

Appendix E

Technical working paper:
Traffic and transport

NorthConnex

Building for the future



Technical working paper: Traffic and transport

Technical Working Paper: Traffic and Transport

NorthConnex

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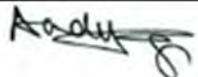
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Table of Contents

Executive Summary	i
Background	i
Existing traffic and transport conditions	ii
Forecast future conditions <u>without</u> the project	iii
Forecast future conditions <u>with</u> the project	iv
Mitigation measures	vi
1.0 Introduction	1
1.1 Project overview	1
1.2 Director-General's requirements	7
1.3 Objectives of the traffic and transport assessment	8
1.4 Structure of this document	8
2.0 The project	9
2.1.1 Description of the project	9
2.1.2 Project objectives	13
3.0 Existing traffic and transport environment	15
3.1 Study area	15
3.2 Pennant Hills Road corridor and Pacific Highway corridor	15
3.2.1 Route description	15
3.2.2 Modes of travel	27
3.2.3 Public transport services	27
3.2.4 Walking and cycling	31
3.2.5 Existing traffic volumes and patterns	31
3.3 Hills M2 Motorway corridor	36
3.3.1 Route description	36
3.3.2 Modes of travel	36
3.3.3 Public transport services	36
3.3.4 Walking and cycling	38
3.3.5 Existing traffic volumes and patterns	39
3.4 M1 Pacific Motorway corridor	40
3.4.1 Route description	40
3.4.2 Public transport services	40
3.4.3 Walking and cycling	40
3.4.4 Existing traffic volumes	40
3.5 Westlink M7 Motorway corridor	41
3.5.1 Route description	41
3.5.2 Public transport services	41
3.5.3 Walking and cycling	42
3.5.4 Existing traffic volumes	42
4.0 Existing road network performance	43
4.1 Pennant Hills Road corridor and Pacific Highway corridor	43
4.1.1 Traffic crashes	43
4.1.2 Travel times and speeds	47
4.1.3 Operational assessment	48
4.2 Hills M2 Motorway corridor	54
4.2.1 Traffic crashes	54
4.2.2 Travel times and speeds	56
4.2.3 Operational assessment	56
4.3 M1 Pacific Motorway corridor	57
4.3.1 Travel times and speeds	57
4.3.2 Operational assessment	57
4.4 Westlink M7 Motorway corridor	58
4.4.1 Travel times and speeds	58
4.4.2 Operational assessment	58
5.0 Traffic modelling and forecasting process	59
5.1 Introduction to traffic modelling	59

5.2	Strategic model and traffic forecasting methodology	59
5.2.1	Overview	59
5.2.2	Strategic modelling assumptions	60
5.3	Corridor operational traffic modelling methodology	65
5.3.1	Derivation of base year traffic patterns	65
5.3.2	Base and future year model development	65
6.0	Future conditions without the project	75
6.1	Pennant Hills Road corridor and Pacific Highway corridor	75
6.1.1	Traffic volumes and patterns	75
6.1.2	Roadway level of service	79
6.1.3	Intersection level of service	82
6.1.4	Travel times	84
6.1.5	Traffic crashes	84
6.1.6	Public transport services	85
6.1.7	Walking and cycling	86
6.2	Hills M2 Motorway corridor	86
6.2.1	Traffic volumes and patterns	86
6.2.2	Roadway level of service	87
6.2.3	Intersection level of service	87
6.2.4	Travel times	88
6.2.5	Traffic crashes	88
6.2.6	Public transport services	88
6.2.7	Walking and cycling	88
6.3	M1 Pacific Motorway corridor	89
6.3.1	Traffic volumes and patterns	89
6.3.2	Roadway level of service	89
6.4	Westlink M7 Motorway corridor	90
6.4.1	Traffic volumes and patterns	90
6.4.2	Roadway level of service	90
6.5	Surrounding road network: traffic volumes and patterns	91
7.0	Construction traffic impact assessment	95
7.1	Description of construction activities	95
7.1.1	Construction traffic	99
7.1.2	Construction compounds	112
7.2	Access requirements for surrounding local roads	153
7.3	Pennant Hills Road corridor and Pacific Highway corridor	159
7.3.1	Background traffic volumes and patterns	159
7.3.2	Scenario A (northbound spoil disposal)	160
7.3.3	Scenario A (southbound spoil disposal)	164
7.3.4	Traffic crashes	167
7.3.5	Public transport services	168
7.3.6	Walking and cycling	168
7.4	Hills M2 Motorway corridor	169
7.4.1	Traffic delays and disruptions	169
7.4.2	Roadway level of service	169
7.4.3	Intersection level of service	169
7.4.4	Traffic crashes	169
7.4.5	Public transport services	170
7.4.6	Walking and cycling	170
7.5	M1 Pacific Motorway corridor	170
7.5.1	Traffic delays and disruptions	170
7.6	Emergency vehicles	170
7.7	Cumulative impacts	171
7.7.1	Epping to Thornleigh Third Track	171
7.7.2	North West Rail Link (NWRL)	172
7.7.3	WestConnex – Stages 1 and 2	173
8.0	Operational traffic impact assessment	175
8.1	Pennant Hills Road corridor and Pacific Highway corridor	175

	8.1.1	Traffic volumes and patterns	175
	8.1.2	Roadway level of service	178
	8.1.3	Intersection level of service	186
	8.1.4	Travel times	189
	8.1.5	Traffic crashes	190
	8.1.6	Public transport services	193
	8.1.7	Walking and cycling	195
8.2		Hills M2 Motorway corridor	196
	8.2.1	Traffic volumes and patterns	196
	8.2.2	Roadway level of service	196
	8.2.3	Intersection level of service	198
	8.2.4	Travel times	198
	8.2.5	Traffic crashes	199
	8.2.6	Public transport services	199
	8.2.7	Walking and cycling	200
8.3		M1 Pacific Motorway corridor	200
	8.3.1	Traffic volumes and patterns	200
	8.3.2	Roadway level of service	200
8.4		Westlink M7 Motorway corridor	201
	8.4.1	Traffic volumes and patterns	201
	8.4.2	Roadway level of service	202
	8.5	Surrounding road network: traffic volumes and patterns	204
9.0		Mitigation and management measures	209
	9.1	Construction	209
	9.2	Operation	211
Appendix A			
		Traffic crash maps	A

List of Figures

Figure 1-1	Regional context	3
Figure 1-2	Local context	5
Figure 2-1	The project	11
Figure 3-1	Study area	17
Figure 3-2	Existing M1 Pacific Motorway – Pacific Highway intersection layout	19
Figure 3-3	Existing M1 Pacific Motorway – Pennant Hills Road intersection layout	21
Figure 3-4	Existing Pennant Hills Road – Pacific Highway intersection	23
Figure 3-5	Existing Hills M2 Motorway – Pennant Hills Road intersection	25
Figure 3-6	Sydney Trains network map	28
Figure 3-7	HillsBus: The Hills network map	29
Figure 3-8	Transdev: Hornsby network map	30
Figure 3-9	Average weekday traffic profile at Pennant Hills Road, north of Hills M2 Motorway	34
Figure 3-10	Average weekday traffic profile at Pennant Hills Road, south of Hills M2 Motorway	34
Figure 3-11	Weekly traffic profile at Pennant Hills Road, north of Hills M2 Motorway	35
Figure 3-12	Weekly traffic profile at Pennant Hills Road, south of Hills M2 Motorway	35
Figure 3-13	Bus network around the Oakes Road M2 Bus Station, at the Hills M2 Motorway and Pennant Hills Road interchange	37
Figure 3-14	Bus network surrounding the Bella Vista area (Source: Busways, March 2014)	41
Figure 3-15	Bus network surrounding the Bella Vista area (Source: CDC Hills Bus, March 2014)	42
Figure 4-1	Crash severity index calculation	44
Figure 4-2	Crash rate per 100 million vehicle kilometres calculation	45
Figure 5-1	Overview of traffic modelling approach	59
Figure 5-2	Traffic count locations	67
Figure 5-3	Model locations	71
Figure 6-1	Assessed mid-blocks and intersections	77
Figure 7-1	Construction site locations	97

Figure 7-2	Haulage routes	101
Figure 7-3	Haulage routes – southern interchange compound	103
Figure 7-4	Haulage routes – Wilson Road compound	105
Figure 7-5	Haulage routes – Trelawney Street compound	107
Figure 7-6	Haulage routes – northern interchange compound	109
Figure 7-7	Windsor Road compound	113
Figure 7-8	Darling Mills Creek compound	117
Figure 7-9	Barclay Road compound	121
Figure 7-10	Yale Close compound	125
Figure 7-11	Southern Interchange construction compound	129
Figure 7-12	Wilson Road construction compound	133
Figure 7-13	Trelawney Street construction compound	137
Figure 7-14	Pioneer Avenue construction compound	141
Figure 7-15	Northern Interchange construction compound	145
Figure 7-16	Bareena Avenue construction compound	149
Figure 7-17	Junction Road compound	151
Figure 7-18	ETTT project map	172
Figure 7-19	NWRL construction site map	173
Figure 7-20	Westconnex project map	174
Figure 8-1	2019 and 2029 AWDT without and with project	179

List of Tables

Table 1-1	Traffic and transport Director-General's requirements checklist	7
Table 3-1	Existing key intersection details	16
Table 3-2	Average weekday travel mode share for The Hills / Hornsby local government areas (2011/12)	27
Table 3-3	Sydney Trains services	28
Table 3-4	Station entry and exit barrier counts (2011)	29
Table 3-5	Pennant Hills Road bus services	30
Table 3-6	Historical Pennant Hills Road AADT (two-way)	32
Table 3-7	Weekday traffic flows on Pennant Hills Road (2013) (two-way)	32
Table 3-8	Intersection count summary (2013)	33
Table 3-9	Hills M2 Motorway peak hour bus services	38
Table 3-10	Weekday (Mon-Fri) traffic volumes on the Hills M2 Motorway (2013)	39
Table 3-11	Weekday (Mon-Fri) traffic volumes on the M1 Pacific Motorway (2013)	40
Table 3-12	Weekday (Mon-Fri) traffic volumes on the Westlink M7 Motorway (2013)	42
Table 4-1	Crash history (1 July 2008 to 30 June 2013)	44
Table 4-2	Crash severity indices (1 July 2008 to 30 June 2013)	45
Table 4-3	Crash rates per 100MVKT (2013)	46
Table 4-4	Crash costs (1 July 2008 to 30 June 2013)	47
Table 4-5	Speed and Travel Time (2013) – Pennant Hills Road corridor, between the M1 Pacific Motorway / Pennant Hills Road intersection and North Rocks Road	47
Table 4-6	Average Speed and Travel Time (2013) – Pacific Highway Corridor, between M1 Pacific Motorway / Pacific Highway interchange and Pacific Highway / Ryde Road / Mona Vale Road interchange	48
Table 4-7	Mid-block level of service definitions and criteria – multi lane roads	49
Table 4-8	Level of service criteria for intersections	50
Table 4-9	Mid-block traffic volumes and LoS: Existing 2013	51
Table 4-10	Modelled intersection performance 2013 (AM and PM Peak Hour)	52
Table 4.11	Hills M2 Motorway crash history (1 July 2008 to 30 June 2013)	54
Table 4.12	Hill M2 Motorway crash severity indices (1 July 2008 to 30 June 2013)	54
Table 4-13	Hills M2 Motorway crash rates per 100MVKT (2013)	55
Table 4-14	Hills M2 Motorway crash costs (1 July 2008 to 30 June 2013)	55
Table 4-15	Speed and Travel Time (2013) – Hills M2 Motorway, between Westlink M7 Motorway and Lane Cove Tunnel	56

Table 4-16	Mid-block traffic volume and LoS: Existing 2013 – Hills M2 Motorway, east of Pennant Hills Road	56
Table 4-17	Mid-block traffic volume and LoS: Existing 2013 – Hills M2 Motorway, west of Pennant Hills Road	56
Table 4-18	Mid-block traffic volumes and level of service: Existing 2013 – M1 Pacific Motorway, north of Pacific Highway	57
Table 4-19	Mid-block traffic volumes and LoS: Existing 2013 – Westlink M7 Motorway	58
Table 5-1	Employment changes in Sydney (2011-2031)	61
Table 5-2	Population changes in Sydney (2011-2031)	61
Table 5-3	PCU Factor	69
Table 5-4	Model extents	69
Table 6-1	Comparison between 2013 and 2019 'without project' traffic flows	75
Table 6-2	Pennant Hills Road corridor modelled AWDT volumes: 2019 and 2029 without project	79
Table 6-3	Mid-block traffic volumes and level of service (2019 without project)	79
Table 6-4	Mid-block traffic volumes and LoS (2029 without project)	81
Table 6-5	2019 and 2029 Intersection performance: Without project (AM and PM Peak Hour)	82
Table 6-6	Comparison of average travel time (2013, 2019 and 2029 without project) – Pennant Hills Road Corridor, between M1 Pacific Motorway intersection and Hills M2 Motorway interchange	84
Table 6-7	Comparison of average travel time (2013, 2019 and 2029 without project) – Pacific Highway Corridor, between M1 Pacific Motorway and Ryde Road / Mona Vale Road interchanges	84
Table 6-8	Comparison of peak hour traffic volumes (2013, 2019 and 2029 without project) – Hills M2 Motorway, east of Pennant Hills Road	86
Table 6-9	Comparison of peak hour traffic volumes (2013, 2019 and 2029 without project) – Hills M2 Motorway, west of Pennant Hills Road	86
Table 6-10	Mid-block traffic volumes and LoS (2019 and 2029 without project) – Hills M2 Motorway, east of Pennant Hills Road	87
Table 6-11	Mid-block traffic volumes and LoS (2019 and 2029 without project) – Hills M2 Motorway, west of Pennant Hills Road	87
Table 6-12	Comparison of average travel time (2013, 2019 and 2029 without project) – Hills M2 Motorway Corridor, between Pennant Hills Road and Windsor Road interchanges	88
Table 6-13	Comparison of peak hour traffic volumes (2013, 2019 and 2029 without project) – M1 Pacific Motorway, between Ku-Ring-Gai Interchange and Windy Banks Interchange	89
Table 6-14	Mid-block traffic volumes and LoS (2019 and 2029 without project) – M1 Pacific Motorway, between Ku-ring-gai Chase Road interchange and Windy Banks interchange	89
Table 6-15	Comparison of peak hour traffic volumes (2013, 2019 and 2029 without project) – Westlink M7 Motorway	90
Table 6-16	Mid-block traffic volumes and LoS (2019 without project) – Westlink M7 Motorway	90
Table 6-17	Mid-block traffic volumes and LoS (2029 without project) – Westlink M7 Motorway	91
Table 6-18	Comparison of 2013, 2019 and 2029 light vehicle volumes on the surrounding road network (without project)	91
Table 6-19	Comparison of 2013, 2019 and 2029 heavy vehicle volumes on the surrounding road network (without project)	93
Table 7-1	Construction site locations	96
Table 7-2	Heavy construction vehicles	111
Table 7-3	Light construction vehicles	111
Table 7-4	Windsor Road compound indicative construction program	112
Table 7-5	Darling Mills Creek compound indicative construction program	115
Table 7-6	Barclay Road compound indicative construction program	119
Table 7-7	Yale Close compound indicative construction program	123
Table 7-8	Southern interchange indicative construction program	127
Table 7-9	Wilson Road indicative construction program	131
Table 7-10	Trelawney Street indicative construction program	135
Table 7-11	Pioneer Avenue compound indicative construction program	139
Table 7-12	Northern interchange indicative construction program	143
Table 7-13	Bareena Avenue indicative construction program	147
Table 7-14	Junction Road compound indicative construction program	147

Table 7-15	Access requirements on local roads	155
Table 7-16	Comparison between 2013 and 2016 background traffic flows	159
Table 7-17	2016 Mid-block traffic volumes and LoS: Construction (northbound spoil disposal)	160
Table 7-18	2016 Intersection performance (AM and PM Peak Hour) (northbound spoil disposal)	161
Table 7-19	2016 Mid-block traffic volumes and LoS: Construction (southbound spoil disposal)	164
Table 7-20	2016 Intersection performance (AM and PM Peak Hour) (southbound spoil disposal)	165
Table 7-21	2016 Intersection performance (AM and PM Peak Hour with and without construction)	169
Table 8-1	Comparison between 2019 'without project' and 2019 'with project' traffic flows	175
Table 8-2	Comparison between 2029 'without project' and 2029 'with project' traffic flows	176
Table 8-3	Comparison between 2019 and 2029 'in tunnel' traffic flows	176
Table 8-4	Pennant Hills Road corridor AWDT volumes: without / with project 2019 / 2029	177
Table 8-5	Origin and destination of 2019 and 2029 tunnel AWDT volumes	178
Table 8-6	Mid-block traffic volumes and LoS: Comparison of 2019 'without project' and 'with project'	181
Table 8-7	Mid-block traffic volumes and LoS: Comparison of 2029 'without project' and 'with project'	183
Table 8-8	Mid-block traffic volumes and LoS: 'in tunnel'	185
Table 8-9	Intersection performance: Comparison of 2019 'with project' and 2019 'with project' (AM and PM Peak Hour)	186
Table 8-10	Intersection performance: Comparison of 2029 'with project' and 2029 'with project' (AM and PM Peak Hour)	187
Table 8-11	Comparison of average travel time and speed (2019 / 2029 with project) – Pennant Hills Road corridor, between M1 Pacific Motorway interchange and Hills M2 Motorway interchange	189
Table 8-12	Comparison of average travel time and speed (2019 / 2029) – NorthConnex Tunnel versus Pennant Hills Road (PHR) corridor, between M1 Pacific Motorway interchange and Hills M2 Motorway interchange, without the project	189
Table 8-13	Comparison of average travel time and speed (2019 / 2029 with Project) – Pacific Highway corridor, between M1 Pacific Motorway and Ryde Road / Mona Vale Road interchanges	190
Table 8-14	Project area crash history (1 July 2008 – 30 June 2013)	191
Table 8-15	Projected crash statistics (2029)	192
Table 8-16	Preliminary intersection upgrade opportunities (buses)	194
Table 8-17	Comparison of peak hour traffic volumes (2013, 2019 and 2029 with and without project) – Hills M2 Motorway, east of Pennant Hills Road	196
Table 8-18	Comparison of peak hour traffic volumes (2013, 2019 and 2029 with and without project) – Hills M2 Motorway, west of Pennant Hills Road	196
Table 8-19	Mid-block traffic volumes and LoS: 'without project' and 'with project' scenarios 2019 – Hills M2 Motorway, east of Pennant Hills Road	197
Table 8-20	Mid-block traffic volumes and LoS: 'without project' and 'with project' scenarios 2019 – Hills M2 Motorway, west of Pennant Hills Road	197
Table 8-21	Mid-block traffic volumes and LoS: 'without project' and 'with project' scenarios 2029 – Hills M2 Motorway, east of Pennant Hills Road	197
Table 8-22	Mid-block traffic volumes and LoS: 'without project' and 'with project' scenarios 2029 – Hills M2 Motorway, west of Pennant Hills Road	198
Table 8-23	Comparison of average travel time and speed (2019 / 2029 with project) – Hills M2 Motorway Corridor, between Pennant Hills Road and Windsor Road interchanges	198
Table 8-24	Comparison of peak hour traffic volumes (2013, 2019 and 2029 with and without project) – M1 Pacific Motorway, between Ku-ring-gai Chase Road interchange and Windy Banks interchange	200
Table 8-25	Mid-block traffic volumes and LoS (2019 'without project' and 'with project') – M1 Pacific Motorway, between Ku-ring-gai Chase Road interchange and Windy Banks interchange	200
Table 8-26	Mid-block traffic volumes and LoS (2029 'without project' and 'with project') – M1 Pacific Motorway, between Ku-ring-gai Chase Road interchange and Windy Banks interchange	201
Table 8-27	Comparison of peak hour light vehicle volumes (2013, 2019 and 2029 with and without project) – Westlink M7 Motorway	201
Table 8-28	Comparison of peak hour heavy vehicle volumes (2013, 2019 and 2029 with and without project) – Westlink M7 Motorway	202

Table 8-29	Mid-block traffic volumes and LoS (2019 'without project' and 'with project') – Westlink M7 Motorway	202
Table 8-30	Mid-block traffic volumes and LoS (2029 'without project' and 'with project') – Westlink M7 Motorway	203
Table 8-31	Comparison of 2019 and 2029 'without project' and 'with project' light vehicle volumes on the surrounding road network	204
Table 8-32	Comparison of 2019 and 2029 'without project' and 'with project' heavy vehicle volumes on the surrounding road network	206

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Executive Summary

Background

Roads and Maritime is seeking approval to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at West Pennant Hills in northern Sydney (the project). The project would deliver a high standard motorway that integrates with the regional transport network.

The NSW Long Term Transport Master Plan (2012) (the Master Plan) recognises that a missing orbital motorway connection exists between the M1 Pacific Motorway and the Hills M2 Motorway. In chapter seven of the Master Plan, this particular missing link is also identified as an important long term road freight corridor. Sydney's motorway network is part of the primary freight network in Sydney and its efficient operation is critical to ongoing productivity. In providing an efficient link between the M1 Pacific Motorway and the Hills M2 Motorway, the project would improve freight access, connectivity and reliability across the greater Sydney area.

The project would comprise the following key features:

- Twin motorway tunnels up to around nine kilometres in length with two lanes in each direction. The tunnels would be constructed with provision for a possible third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the project travelling northbound, and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities along the main alignment.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

The objective of the traffic and transport assessment is to address the Director-General's requirements by documenting the existing and future conditions, during the construction and operation of the project, structured around the following three elements:

- Existing traffic and transport conditions (including current traffic volumes, network and intersection performance, public transport and walking / cycling facilities).
- Forecast future conditions without the project (by assessing the network and intersection performance, based on current traffic conditions with background growth to represent future year scenarios).
- Forecast future conditions with the project (including detailing forecast demand, performance testing of the proposed project layouts and demonstration of the overall benefits and impacts of the project).

The existing and future traffic and transport conditions have been assessed on the road network surrounding the main alignment tunnels and Hills M2 Motorway integration works, including the Pennant Hills Road corridor (north of the Hills M2 Motorway), the southern end of the M1 Pacific Motorway corridor, a section of the Pacific Highway corridor and the Hills M2 Motorway corridor, including part of the Westlink M7 Motorway. The focus of the study has been the impact on the Pennant Hills Road corridor and the Hills M2 Motorway corridor due to the significant traffic and transport impacts expected on these roads.

Existing traffic and transport conditions

Pennant Hills Road and Pacific Highway corridors

Between the M1 Pacific Motorway and the Hills M2 Motorway, Pennant Hills Road operates as an arterial road and forms part of the National Land Transport Network – national and inter-regional transport corridors that together are of critical importance to national and regional economic growth, development and connectivity. However, there are currently 21 signalised intersections on Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway. Cars, public transport and cyclists using Pennant Hills Road share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne.

Pennant Hills Road is an important bus corridor and is adjacent to Thornleigh and Pennant Hills stations, providing access to these stations. With the exception of a short section near the Pennant Hills Road / Castle Hill Road intersection and the Hills M2 Motorway / Pennant Hills Road interchange, there are no dedicated cyclist facilities along Pennant Hills Road in the study area. Hornsby Council recognises the Pennant Hills Road corridor as a high difficulty cycle route.

Pennant Hills Road carries large volumes of traffic with two-way annual average daily traffic (AADT) of about 80,000 vehicles per day. Congestion is experienced during commuter peak periods and business hours, resulting in low average peak travel speeds, unreliable travel times and disruptions to inter-regional traffic movements. A number of roadway links and intersections currently operate at a poor level of service with long delays during peak traffic periods, with a number of key intersections operating at or close to capacity in the peaks.

In the study area, both Pennant Hills Road and the Pacific Highway have a crash history which is broadly consistent with NSW averages. On both routes, fatal crashes have occurred at a lower frequency than average, while injury crashes have occurred on a slightly higher than average frequency. However, even minor crashes have a significant congestion impact due to the high traffic flows and strategic importance of Pennant Hills Road.

Hills M2 Motorway corridor

The Hills M2 Motorway forms part of the Sydney Orbital Network, which provides a key arterial link between Sydney's north west suburbs and a number of major employment, education and leisure centres, including the Sydney central business district, North Sydney and Macquarie Park. Along with the M7 Motorway, the Hills M2 Motorway provides a key link by providing access between the Hume Highway and the M1 Motorway, effectively linking southern NSW to Sydney and onward to the Central Coast, Newcastle and northern NSW. Due to the role the Hills M2 Motorway plays in linking these key freight links, heavy vehicle volumes along the corridor are high.

A distinct feature of the Hills M2 Motorway is the provision of dedicated bus lanes between Beecroft Road and Windsor Road. The bus lanes operate in the centre of the roadway, with median bus stops allowing passenger access via over or under passes. In the morning peak hour, over 120 bus services use this facility.

Traffic on the Hills M2 Motorway is influenced by time of day, with high traffic volumes in the morning in the eastbound direction, which is reversed in the afternoon peak. The Hills M2 Motorway also carries large traffic volumes with a two-way AADT of about 80,000 vehicles per day. After the completion of the Hills M2 Motorway Upgrade project in August 2013, there are now three general travel lanes and one dedicated bus lane in the eastbound direction, between Windsor Road and Beecroft Road. In the westbound direction, between Beecroft Road and Pennant Hills Road, there are now three general travel lanes and one dedicated bus lane, however, between Pennant Hills Road and Windsor Road, there are only two general travel lanes and one dedicated bus lane. Congestion and travel delays are therefore more pronounced in the westbound direction.

Due to the Hills M2 Motorway being a closed access road, pedestrians are not permitted to travel on the roadway. Use of the shoulder lane is provided for cyclists in each direction, which provides access along the length of the motorway to local network links. However, access is currently restricted to eastbound cyclists from Pennant Hills Road interchange to Delhi Road, North Ryde, given current active construction activities on the motorway.

While the crash severity index for the Hills M2 Motorway is broadly consistent with NSW averages, the frequency per vehicle kilometre travelled for both fatal and injury crashes is significantly lower than average.

M1 Pacific Motorway corridor

The M1 Pacific Motorway is the major road transport link between Sydney, the Central Coast and the Hunter regions. In the study area, it intersects with Pennant Hills Road and also has an interchange with the Pacific Highway, which has north-facing on and off-ramps.

The M1 Pacific Motorway carries large traffic volumes with a two-way AADT of about 70,000 vehicles per day just north of the Pacific Highway interchange. While there is relatively little congestion northbound on the M1 Pacific Motorway, north of the Pacific Highway interchange, congestion and long queues on the southbound approaches to the Pennant Hills Road intersection and the Pacific Highway interchange occur in peak periods.

Due to the M1 Pacific Motorway being a closed access road, pedestrians are not permitted to travel on the roadway. Use of the shoulder lane is provided for cyclists in each direction between Windy Banks Interchange and the Pennant Hills Road intersection.

Westlink M7 Motorway corridor

Along with the Hills M2 Motorway, the Westlink M7 Motorway provides a key link in the Sydney Orbital Network. The Westlink M7 Motorway plays an important role in linking key freight links and heavy vehicle volumes are therefore high. Unlike the Hills M2 Motorway, there are no bus facilities on the Westlink M7 Motorway.

Traffic volumes vary along the Westlink M7 Motorway with the largest volume occurring between The Horsley Drive and Old Wallgrove Road with a two-way AADT of about 70,000 vehicles per day.

The Westlink Shared Path runs parallel and traverses the Westlink M7 Motorway providing an off-road facility for cyclists and pedestrians. Just under 40 kilometres long, it connects with the Sydney Cycleway network.

Forecast future conditions without the project

Basis for assessing future traffic conditions

A strategic transport model was used to forecast traffic network volumes with and without the project by including anticipated land use changes, toll regime changes on the Westlink M7 Motorway and upgrades to the road network. In accordance with project requirements, modelling was undertaken in the analysis years of 2019 and 2029 which represent year of opening and 10 years following the year of opening of the project.

Pennant Hills Road and Pacific Highway corridors

Growth in background traffic results in a decreased level of roadway and intersection performance. All key intersections along the Pennant Hills Road corridor would experience significant congestion during the AM and PM peak hours in both 2019 and 2029. By 2029, all key intersections assessed experience a significant increase in average delay, with the majority achieving only level of service (LoS) F intersection performance in the peak periods.

Peak direction travel time would deteriorate along the Pennant Hills Road corridor without the project. The northbound journey on Pennant Hills Road in the 2019 PM peak would take approximately 12 minutes longer to complete than it did in 2013. By 2029, this would continue to deteriorate with an increase in travel time of a further 15 minutes. A similar effect is observed in the southbound direction in the AM peak.

As with the Pennant Hills Road corridor, the Pacific Highway experiences a significant increase in travel time in the peak period in the peak direction. While the reduction in performance is not as significant as on Pennant Hills Road, the southbound average travel time in the 2019 AM peak increases by five minutes compared to the 2013 travel time. By 2029, the average travel time for this movement is expected to increase by a further nine minutes. A similar effect is observed in the northbound direction in the PM peak.

The forecast growth in traffic on the existing road network within the study area would be expected to result in a considerable increase in the total number and cost of crashes occurring. The lower travel speeds and associated increased delays at intersections would also result in a reduced performance level for public transport services and reduced amenity for pedestrians and cyclists, including reduced road safety.

Hills M2 Motorway corridor

Westbound traffic on the Hills M2 Motorway, west of Pennant Hills Road, would operate with peak traffic volumes above the theoretical design capacity in 2019. Eastbound traffic on the Hills M2 Motorway west of Pennant Hills Road is expected to approach the theoretical design capacity in 2029 during the AM peak.

Without the project (but with the recent completion of the Hills M2 Motorway Upgrade), the AM peak and the eastbound PM peak travel times remain largely unchanged from the existing. However, during the 2019 PM peak, the westbound average travel times are estimated to increase by nine minutes. Between 2019 and 2029, the average travel time for this movement is expected to increase by a further 11 minutes.

The frequency of crashes on the Hills M2 Motorway would be expected to increase in proportion to forecast traffic growth in the future.

The dedicated bus lane along the Hills M2 Motorway is solely for public transportation purposes, which results in it being largely unaffected by increasing capacity constraints on lanes occupied by general traffic.

While cyclists are likely to be unaffected as they are permitted to use a portion of road space that is not used as a travel lane by general traffic, there is the potential that as traffic volumes and density on the corridor increase, a greater rate of incidents may occur which require vehicles to be stored in the road shoulder currently utilised by cyclists. Walking is not permitted on the motorway and as such would not be impacted regardless of whether the project proceeds.

M1 Pacific Motorway and Westlink M7 Motorway corridors

Growth in background traffic results in a decreased level of roadway and intersection / interchange performances on these motorways. The section of the Westlink M7 Motorway, between The Horsley Drive and Old Wallgrove Road, would operate with peak traffic volumes above the theoretical design capacity in 2019 and 2029.

Forecast future conditions with the project

Pennant Hills Road and Pacific Highway corridors

Construction

Construction of the project is expected to occur over a period of approximately four years. The majority of the construction footprint is located underground within the main alignment tunnels, however surface areas would be required to support tunnelling activities, and to construct the interchanges, tunnel portals, the Hills M2 Motorway integration works, the M1 Pacific Motorway tie-in, the motorway operations complex, northern and southern ventilation facilities, tunnel support facilities and other ancillary operations buildings and facilities.

Temporary works are proposed at various stages of construction, such as temporary diversions for road, cycle and pedestrian traffic near work areas, and alternative arrangements where property accesses may be temporarily disrupted. Tunnelling and associated above-ground tunnelling support activities are proposed to operate 24 hours a day, seven days a week. Other activities that would significantly reduce the performance of the road network would be scheduled for periods of typically lower traffic volumes where feasible and reasonable so as to minimise potential disruption to regional and local traffic network.

Heavy vehicles would be required to deliver and remove construction plant, equipment and materials as well as remove spoil / waste from the construction sites. The construction period would also result in increased use of light vehicles on the surrounding road network associated with the construction workforce. Employee worksite transfer would likely occur in the peak periods. During the establishment of construction sites, and during their operation, local streets which surround construction compounds may require access from either light or heavy construction vehicles. The impact of these vehicles and their volume in association with the duration of the access is not anticipated to be significant.

As a result of background traffic growth, a number of intersections on Pennant Hills Road operate at capacity during peak periods without construction vehicles, and the additional demands created by construction, sees the performance of all of these intersections decrease further.

As the volume of traffic generated by construction is expected to be relatively low compared to existing traffic, the effects of this short-term increase on the existing road network is not expected to significantly impact road safety in the project area.

Operation

The operation of the project would provide an alternative route for travel between the Hills M2 Motorway and the M1 Pacific Motorway, especially for inter-regional freight traffic. As such, a number of traffic-related benefits are anticipated along Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway. The project would alter the existing M1 Pacific Motorway / Pennant Hills Road intersection and the Hills M2 Motorway / Pennant Hills Road interchange resulting in operational traffic changes.

Although these alterations would provide benefits to the local area, it is anticipated that by 2029, traffic volumes and associated delays on Pennant Hills Road would remain high due to the large degree of localised traffic movements which are not impacted upon by the construction of the project. As a result, background growth absorbs the spare capacity that is provided by the tunnel.

However, the average travel time in the peak directions show a reduction in travel time in the 2019 and 2029 'with project' scenarios. The northbound journey on Pennant Hills Road would take about 13 minutes less to complete during the 2019 PM peak compared to the 'without project' scenario. By 2029, the northbound journey on Pennant Hills Road in the PM peak is forecast to take about 20 minutes less compared to the 'without project' scenario.

Estimated travel time in the NorthConnex tunnel is around six minutes in the northbound direction and around five minutes in the southbound direction. This offers travel time savings of approximately six to 15 minutes in 2019 and nine to 25 minutes in 2029 when compared to travel times on Pennant Hills Road. This travel time saving will benefit commercial and freight vehicles transporting goods on the regional and state road network, as well as commuters and other private vehicles.

The project would provide an alternative route to Pennant Hills Road with a higher level of road safety than currently experienced by motorists in the corridor. In addition, the project is expected to reduce the frequency and cost of crashes occurring on Pennant Hills Road in the study area when compared to future conditions without the project. In combination, these effects would be expected to increase the level of safety for road users and reduce the cost of crashes in the project area.

The project is also expected to improve public transport operations and active transport amenity through the reduction in heavy vehicles and through traffic, and the reduction in travel time on Pennant Hills Road and the surrounding road network.

Hills M2 Motorway corridor

Construction

Construction compounds accessed and egressed on the Hills M2 Motorway would not impact on the mid-block operational performance of the corridor in the AM and PM peak hour periods, as no construction movements that would significantly reduce the performance of the road network are proposed during these peak periods. Other construction sites for the Hills M2 Motorway integration works are predicted to have a minimal impact on local intersection performance. As the volume of traffic generated by construction is expected to be relatively low compared to existing traffic, the effects of this short-term increase on the existing road network is not expected to significantly impact road safety in the project area.

Given two traffic lanes must be maintained on the mainline during construction and the westbound kerbside lane is to be used for construction, the existing bus lane would be utilised for general traffic during the construction phase to maintain two-lane capacity for westbound traffic. Westbound buses would be required to use the general traffic lanes during the construction period.

Pedestrian access to the bushwalking track (Murri-Yanna track) underneath the Darling Mills Creek Bridge would not be allowed while construction is occurring to ensure the safety of the public. Despite this, options would be investigated to enable the walking track to be open when works are not actively occurring in the area. During times of closure, alternative routes would be identified and signage would be erected.

There would not be access for cyclists to the motorway during construction, but an alternative cycle route would be created in the vicinity of the works area during the construction period.

Operation

The Hills M2 Motorway integration works increases the capacity of the motorway in the westbound direction between Pennant Hills Road and Windsor Road, improving the level of performance, especially in the PM peak hour. In the PM peak hour, westbound average travel times are expected to reduce by 13 minutes in 2019 and by 24 minutes in 2029, when compared to the 'without project' scenarios.

The project is expected to result in a transfer of traffic to the Hills M2 Motorway which offers a higher level of safety than arterial roads in the project area. The project is also expected to reduce the frequency and cost of crashes occurring on arterial roads in the study area when compared to future conditions without the project. In combination, these effects would be expected to increase the overall level of safety for road users and reduce the cost of crashes.

At the completion of the Hills M2 Motorway integration works, the westbound bus lane would be returned for use solely by public transport services using the corridor. Bus travel times are anticipated to remain consistent with existing conditions due to the capacity available within the dedicated bus lane. There would be minor alterations to facilities at the existing Oakes Road and Barclay Road bus stops along the Hills M2 Motorway as a result of the integration works.

Use of the shoulder for cycling on the motorway will be restored and all pedestrian facilities will be reopened to the public. The design of the project has included specific provision for grade separated cycle infrastructure on the Hills M2 Motorway at the main alignment tunnel connections. This would provide a safe cycling environment by removing the need to cross two traffic lanes.

M1 Pacific Motorway and Westlink M7 Motorway corridors

Construction

The construction impact is expected to be minimal on the Westlink M7 Motorway corridor. During construction of the M1 Pacific Motorway integration works, three general traffic lanes are planned to be generally maintained. Road works may require temporary road closures and these will be undertaken in accordance with approvals by Roads and Maritime and Traffic Management Centre, as relevant. Lower speed limits would also be required around construction areas, but this is not likely to affect peak period traffic, when speeds are already lower.

Operation

Minimal change in future traffic volumes (both light and heavy vehicles) is expected on the M1 Pacific Motorway as a result of the project, as traffic that would have used the motorway is likely to continue to use the motorway – only the entry points onto and exit points off the motorway would change.

Minimal change in future light vehicle traffic volumes are expected on the Westlink M7 Motorway as a result of the project, as traffic that would have used the motorway would continue to use the motorway and there is no change in the tolling regime for light vehicles. Significant reduction in future heavy vehicle traffic volumes are expected on the Westlink M7 Motorway as a result of the project, as increased tolls for heavy vehicles are proposed.

The design of the project has included specific provision for grade separated cycle infrastructure on the M1 Pacific Motorway at the main alignment tunnel connections. This would provide a safe cycling environment by removing the need to cross two traffic lanes.

Mitigation measures

Construction

Even without construction, the majority of the Pennant Hills Road corridor is forecast to operate at or close to practical capacity during the AM and PM peak periods in 2016, the year of peak construction traffic. As such, the intersections are susceptible to large increases in average delay with only small levels of increased demand. At several key intersections, the intersection performance is at or approaching capacity and experiences high levels of delay. Additional construction traffic will exacerbate these conditions.

A traffic management plan (TMP) would be prepared as part of the construction environmental management plan (CEMP). The traffic management plan would include the guidelines, general requirements and procedures to be used when construction activities would have a potential impact on existing traffic arrangements. Implementation of the measures in the traffic management plan would ensure that delays and disruptions are managed with appropriate measures, and identify and respond to any changes in road safety as a result of construction works.

Overall, the traffic management plan would set out the strategy and procedures to minimise, mitigate and communicate the impacts of the construction of the project on the capacity, performance and safety of the local road network and traffic systems. The traffic management plan would also address the management of impacts on emergency services, cyclists, pedestrians, public transport and parking.

Operational

The intersection performances of the key intersections assessed improve when compared to 2019 and 2029 without the project. However, most of the key intersections along the Pennant Hills Road corridor will experience significant congestion during one or both of the AM and PM peak hours in 2029, irrespective of the project. While the project would improve the situation for the same time periods in general (eg by removing heavy vehicles and through traffic on Pennant Hills Road), it would not resolve the existing congestion problems in the local area in the long term.

The need to undertake additional works from time to time to address longer term congestion across the major network is a separate consideration by Roads and Maritime in its road network planning and management role. A separate study into Pennant Hills Road, which is separate to this project, would be undertaken by Roads and Maritime and Transport for NSW to investigate public transport improvements and intersection treatments that could be delivered on Pennant Hills Road upon opening of the project.

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1.0 Introduction

1.1 Project overview

Roads and Maritime is seeking approval to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at West Pennant Hills in northern Sydney (the project). The project would deliver a high standard motorway that integrates with the regional transport network.

The project would be located within The Hills, Hornsby and Ku-ring-gai local government areas about 20 kilometres north-west of the Sydney central business district. It would span the suburbs of Wahroonga, Normanhurst, Thornleigh, Pennant Hills, Beecroft, West Pennant Hills, Carlingford and North Rocks. The project would consist of underground tunnel(s) generally following the alignment of Pennant Hills Road. At the northern and southern end of the project, interchanges would connect the tunnels to the M1 Pacific Motorway, the Hills M2 Motorway and Pennant Hills Road, and would facilitate access to and from the Pacific Highway.

The regional context of the project is shown in **Figure 1-1**, while the local context is shown in **Figure 1-2**. The project is an unsolicited proposal and subject to a final binding agreement. Funding arrangements for the project would include changes to tolling for heavy vehicles on some Sydney motorways (discussed in **Section 4.2**).

Further details on the project description and objectives are included in **Section 2**.

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Figure 1-1 Regional context of the project

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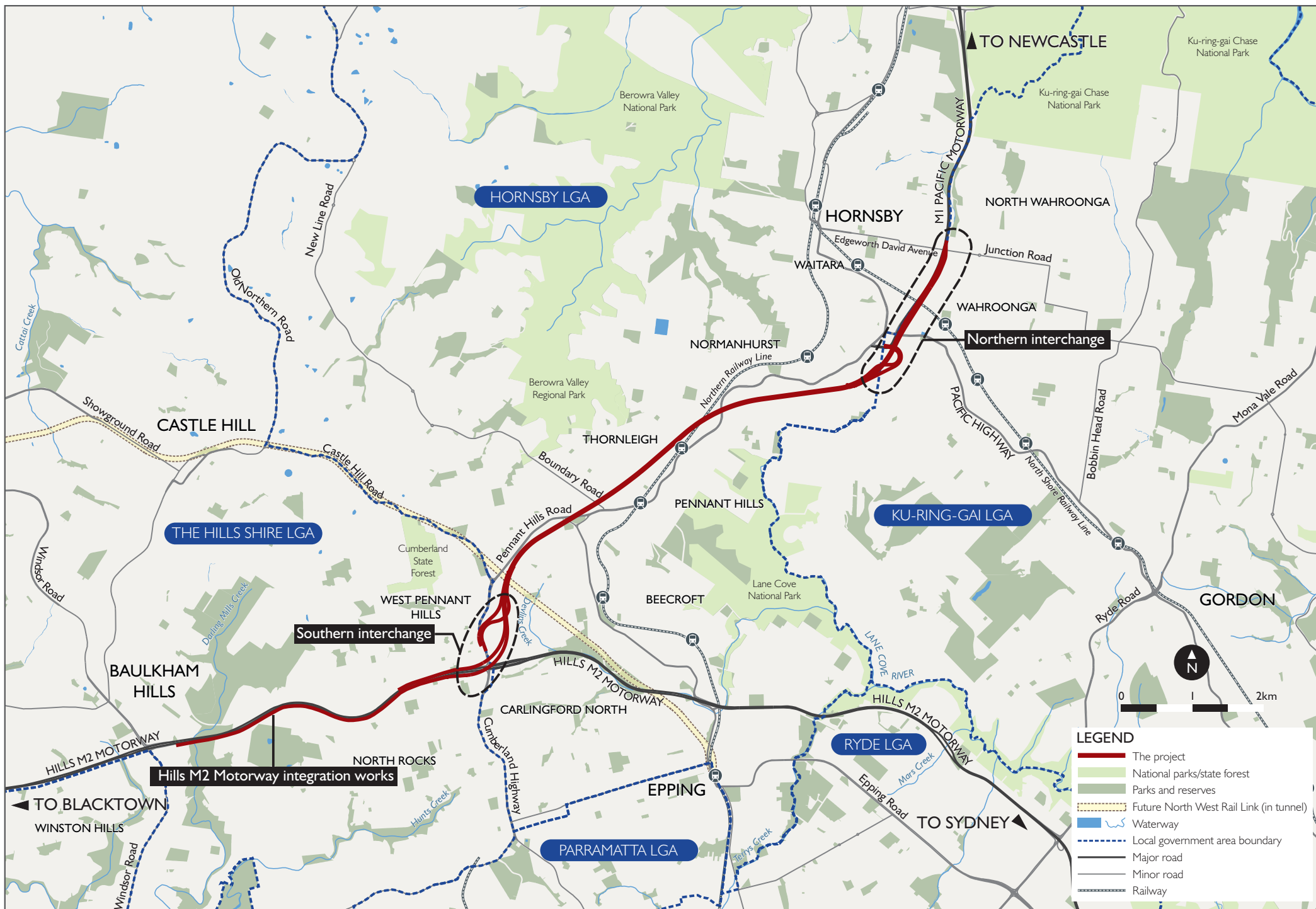


Figure 1-2 Local context of the project

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1.2 Director-General's requirements

The NSW Department of Planning and Environment has issued a list of Director-General's requirements (DGRs) that inform the environmental impact statement. **Table 1-1** presents the Director-General's requirements related to traffic and transport and in which section of the report they have been addressed.

In addition, in two letters which accompanied the Director-General's requirements, Hornsby Shire Council requested the transportation and disposal of spoil from the project be included in the assessment of cumulative construction impacts, while The Hills Shire Council requested that the surrounding state road network (i.e. Castle Hill Road, Beecroft Road, and Pacific Highway) be included in the assessment of the operational traffic impacts.

Table 1-1 Traffic and transport Director-General's requirements checklist

Director-General's requirements	Section addressed
Key issues (general requirements)	
<ul style="list-style-type: none"> A detailed description of the project and its relationship and/or interaction with the existing public transport service (rail and bus), bus stops, passenger facilities, location of routes, operator amenities, cyclist facilities, and the location and operational requirements of construction compounds. 	Section 2 Section 7 Section 8
Traffic and transport	
The EIS must also address the following specific matters, including but not limited to:	
<ul style="list-style-type: none"> An assessment (including modelling) of the operational traffic impacts of the project, impacts (volumes, speeds, intersection performance, freight volumes, tolling etc) on the M1 (M1 Pacific Motorway), M2 and M7 Motorways, Pennant Hills Road and the surrounding local, regional and state road network. 	Section 8
<ul style="list-style-type: none"> An assessment of wider transport interactions (local and regional roads and public and freight transport). 	Section 8
<ul style="list-style-type: none"> An assessment of the induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consideration of opportunities to improve public transport. The assessment must address impacts on cyclists and pedestrian access and safety (for those ancillary works around the project corridor, as relevant) and consider opportunities to integrate cycleway and pedestrian elements with surrounding networks. 	Section 8.1.6 Section 8.1.7 Section 8.2.6 Section 8.2.7
<ul style="list-style-type: none"> An assessment of construction traffic impacts, including a considered approach to route identification and scheduling of transport movements, the number, frequency and size of construction related vehicles (passenger, commercial and heavy vehicles, including spoil management movements), construction worker parking, the nature of existing traffic on construction access routes (including consideration of peak traffic times and sensitive road users, including emergency vehicles and buses), and the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project. 	Section 7
<ul style="list-style-type: none"> A strategy for managing construction traffic impacts, with a particular focus placed on those activities identified as having the greatest potential for adverse traffic flow, capacity or safety implications, and a broader, more generic approach developed for day-to-day traffic management. 	Section 9.1
<ul style="list-style-type: none"> Consideration of the cumulative construction impacts on residents/businesses taking into account other infrastructure projects that have either commenced construction, are preparing for construction or have recently been completed. 	Section 7.5

(Source: NSW Department of Planning and Infrastructure, 2014)

Changes in heavy vehicle volumes are generally an indicator of changes in freight volumes on the road network. Freight assumptions for operational traffic impacts of the project are discussed in **Section 5.2.2.3**.

1.3 Objectives of the traffic and transport assessment

The objective of the traffic and transport assessment is to address the Director-General's requirements by documenting the existing and future conditions structured around the following three elements:

- Existing traffic and transport conditions, including current traffic volumes, network and intersection performance, public transport and walking / cycling facilities.
- Forecast future conditions without the project. This will assess network and intersection performance based on current traffic conditions with background growth to represent future year scenarios.
- Forecast future conditions with the project during construction. This element details performance testing of the roads that would be impacted by construction related vehicles and construction activities.
- Forecast future conditions with the project during operation. This element details forecast demand, performance testing of the proposed project layout and demonstration of the overall benefits and impacts of the project.

1.4 Structure of this document

The report has been structured into the following Sections:

- Section 2 provides an overview of the project.
- Section 3 provides an overview of the existing traffic and transport conditions, including description of the route, details of public transport frequency and patronage, a review of walking and cycling routes, and a summary of daily and peak period traffic patterns.
- Section 4 contains a summary of the operational performance of the existing road network in terms of roadway midblock and intersection level of service (LoS), travel time analysis and a review of historical crash data.
- Section 5 documents the traffic modelling approach adopted to predict future traffic volumes for the project and the surrounding road network and to test the construction and operational impacts.
- Section 6 presents the details of the future traffic and transport operational conditions without the project.
- Section 7 documents the impact assessment undertaken for the construction scenarios of the project.
- Section 8 documents the impact assessment undertaken for the operational scenarios of the project.
- Section 9 provides conclusions and management measures developed to mitigate the impacts to traffic and transport.

2.0 The project

2.1.1 Description of the project

Roads and Maritime is proposing the construction and operation of a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at West Pennant Hills. **Figure 2-1** shows the general location of the project including the proposed interchanges.

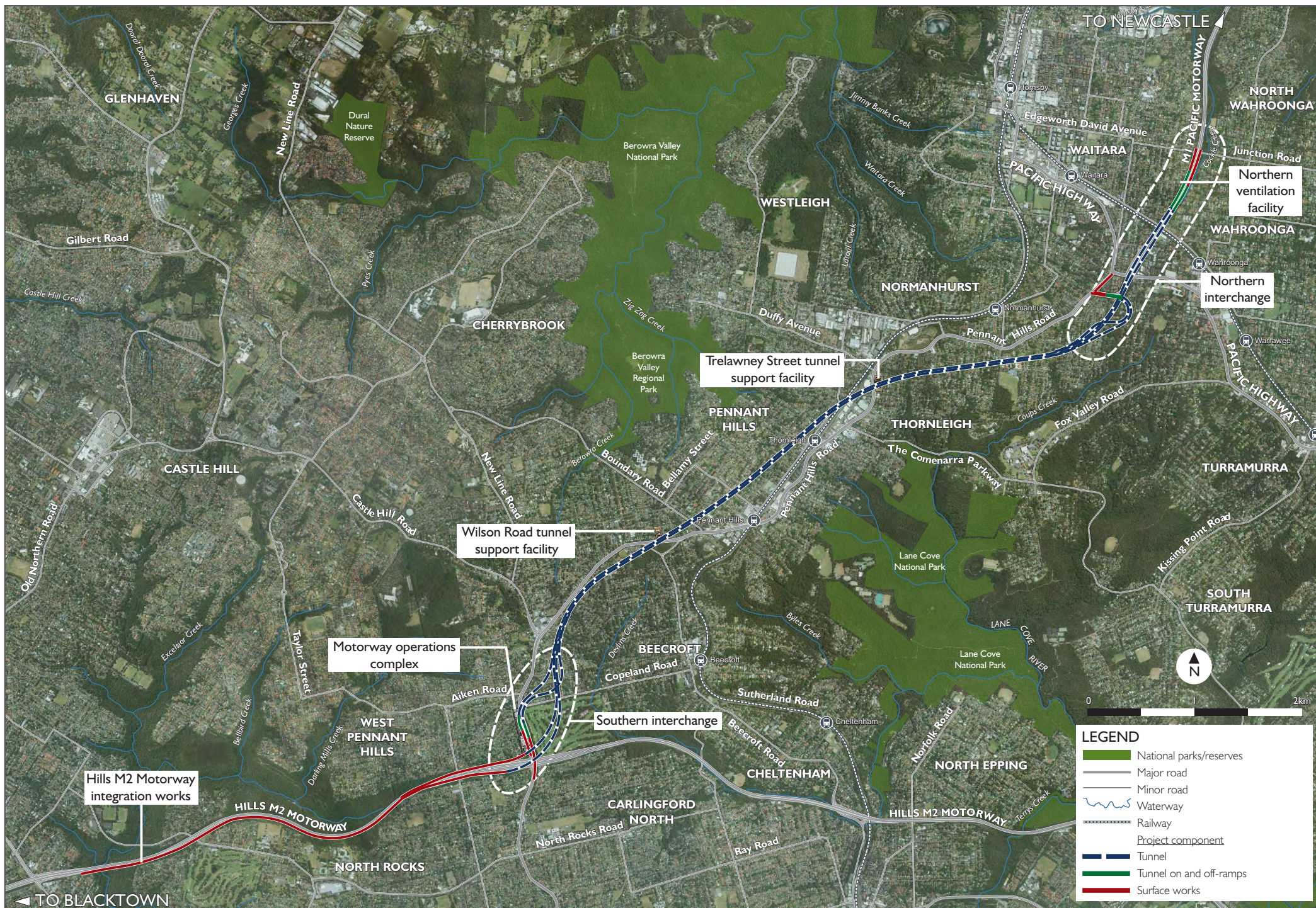
Pennant Hills Road, between the M1 Pacific Motorway and the Hills M2 Motorway, forms part of the National Land Transport Network. Vehicles using Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne.

This section of Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway is one of the two remaining sections of the National Land Transport Network within Sydney that is not of a motorway standard.

The project would comprise the following key features:

- Twin motorway tunnels up to around nine kilometres in length with two lanes in each direction. The tunnels would be constructed with provision for a possible third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the project travelling northbound, and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Integration works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities along the main alignment, incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

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TO BLACKTOWN
 Figure 2-1 The project

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2.1.2 Project objectives

The project would deliver a high standard motorway that integrates with the regional transport network. The project objectives, which incorporate environmental, social and economic considerations, are as follows:

- Provide a high standard access controlled motorway that integrates with the regional transport network.
- Minimise adverse social and environmental impacts in the local area during construction and operation.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Assist in a reduction in traffic congestion, particularly along Pennant Hills Road, and provide shorter travel times for road users.
- Provide a motorway that is safe and reliable for road users.
- Contribute towards the achievement of the national objective of connecting Melbourne to Brisbane via a duplicated highway in order to improve the efficient movement of state and national freight, and in doing so, reduce costs for freight operators and carriers.
- Contribute towards a reduction in the number of heavy vehicles using Pennant Hills Road and as a result improve local air quality and noise amenity along that corridor.
- Demonstrate excellence in design and environmental sustainability.
- Be economically justified and affordable to government.

While the project may assist in reducing congestion on Pennant Hills Road through reducing heavy vehicle and through traffic volumes, it is not anticipated that the project would result in a significant reduction in light vehicle traffic volumes in the long term, due to the travel patterns and ongoing local development in the surrounding region.

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3.0 Existing traffic and transport environment

This section outlines the existing traffic and transport environment within the study area. All data presented in this Section represents the base or existing conditions and is based on the latest publicly available information or was specifically sourced for the project in 2013.

3.1 Study area

The study area for the assessment of traffic and transport impacts is shown in **Figure 3-1**. The study area encompasses the road network surrounding the main alignment tunnels and Hills M2 Motorway integration works, including the Pennant Hills Road corridor (north of the Hills M2 Motorway), the southern end of the M1 Pacific Motorway corridor, a section of the Pacific Highway corridor and the Hills M2 Motorway corridor, including part of the Westlink M7 Motorway.

The focus of the study has been the impact on the Pennant Hills Road corridor and the Hills M2 Motorway corridor. This is due to the significant traffic and transport impacts expected on these roads as a result of the project. Traffic impacts on the M1 Pacific Motorway and the Westlink M7 Motorway, as well as key links on the wider road network have also been assessed.

3.2 Pennant Hills Road corridor and Pacific Highway corridor

3.2.1 Route description

Pennant Hills Road currently provides access between the Hills M2 Motorway and Epping Road in the south to the M1 Pacific Motorway and Pacific Highway in the north, travelling through suburbs including West Pennant Hills, Thornleigh and Normanhurst.

Pennant Hills Road has two to three lanes in the north and southbound directions. Most of Pennant Hills Road has a posted speed limit of 70 kilometres per hour, except at the southern end of the study area, where the speed limit changes to 60 kilometres per hour just north of Murray Farm Road. There are two school zones along Pennant Hills Road which extend from just after Hill Road to Beecroft Road and from Buckingham Avenue to Hinemoa Avenue. Clearway conditions operate along Pennant Hills Road from 6am to 10am and 3pm to 7pm, Monday to Friday.

Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway operates as an arterial road and forms part of the National Land Transport Network. The National Land Transport Network is based on national and inter-regional transport corridors including connections through urban areas, links to ports and airports, rail, road and intermodal connections that together are of critical importance to national and regional economic growth, development and connectivity. Pennant Hills Road links the M1 Pacific Motorway to the Sydney Orbital Network.

However, between the M1 Pacific Motorway at Wahroonga and the Hills M2 Motorway at West Pennant Hills, Pennant Hills Road currently has 21 signalised intersections. Cars, public transport and cyclists using Pennant Hills Road share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne.

The NSW Long Term Transport Master Plan (2012) (the Master Plan) recognises that a missing orbital motorway connection exists between the M1 Pacific Motorway and the Hills M2 Motorway. In chapter seven of the Master Plan, this particular missing link is also identified as an important long term road freight corridor. Sydney's motorway network is part of the primary freight network in Sydney and its efficient operation is critical to ongoing productivity. In providing an efficient link between the M1 Pacific Motorway and the Hills M2 Motorway, the project would improve freight access, connectivity and reliability across the greater Sydney area.

The Pacific Highway serves a strategic purpose by providing access between the M1 Pacific Motorway and the Sydney central business district. It also provides access from the north of the project area to Hornsby. The section of the Pacific Highway in the study area has two to three lanes in the north and southbound directions. Clearway conditions operate southbound from 6am to 10am and northbound from 3pm to 7pm, Monday to Friday. Most of this section of the Pacific Highway has a posted speed limit of 60 kilometres per hour. There are a number of school zones along this section of the Pacific Highway, between Lucinda Avenue and Finlay Road.

Existing intersections at the northern end of the project corridor include the M1 Pacific Motorway / Pennant Hills Road intersection, the M1 Pacific Motorway / Pacific Highway interchange and the Pennant Hills Road / Pacific

Highway intersection. At the southern end of the project corridor is the existing Hills M2 Motorway / Pennant Hills Road interchange. Details of these key intersections are provided in **Table 3-1** and shown in **Figure 3-2** to **Figure 3-5**.

Table 3-1 Existing key intersection details

Intersection	Intersection Type	Vehicle / Pedestrian / Cycle movements
M1 Pacific Motorway / Pacific Highway	Grade separated for M1 Pacific Motorway through movements with signalised T-intersections on the ramps	<ul style="list-style-type: none"> - A left turn movement from the M1 Pacific Motorway southbound to the Pacific Highway eastbound. - A right turn movement from the M1 Pacific Motorway southbound to the Pacific Highway westbound. - A left turn movement from the Pacific Highway eastbound to the M1 Pacific Motorway northbound. - A right turn movement from the Pacific Highway westbound to the M1 Pacific Motorway northbound. - Straight through movements along the Pacific Highway. - Straight through movements along the M1 Pacific Motorway. - East-west pedestrian movements on the northern and southern sides of the intersection.
M1 Pacific Motorway / Pennant Hills Road	At-grade signalised T-intersection	<ul style="list-style-type: none"> - A left turn movement only from the M1 Pacific Motorway southbound to Pennant Hills Road southbound. - A right turn movement from Pennant Hills Road northbound to the M1 Pacific Motorway northbound. - A left turn movement from Pennant Hills Road southbound to the M1 Pacific Motorway northbound. - Straight through movements along the M1 Pacific Motorway. - North-south pedestrian movements on the eastern and western sides of the intersection. - East-west pedestrian movements on the northern side of the intersection only.
Pennant Hills Road/ Pacific Highway	At-grade signalised T-intersection	<ul style="list-style-type: none"> - A right turn movement from the Pacific Highway westbound to the Pacific Highway northbound. - A left turn movement from the Pacific Highway westbound to Pennant Hills Road southbound. - A right turn movement from Pennant Hills Road northbound to the Pacific Highway eastbound. - A straight movement from Pennant Hills Road northbound to the Pacific Highway northbound. - A left turn movement from the Pacific Highway southbound to the Pacific Highway eastbound. - A straight movement from the Pacific Highway southbound to Pennant Hills Road southbound. - North-south pedestrian movements on the eastern and western sides of the intersection. - East-west pedestrian movements on the northern side of the intersection only.
Hills M2 Motorway / Pennant Hills Road	Grade separated four-way signalised intersection	<ul style="list-style-type: none"> - An all movements interchange between the Hills M2 Motorway and Pennant Hills Road. - Dedicated east-facing bus ramps between Pennant Hills Road and the Hills M2 Motorway. - North-south pedestrian movements on the eastern and western sides of the interchange. - East-west pedestrian movements on the northern side of the intersection only. - Provision for cyclists northbound and southbound on Pennant Hills Road across the interchange.

(Source: AECOM, 2014)