8 per cent of traffic volumes during peak periods. Due to the low predicted increase in traffic volumes, this worst-case scenario is considered unlikely to affect the level of service at the intersections servicing these roads.

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1 Introduction

1.1 The project

1.1.1 Overview

Roads and Maritime Services (Roads and Maritime) is seeking approval to construct the fifth section of the Newcastle Inner City Bypass between Rankin Park and Jesmond (the project). The approval is sought under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The project would involve the construction of about 3.4 kilometres of new four lane divided road between Lookout Road at New Lambton Heights and Newcastle Road at Jesmond. The project is located in the Newcastle local government area, about 11 kilometres west of the Newcastle central business district and about 160 kilometres north of Sydney (Figure 1-1).

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs, an environmental impact statement (EIS) was prepared by Roads and Maritime in November 2016 (*Newcastle Inner City Bypass – Rankin Park to Jesmond Environmental Impact Statement* (Roads and Maritime Services 2016) to assess the potential impacts of the project. The EIS was exhibited by the Department of Planning and Environment (DP&E) for 30 days from 16 November 2016 to 16 December 2016.

Following exhibition of the EIS, receipt of submissions and further consultation with stakeholders a number of design refinements have been made to the project.

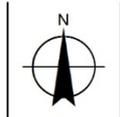
The key features of the project (Figure 1-2) now include:

- New road with two lanes in each direction, separated by a median
- Three interchanges, consisting of:
 - Northern interchange providing access to Newcastle Road and the existing Jesmond to Shortland section of the Newcastle Inner City Bypass. The full interchange provides all movements to/from the bypass and Newcastle Road
 - Hospital interchange providing access between John Hunter Hospital precinct and the bypass. The full interchange provides all movements to/from the bypass
 - Southern interchange providing access to Lookout Road and the existing Kotara to Rankin Park section of the Newcastle Inner City Bypass. The bypass would travel under McCaffrey Drive. The half interchange provides connection in both directions on Lookout Road
- Structures along the road to allow for drainage, animal and bushwalker access
- Tie in and upgrades to connecting roads, including Lookout Road, McCaffrey Drive and Newcastle Road
- Large cut and fill embankments due to steep and undulating terrain
- Pedestrian and cycling facilities, including a shared path bridge over Newcastle Road and grade separation of the existing east-west Jesmond Park shared path at the northern interchange
- Noise barriers and/or architectural treatment, as required
- Permanent operational water quality measures.



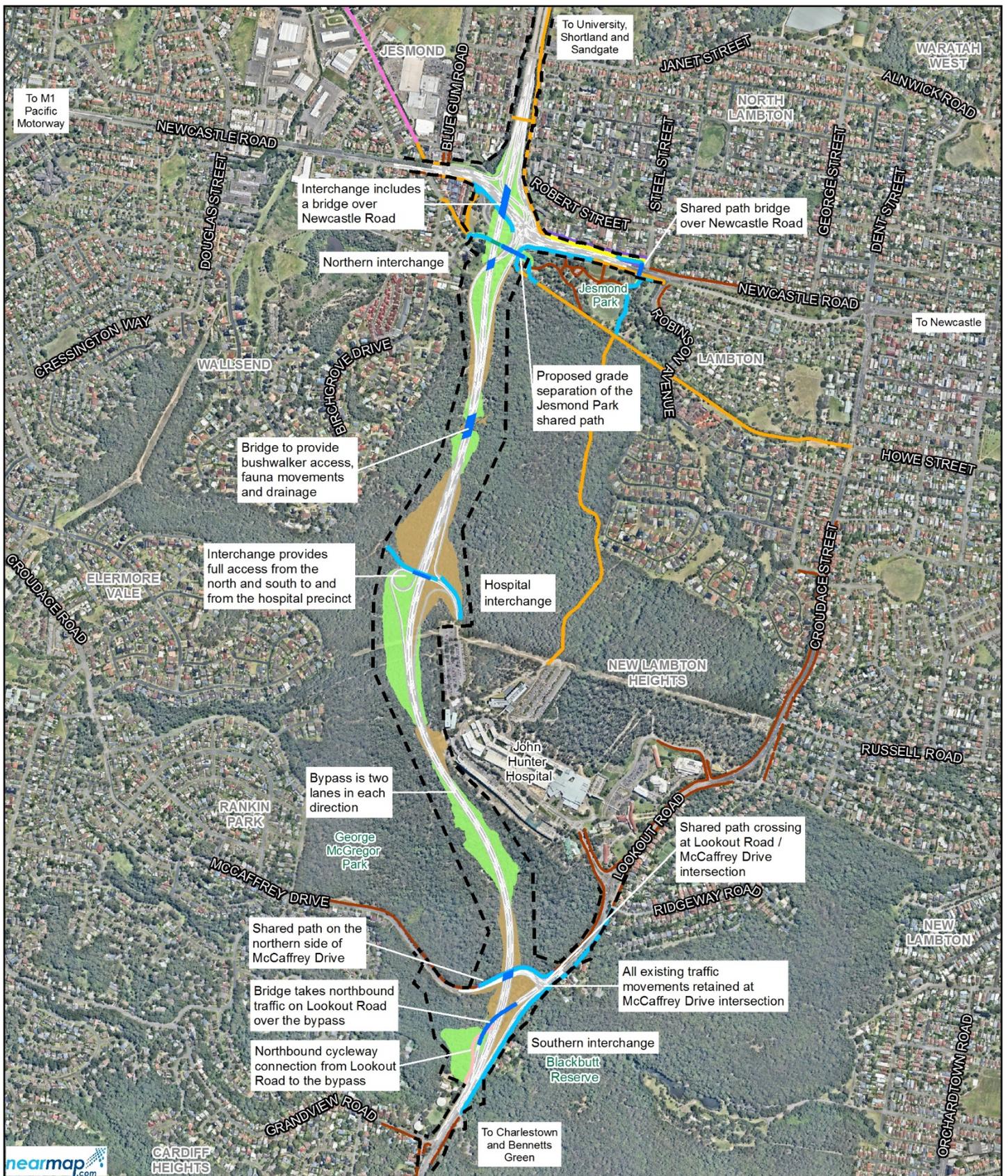
- LEGEND**
- The Project
 - Road
 - Local government area
 - National Parks and Wildlife Service Estate and bushland reserves
 - Watercourse area

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 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Rankin Park to Jesmond

Figure 1-1
 Project locality



Rankin Park to Jesmond

Figure 1-2
Project overview

Ancillary work to facilitate construction of the project (Figure 1-3), including:

- Adjustment, relocation and/or protection of public utilities and services
- Mine subsidence treatment, as required
- Temporary construction facilities, including sedimentation basins, compounds and stockpile sites
- Temporary and permanent access tracks
- Concrete/asphalt batching plant, as required.

1.1.2 Design refinements

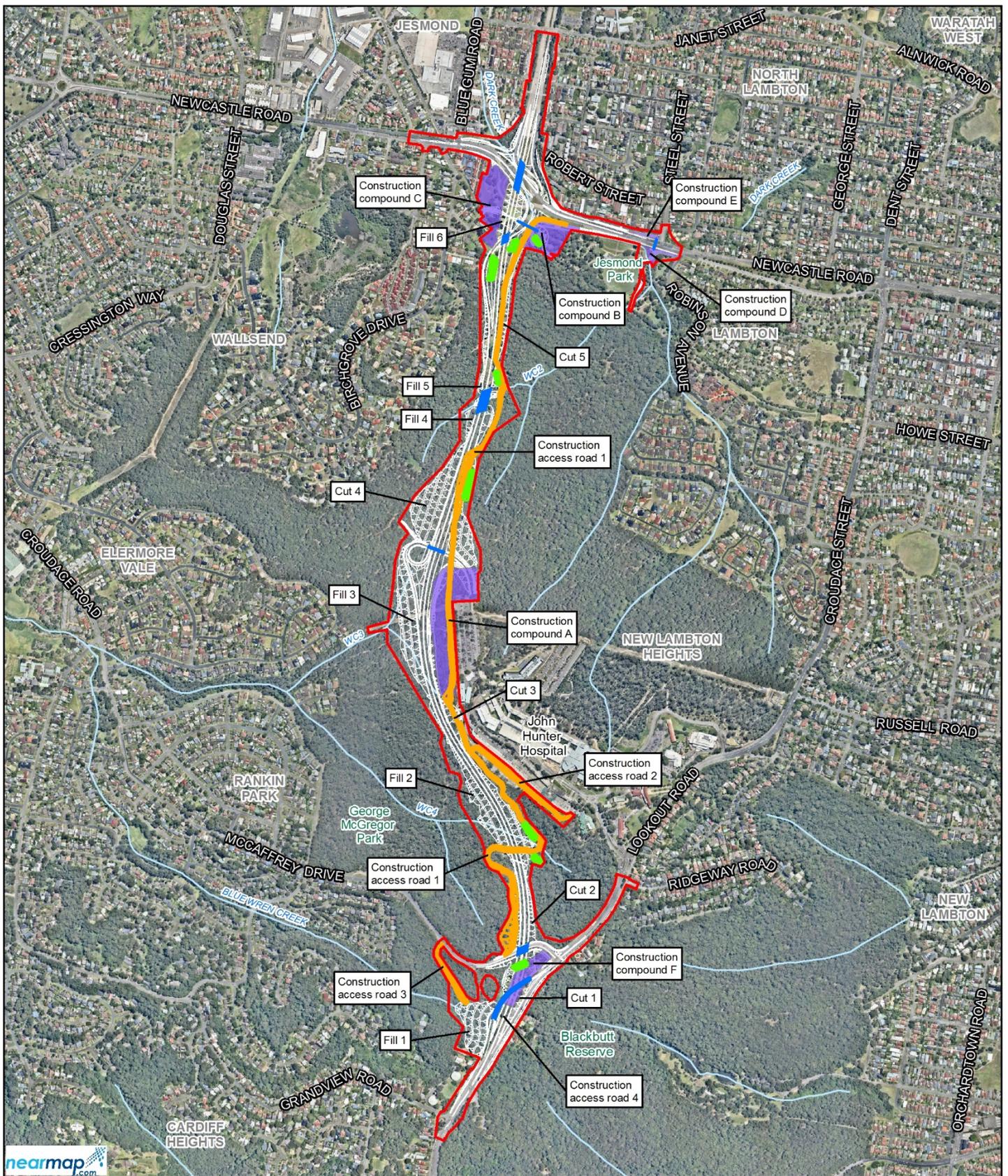
There are two types of design refinements:

- Main design refinements
- Minor design refinements.

Main design refinements

The main design refinements are:

- Hospital interchange layout:
 - The addition of south-facing ramps results in a full interchange with both north and south facing ramps, providing access between the bypass and the hospital precinct
- Pedestrian and cyclist facilities
 - Jesmond Park shared path – an overpass bridge (Bridge 8) and underpass arrangement would now be provided at the northern interchange to provide an east-west grade separated shared path for both pedestrians and cyclists
 - Hospital interchange – the shared path crossing of the southbound off-ramp would now be controlled by traffic lights
 - Southern interchange – a new northbound cycleway connection from Lookout Road to the bypass would be provided for on-road cyclists
 - Southern interchange – a new southbound cycleway crossing controlled by traffic lights would be provided from the bypass to Lookout Road for on-road cyclists
 - McCaffrey Drive – the proposed pedestrian footpath on the northern side would now be replaced with a wider shared path for use by both pedestrians and cyclists
 - Lookout Road and McCaffrey Drive intersection – the pedestrian crossings on the left turn lane from McCaffrey Drive onto Lookout Road, and across Lookout Road would now both be shared path crossings controlled by traffic lights
 - Shared path bridge over Newcastle Road – the connections either side of the shared path bridge (Bridge 7) over Newcastle Road have been refined to improve connectivity with existing shared paths
- Water quality treatment structures:
 - Refinement and inclusion of additional treatment measures with permanent operational water quality structures increased from five to eight
- Construction work:
 - New/adjusted construction compounds including access and utility connections
 - Refinement of the proposed extended construction hours to limit construction activities carried out during the morning.



LEGEND

- Construction footprint
- Construction compound
- Construction access tracks
- Construction sedimentation basin
- Design
- Bridge
- Watercourse

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Rankin Park to Jesmond

Figure 1-3
 Construction ancillary facilities - overview



Minor design refinements

The minor design refinements are mostly as a result of the main design refinements and are:

- Bridges
 - Adjustments to the cross section of Bridge 2 to allow for the McCaffrey Drive shared path
 - Widening of Bridge 3 to allow for the full hospital interchange.
- Flooding and drainage:
 - Refinement of the proposed flood mitigation work near the northern interchange, to allow for the grade separation of the Jesmond Park shared path
 - Adjustments to the project drainage design to reflect other design refinements
- Cuttings and embankments:
 - Adjustments to the estimated cut and fill volumes required for the project to reflect other design refinements
- Proposed road corridor:
 - Minor adjustments to the proposed road corridor to reflect other design refinements
- Property acquisition:
 - Minor adjustments to the property acquisition requirements for the project to reflect other design refinements
- Noise mitigation work:
 - Adjustments to the preliminary operational noise mitigation scenario
- Directional signage:
 - Addition of directional signage on the surrounding road network
- Construction work:
 - Minor adjustments to the construction footprint to reflect other design refinements
 - Minor adjustments to potential construction lease areas to reflect other design refinements
 - Adjustments to earthworks, erosion and sediment control and construction materials to reflect other design refinements
 - Refinement of the early work construction activities.

1.2 Purpose of this report

A Traffic and Transport Assessment (Aurecon 2016) was prepared in support of the EIS for the project. The purpose of the assessment was to provide an assessment of the traffic and transport related impacts and benefits that may result from construction and operation of the project.

The assessment was prepared to address the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs as described in Section 1.4 of the Traffic and Transport Assessment (Aurecon 2016). This supplementary traffic and transport assessment has been prepared to assess the potential impacts of the project, including the design refinements described in Section 1.1.2.

The main design refinements affecting traffic and transport are:

- The addition of south facing ramps at the hospital interchange layout resulting in a full interchange.

- 
- The addition of an overpass bridge (Bridge 8) and underpass arrangement for the Jesmond Park shared path at the northern interchange to provide an east-west grade separated shared path for both pedestrians and cyclists.
 - The addition of three additional construction compounds, resulting in a total of six construction compounds.

Whilst the focus of the supplementary assessment was on these design refinements, the potential impacts of other refinements were also included and are presented in this report.

This supplementary assessment only includes information that has changed since the EIS and should be read in conjunction with the Traffic and Transport Assessment (Aurecon 2016).

The study area for this assessment has been defined as all areas within the project's construction and operational footprint and the surrounding road network that connects with the project. This is described in detail in Section 2 of the Traffic and Transport Assessment (Aurecon 2016).



2 Existing traffic and transport environment

Section 2 of the Traffic and Transport Assessment (Aurecon 2016) provides a detailed description of the existing traffic and transport features and conditions relevant to the study area, including: existing road, pedestrian and cycling networks; on-street and off-street parking; heavy and restricted access vehicle routes; historical traffic growth; historical crash data; and public transport services. This chapter provides an overview of these features.

Section 3 of the Traffic and Transport Assessment (Aurecon 2016) provides a detailed overview of the performance of the existing transport network within the study area, including results from traffic surveys, assessments of traffic volumes and the results of an origin-destination traffic study.

Section 4 of the Traffic and Transport Assessment (Aurecon 2016) details the approach used for traffic modelling and forecasting for the project, which included:

- strategic traffic modelling which was used to identify future traffic growth and the forecast traffic redistribution on the surrounding road network post implementation of the project
- microsimulation traffic modelling, which was used to assess the operational performance of design options for comparison and evaluation.

2.1 Overview

2.1.1 General traffic

Traffic movements within the study area are dominated by the north-south traffic flows on the existing sections of the Newcastle Inner City Bypass, Lookout Road and Croudace Street which form part of route A37, and east-west traffic flows along Newcastle Road which forms part of route A15. The study area and road network surrounding the project are shown on Route A15 is the main east-west road transport route through Newcastle, providing road connection between the city and national and state highways located to the west. The route links the M1 Pacific Motorway and Hunter Expressway (route M15) at West Wallsend, and Stewart Avenue (Pacific Highway route A43) at Newcastle West. Route A15 connects with a number of other arterial roads, including: Lake Road (route B53) which is the main arterial road servicing the western side of Lake Macquarie; and Turton Road (route B63) which links the northern suburbs of Newcastle and the Port of Newcastle with suburbs to the south such as Kotara and Broadmeadow.

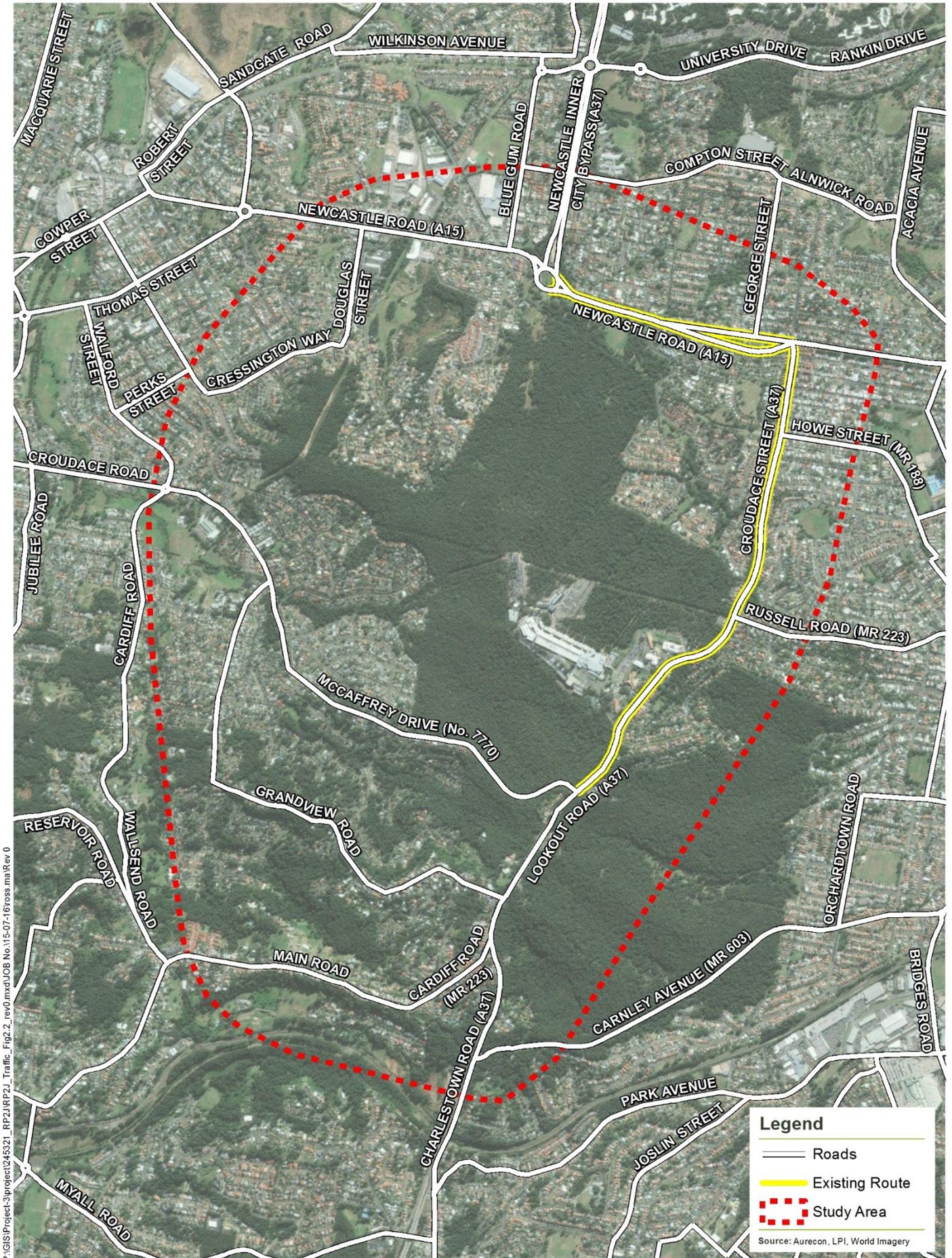
Route A37 is a key north-south road transport route through Newcastle, providing an alternate 'bypass' route to the Pacific Highway that avoids the inner suburbs of the city. The route connects the Pacific Highway (route A43) at Bennetts Green in the south and again at Sandgate (route A43) in the north. Route A37 shares a section of Route A15 between the intersection with Newcastle Road (Jesmond Roundabout) and Croudace Street. The section of Route A37, from Charlestown Road to Newcastle Road is located along a major ridge line over the majority of its length. The A37 route is along Charlestown Road, Lookout Road and Croudace Street, and is intersected by a number of regional roads, all of which are signalised intersections.

There are a number of intersections along the length of A37 meaning there are numerous weaving movements as traffic joins A37 at one intersection and exit at another intersection, sometimes in close proximity.



The road network surrounding the project currently suffers from traffic congestion and delays at key intersections, particularly during peak periods. There are a number of constraints along the existing route of Lookout Road, Croudace Street and Newcastle Road (refer to Figure 2-1) which include:

- Eleven sets of existing traffic lights on Lookout Road, Croudace Street and Newcastle Road from the McCaffrey Drive intersection to the existing roundabout on Newcastle Road at Jesmond
- Sixteen uncontrolled intersections with local and regional roads
- A large number of driveways to private properties, which reduce the allowable traffic speed and contribute to traffic congestion
- A public school located on Croudace Street with a 40 kilometre per hour school zone speed limit in place during peak hours.



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Newcastle Inner City Bypass Rankin Park to Jesmond **Traffic and Transport Assessment**

Projection: GDA 1994 MGA Zone 56

FIGURE 2-1: Road network



2.1.2 Heavy and restricted access vehicles

Heavy vehicles are defined under the Heavy Vehicle National Law (which is administered by the National Heavy Vehicle Regulator) as a vehicle with a single, or combined (i.e. with trailer) mass of more than 4.5 tonnes. This includes many types of trucks and large vehicles such as buses.

Restricted access vehicles are any single or combined vehicle which when either empty or loaded exceed the overall dimensions specified for heavy vehicles under the Heavy Vehicle National Law. These include vehicles such as B-double trucks, road trains, and vehicles over 4.6 metres in height.

Restricted access vehicles are not permitted to travel on a number of roads and these include the existing route of Lookout Road and Croudace Street. A review of restricted access vehicle movements on the road network surrounding the project is provided in Section 2 of the Traffic and Transport Assessment (Aurecon 2016).

Sections of the Newcastle Inner City Bypass route south of Newcastle Road are not approved for use by restricted access vehicles. Volumes of heavy vehicles that use the existing route are currently low at about four per cent of all traffic.

There are no approved routes for road trains within the study area or broader region.

2.1.3 Road network

The existing State road network relevant to the project comprises the following key routes (refer to Figure 2.1):

- Newcastle Inner City Bypass (A37) – Newcastle Road, Jesmond to Pacific Highway, Sandgate
- Newcastle Inner City Bypass (A37) – Charlestown Road, Lookout Road and Croudace Street
- Newcastle Road (A15) – generally between Wallsend and Broadmeadow, specifically between Blue Gum Road, Jesmond and Croudace Street, Lambton.

Key regional roads within the study area include:

- Howe Street
- Russell Road
- McCaffrey Drive
- Cardiff Road
- Carnley Avenue.

A description of each of these major traffic routes is provided in Section 2.2 of the Traffic and Transport Assessment (Aurecon 2016).

2.1.4 Historical traffic growth

Annual average daily traffic (AADT) data was collected by Roads and Maritime between 2004 and 2014 on Newcastle Road, Croudace Street and Lookout Road within the study area. This data is displayed on Figure 2-3 of the Traffic and Transport Assessment (Aurecon 2016) and shows that between 2004 and 2014, traffic on the key traffic routes through the study area had grown by about 0.6 to 1.8 per cent per annum.

2.1.5 Public transport

There are no rail services within the study area, although the main northern railway line is located about three kilometres to the south. A number of bus services operate within the study area, with the John Hunter Hospital and Stockland Jesmond Shopping Centre being key passenger destinations.



Other public transport services operating in the study area include taxis, hire cars and community transport services.

2.1.6 Cycling and pedestrian network

A number of existing shared paths and paved pedestrian footpaths are located at the northern end of the project within Jesmond Park and around Newcastle Road. There is also a network of unpaved tracks, some of which are fire trails that occur throughout the bushland area bounded by Jesmond Park, John Hunter Hospital, Lookout Road, McCaffrey Drive and residential properties associated with Lambton, Wallsend, Elmore Vale and Rankin Park. These tracks are used informally for activities such as bike riding and bush walking, and for pedestrian access to John Hunter Hospital precinct. At the southern end of the project, there are a number of existing paved pedestrian footpaths along the existing route of Lookout Road and McCaffrey Drive.

Newcastle's existing bicycle network is made up of marked on-road routes and off-road shared paths. *Newcastle City Council's Cycling Strategy and Action Plan* (Newcastle City Council 2012) (the action plan) identifies proposed off-road and on-road cycling routes within the study area (refer to Figure 2-2).

Existing off-road shared paths exist at the northern end of the project, including:

- East-west shared path on the southern side of Jesmond Park, running from Howe Street, Lambton to Newcastle Road, Jesmond, near its intersection with Blue Gum Road. This path forms part of regional cycling route R5 – Newcastle City Centre to Glendale, as defined by the action plan. This route connects a number of key locations in Newcastle, including the city centre, Broadmeadow sports and entertainment precinct, Lambton Park and Glendale TAFE. This route connects to other on-road cycling routes and shared paths, as shown on Figure 2-2.
- East-west shared path on the southern side of Newcastle Road, running between Robinson Avenue and the mid-block signalised pedestrian crossing near Hill Street.
- North-south shared path running through the bushland area to the south of Jesmond Park, connecting the Jesmond Park path to the John Hunter Hospital. This path forms part of local cycling route L8 – University to John Hunter Hospital under the action plan and connects to route R5 at the eastern end of Jesmond Park.
- North-south shared path running along the eastern side of the Jesmond to Shortland section of the Newcastle Inner City Bypass. This path connects the University of Newcastle with Coles Street, Jesmond, providing access to Jesmond Park via an existing traffic light controlled crossing on Newcastle Road. This path forms part of local cycling route L8 – University to John Hunter Hospital as defined by the action plan. This route provides connections to route R5 at Jesmond Park and to regional route R6 (Newcastle City Centre, University, Birmingham Gardens) at University Drive.

On the existing sections of the Newcastle Inner City Bypass, cyclists are currently able to use the predominantly 2-2.5 metre shoulders.

The project footprint also includes the following planned cycling routes:

- R3 (Kotara to Sandgate). This regional cycling route would generally follow the corridor of the overall Newcastle Inner City Bypass, connecting to route R3 (Newcastle to Maitland) at Sandgate and to Bennetts Green in Lake Macquarie LGA. This route relies on the Newcastle Inner City Bypass creating suitable provisions for cyclists and the project would achieve this within the project footprint, and includes proposed on-road provision for the length of the project. Cycling provisions provided by the project are described in more detail in Section 3.6.
- L31 (John Hunter Hospital to Wallsend). This local cycling route would provide a connection from the John Hunter Hospital precinct to Elmore Parade, Elmore Vale. The route would generally



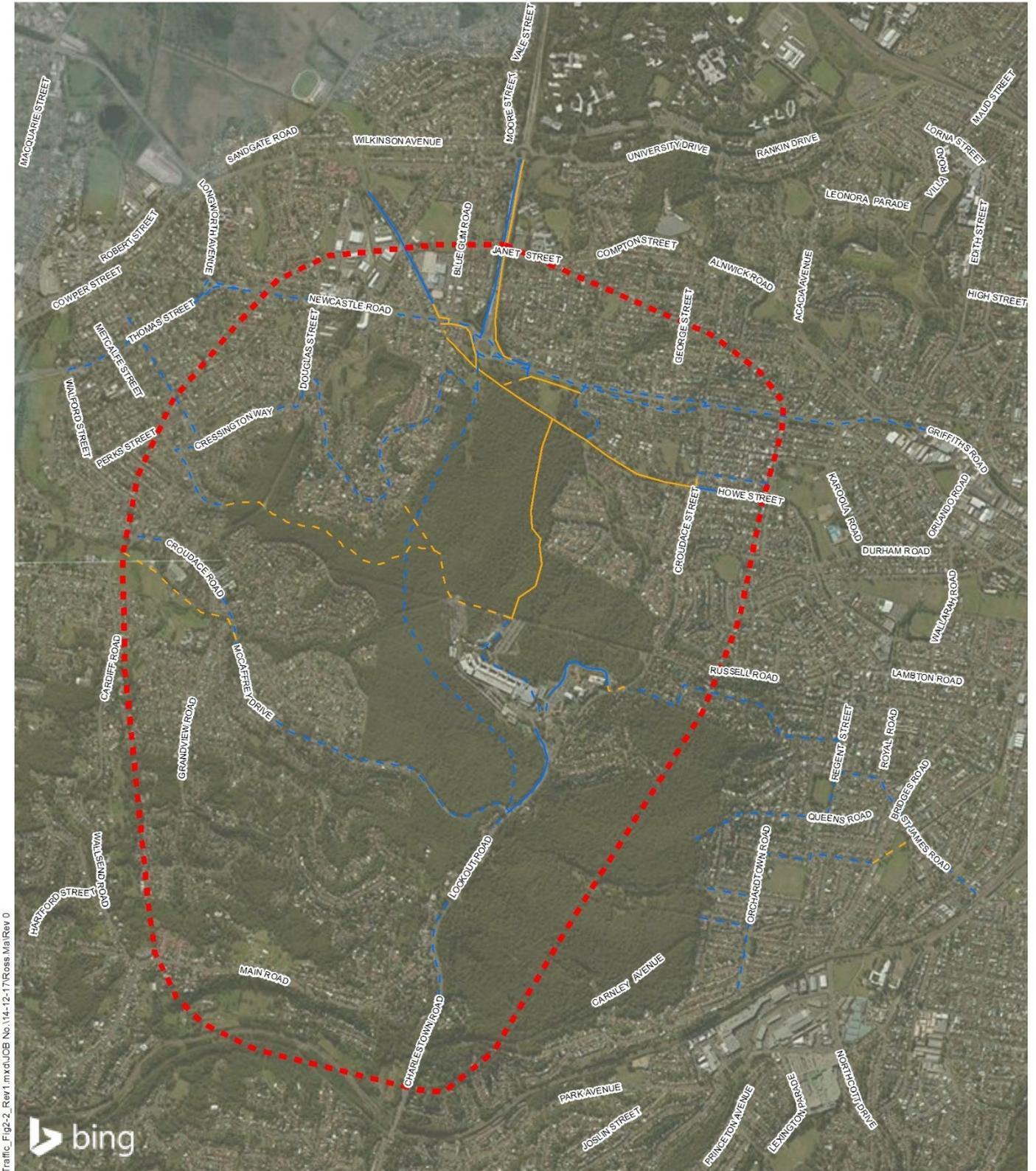
travel through bushland, traversing the project footprint and passing through Invermore Reserve and Dangerfield Drive Reserve to the west. This route would cross route R3 and would require extensive construction of off-road paths.

Following exhibition of the EIS, receipt of submissions and further consultation with key stakeholders, the proposed pedestrian and cyclist facilities have been further refined as described in Section 3.6.

2.1.7 Car parking

Car parking is available at a number of locations throughout the study area, including:

- Untimed, on-street parking is available on most regional and local roads, however; parking restrictions apply on some parts of Newcastle Road and Lookout Road.
- John Hunter Hospital Complex has a series of car parks, providing about 3,400 car parking spaces.
- Stockland Jesmond Shopping Centre provides over 900 car parking spaces.

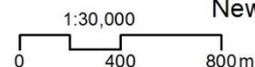


Legend

- - - Study Area
- - - On road - proposed route
- Cycling Routes**
- - - Off road - existing route
- On road - existing route
- - - Off road - proposed route

Source: BingMaps

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Newcastle Inner City Bypass Rankin Park to Jesmond **Traffic and Transport Assessment**

Projection: GDA 1994 MGA Zone 56

FIGURE 2-2: Cycling routes

3 Operational impacts

This section provides an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur from the operation of the elements of the project that have undergone design refinement, as described in Section 1.

3.1 Strategic traffic modelling

The assessment of the project’s operational impacts with respect to the predicted redistribution of traffic demand in the study area was based on modelling of the following features of the project using Roads and Maritime’s Lower Hunter Traffic Model (LHTM):

- **Southern interchange:** A half interchange with Lookout Road with south facing ramps. This provides a northbound off-ramp to Lookout Road and southbound on-ramp from Lookout Road
- **Hospital interchange:** the hospital interchange would now be a full interchange with both north and south facing ramps, via a connection from the bypass to the west of the John Hunter Hospital precinct.
- **Northern interchange:** A full interchange at the northern connection with Newcastle Road and the existing Jesmond to Shortland section of the Newcastle Inner City Bypass.

The results of this modelling are discussed in the following sections.

3.2 Traffic forecasts for the project

Forecast traffic volumes for the project for 2014, 2020, 2030 and 2040, are as shown in Table 3-1. These volumes reflect the redistribution of traffic demand within the study area’s road network that would use the project during its operational phase, with predicted traffic growth rates included for future years.

Table 3-1 Forecast daily traffic volumes on the project

ID	Location	Forecast daily traffic volumes (two-way in vehicles)			
		2014	2020	2030	2040
20	Project northern section, south of Newcastle Road	29,400	31,300	34,500	37,700
21	Project southern section, west of McCaffrey Drive	23,700	25,300	28,100	30,900
22	New Western Hospital access, east of RP2J	9,400	10,000	11,100	12,300

Note, Average Weekday Daily Traffic (two-way in vehicles).

Source: Lower Hunter Traffic Model (LHTM).

Analysis of the traffic forecast data shows:

- Based on 2020 traffic volumes (when the project is expected to be operating), the project is predicted to carry between 25,300 and 31,300 vehicles per day on average weekdays. The northern section between Newcastle Road and the proposed hospital interchange is expected to carry higher traffic. The new western hospital access is predicted to carry about 10,000 vehicles per day
- By 2030, traffic volumes on the project’s northern section, south of Newcastle Road are forecast to grow to about 34,500 vehicles per day and by 2040, 37,700 vehicles per day
- By 2030, traffic volumes on the project’s southern section, north of McCaffrey Drive are forecast to grow to about 28,100 vehicles per day and by 2040, 30,900 vehicles per day

- 
- Traffic volumes on the proposed hospital interchange are predicted to be about 11,100 vehicles per day in 2030. By 2040, traffic volumes are forecast to grow to about 12,300 vehicles per day.

Overall traffic volumes in the study area are predicted to increase by about one per cent per annum to 2040 and this would place increasing demands on the existing road network if no road improvements are carried out. The forecast increase in traffic volumes would lead to increased crash frequencies and decrease the level of service of the key transport routes in the study area, if current traffic arrangements are maintained.

3.3 Traffic impacts on the existing road network

A comparison of traffic volumes and changes to traffic patterns on existing roads in the study area has been carried out for current and future traffic conditions, both with and without the project and is presented in Table 3-2.

The key findings shown in Table 3-2 for 2020 conditions include:

- The project is expected to increase traffic on Charlestown Road south of Cardiff Road (ID1) by 3,900 vehicles per day (7 per cent) from about 55,500 vehicles per day (without the project) to about 59,400 vehicles per day (with the project).
- Similarly, the project is expected to increase traffic on Lookout Road south of McCaffrey (ID19), where the project joins Lookout Road, by 5,100 vehicles per day (10.5 per cent) from about 48,300 vehicles per day (without the project) to about 53,400 vehicles per day (with the project).
- The project is expected to reduce north-south and west-south through and regional traffic on the existing route of Lookout Road (north of McCaffrey Drive), Croudace Street and Newcastle Road (between Croudace Street and Newcastle Inner City Bypass). The project would reduce traffic on these roads by 25 to 43 per cent depending on location. This would substantially improve traffic flow along this route.
- The project is expected to substantially reduce traffic on Lookout Road north of McCaffrey Drive, where the project joins Lookout Road (ID7) by 20,600 vehicles per day (39 per cent) from about 52,500 vehicles per day (without the project) to about 31,900 vehicles per day (with the project).
- The project is expected to reduce traffic on Croudace Street north of Elder Street (ID17) by about 18,800 vehicles per day (43 per cent) from about 43,900 vehicles per day (without the project) to about 25,100 vehicles per day (with the project).
- Traffic on Newcastle Road east of Newcastle Inner City Bypass (ID16) is expected to decrease due to the project by about 16,800 vehicles per day (25 per cent) from about 66,200 vehicles per day (without the project) to about 49,400 vehicles per day (with the project).
- The project is expected to reduce traffic on McCaffrey Drive (ID5) by 3,300 vehicles per day (17 per cent) from about 19,100 vehicles per day (without the project) to about 15,800 vehicles per day (with the project).
- The project is expected to increase traffic on the Newcastle Inner City Bypass north of Newcastle Road (ID11) by about 5,200 vehicles per day (12 per cent) from about 41,700 vehicles per day (without the project) to about 46,900 vehicles per day (with the project).
- The project is expected to reduce traffic on Newcastle Road east of Croudace Street (ID10) by about 3,800 vehicles per day (7 per cent) from 51,600 vehicles per day (without the project) to 47,800 vehicles per day (with the project).
- The project is expected to marginally reduce traffic on Dent Street north of Newcastle Road (ID13) by about 500 vehicles per day.

- 
- The project is expected to marginally increase traffic on Grandview Road west of Lookout Road (ID4) by about 200 vehicles per day.
 - The project is expected to marginally increase traffic on Carnley Avenue east of Lookout Road (ID2) by about 300 vehicles per day.
 - The proposed hospital interchange is expected to significantly reduce traffic on the existing John Hunter Hospital access (Kookaburra Circuit) (ID8) by about 9,900 vehicles per day (61 per cent) from 16,200 vehicles per day (without the project) to 6,300 vehicles per day (with the project).

Once constructed, the project would redistribute traffic in the study area and surrounding road network for north-south and south-west movements. Figure 3-1 to Figure 3-4 provide a comparison of traffic volumes for key locations in the study area, with and without the project for 2014, 2020, 2030 and 2040.

Table 3-2 Forecast daily volumes on key locations with the project

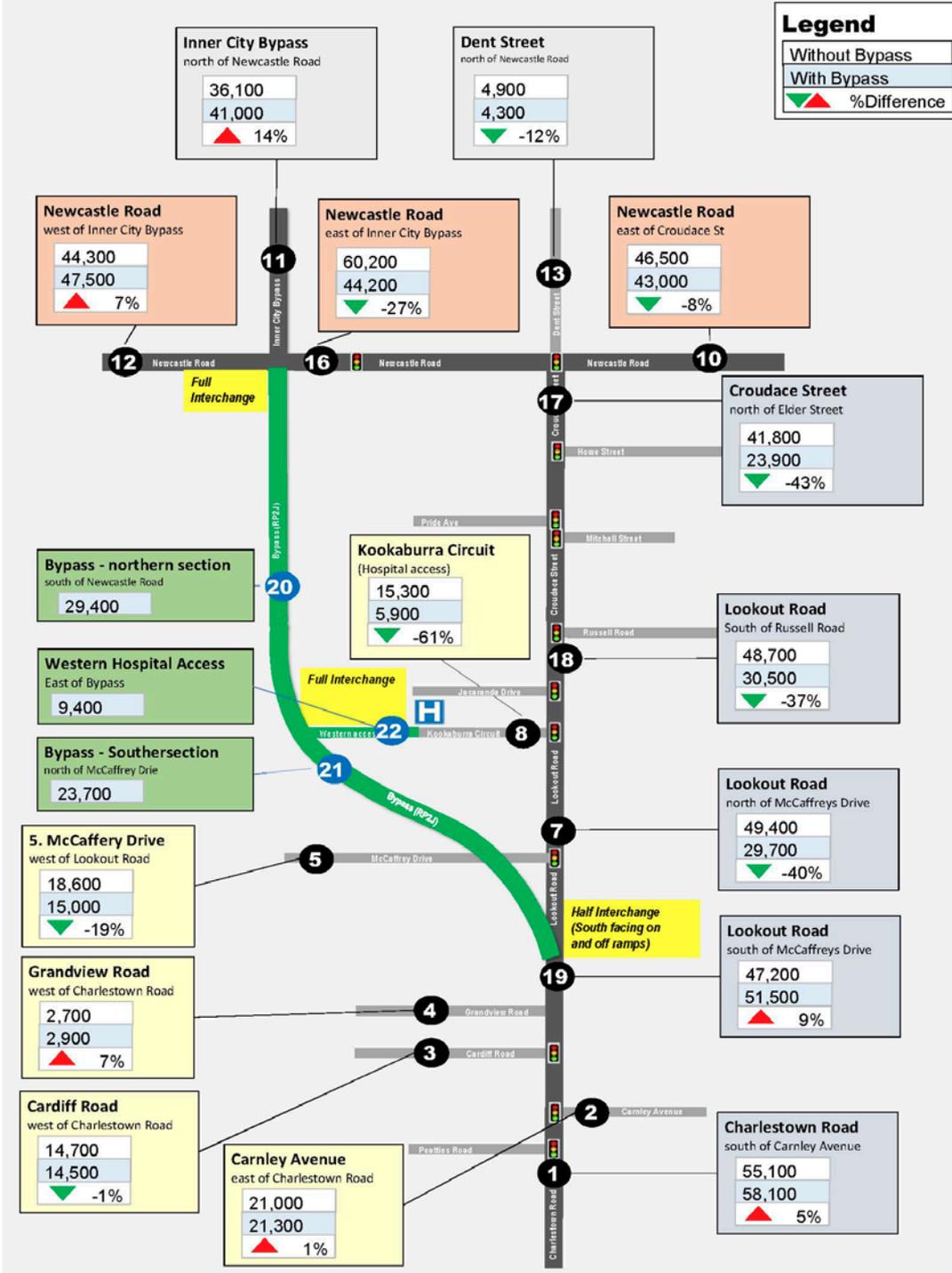
ID	Location	2014			2020			2030			2040		
		No project	With project	Change	No project	With project	Change	No project	With project	Change	No project	With project	Change
1	Charlestown Road, south of Cardiff Road	55,100	58,100	3,000	55,500	59,400	3,900	56,300	61,700	5,400	57,100	64,000	6,900
2	Carnley Avenue, east of Charlestown Road	21,000	21,300	300	21,100	21,400	300	21,400	21,600	200	21,700	21,900	200
3	Cardiff Road, west of Lookout Road	14,700	14,500	-200	15,100	14,700	-400	15,800	15,100	-700	16,600	15,500	-1,100
4	Grandview Road, west of Lookout Road	2,700	2,900	200	2,800	3,000	200	3,000	3,200	200	3,100	3,400	300
5	McCaffrey Drive, west of Lookout Road	18,600	15,000	-3,600	19,100	15,800	-3,300	20,000	17,000	-3,000	20,900	18,200	-2,700
6	Croudace Road, west of Grandview Road	19,900	16,100	-3,800	20,100	16,600	-3,500	20,600	17,500	-3,100	21,000	18,500	-2,500
7	Lookout Road, north of McCaffrey Drive	49,400	29,700	-19,700	52,500	31,900	-20,600	57,700	35,500	-22,200	63,100	39,500	-23,600
8	Kookaburra Circuit (John Hunter Hospital access)	15,300	5,900	-9,400	16,200	6,300	-9,900	17,900	6,800	-11,100	19,800	7,500	-12,300
9	Russell Road, east of Lookout Road	16,200	15,300	-900	17,600	16,800	-800	20,100	19,400	-700	22,600	21,900	-700
10	Newcastle Road, east of Croudace Street	46,500	43,000	-3,500	51,600	47,800	-3,800	60,100	055,900	-4,200	68,500	64,000	-4,500
11	Newcastle Inner City Bypass, north of Newcastle Road	36,100	41,000	4,900	41,700	46,900	5,200	51,000	56,800	5,800	60,300	66,900	6,600
12	Newcastle Road, west of Newcastle Inner City Bypass	44,300	47,500	3,200	48,200	51,600	3,400	54,700	58,500	3,800	61,200	65,300	4,100
13	Dent Street, north of Newcastle Road	4,900	4,300	-600	5,400	4,900	-500	6,300	5,900	-400	7,200	6,800	-400

ID	Location	2014			2020			2030			2040		
		No project	With project	Change	No project	With project	Change	No project	With project	Change	No project	With project	Change
14	Jacaranda Drive (John Hunter Hospital access)	2,700	2,700	0	2,700	2,700	0	2,800	2,800	0	2,900	2,900	0
15	Howe Street, east of Croudace Street	8,500	8,600	100	9,600	9,700	100	11,400	11,700	300	13,300	13,600	300
16	Newcastle Road, east of Newcastle Inner City Bypass	60,200	44,200	-16,000	66,200	49,400	-16,800	76,200	58,200	-18,000	86,200	67,100	-19,100
17	Croudace Street, north of Elder Street	41,800	23,900	-17,900	43,900	25,100	-18,800	47,300	27,100	-20,200	50,800	29,100	-21,700
18	Lookout Road, south of Russell Road	48,700	30,500	-18,200	51,500	32,500	-19,000	56,400	36,000	-20,400	61,300	39,500	-21,800
19	Lookout Road, south of McCaffrey Drive	47,200	51,500	4,300	48,300	53,400	5,100	50,200	56,600	6,400	52,200	59,800	7,600

Note, Average Weekday Daily Traffic (two-way in vehicles).

Source: Lower Hunter Traffic Model (LHTM).

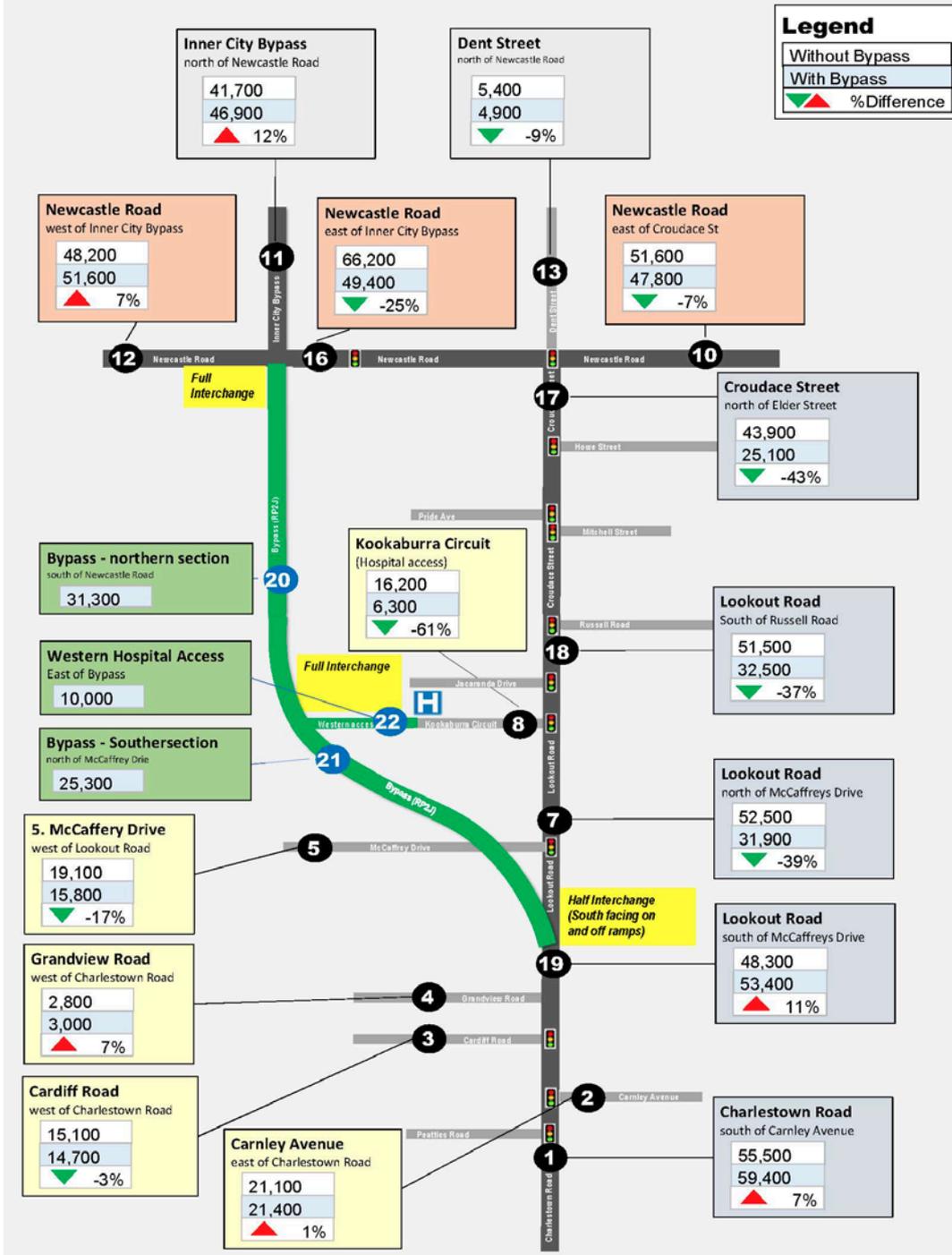
Forecast Daily Traffic with and Without RP2J Project in 2014



Note, Average Weekday Daily Traffic (two-way in vehicles).
Source: Lower Hunter Traffic Model (LHTM).

Figure 3-1 Forecast daily traffic with and without the project in 2014

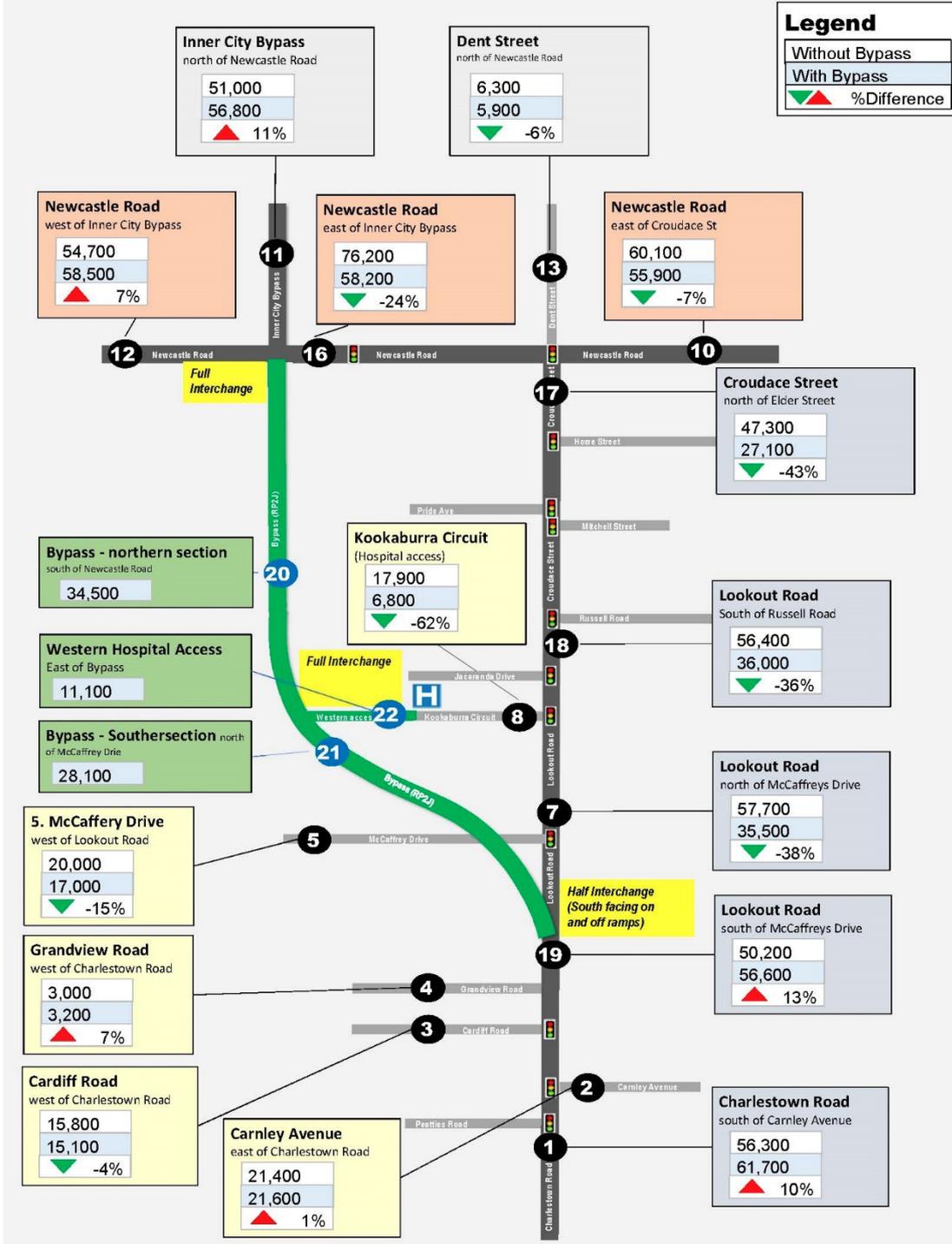
Forecast Daily Traffic with and Without RP2J Project in 2020



Note, Average Weekday Daily Traffic (two-way in vehicles).
Source: Lower Hunter Traffic Model (LHTM).

Figure 3-2 Forecast daily traffic with and without the project in 2020

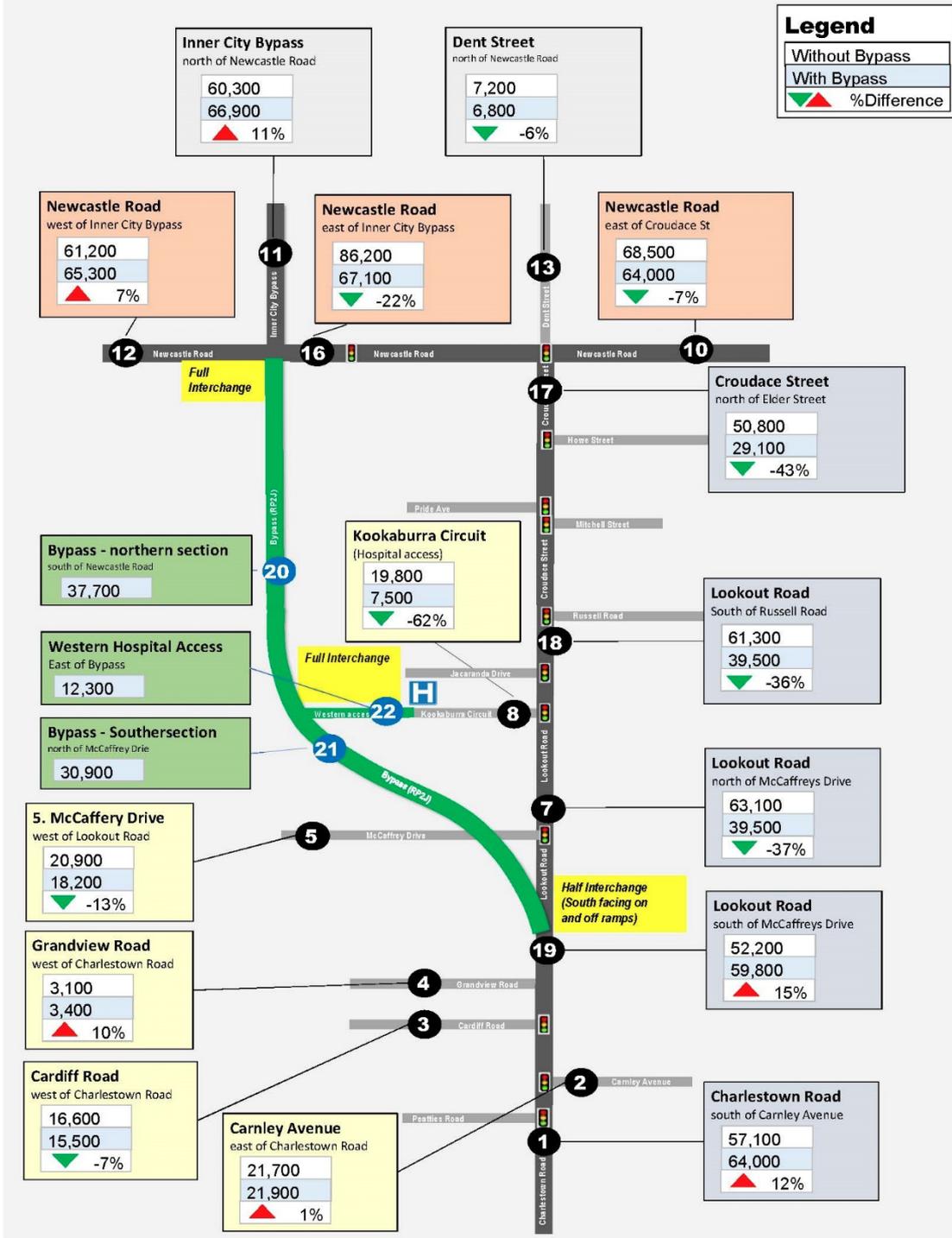
Forecast Daily Traffic with and Without RP2J Project in 2030



Note, Average Weekday Daily Traffic (two-way in vehicles).
Source: Lower Hunter Traffic Model (LHTM).

Figure 3-3 Forecast daily traffic with and without the project in 2030

Forecast Daily Traffic with and Without RP2J Project in 2040



Note, Average Weekday Daily Traffic (two-way in vehicles).
Source: Lower Hunter Traffic Model (LHTM).

Figure 3-4 Forecast daily traffic with and without the project in 2040

3.4 Operational performance

3.4.1 Network statistics

In assessing the network performance levels with and without the project, the following criteria were used based on outputs from the microsimulation traffic modelling described in Section 5.4 of the Traffic and Transport Assessment (Aurecon 2016):

- Vehicle kilometres travelled (VKT); measures the total distance travelled by all vehicles in the network during the modelled peak period
- Vehicle hours travelled (VHT); measures the total travel time of all vehicles on the network during the modelled peak period. VHT corresponds to the delay and congestion in a network and as such a lower VHT correlates to lower congestion
- Total number of stops; corresponds to congestion, delay and travel time and measures the total stops for all vehicles within the modelled peak period. It is used to calculate the additional vehicle operating costs associated with stopping and accelerating from rest. In an uncongested network, the number of stops is infrequent as higher proportions of vehicles travel at free flow with lower occurrences of stopping behind queued vehicles
- Average Network Speed; is recorded for all traffic in the network over the modelled period. It is calculated by dividing the VKT by the VHT. Average network speed correlates to congestion and delay, higher average network speeds are indicative of a network in which traffic is able to flow more readily.

Table 3-3 provides a summary of network statistics for the study area for the two-hour modelled morning (07:00am to 09:00am) and afternoon (16:00pm to 18:00pm) peak periods for 2020 and 2030 with and without the project. This data is compared graphically on Figure 3-5 to Figure 3-8.

Table 3-3 Summary of peak network performance statistics for 2020 and 2030 with and without the project

Option	VHT	VKT	# of stops	Average speed (kph)
Morning period 2020				
1. No project	3,392	96,453	144,094	29
2. Project operational	2,615	98,159	100,563	38
Evening period 2020				
1. No project	4,041	105,812	183,175	26
2. Project operational	2,719	107,598	1 08,003	40
Morning period 2030				
1. No project	4,830	107,343	185,148	22
2. Project operational	3,027	109,351	110,014	36
Evening period 2030				
1. No project	6,072	119,195	228,058	20
2. Project operational	3,320	119,302	134,785	36

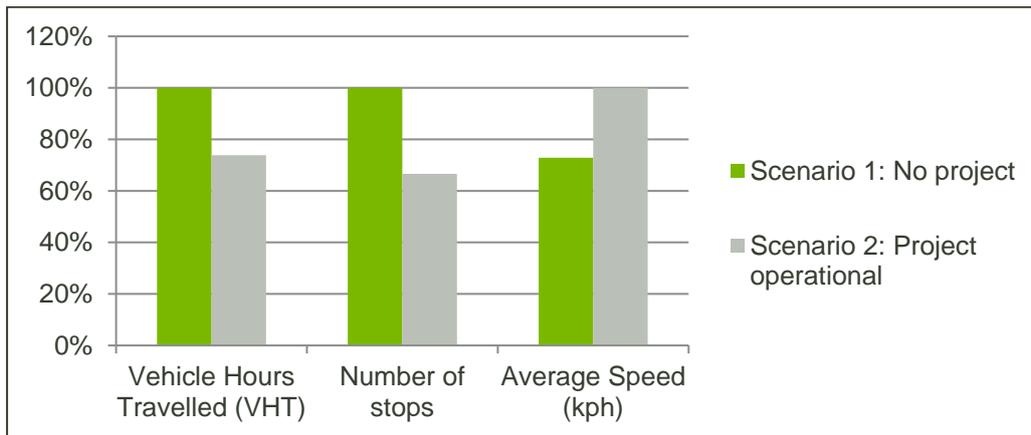
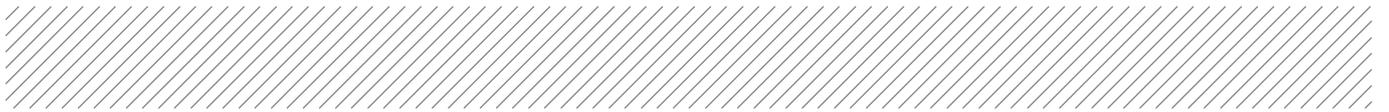


Figure 3-5 Network performance – Morning Peak 2020 with and without the project

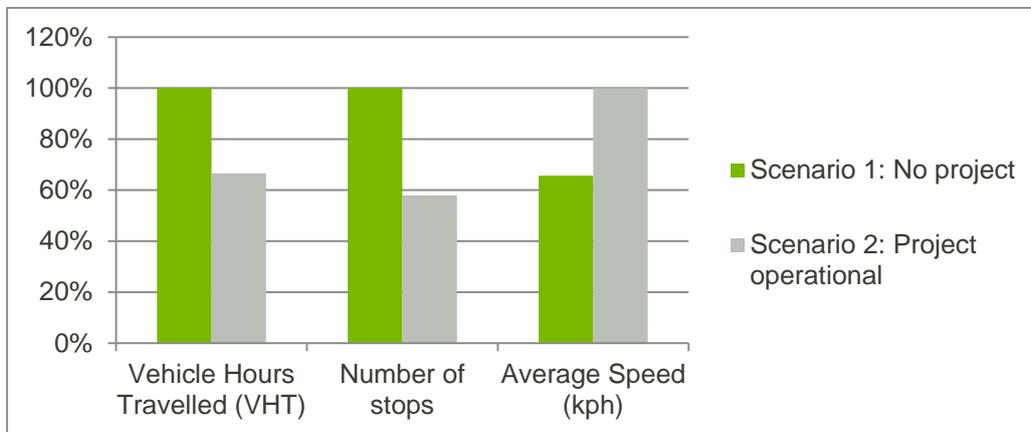


Figure 3-6 Network performance – Afternoon Peak 2020 with and without the project

In reviewing the network performance data for 2020 the following conclusions can be derived:

- With the project, congestions levels are predicted to substantially improve with VHT reduced by about 23 per cent in the morning peak and 33 per cent in the afternoon peak
- Similarly, with the project the number of stops are reduced by about 30 per cent in the morning peak and 41 per cent in the afternoon peak
- Travel times are predicted to improve with the project with the average travel speed to increase by about 24 per cent in the morning peak and 34 per cent in the afternoon peak.

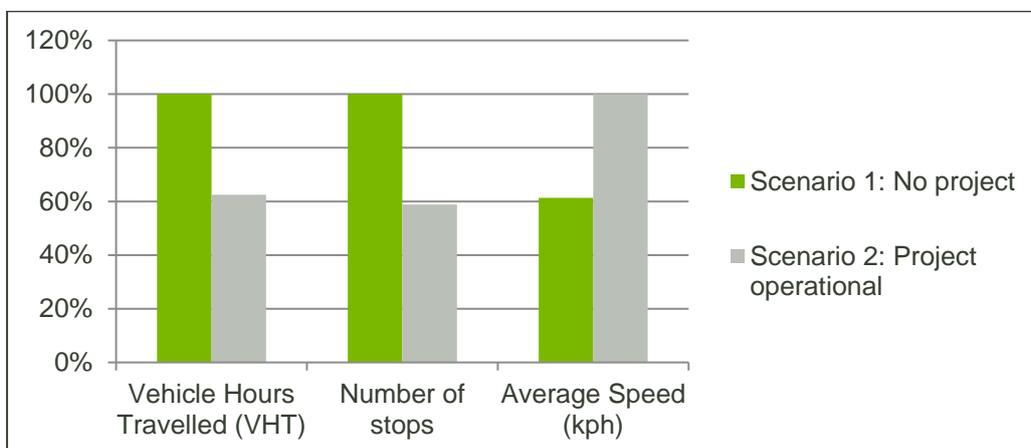


Figure 3-7 Network performance – Morning Peak 2030 with and without the project

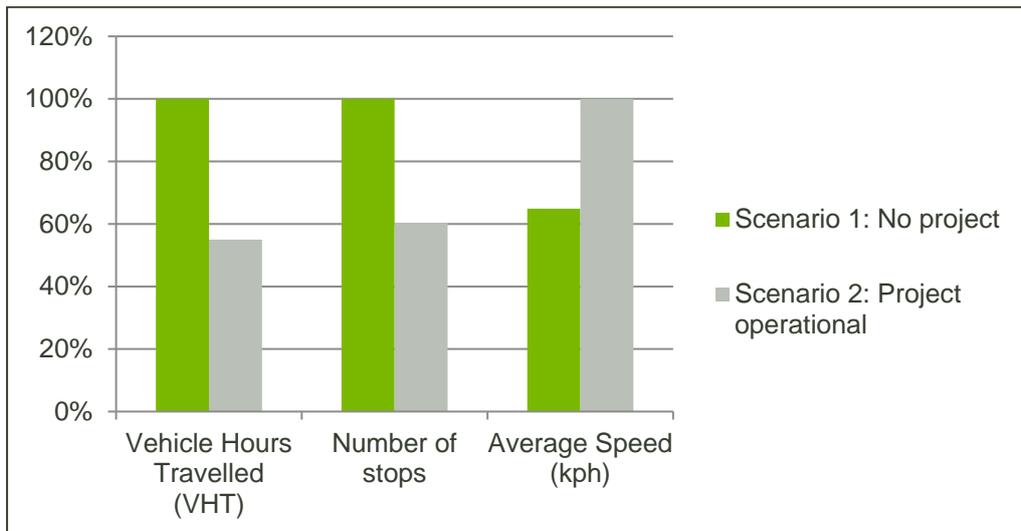


Figure 3-8 Network performance – Afternoon Peak 2030 with and without the project

In reviewing the network performance data for 2030 the following conclusions can be derived:

- With the project, congestion levels are predicted to further reduce (relative to the No project scenario) with VHT reduced by about 37 per cent in the morning peak and 45 per cent in the afternoon peak
- Similarly, with the project the number of stops are reduced by about 41 per cent in the morning peak and 41 per cent in the afternoon peak
- Travel times are predicted to further improve (relative to the No project scenario) with average travel speed to increase by about 38 per cent in the morning peak and 45 per cent in the afternoon peak.

Overall, the project would provide major benefits to road users with substantial reductions in VHT, VKT, and number of stops, as well as increases in average travel speeds across the road network. The No project scenario would not alleviate the forecast congestion and traffic delays due to the predicted increases in VHT, VKT, and number of stops that the road network would face in future years.

3.4.2 Intersection performance

The traffic conditions on major roads and intersections can be quantified in terms of their operating level of service (LoS). Level of service is defined as a qualitative measure of features that include speed, travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort, convenience and operating costs.

The LoS for each intersection analysed has been reported in accordance with the Roads and Maritime's guideline (Guide to Traffic Generating Developments, Issue 2.2, Roads and Traffic Authority, October 2002). Under these guidelines, the performance of an intersection is measured by the intersection average delay per vehicle. For roundabouts and sign-controlled intersections this is critical movement in the intersection with the highest delay and for signalised intersections this is the average intersection delay measured in seconds per vehicle.

LoS criteria are shown in Table 3-4. Table 3-5 shows a summary of LoS for key intersections in the study area which have been calculated for morning and evening peak periods for 2014, 2020 and 2030, with and without the project. It is noted that since the exhibition of the EIS, the modelling for this assessment has been further refined and this, in addition to design refinements, has resulted in minor changes to both the base case (no project) and with project scenarios as previously presented in the EIS.



Detailed LoS data for each intersection, including traffic volumes and movements at each intersection and average delays is provided in Appendix A.

Table 3-4 Level of service criteria

Level of service	Average delay (seconds)	Traffic implication
A	<14	Good operation
B	15-28	Good operation with acceptable delays and spare capacity
C	29-42	Satisfactory operation
D	43-56	Operating near capacity
E	57-70	Operating at capacity
F	>70	Extra capacity required

Table 3-5 Intersection performance

Intersection	Level of Service (LoS)									
	2014 AM/PM Peak		2020 AM Peak		2020 PM Peak		2030 AM Peak		2030 PM Peak	
	No project AM	No project PM	No project	With project	No project	With project	No project	With project	No project	With project
University Interchange	B	A	D	C	C	A	F	D	E	C
Blue Gum Road/ Newcastle Road	B	B	B	B	B	B	C	B	C	B
Jesmond Roundabout / Northern Interchange	C	C	C	C	D	C	D	C	D	C
Croudace Street/ Dent Street/ Newcastle Road	D	E	D	D	F	C	F	D	F	D
Croudace Street/ Howe Street	B	B	B	B	B	B	B	B	C	B
Croudace Street/ Lookout Road/ Russell Road	B	D	B	B	E	B	B	B	F	C
Lookout Road/ John Hunter Hospital (Kookaburra Circuit)	B	B	C	B	B	A	C	B	B	B
John Hunter Hospital Interchange				A		A		A		A
Lookout Road/ McCaffrey Drive	C	B	E	B	B	B	F	B	C	B
Lookout Road/Grandview Road	A	A	A	A	A	A	B	A	A	A
Lookout Road/ Cardiff Road	C	B	D	D	C	E	D	C	C	D

Source: Aurecon 2016b



Table 3-5 shows that without the project, the performance at key intersections in the study area varies, with the intersections of Croudace Street / Newcastle Road and Lookout Road /Russell Road having the worst performance in the evening peak period. Other intersections generally function at good levels of service, although as shown in Table 3-5 a number of these intersections are predicted to have reduced performance under forecast traffic volumes. For example, the intersection of Lookout Road and McCaffrey Drive is predicted to reduce in performance from LoS E to F between 2020 and 2030.

Table 3-5 shows that under forecast traffic volumes, the project would generally improve intersection performance at key existing intersections in the study area for 2020 and 2030 scenarios in both the morning and afternoon peak periods. In particular, Table 3-5 shows:

- The project is expected to substantially improve the LoS at the following key intersections in 2020:
 - Croudace Street/Dent Street/Newcastle Road in the afternoon peak period from LoS F to LoS C
 - Croudace Street/Lookout Road/Russell Road in afternoon peak period from LoS E to LoS B
 - Lookout Road/McCaffrey Drive in morning peak from LoS E to LoS B
 - Lookout Road /John Hunter Hospital in the morning peak from LoS C to LoS B, with the proposed Hospital Interchange operating at LoS A in both peak periods.
- The project is expected to substantially improve the LoS at the following key intersections in 2030:
 - Croudace Street/Dent Street/Newcastle Road in the afternoon peak period from LoS F to LoS D
 - Croudace Street/Lookout Road/Russell Road in afternoon peak period from LoS F to LoS C
 - Lookout Road/McCaffrey Drive in morning peak from LoS F to LoS B
 - Lookout Road/John Hunter Hospital in the morning peak from LoS C to LoS B, with the proposed Hospital Interchange operating at LoS A in both peak periods.

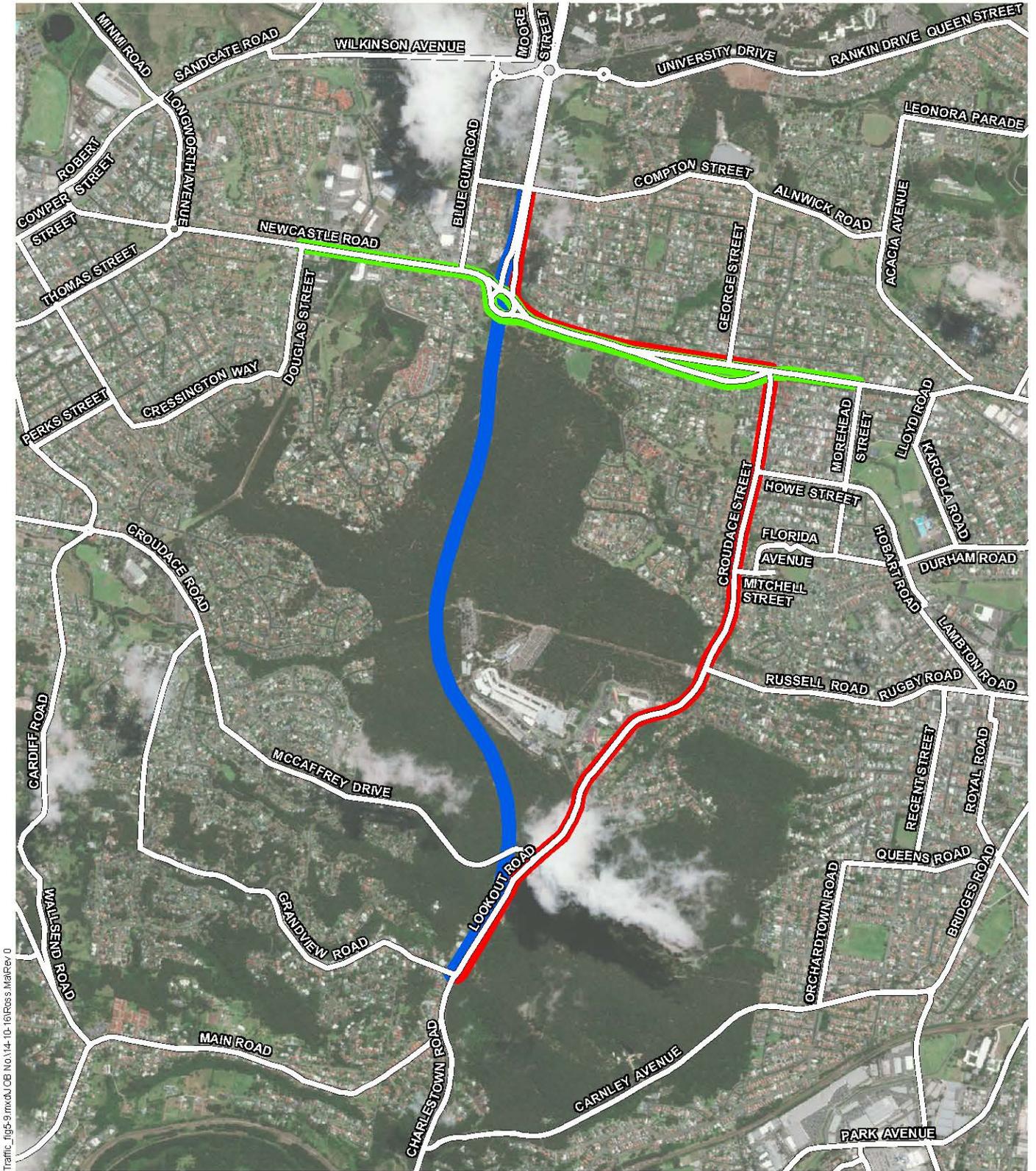
It is noted that as shown in Appendix A, the project caters for higher traffic volumes at the key intersections to the north, west and south of the project. As such the LoS comparison for No project and With project is considered conservative as there are additional benefits associated with the additional throughput of traffic with the project.

3.4.3 Travel times

Travel times for key routes in the study area, including the project, have been determined from the model for the following routes (refer to Figure 3-9):

- **Route A (Green):** Newcastle Road from Douglas Street to Morehead Street
- **Route B (Red):** Existing route from Lookout Road (north of Grandview Road), Croudace Street, Newcastle Road and Newcastle Inner City Bypass (north of Newcastle Road)
- **Route C (Blue):** New route formed by the project, from Lookout Road north of Grandview Road to Newcastle Inner City Bypass (north of Newcastle Road).

For motorists wishing to travel between zones with two route choices, the project's Paramics traffic model takes into account both travel time and travel distance when calculating the most attractive route to take, with travel time weighted higher than travel distance. The concept is that a driver perceives each route to have a total cost based on its travel time and travel distance, and can therefore rank each route from most attractive to least attractive. The traffic modelling predicts all traffic would use the new route formed by the bypass (Route C) for trips between Lookout Road (north of Grandview) and the Newcastle Inner City Bypass (north of Newcastle Road).



Legend

- Road and Street
- Route A - Newcastle Road - Douglas Street to Morehead Street
- Route B - Existing A37 Route
- Route C - The Project Route

Source: BingMaps, Aurecon

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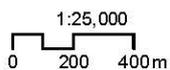


Figure 3-10 to Figure 3-13 show the estimated travel times (in minutes) along these routes for the morning and afternoon peak periods in 2020 and 2030, with and without the project.

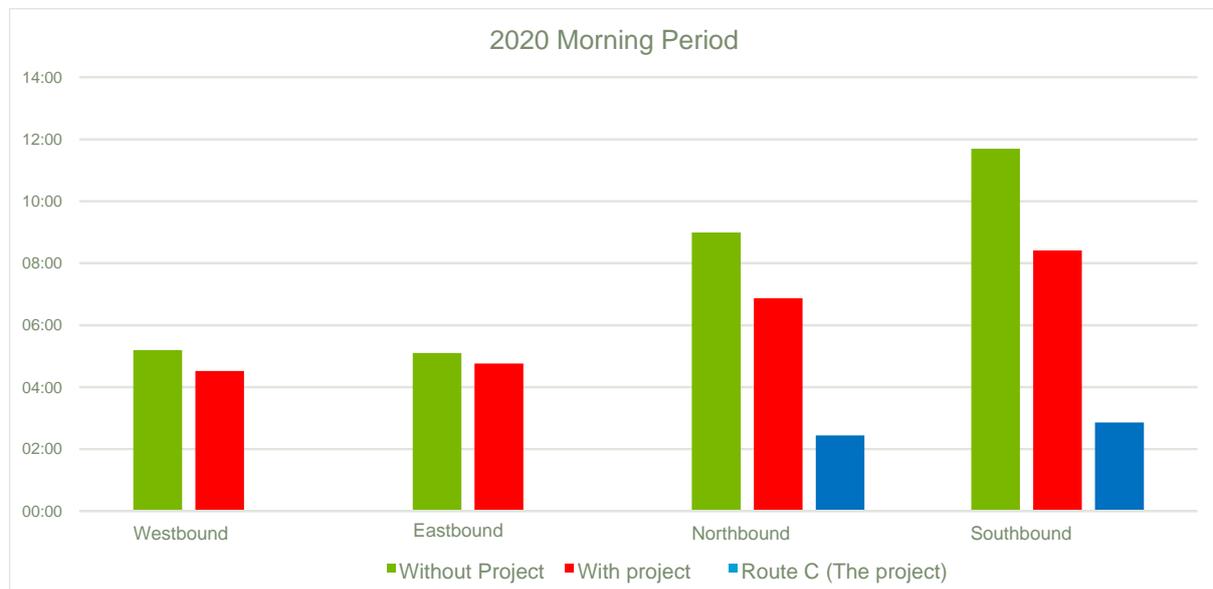


Figure 3-10 Morning peak period travel times 2020

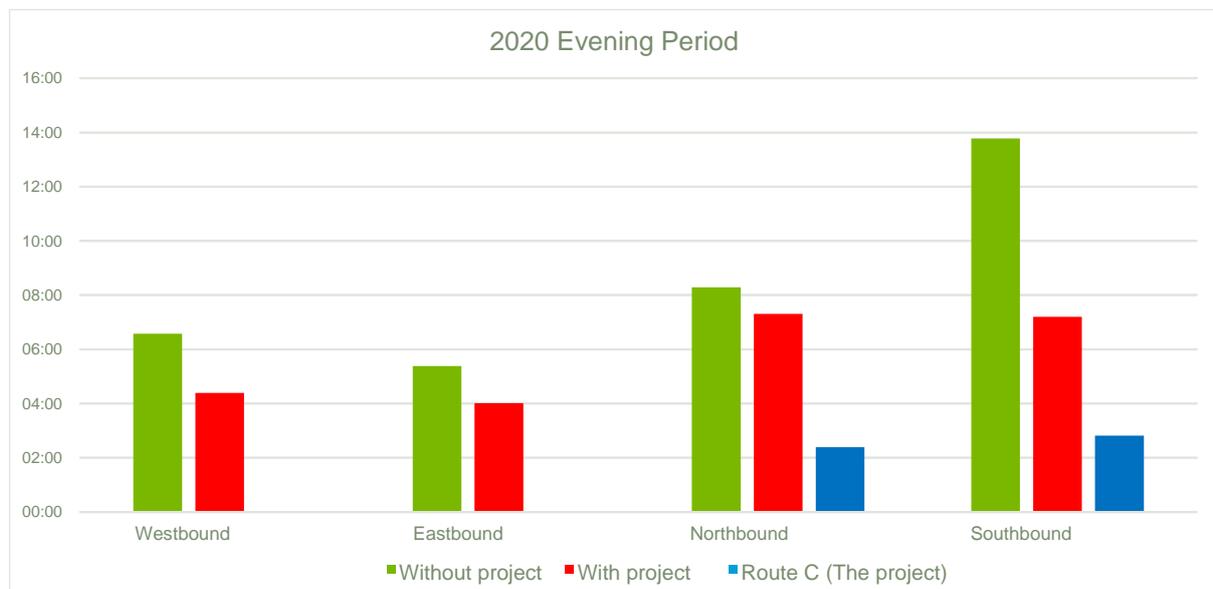


Figure 3-11 Evening peak period travel times 2020

In reviewing the travel time data for 2020 for the bypass route compared to the existing route (Without project scenario), the following conclusions can be derived:

- With the project, northbound travel times for the bypass route are predicted to reduce by about 73 per cent in the morning peak and 71 per cent in the afternoon peak
- With the project, southbound travel times for the bypass route are predicted to reduce by about 75 per cent in the morning peak and 79 per cent in the afternoon peak.

In addition, with the project travel times are also predicted to reduce for both north-south trips on the existing route and east-west trips on Newcastle Road (Douglas Street to Morehead Street).

- With the project, northbound travel times for the existing route are predicted to reduce by about 23 per cent in the morning peak and 13 per cent in the afternoon peak
- With the project, southbound travel times for the existing route are predicted to reduce by about 29 per cent in the morning peak and 48 per cent in the afternoon peak
- With the project, eastbound travel times for Newcastle Road are predicted to reduce by about 8 per cent in the morning peak and 25 per cent in the afternoon peak
- With the project, westbound travel times for the existing route are predicted to reduce by about 14 per cent in the morning peak and 33 per cent in the afternoon peak.

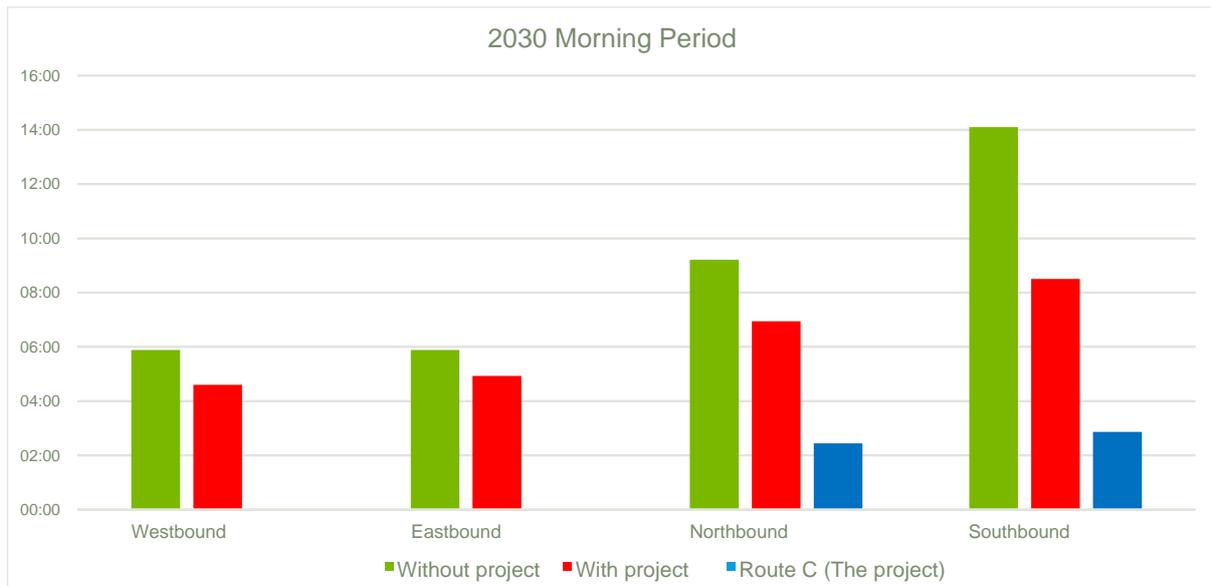


Figure 3-12 Morning peak period travel times 2030

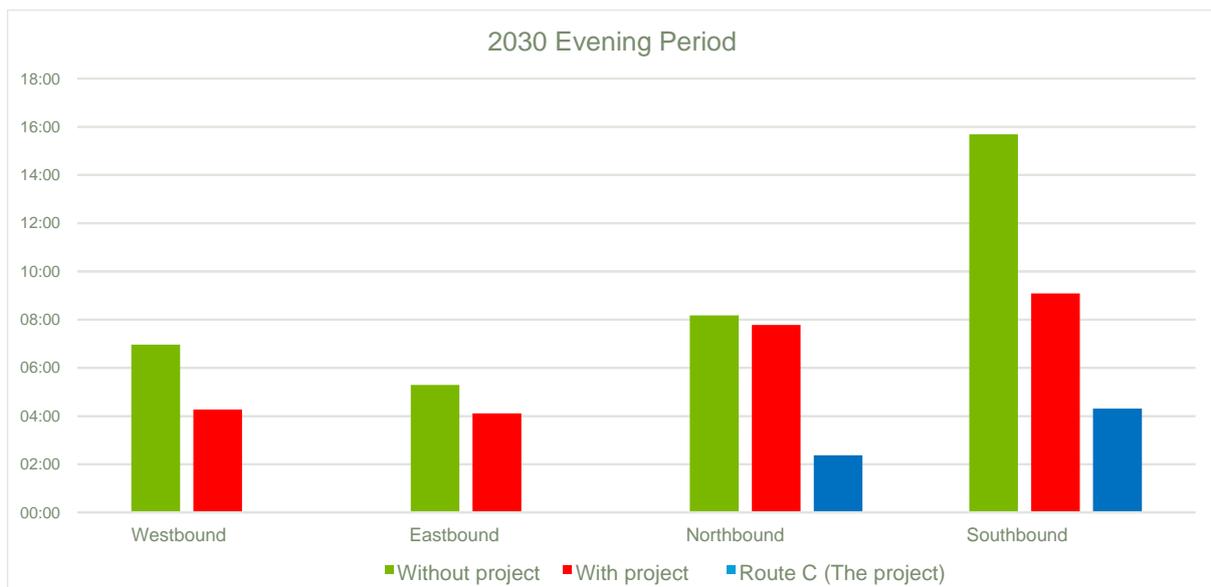


Figure 3-13 Evening peak period travel times 2030

In reviewing the travel time data for 2030 for the bypass route compared to the existing route (Without project scenario), the following conclusions can be derived:

- With the project, northbound travel times for the bypass route are predicted to reduce by about 73 per cent in the morning peak and 71 per cent in the afternoon peak

- With the project, southbound travel times for the bypass are predicted to reduce by about 80 per cent in the morning peak and 73 per cent in the afternoon peak.

In addition, with the project travel times are also predicted to reduce for both north-south trips on the existing route and east-west trips on Newcastle Road (Douglas Street to Morehead Street).

- With the project, northbound travel times for the existing route are predicted to reduce by about 25 per cent in the morning peak and 5 per cent in the afternoon peak
- With the project, southbound travel times for the existing route are predicted to reduce by about 40 per cent in the morning peak and 44 per cent in the afternoon peak
- With the project, eastbound travel times for Newcastle Road are predicted to reduce by about 16 per cent in the morning peak and 23 per cent in the afternoon peak
- With the project, westbound travel times for the existing route are predicted to reduce by about 23 per cent in the morning peak and 39 per cent in the afternoon peak.

In the southbound direction in the 2030 evening peak period, compared to 2020 the predicted travel times on both the existing route and on the bypass route reflect an increase in congestion in the southern sections of the road network due to capacity constraints including the Cardiff Road and Lookout Road intersection.

As part of the Roads and Maritime Inner Newcastle Traffic Study, preliminary investigations were carried out to the south of the Rankin Park to Jesmond connection with Lookout Road. The primary focus of the study was to inform future road network planning in inner Newcastle. The community was invited to comment on the Inner Newcastle Traffic Study in July and August 2014. The feedback and suggestions received have been considered to prioritise future projects and seek funding.

In reviewing the travel time data for 2020 and 2030, the following conclusions can be derived:

- The project is predicted to provide major benefits for motorists using the Newcastle Inner City Bypass with substantial improvements in traffic flow and travel time for both northbound and southbound journeys, relative to the Without project scenario
- The project is also predicted to improve travel times for north-south trips on the existing route and for east-west trips on Newcastle Road.

3.4.4 Summary of operational performance of the project

In summary, in reviewing the predicted operational performance of the project, the following conclusions can be derived:

- The project is predicted to provide major benefits for motorists using the Newcastle Inner City Bypass with substantial improvements in traffic flow and travel time for both northbound and southbound journeys, relative to the 'No project' scenario
- The project is also predicted to improve travel times for north-south trips on the existing route and for east-west trips on Newcastle Road
- The project is predicted to improve intersection performance at key existing intersections in the study area

In addition, the project is predicted to provide strong economic benefits and high value for money with a benefit-cost ratio of 5.1.

As such, the concept design for the project meets the primary objectives for the project which are to:

- Reduce travel times and improve traffic flow on the Newcastle Inner City Bypass
- Provide traffic relief on key parts of the surrounding road network
- Provide continuity of the Newcastle Inner City Bypass between Bennetts Green and Sandgate.

3.5 Implications for existing traffic movements

3.5.1 Impacts on road safety

A detailed road safety analysis was prepared for the Traffic and Transport Assessment (Aurecon 2016), which found that the project is expected to improve road safety on the existing route (Lookout Road, Croudace Street and Newcastle Road) as a result of reduction in traffic volumes and improved traffic flow. The crash analysis presented in Section 5.5 of the Traffic and Transport Assessment (Aurecon 2016) was reviewed in light on the project design refinements described in Section 1 and it was found that the data presented in that section has not changed.

3.5.2 Interchanges and intersections

Detailed descriptions of the interchanges and intersections that would be constructed or altered for the project are provided in Sections 5.5.2 to 5.5.5 of the Traffic and Transport Assessment (Aurecon 2016). As outlined in Section 1 of this report, following exhibition of the EIS, a number of design refinements were made to the project, including the following interchange and intersection alterations:

- Southern interchange:
 - a new northbound cycleway connection from Lookout Road to the bypass would be provided for on-road cyclists
 - a new southbound cycleway crossing controlled by traffic lights would be provided from the bypass to Lookout Road for on-road cyclists
- Lookout Road/McCaffrey Drive intersection – the pedestrian crossings on the left turn lane from McCaffrey Drive onto Lookout Road, and across Lookout Road would now both be shared path crossings controlled by traffic lights
- Hospital interchange – the addition of south facing ramps results in a full interchange with both north and south facing ramps, providing access between the bypass and the hospital precinct
- Northern interchange – Grade separation for the east-west shared path at northern interchange. This includes a shared path bridge (Bridge 8) over interchange northbound on-ramp and southbound off-ramp and an underpass under the bypass.

Interchange and intersection changes that have implications for pedestrian and cyclist movements are discussed in more detail in Section 3.6. The effect of the new hospital interchange arrangement on traffic movements is discussed in more detailed in Section 3.5.3.

3.5.3 Hospital interchange

The hospital interchange would now be a full interchange with both north and south facing ramps as shown in Figure 3-14b. The interchange would provide access to and from the north and south for use by all hospital users including public, staff and emergency services.

The key features of the interchange include:

- Access to/from the south which includes a southbound on-ramp to enter the bypass and exit the hospital precinct and a northbound off-ramp to exit the bypass and enter the hospital precinct
- Widening of the bridge (Bridge 3) over the bypass to provide an additional traffic lane

The hospital interchange would be connected via a new access road to provide for connection to the hospital's internal road system. NSW Health Infrastructure would carry out any required road work in the hospital's internal road system to accommodate traffic movements to and from the interchange.

The interchange would provide connections from the bypass and the hospital precinct via:

- Southbound off-ramp – southbound traffic on the bypass would diverge to the left to exit the bypass to the hospital precinct

- 
- Southbound on-ramp – traffic leaving the hospital precinct would diverge to the left and enter the bypass to travel in a southbound direction
 - Northbound on-ramp – traffic leaving the hospital precinct would travel west over the main project alignment on Bridge 3 and enter an anti-clockwise loop to the left before travelling under Bridge 3 next to the projects northbound alignment. The on-ramp would then merge with the project's two northbound lanes
 - Northbound off-ramp – northbound traffic on the bypass would diverge to the left to exit the bypass and travel east over the main project alignment on Bridge 3 to enter the hospital precinct.

3.6 Implications for pedestrians and cyclists

The project as described in the EIS would incorporate facilities for pedestrians and cyclists. The proposed facilities were designed in accordance with the *NSW Bicycle Guidelines* (Roads and Traffic Authority 2005). The provision for pedestrian and cyclist connectivity are consistent with the on-road and off-road routes through the study area proposed in the *Newcastle Cycling Strategy and Action Plan* (The City of Newcastle 2012).

Following exhibition of the EIS, receipt of submissions and further consultation with stakeholders, the proposed pedestrian and cyclist facilities have been refined as described in the following sections.

3.6.1 Southern interchange – northbound cycleway connection

At the southern interchange, northbound on-road cyclists seeking to remain on the bypass would have needed to cross the two traffic lanes associated with the Lookout Road flyover. The design has now been modified and a new northbound cycleway connection (one way only) is provided as shown on Figure 3-14. This enables northbound on-road cyclists to exit Lookout Road and pass beneath the flyover before re-joining the road shoulder of the bypass, eliminating potential conflict with traffic exiting the bypass on the Lookout Road flyover. The cycleway would not be available for use by pedestrians.

The cycleway would be located on a bench on the fill batter (fill batter 1) to the west of the Lookout Road flyover. This would require refinement of the bench, resulting in a minor widening of the overall fill batter slope by about five metres. The cycleway would be two metres wide and about 225 metres long.

3.6.2 Southern interchange – southbound cycleway crossing

As stated in Section 8.3.2 of the EIS, provision for cyclists to cross on and off-ramps at the interchanges would be provided for in accordance with *NSW Bicycle Guidelines* (Roads and Traffic Authority 2005).

At the southern interchange, the movement of southbound cyclists on the bypass across Lookout Road was proposed to be provided via the new traffic lights whereby the traffic on Lookout Road would be at a stop when cyclists are crossing with the southbound bypass traffic. This would enable southbound on-road cyclists to safely access the shoulder of Lookout Road. The design has now been refined and a cyclist crossing point controlled by traffic lights would be provided across Lookout Road to enable on-road cyclists to access the road shoulder of Lookout Road when the traffic on Lookout Road is stopped at the traffic lights (Figure 3-14d). All on-road cyclists on the bypass would be required to cross at this location, avoiding potential for conflict with traffic. The crossing point would be designed in accordance with the *NSW Bicycle Guidelines* (Roads and Traffic Authority 2005).

3.6.3 McCaffrey Drive – shared path

The proposed footpath located on the northern side of McCaffrey Drive would now be a shared path for use by both pedestrians and cyclists as shown on Figure 3-14a. The shared path would be three metres wide and would connect with existing footpaths on Lookout Road and McCaffrey Drive.

3.6.4 Lookout Road/McCaffrey Drive intersection – shared path facilities

As stated in Section 8.3.2 of the EIS, the existing traffic light controlled pedestrian crossing on the southern and western sides of the Lookout Road/McCaffrey Drive intersection would be removed. These crossings are no longer required as they mainly service properties on the south-west side of the intersection which would be removed by the project. The existing traffic light controlled pedestrian crossing on the northern side of the intersection would be retained.

The EIS design has been refined and the retained northern crossing would be for use by both pedestrians and cyclists as shown on Figure 3-14d. The existing western crossing, which is a pedestrian only crossing point, would not be retained as described in the EIS.

3.6.5 Hospital interchange – shared path facilities

As described in Sections 5.3.5 and 5.3.14 of the EIS, at the hospital interchange a new shared path would be provided next to the new hospital access road from the John Hunter Hospital precinct to the west, crossing the main project alignment on Bridge 3. The path would provide access to existing off-road tracks and suburbs such as Elermore Vale and Wallsend to the west of the project.

The shared path crossing of the southbound off-ramp was designed in accordance with the Guide to Road Design (Austroads 2009) and *NSW Bicycle Guidelines* (Roads and Traffic Authority 2005). Pedestrians and cyclists would be required to give way to vehicles travelling on the off-ramp and appropriate signage and street lighting would be provided. Warning signs (shared path crossing ahead or similar) would be provided on the off-ramp to advise vehicles of the shared path crossing at an appropriate distance from the crossing to suit the off-ramp speed limit of 50 kilometres per hour.

The EIS design has been refined and the project would now provide traffic lights at the crossing point for use by pedestrians and cyclists so that pedestrians and cyclists do not need to give way to vehicles.

3.6.6 Jesmond Park shared path

At the northern interchange, the project as presented in the EIS (Section 5.3.14 and Figure 5-1 of the EIS) severs the shared path through Jesmond Park. This shared path currently links to the pedestrian crossings across Newcastle Road at Blue Gum Road intersection, which provides connections to the north and the retail outlets at Jesmond including Stockland Jesmond Shopping Centre.

These connections were proposed to be maintained by the project at the northern interchange via:

- New shared path connecting to the traffic lights at the new intersection on Newcastle Road associated with the northern interchange
- Three traffic light controlled pedestrian crossings for east-west movements to/from the Jesmond Park shared path.

The EIS design has been refined and the project would now provide a grade separated shared path consisting of an overpass bridge (Bridge 8) and underpass arrangement as shown in Figure 3-14a.

This means pedestrians and cyclists do not need to cross the project via traffic lights for east-west movements. This will provide access to the Newcastle Road/Blue Gum Road intersection via Illoura Street.



The three traffic light controlled crossings on the southern side of the northern interchange as proposed in the EIS would be retained in the refined design, to provide for wheelchairs and mobility impaired persons, and as an alternative route for pedestrians and cyclists.

The overpass would not be suitable for use by wheelchairs due to its steep grades and the lack of room to construct an overpass with landings as required by the relevant design guidelines. As such, the traffic light controlled crossings on the southern side of the northern interchange would be retained in the modified design, to provide for wheelchairs and mobility impaired persons, and as an alternative route for pedestrians and cyclists.

3.6.7 Newcastle Road – shared path bridge (Bridge 7)

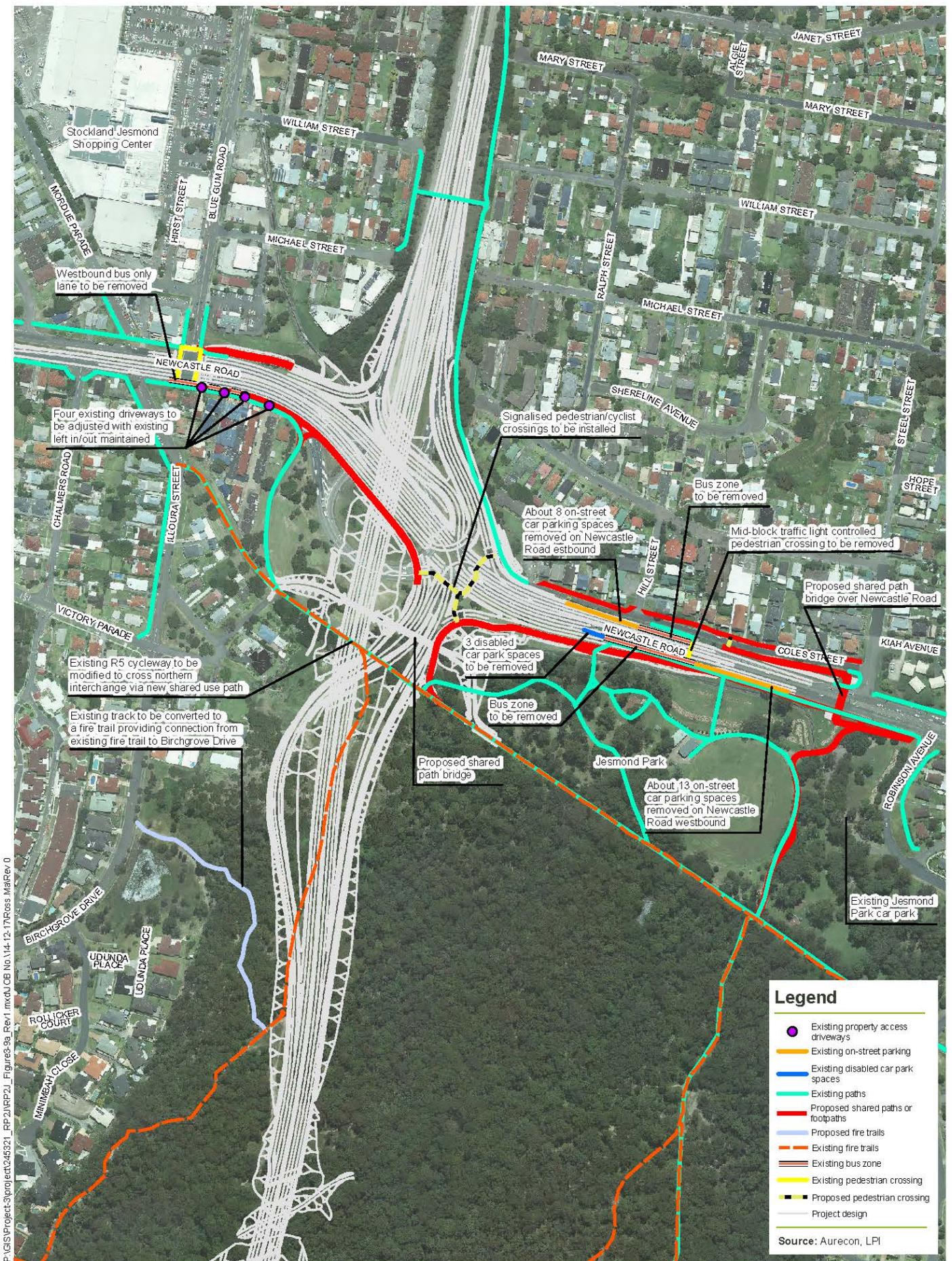
Following further consultation with stakeholders the EIS design the connections either side of the shared path bridge (bridge 7) over Newcastle Road have been refined to improve connectivity with existing shared paths.

Between the Jesmond Park sports field and Newcastle Road, the shared path would now continue to the north-east passing under the Bridge 7 ramp connecting to an existing shared path on the southern side of Newcastle Road opposite Steel Street. This design refinement reduces impact to the north-east corner of Jesmond Park.

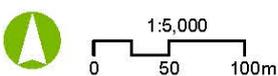
The proposed connections are shown on Figure 3-14a.

3.7 Property access and on-street parking

Changes to access arrangements for private properties and on-street parking that would occur from the project are described in Section 5.7 of the Traffic and Transport Assessment (Aurecon 2016). The project design refinements described in Section 1 of this report would not alter these changes.



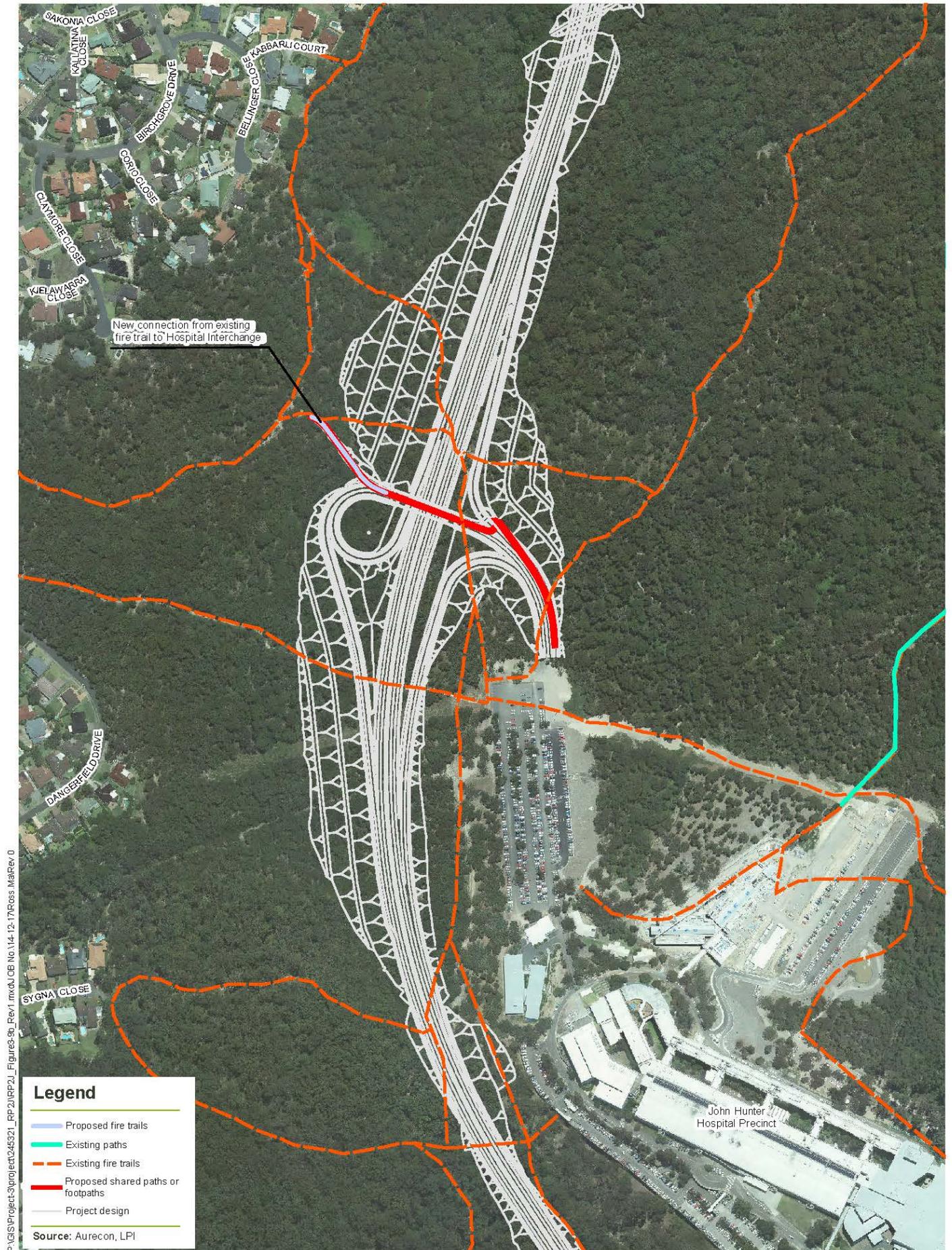
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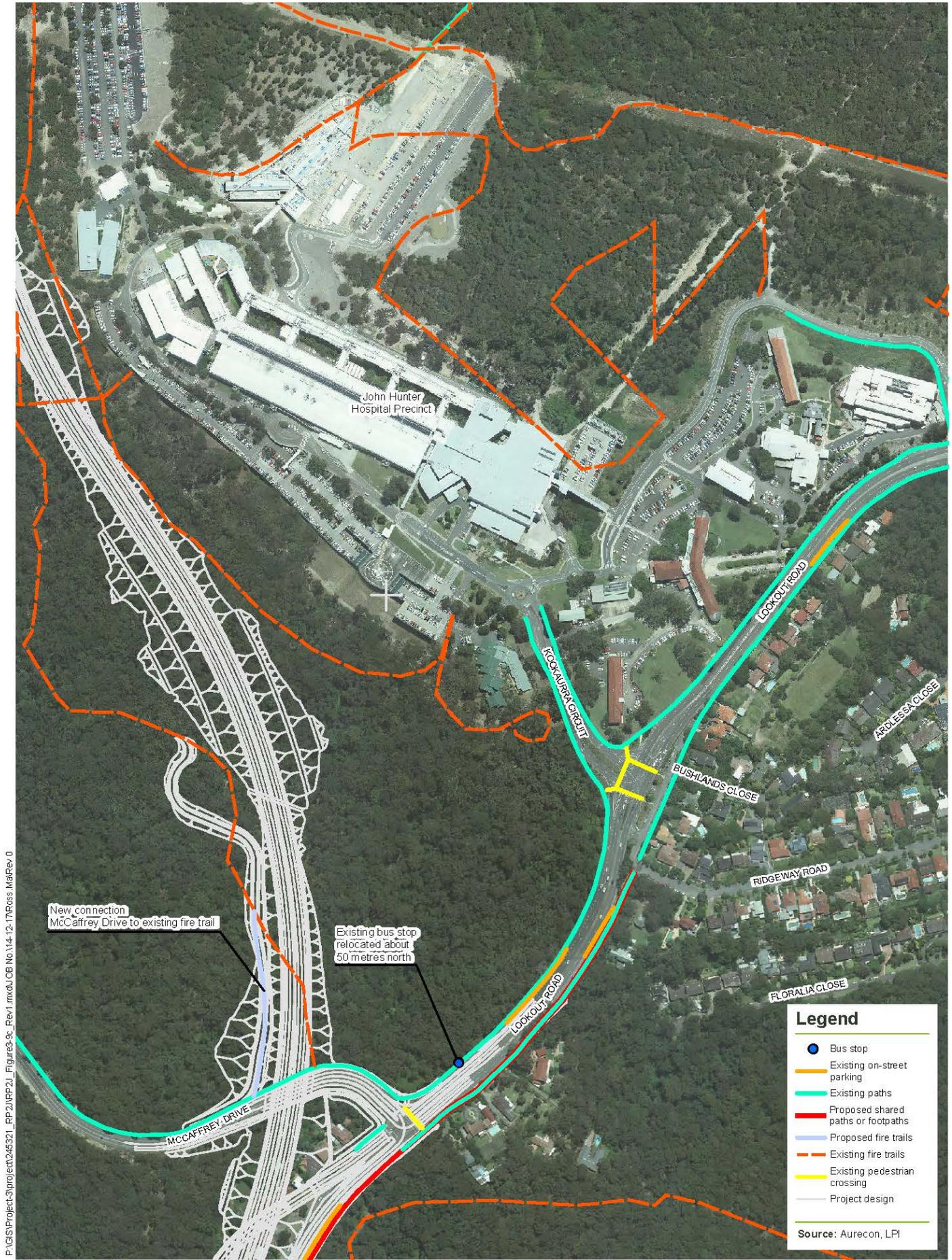
Projection: GDA 1994 MGA Zone 56

FIGURE 3-14a: Existing and proposed property access provisions, on-street parking and paths

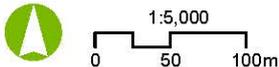


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FIGURE 3-14b: Existing and proposed property access provisions, on-street parking and paths



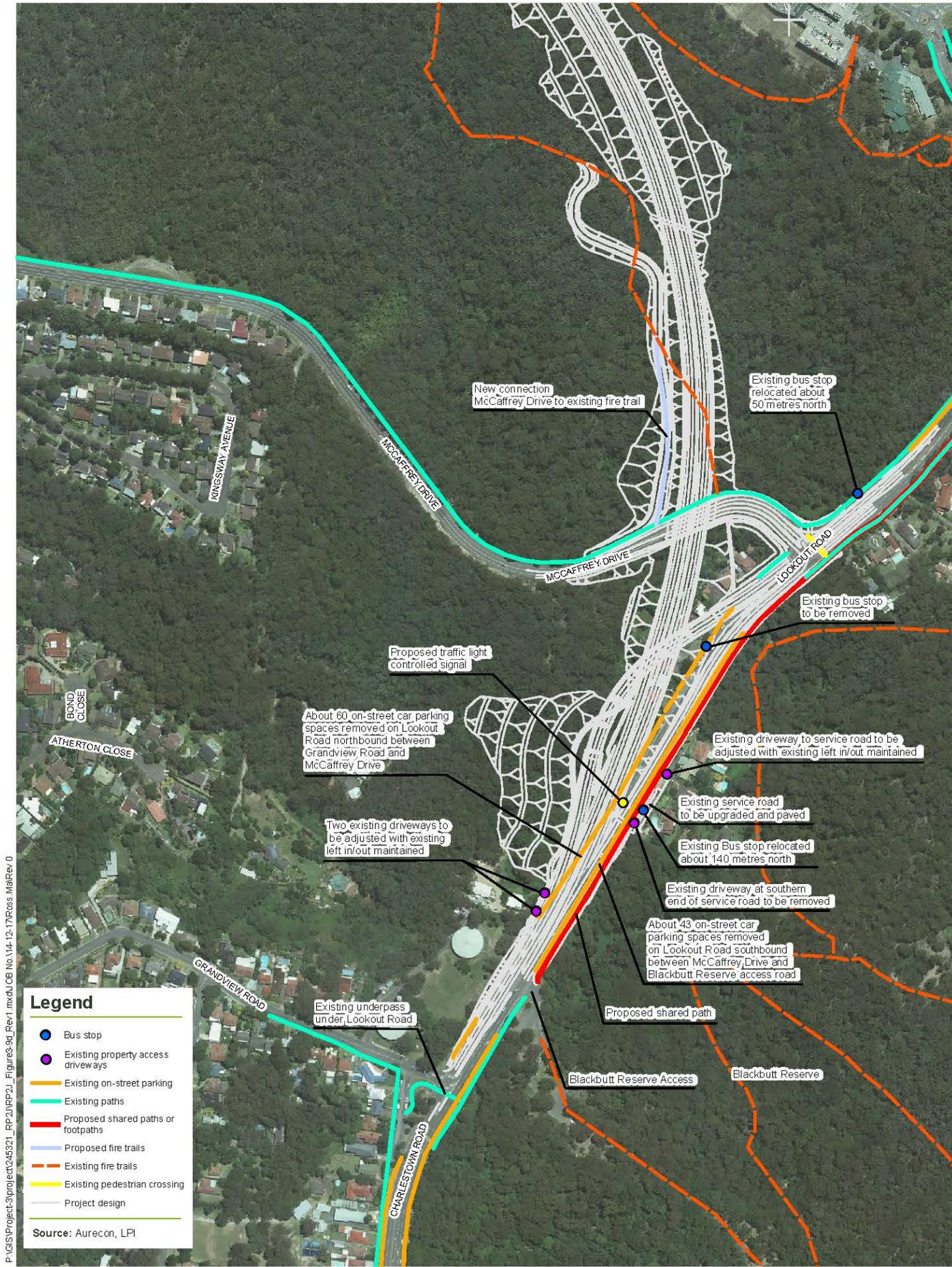
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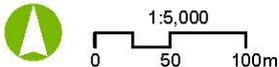
Newcastle Inner City Bypass Rankin Park to Jesmond **Traffic and Transport Assessment**

Projection: GDA 1994 MGA Zone 56

FIGURE 3-14c: Existing and proposed property access provisions, on-street parking and paths



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Newcastle Inner City Bypass Rankin Park to Jesmond **Traffic and Transport Assessment**

Projection: GDA 1994 MGA Zone 56

FIGURE 3-14d: Existing and proposed property access provisions, on-street parking and paths

4 Construction impacts

Potential traffic and transport risks and impacts of the construction elements of the project were discussed in Section 6 of the Traffic and Transport Assessment (Aurecon 2016) and these are still relevant for the modified design. The design refinements have altered the estimates of materials that would be handled during construction of the project and these refinements have been considered in this section. Construction traffic and transport impacts will be managed in accordance with the management measures outlined in the Traffic and Transport Assessment (Aurecon 2016) and in Section 5 of this supplementary report. These measures would be further developed during detailed design and implemented to ensure that impacts are minimised.

4.1 Ancillary sites

In the Traffic and Transport Assessment (Aurecon 2016), three main areas were identified within the construction boundary of the project for potential use as site compounds and other ancillary uses needed to construct the project (Construction compounds A, B and C). An additional three areas have been identified as part of the revised project design (Construction compounds D, E and F). Compounds A, B and C would be used for the duration of main construction activities. Compounds D and E would only be required during the early work phase associated with construction of the shared path bridge (Bridge 7) over Newcastle Road. Compound F would be used during both the early work and main construction phases.

All ancillary site locations are shown on Figure 4-1. These sites have been located based on:

- Topography and accessibility to construction areas.
- Minimising impacts on native vegetation and residential areas where possible.
- Location above the 20-year average recurrence interval (ARI) flood level where possible.

The proposed uses of the ancillary sites are provided in Table 4-1. It should be noted that these are indicative only and would require further refinement based on the needs of the construction contractor. Construction staging would influence the staging and use requirements of these sites.

Table 4-1 Indicative on-site compound use

Site Compound	Proposed use									
	Main Site Compound	Materials Handling	Crushing Plant	Stockpile Site	Batching plant	Bridge Girders / components	Site offices	Deliveries	Parking	Construction support activities
A	x	x	x	x	x	x	x	x	x	x
B						x	x	x	x	x
C						x	x	x	x	x
D	x	x		x		x	x	x	x	x
E		x				x		x	x	x
F (early work)	x	x		x			x	x	x	x
F (main work)		x		x		x	x	x	x	x



These ancillary sites would be accessed from the proposed construction access roads and access points discussed in Section 6.3 of the Traffic and Transport Assessment (Aurecon 2016).

4.2 Construction traffic

Construction related traffic would use the surrounding road network to:

- Haul material from quarries / borrow source to work site areas.
- Transport equipment and materials from one section of the construction area to another (where required).
- Provide access for the delivery of construction materials and the removal of waste.
- Provide access for the workforce to the various locations along the construction boundary, in particular site compounds.

The most significant contributions to additional vehicle movements on the existing road network would occur at access points to the proposed construction access roads and on the roads linking to sources of key construction materials such as asphalt, gravel road base and concrete products.

The majority of construction traffic movements are expected to be contained within the project's construction boundary with the exception of deliveries to site, disposal of waste and staff travel. Construction access routes have been located with consideration of potential noise and vibration impacts on sensitive receivers.

Haulage of material to the site would generally occur via the restricted access vehicle network described in Section 2.1.2. However, use of local roads for haulage of bulk materials is required on sections of McCaffrey Drive, Lookout Road and Kookaburra Circuit (John Hunter Hospital access) during some stages of construction. This is discussed further in Section 6.3.2 of the Traffic and Transport Assessment (Aurecon 2016).

4.2.1 On-site construction access roads

The project would require construction of temporary roads within the project boundary to provide access during construction. The main project alignment has a number of constraints that limit access options, including: steep terrain, access and egress from local road network, proximity to John Hunter Hospital and local residents, and sensitive flora and fauna.

The proposed construction access roads have been developed and assessed as shown in Figure 4-1. These access roads provide options for accessing the project's construction areas. The selected construction contractor(s) may use some or all of these roads during the construction period.

- **Construction access road 1 (CAR1)** – would be the main access road for the northern section of the project. It would extend along the main project alignment between Newcastle Road and McCaffrey Drive.

Access to CAR1 from the north would be provided with connection(s) off Newcastle Road near, or from, the Jesmond Roundabout. Temporary traffic light controls may be used for the roundabout on Newcastle Road to allow construction traffic to access the construction site from all directions.

Access to CAR1 from the south would be provided with a connection off McCaffrey Drive to the west of the main project alignment.

The access point at Jesmond Roundabout is expected to be the main access point for delivery of bulk materials to the site, such as concrete, gravel road base and asphalt.

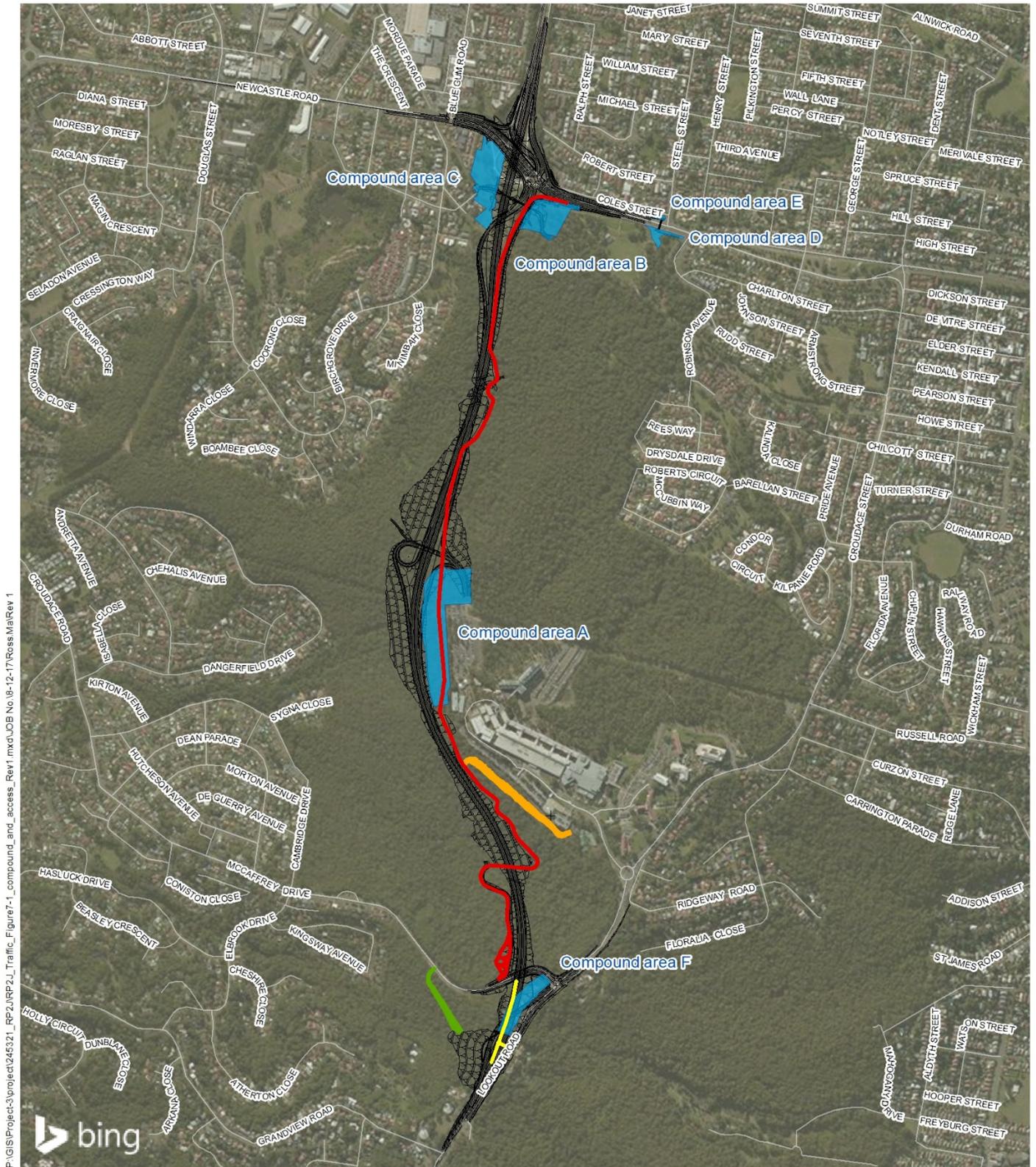
- **Construction access road 2 (CAR2)** – would provide access off the existing John Hunter Hospital access road (Kookaburra Circuit) and along the southern boundary of John Hunter Hospital. This option would provide a secondary access to CAR1 at cut area 3 (shown on Figure 4-1). CAR2



would generally be used by light vehicles and may be used for the haulage of excavated material from the section south of McCaffrey Drive.

This route would require use of parts of the hospital's road network and construction traffic would pass in close proximity to Ronald McDonald House Newcastle (located within the hospital grounds). Use of this access road would be managed to minimise impacts to the hospital's road network and Ronald McDonald House Newcastle, particularly during peak periods. Consultation would be carried out with the John Hunter Hospital and Hunter New England Local Health District to establish a set of rules for use of this access road during peak periods, prior to the commencement of construction.

- **Construction access road 3 (CAR3)** – would provide access from McCaffrey Drive to the southern section of the project. This access road may be used to haul material to and from cut 1 and fill 1 (shown on Figure 4-2).
- **Construction access road 4 (CAR4)** – Would provide access from Lookout Road to the southern section of the project. This access road may be used to haul material to and from cut 1 and fill 1 as well as the construction of Bridge 1 (shown on Figure 4-2). Once McCaffrey Drive bridge is sufficiently completed CAR4 may be continued along the alignment and connect to CAR1.

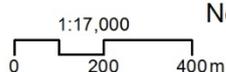


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Legend

-  Design
-  Site compounds
-  Construction Access Road 1 - Northern Access
-  Construction Access Road 2 - South Eastern Access
-  Construction Access Road 3 - Southern Access
-  Construction Access Road 4 - Southern Access

Source: BingMaps, Aurecon



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Projection: GDA 1994 MGA Zone 56

FIGURE 4-1: Site compounds and access roads

4.3 Material haulage

4.3.1 General construction materials

Construction of the project would require a range of materials to be transported to and within the construction footprint and compound/stockpile areas. Due to the project design refinements described in this report there has been minor changes to the estimated usage of concrete, asphalt and water as described in this section.

4.3.1.1 Concrete

Construction of the project would require about 13,000 cubic metres of concrete. This would most likely be supplied from external sources or could involve the establishment of a batching plant on-site (as discussed in Section 5.4.5 of the EIS). Concrete would be required for bridge and drainage structures, kerbs and medians.

4.3.1.2 Asphalt

Construction of the project would require about 57,000 tonnes of asphalt. This would most likely be supplied from external sources or could involve the establishment of a batching plant on-site (as discussed in Section 5.4.5 of the EIS). Asphalt would be used to construct road surfaces.

4.3.1.3 Water

Water would be required for the various construction activities including:

- Compacting and stabilising earthworks
- Suppressing dust
- Watering landscaped areas
- On-site concrete batching
- Concrete curing
- Washing plant and machinery
- Site amenities.

Water supply would be sourced from the Hunter Water Corporation potable water network at the Jesmond roundabout at the northern end of the project and/or Lookout Road at the southern end of the project. Consultation would be carried out with Hunter Water Corporation during the detailed design stage regarding potential water use requirements. The final connection points and arrangement of potable water supply would be determined by the construction contractor.

Indicative water requirements to facilitate construction have been estimated and are provided in Table 4-2.

Table 4-2 Indicative water requirements for construction

Construction activity	Estimated water consumption during construction (mega litres)
Bulk earthworks	26
Dust suppression	5
Landscape watering	4
Road surface construction	5

4.3.2 On-site earthworks

The project involves large cut and fill activities to the existing topography to match the proposed road. Areas of major cut and fill are shown on Figure 4-2. Due to the project design refinements described in this report there has been changes to the required cut and fill volumes as described below.

The indicative quantities of the various material types generated during excavations by the project are listed in Table 4-3. The indicative earthworks fill volumes required by the project are shown in Table 4-4.

Table 4-3 Cut volumes

Cut material description	Cut volume (cubic metres)
Suitable for general fill	421,000 (41%)
Suitable for upper zone formation	200,000 (20%)
Suitable for select material zone	112,000 (11%)
Coal	102,000 (10%)
Tuffaceous materials	184,000 (18%)
<i>Total</i>	<i>1,019,000 (100%)</i>

Table 4-4 Fill volumes

Fill material description	Fill volume (cubic metres)
General fill (cut/fill)	891,000 (95%)
Upper zone formation	46,000 (5%)
<i>Total</i>	<i>937,000 (100%)</i>

Table 4-3 and Table 4-4 shows that the project would indicatively generate about 82,000 cubic metres of surplus material from cuts. There is potential that as the detailed design is developed grade lines will be adjusted to further balance the cut and fill requirements. Where a surplus of cut materials still occurs this material could be used in a number of ways through the project, such as to flatten batters or to provide visual screenings. Where surplus material cannot be reused in the project it would be disposed off-site to a licensed facility.

It is predicted that about 40,700 cubic metres of surplus material that is unsuitable for use in fill may have to be disposed off-site.

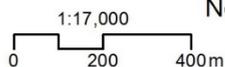


Legend

-  Design
-  Earthworks cut
-  Earthworks fill

Source: BingMaps, Aurecon

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Projection: GDA 1994 MGA Zone 56

FIGURE 4-2: Earthworks locations

Table 4-5 Major earthworks cut/fill volumes

Cut/ Fill No.	Ch Start (m)	Ch Finish (m)	Cut (m ³)	Fill (m ³)
Fill 1	7270	7510		145,000
Cut 1	7440	7700	175,000	
Cut 2	7700	7970	88,000	
Fill 2	7930	8470		283,000
Cut 3	8380	8590	39,000	
Fill 3	8580	9100		357,000
Cut 4	8920	9450	603,000	
Fill 4	9430	9580		43,000
Fill 5	9610	9710		14,000
Cut 5	9690	10170	114,000	
Fill 6	10020	10480		95,000
Total			1,019,000	937,000

Earthworks haulage within the site is expected to be carried out by a range of earthmoving vehicles including trucks, truck and trailer and scrapers.

Main haulage movements between the cut and fill areas shown on Figure 4-2 are expected to be contained within the construction boundary with the exception of any off-site disposal.

Use of CAR2 may be required for haulage or excavated material from cut 1 to the areas north of McCaffrey Drive. This would involve haulage of material through the John Hunter Hospital Road network and the existing hospital access intersection on Lookout Road. If required, these haulage activities would be carried out either by truck or truck and trailer. If only using trucks, it is estimated that about 144 vehicle movements (two way) per day would be required for an 85 day period. If truck and trailer were to be used it is estimated that about 84 trips per day would be required for a 76 day period.

As above, it is predicted that about 40,700m³ of excavated material that is unsuitable for use in fill may have to be disposed of off-site. This material would be transported via designated restricted access vehicle routes A37 (Lookout Drive, Croudace Street, Charlestown Road) or Newcastle Road and would require about 4,100 vehicle movements.

4.4 Construction traffic impacts

4.4.1 Construction traffic volumes

An estimate of the number of construction vehicles that would access the project construction site via the public road network has been made based on estimates of materials required for the project, typical capacities of construction vehicles and anticipated staff numbers. This estimate is provided in Table 4-6.

Table 4-6 Estimate of construction traffic movements

Task	Activity	Quantity	Rate per day	Vehicle capacity	Trips/day per activity	No. of sites with activity	Trips/day (two way)	Total trips (two way)	Duration (days)	Worst-case vehicle movements per day
Bridge construction	Concrete delivery	2,500m ³	100	8	13	2	50	625	13	50
Earthworks	Unsuitable removal	38,000m ³	200	19	10	3	60	4,000	65	65
Pavements	Imported heavily bound base	35,000m ³	500	19	26	2	105	3,684	35	105
	Asphalt - intermediate courses	12,500 T	400	25	16	1	32	1,000	31	32
	Drainage layer delivery	11,500m ³	500	19	26	1	53	1211	23	55
Drainage installation	Concrete delivery	488m ³	50	8	6	2	25	122	15	10
Kerbs and barriers	Concrete delivery	8,330m ³	100	8	13	2	50	2,083	15	40
Workforce	Staff vehicles	100			100		200		Peak per day	200
Total vehicle movements per day									Heavy	357
									Light	200

Light vehicles used for construction of the project would typically be used to transport staff to construction areas and for minor construction activities such as inspections and movement of light equipment. As shown in Table 4-6, construction of the project is expected to involve up to 200 light (including passenger) vehicle movements per day. The majority of these movements would occur along main roads such as Newcastle Road and Lookout Road, although small numbers of light vehicles may use local roads during the construction period.

To provide an indication of the worst-case impacts of construction traffic on the current network, the estimated volume (including both light and heavy vehicles) that would use the existing road network has been expressed as a percentage of the existing average weekday traffic flow (two way) at a range of locations in the vicinity of the construction site. This was also calculated for AM and PM peak periods.

This analysis indicates that in comparison to total vehicle trips on the existing road network, the volume generated by the proposed construction would not exceed 1.5 per cent of average weekday daily traffic volumes and 1.8 per cent of traffic volumes during peak periods. Due to the low predicted increase in traffic volumes, this worst-case scenario is considered unlikely to affect the level of service at the intersections servicing these roads.

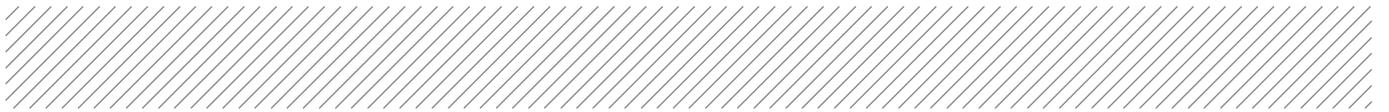
The estimated weekday traffic volumes and predicted construction traffic impacts are indicated in Table 4-7. Estimated weekday peak hour traffic volumes and predicted construction traffic impacts are indicated in Table 4-8 and Table 4-9. All sites indicated are located on designated restricted access vehicle routes suitable for use by construction traffic associated with the project.

Table 4-7 Impact of estimated worst-case construction traffic on current (2014) traffic volumes

ID	Road/location	Average weekday daily traffic (two-way in vehicles)	Indicative predictive construction traffic impact (% increase)
1	Charlestown Road, south of Carnley Avenue	55,100	1.0%
7	Lookout Road, north of McCaffrey Drive	49,400	1.1%
10	Newcastle Road, east of Croudace Street	46,500	1.2%
11	Newcastle Inner City Bypass, north of Newcastle Road	36,100	1.5%
12	Newcastle Road, west of Newcastle Inner City Bypass	44,300	1.3%
16	Newcastle Road, east of Newcastle Inner City Bypass	60,200	0.9%
17	Croudace Street, north of Elder Street	41,800	1.3%
18	Lookout Road, south of Russell Road	48,700	1.1%
19	Lookout Road, south of McCaffrey Drive	47,200	1.2%

Table 4-8 Impact of estimated worst-case construction traffic on current (2014) AM peak traffic volumes

ID	Road/location	Average weekday AM peak hour traffic (two-way in vehicles)	Indicative predictive construction traffic impact (% increase)
1	Charlestown Road, south of Carnley Avenue	4,209	1.2%
7	Lookout Road, north of McCaffrey Drive	3,942	1.3%
10	Newcastle Road, east of Croudace Street	3,801	1.3%
11	Newcastle Inner City Bypass, north of Newcastle Road	3,149	1.6%



ID	Road/location	Average weekday AM peak hour traffic (two-way in vehicles)	Indicative predictive construction traffic impact (% increase)
12	Newcastle Road, west of Newcastle Inner City Bypass	4,001	1.3%
16	Newcastle Road, east of Newcastle Inner City Bypass	4,498	1.1%
17	Croudace Street, north of Elder Street	2,774	1.8%
18	Lookout Road, south of Russell Road	3,728	1.4%
19	Lookout Road, south of McCaffrey Drive	3,606	1.4%

Table 4-9 Impact of estimated worst-case construction traffic on current (2014) PM peak traffic volumes

ID	Road/location	Average weekday PM peak hour traffic (two-way in vehicles)	Indicative predictive construction traffic impact (% increase)
1	Charlestown Road, south of Carnley Avenue	4,638	1.1%
7	Lookout Road, north of McCaffrey Drive	3,986	1.3%
10	Newcastle Road, east of Croudace Street	3,998	1.3%
11	Newcastle Inner City Bypass, north of Newcastle Road	2,767	1.8%
12	Newcastle Road, west of Newcastle Inner City Bypass	3,599	1.4%
16	Newcastle Road, east of Newcastle Inner City Bypass	4,387	1.1%
17	Croudace Street, north of Elder Street	3,114	1.6%
18	Lookout Road, south of Russell Road	3,618	1.4%
19	Lookout Road, south of McCaffrey Drive	3,917	1.3%



5 Mitigation and management measures

Management measures will be implemented during the construction and operational phases of the project to minimise the potential traffic and transport impacts. These mitigation measures are detailed in Section 7 of the *Transport and Traffic Assessment* (Aurecon 2016). They are still relevant for the refined design and no additional management measures are required.



6 Conclusion

This supplementary assessment has found that design refinements to the project that have occurred since public exhibition of the EIS would not increase the traffic and transport impacts associated with the project that were predicted in the *Traffic and Transport Assessment* (Aurecon 2016)

The following points summarise the findings of this supplementary assessment:

- The project would provide major benefits for motorists using the Newcastle Inner City Bypass with substantial reductions in travel time for both northbound and southbound journeys.
- The project would improve travel times for north-south trips on the existing route and for east-west trips on Newcastle Road.
- The project would generally improve intersection performance at key existing intersections in 2020 and 2030 in both the morning and afternoon peaks.
- The project would improve connections to the existing shared paths in the study area and enhance options for walking and cycling. This would improve safety for pedestrians and cyclists.
- The majority of construction traffic movements are expected to be contained within the project's construction boundary with the exception of deliveries to site, disposal of waste and staff travel.
- During construction, the project would result in small increases of traffic volumes on the existing road network of up to 1.5 per cent of average weekday daily traffic volumes and 1.8 per cent of traffic volumes during peak periods. Due to the low predicted increase in traffic volumes, this worst-case scenario is considered unlikely to affect the level of service at the intersections servicing these roads.



7 References

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Roads and Traffic Authority 2002, *Guide to Traffic Generating Developments, Issue 2.2*. October 2002.

Roads and Traffic Authority 2005, *NSW Bicycle Guidelines*.

Roads and Traffic Authority (RTA) 2010, *Traffic Control at Work Sites*.

8 Glossary

Glossary of Terms

Term	Definition
%	Per cent
A37	Route of National Significance A37
AADT	Annual Average Daily Traffic
ARI	Average Recurrence Interval
AS	Australian Standard
CBD	Central Business District
CEMP	Construction Environment Management Plan
CH	Chainage
CTMP	Construction Traffic Management Plan
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning & Assessment Act 1979</i>
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
HW23	State Highway 23
km	Kilometres
LGA	Local Government Area
LHTM	Lower Hunter Traffic Model
LoS	Level of Service
m	Metres
m ³	Cubic metres
MR	Main Road
OD	Origin-destination
Roads and Maritime	Roads and Maritime Services
RTA	Roads and Traffic Authority
SEARS	Secretary's Environmental Assessment Requirements
The project	Newcastle Inner City Bypass – Rankin Park to Jesmond
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled
VMP	Vehicle Movement Plan

Appendix A

Level of Service data



Intersection	Approach	Mvt	2020 Do Minimum AM															
			Movement			Approach			Intersection									
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS							
University Interchange	ICB North	Left	193	70	F	257	89	F	2709	48	D							
		Right	64	147	F													
	University East	Left	238	16	B													
		Thru	373	17	B													
	ICB South	Left	129	17	B													
		Right	35	7	A													
University West	Left	Thru	802	8	A													
		Right	66	81	F													
	Thru	625	103	F														
Jesmond Roundabout	ICB	Left	185	101	F	1065	112	F	6852	41	C							
		Right	702	95	F													
		Thru	363	145	F													
	Newcastle East	Left	1123	22	B													
		Right	1012	32	C													
	Newcastle West	Left	1046	18	B													
Thru		1793	40	C														
Right		31	44	D														
Croudace/ Dent/ Newcastle	Dent	Left	206	56	E	281	55	D	6089	55	D							
		Thru	45	57	E													
		Right	332	15	B													
	Newcastle East	Left	1193	67	E													
		Thru	74	100	F													
		Right	946	22	B													
	Croudace	Left	313	72	F													
		Thru	509	70	F													
		Right	9	50	D													
	Newcastle West	Left	1752	55	D													
		Thru	680	80	F													
		Right	226	8	A													
Croudace/ Howe	Croudace North	Left	1015	11	A	1240	11	A	3045	17	B							
		Thru	41	29	C													
	Howe	Left	275	57	E													
		Right	1357	7	A													
	Croudace South	Left	132	89	F													
		Right	31	31	C													
Croudace/ Lookout/ Russell	Croudace	Left	1099	32	C	1130	32	C	3901	23	B							
		Thru	577	11	A													
	Russell	Left	28	52	D													
		Right	1431	13	A													
	Lookout	Left	735	36	C													
		Right	1154	15	B													
Lookout/ Hospital	Lookout North	Left	725	83	F	1879	41	C	4920	29	C							
		Right	675	16	B													
	Lookout South	Left	2004	21	B													
		Thru	146	7	A													
	Hospital	Left	216	43	D													
		Right	1162	3	A													
Lookout/ McCaffrey	Lookout North East	Left	208	57	E	1370	11	A	4679	57	E							
		Right	235	66	E													
	Lookout South West	Left	2054	72	F													
		Thru	644	73	F													
	McCaffrey North West	Left	377	110	F													
		Right	1285	14	B													
Lookout/ Cardiff	Lookout North	Left	199	84	F	1484	24	B	4300	47	D							
		Right	178	52	D													
	Lookout South	Left	1862	65	E													
		Thru	376	31	C													
	Cardiff	Left	401	62	E													
		Right	340	29	B													
Haley/ Charlestown/ Lookout	Lookout	Left	1348	43	D	1688	40	C	5100	36	C							
		Thru	485	3	A													
	Carnley	Left	229	146	F													
		Right	1895	21	B													
	Douglass/Newcastle	Charlestown	Left	803	52							D	2698	30	C	4726	21	B
			Right	140	57							E						
Douglass North		Left	38	80	F													
		Thru	71	71	F													
Newcastle East		Left	72	22	B													
		Thru	1396	20	B													
Douglass South	Left	54	57	E														
	Thru	34	32	C														
	Right	103	40	C														
Newcastle West	Left	214	52	D														
	Thru	26	11	A														
	Right	2532	12	A														
BlueGum/Newcastle	Blue Gum North	Left	46	61	E	309	40	C	4682	19	B							
		Thru	153	36	C													
	Newcastle East	Left	156	45	D													
		Thru	1345	6	A													
	Newcastle West	Left	144	88	F													
		Thru	151	17	B													
Grandview/Lookout	Lookout North	Left	2733	19	B	2884	19	B	3915	11	A							
		Right	1505	5	A													
	Lookout South	Left	32	103	F													
		Thru	43	11	A													
	Lookout West	Left	2175	12	A													
		Right	160	43	D													

Intersection	Approach	Mvt	2020 Do Minimum PM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	77	3	A	229	9	A	2785	38	C
		Right	151	13	A						
	University East	Left	491	53	D	1490	57	E			
		Thru	774	59	E						
	ICB South	Left	225	59	E	423	26	B			
		Right	143	19	B						
University West	University West	Left	280	29	C	644	13	A			
		Thru	75	5	A						
		Right	402	15	B						
Jesmond Roundabout	ICB	Left	166	13	A	1752	91	F	6837	43	D
		Right	1075	76	F						
	Newcastle East	Left	677	114	F	3156	34	C			
		Thru	1407	32	C						
	Newcastle West	Left	756	51	D	1929	14	B			
		Thru	439	7	A						
Croudace/ Dent/ Newcastle	Dent	Left	1490	16	B	370	116	F	6496	86	F
		Thru	28	106	F						
		Right	323	117	F						
	Newcastle East	Left	19	111	F	2089	97	F			
		Thru	614	55	D						
		Right	1379	112	F						
	Croudace	Left	96	149	F	1462	29	C			
		Thru	797	8	A						
		Right	286	54	D						
	Newcastle West	Left	379	54	D	2575	105	F			
		Thru	22	68	E						
		Right	1559	69	E						
Croudace/ Howe	Croudace North	Left	994	162	F	1930	22	B	3499	24	B
		Thru	288	17	B						
	Howe	Left	1642	23	B	398	57	E			
		Right	87	29	C						
	Croudace South	Left	311	65	E	1171	16	B			
		Thru	1018	8	A						
Croudace/ Lookout/ Russell	Croudace	Left	153	64	E	1719	116	F	3981	63	E
		Thru	32	120	F						
	Russell	Left	1688	116	F	562	24	B			
		Right	533	22	B						
	Lookout	Left	29	56	D	1700	22	B			
		Thru	1112	12	A						
Lookout/ Hospital	Lookout North	Left	588	40	C	2330	9	A	4672	23	B
		Thru	2079	5	A						
	Lookout South	Left	251	39	C	1435	29	C			
		Thru	225	5	A						
	Hospital	Left	1210	33	C	907	49	D			
		Right	307	31	C						
Lookout/ McCaffrey	Lookout North East	Left	600	59	E	2668	27	B	5019	28	B
		Thru	2039	13	A						
	Lookout South West	Left	629	75	F	1641	27	B			
		Thru	504	22	B						
	McCaffrey North West	Left	1136	29	B	710	33	C			
		Right	308	5	A						
Lookout/ Cardiff	Lookout North	Left	401	55	D	2323	23	B	4628	35	C
		Thru	1966	14	A						
	Lookout South	Left	357	74	F	1750	33	C			
		Thru	348	19	B						
	Cardiff	Left	1403	37	C	554	93	F			
		Right	226	59	E						
Carnley/ Charlestown/ Lookout	Lookout	Left	328	117	F	2264	88	F	5291	51	D
		Thru	276	73	F						
	Carnley	Left	1987	90	F	1233	35	C			
		Right	866	5	A						
	Charlestown	Left	366	105	F	1794	17	B			
		Right	1388	7	A						
Douglass/Newcastle	Douglass North	Left	406	52	D	265	59	E	4603	28	B
		Thru	78	51	D						
		Right	91	65	E						
	Newcastle East	Left	96	59	E	2292	34	C			
		Thru	234	35	C						
		Right	2004	33	C						
	Douglass South	Left	53	80	F	265	45	D			
		Thru	56	30	C						
		Right	43	38	C						
	Newcastle West	Left	167	52	D	1781	12	A			
		Thru	32	11	A						
		Right	1711	11	A						
BlueGum/Newcastle	Blue Gum North	Left	38	59	E	519	34	C	4563	27	B
		Thru	242	25	B						
	Newcastle East	Left	276	42	C	2099	20	B			
		Thru	1866	13	A						
	Newcastle West	Left	233	77	F	1946	33	C			
		Thru	254	32	C						
Grandview/Lookout	Lookout North	Left	1692	33	C	2444	10	A	4151	7	A
		Right	2332	9	A						
	Lookout South	Left	112	25	B	1629	2	A			
		Thru	96	2	A						
	Lookout West	Left	1533	2	A	77	2	A			
		Right	77	2	A						

Intersection	Approach	Mvt	2030 Do Minimum AM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	185	123	F	247	153	F	2717	79	F
		Right	63	244	F						
	University East	Left	231	79	F	735	68	E			
		Thru	376	63	E						
	ICB South	Right	128	62	E	881	12	A			
		Left	34	10	A						
	University West	Right	847	12	A	853	136	F			
		Left	62	112	F						
		Thru	602	137	F						
	Jesmond Roundabout	ICB	Right	189	140	F	990	166			
Left			662	141	F						
Right		328	217	F							
Newcastle East		Thru	1205	18	B						
		Right	1048	27	B						
Newcastle West		Left	1153	22	B	3028			37	C	
	Thru	1874	47	D							
Croudace/ Dent/ Newcastle	Dent	Left	37	52	D	316	60	E	6319	71	F
		Thru	230	63	E						
		Right	49	53	D						
	Newcastle East	Left	343	52	D	1687	104	F			
		Thru	1256	115	F						
		Right	88	154	F						
	Croudace	Left	966	25	B	1822	50	D			
		Thru	333	81	F						
		Right	523	78	F						
	Newcastle West	Left	7	53	D	2493	64	E			
		Thru	1816	58	E						
		Right	670	80	F						
Croudace/ Howe	Croudace North	Left	243	8	A	1266	11	A	3103	19	B
		Thru	1024	12	A						
	Howe	Left	42	27	B						
		Right	297	62	E						
	Croudace South	Thru	1370	10	A						
		Right	128	94	F						
Croudace/ Lookout/ Russell	Croudace	Left	31	24	B	1139	30	C	3962	22	B
		Thru	1108	30	C						
	Russell	Left	630	14	A						
		Right	29	54	D						
	Lookout	Thru	1448	12	A						
		Right	717	35	C						
Lookout/ Hospital	Lookout North	Thru	1164	26	B	1926	56	E	4961	36	C
		Right	762	101	F						
	Lookout South	Left	675	19	B						
		Thru	2005	23	B						
	Hospital	Left	150	9	A						
		Right	206	45	D						
Lookout/ McCaffrey	Lookout North East	Thru	1157	5	A	1363	13	A	4663	71	F
		Right	206	59	E						
	Lookout South West	Left	239	81	F						
		Thru	2055	87	F						
	McCaffrey North West	Left	644	105	F						
		Right	362	127	F						
Lookout/ Cardiff	Lookout North	Thru	1261	14	A	1448	22	B	4281	55	D
		Right	188	81	F						
	Lookout South	Left	180	64	E						
		Thru	1863	77	F						
	Cardiff	Left	371	45	D						
		Right	418	77	F						
Carnley/ Charlestown/ Lookout	Lookout	Left	353	27	B	1688	38	C	5141	44	D
		Thru	1334	41	C						
	Carnley	Left	512	4	A						
		Right	220	152	F						
	Charlestown	Thru	1912	39	C						
		Right	809	65	E						
Douglass/Newcastle	Douglass North	Left	162	60	E	277	65	E	4958	24	B
		Thru	40	84	F						
		Right	76	67	E						
	Newcastle East	Left	84	20	B	1575	21	B			
		Thru	1429	20	B						
		Right	62	58	E						
	Douglass South	Left	38	31	C	378	55	D			
		Thru	101	41	C						
		Right	238	66	E						
	Newcastle West	Left	30	15	B	2727	16	B			
		Thru	2652	16	B						
		Right	45	62	E						
BlueGum/Newcastle	Blue Gum North	Left	184	42	C	348	44	D	4931	29	C
		Thru	165	46	D						
	Newcastle East	Thru	1390	9	A						
		Right	150	97	F						
	Newcastle West	Left	159	31	C						
		Thru	2884	33	C						
Grandview/Lookout	Lookout North	Thru	1474	14	B	1502	17	B	3884	18	B
		Right	29	136	F						
	Lookout South	Left	43	16	B						
		Thru	2171	15	B						
	Lookout West	Left	167	57	E						
		Right	0	0	A						

Intersection	Approach	Mvt	2030 Do Minimum PM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	59	10	A	171	24	B	2419	58	E
		Right	111	31	C						
	University East	Left	337	118	F						
		Thru	522	116	F						
	ICB South	Left	155	8	A						
		Right	305	12	A						
University West	Left	86	6	A							
	Thru	489	16	B							
	Right	204	20	B							
Jesmond Roundabout	ICB	Left	945	85	F	1541	106	F	6873	42	D
		Right	596	139	F						
	Newcastle East	Thru	1423	27	B						
		Right	777	43	D						
	Newcastle West	Left	490	7	A						
		Thru	1631	18	B						
Croudace/ Dent/ Newcastle	Dent	Left	30	387	F	398	399	F	6620	100	F
		Thru	343	400	F						
		Right	24	393	F						
	Newcastle East	Left	633	66	E						
		Thru	1391	114	F						
		Right	88	151	F						
	Croudace	Left	833	9	A						
		Thru	289	58	E						
		Right	404	59	E						
	Newcastle West	Left	23	62	E						
		Thru	1629	62	E						
		Right	931	146	F						
Croudace/ Howe	Croudace North	Left	280	42	C	1882	45	D	3517	36	C
		Thru	1603	46	D						
	Howe	Left	84	31	C						
		Right	315	65	E						
	Croudace South	Thru	1080	9	A						
		Right	156	62	E						
Croudace/ Lookout/ Russell	Croudace	Left	36	130	F	1676	134	F	4096	73	F
		Thru	1640	134	F						
	Russell	Left	615	51	D						
		Right	39	73	F						
	Lookout	Thru	1163	14	A						
		Right	603	44	D						
Lookout/ Hospital	Lookout North	Thru	2094	7	A	2358	10	A	4800	27	B
		Right	264	36	C						
	Lookout South	Left	247	7	A						
		Thru	1280	34	C						
	Hospital	Left	308	42	C						
		Right	607	78	F						
Lookout/ McCaffrey	Lookout North East	Thru	1983	20	B	2660	39	C	5104	34	C
		Right	677	93	F						
	Lookout South West	Left	508	22	B						
		Thru	1190	28	B						
	McCaffrey North West	Left	330	3	A						
		Right	416	56	D						
Lookout/ Cardiff	Lookout North	Thru	1924	9	A	2291	17	B	4639	37	C
		Right	366	61	E						
	Lookout South	Left	350	19	B						
		Thru	1432	37	C						
	Cardiff	Left	233	92	F						
		Right	334	155	F						
Carnley/ Charlestown/ Lookout	Lookout	Left	276	83	F	2229	99	F	5315	58	E
		Thru	1953	101	F						
	Carnley	Left	850	12	A						
		Right	376	120	F						
	Charlestown	Thru	1416	7	A						
		Right	443	54	D						
Douglass/Newcastle	Douglass North	Left	89	74	F	284	77	F	4836	31	C
		Thru	101	98	F						
		Right	93	57	E						
	Newcastle East	Left	222	40	C						
		Thru	2006	39	C						
		Right	52	77	F						
	Douglass South	Left	57	26	B						
		Thru	44	37	C						
		Right	177	57	E						
	Newcastle West	Left	41	11	A						
		Thru	1912	11	A						
		Right	40	62	E						
Blue Gum/Newcastle	Blue Gum North	Left	267	30	C	580	42	D	4759	30	C
		Thru	313	52	D						
	Newcastle East	Thru	1803	15	B						
		Right	224	80	F						
	Newcastle West	Left	285	32	C						
		Thru	1867	33	C						
Grandview/Lookout	Lookout North	Thru	2290	3	A	2398	4	A	4157	3	A
		Right	108	19	B						
	Lookout South	Left	100	1	A						
		Thru	1569	1	A						
	Lookout West	Left	90	2	A						
		Right	0	0	A						

Intersection	Approach	Mvt	2020 Refined Strategic Design AM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	181	137	F	228	151	F	3076	36	C
		Right	47	206	F						
	University East	Left	315	1	A	815	4	A			
		Thru	378	6	A						
		Right	123	6	A						
	ICB South	Left	36	9	A	1121	9	A			
		Right	1085	9	A						
	University West	Left	67	47	D	911	68	E			
		Thru	632	71	F						
Right		212	63	E							
Northern Interchange C7	ICB North	Left	391	23	B	865	19	B	5842	36	C
		Right	474	16	B						
	Newcastle East	Left	137	10	A	1664	43	D			
		Thru	1024	46	D						
		Right	503	44	D						
	ICB South	Left	226	40	C	233	40	C			
		Right	8	58	E						
	Newcastle West	Left	1063	32	C	3080	37	C			
		Thru	1680	40	C						
Right		337	41	C							
Croudace/ Dent/ Newcastle	Dent	Left	50	42	D	284	54	D	4683	44	D
		Thru	143	57	E						
		Right	91	57	E						
	Newcastle East	Left	180	6	A	1536	29	C			
		Thru	1278	29	C						
		Right	77	76	F						
	Croudace	Left	323	7	A	788	35	C			
		Thru	128	53	D						
		Right	337	56	D						
Newcastle West	Left	12	45	D	2076	58	E				
	Thru	1808	54	D							
	Right	256	81	F							
Croudace/ Howe	Croudace North	Left	256	8	A	584	18	B	1504	20	B
		Thru	328	25	B						
	Howe	Left	41	11	A	327	19	B			
		Right	286	20	B						
	Croudace South	Thru	514	12	A	593	22	B			
		Right	79	86	F						
Croudace/ Lookout/ Russell	Croudace	Left	29	51	D	441	51	D	2367	18	B
		Thru	412	51	D						
	Russell	Left	543	4	A	567	6	A			
		Right	24	50	D						
	Lookout	Thru	621	6	A	1359	12	A			
		Right	739	17	B						
Lookout/ Hospital	Lookout North	Thru	571	6	A	805	18	B	2729	14	B
		Right	234	47	D						
	Lookout South	Left	453	5	A	1701	10	A			
		Thru	1248	12	A						
	Hospital	Left	98	3	A	223	24	B			
		Right	125	41	C						
Lookout/ McCaffrey	Lookout North East	Thru	542	2	A	688	16	B	2909	14	B
		Right	146	69	E						
	Lookout South West	Left	189	2	A	1333	10	A			
		Thru	1143	11	A						
	McCaffrey North West	Left	558	3	A	888	18	B			
		Right	330	44	D						
Lookout/ Cardiff	Lookout North	Thru	1432	9	A	1650	19	B	4641	54	D
		Right	218	85	F						
	Lookout South	Left	178	66	E	2126	76	F			
		Thru	1947	77	F						
	Cardiff	Left	446	54	D	866	68	E			
		Right	420	83	F						
Carnley/ Charlestown/ Lookout	Lookout	Left	363	26	B	1837	38	C	5362	47	D
		Thru	1475	40	C						
	Carnley	Left	500	6	A	730	49	D			
		Right	230	144	F						
	Charlestown	Thru	1983	42	D	2795	52	D			
		Right	811	77	F						
Hospital Interchange	SBD Off Ramp	Left	322	2	A	322	2	A	574	1	A
		Right	103	0	A						
	Hospital	Left	39	0	A	141	0	A			
		Right	111	0	A						
	NBD Off Ramp	Left	111	0	A	111	0	A			
		Right	111	0	A						
Douglass/Newcastle	Douglass North	Left	137	66	E	250	70	F	5159	20	B
		Thru	40	92	F						
		Right	73	66	E						
	Newcastle East	Left	91	16	B	1736	18	B			
		Thru	1584	16	B						
		Right	61	74	F						
	Douglass South	Left	36	39	C	348	71	F			
		Thru	90	47	D						
		Right	222	86	F						
Newcastle West	Left	27	11	A	2825	11	A				
	Thru	2749	10	A							
	Right	49	65	E							
BlueGum/Newcastle	Blue Gum North	Left	163	31	C	318	38	C	5147	21	B
		Right	154	45	D						
	Newcastle East	Thru	1577	13	A	1725	20	B			
		Right	148	89	F						
	Newcastle West	Left	154	20	B	3105	19	B			
		Thru	2951	19	B						
Grandview/Lookout	Lookout North	Thru	1659	0	A	1697	1	A	4275	4	A
		Right	38	35	C						
	Lookout South	Left	39	5	A	2396	5	A			
		Thru	2357	5	A						
	Lookout West	Left	182	20	B	182	20	B			
		Right	0	0	A						

Intersection	Approach	Mvt	2020 Refined Strategic Design PM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	77	3	A	226	6	A	3335	11	A
		Right	149	7	A						
	University East	Left	712	6	A	1856	9	A			
		Thru	888	12	A						
		Right	256	11	A						
	ICB South	Left	174	16	B	625	19	B			
		Right	450	20	B						
		University West	Left	70	2						
	Thru	381	12	A							
Right	177	8	A								
Northern Interchange C	ICB North	Left	567	18	B	1346	15	B	5684	31	C
		Right	779	13	A						
	Newcastle East	Left	33	6	A	1958	38	C			
		Thru	1375	33	C						
		Right	549	52	D						
	ICB South	Left	353	44	D	402	44	D			
		Right	49	49	D						
	Newcastle West	Left	423	21	B	1979	32	C			
		Thru	1268	33	C						
Right		288	43	D							
Croudace/ Dent/ Newcastle	Dent	Left	44	54	D	359	68	E	5184	32	C
		Thru	273	69	E						
		Right	42	71	F						
	Newcastle East	Left	555	7	A	2150	23	B			
		Thru	1503	25	B						
		Right	91	84	F						
	Croudace	Left	426	5	A	764	28	B			
		Thru	108	56	D						
		Right	229	57	E						
Newcastle West	Left	37	32	C	1911	37	C				
	Thru	1589	31	C							
	Right	286	67	E							
Croudace/ Howe	Croudace North	Left	309	7	A	1119	20	B	2044	21	B
		Thru	811	25	B						
	Howe	Left	78	20	B	397	29	C			
		Right	319	31	C						
	Croudace South	Thru	446	11	A	527	17	B			
		Right	81	53	D						
Croudace/ Lookout/ Russell	Croudace	Left	31	12	A	938	9	A	2649	16	B
		Thru	906	9	A						
	Russell	Left	562	8	A	590	10	A			
		Right	28	47	D						
	Lookout	Thru	545	10	A	1121	25	B			
		Right	575	39	C						
Lookout/ Hospital	Lookout North	Thru	1373	2	A	1436	3	A	2923	13	A
		Right	63	37	C						
	Lookout South	Left	160	2	A	913	20	B			
		Thru	753	23	B						
	Hospital	Left	198	11	A	574	29	C			
		Right	377	39	C						
Lookout/ McCaffrey	Lookout North East	Thru	1235	5	A	1727	17	B	3402	16	B
		Right	493	46	D						
	Lookout South West	Left	413	3	A	1063	8	A			
		Thru	650	12	A						
	McCaffrey North West	Left	266	3	A	612	24	B			
		Right	346	41	C						
Lookout/ Cardiff	Lookout North	Thru	2216	12	A	2668	18	B	5086	60	E
		Right	452	50	D						
	Lookout South	Left	351	83	F	1864	93	F			
		Thru	1513	95	F						
	Cardiff	Left	245	116	F	554	155	F			
		Right	309	186	F						
Carnley/ Charlestown/ Lookout	Lookout	Left	296	102	F	2472	115	F	5714	68	E
		Thru	2176	116	F						
	Carnley	Left	897	6	A	1310	34	C			
		Right	413	95	F						
	Charlestown	Thru	1505	17	B	1932	33	C			
		Right	427	87	F						
Hospital Interchange	SBD Off Ramp	Left	124	1	A	124	1	A	567	0	A
		Right	311	0	A						
	Hospital	Left	92	0	A	403	0	A			
		Right	40	0	A						
Douglass/Newcastle	Douglass North	Left	81	77	F	255	85	F	5132	19	B
		Thru	86	104	F						
		Right	88	74	F						
	Newcastle East	Left	259	14	A	2733	15	B			
		Thru	2421	13	A						
		Right	53	72	F						
	Douglass South	Left	48	34	C	248	66	E			
		Thru	39	46	D						
		Right	161	81	F						
	Newcastle West	Left	33	11	A	1895	10	A			
		Thru	1825	9	A						
		Right	37	66	E						
BlueGum/Newcastle	Blue Gum North	Left	249	20	B	536	31	C	5110	22	B
		Right	287	41	C						
	Newcastle East	Thru	2270	19	B	2540	23	B			
		Right	271	63	E						
	Newcastle West	Left	255	15	B	2033	17	B			
		Thru	1778	18	B						
Grandview/Lookout	Lookout North	Thru	2671	2	A	2795	3	A	4645	3	A
		Right	124	20	B						
	Lookout South	Left	75	3	A	1764	3	A			
		Thru	1690	3	A						
	Lookout West	Left	86	7	A	86	7	A			
		Right	0	0	A						

Intersection	Approach	Mvt	2030 Refined Strategic Design AM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	216	202	F	267	217	F	3464	54	D
		Right	51	280	F						
	University East	Left	364	2	A	957	5	A			
		Thru	452	7	A						
		Right	141	7	A						
	ICB South	Left	46	22	B	1313	25	B			
		Right	1268	26	B						
	University West	Left	61	75	F	926	97	F			
		Thru	645	100	F						
Right		220	91	F							
Northern Interchange C7	ICB North	Left	448	26	B	896	26	B	6331	35	C
		Right	448	26	B						
	Newcastle East	Left	103	12	A	1824	43	D			
		Thru	1114	46	D						
		Right	608	42	D						
	ICB South	Left	253	39	C	258	39	C			
		Right	5	56	E						
	Newcastle West	Left	1218	21	B	3353	33	C			
		Thru	1770	40	C						
Right		365	40	C							
Croudace/ Dent/ Newcastle	Dent	Left	78	49	D	344	59	E	5143	48	D
		Thru	170	61	E						
		Right	96	63	E						
	Newcastle East	Left	218	8	A	1712	36	C			
		Thru	1402	37	C						
		Right	91	87	F						
	Croudace	Left	361	8	A	870	36	C			
		Thru	143	53	D						
		Right	366	57	E						
Newcastle West	Left	15	54	D	2216	61	E				
	Thru	1954	58	E							
	Right	247	86	F							
Croudace/ Howe	Croudace North	Left	269	6	A	640	17	B	1663	20	B
		Thru	371	25	B						
	Howe	Left	46	13	A	367	20	B			
		Right	321	21	B						
	Croudace South	Thru	566	13	A	656	24	B			
		Right	90	88	F						
Croudace/ Lookout/ Russell	Croudace	Left	27	48	D	487	51	D	2584	18	B
		Thru	460	51	D						
	Russell	Left	595	6	A	616	7	A			
		Right	21	48	D						
	Lookout	Thru	682	6	A	1482	12	A			
		Right	800	18	B						
Lookout/ Hospital	Lookout North	Thru	670	7	A	907	17	B	3047	18	B
		Right	237	47	D						
	Lookout South	Left	518	11	A	1882	17	B			
		Thru	1364	19	B						
	Hospital	Left	102	7	A	258	28	B			
		Right	156	42	D						
Lookout/ McCaffrey	Lookout North East	Thru	650	2	A	820	16	B	3233	15	B
		Right	169	70	F						
	Lookout South West	Left	181	3	A	1433	12	A			
		Thru	1253	13	A						
	McCaffrey North West	Left	633	3	A	980	18	B			
		Right	347	44	D						
Lookout/ Cardiff	Lookout North	Thru	1476	7	A	1763	14	B	5062	35	C
		Right	287	52	D						
	Lookout South	Left	215	25	B	2318	32	C			
		Thru	2103	33	C						
	Cardiff	Left	523	62	E	981	79	F			
		Right	458	99	F						
riley/ Charlestown/ Lookout	Lookout	Left	391	18	B	1921	28	B	5769	50	D
		Thru	1530	30	C						
	Carnley	Left	588	3	A	872	48	D			
		Right	284	141	F						
	Charlestown	Thru	2075	51	D	2976	65	E			
		Right	900	97	F						
Hospital Interchange	SBD Off Ramp	Left	424	2	A	424	2	A	711	1	A
		Right	138	0	A						
	Hospital	Left	33	0	A	171	0	A			
		Right	115	1	A						
NBD Off Ramp	Left	115	1	A	115	1	A				
	Right	115	1	A							
Douglass/Newcastle	Douglass North	Left	153	80	F	272	97	F	5632	24	B
		Thru	43	111	F						
		Right	76	124	F						
	Newcastle East	Left	107	16	B	1928.4	17	B			
		Thru	1753	15	B						
		Right	68	69	E						
	Douglass South	Left	45	38	C	380.4	104	F			
		Thru	105	48	D						
		Right	231	143	F						
	Newcastle West	Left	35	11	A	3051.4	12	A			
		Thru	2965	11	A						
		Right	51	67	E						
Blue Gum North	Left	Left	185	31	C	364	39	C	5634	21	B
		Right	179	47	D						
	Newcastle East	Thru	1743	14	A	1908	22	B			
		Right	165	105	F						
Newcastle West	Left	167	19	B	3363	19	B				
	Thru	3196	19	B							
Grandview/Lookout	Lookout North	Thru	1769	2	A	1821	3	A	4637	5	A
		Right	52	48	D						
	Lookout South	Left	34	4	A	2627	4	A			
		Thru	2593	4	A						
	Lookout West	Left	189	36	C	189	36	C			
		Right	0	0	A						

Intersection	Approach	Mvt	2030 Refined Strategic Design PM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	84	3	A	260	7	A	3767	30	C
		Right	175	9	A						
	University East	Left	825	15	B	2102	20	B			
		Thru	1007	23	B						
	ICB South	Left	197	73	F	706	87	F			
		Right	509	93	F						
University West	Left	86	3	A	699	10	A				
	Thru	423	13	A							
	Right	190	9	A							
Northern Interchange C7	ICB North	Left	644	20	B	1288	20	B	6194	33	C
		Right	644	20	B						
	Newcastle East	Left	119	8	A	2283	42	D			
		Thru	1485	31	C						
	ICB South	Left	385	40	C	482	42	D			
		Right	97	51	D						
	Newcastle West	Left	465	7	A	2141	29	C			
		Thru	1356	33	C						
Right		320	43	D							
Croudace/ Dent/ Newcastle	Dent	Left	63	116	F	409	124	F	5714	42	D
		Thru	259	127	F						
		Right	87	123	F						
	Newcastle East	Left	543	13	A	2389	35	C			
		Thru	1747	38	C						
		Right	100	94	F						
	Croudace	Left	465	5	A	781	27	B			
		Thru	107	60	E						
		Right	209	59	E						
	Newcastle West	Left	63	32	C	2135	39	C			
Thru		1764	34	C							
Right		308	69	E							
Croudace/ Howe	Croudace North	Left	351	5	A	1113	18	B	2081	19	B
		Thru	762	24	B						
	Howe	Left	88	20	B	438	28	B			
		Right	350	30	C						
Croudace South	Thru	433	6	A	530	14	B				
	Right	97	46	D							
	Left	36	62	E							
Croudace/ Lookout/ Russell	Croudace	Left	36	62	E	881	52	D	2735	37	C
		Thru	845	51	D						
	Russell	Left	676	10	A	700	10	A			
		Right	24	30	C						
Lookout	Thru	538	29	B	1154	42	D				
	Right	616	53	D							
	Left	1414	2	A							
Lookout/ Hospital	Lookout North	Right	61	39	C	1475	4	A	3047	15	B
		Left	164	4	A						
	Lookout South	Left	772	28	B	936	24	B			
		Thru	210	13	A						
Hospital	Left	425	38	C	635	30	C				
	Right	1286	8	A							
	Thru	537	50	D							
Lookout/ McCaffrey	Lookout North East	Right	537	50	D	1822	20	B	3521	18	B
		Left	405	3	A						
	Lookout South West	Left	625	14	B	1030	10	A			
		Thru	312	3	A						
McCaffrey North West	Left	357	43	D	669	24	B				
	Right	2281	30	C							
	Thru	541	54	D							
Lookout/ Cardiff	Lookout North	Right	541	54	D	2822	35	C	5344	54	D
		Left	386	12	A						
	Lookout South	Left	1543	19	B	1929	17	B			
		Thru	267	190	F						
Cardiff	Left	325	331	F	592	267	F				
	Right	292	94	F							
Carnley/ Charlestown/ Lookout	Lookout	Left	292	94	F	2553	105	F	5776	69	E
		Thru	2261	106	F						
		Right	102	93	F						
	Carnley	Left	786	12	A	1128	51	D			
		Right	342	141	F						
	Charlestown	Thru	1592	10	A	2095	34	C			
Right		503	109	F							
Hospital Interchange	SBD Off Ramp	Left	161	1	A	161	1	A	678	0	A
		Right	101	0	A						
	Hospital	Left	379	0	A	480	0	A			
		Right	37	0	A						
NBD Off Ramp	Left	87	90	F	37	0	A				
	Thru	89	112	F							
Douglass/Newcastle	Douglass North	Left	89	112	F	277.4	98	F	5659	19	B
		Thru	102	93	F						
		Right	302	11	A						
	Newcastle East	Left	2688	10	A	3048.4	11	A			
		Thru	59	77	F						
		Right	176	113	F						
	Douglass South	Left	51	33	C	271.6	86	F			
		Thru	44	44	D						
		Right	176	113	F						
	Newcastle West	Left	32	9	A	2061.6	10	A			
Thru		1991	9	A							
Right		39	61	E							
Blue Gum/Newcastle	Blue Gum North	Left	254	22	B	570	33	C	5562	21	B
		Right	315	42	D						
	Newcastle East	Thru	2519	16	B	2780	20	B			
		Right	261	59	E						
Newcastle West	Left	285	16	B	2213	19	B				
	Thru	1927	19	B							
Grandview/Lookout	Lookout North	Thru	2846	17	B	2998	18	B	4883	11	A
		Right	152	37	C						
	Lookout South	Left	69	0	A	1807	0	A			
		Thru	1738	0	A						
	Lookout West	Left	78	5	A	78	5	A			
		Right	0	0	A						

Intersection	Approach	Mvt	2014 Base AM												
			Movement			Approach			Intersection						
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS				
University Interchange	ICB North	Left	191	13	A	265	21	B	2517	22	B				
		Right	74	43	D										
	University East	Left	217	1	A	669	4	A							
		Thru	326	6	A										
		Right	126	5	A										
	ICB South	Left	28	5	A	749	6	A							
		Right	721	6	A										
	University West	Left	61	36	C	834	52	D							
		Thru	595	55	D										
Right		179	49	D											
Jesmond Roundabout	ICB	Left	725	27	B	1139	37	C	6464	29	C				
		Right	414	54	D										
	Newcastle East	Thru	1036	24	B	2678	28	B							
		Right	903	39	C										
	Newcastle West	Left	977	19	B	2648	27	B							
		Thru	1671	32	C										
Croudace/ Dent/ Newcastle	Dent	Left	24	50	D	259	55	D	5739	47	D				
		Thru	195	56	E										
		Right	40	51	D										
	Newcastle East	Left	308	6	A	1439	36	C							
		Thru	1064	42	D										
	Croudace	Right	68	72	F	1697	45	D							
		Left	880	19	B										
	Newcastle West	Thru	302	74	F	2344	55	D							
		Right	514	72	F										
		Left	9	41	C										
	Croudace/ Howe	Croudace North	Left	225	8	A	1200	10				A	2937	16	B
			Thru	975	11	A									
Howe		Left	35	25	B	302	49	D							
		Right	267	52	D										
Croudace South		Thru	1301	5	A	1435	13	A							
		Right	134	90	F										
Croudace/ Lookout/ Russell	Croudace	Left	28	27	B	1062	28	B	3738	20	B				
		Thru	1033	28	B										
	Russell	Left	537	9	A	565	11	A							
		Right	29	52	D										
	Lookout	Thru	1390	11	A	2111	19	B							
		Right	721	33	C										
Lookout/ Hospital	Lookout North	Thru	1088	11	A	1769	35	C	4745	25	B				
		Right	681	73	F										
	Lookout South	Left	672	13	A	2634	17	B							
		Thru	1962	19	B										
	Hospital	Left	144	6	A	342	28	B							
		Right	197	44	D										
Lookout/ McCaffrey	Lookout North East	Thru	1077	2	A	1281	12	A	4550	39	C				
		Right	204	61	E										
	Lookout South West	Left	234	37	C	2220	42	D							
		Thru	1986	43	D										
	McCaffrey North West	Left	662	52	D	1049	67	E							
		Right	387	91	F										
Lookout/ Cardiff	Lookout North	Thru	1224	14	A	1422	23	B	4146	31	C				
		Right	198	83	F										
	Lookout South	Left	186	16	B	1972	25	B							
		Thru	1786	26	B										
	Cardiff	Left	344	43	D	751	61	E							
		Right	407	77	F										
Carnley/ Charlestown/ Lookout	Lookout	Left	341	27	B	1633	38	C	4928	25	B				
		Thru	1291	41	C										
	Carnley	Left	499	1	A	736	22	B							
		Right	237	66	E										
	Charlestown	Thru	1783	7	A	2559	17	B							
		Right	776	41	C										
Douglass/Newcastle	Douglass North	Left	125	45	D	228	52	D	4412	20	B				
		Thru	35	63	E										
		Right	68	60	E										
	Newcastle East	Left	78	19	B	1457	21	B							
		Thru	1322	19	B										
		Right	57	56	D										
	Douglass South	Left	31	28	B	325	42	D							
		Thru	88	39	C										
	Newcastle West	Right	206	46	D	2403	13	A							
		Left	26	11	A										
		Thru	2336	12	A										
	Blue Gum/Newcastle	Blue Gum North	Left	140	23	B	271	31				C	4420	22	B
Thru			131	40	C										
Newcastle East		Thru	1315	6	A	1456	11	A							
		Right	141	65	E										
Newcastle West		Left	143	26	B	2693	27	B							
		Thru	2550	28	B										
Grandview/Lookout	Lookout North	Thru	1438	2	A	1467	2	A	3758	8	A				
		Right	28	46	D										
	Lookout South	Left	40	11	A	2125	12	A							
		Thru	2085	12	A										
	Lookout West	Left	166	11	A	166	11	A							
		Right	0	0	A										

Intersection	Approach	Mvt	2014 Base PM								
			Movement			Approach			Intersection		
			Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS	Volume	Average Delay (s/veh)	LOS
University Interchange	ICB North	Left	65	2	A	201	6	A	2749	7	A
		Right	136	7	A						
	University East	Left	537	2	A	1596	6	A			
		Thru	835	7	A						
		Right	224	7	A						
	ICB South	Left	140	10	A	395	12	A			
		Right	255	13	A						
		University West	Left	66	3						
	Thru	345	12	A							
Right	145	9	A								
Jesmond Roundabout	ICB	Left	1122	20	B	1833	31	C	6566	31	C
		Right	711	48	D						
	Newcastle East	Thru	1338	38	C	2994	40	C			
		Right	729	60	E						
	Newcastle West	Left	385	8	A	1739	14	B			
		Thru	1355	16	B						
Croudace/ Dent/ Newcastle	Dent	Left	27	79	F	336	81	F	6264	69	E
		Thru	291	81	F						
		Right	18	72	F						
	Newcastle East	Left	609	23	B	2060	60	E			
		Thru	1361	73	F						
	Croudace	Right	89	108	F	1423	37	C			
		Left	771	18	B						
	Newcastle West	Thru	277	61	E	2445	94	F			
		Right	374	58	E						
		Left	19	58	E						
		Thru	1440	60	E						
	Croudace/ Howe	Croudace North	Left	277	15	B	1892	19			
Thru			1615	20	B						
Howe		Left	87	30	C	384	56	E			
		Right	297	64	E						
Croudace South		Thru	1009	9	A	1157	16	B			
		Right	148	61	E						
Croudace/ Lookout/ Russell	Croudace	Left	32	82	F	1699	79	F	3906	46	D
		Thru	1668	79	F						
	Russell	Left	498	17	B	527	19	B			
		Right	29	59	E						
	Lookout	Thru	1112	11	A	1680	20	B			
		Right	568	38	C						
Lookout/ Hospital	Lookout North	Thru	2021	3	A	2262	7	A	4587	20	B
		Right	241	36	C						
	Lookout South	Left	233	6	A	1441	28	B			
		Thru	1208	32	C						
	Hospital	Left	299	24	B	884	41	C			
		Right	585	49	D						
Lookout/ McCaffrey	Lookout North East	Thru	1973	9	A	2594	23	B	4908	25	B
		Right	621	67	E						
	Lookout South West	Left	465	19	B	1602	24	B			
		Thru	1137	26	B						
	McCaffrey North West	Left	306	3	A	713	32	C			
		Right	406	53	D						
Lookout/ Cardiff	Lookout North	Thru	1910	10	A	2258	18	B	4520	27	B
		Right	348	61	E						
	Lookout South	Left	336	17	B	1683	32	C			
		Thru	1347	36	C						
	Cardiff	Left	237	19	B	579	50	D			
		Right	342	72	F						
Carnley/ Charlestown/ Lookout	Lookout	Left	259	59	E	2226	73	F	5159	43	D
		Thru	1967	75	F						
	Carnley	Left	835	6	A	1197	25	B			
		Right	362	68	E						
	Charlestown	Thru	1327	6	A	1736	17	B			
		Right	409	53	D						
Douglass/Newcastle	Douglass North	Left	66	50	D	233	58	E	4360	24	B
		Thru	87	62	E						
		Right	80	60	E						
	Newcastle East	Left	231	26	B	2248	28	B			
		Thru	1962	27	B						
		Right	55	78	F						
	Douglass South	Left	45	27	B	230	41	C			
		Thru	41	35	C						
		Right	144	46	D						
	Newcastle West	Left	32	9	A	1649	12	A			
Thru		1579	10	A							
Right		38	62	E							
Blue Gum/Newcastle	Blue Gum North	Left	218	23	B	487	32	C	4324	25	B
		Thru	270	40	C						
	Newcastle East	Thru	1841	11	A	2057	18	B			
		Right	216	74	F						
	Newcastle West	Left	251	32	C	1780	32	C			
		Thru	1529	33	C						
Grandview/Lookout	Lookout North	Thru	2269	5	A	2378	5	A	4035	4	A
		Right	109	19	B						
	Lookout South	Left	88	1	A	1585	1	A			
		Thru	1496	1	A						
	Lookout West	Left	72	1	A	72	1	A			
		Right	0	0	A						



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