# M2 Upgrade

VOLUME 1

ENVIRONMENTAL ASSESSMENT

**MAY 2010**

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# M2 Upgrade project environmental assessment

## Prepared by

AECOM

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# Statement of Validity

| | | |
|---|---|---|
| Submission of environmental assessment | | |
| *Prepared under Part 3A of the Environmental Planning and Assessment Act 1979* | | |
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| *In respect of:* | M2 Motorway Upgrade – environmental assessment | |
| *Applicant name:* | NSW Roads and Traffic Authority | |
| *Applicant address:* | Level 9, 101 Miller Street<br>North Sydney<br>NSW 2060 | |
| *Proposed development:* | The NSW Roads and Traffic Authority proposes to widen the M2 Motorway between North Ryde and Baulkham Hills, Sydney. The project would comprise widening and/or provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road. Design features of the project include construction of new on- and off-ramps at Windsor Road, a new off-ramp at Herring Road, a new on-ramp at Christie Road and local road upgrades to Windsor, Talavera and Christie Roads as well as upgrades to the M2 Motorway Intelligent Transport System. | |
| *Land to be developed:* | Land generally required for the design refinement, construction and operation of the proposed development (refer to Figure 5). | |
| *Environmental assessment:* | An environmental assessment is attached, which addresses all matters in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979*. | |
| *Declaration* | I certify that I have prepared the contents of this environmental assessment in accordance with the Director-General's Requirements (DGRs) dated 6 April 2009, to the best of my knowledge, the information contained in the environmental assessment is not false or misleading. | |
| *Signature:* | | |
| *Name:* | Louisa Rebec | Craig Niles |
| *Date:* | 10 May 2010 | 10 May 2010 |

# Executive Summary

## What is proposed?

The Roads and Traffic Authority (RTA) of NSW proposes to upgrade the M2 Motorway from Windsor Road, Baulkham Hills, to Lane Cove Road, North Ryde. The M2 Upgrade project would extend over 14.5 kilometres in length and involves construction works including:

- Widening and/or provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road.
- Provision of new on and off-ramps at Windsor Road, a new on-ramp at Christie Road and a new off-ramp at Herring Road.
- Widening and provision of a third lane eastbound and westbound in the Norfolk Tunnel.
- Restoration of the westbound breakdown lane and provision of 3.5 metre wide traffic lanes between Lane Cove Road and Beecroft Road.
- Removal of the Beecroft Road bus on and off-ramp.
- Upgrade to the intersection of the M2 Motorway and Windsor Road, and the Christie Road and Herring Road intersections with Talavera Road.
- Upgrade to the M2 Motorway Intelligent Transport System.

The project also includes the operation of the upgraded M2 Motorway.

The Minister for Planning declared, by Ministerial Order, that the M2 Upgrade project is a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies and the project is critical infrastructure. The RTA has requested that the declarations be amended to better reflect the proposed project. These are currently being amended. This environmental assessment considers the project as described by the amended declarations.

Further description of the project is provided in Chapter 6 of the environmental assessment.

## Why is it needed?

The M2 Upgrade project provides essential improvements to a key link in the Sydney Orbital Motorway network which would support the significant growth planned in Sydney's north west and the 'global arc'. At present the performance of the M2 Motorway is, especially during peak periods, of concern to many users. Users pay a toll to use the M2 Motorway and subsequently they have an expectation that travel times should be lower and feel that they may not be obtaining value for money.

The project is consistent with the goals and objectives described in key NSW Government strategy documents, including the State Plan and Metropolitan Strategy. The project would provide:

- Improved accessibility for cars, freight vehicles, public transport and bicycles.
- Improved capacity and efficiency of existing commuter, commercial, freight and road-based public transport infrastructure.
- Reduced congestion during peak periods.

For more details on the need for the project refer to Chapter 2.

## How would it satisfy this need?

The project objectives were designed to facilitate outcomes that satisfy the strategic need for the project. The objectives are to:

- Support the NSW Government's State Plan, Metropolitan Strategy, Urban Transport Statement and State Infrastructure Strategy.
- Enhance the strategic road network in Sydney's north west to support economic growth.
- Improve access and accessibility between key residential, employment and educational precincts in Sydney's north west.
- Improve travel times by reducing congestion during peak periods for the benefit of local and regional traffic that has limited opportunity to travel outside peak periods.
- Improve safety and amenity for road users and surrounding communities.
- Provide value for money to the community.
- Minimise environmental and social impacts during construction and operation.

The project objectives are detailed further in Section 2.3.

To achieve the project objectives, the M2 Upgrade project aims to:

- Improve the reliability, safety and efficiency of the M2 corridor.
- Reduce congestion along the M2 Motorway.
- Improve and retain accessibility to local arterial roads.
- Minimise environmental effects and manage potential adverse effects appropriately.
- Enhance potential benefits to community and stakeholders in the short and long-term.
- Manage potential adverse impacts on the community.

The preferred design, which is assessed in this report, was selected following an assessment of various alternatives due to its ability to meet the design criteria, the project objectives, and ultimately, the strategic need for the project.

## What alternatives were considered?

The alternatives to the M2 Upgrade project that were identified and considered as part of the development of the project include the following:

- Do nothing – No upgrade to the M2 Motorway.
- Line marking – Line marking to provide additional lanes within the existing carriageways of the M2 Motorway.
- Local arterial road upgrade – Widening of the existing sub-arterial and arterial road network in the vicinity of the M2 Motorway.
- Provision of public transport – Increase provision for public transport within the M2 Motorway catchment.
- Widening of the M2 Motorway to provide additional lane capacity – current project (preferred).

For more details of the alternatives considered as part of this assessment and the reasons why the preferred alternative was selected, refer to Chapter 3. The preferred option is described in detail in Chapter 6.

## What are the likely consequences of the project?

The M2 Motorway provides accessibility and capacity for commuter, commercial, freight and road-based public transport. The M2 Upgrade project would enhance the road networks to Sydney's north west, providing an essential service to new growth areas and improving travel times in the morning and afternoon peaks. The project would also provide new access points to M2 Motorway in the west and at Macquarie Park, relieve traffic pressure on local roads, improve bus and cycle travel times and improve road safety.

The proposed upgrade would result in some adverse impacts in the long-term, including:

- Increased traffic on local roads leading to new access ramps.
- Impacts to visual amenity as a result of modified or new noise walls and vegetation removal.
- Noise impacts to some residents and businesses resulting from increased traffic on M2 Motorway.
- Loss of approximately 21 hectares of vegetation (including 10 hectares of native and 11 hectares of exotic vegetation). Direct impact to one threatened flora species and loss of habitat for significant fauna species.
- Potential impact to three Aboriginal cultural heritage sites including an artefact of low significance, a site potentially affected by sedimentation and potential vibration impacts to a rock shelter.
- Property acquisition including partial acquisition of seven privately owned residential properties and full acquisition of a number of properties owned by public authorities.

There would also be impacts during construction of the M2 Upgrade project. Many of these impacts would be temporary, but some (like impacts on property and biodiversity) would be longer term or permanent. Some minor cumulative impacts with other developments proposed within the area may be experienced if they occur at a similar time to the M2 Upgrade project. Impacts of the project are detailed in Chapter 9 and Chapter 10.

## How will the likely consequences be managed?

This environmental assessment assesses the likely consequences of the proposed upgrade. As part of this assessment, measures to mitigate or manage each likely impact have been proposed. The mitigation measures developed for the proposed upgrade aim to remove or minimise potential impacts through design in the first instance. However, where a potential impact is unable to be mitigated through design, management measures are outlined.

The environmental, social and economic impacts and measures identified to minimise those impacts are discussed in Chapter 9, Chapter 10 and Chapter 11 of this environmental assessment.

## How can I comment on the project and/or the environmental assessment?

The NSW Department of Planning has made the environmental assessment publicly available for a minimum period of 30 days. The RTA will also be conducting community information sessions during the exhibition period. The project telephone information line and email enquiries facility would be available throughout the exhibition period, being 1800 196 266 and enquiries@hillsm2upgrade.com.au respectively.

Any person may make a written submission to the Director-General of the Department of Planning during the exhibition period. Submissions should be made to:

Director, Major Infrastructure Assessments
Department of Planning
GPO Box 39
SYDNEY NSW 2001

# 1. Introduction

## 1.1 The project

The Roads and Traffic Authority (RTA) of NSW proposes to upgrade 14.5 kilometres of the M2 Motorway from Windsor Road, Baulkham Hills, to Lane Cove Road, North Ryde. The M2 Upgrade project would include construction works including widening and provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road and provision of new on/off-ramps. The project also involves the operation of the upgraded M2 Motorway with an Upgrade of the Intelligent Transport System.

The project would include:

- Widening and/or provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road.
- Provision of new on/off ramps at Windsor Road, Christie Road and Herring Road.
- Widening and/or provision of a third lane eastbound and westbound in the Norfolk Tunnel.
- Restoration of the westbound breakdown lane from Lane Cove Road to Beecroft Road.
- Removal of the Beecroft Road bus on/off ramp.
- Upgrade of the M2 Motorway/Windsor Road, Christie Road/Talavera Road and Herring Road/Talavera Road intersections.
- Upgrades to M2 Motorway Intelligent Transport System.

## 1.2 Overview

The existing M2 Motorway is a four lane dual carriageway motorway, with bus lanes in certain sections that extends 21 kilometres from the intersection of Abbott Road/Old Windsor Road at West Baulkham Hills, to Lane Cove Tunnel (refer to Figure 1).

Operation of the M2 Motorway is covered by the M2 Motorway Project Deed. Under this deed The Hills Motorway Limited (Hills M2) operates, maintains and repairs the M2 Motorway on behalf of the RTA. The RTA has leased the necessary land to Hills M2 (M2 Motorway operator) to facilitate this and has granted Hills M2 the right to collect tolls for the use of the M2 Motorway. These arrangements continue until expiry of the M2 Motorway Project Deed in 2042.

The M2 Motorway plays a key role in Sydney's Orbital network, linking Sydney's north west to the lower north shore and Sydney's CBD. The M2 Motorway was a priority section of the Orbital route identified in the Department of Main Roads publication *Roads 2000* (1987), which included a strategic plan for Sydney's road needs to the year 2000. Upon opening in 1997, the M2 Motorway provided much needed accessibility and capacity for commuter, commercial, freight and road-based public transport, thereby reducing travel times and peak hour congestion.

The NSW Government's *Urban Transport Statement* (November 2006) identifies the efficient movement of people and goods in and around Sydney as a key transport objective and identifies the M2 Motorway as a key part of the Macquarie Park to Port Botany Economic corridor. The proposed upgrade would relieve current congestion, thereby facilitating more efficient movement of people and goods and would also be consistent with potential future development of an M2 Motorway to F3 Freeway connection.

Since the M2 Motorway opened to traffic in 1997, land use density has increased within M2 Motorway catchment, particularly in Sydney's north west. The proposed upgrade is a result of feedback received from motorists, businesses, public transport providers, councils, cyclists and the community about the need to improve travel times and provide greater accessibility for the M2 Motorway users.

## 1.3 Project delivery

The RTA is the proponent for the proposed M2 Upgrade. The M2 Upgrade project would be delivered by Hills M2 who has engaged Leighton Contractors Pty Ltd (LCPL) under a 'design and construct' contract.

AECOM have been appointed to prepare this environmental assessment, which has been prepared in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The RTA has reviewed and approved this environmental assessment.

The project application was submitted to the Department of Planning on 27 February 2009 and consultation with the community and other stakeholders was commenced. A summary of the project was presented on the Hills M2 website as information for community and stakeholder groups.

Development of the concept design and the environmental assessment process involved an analysis of various strategic project alternatives and an assessment of design options, which were investigated in selecting the preferred project concept for the M2 Upgrade project. Refinement and further development of the project concept design has been carried out concurrently with the environmental assessment process to minimise impacts where possible and to consider ecologically sustainable development principles within the design. Figure 2 provides an overview of the M2 Upgrade project.

## 1.4 Project cost and funding

The M2 Upgrade project is estimated to cost in the vicinity of $550 million and there would be ongoing additional maintenance costs associated with the project. It would be funded by the M2 Motorway operator (Hills M2) and the funds would be recouped from tolls imposed on the M2 Motorway over the concession period. Funds required by the M2 Motorway operator for the upfront capital expenditure for upgrading the M2 Motorway would typically be obtained from borrowings or issuing shares to investors. These funding mechanisms would require the M2 Motorway operator to achieve a return on investment to investors or pay back the loan with interest payments.

The project would attract additional traffic to the M2 Motorway and hence increase toll revenue. The provision of new tolled ramps at Baulkham Hills and Macquarie Park would also increase revenue. The final toll amount is yet to be determined, however, indicative tolls (Class 2 vehicles – including GST) proposed for the new ramps are in the order of $1.70 at Windsor Road and $2.40 at Herring Road and Christie Road. However, the increase in toll revenue from the above would not be sufficient to fund the full capital costs of the project, at current toll levels within the current concession period.

In light of this, the following potential funding alternatives considered included:

- Funding the shortfall by Government.
- A one off toll increase when the M2 Upgrade project is opened.
- An extension of the toll collection/concession period.

The NSW Government has agreed to a combination of funding sources, involving a one off toll increase upon opening of the M2 Upgrade project as well as an extension of the toll collection concession period. The announcement of the signing of the 'In Principle Agreement' in October 2009 indicated that the M2 Upgrade project *"would be funded by Transurban, with the NSW Government contributing by extending the toll concession by 4 years and allowing for a one-off increase in the toll of around 8 percent on completion of the works".*

Based on a Road User Cost Benefit Analysis (RUCBA) undertaken for the M2 Upgrade project (refer to Appendix E), the economic worth of the project case relative to the base case has been estimated to be:

- Net present value of $1.2 billion.
- A benefit cost ratio value of 3.4.

Based on either measure, it is economically worthwhile to proceed with the project. It is noted that a benefit cost ratio of more than two is considered to be a favourable outcome and economically worthwhile. A series of sensitivity tests were carried out by varying the discount rate, construction costs, benefits and diminishing travel time savings. Under these conditions, the benefit cost ratio varies between 2.3 and 4.9 and the net present value between $629 million and $2.1billion.

By adding substantial capacity to an existing and congested motorway, the project provides economic benefits from reduced travel time in return for low additional travel costs. In addition, capital costs are relatively low in comparison to construction of a new link. These factors generate a high benefit cost ratio.

The proposed tolls for the new Herring Road (east facing) ramps were determined based on existing toll rates for the section east of Beecroft Road. These rates reflect the level of congestion on the alternative route for this segment of the corridor. The proposed tolls for the new Windsor Road (west facing) ramps are approximately 30 percent lower than the Pennant Hills Road tolls. These toll rates were determined with the objective of minimising adverse traffic impacts on longer motorway trips and off-motorway arterial routes.

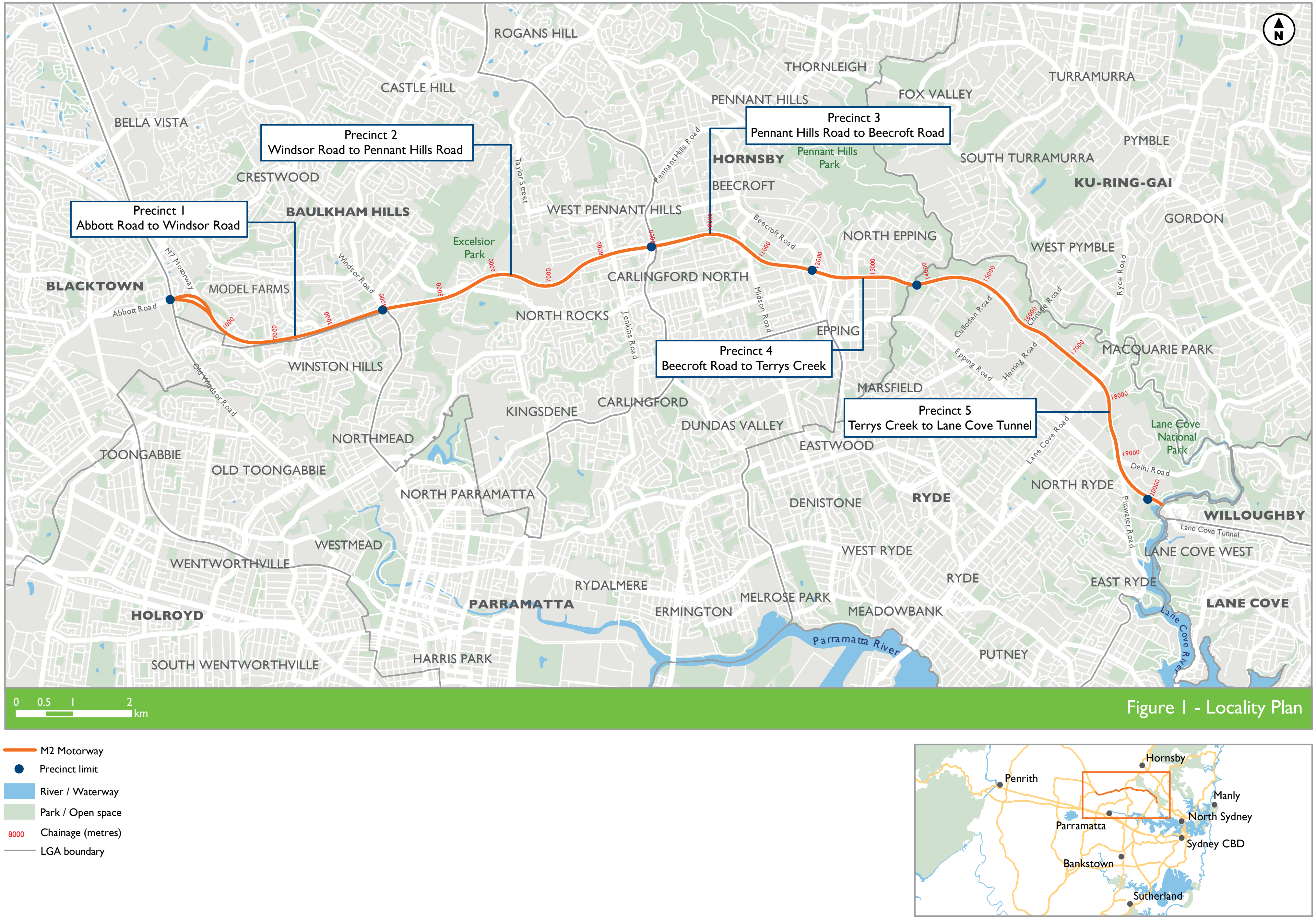
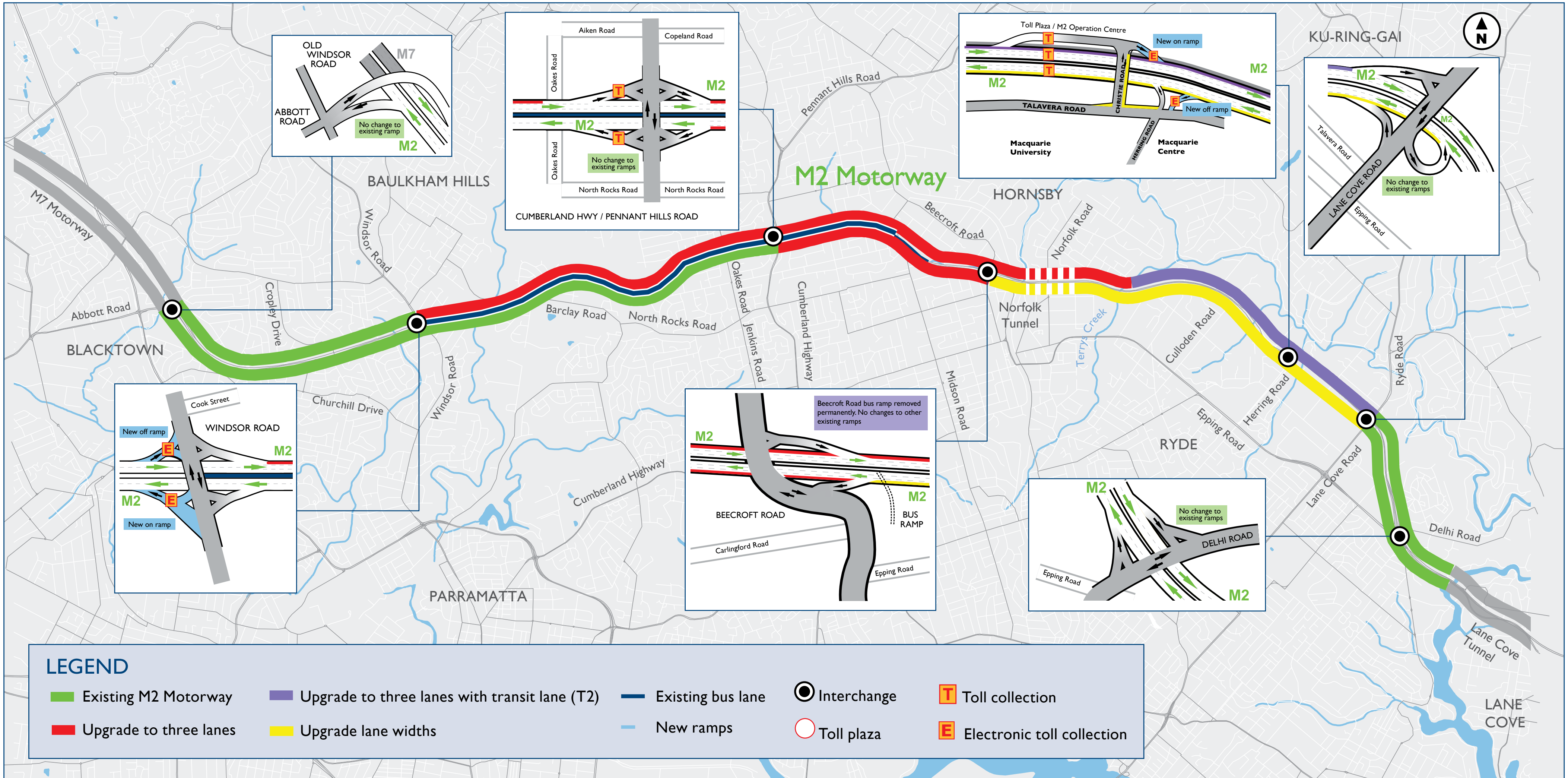



Figure 1 - Locality Plan

Source: MapData, 2010




Not to scale

Figure 2 - Proposed M2 Upgrade


Source: MapData, 2010; Transurban, 2010

## 1.5 M2 Motorway precincts

For the purposes of this environmental assessment, the M2 Motorway is divided into five precincts, based on the key defining physical and operational characteristics (refer Figure 1). The M2 Motorway precincts and their key landscape attributes are as follows:

- Precinct 1 – Abbott Road to Windsor Road.
- Precinct 2 – Windsor Road to Pennant Hills Road.
- Precinct 3 – Pennant Hills Road to Beecroft Road.
- Precinct 4 – Beecroft Road to Terrys Creek (including Norfolk Tunnel).
- Precinct 5 – Terrys Creek to Lane Cove Tunnel.

The following subsections describe each of the five precinct areas.

### 1.5.1 Precinct 1 – Abbott Road to Windsor Road

The Abbott Road to Windsor Road section of the M2 Motorway falls within The Hills Shire. It extends for four kilometres from the intersection of the M2 Motorway, Abbott Road and Old Windsor Road. At the western end the M2 Motorway links with the M7 Motorway and east-facing ramps connect M2 Motorway to the local road network at Old Windsor Road/Abbott Road. There are currently no west-facing ramps at Windsor Road. The M2 Motorway comprises two carriageways, each carriageway consisting of a breakdown lane and two traffic lanes. In this precinct the carriageways are separated by grassed or concrete barrier medians. Cyclists are able to utilise the breakdown lanes. Bus stops are located along the M2 Motorway in this precinct with buses using the breakdown lane.

### 1.5.2 Precinct 2 – Windsor Road to Pennant Hills Road

The Windsor Road to Pennant Hills Road (Cumberland Highway) section is located within The Hills Shire. The section extends for five kilometres and is characterised by two carriageways, each one comprising a breakdown lane, two traffic lanes, plus a bus lane in each direction. The carriageways are separated by a concrete barrier median. Cyclists are able to utilise the breakdown lanes. Toll collection points are located on the west facing ramps at Pennant Hills Road. East facing ramps at Windsor Road provide access to and from this precinct and Windsor Road. West facing ramps at Pennant Hills Road provide access to and from this precinct and Pennant Hills Road

### 1.5.3 Precinct 3 – Pennant Hills Road to Beecroft Road

The Pennant Hills to Beecroft Road precinct is the central section of the M2 corridor and extends for three kilometres. It is situated within Hornsby Shire. This section is characterised by two carriageways, each one comprising a breakdown lane, two traffic lanes plus a bus lane in each direction. The carriageways are separated by a concrete barrier median (although at Devlins Creek bridge the bridges are separated so there are two median barriers). Cyclists are able to utilise the breakdown lanes. The temporary cycleway detour from the westbound carriageway near Lane Cove Road connects to the westbound breakdown lane near Beecroft Road. The east facing ramps at Pennant Hills Road provide access to and from the M2 Motorway in this precinct. The bus only ramp near Beecroft Road allows bus access to and from the M2 Motorway from Epping (via an underpass at the main northern railway). Eastbound to southbound busses on the M2 Motorway can also access Beecroft Road.

### 1.5.4 Precinct 4 – Beecroft Road to Terrys Creek (including Norfolk Tunnel)

This precinct is located within Hornsby Shire and extends from Beecroft Road to Terrys Creek. In the eastbound direction, this precinct features a breakdown lane and two traffic lanes. In the westbound direction, this precinct features three traffic lanes and no breakdown lane. The third lane was marked by removing the breakdown lane as part of an interim widening scheme implemented in 2007. The three lanes merge to two lanes immediately past the western tunnel portal. Eastbound cyclists are able to use the shoulder through this precinct. However, a temporary off-Motorway cycle path is provided for westbound cyclists, as there is no shoulder to use in this direction.

The Norfolk Tunnel (sometimes referred to as the Epping Tunnel) is 460 metres in length and consists of two tunnel tubes separated by a wall of rock. There are two traffic lanes (plus breakdown lane) in the eastbound tube and three traffic lanes westbound (without breakdown lane) in the westbound tube. The tunnel is a large cut into the sandstone bedrock. Surrounding the tunnel is predominantly detached residential dwellings, dispersed with parklands. Directly above Norfolk Tunnel, there is a small cluster of detached dwellings and Epping Oval.

### 1.5.5 Precinct 5 – Terrys Creek to Lane Cove Tunnel

Precinct 5 falls within the City of Ryde and stretches from Terrys Creek to the eastern extent of the M2 Motorway at the start of the Lane Cove Tunnel.

#### Terrys Creek to Herring Road

The Terrys Creek to Herring Road section of the M2 Motorway is approximately 2.5 kilometres in length and is characterised by two carriageways, the eastbound comprising a breakdown lane with two traffic lanes and westbound comprising three traffic lanes without breakdown lane. The carriageways are separated by a concrete barrier.

The M2 Motorway Toll Plaza is located adjacent to the Macquarie University site, between Culloden Road and Christie Road. The westbound cycleway in this section is by way of temporary westbound detour, along Talavera Road.

The west facing off ramp at Christie Road and overpass is located approximately 500 metres east of the M2 Motorway Toll Plaza. Traffic travelling westbound cannot access the M2 Motorway from Christie Road. Westbound traffic access M2 Motorway via the west facing ramp at Herring Road, which joins the M2 Motorway just east of the Christie Road local road crossing.

#### Herring Road to Lane Cove Road

Herring Road to Lane Cove Road is approximately 1.3 kilometres in length consisting of two carriageways. The eastbound consists of a breakdown lane with two traffic lanes and the westbound three traffic lanes (without a breakdown lane). The carriageways are separated by a concrete barrier.

West facing on- and off-ramps provide access to and from the M2 Motorway and Lane Cove Road. Lane Cove Road is a three lane dual carriageway major arterial road that crosses the M2 Motorway by a double span overbridge. The corridor in this section is dominated by large scale commercial buildings and low to medium density residential development. Shrimptons Creek crosses the M2 Motorway approximately 400 metres east of Christie Road.

### Lane Cove Road to Lane Cove Tunnel

Lane Cove Road to Lane Cove Tunnel is approximately 2.6 kilometres in length and is characterised by two carriageways, each comprising a breakdown lane and two traffic lanes. The carriageways are separated by a concrete barrier. The M2 Motorway ends approximately 100 metres west of the bridge crossing the Lane Cove River and connects directly to the Lane Cove Tunnel.

West facing on- and off-ramps provide access to and from M2 Motorway at Delhi Road. The road shoulder is used in the eastbound direction by cyclists. Cyclists in the westbound direction are directed off the M2 Motorway in this section to the temporary cycle detour route, as the shoulder has been taken up to provide three lanes from Lane Cove Road through until after the Norfolk Tunnel. At its easternmost extremity, the M2 Motorway crosses over the Lane Cove River via a bridge. Pages Creek runs along the western edge of Epping Road, parallel to the M2 Motorway, and flows into Lane Cove River.

## 1.6 Structure of this report

Table 1(Volume One) and Table 2 (Volume Two) summarise the structure and content of this environmental assessment.

Table 1 Report structure – volume one environmental assessment

| Section | Content |
|---|---|
| Volume one – environmental assessment | |
| Chapter 1: Introduction | Provides a broad overview of the project and a general description of the study area. |
| Chapter 2: Strategic justification and project need | Establishes the need for the project and describes project objectives. |
| Chapter 3: Project alternatives | Provides a detailed description and assessment of the strategic alternatives and design options considered for the project. |
| Chapter 4: Planning and statutory requirements | Outlines the approval process and statutory requirements for the project. |
| Chapter 5: Community and stakeholder engagement | Outlines stakeholder consultation undertaken during project development and preparation of the environmental assessment. |
| Chapter 6: Project description | Provides a detailed description of M2 Motorway alignment, design elements, construction methodologies and related ancillary facilities. |
| Chapter 7: Construction and staging | Provides an overview of the potential construction methods to be employed, including ancillary facilities, equipment, compound sites and an indicative construction and opening staging program. |
| Chapter 8: Environmental risk analysis | Provides an analysis that confirms the nominated key issues and identifies additional key issues. |
| Chapter 9: Assessment of key issues | Provides an assessment and analysis of the key environmental issues and impacts and provides appropriate management measures. |
| Chapter 10: Other environmental issues | Provides an assessment and analysis of other environmental issues and impacts and provides appropriate management measures. |
| Chapter 11: Draft Statement of Commitments | Describes measures to manage and mitigate major impacts identified by the environmental assessment. |
| Chapter 12: Conclusion | Outlines the justification for proceeding with the proposed upgrade considering the project objectives, suitability of the site, public interest, the principles of ecological sustainable development and objects of the Environmental Planning and Assessment Act 1979. |

| Section | Content |
|---|---|
| Chapter 13: References | Provides a list of published documents referred to in the environmental assessment. |
| Chapter 14: Glossary and abbreviations | Provides an explanation of terms and abbreviations used in the environmental assessment. |
| Appendices | |
| Appendix A Minister's Declaration | A copy of the Orders gazetted to declare the project a major project and then a critical infrastructure project. |
| Appendix B Director-General's Requirements | A copy of the Director-General's Requirements (DGRs) issued by the Department of Planning. |
| Appendix C Director-General's Requirements Checklist | Cross-reference to where in the environmental assessment each issue in the DGRs is addressed. |
| Appendix D Consultation summary | Provides a summary of consultation activities. |
| Appendix E Road User Cost Benefit Analysis | A copy of the *Road User Cost Benefit Analysis* for the M2 Upgrade project. |
| Appendix F Construction Environmental Management Framework | Provides an overview of the content of the Construction Environmental Management Plan to be formulated to manage construction. |
| Appendix G EPBC Act referral decision | A copy of the decision by the Commonwealth Department of Environment, Water, Heritage and the Arts that the M2 Upgrade project is not a controlled action under the *Environmental Protection and Biodiversity Conservation Act 1999*. |

Table 2 Report structure – volume two technical papers

| Section | Content |
|---|---|
| Volume two – technical papers | |
| Technical paper 1 | Transport and traffic (Transurban) |
| Technical paper 2 | Noise and vibration (Heggies Pty Ltd) |
| Technical paper 3 | Flora and fauna (AECOM Australia Pty Ltd) |
| Technical paper 4 | Urban design, visual and landscape (HBO+EMTB and Tract) |
| Technical paper 5 | Aboriginal heritage (AECOM Australia Pty Ltd) |
| Technical paper 6 | Water management (AECOM Australia Pty Ltd) |
| Technical paper 7a | Non-Aboriginal heritage (HBO+EMTB Heritage Pty Ltd) |
| Technical paper 7b | Statement of Heritage Impact (AECOM Australia Pty Ltd) |

Other studies prepared to inform this environmental assessment include:

- Groundwater (Coffey Environment)
- Contamination (Coffey Environment)
- Socio-economic (AECOM Australia Pty Ltd)
- Air quality (operational and construction) (Heggies Pty Ltd)
- Lighting (Heggies Pty Ltd)
- Sustainability (AECOM Australia Pty Ltd)

Technical papers and other studies prepared for the environmental assessment can be located at www.rta.nsw.gov.au.

# 2. Strategic justification and project need

This chapter discusses the strategic justification and need for the project and identifies the relationship of the project to the NSW Government's infrastructure planning and development strategies. It describes the role of the project in meeting Sydney's strategic transport needs. The project objectives and the strategic context of the proposed upgrade works are outlined. This section should be read in conjunction with Chapter 3 of this environmental assessment, which provides an assessment of project alternatives.

| Director-General's Requirements | Where addressed |
|---|---|
| *Strategic justification* | |
| *the environmental assessment must outline the strategic need and justification for the project, taking into account existing and proposed transport infrastructure and services within the adjoining subregions,* | *Sections 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6* |
| *and as relevant the outcomes and objectives of the State Plan (2006), City of Cities: A Plan for Sydney's Future (2005) (the "Metropolitan Strategy") and the accompanying draft subregional strategies, and the NSW Government's Urban Transport Statement (November, 2006).* | *Sections 2.2.1, 2.2.2, 2.2.3, 2.2.4* |

## 2.1 Transport infrastructure and services

### 2.1.1 Strategic setting

At the time of construction, the M2 Motorway was a priority section of the 'Sydney Orbital Route' identified in the Department of Main Roads publication *Roads 2000* (1987), which included a strategic plan for Sydney's road needs to the year 2000. Upon opening, the M2 Motorway provided much needed accessibility and capacity for commuter, commercial, freight and road-based public transport, thereby reducing travel times and peak hour congestion. It also serviced heavy vehicle and public transport demand, in the absence of a rail line. The need and justification for the M2 Motorway enhancement relates to servicing residential and employment growth in Sydney's North West Growth Centre and the deficiencies of the existing arterial road network, which was operating at or near capacity in the early 1990s.

Major transport projects completed in the vicinity of the M2 Motorway since its opening include:

- M7 Motorway, which opened to traffic in December 2005 and links to the western end of the M2 Motorway.
- Lane Cove Tunnel, which opened to traffic in March 2007 and links to the eastern extent of the M2 Motorway.

Since the M2 Motorway opened to traffic over a decade ago, land use density has increased within the M2 Motorway catchment particularly in Sydney's north west. In addition, the completion of the Sydney Orbital Motorway network has improved accessibility for businesses along the M2 Motorway, and has led to agglomeration benefits for IT-related businesses around the Macquarie Park area. The M2 Motorway now functions primarily as a key freight route (particularly in the west) and commercial and commuter route (particularly in the east).

The M2 Motorway is an essential element of the Sydney Orbital and serves not only the north west but traffic from the south and west seeking to travel to Sydney's north, the Central Coast and the Hunter

Valley. The section between the M7 Motorway and Pennant Hills Road now functions as part of the Federal Auslink Network. In addition, bus use of the M2 Motorway has increased significantly in recent years, and continues to grow.

To this end, the need and justification for the proposed M2 Upgrade project is focused on five key strategic themes, which are as follows:

- Address existing constraints and traffic congestion – The need to address existing constraints on the Sydney Motorway Network to minimise traffic spilling over onto parallel arterial roads and to provide relief to traffic congestion in Sydney's north west.
- Support economic growth – The need to support economic growth in Sydney's north west and to support industry agglomeration at Macquarie Park through enhancing road network capacity.
- Provide for population growth – The need to provide for travel demands generated by population growth.
- Enhance accessibility – The need to enhance accessibility to growing residential and employment areas.
- Enhance public transport – The need to create opportunities to enhance public transport and support its growth.

These are discussed in the following sections.

### 2.1.2 Address existing constraints and traffic congestion

The M2 Motorway is the principal transport link connecting Sydney's north west to the lower North Shore and the Sydney Orbital Motorway network leading to North Sydney and Sydney's CBD. It is a heavily utilised transport corridor, currently used (average in June quarter 2009) by 103,000 vehicle trips per work day.

The busiest sections of the M2 Motorway are used by up to 4,200 vehicles per hour eastbound in the morning peak and 4,800 vehicles per hour westbound in the evening peak. Contra-peak flows are about 50 percent of peak directional flows.

The average travel time for the M2 Motorway eastbound in the AM peak, between Old Windsor Road and the Lane Cove Tunnel, is 38 minutes (base year of 2011), which is forecast to increase to 50 minutes by 2021 with no upgrade. Conversely, the average travel time westbound in the PM peak is 29 minutes in 2011, increasing to 36 minutes in 2021 with no upgrade (Transurban, 2010).

With the completion of the Sydney Orbital Motorway network, the M2 Motorway has become part of a major strategic network for Sydney. The opening of the M7 Motorway in December 2005 also increased traffic volumes on the M2 Motorway (Hills M2, 2008).

A temporary measure to manage predicted traffic increases associated with the opening of the Lane Cove Tunnel was implemented in March 2007 consisting of an additional westbound lane created through line marking between Lane Cove Road and Beecroft Road. This scheme is not a long term solution for the following reasons:

- The reduced lane widths and the removal of the shoulder (breakdown/bicycle lane) are inconsistent with design standards along the remainder of the M2 Motorway.
- The westbound speed limit on the M2 Motorway between Lane Cove Road and Beecroft Road has been reduced by up to 30 kilometres per hour, significantly impacting the travel time benefits of the M2 Motorway in off-peak periods.
- The reallocation of road space has required the diversion of westbound cyclists off a section of the M2 Motorway. This diversion provides a reduced standard of facility for cyclists and is not preferred by these users as a long-term solution.

The highest peak hour traffic flows on the M2 Motorway are recorded on the following sections:

- Westbound – Herring Road to Beecroft Road in the PM peak.
- Eastbound – Beecroft Road to Christie Road in the AM peak.

Volumes in these sections are highest as the M2 Motorway provides access from Epping, Baulkham Hills, Castle Hill and Pennant Hills residential areas to the specialised centres of Macquarie Park and Norwest Business Park. The following critical capacity constraints have been identified:

- Westbound – Lane Cove Road to Pennant Hills Road in the PM peak.
- Eastbound – M7 Motorway/Abbott Road to Christie Road in the AM Peak.

Currently, midblock traffic volumes (traffic travelling on the M2 Motorway between interchanges) often exceed theoretical motorway lane capacities leading to congestion and increased travel times, particularly during peak periods. This also impacts on the surrounding arterial road network due to traffic seeking alternative routes. By providing additional lane capacity, the project would alleviate this existing congestion along the M2 Motorway and provide relief for surrounding arterial routes.

Key benefits of the widened M2 Motorway include:

- Capacity enhancement at locations of constraint.
- Improved travel speeds and travel time reliability.

### 2.1.3 Support economic growth

As described in the Sydney Metropolitan Strategy, titled *City of Cities: A Plan for Sydney's Future* (December 2005) (Metropolitan Strategy), the M2 Motorway plays an important and strategic function in providing high quality access between Sydney's north west and the 'global arc', spanning from Macquarie Park, Chatswood, St Leonards, North Sydney, Sydney CBD, Sydney Airport and Port Botany.

The M2 Motorway services key employment and educational precincts, including:

- Norwest Business Park.
- Macquarie Business Park.
- Macquarie University.
- TAFE NSW Northern Sydney Institute.
- Rouse Hill Town Centre.
- Industrial areas in Blacktown, Ryde and Castle Hill.

Over the next 25 to 30 years, the Metropolitan Strategy predicts that 99,000 jobs will be created in Sydney's north west, with over 55,000 new jobs being created in the immediate vicinity of the M2 corridor. The project would provide better access to the employment hubs in Sydney's west and north west and improved accessibility to the specialised centre at Macquarie Park to the Sydney Orbital Motorway network. The M2 Motorway is supporting agglomeration of high technology industries in Norwest Business Park and Macquarie Park.

In addition, the M2 Motorway will continue to form a key section of the Federal Auslink Network, connecting the M7 Motorway to the F3 Freeway via Pennant Hills Road. Freight transport along this section of the M2 Motorway (Precincts 1 and 2) is predicted to grow in line with predicted urban growth.

### 2.1.4 Provide for population growth

The Sydney region currently has a population of 4.3 million people (2006) and is projected to grow to 6.0 million by 2036, which is an increase of 1.7 million or 40 percent over the period (DoP, 2008).

The Metropolitan Strategy states that in Sydney's north west, dwelling stock is forecast to increase by 70,000 houses from 250,000 to 320,000 (a 28 percent increase) by 2031 and post-2031 by up to 140,000 (DoP, 2005). In particular, the North West Growth Centre, located just to the west of the M2 Motorway is planned to accommodate a significant proportion of Greenfield residential development under the Strategy.

The project would facilitate access between residential and employment lands and educational and recreational facilities. In particular, the proposed new west facing ramps at Windsor Road would enhance the accessibility to the Rouse Hill Town Centre.

### 2.1.5 Enhance accessibility

The project includes the provision of west facing ramps at Windsor Road, including local widening of Windsor Road at the interchange of the M2 Motorway at Baulkham Hills to accommodate turning movements, and east facing ramps at Herring Road and Christie Road at Macquarie Park. The west facing ramps at Windsor Road would enhance accessibility to and from the M2 Motorway for residents and businesses located in North Rocks, Parramatta, Blacktown, Seven Hills, Kings Langley and Baulkham Hills. The Windsor Road ramps are supported by the Western Sydney Regional Organisation of Councils and, in particular, the Hills Shire Council. The east facing ramps at Herring Road and Christie Road would increase the accessibility of Macquarie Business Park and Macquarie University to the M2 Motorway and are supported by The City of Ryde and Macquarie University.

Key benefits of the enhanced accessibility that would be provided by these new ramp connections include:

- Reduced congestion on surrounding arterial roads.
- Reduced vehicle kilometres travelled (VKTs) on local roads.
- Increased accessibility to Sydney Orbital Motorway network and travel time saving.
- Reduced travel times.
- Support for the agglomeration of high technology businesses at focal points on the M2 Motorway.

### 2.1.6 Enhance public transport

The M2 Motorway is a major bus corridor, being one of the key bus corridors identified in the *Review of Bus Services in NSW* (2004). Approximately 600 'Hillsbus' services use the M2 Motorway each weekday (eastbound and westbound). Patronage data indicates that the M2 Motorway services carried over 17,000 passengers each workday in 2008 (Hillsbus, pers. comm., 2008).

Buses using the M2 Motorway serve Sydney's north west, with routes to Sydney CBD and North Sydney and to a lesser extent Lane Cove, Epping and Macquarie Park. Service levels and reliability of bus operations along M2 Motorway routes are dependent on traffic conditions on the M2 Motorway as well as on the surrounding sub-arterial and arterial road network. Further discussion of public transport conditions is provided in Section 9.1.

In the three years prior to 2008, M2 Motorway bus patronage grew at a rate of approximately 35 percent per annum. Further growth in services and patronage has been enabled in the past year as a result of the commencement of delivery of new buses under the NSW Government's Growth Buses program. Under this program funding for 300 new buses (113 in the North West) was committed.

The M2 Motorway already includes significant public transport infrastructure, comprising a two-lane (two-way) eight kilometre bus way in the median from Beecroft Road to Windsor Road. Bus stops are located at Gooden Reserve (Model Farms), Cropley Drive (Baulkham Hills), Barclay Road (North Rocks) and Oakes Road (Carlingford North).

Bus patronage has increased markedly in the last few years, particularly trips to/from Macquarie Park and the Sydney CBD, and is predicted to experience strong growth into the future. The project would improve bus travel times and reliability in the short term and into the future, because of the increased capacity on the M2 Motorway provided by the project. The direct advantage of the project in relation to bus operations is the provision of an eastbound T2 transit lane between Terrys Creek and Lane Cove Road. Subject to the enforcement of the T2 lane, buses would experience faster travel times and consequently improved reliability.

In addition to improved travel times, the project provides an opportunity to increase the public transport accessibility of the Macquarie Business Park and University precinct by providing new access points at Christie and Herring Roads that could be utilised to achieve more efficient access to the Macquarie Centre Bus Interchange. The provision of these new access points also provides the opportunity for new bus routes to be developed. The NSW Department of Transport and Infrastructure is considering the upgrade of the Macquarie Centre Bus Interchange at Herring Road which would further enhance the bus facilities in the M2 corridor.

## 2.2 NSW Government plans and strategies

The NSW Government has released a number of plans and strategies in recent years to guide the growth and development of Sydney, which is forecast to continue to experience significant population, economic and travel growth. The concept for the project has been developed within the context of these strategic plans and seeks to respond to the existing and emerging demands of this dynamic part of Sydney. The following sections discuss the relationship between the project and the relevant outcomes and objectives of key NSW Government planning documents.

### 2.2.1 State Plan

The project would contribute to the following Priorities in the State Plan, titled *A New Direction for Sydney* (November 2006a):

- *Priority P2 – Maintain and invest in infrastructure*: With the opening of the M7 Motorway in December 2005, the western section of the M2 Motorway between the M7 Motorway and Pennant Hills Road became part of the Federal AusLink Network. As a result, traffic on the M2 Motorway, particularly heavy vehicles, has increased substantially. The M2 Motorway needs to be enhanced to serve the growth in commuter and freight traffic. The project would contribute to the maintenance of, and investment in, infrastructure required for growth across NSW.
- *Priority P5 – AAA rating maintained*: Funding of the project by the private sector (refer to Section 1.4 for description of project funding) would assist in maintaining the State's AAA credit rating, which provides confidence to investors and underpins business confidence by maintaining the operating budget in surplus through the budget cycle.
- *Priority E3 – Cleaner air and progress on greenhouse gas reductions*: The project would improve traffic flow on the M2 Motorway and reduce traffic on some existing alternative routes to the M2 Motorway. Reducing traffic congestion on the M2 Motorway and surrounding road network would potentially result in reduced vehicle emissions and a net reduction in greenhouse gas emissions. Improving public transport facilities through faster travel times, improved access points and more potential route options may also generate greenhouse gas emission savings by encouraging the use of public transport.
- *Priority E5 – Jobs closer to home*: The project would improve access within Sydney's north west where 140,000 new dwellings and 99,000 new jobs are planned over the next 25 to 30 years. The new access points would provide more and better route options in the M2 corridor and adjacent areas. This would reduce travel distances and times between home and work. Improved access to the M2 Motorway would encourage further development around the M2 corridor.
- *Priority E7 – Improve the efficiency of the road network*: The project would improve traffic flow on the M2 Motorway and reduce traffic on some existing alternative routes to the M2 Motorway. This would increase peak period travel speeds along the M2 Motorway.
- *Priority S7 – Safer Roads*: An enhanced and widened M2 Motorway with increased capacity would result in safer trips on the M2 Motorway and the surrounding network, including improved safety for pedestrians, cyclists and local traffic.

An updated State Plan was released in October 2009, which had very similar priorities. The M2 Upgrade project would contribute to these priorities.

### 2.2.2 Metropolitan Strategy

The project is consistent with the Metropolitan Strategy. The supporting information to the Metropolitan Strategy identifies the possible widening of the M2 Motorway to serve residential and employment growth in Sydney's north west. The project is consistent with this objective. In particular, the project would support the Metropolitan Strategy with respect to the following considerations:

- Improving access within and to employment lands in Sydney's north west where 99,000 new jobs are planned by 2031 including:
- Identified Specialised Centres such as Macquarie Park, with projected job growth to reach 55,000 (a 70 percent increase) and Norwest Business Park, with a projected job growth to reach 15,000.
- Castle Hill, identified as a Major Centre with projected job growth to reach 12,000.
- Rouse Hill, identified as a Planned Major Centre with projected job growth to reach 9,000.
- Other key industrial and business localities including Blacktown and the University of Western Sydney.
- Improving access within and to residences in Sydney's north west where dwelling stock is predicted to increase by 70,000 houses from 250,000 to 320,000 (a 28 percent increase) by 2031 and by up to 140,000 into the future.
- The M2 Motorway is identified as a key bus route with strong patronage growth forecast which would be facilitated by the project through improved bus travel times and more efficient access to Macquarie Park businesses and rail facilities.
- The east facing ramps at Christie Road and Herring Road would improve the accessibility of the specialised centre at Macquarie Park to the Sydney Orbital Motorway network. In particular, traffic from the east would be able to access the area directly from the Sydney Orbital.
- The west facing ramps at Windsor Road would improve the accessibility of the Norwest Business Park, the planned growth centre at Rouse Hill and Blacktown to the Sydney Orbital.
- Reducing traffic, including heavy vehicles, on some existing alternative routes to the M2 Motorway, such as Epping Road, Carlingford Road, North Rocks Road, Norwest Boulevard, Seven Hills Road and Churchill Drive/Caroline Chisholm Drive. This would provide enhanced opportunities for public transport, cycling and pedestrians on these roads.

### 2.2.3 Metropolitan Subregional Strategies

The M2 Motorway traverses local government areas (LGAs, as underlined) within four metropolitan Sydney subregions, as defined by the Metropolitan Strategy, which are:

- Inner North Subregion (Lane Cove, North Sydney, <u>Ryde</u>, Willoughby, Hunters Hill, Mosman LGAs).
- North Subregion (<u>Hornsby</u>, Ku-ring-gai LGAs).
- West Central Subregion (Auburn, Bankstown, Fairfield, Holroyd, <u>Parramatta</u> LGAs).
- North West Subregion (<u>Baulkham Hills</u>, Blacktown, Blue Mountains, Hawkesbury, Penrith LGAs).

Subregional strategies have been adopted for each of the four relevant subregions to translate objectives of the Metropolitan Strategy's long-term planning blueprint to the local level.

Overall, the project would contribute to the following key actions, which are consistent across the four relevant subregional strategies:

- *D1.1 – Extension of rail and bus networks to connect centres*: The project would contribute to bus capacity, particularly during morning peak, through an eastbound T2 lane (Terrys Creek to Lane Cove Road) and greater capacity for bus access to Macquarie Park (a 'Specialised Centre'). The project would also provide improved connections to Macquarie Park.
- *D1.2 – Extension of transport networks to serve growth*: The project would serve growth in the area through providing additional capacity on the M2 Motorway delivering improvements in travel time.
- *D1.3 – Connect regions and economic gateways within the greater metropolitan region*: The project would provide the greater metropolitan region with more capacity to access key economic centres in the area including Norwest Business Park, Macquarie Park and Macquarie University.
- *D2.1 – Complete major transport infrastructure projects*: The completion of the upgrade of the M2 Motorway would provide critical transport infrastructure for the area.
- *D2.3 – Improve integration of public transport:* The project would improve the integration of public transport through allowing more efficient use of bus fleets, faster transit times and the provision of new access points that would enable the future development of new bus route options.
- *D3.1 – Improve local and regional walking and cycling networks*: The project would improve local and regional cycling networks through reinstatement of cyclist access to the breakdown lane for the entire length of the M2 Motorway.

For further discussion regarding the transport outcomes, refer to Technical Paper 1 and Section 9.1 and 9.2 of this environmental assessment. The following subsections describe the existing and proposed transport infrastructure and services within the adjoining subregions, as relevant to the objectives of the subregional strategies. Four subregional strategies cover the M2 corridor and the surrounding localities.

### Inner North Subregional Strategy

As described in the *Inner North Subregional Strategy* (DoP, 2007a) the Inner North Subregion is a key component in Sydney's Global Economic corridor, forming the northern section of the M2 corridor from North Sydney to Macquarie Park. The Strategy recognises that the Inner North has a well established transport network, but some key links, such as the M2 Motorway, are operating beyond their technical capacity. Several projects including mainly rail and road infrastructure, are currently in progress or proposed that, in addition to the upgrade of the M2 Motorway, would further improve the transport network of the Inner North Subregion.

As described in the Inner North Subregional Strategy, Macquarie Park is currently predominantly accessed via cars, due to limited public transport alternatives and the quantity of off street parking provided. However, the Epping-Chatswood Rail Link provides direct rail access to Macquarie Park and the University. The upgrade of the M2 Motorway would also facilitate efficient and reliable bus access to this key centre through works including a T2 lane and widening of the Christie Road Bridge and Talavera Road.

Several roads in the Inner North Subregion are operating at or close to capacity, especially during peak periods. These roads include Epping Road, Lane Cove Road, the Pacific Highway, Victoria Road and sections of the M2 Motorway and the intersections that connect them. The upgrade of the M2 Motorway would relieve congestion and improve access in this region, thereby assisting in meeting the objectives of the *Inner North Subregional Strategy* (DoP, 2007a).

### North Subregional Strategy

As described in the *North Subregional Strategy* (DoP, 2007a) the North Subregion acts as a gateway to the Central Coast and historically population growth has been associated with the two rail lines servicing the subregion. The North Subregion has good accessibility to the rest of Sydney's metropolitan areas by road and rail. The subregion contains environmentally sensitive landforms, including 175 square kilometres of National Park (Ku-ring-gai Chase National Park).

Settlement in this subregion has occurred along the ridges, following the two rail lines and the two major arterial roads, the Pacific Highway and Pennant Hills Road. Rail is the main form of public transport at present. None of the existing bus services operate along major bus corridors. The existing bus services in the north subregion are generally operating below capacity. As this subregion grows, trip making is becoming more complex, especially as the focus on Macquarie Park grows. Bus services in the north subregion will be improved through the implementation of four strategic bus corridors, linking Hornsby to its surrounding Strategic Centres, including Castle Hill, Parramatta, Chatswood and Macquarie Park. The upgrade of the M2 Motorway and resultant improvements to traffic conditions would provide for improved bus operations in these corridors and would assist in the delivery of the objectives of the *North Subregional Strategy* (DoP, 2007a).

### West Central Subregional Strategy

As described in the *West Central Subregional Strategy* (DoP, 2007d) the West Central Subregion is a key economic driver of the Greater Metropolitan Region. Parramatta, identified as one of Sydney Region's key centres, is considered to be Sydney's second CBD. There has been a consistent focus from Government on development within this centre and this has led to the delivery of infrastructure and service improvements to facilitate sustainable growth of Parramatta Regional City.

Although the West Central Subregion is relatively well resourced with public transport infrastructure, traffic volumes can be heavy even outside peak periods. Improvements to the public transport system identified by the *West Central Subregional Strategy* will encourage an increase in patronage and will in turn relieve road congestion. These improvements include the provision of strategic bus corridors that would improve access to Parramatta from Hornsby, Chatswood, Ryde and Macquarie Park. A key outcome of the project would be improved travel times for buses and access points that enable new bus route options to be developed in the future.

### North West Subregional Strategy

As described in the *North West Subregional Strategy* (DoP, 2007c) the North West is the largest and fastest growing of Sydney's subregions. The North West subregion plays an important role in Sydney's economy. The north west growth centre is located within the subregion and would be the focus for new land release over the next 25 years. Recent employment growth in this subregion has been above average, and this trend is expected to continue with further employment growth planned in the Western Sydney Employment Hub and Norwest Business Park. Agglomeration benefits to businesses in the areas will be strengthened through the upgrading of the M2 Motorway.

Through increased development in the north west, there has been increased pressure on the M4 and M2 Motorways and a number of arterial roads during peak periods. A strategic initiative is to maximise use of existing road infrastructure through the promotion of self containment of employment within the subregion to decrease pressure on the transport network. The *North West Subregional Strategy* states that the upgrade of the M2 Motorway would alleviate the pressures associated with the increased development in the north west by providing a more efficient and reliable transport corridor (DoP, 2007c).

### 2.2.4 Urban Transport Statement

The NSW Government's *Urban Transport Statement* (November 2006b) identifies the efficient movement of people and goods in and around Sydney as a key transport objective. This Statement confirms the strategic importance of the Sydney Orbital Motorway network and identifies the M2 Motorway as a key part of the Macquarie Park to Port Botany Economic corridor, or Global Arc, with a total daily travel volume of 8.25 million passenger kilometres. The Statement also identifies a number of possible motorway connections to this network, including the connection of the M2 Motorway to the F3 Freeway. The project, which includes road widening, would relieve current congestion through the Global Arc, thereby facilitating more efficient movement of people and goods and would be consistent with potential future development of a motorway to the F3 Freeway connection.

### 2.2.5 Strategic Bus Corridor Strategy

The NSW Government has identified 43 strategic bus corridors across the Sydney metropolitan area following the Unsworth report of 2004. Bus priority measures, such as bus lanes and bus priority signals, are being implemented along these corridors to protect bus services from traffic congestion and achieve average peak period bus speeds of 20-25 kilometres per hour. Strategic bus corridors within the M2 Motorway corridor include Castle Hill – City via Macquarie, Macquarie – City, Macquarie – Burwood, Parramatta – City via Macquarie. The strategic bus corridors are shown in Figure 16.

On 1st March 2010, the NSW Government announced that 2,000 state government buses had been fitted with a special global positioning priority system linking them to traffic lights to help late buses make up lost time. This Public Transport Information and Priority System (PTIPS) is part of a $295 million package of bus priority measures to support the operation of strategic bus corridors across the Sydney road network. Bus priority is part of the *Strategic Bus Corridor Strategy* and its overall $50.2 billion *Metropolitan Transport Plan*.

The *Metropolitan Transport Plan* has allocated $2.9 billion for extra buses for strategic corridors and local routes and bus depots, including an additional 1,000 buses for these strategic corridors and local routes in Sydney, Wollongong, Newcastle and the Central Coast. The *Metropolitan Transport Plan* reports that 31 of these corridors have already been fully or partially delivered.

### 2.2.6 State Infrastructure Strategy

The *State Infrastructure Strategy* (NSW Treasury) is a rolling 10-year plan that guides the State's expenditure on capital assets and describes the infrastructure to be provided in Sydney over the next ten years. The Strategy describes how to manage public investment growth in line with funding sources. It is updated every two years and was last updated in 2008.

As the M2 Motorway is a privately operated motorway and as the enhancements would be privately funded, the project is not currently included in the State Infrastructure Strategy. With continuing growth in the north west subregion, it is appropriate to enhance the existing network serving that area where benefits and value for money can be demonstrated. The M2 Motorway operator and the NSW Government signed an In Principle agreement for the M2 Upgrade project since the last revision of the Strategy. Hence it would be possible to include the proposed upgrade in the Strategy at the next revision.

### 2.2.7 Metropolitan Transport Plan

On 21 February 2010, the Premier of NSW released the *Metropolitan Transport Plan*, which was prepared by the newly created transport authority – NSW Transport and Infrastructure. The *Metropolitan Transport Plan* outlines a 25 year vision for land use planning in Sydney together with a ten year fully funded package of transport infrastructure to support it. The vision of the *Metropolitan Transport Plan* is: for commuting to work to be easy and quick; for transport and services to be accessible to all members of our community; for an efficient, integrated and customer focused public transport system; and for revitalised neighbourhoods with improved transport hubs. Six main objectives are outlined to achieve this vision. These are to:

- Manage population and employment growth.
- Reduce congestion on our roads.
- Increase capacity on public transport.
- Improve pedestrian and cycle links.
- Improve the customer experience.
- Improve governance structures.

The largest increase in dwellings and jobs in the next 10 years for the Sydney region is expected to be in the north west subregion. The project would support the objective of managing population and employment growth through increasing the capacity of the M2 Motorway which services this area. In addition, the increase in capacity of the M2 Motorway would support the objective of reducing congestion on our roads, both on the M2 Motorway and on the surrounding local road network. Further, public transport improvements would be achieved through the introduction of an eastbound T2 transit lane and the upgrade of the Windsor Road and Christie and Herring Road interchanges. These upgrade works would provide new access points for buses to the M2 Motorway and create the potential for new bus route options to be developed in the future. Cycle links would also be improved through the reinstatement of cyclist access to the breakdown lane for the entire length of the M2 Motorway.

To meet travel demand generated by planned growth in the north west, the Metropolitan Transport Plan specifically commits to the delivery of an extra lane each way on the M2 Motorway within the next ten years, and identifies the M2 Motorway as a strategic bus corridor. The project would deliver the additional eastbound and westbound lane in the sector of the M2 Motorway proposed to be upgraded, and, through the introduction of a transit lane and interchange upgrades the project would facilitate improved bus services in the M2 corridor.

### 2.2.8 Action for Air

*Action for Air* was prepared by DECCW and adopted in 1998 (updated 2009) as the State Government's 25 year plan for managing air quality in Sydney, the Illawarra and the Lower Hunter. The objectives of *Action for Air* include reducing vehicle emissions, making businesses cleaner, making homes and local environments cleaner, healthier and more liveable, reducing particle pollution in regional NSW and improved communication and air quality education.

Reducing motor vehicle emissions is a substantial focus of the report as these are the dominant source of ozone forming pollutants in Sydney (DECCW, 2009d). Emission reduction strategies under *Action for Air* include the use of cleaner fuels, vehicles and fleets, reduced vehicle use through land use changes and sustainable transport initiatives including public and active transport.

The project would support the *Action for Air* through greater efficiency of traffic movement in the corridor. Reduced congestion following the upgrade of the M2 Motorway would provide driving conditions that result in lower vehicle emissions for each kilometre of travel.

The project would improve access to new commercial centres such as Norwest Business Park and Macquarie Business Park through new on and off ramps at Windsor Road, Christie Road and Herring Road. This improved motorway access would encourage the further development of these commercial precincts, reduce congestion on local roads and provide employment opportunities for the expanding residential areas in Sydney's north west. The location of jobs closer to residential areas would reduce the need to travel and the distance travelled.

## 2.3 Identification of project objectives

The M2 Motorway provides accessibility and capacity for commuter, commercial, freight and road-based public transport. The project is significant to the State and region as it would improve traffic flow and reduce bus travel times. The following objectives establish intent and provide justification for the project.

- Support the NSW Government's State Plan, Metropolitan Strategy, Urban Transport Statement, State Infrastructure Strategy, Action for Air and Metropolitan Transport Plan.
- Support for strategy objectives and targets of relevant plans.
- Aligns with other planned transport projects.
- Enhance the strategic road network in Sydney's north west to support economic growth.
- Accessibility between key traffic generators.
- Heavy and commercial vehicle growth.
- To improve access to and accessibility between key residential, employment and educational precincts in Sydney's north west.
- Accessibility between residential, employment and educational precincts.
- Improved reliability and safety for local and regional traffic.
- Improve travel times by reducing congestion during peak periods for the benefit of local and regional traffic.
- Enhanced capacity of the corridor.
- Travel time savings.
- Reliability of travel times.
- Improve safety and amenity for road users and surrounding communities.
- Reduced crash rates.
- Improved safety management measures.
- Relieve traffic pressure on surrounding local traffic routes.
- Provide opportunities to improve road based public transport.
- Improved bus travel times and reliability.
- Improved public transport accessibility in the North West corridor.
- Provide opportunities for additional public transport facilities.
- Provide value for money to the community.
- Viable cost benefit analysis.
- Consideration of wider economic benefits.
- Minimise environmental and social impacts during construction and operation.

- Avoid, minimise and manage adverse environmental and social impacts.
- Maximise environmental and social benefits.

## 2.4 Transport infrastructure and services

The M2 Upgrade project is essential to the State of NSW as it provides essential improvements to a key link in the Sydney Orbital Motorway network and integrated efficient public transport (bus) facilities, which would support the significant growth planned in Sydney's north west and the 'global arc'. The project is consistent with the goals and objectives described in key NSW Government strategy documents, including the State Plan, Metropolitan Strategy and Metropolitan Transport Plan. The project would provide:

- Improved accessibility for cars, freight vehicles, public transport and bicycles.
- Improved capacity and efficiency of existing commuter, commercial, freight and road-based public transport infrastructure.
- Improved traffic flow and reduced peak hour travel times.
- Improved public transport which is a more attractive and reliable option for passengers.
- Reduced congestion on the M2 Motorway and the surrounding local road network.
- Provision of traffic conditions that result in lower vehicle emissions for each kilometre travelled.
- Sufficient capacity to service planned residential and commercial growth in the north west.

# 3. Project alternatives

This section outlines the project development process, examines the possible alternatives to the project and explains the design decisions that have led to the formulation of the preferred project that is the subject of this environmental assessment.

| Director-General's Requirements | Where addressed |
|---|---|
| *Project justification* | |
| *This justification must include an assessment of alternatives considered* | *Chapter 3* |
| *demonstrate that the project will enhance the use of public transport* | *Sections 3.1, 9.1* |
| *demonstrate that the project will not unduly induce traffic and exacerbate congestion in the medium to longer term within the adjoining subregions* | *Sections 3.1, 9.1* |
| *The assessment must specifically address how the proposed park and ride facility will enhance public transport patronage, including a cost benefit analysis* | *Section 3.1.3* |

## 3.1 Alternatives to the project

As demonstrated in Chapter 2 of this report, there is a need to address existing constraints and traffic congestion on the M2 Motorway, as it currently operates as the second most trafficked corridor in Sydney. In its current form, the M2 Upgrade project provides an opportunity to better utilise an existing asset, by adding to it to increase its capacity.

A range of alternatives to the M2 Upgrade project were identified and considered as part of the development of the project, including the following:

- Alternative one – Do nothing.
- Alternative two – Other road based improvement options, including:
  - Line marking to add additional lanes within the existing carriageway.
  - Upgrade of the local sub-arterial and arterial road network.
- Alternative three – Provision of public transport – increase provision for public transport within the M2 Motorway catchment.
  - Rail based alternatives, including light rail and heavy rail.
  - Enhancement of existing road based public transport (bus lane and park and ride facility).
- Alternative four – Demand management, including differential tolling and amended toll structures.

These alternatives to the project were evaluated to identify the preferred strategic option and are discussed below.

It is noted that the preferred strategic option was then further refined through an evaluation of project options, which included the need for and location of additional ramps, bridges and sections of the M2 Motorway requiring widening works. Section 3.2 discusses the project options that were considered.

### 3.1.1 The base case or ‘do nothing’ alternative

This section considers the transport outcomes should the M2 Motorway remain in its current state into the future. The base case alternative involves retaining the existing M2 Motorway as a four lane dual carriageway motorway, with bus lanes in certain sections. This assumes that the interim widening that is currently in place between Lane Cove Road and Beecroft Road would remain, but that no other upgrade to the M2 Motorway would be undertaken.

- The ‘do nothing’ alternative would result in the following outcomes:
- Existing congestion on the M2 Motorway demonstrates that demand exceeds the current capacity in certain sections. With significant new commercial and residential development planned in the north west of Sydney and proximate to the M2 Motorway, traffic volumes would increase and the level of service provided by the M2 Motorway would continue to decline as demand increases into the future (refer to Technical Paper 1 for further description).
- As the travel time savings provided by using the M2 Motorway are diminished, due to increased congestion, there would be a greater propensity for traffic to use alternative routes. M2 Motorway access roads and intersection performance within the M2 corridor would continue to deteriorate.
- The interim widening that is currently in place between Lane Cove Road and Beecroft Road has resulted in reduced lane widths, removal of the breakdown lane and reduction of the speed limit. This is not consistent with the design standards in place along the remainder of the M2 Motorway and results in a reduced level of service for users.
- The interim widening that is currently in place between Lane Cove Road and Beecroft Road necessitates the diversion of westbound cyclists from a section of the M2 Motorway. This diversion provides a reduced standard of facility for cyclists and is not preferred as a long-term solution.

The ‘do nothing’ option would not satisfy the project objectives described in Section 2.3 of this report and, combined with the issues identified above, is not an acceptable solution.

### 3.1.2 Road based improvement

#### Line Marking

The ‘line marking’ alternative is a very low cost alternative comprising the provision of an additional (third) lane along sections of the M2 Motorway through reallocation of existing road space and modification to existing lanes (no M2 Motorway widening). For consistency with RTA Road Design Guide standards for motorways, this would involve narrowing of traffic lanes, loss of breakdown lanes and reduction of the speed limit to 80/70 kilometres per hour (a reduction of 20 to 30 kilometres per hour).

This alternative provides a similar outcome to the M2 Upgrade project in terms of the number of lanes available. However, the outcome would have shortcomings similar to that of the interim widening (line marking) already established between Lane Cove Road and Beecroft Road. These shortcomings are described below:

- The removal of the breakdown lane along the majority of the M2 Motorway would create significant limitations for responding to and managing incidents.
- As a result of reduced speed limits, travel time benefits of the M2 Motorway would be significantly reduced and the potential of the M2 Motorway to provide relief to surrounding local traffic routes would be reduced.
- Reduced speed limits are perceived as poor value for money due to reduced travel time savings by M2 Motorway users, particularly during off-peak periods when traffic flow is less likely to be compromised by congestion.
- The reallocation of road space would require the diversion of cyclists off the majority of the M2 Motorway. This diversion would result in cyclists not having access to the M2 Motorway, incurring a reduced standard of facility which is not a preferred outcome for these users.

The line marking option would not satisfy the objectives described in Section 2.3 of this report and, combined with the reasons outlined above, is not an acceptable solution.

### Local sub-arterial and arterial road upgrade

The 'upgrading the local sub-arterial and arterial road network' alternative would involve the provision of additional road capacity in the M2 Motorway catchment area, by widening existing sub-arterial and arterial roads and removing bottlenecks by introducing potential grade separations and the provision of new links with improvements to existing intersections.

Alternatives for local road widening (including upgrades to appropriate intersections) would generally follow the existing alignment of the M2 Motorway where possible. Two alternatives for upgrading the local road networks were considered. These alternatives are described below and shown in Figure 3.

- Option one, involves the widening of:
  - Renown Road – Windsor Road to Barclay Road (north of the M2 Motorway, Baulkham Hills).
  - North Rocks Road, Plympton Road, Ray Road, Carlingford Road to link with Beecroft Road (south of the M2 Motorway, Epping).
  - Epping Road – Beecroft Road to Delhi Road (south of the M2 Motorway to cross the corridor at Delhi Road, Land Cove).
- Option two involves widening of:
  - Old Windsor Road – Abbott Road to the Cumberland Highway (Hart Drive) (south of the M2 Motorway, Northmead).
  - Pennant Hills Road (Cumberland Highway) – Old Windsor Road to Carlingford Road (South of the M2 Motorway, Beecroft).
  - Epping Road – Carlingford Road to Delhi Road (Macquarie Park).

With the exception of Epping Road, the other roads in Option one are sub-arterial roads under the care and control of the local council. All the roads in Option two are arterial (State) roads under the care and control of the RTA. Some sections of the sub-arterial roads are too narrow to be marked as four lane roads with a central median. Hence, property would need to be acquired along these roads to enable them to be upgraded to the minimum standard required for a reasonable alternative route to the M2 Motorway.

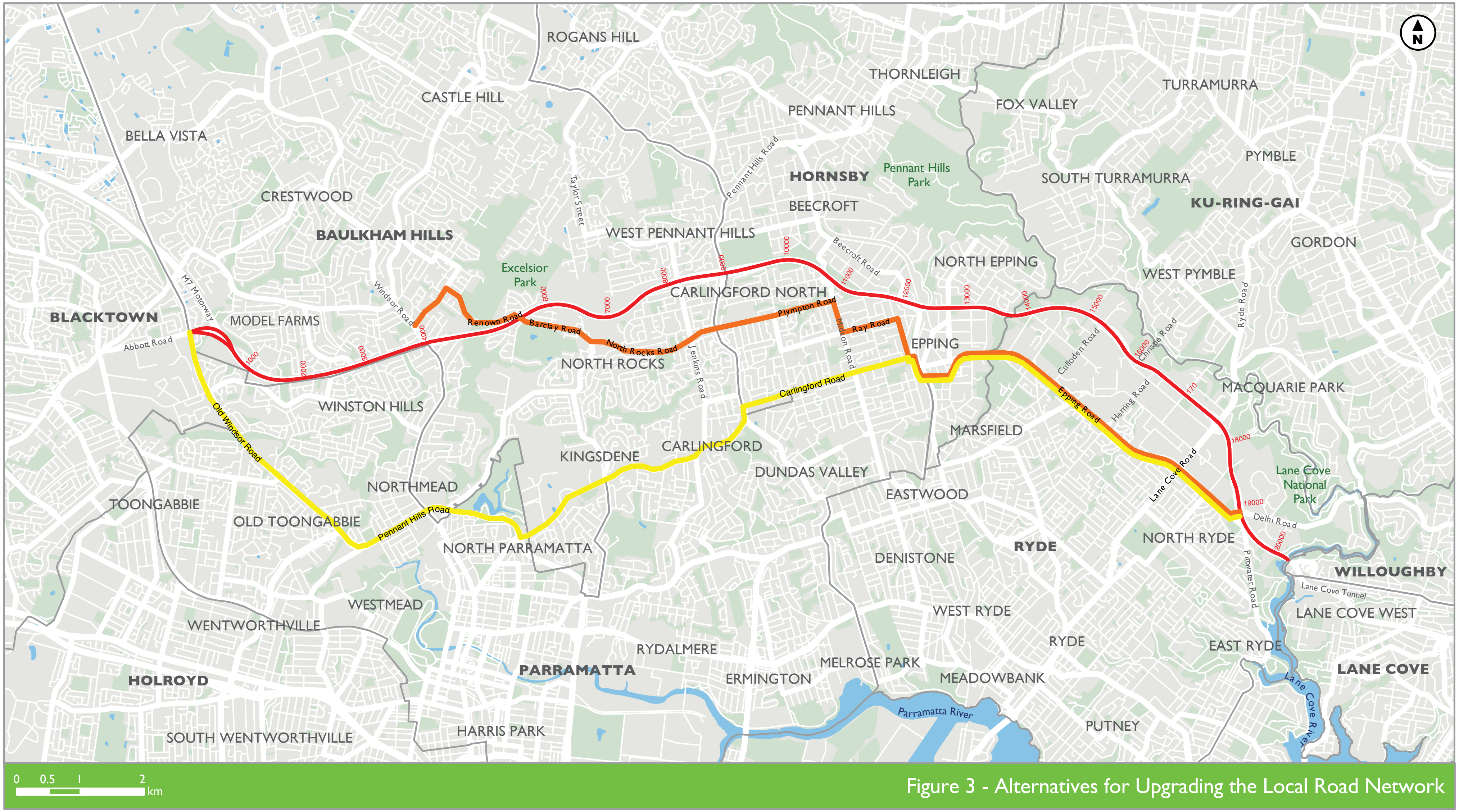



Figure 3 - Alternatives for Upgrading the Local Road Network

- M2 Motorway
- Option 1
- Option 2
- River/Waterway
- Park/Open space
- 8000 Chainage (metres)
- LGA boundary

Source: MapData, 2010

The two local road widening alternatives provide the most direct routes via the local sub-arterial and arterial road network from Windsor Road through to Delhi Road. Notwithstanding, the feasibility of upgrading the local road network is challenged by the potential impacts such an upgrade would have on surrounding land use, environmental features and property.

The key features of both routes are described as:

- The western section of both alternatives (west of Pennant Hills Road) is largely characterised by residential land use, with some sections containing mature native vegetation. Development of North Rocks Road and Carlingford Road would be heavily constrained due to residential development, schools and commercial land uses which are located along and adjacent to the dual carriageways.
- The eastern section of both alternatives (between Pennant Hills Road and Delhi Road) is characterised by residential and commercial (local business) land uses. Development of the southern side of Epping Road would be largely constrained by residential development and a densely vegetated area surrounding Terrys Creek. Land use north of Epping Road is characterised by residential development between Pennant Hills Road and Terrys Creek. East of Terrys Creek, educational and commercial land uses dominate the area and development of the local road network would be highly constrained by Macquarie University and Macquarie Business Park.

Upgrading the local sub-arterial and arterial road network would have the following impacts:

- The footprint of Carlingford, Beecroft and Epping Roads would increase, potentially impacting on the surrounding landscape and visual amenity.
- Residences, businesses and other commercial land uses located adjacent to the affected roads would potentially suffer local impacts such as property acquisition, construction impacts, amenity (noise) impacts and socio-economic impacts.
- Increased road width and traffic volumes would potentially exacerbate community severance and reduce amenity.

Widening of local roads is constrained by the proximity of surrounding land use and associated difficulties in obtaining land and/or minimising impacts on surrounding properties. Implementation of the alternative to ‘upgrade the local road network’ would consequently present limited opportunity to enhance the current public transport system due to carriageway constraints. The option of widening the M2 Motorway as opposed to the local arterial road network is a more feasible option as the M2 corridor exists, surrounding land uses are located outside the corridor, and the level of disturbance is considered to be less.

Further, the widening of local roads is likely to be more costly than upgrading the M2 Motorway, resulting in comparatively low value for money.

### 3.1.3 Provision of public transport

The ‘increasing the provision of public transport within the M2 Motorway catchment’ alternative has been considered for the purpose of achieving the objectives of the project as stated in Section 2.3. Two sets of alternatives under public transport provision schemes have been considered: rail based and road based.

#### Rail based public transport

The main public transport destinations for users within the M2 Motorway catchment are Macquarie Park and the CBD. In 2009, a rail line between Epping and Chatswood was completed with new train stations introduced at Macquarie University, Macquarie Park and North Ryde. This project involved major upgrades to Chatswood and Epping junction stations, and the rail line has increased the accessibility of Macquarie Park and the CBD to commuters from Sydney’s north west. However, the provision of the new line has not resolved congestion in the M2 corridor. These rail improvements were taken into consideration during assessment of the 'do nothing' option.

Even with a rail link to Sydney's north west, the M2 Motorway would still be subject to growth in traffic volumes over time with many trip origins and destinations of M2 Motorway users not effectively served by the selected route. In addition there are several trip purposes not suited to rail travel (for example, occupations that require transport of goods, or travel between several locations throughout the workday). These factors, combined with the existing levels of congestion, demonstrate the need for the project to proceed regardless of whether a heavy rail link is provided.

As part of the recently released *Metropolitan Transport Plan, t*he NSW government has committed to the construction of the North West Rail Link, with construction due to commence in 2017 for completion in 2024. The M2 Upgrade project would not preclude construction of the North West Rail Link or other such enhancements to public transport networks. The 14 year timeframe for commissioning of the North West Rail Link means that it would not be operational in time to avoid congestion on the M2 Motorway reaching an unacceptable level. The project, which has a two year construction program, remains the most effective means of reducing congestion on the M2 Motorway and enhancing transport networks that service Sydney's north west.

Another rail based public transport option is the introduction of light rail along the M2 Motorway. This option, however, is not a feasible option to consider unless it is introduced along the full length from the north west to the Harbour Bridge and the CBD. Introduction of limited light rail to the M2 corridor would not be an effective or feasible solution as it would have no direct links at either end of the corridor. At the time of preparing this assessment, there are no plans in place to introduce a light rail network connecting the end of the M2 corridor.

### Road based public transport

#### Dedicated Bus Lane

This alternative would involve establishing a dedicated bus lane along the M2 Motorway, comprising either a dedicated bus lane or a separated rapid transit route, to link with the Lane Cove Tunnel and Epping Road at Lane Cove West and the CBD. This option would necessitate continuation of the existing bus lanes and would likely involve widening for the sections of the M2 Motorway that currently do not provide a bus lane.

A bus lane along the M2 Motorway is not the preferred option for alleviating congestion, for the following reasons:

- A typical AM peak bus trip from Sydney's north west, such as from Castle Hill, to the Sydney CBD via the M2 Motorway takes over an hour. The travel time improvements expected from a bus lane for the full length of the M2 Motorway is estimated to be around five minutes (less than 10 percent). Based on observed increases in public transport patronage due to changes in travel time (*Australasian travel demand elasticities - an update of the evidence* - Wallis I, 2003), a bus only lane would be expected to reduce the number of cars on the M2 Motorway by less than 100 vehicles per hour in the AM peak. This would have negligible benefits in terms of relieving congestion and improving the level of service for cars and trucks.
- Buses would not generate sufficient patronage to alleviate peak hour congestion on the existing M2 Motorway as there would be little travel time improvement from the 'do nothing' case for buses. Consequently, the mode shift from car to bus would not be significant enough to reduce congestion on the M2 Motorway.

- Cost effectiveness – this solution would not generate sufficient benefits to road users to justify the level of expenditure required and the potential environmental impacts generated by widening sections for the bus lane extensions.

A rapid bus transit system alternative is similar to the full length bus lane alternative with the difference being that buses would operate in a dedicated right of way (separated). There would be minimal travel time advantages over a dedicated bus lane as buses would be limited to the same speed. Accordingly, a rapid bus transit system is not preferred for the same reasons as described for the bus lane above.

A rapid bus transit system along the M2 Motorway would necessitate additional widening and civil works, beyond that of a dedicated bus lane, to establish physical barriers and entry / exit interchanges for buses using the transit system. This alternative would potentially generate additional environmental impacts as a result of additional widening. Hence, the costs of implementing this alternative would be higher than a full length bus lane but again would provide insufficient improvements in travel times to encourage enough mode shift to buses to improve traffic conditions for cars and trucks.

### Park and ride

A park and ride and bus interchange facility was proposed during early project development stages and formed part of the project as declared by the Minister for Planning. The park and ride facility would have comprised a car park potentially able to accommodate up to 2500 vehicles and a bus interchange adjacent to the proposed east facing Herring Road ramps.

At that time, preliminary analyses indicated potential demand for commuters to utilise the parking facility and access the bus interchange to continue their journey to North Sydney or Sydney's CBD via bus or rail services (noting that the facility would also have been in proximity to the Macquarie University Rail Station). However, following more detailed analysis, this project element is no longer proposed.

It is noted that as the park and ride is no longer part of the project, a cost benefit analysis, which was identified in the Director-General's Requirements (DGRs), is not provided. Instead, the rationale for not proceeding with the park and ride and bus interchange facility, including consideration of costs and benefits and public transport patronage, is described below.

The objectives of the park and ride and bus interchange facility were to:

- Increase public transport opportunities between the north west and Macquarie Park by providing set down and pick up opportunities for buses.
- Provide an alternative for motorists from the north west with a destination of North Sydney or the Sydney CBD to use public transport (bus or rail) for the last leg of their journey between Macquarie Park and the CBD.
- Provide parking for the Macquarie Park area with access arrangements that would minimise local traffic impacts.
- Provide a funding source for the project that would offset (reduce) the toll price.

Analysis of the park and ride demand indicated that a substantial proportion of the demand would be generated by commuters travelling to Macquarie Park rather than park and ride users travelling to the CBD. The initial usage estimates by user group for the facility include:

- Park and Ride (bus) to CBD – 200 users per day.
- Macquarie Shopping Centre – potential usage by Macquarie Centre, which recently imposed limits on parking availability for staff. Estimated 250 users per day.
- Macquarie Park commercial – estimated 263 users per day (including new commercial developments).
- Very low patronage was anticipated for park and ride use by rail commuters due to the distance from the site to the rail station and inconvenience of interchanging to a shuttle bus as would be required.

Although objectives one and two would be met by a park and ride facility, the demand for parking by users with a final destination of Macquarie Park would exceed use by patrons connecting to public transport services to North Sydney and the CBD. The analysis anticipated very low patronage for park and ride use by rail commuters due to the distance from the site to the rail station and inconvenience of interchanging to a shuttle bus as would be required. It is also noted that the layout and utility of the park and ride would have been constrained by project elements identified during further development of the concept design for the new Herring Road and Christie Road ramps (refer Section 6.3.2 of this report for discussion regarding the Christie Road / Herring Road interchange).

The outcomes of the demand analysis indicated forecasts for the facility would not be adequate to subsidise (reduce) the M2 Motorway toll (objective four), the analysis did indicate the facility would be commercially viable in its own right to mainly accommodate demand for commercial parking in the Macquarie Park area.

A parking facility at this site would have benefits over other parking facilities in the Macquarie Park area as it would provide for direct access from the M2 Motorway and hence minimise traffic impacts on the local road network.

The M2 Motorway operator intends to monitor the parking supply and demand balance in the Macquarie Park area with a view to future consultation with stakeholders (City of Ryde, RTA and local business groups and the community) regarding consideration of the site in future parking strategies developed for the area.

### 3.1.4 Demand management tolling options

Travel demand management, by means of introducing a variable time of day toll, was considered as an option but not proposed for the M2 Upgrade project. While a tolling regime of this nature could assist in spreading the demand for peak travel to less congested time periods, it’s effectiveness would be limited by other constraints, such as availability of other travel modes at the user’s origin and destination and flexibility of working arrangements. Time-of-day tolling would not reduce demand during the peak periods to the extent that widening would not be required.

Another alternative tolling scheme that was considered but not proposed by the M2 Motorway operator was distance based tolling. This scheme would result in some users benefiting from lower tolls (short trips) and others being charged higher tolls (longer trips). In terms of demand management such a scheme could have undesired impact of additional congestion in the highest demand section of the M2 Motorway (at the Norfolk Tunnel – east of Beecroft Road). This would be due to additional short trips (from Beecroft Road) attracted by a lower toll resulting in additional congestion that would discourage utilisation of the M2 Motorway for some longer trips.

The above tolling options would require implementation of Full Electronic Toll Collection (FETC). Currently the toll collection points on the M2 Motorway at Pennant Hills Road and the main toll plaza at North Ryde accept electronic payment (tag) or cash. Although there are new toll roads in Australia that have been constructed in recent years utilise FETC (cashless), it was decided that a move to electronic only payment would not be included as part of the M2 Upgrade project.

There are still a large number of existing users that do not use the M2 Motorway regularly and prefer to pay the toll with cash rather than electronic payment. The M2 Motorway operator would only consider removing the cash option of payment for these customers when the number of cash users dropped to such a level that retention of this payment method could not be justified. . The M2 Upgrade project does not preclude FETC or the above tolling strategies being implemented at some time in the future, however this would be the subject of further consideration including costs of implementation (system installation and toll revenue) and impacts on the traffic network in the M2 corridor.

### 3.1.5 Comparison of the alternatives with the project

Following an assessment of the alternatives against the project objectives and on performance and environmental grounds, alternatives one to four were eliminated. The reasons for this are given below.

- Alternative one (do nothing) would not address the growing traffic and public transport problems along the M2 corridor and may result in a deteriorating situation for both buses and general traffic.
- Alternative two (road based improvement – line marking) - may result in a reduced level of service for M2 Motorway users including motorists, cyclists and those commuting by public transport. Safety and the ability to manage incidents may be compromised by the removal of the break down lane.
- Alternative two (road based improvement – local sub-arterial and arterial road upgrade) would potentially have social and economic impacts as existing development adjacent to local sub-arterial and arterial roads would necessitate the acquisition of property to enable these roads to be widened. This may impact on individual property owners and the character of the area, and would be a costly exercise, therefore not providing value for money. Construction impacts such as noise may also be potentially significant.
- Alternative three (provision of public transport – rail) would not address the growing traffic and public transport problems along the M2 corridor and may result in a deteriorating situation for both buses and general traffic. Rail projects such as the North West Rail Link would not be constructed in time to alleviate growing congestion on the M2 Motorway. Additionally, rail is not suited to multi-stop or freight related trips. Light rail would be largely ineffective unless it was extended beyond the M2 Motorway and there are currently no plans for this to occur.
- Alternative three (provision of public transport – road) – would not significantly alleviate the growing traffic and public transport problems along the M2 corridor. Construction of a dedicated bus lane along the length of the M2 Motorway may generate additional environmental impacts and require significant expenditure. This is not considered to be justified as it would provide insufficient improvements in travel times to encourage enough mode shift to buses to improve traffic conditions for cars and trucks. A park and ride facility would not change this situation as analysis shows that the park and ride facility would be primarily utilised by commuters with a final destination of Macquarie Park with only minor usage by commuters on-travelling to alternative destinations.
- Alternative four (demand management – tolling options) would result in a number of potential changes to commuter behaviour which may result in changed patterns of congestion and even avoidance of the M2 Motorway. It is not considered that this option would achieve the traffic related project objectives.

The project is consistent with relevant State Government plans, strategies and polices and would not preclude other transport solutions for Sydney's north west. The project meets requirements for the projected growth in traffic and transport on the M2 Motorway by providing additional motorway capacity that meets appropriate RTA design standards. When compared to other alternatives and assessed against the project objectives and other environmental factors, widening of the M2 Motorway is preferred in relation to social, environmental, design and economic considerations.

Options for widening the M2 Motorway are assessed in Section 3.2 below.

## 3.2 Motorway widening options

The evaluation of project alternatives described in Section 3.1 above identified widening of the existing M2 Motorway as the preferred solution. A more detailed analysis of project options was then considered to identify the preferred project option for key sections of the M2 Motorway. The following sections described the criteria used and the key findings from the analysis of project options.

### 3.2.1 Option evaluation criteria

To achieve the project objectives (described in Section 2.3 of this report), a range of criteria have been formulated to evaluate options for the project. These criteria target an appropriate balance of community, natural resource and economic imperatives as well as applying RTA and AustRoads road design guidelines.

Criteria used to assess the options include:

- Meet design criteria and geometry standards – Demonstrates compliance with RTA Road Design and AustRoads design guidelines. Maintaining or enhancing operation efficiency, safety and functionality of the M2 Motorway during and post construction.
- Maximise cost effectiveness – Maximises cost effectiveness and value for money of public infrastructure.
- Constructability, operation and maintenance – The proposed design can be constructed in a practical manner whilst minimising disruption to traffic flows and impacts on social, economic and environmental values. Maximises efficiencies of operation and maintenance activities, including minimising the requirement for maintenance where practical.
- Minimise impact on natural resources and ecology – Minimises impacts on natural resources, environmental and heritage values during construction and operation.
- Minimise property impacts – Minimises direct property impacts.
- Minimise social and economic impacts – Minimises impacts on land use, local business, provision of safe and convenient public transport, pedestrian and cyclist accessibility.
- Promote sustainable development – Implements principles of Ecologically Sustainable Development and sustainability (including minimising Greenhouse Gas Emissions) within design solutions.

The project options were assessed against these criteria in order to select the best design solution.

### 3.2.2 Motorway widening design options

The following sections summarise the factors that influence the need for widening relevant sections of the M2 Motorway. When referring to motorway widening, the design options described in this section generally comprise the following (or a combination).

- For eastbound widening, the M2 Upgrade project could involve either:
  - widening to north to create a wider eastbound carriageway;
  - widening to the south and moving the median to the south to create a wider eastbound carriageway; and/or
  - narrowing of the median to create a wider eastbound carriageway.
- For westbound widening, the M2 Upgrade project could involve either:
  - widening to south to create a wider westbound carriageway;
  - widening to north and moving the median to the north to create a wider westbound carriageway; and/or
  - narrowing of the median to create a wider westbound carriageway.

#### Abbott Road to Windsor Road

No widening is proposed westbound or eastbound from Abbott Road to Windsor Road, for the following reasons:

- Traffic demand is lower than available capacity in this section in the eastbound direction during the AM peak period, even taking into account the proposed west-facing ramps at Windsor Road. A large number of vehicles enter from Windsor Road and travel eastbound resulting in the volumes in downstream section (Windsor Road to Pennant Hills Road) exceeding capacity. This capacity constraint results in queues extending back to this section from the Windsor Road merge. This constraint would be removed with the project as eastbound traffic entering from Windsor Road would enter the M2 Motorway in an added lane rather than merging with the mainline traffic.
- Additional lane capacity in this section would not provide road user benefits to warrant widening.
- At the Windsor Road interchange, current westbound traffic volumes using the off ramp would be higher than the predicted volumes of traffic entering at the new westbound on ramp. Therefore there would be lower traffic volumes in this section than the upstream section (Pennant Hills Road to Windsor Road).

Works associated with the west-facing ramps at Windsor Road are discussed in Section 6.3.2.

#### Windsor Road to Pennant Hills Road

##### Eastbound widening

Eastbound widening from Windsor Road to Pennant Hills Road is proposed for the following reasons:

- Merging traffic from the existing Windsor Road on ramp creates substantial eastbound congestion during the morning peak hour period, resulting in traffic queues often extending back to the M7 Motorway. Provision of a third eastbound lane would increase the capacity east of the Windsor Road merge and substantially improve the level of service.
- The steep incline approaching the Barclay Road overbridge causes a large number of trucks to reduce speed, which increases congestion and limits the capacity of the M2 Motorway in this section. Widening of this section would provide additional overtaking opportunities (two lanes for other

vehicles to overtake instead of one), hence reducing the impacts slow vehicles have in reducing capacity in this section.

The preferred design for eastbound widening between Windsor Road and Barclay Road is widening to the north, for the following reasons:

- Due to the large cutting to the south of the carriageway, widening to the south would involve more intensive earthworks than widening to the north. Widening to the south would require more complex, lengthy and costly construction to undertake earthworks, which would necessitate implementing additional traffic management measures during construction to maximise traffic safety.
- Existing dwellings are located near the top of the cutting. Widening to the south may generate additional impacts, such as noise and vibration impacts during construction, compared to widening to the north.
- Existing bus stops in the M2 Motorway median at Windsor Road and Barclay Road limit the potential alignment options. To provide safe lane dimensions and curve radii, it is not possible to widen to the south in this section and tie in to the existing lanes adjacent to the bus stop. Realignment of the bus stops is limited due to the bridge structure at Barclay Road.
- Currently, the Windsor Road eastbound on ramp determines the position of the M2 Motorway median. Widening to the north minimises works required to the westbound off ramp compared to widening to the south, which would require reconfiguration of this ramp. Impact on the westbound off ramp would increase construction time, cost and materials.
- Widening to the north is the most cost effective option as it avoids impact to bus stops, existing Windsor Road ramps and the large cutting to the south. Widening to the south, which would involve relocating the existing Windsor Road and Barclay Road bus stops, reconfiguring the east facing Windsor Road on ramp and intensive earthworks at the large cutting, would increase the cost of the project.

Widening to the south between Windsor Road and Barclay Road does not meet design criteria and geometry standards and decreases the cost effectiveness of the project. Whereas widening to the north improves constructability and reduces property impacts.

The preferred design for eastbound widening between Barclay Road and Pennant Hills Road is widening to the south, for the following reasons:

- Darling Mills State Forest is located to the north of the M2 Motorway. Widening to the north would require large amounts of vegetation removal for construction and access, whereas, widening to the south would minimise the vegetation removal required.
- The large sections of existing retaining walls to the north would require demolition and relocation if widening was to occur to the north. This would increase the cost, materials and construction time of the project. Widening to the south would reduce the cost and materials by avoiding these existing retaining walls.

Due to steep topography, which slopes down from south to north, access for works to bridge structures on the north side of the M2 Motorway through Darling Mills State Forest would be difficult and would require greater earthworks and vegetation removal. In comparison, construction to the south can be achieved utilising local roads for construction access, generating less potential impact on natural areas. Widening to the south between Barclay Road and Pennant Hills Road minimises impact on natural resources and maximises the cost effectiveness in this section. Whereas widening to the north decreases constructability and cost effectiveness of the upgrade.

### Westbound widening

Widening westbound between Pennant Hills Road and Windsor Road was presented as an optional widening in the preliminary environmental assessment (RTA, 2009). Upon detailed investigation, it was decided not to widen westbound between Windsor Road and Pennant Hills Road, for the following reasons:

- Travel time surveys undertaken in 2009 indicate average peak hour speeds are typically higher than 80 kilometres per hour with congestion not observed in this section despite high volumes.
- Widening of the M2 Motorway in this section, in addition to the widening required for the additional lane eastbound, would generate additional impacts on natural vegetation and habitat in the Darling Mills Creek and Bidjigal Reserve area.
- Additional lane capacity in this section would not provide road user benefits to warrant widening. Traffic in this section experiences an earlier PM peak hour than the rest of the M2. Although future traffic growth could lead to some congestion in this section during the PM peak the earlier timing and relatively short duration of this would not justify the additional expenditure ($40 -$50 million) required for widening.

The potential F3 Freeway to M2 Motorway link may result in additional westbound traffic between Windsor Road and Pennant Hills Road and could require additional capacity to be provided in this section at some point in the future, although currently no funding has been committed to this project. Peak period traffic impacts on this part of the M2 Motorway could be reassessed when funding is committed to the F3 Freeway to M2 Motorway link and project alignment is confirmed.

## Pennant Hills Road to Lane Cove Road

### Eastbound widening

Widening is proposed eastbound from Pennant Hills Road to Lane Cove Road, for the following reasons:

- There are major, recurrent congestion issues extending west from the Beecroft Road merge and the Norfolk Tunnel.
- Widening through this section would resolve the current traffic constraints and resulting congestion.
- The new lane extending from the Pennant Hills Road on ramp would result in safer access conditions. Traffic entering the M2 Motorway from this ramp would not need to merge into the heavily congested mainline flow.
- Additional travel time saving would be provided for buses and vehicles with two or more people via a transit lane from Terrys Creek to Lane Cove Road.

### Westbound widening

Widening is proposed westbound from Lane Cove Road to Pennant Hills Road, for the following reasons:

- Demand in this section is already near/at capacity especially west of Beecroft Road.
- An interim solution has been in place to accommodate the additional traffic between Beecroft Road and Lane Cove Road. This involved re-line marking the existing pavement with three traffic lanes. The arrangement required narrower traffic lanes, reduced speed limits and the loss of the breakdown lane. The removal of the breakdown lane resulted in the provision of an off-motorway route for cyclists.

- Widening of this section would allow traffic arrangements (such as lane width and speed limit) to be restored to an acceptable Motorway standard. This would relieve the congestion and improve travel times during the afternoon peak period.
- The following discusses options in the various sections for both eastbound and westbound described from west to east.

### Devlins Creek Bridge

As the existing M2 Motorway over Devlins Creek is comprised of separate eastbound and westbound bridge structures, widening of the M2 Motorway to provide additional lanes eastbound and westbound would involve either:

- Widening north and south of the M2 Motorway, providing a single additional outside lane in both directions.
- Closing the existing gap between bridge structures and widening in the existing median and to the south.

The preferred design is to close the gap to provide the new eastbound lane in the existing median and widening westbound to the south, for the following reasons:

- Widening to the north would result in partial clearing for carriageway and construction access adjacent to an area of Blue Gum High Forest, an Endangered Ecological Community, located adjacent to Pennant Hills Golf Course (refer to Technical Paper 3 for discussion of significance of vegetation). Widening to the south would avoid impacts on this community.
- Closing the existing gap between the eastbound and westbound bridge structures would allow eastbound construction activities to take place from the M2 Motorway carriageway, reducing the impact on surrounding bushland.
- Devlins Creek is located to the north of the M2 Motorway. Widening to the north would come into direct contact with Devlins Creek near Kirkham Street, requiring the construction of new culverts which would potentially impact water quality of the creek during construction.
- Closing the gap reduces the impact to higher value riparian vegetation north of the M2 as opposed to lower value vegetation under the bridges. The vegetation under and between the bridges is considered to be of a lower value due to limited exposure to light and disconnection from surrounding vegetation. The vegetation to the north of the M2 Motorway is considered to be of higher value because it has greater potential for rehabilitation due to greater exposure to light and greater accessibility.

The preferred option was chosen because it is the only option that meets design criteria and minimises constructability issues. This option has the lowest impact on properties, natural resources and ecology, and best meets the principles of Ecologically Sustainable Development.

### Bus lane termination between Kirkham Street and Beecroft Road

Design options considered for this section of the M2 Motorway, eastbound, include widening to the north or terminating the bus lane to provide three general purpose traffic lanes. The preferred design option is to terminate the bus lane (eastbound and westbound) west of Beecroft Road, to utilise the existing carriageway to provide three general purpose traffic lanes and a breakdown lane on both the eastbound and westbound carriageways. This design option is preferred for the following reasons:

- Utilising the bus lane does not require widening. It would avoid impact to existing noise walls and retaining walls, which would minimise the time, cost, and materials required for construction. Widening to the north or south would increase construction cost, time and materials. Widening to the south would have the greatest cost as it would require widening, earthworks and moving the M2 Motorway median to the south.
- Devlins Creek is situated to the north of the M2 Motorway through this section. Avoiding widening would reduce the impact on Devlins Creek as the construction of new culverts would not be required and construction impacts on the water quality would be avoided. Widening to the north would be difficult as Devlins Creek restricts access for construction and would result in greater ecological impacts.
- Use of the bus lane is enabled through removal of the Beecroft Road bus ramp, which is currently underutilised. The project improves bus access to Macquarie Park via Christie Road, which provides direct bus access between the M2 Motorway and the bus station at Macquarie Centre. Refer to Section 6.3.6 of this report for discussion regarding removal of the Beecroft Road bus ramp.
- Whilst use of the bus lane and removal of the Beecroft Road bus ramp would require replacement of the existing piers at Beecroft Road with one row of central piers, this would eliminate the need to rebuild both abutments of Beecroft Road bridge, reducing the cost and time of construction.
- The westbound Motorway after Kent Street has reduced stopping sight distances for general traffic and therefore would be retained for buses as it is currently utilised.
- The bus lane would be terminated and utilised as the third general traffic lane east from Kent Street to minimise impact on Epping Heights Public School, located at Chainage 11500, and avoid other impacts as discussed above. Widening to the south would require moving the noise walls closer to the school buildings and a reduction in the land able to be used by the school.
- Widening to the north for both eastbound and westbound carriageways would be the most costly and hardest to construct as it would require earthworks within bushland areas and moving the M2 Motorway median to the north.

Terminating the bus lane to form the third general traffic lane was the preferred option as it is the most cost effective option and it removes the potential need for property acquisition in this section.

### Norfolk Tunnel

Design options considered for widening the Norfolk Tunnel include:

- Tunnel widening – 100 kilometres per hour design speed, with lane width and configurations as follows:
  - 3 x 3.5 metre wide lanes.
  - 1 x 0.5 metre wide shoulder lane.
  - 1 x 2.5 metre wide breakdown lane (cycle access provided to breakdown lane through Tunnel).
  - 1 x 1.05 metre wide walkway including concrete barrier.

- Partial tunnel widening – 80 kilometres per hour design speed, with lane width and configurations as follows:
  - 3 x 3.5 metre wide lanes.
  - 2 x 0.5 metre wide shoulder lane.
  - 1 x 1.05 metre wide walkway.
  - Cycle bypass (via local streets and ramps over tunnel).
- No tunnel widening – 70 kilometres per hour design speed, with re-line marked lane widths and configurations as follows:
  - 3 x 3.1 metre wide lanes.
  - 1 x 0.25 metre wide shoulder (no breakdown lane and no cycle access through Tunnel)
  - 1 x 1.1 metre wide kerb line.
  - 1 x 0.6 metre wide walkway.
  - Cycle bypass (via local streets and ramps over tunnel).

The preferred design is full tunnel widening, for the following reasons:

- To provide consistency for M2 Motorway users, the project would provide a 100 kilometre per hour speed limit along the M2 Motorway between Windsor Road and Lane Cove Tunnel.
- Tunnel widening is the safest option as it provides a full 2.5 metre wide breakdown lane. It would allow for a car to stop safely in the tunnel without disrupting the traffic flow and without becoming a hazard to vehicles travelling past at the 100 kilometre per hour speed limit. While partial tunnel widening provides the equivalent general traffic lanes, the breakdown lanes are narrower and so the 100 kilometre per hour speed limit would not be achieved. Partial and no tunnel widening are the less safe options with narrow shoulder lanes that would not provide adequate space for a car to stop safely in the tunnel. This would require a lower speed limit as traffic incidents in the tunnel would interrupt the traffic flow.
- Reinstatement of the westbound breakdown lane in the tunnel would eliminate the existing operational requirement for an incident response crew on standby during peak periods.
- The wider shoulder allows cyclists to access the breakdown lane, which would decrease travel time for cyclists travelling between the CBD and Sydney's north west. Partial or no tunnel widening would require cyclists to bypass the tunnel either via a diversion through local roads or via ramps to carry cyclists over the tunnel, which would increase the travel time for cyclists utilising the M2 Motorway. Cycle ramps over the M2 Motorway would be difficult to construct and likely to be avoided by commuter and training cyclists who would risk travelling through the tunnel to avoid the ramps.
- The impacts that would be experienced by the local community during construction such as increased noise and dust emissions and an increase to the toll would be more likely to be accepted by the community if a 100 kilometres per hour design is provided.

While no tunnel widening is the least costly option, it does not meet the project's design criteria and geometry standards. Tunnel widening is the only option that meets design criteria for safety and required speed limit and is the only option that justifies the increased toll following completion of the project.

### Terrys Creek to Toll Plaza

Design options for widening this section of the M2 Motorway include widening to the north, widening to the south or widening to the north and south.

The preferred design is to widen to the north, for the following reasons:

- Due to the existing noise walls on the southern side of the M2 Motorway, widening to the south would require costly and lengthy construction as these noise walls would need to be relocated. Widening to the north minimises the time, cost and materials required for construction as it avoids impact to these noise walls.
- Three westbound lanes must be maintained during construction at peak times. Widening to the south while meeting these operational criteria would be extremely difficult due to the constraints in this section where the breakdown lane has been removed and lane widths are already below motorway standards.
- Due to the large cutting to the south of the carriageway, widening to the south would involve more intensive earthworks than widening to the north. Widening to the south would require more complex, lengthy and costly construction to undertake earthworks, which would necessitate implementing additional traffic management measures during construction to maximise traffic safety. The northern carriageway was initially constructed on an area of fill, therefore, widening to the north would be more cost effective and easier to construct.
- Construction access is difficult on the southern side due to the large cutting.
- Widening to the south would require more extensive vegetation removal than widening to the north.
- Approaching the Toll Plaza, widening would occur to the north and south of the M2 Motorway in order to align with the Toll Plaza lanes and avoid the need to adjust the existing central piers of the Culloden Road overbridge.

Widening to the south would not be cost effective and construction and access would be difficult. Widening to the north minimises cost, constructability issues and vegetation impact on natural resources.

### Lane Cove Road to Lane Cove Tunnel

No widening is proposed between Lane Cove Road and Lane Cove Tunnel, for the following reasons:

- An acceptable level of service has been experienced through this section since the opening of the Lane Cove Tunnel.
- The traffic demand is not high enough to warrant widening.
- Widening through this section would require the lengthening of Lane Cove Road bridge. The cost and construction impact associated with this is not considered warranted given the current traffic demand.

### 3.2.3 Interchange and ramp options

The M2 Motorway comprises a number of interchanges, two of which are subject to the proposed upgrade, with new access ramps being incorporated and some modified. The interchange access ramps subject to the proposed upgrade works are:

- Windsor Road west facing on and off ramps, including widening of Windsor Road near the M2 Motorway to provide adequate ramp turning lanes, at the Windsor Road grade separated interchange.
- Herring Road and Christie Road ramps to facilitate access between the M2 Motorway and Macquarie Park.

New ramps were also considered at the Beecroft Road and Lane Cove Road interchanges. An assessment of ramp options is provided below.

#### Windsor Road west facing ramps

West facing ramps are proposed at the existing Windsor Road interchange. The primary purpose of the proposed Windsor Road west facing ramps is to provide motorists with the ability to exit on to Windsor Road when travelling from the west (from Abbott Road, Old Windsor Road and M7 Motorway) and also to provide access to the western carriageway of M2 from Windsor Road to access Abbott Road, Old Windsor Road and M7 Motorway. Currently there is no opportunity for motorists to exit the Sydney Orbital network between Norwest Boulevard (if on the M7 Motorway), Old Windsor Road and Pennant Hills Road, a distance of approximately 12 kilometres. Also there is no opportunity to enter the M2 Motorway westbound west of Pennant Hills Road, which reduces access to the westbound M7 Motorway.

The ‘do-nothing’ option limits the ability of the surrounding road system to cater for the increasing M7 Motorway traffic, thereby increasing travel time, travel distance, congestion of the local road system and accident potential.

Whilst ramps could be constructed in the middle of the M2 Motorway (in the median area) it is more appropriate to put the ramps on the sides of the M2 Motorway for the following reasons:

- Allows future provision of bus only ramps (as on the eastern side of Windsor Road) if these are warranted in the future.
- Ensures the M2 Motorway/Windsor Road intersection operates efficiently.

The installation of west facing ramps at Windsor Road would improve access to Sydney’s north west and the Sydney Orbital network generally, while reducing travel time and providing a more efficient link for motorists in the ramp catchment area.

### Beecroft Road west facing ramps

While provision of west facing ramps at Beecroft Road would facilitate greater accessibility to areas off the M2 Motorway (via Pennant Hills Road, Windsor Road and Abbott Road), the Sydney Orbital network and the north west generally and would potentially decrease the amount of vehicles on Beecroft Road South and Carlingford Road. The preferred solution is to maintain the current configuration, for the following reasons:

- The current composition of the interchange is spatially constrained by the location of Devlins Creek and associated riparian vegetation, required land acquisition and the existing curve of Beecroft Road.
- New west facing ramps would require a complete re-configuration of Beecroft Road intersection and providing new ramps at Beecroft Road would not be cost effective.

In reviewing the nature of these spatial constraints, the level of potential impact and how the design meets the principles of Ecologically Sustainable Development, this option was excluded from further consideration.

### Christie Road and Herring Road ramps

The primary purpose of the proposed Christie Road and Herring Road ramps is to provide improved access and accessibility between Macquarie Park, Macquarie Centre and the M2 Motorway. Currently there is no opportunity to access the M2 Motorway eastbound or exit the M2 Motorway westbound in Macquarie Park. A number of options have been considered for such ramps in the vicinity of Christie Road and Herring Road to provide an eastbound on ramp and a westbound off ramp. Two of the options considered also include access to a park and ride facility which no longer forms part of the project scope.

Design options for Christie Road and Herring Road interchanges include:

- A new eastbound on ramp and new westbound off ramp at Herring Road.
- A new eastbound on ramp at Christie Road and a new westbound off ramp at Herring Road.

The preferred design is a split interchange configuration, with an eastbound on ramp at Christie Road and westbound off ramp at Herring Road, for the following reasons:

- The split interchange utilises existing pavement as far as practical and generates the least increase in construction footprint, minimising vegetation clearance.
- Involves at grade ramps, with minor widening works to Christie Road Bridge, thereby minimising cost, construction time and materials compared to the Herring Road interchange option that would have required a new bridge over the M2 Motorway at Herring Road.
- There is reduced impact to Shrimptons Creek culvert.
- The eastbound on ramp at Christie Road is a larger distance from the eastbound off ramp at Lane Cove Road, providing the greatest merging distance between the two ramps, which improves traffic safety and flows.

### Lane Cove Road

While provision of east facing ramps at Lane Cove Road (a major arterial road) would facilitate greater accessibility to the M2 Motorway in close proximity to Lane Cove Tunnel, the preferred solution is to maintain the current configuration, for the following reasons:

- An east facing entry ramp from Lane Cove Road to the eastbound M2 Motorway may be feasible but there would be issues with provision of such a ramp that would need further consideration, including required works on the M2 Motorway east of the ramp and potential impacts on the adjoining road network (such as increased traffic on routes leading to Lane Cove Road) and the local environment.
- An east facing exit ramp at Lane Cove Road would necessitate a major reconfiguration of the interchange, including:
  - Adjustment of the existing loop entry that is used for westbound traffic that approaches from the north and enters the M2 Motorway via loop ramp.
  - Potential property acquisition to connect ramp to Talavera Road.
  - Potential reconfiguration of road space and traffic lights on Lane Cove Road.
- An eastbound on ramp to accommodate left only entries from Lane Cove Road could be considered in the future if traffic demand was adequate to justify construction and the issues mentioned above can be satisfactorily resolved. The M2 Motorway operator has recently had discussions with the RTA to preserve the option for future provision of this ramp.
- The proposed east-facing ramp connecting to Herring Road would possibly provide this exit ramp although traffic wanting to access Lane Cove Road would need to travel east along Talavera Road for nearly 1.5 kilometres.

Accordingly, the preferred option for the M2 Motorway/Lane Cove Road interchange at this time is to maintain the current interchange configuration.

### 3.2.4 Main compound site alternatives

The TIDC compound in the Macquarie Park industrial area (near the corner of Epping Road and Delhi Road) is preferred as the primary construction compound due to its potential to be the least intrusive of four potential sites considered. The alternative main compound sites are described below together with a summary of why each was not preferred:

- Macquarie compound (vacant land on northern side of M2 Motorway in proximity to Herring Road), is not preferred due to the close proximity of medium density housing along Khartoum Road and the lack of local road access.
- The Cemetery site (land at the end of Wicks Road, adjacent to Macquarie Cemetery), is not preferred due to the sensitive nature of the adjacent cemetery and as a large proportion of this site was originally a landfill site it would necessitate specific leachate treatment if used as a compound site.
- The Parramatta to Epping rail link compound site (TIDC owned land) on Waterloo Road in Macquarie Park was not selected due to the close proximity to local businesses, it has no direct access onto the M2 Motorway, and the potential disruption generated by construction traffic moving in and out of a busy commercial and retail centre.

The TIDC M2 Motorway compound is preferred due to the following key characteristics:

- The ease of access onto the M2 Motorway, via a direct access point onto the westbound on-ramp at Delhi Road.
- It has been previously used as a construction compound for the Epping to Chatswood rail link.
- The relative size of the land available provides suitable space for compound activities.
- The comparatively low prevalence of sensitive receivers in close proximity (the only residential properties in close proximity are located at the extreme southern end of the compound on the opposite side of the busy Epping Road.

Other work sites and compounds proposed as part of the M2 Upgrade project were subject to a similarly rigorous process of consideration, based upon other alternatives available, proximity to the M2 Motorway, location and relative number of adjacent sensitive receivers, as well as the level of environmental values present on the land in question. Refer to Section 7.8 for further discussion regarding compound sites.

# 4. Planning and statutory requirements

| Director-General's Requirements | Where addressed |
| --- | --- |
| *An assessment of the key issues, with the following aspects addressed for each key issue (where relevant):*<br>*Identification of how relevant planning, land use and development matters (including relevant strategic and statutory matters), have been considered in the impact assessment and/or in developing management/mitigation measures.* | *Chapter 4, Chapter 9, Technical Papers* |

## 4.1 Approval framework

### 4.1.1 Environmental Planning and Assessment Act 1979

The RTA is seeking project approval for the M2 Upgrade project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In accordance with Section 75B(1) of the EP&A Act the Minister for Planning declared, by Ministerial Order published in NSW Government Gazette No.44 on 27 February 2009, that the M2 Upgrade project is a project to which Part 3A applies. The Minister also declared under an Order published in the NSW Government Gazette No. 44 on 27 February 2009, that the project is a critical infrastructure project under Section 75C of the EP&A Act. The RTA is seeking an amendment to the Part 3A and critical infrastructure declarations to remove the park and ride facility and include clarification with respect to the proposed access ramps at Herring and Christie Roads. Copies of the current Minister's Orders are provided in Appendix A.

The project requires the approval of the Minister for Planning.

The approval process under Part 3A of the EP&A Act is illustrated in Figure 4. Further detail on the Part 3A process can be found on the Department of Planning website at www.planning.nsw.gov.au.

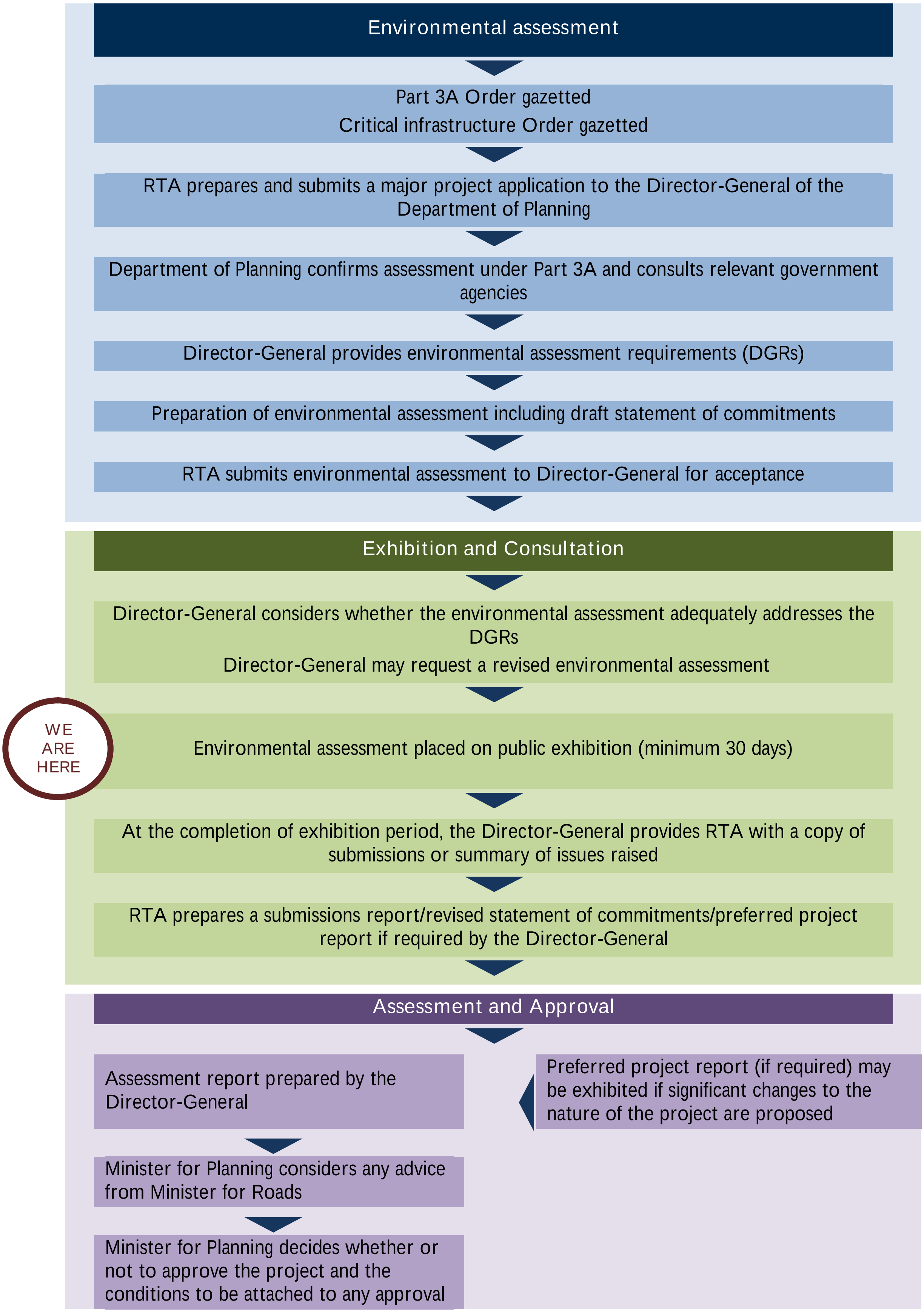
### 4.1.2 Environmental Planning Instruments

Section 75R of the EP&A Act excludes the application of the provisions of environmental planning instruments (other than SEPPs) to approved projects, including approved critical infrastructure projects. A SEPP only applies to critical infrastructure projects to the extent that the provisions of the SEPP expressly provide that they apply to the particular project (EP&A Act section 75R(2)). There are no SEPPs that expressly relate to the M2 Upgrade project.

However, in deciding whether or not to approve the carrying out of a project, the Minister for Planning may (but is not required to) take into account the provisions of relevant environmental planning instruments (EPIs) that would not (because of Section 75R) apply to the project if approved. Such EPIs include:

- State Environmental Planning Policy (Infrastructure) 2007
- State Environmental Planning Policy No. 19 – Bushland in Urban Areas
- State Environmental Planning Policy No. 18 Public Transport corridor (now deemed a SEPP)
- Baulkham Hills Local Environmental Plan 2005
- Hornsby Shire Local Environmental 1994
- Ryde Planning Scheme Ordinance.

Figure 4 The approval process under Part 3A of the EP&A Act



## 4.2 Other legislation

### 4.2.1 NSW legislation

A number of approvals are not required for a project approved under Part 3A of the EP&A Act (section 75U). Exemptions of relevance to the project include:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*.
- An approval under Part 4, or an excavation permit under section 139 of the *Heritage Act 1977*.
- A permit under section 87 or consent under section 90 of the *National Parks and Wildlife Act 1974*.
- A permit under Part 3A of the Rivers and Foreshores Improvement Act 1948.
- A bushfire safety authority under section 100B of the *Rural Fires Act 1997*.
- A water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the *Water Management Act 2000*.

Approvals under other NSW legislation that may apply to the project include:

- An Environment Protection Licence under chapter 3 of the *Protection of the Environment Operations Act 1997* in accordance with section 75V(1) of the EP&A Act. Such a licence cannot be refused for an approved project and is to be substantially consistent with the Part 3A approval.
- An approval under the *Water Act 1912* for access to ground or surface water during construction.
- An approval under the *Crown Lands Act 1989* to grant a relevant interest (licence, permit, easement or right of way) over a Crown Reserve.

Other legislation that may apply to the project includes the *Land Acquisition (Just Terms Compensation) Act 1991 No. 22*. This Act applies to the acquisition of land required for the project. Refer also to Section 10.6.

### 4.2.2 Commonwealth legislation

#### Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) proposed ‘actions’ that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land or that are being carried out by a Commonwealth agency that is likely to have a significant impact on the environment must be referred to the Australian Government Minister for the Environment, Heritage and the Arts.

Matters of National Environmental Significance (NES), of relevance to the project include:

- Nationally threatened species and ecological communities.
- Migratory species listed under the EPBC Act.

An assessment of this project’s potential impact on threatened fauna and flora species, endangered ecological communities and migratory fauna species found that the project was not likely to have a significant impact on relevant matters of national environmental significance. However, a precautionary approach has been taken and the RTA submitted a referral to the Australian Government Department of the Department of Environment, Water, Heritage and the Arts (DEWHA) as a precautionary measure. On 19 February 2010 notification was received from DEWHA of the decision (refer to Appendix G) that the proposed M2 Upgrade project is not a controlled action and does not require further assessment and approval under the EPBC Act before it can proceed.

# 5. Community and stakeholder engagement

This section provides an overview of the project's approach to community and stakeholder engagement.

In conjunction with Appendix D, this section describes the communication and consultation activities undertaken to date during preparation of the environmental assessment. It also outlines activities planned for the upcoming public exhibition of the environmental assessment as well as the future construction and commissioning phases of the project.

| Director-General's Requirements | Where addressed |
|---|---|
| *The environmental assessment must reflect an appropriate and justified level of consultation with relevant stakeholders during the preparation of the environmental assessment, including:*<br>• *The Department of Environment and Climate Change.*<br>• *The Department of Water and Energy.*<br>• *The Department of Primary Industries.*<br>• *Ryde City Council, Hornsby Shire Council and Baulkham Hills Shire Council.*<br>• *Relevant public stakeholders, including special interest groups and affected landowners.* | *Chapter 5* |
| *The environmental assessment must outline the consultation process, document all community consultation undertaken to date and identify the issues raised (including where these have been addressed in the environmental assessment).* | *Chapter 5* |

## 5.1 Community and stakeholder engagement overview

### 5.1.1 Overview

Community and stakeholder engagement for the M2 Upgrade project engagement program has been undertaken in accordance with the DGRs, the Department of Planning's *Guidelines for Major Project Community Consultation* (2007) and in consultation with the RTA Infrastructure Communications Branch.

To determine appropriate levels of consultation the engagement approach has also considered the project's proposed scope to upgrade an existing and mature asset within its established boundary.

Communication and consultation activities have been tailored for each phase of the project, including:

- Preparation of the environmental assessment.
- Public Exhibition of the environmental assessment and subsequent environmental approval.
- Construction of the project.
- Commissioning and initial operation of the upgraded M2 Motorway.

### 5.1.2 Engagement approach

The engagement program aims to provide optimum opportunities for community and stakeholder involvement. Key objectives are to:

Provide an open, accountable and transparent engagement process.

- Offer a range of accessible opportunities for stakeholders and the community to be informed about the project.
- Foster two-way communication to achieve optimum outcomes for the community and the project.

The project's community engagement program proactively informs and involves stakeholders and community members at each stage. By maximising public access to information and feedback channels, the engagement approach aims to increase awareness and understanding of the project and encourage participation in consultation activities.

### 5.1.3 Identification of stakeholders

Project stakeholders have been identified from the DGRs and an assessment of the relevant government bodies, Motorway stakeholders and interest groups within the project area. Stakeholders have been classified into six key categories, which are:

- Government.
- Interest groups.
  - Motorway users including bus operators and cyclist groups.
  - Community groups.
  - Environmental groups.
  - Business groups.
- Affected landowners.
- Indigenous community.
- Local corridor community.
- Broader community.

Table 4, Table 5 and Table 6 list agency, local government and community issues and identify where these issues are addressed within this environmental assessment.

### 5.1.4 Communication and consultation activity – phase one environmental assessment preparation

During preparation of the environmental assessment, the consultation approach has focused on engaging with state and local government authorities and targeting relevant public stakeholders including special interest groups and affected landowners. Targeted stakeholders were selected to access a cross section of organisations and groups with an interest in the M2 Motorway and corridor. This approach has enabled the collection and consideration of diverse stakeholder feedback.

Information and discussion with stakeholders has addressed the project scope, approval process, environmental assessment specialist studies, geotechnical and services investigations, changes to noise walls and the proposed construction staging. Appendix D provides detailed information about specific tools and activities used to consult with these groups.

In conjunction with targeted stakeholder consultation, the corridor community and broader community were provided information about the project scope and the environmental assessment process and invited to contribute feedback during the public exhibition. Questions and concerns raised by the corridor community and broader community have been addressed through telephone contact, formal correspondence and on-site meetings where required. These issues were recorded and considered during preparation of the environmental assessment and design development.

## 5.2 Key consultation activities and outcomes

Key consultation activities undertaken during preparation of the environmental assessment are described in Table 3.

Table 3 Key consultation activities

| Item | Summary | Date |
|---|---|---|
| Project website | Website includes project information materials and is updated regularly. | Established 13 November 2009. |
| Project telephone line and email address | The telephone is staffed during business hours (8.30am to 5.00pm) and during investigations or works conducted outside of business hours.<br>The telephone line and email enquiries@hillsM2upgrade.com.au facilitates responses to community and stakeholders' enquiries. | Established 13 November 2009. |
| Community subscriber register | Community members have been invited to register their interest in receiving project updates.<br>Over 339 subscribers have registered. | Established June 2008. |
| Corridor community correspondence | An unaddressed letter was delivered to approximately 7,000 householders and businesses located in the M2 corridor. | Issued 16 November 2009. |
| Shopping centre displays | Staffed displays were held at the Macquarie and Winston Hills shopping centres. | Held on 26 and 28 November 2009 respectively. |
| Planning Focus meeting | The Planning Focus Meeting was held with relevant Government agencies. | Held 19 March 2009. |
| Stakeholder meetings | 48 meetings with stakeholders including; local councils, interest groups and affected landowners. | Held between13 November 2009 to 30 January 2010. |

## 5.3 Summary of issues raised during consultation

Issues raised during the consultation process by government agencies, local government, M2 Motorway stakeholders, interest groups and the broader community have been recorded and have been considered in the environmental assessment and ongoing development of the project. Table 4, Table 5 and Table 6 list the issues and where they are addressed in this document. The issues raised by stakeholders and the community generally questioned how the design, construction methodology or environmental management measures would minimise potential impacts.

Table 4 Agency issues

| Item | Summary | Environmental assessment section |
|---|---|---|
| Department of Climate Change and Water | Construction work – program and planning<br>Construction work – noise impact assessment and management | Section 7.2, Section 7.3 and Section 9.4.3 |
| | Public transport – integration and outcomes<br>Project scope – park and ride viability and assessment | Section 2.1, Section 2.2 and Section 3.1. |
| | Indigenous heritage – impact assessment and management | Section 9.7 |
| | Noise and vibration – assessment of current and future noise levels | Section 9.3 and Section 9.4.3. |
| | Flora and fauna – threatened species | Section 9.5 |
| | Water – surface water management, erosion and sedimentation control | Section 9.8 and Section 10.1. |
| | Consultation – community consultation | Chapter 5 |
| | Climate change and drainage – historic and predicted rainfall patterns | Section 10.1 and Section 10.9. |
| Department of Primary Industries | Water – works to bridges, culverts and stormwater outlets to creeks<br>Water – culverts and effects on aquatic life<br>Water – water quality | Section 6.3, Section 9.8, Section 10.1 and Section 9.5. |
| Transport working group including:<br>Department of Transport and Infrastructure,<br>Hillsbus,<br>Busways | Consultation – public perception of removal of Beecroft Road bus ramp.<br>Commuter considerations – potential impacts on people using Epping Station through removal of Beecroft Road bus ramp.<br>Bus operations – bus services to Epping continue to Macquarie Park.<br>Bus operations – some services use the Beecroft Road bus ramp for convenience on 'dead runs' and to avoid tolls.<br>Construction timing – timing of demolition of the Beecroft Road bus ramps is critical to programme.<br>Construction timing – earliest closure of the Beecroft Road bus ramps is commencement of construction.<br>Design – bus operators confirmed that the bus underpass at north rail line would no longer be required once the Beecroft Road bus ramp is closed. | Chapter 5<br>Section 9.1 |

Table 5 Local government issues

| Issue | Details | Environmental assessment section |
|---|---|---|
| Hornsby Shire Council | | |
| Construction | Traffic – impact of tunnel widening on traffic.<br>Construction impacts – potential impact to private property from tunnel excavation and provision of condition surveys. | Section 9.2 and Section 9.4. |
| Economic | Tolling – consideration of implementation of variable tolling consideration.<br>Planning – impact of bus ramp removal to Epping centre and longer term planning for Epping | Section 1.4, Section 3.1, Section 9.1 and Section 10.4. |
| Environment | Flora and Fauna – extent of bushland clearing near Devlins Creek and Terry's Creek.<br>Water – impact on water quality, flooding and on site-detention and drainage.<br>Urban design – opportunity to improve landscaping along M2 Motorway. | Section 9.5, Section 9.8, Section 10.1 and Section 9.5. |
| Functional | Traffic – impacts to Epping from Beecroft Road bus ramp removal.<br>Traffic – reliability of traffic modelling.<br>Traffic – increase in truck volumes resulting from project.<br>Traffic – impact to traffic flow near Lane Cove Tunnel.<br>Cyclist considerations – changes to the existing cycle route following the M2 Upgrade project.<br>Project scope – scope for future upgrades of the M2 Motorway. | Section 9.1, Section 9.2 and Section 7.3,<br>The M2 Upgrade project is proposed to meet demand until at least 2021 and does not preclude future changes to the M2 Motorway network. |
| Process | Consultation – informing and consulting the community and council throughout the project.<br>Project award – process for appointing Leighton Contractors Pty Ltd as preferred contractor and determining project scope and cost.<br>Planning – integration with public transport and other government transport plans. | Chapter 5, Section 1.3, Section 1.4 and Section 2.2.7. |
| Social | Noise walls – impact to residents along the M2 Motorway | Section 9.3 and 10.5. |
| Parramatta City Council | | |
| Construction | Cyclist considerations – cycle detour during construction and council consultation on cycle detour. | Chapter 5, Section 9.2 and Section 7.3. |
| Economic | Tolling – value of toll cost at Windsor Road ramps.<br>Property acquisition – extent of property acquisition. | Section 1.4 and Section 10.5. |
| Environment | Specialist studies – level of specialist engagement for environmental assessment technical reports. | Section 1.3 and Technical Papers. |
| Functional | Traffic – capacity of the M2 Motorway after the M2 Upgrade project.<br>Traffic – reinstatement of cycle and pedestrian paths at Windsor Road following the M2 Upgrade project.<br>Bus operations – whether buses heading north to Parramatta would be given priority through bus lanes.<br>Bus operations – consideration of upgrades to bus stations along the M2 Motorway. | Section9.1, Section 7.3, Chapter 6 and Chapter 3. |
| Process | Consultation – level and type of information to be provided to the community throughout the project. | Chapter 5. |

| Issue | Details | Environmental assessment section |
|---|---|---|
| Lane Cove Council | | |
| Construction | Traffic – traffic and transport management during construction including location of spoil routes. | Section 9.2. |
| Economic | Tolling – consideration of implementation of peak tolling. | Section 1.4 and Section 3.1. |
| Functional | Traffic – extent and impact of widening and increased traffic on Lane Cove Tunnel, surrounding corridor area and wider network.<br>Traffic – total capacity of M2 Upgrade project, remaining available capacity in M2 corridor and options for managing additional capacity requirements.<br>Traffic – impact to residents in the Lane Cove Council area. | Section 9.1, The M2 Upgrade project is proposed to meet demand until at least 2021 and does not preclude future changes to the M2 Motorway network. |
| City of Ryde Council | | |
| Construction | Traffic – impacts for traffic on council roads during construction.<br>Compounds/site office – location and management of site offices and construction compounds. | Section 9.2 and Section 7.8. |
| Economic | Tolling – increase to tolls after the M2 Upgrade project.<br>Economic – impact on Epping following the M2 Upgrade project if bus routes focus on Macquarie Centre.<br>Property acquisition – impact on land owned by City of Ryde Council. | Section 1.4 Section9.1, Section 10.4 and Section 10.5. |
| Environment | Flora and Fauna – extent and location of impact on bushland.<br>Noise – impact and management of increased noise levels.<br>Water – impact on bridges or drainage at creeks/water courses.<br>Air quality – consideration of air quality impacts. | Section 9.3, Section 9.4 Section 9.5, Section 9.8 Section 10.1 and Section 10.6. |
| Functional | Traffic – impact of traffic on council roads after M2 Upgrade project<br>Cyclist considerations – cycle access to the M2 Motorway and consideration of travel time savings for cyclists.<br>Project scope – consideration of extra lane between Lane Cove Road and Lane Cove Tunnel.<br>Project scope – type of works planned for Christie and Talavera Road<br>Project scope – consideration of the Park and Ride as part of project.<br>Project scope – consideration of public transport opportunities, such as metro and rail links. | Section9.1, Section 6.3 and Chapter 3. |
| Process | Consultation – consultation strategy for impacted land owners.<br>Environmental assessment – whether the project has been classified as critical infrastructure.<br>Concession Deed – whether the length of the Deed of Concession has changed.<br>Planning – integration with developments at Macquarie Centre bus interchange.<br>Project funding – ways the project would be funded. | Chapter 5, Appendix A, Section 1.4 and Chapter 2. |
| The Hills Shire Council | | |
| Construction | Staging – timing for the construction of Windsor Road ramps.<br>Construction methodology – management of geomorphic changes.<br>Spoil management – management of spoil/waste, including whether spoil would be sent to landfill or reused.<br>Traffic – traffic management arrangements on local roads during construction, for example, Barclay Road. | Section 7.2, Section 7.4, Section 7.3, Section 7.7, Section 10.1, Section 10.8 and Section 9.2. |

| Issue | Details | Environmental assessment section |
|---|---|---|
| Economic | Tolling – consideration of implementation of distance based tolling.<br>Property acquisition – impact or use of RTA land near Windsor Road and Perry Street. | Section 1.4, Section 3.1 and Section 10.5. |
| Environment | Urban design – potential urban design aspects being considered for Epping Tunnel.<br>Flora and Fauna – impact on micro bat colony near Barclay Road overpass.<br>Water – on-site and downstream management of drainage detention basins and floodplain. | Section 6.4, Section 7.2, Section 9.5, Section 9.5, Section 9.8 and Section 10.1. |
| Functional | Bus operations – location and extent of bus lanes along the M2 Motorway.<br>Project scope – explanation of Windsor Road interchange design<br>Project scope – reasons for exclusion of widening west of Pennant Hills Road<br>Project scope – consideration of commuter parking. | Chapter 3, Section 6.2 and Section 6.3. |
| Process | Environmental assessment – availability of noise and vibration study.<br>Planning – residual land available for Council use after the M2 Upgrade project. | Section 9.3 and Section 9.4, residual land is outside scope of environmental assessment. |
| Blacktown City Council | | |
| Construction | Construction impacts – impact and management of traffic, noise and vibration during construction.<br>Widening works – extent and width of the widening works and M2 corridor and whether works would be contained within the M2 lease boundary. | Section 9.2, Section 9.4, Section 6.2 and Section 10.5. |
| Economic | Tolling – value of toll increases.<br>Property acquisition – extent and location of property acquisition.<br>Planning – consideration of impact on growth centres. | Section 1.4, Section9.1, Section 10.5 and Section 2.2. |
| Environment | Water – location and explanation of basins provided in the narrow corridor.<br>Water – review of flood evacuation routes, for example, Devlin's Creek. | Section 6.3, Section 9.8 and Section 10.1. |
| Functional | Traffic – increasing heavy and commercial vehicle volumes using the M2 Motorway generated from Western Sydney Growth Centres.<br>Traffic – resolving traffic bottleneck at Lane Cove Road.<br>Project scope – consideration of future additional widening and potential for the provision of a connection between the M2 Motorway and the F3.<br>Project scope – reasons for exclusion of widening west of Windsor Road.<br>Design – adequacy of the new traffic lane width for the proposed 100 kilometres per hour speed limit. | Section9.1, Chapter 2, Chapter 3 and Section 6.3. The M2 Upgrade project is proposed to meet demand until at least 2021 and does not preclude future changes to the M2 Motorway network. |
| Process | Consultation – timing and length of the Public Exhibition.<br>Value for money – consideration of whether increases in capacity justify the cost, environmental impacts and toll increase. | Chapter 4, Chapter 5, Chapter 2 Section 1.4 and Chapter 12. |

Table 6 Community and stakeholder issues

| Issue | Issue details | Environmental assessment section |
|---|---|---|
| Functional | | |
| Traffic | Impact to traffic flow on the M2 Motorway, local area networks and the wider Sydney Orbital network.<br>Level of improvement to the capacity of the M2 Motorway and peak travel times.<br>Longer term impacts and management of the traffic resulting from the M2 Upgrade project for the east end of the M2 Motorway near Lane Cove Tunnel.<br>Consideration of queuing and light sequencing in addressing westbound Pennant Hills Road exit congestion.<br>Impacts and management of traffic at the Windsor Road intersection.<br>Current and predicted percentage of heavy vehicles utilising the M2 Motorway, particularly at night.<br>Utilisation of electronic variable messaging signs to display travel time and traffic incident information.<br>Arrangements for access from Epping to the M2 Motorway.<br>Consideration of parking facilities at strategic points to relieve congestion and increase public transport patronage. | Section9.1, Section 9.2, Section 6.4, Section 7.4, Section 3.1 and Section 3.2.<br>There are no works on Pennant Hills Road as part of the project therefore the level of service is not expected to change. |
| Infrastructure reuse | Reuse or demolition of Beecroft Road bus ramp | Section 6.2 and Section 6.3. |
| Bus operations | Inclusion of bus operations in the project scope, including bus priority/transit lanes, merging, bus ramps and bus stations. | Section 2.1, Section 3.1 and Section 9.1. |
| Safety | Reinstatement of median barriers to keep traffic separated where the median is being utilised for widening.<br>Methods utilised to ensure pedestrian safety at intersections points, particularly Windsor Road.<br>Safety improvements for traffic merging from the cash lane at the toll plaza. | Section 6.2, Section 7.3, Section 7.4, Section 9.1, and Section 9.2,<br>The design of merges would be in accordance with RTA guidelines. |
| Cyclist considerations | Project scope for cycle facilities, including cycle routes, detours and grade separation at on/off ramps during construction and following the completion of the M2 Upgrade project.<br>Appoint a specialist consultant for alternative cycle route planning.<br>Safety considerations with regards to cycle access to the M2 Motorway during operation. | Section 6.2, Section 6.3, Section 7.3, Section9.1, Section 9.2 and Chapter 5. |
| Project scope | Consideration of need for the M2 Upgrade project and alternatives other than widening.<br>Adequacy of the M2 Upgrade project works to meet future needs, consideration of additional widening than proposed to meet future capacity requirements.<br>Provision for a connection between the M2 Motorway and the F3.<br>Scope for and justification of widening works, land acquisition, pedestrian paths and footbridges and noise wall changes. | Chapter 2, Chapter 3, Section 6.3, Section 7.3, Section 9.3, Section10.5, and Chapter 12,<br>the M2 Upgrade project is proposed to meet demand until at least 2021 and does not preclude future changes to the M2 Motorway network. |

| Issue | Issue details | Environmental assessment section |
|---|---|---|
| Road surface | Inclusion of re-sheeting the road surface in the project scope.<br>Timing of the M2 Upgrade project in relation to current re-sheeting works. | Section 6.3, current re-sheeting work is outside scope of the project. |
| Design | Comprehensiveness of traffic studies to achieve accurate traffic forecasting, infrastructure design and known accident black spots<br>Adequacy of the new traffic lane width for the proposed 100 kilometres per hour speed limit.<br>Adequacy of width of tunnel widening. | Section9.1, Section 9.2, Section 6.2 and Section 6.3. |
| Transport planning | Description and extent of support for integrated transport planning.<br>Opportunities to review or develop the public transport component of the M2 Upgrade project. | Chapter 2 and Section 3.1. |
| Construction | | |
| Traffic | Measures used for traffic management to maintain flow and construction safety, including the use of barriers and speed limits.<br>Description of traffic management arrangements for local roads. | Section 7.4 and Section 9.2. |
| Staging | Indication of construction timing and likelihood of completion by due date. | Section 7.2, construction proposed to proceed as set out in program. |
| Construction methodology | Requirement for night time work and measures used for the management of the impacts of this work. | Section 7.6, Section 7.8, Section 9.4 and Section 10.7. |
| Compounds/site office | Location of site office/s and compounds. | Section 7.8. |
| Bus operations | Construction impacts on bus operations and management of these impacts | Section 9.2. |
| Cyclist safety | Management of cyclist and pedestrian safety during construction, specifically near school zones, shops, bus stops.<br>Readiness of alternative cycle route prior to the start of construction. | Section 7.3 and Section 9.2. |
| Widening works | Understanding of construction methods in relation to noise walls and widening. | Chapter 7. |
| Construction impacts | Extent of condition surveys to be undertaken for nearby properties potentially affected by construction.<br>Method of construction noise, dust, vibration management to minimise impact to local residents and schools.<br>Whether the M2 Motorway operator has an incentive or requirement to minimise construction impacts and maintain project delivery times. | Section 9.4, Section 10.6, Chapter 11 and Section 7.2, construction proposed to proceed as set out in program. |

| Issue | Issue details | Environmental assessment section |
|---|---|---|
| Tunnelling | Impact and management of tunnel widening works at surface and subsurface levels.<br>Methods of traffic management during tunnel widening.<br>Management of geomorphic changes. | Section9.4.3, Section 7.2, Section 9.2, Section 6.3, and Section 10.1. |
| Project scope | Potential noise impacts of bridge expansion joints and whether there would be improvement to existing joints. | Section 9.3. |
| Environment | | |
| Urban design | Consideration of urban design aspects for the tunnel. | Section 9.5, Section 7.2 and Section 6.4. |
| Flora and fauna | Extent of construction impacts on bushland flora and fauna and measures to manage this impact.<br>Establishment of a maintenance and weed management plan as part of the M2 Motorway's plan of management/operations. | Section 9.5. |
| Bushland groups | Likelihood of the M2 Motorway operator supporting bushland groups in the future.<br>Register of where bush care, bush regeneration and community garden groups are working near the M2 Upgrade project area. | Chapter 5, Section 7.8 and Section 9.5.<br>Support for bushcare groups outside scope of this assessment (liaison included as part of consultation process). |
| Noise | Potential for investment in signs or driver education to lower noise impacts, particularly trucks.<br>Management of truck noise issues including night time noise.<br>Adequacy of traffic and noise models in considering total increased traffic levels.<br>Methods of noise mitigation.<br>Actions to address increased noise and air quality impacts from increased traffic.<br>Method of measuring noise from increased traffic.<br>Consideration of studies such as the North West Transport Link EIS in 1992.<br>Degree of improvement of noise mitigation from reconfiguring existing noise walls and installing new noise walls where there are gaps in bushland/national park and residential areas.<br>Degree of mitigation provided by noise walls and road resurfacing for life of project.<br>Consultation of residents on noise management for construction and operations. | Section 9.3, Section 9.4, Section 9.1, Section 9.2, Chapter 5 and Section 10.6, previous studies were considered as background information for Technical Papers. |
| Spoil management | Management of spoil/waste, including whether spoil would be sent to landfill or reused and where spoil would be stockpiled on site. | Section 7.7 and Section 10.8. |

| Issue | Issue details | Environmental assessment section |
|---|---|---|
| Construction access | Locations where construction compounds would require access via local streets and bush areas and impacts how impact on these areas would be minimised.<br>Availability of access to bush walking tracks throughout construction.<br>Rehabilitation of bush walking tracks post construction. | Section 7.8, Section 7.3, Section 9.2 and Section 9.5. |
| Specialist studies | Impacts on heritage and environmental features. | Section 9.7, Section 9.9 and Chapters 9 and 10 generally. |
| Water | Management of potential impacts to creeks, watercourses, drainage detention basins and floodplain management. | Section 9.8, Section 10.1 and Section 9.5. |
| Air quality | Impacts of the project on air quality and green house gas emissions. | Section 10.6 and Section 10.9. |
| Environmental footprint | Monitoring of the project's environmental impact throughout construction to assess and address impact as the project progresses. | Monitoring would be considered within the CEMP, which is described in the Construction Environmental Management Framework (refer to Appendix F). |
| Social | | |
| Noise walls | Impacts on residents from noise wall changes.<br>Resumption of private land to accommodate the relocation of noise barriers. | Section 9.3, Section 9.5 and Section10.5. |
| Construction impacts | Details of properties that would be acquired by the RTA as a result of the M2 Upgrade project. | Section 10.5. |
| Local assets | Provision of improvements to pedestrian access into Lane Cove National Park. | Not proposed as part of project as all work is within the M2 corridor. |
| Advertising | Introduction of advertising billboards on the M2 Motorway. | Not proposed as part of project. |
| Economic | | |
| Bus operations | Potential decrease of passenger utilisation as a result of construction impact on timely bus operations | Section 9.2. |
| Tolling | Description of new tolling arrangements and changes, including details on electronic or cash tolling for new ramps.<br>Consideration of implementation of peak and variable tolling. | Section 1.4, Section 2.2.7 and Section 6.4. |
| Property acquisition | Extent and location of property acquisition. | Section 10.5. |

| Issue | Issue details | Environmental assessment section |
|---|---|---|
| Economic impacts | Impact on Epping and other shopping areas if, following the M2 Upgrade project, the bus routes focus on Macquarie Centre.<br>Economic impacts and benefits from the M2 Upgrade project for motorist, communities and businesses. | Section 10.4, Section 9.1 and Section 10.5. |
| Process | | |
| Consultation | Potential for the formation of a working group to design and improve cyclists detour.<br>Provision of a phone line throughout planning and construction and commitments on response times.<br>Details of the communications program to advise the community of the M2 Upgrade project scope, environmental assessment results and exhibition period.<br>Method of consultation with Macquarie University, schools, councils, social/environment groups, impacted land owners and public transport industry during planning and construction of the M2 Upgrade project. | Chapter 5, Section 9.1 and Executive Summary. |
| Value for money | Degree to which increase capacity justifies cost, impacts and toll increase.<br>Process for appointing Leighton Contractors Pty Ltd.<br>Progress on design to meet planned construction start. | Chapters 2, 3, and 12, and Sections 1.4 and 7.2, construction proposed to proceed as set out in program. |
| Project approval | Potential actions that may stop or delay the M2 Upgrade project. | Chapter 8 provides environmental risk assessment. |
| Environmental assessment | Assessment methodology for M2 Upgrade project.<br>Details of the proponent for the M2 Upgrade project.<br>Consideration of both construction and operational impacts.<br>Degree to which issues raised by the community are adequately addressed.<br>Degree to which the process is conducted in an independent manner. | Technical Papers, Chapter 9, Chapter 10, Section 1.3, Chapter 5 and Statement of Validity. |
| Environmental assessment | Finality of the concept design once Department of Planning gives M2 Upgrade project approval.<br>Process for change to M2 Upgrade project elements post approval. | Section 6.6. |
| Concession Deed | Length and workings of the Concession Deed.<br>Changes to the Concession Deed as a result of the M2 Upgrade project.<br>Influence of the Concession Deed on government decisions about other public transport initiatives. | Section 1.4.<br>Section 2.2.7 provides discussion regarding Metropolitan Transport Plan |
| Project funding | Funding of the project and level of government contribution. | Section 1.4 and Section 2.2.7. |
| Footbridge assessment | Review of the existing and expected increase in traffic at the intersection and the crossing outside the Our Lady Of Lourdes school. | Section 9.1 and Section 10.4. |

## 5.4 Future and ongoing consultation

The project would continue to identify and manage issues of interest or concern during the approval process and, should the project be approved, during construction, commissioning and operation. The next phase of formal community consultation is expected to commence in the second quarter of 2010 as part of public exhibition of the environmental assessment. Communication and consultation activities are described in the following subsections.

### 5.4.1 Phase two – environmental assessment public exhibition

Consultation during this phase would continue to focus on building community awareness of the project and encourage participation in the public exhibition. The environmental assessment public exhibition period is determined by the Director-General and would extend for at least 30 days. During the exhibition period, the public is able to review the environmental assessment and send written submissions to the Director-General for consideration in its assessment of the project. During this time, the community would be provided with opportunities to discuss the environmental assessment with members of the project team. The RTA would advertise the dates and venues of the public display in the local and metropolitan press.

The comments and RTA's responses would be included in a submissions report. The submissions report would be considered by the Department of Planning in its assessment report to the Minister for Planning. Communication and consultation activities planned for the exhibition period include:

- Newspaper advertisements – public exhibition notification.
- Community update brochure.
- Community information sessions and display materials.
- Fact sheets.
- Stakeholder meetings.
- Email updates to registered list.
- Project telephone and email facilities.

### 5.4.2 Phase three – construction

Community engagement during the construction phase would focus on providing information about the works program, minimising potential impacts and providing timely response to concerns raised by community and stakeholders. The key construction activities and tools would include:

- Works notifications to residents and businesses.
- Traffic management notifications.
- Regular community newsletters.
- Regular website updates.
- Regular advertising in local and metropolitan newspapers.
- Compound site signage.
- Project telephone and email facilities.

### 5.4.3 Phase four – commissioning

Ongoing communications including a range of communication tools would be used to support transition of each element of the M2 Upgrade project from commissioning to operation.

# 6. Project description

The M2 Upgrade project includes the upgrade construction works and operation of the M2 Motorway between Windsor Road and Lane Cove Road. The project also includes the development of all associated or ancillary works, activities, uses, structures and facilities. This chapter describes the project and its operation. A description of the construction of the project is provided in Chapter 7.

| Director-General's Requirements | Where addressed |
|---|---|
| *A description of the project including:* | |
| *Route alignment of the project, including an indication of areas for widened or new carriageways, on-ramps, off-ramps, breakdown lanes and associated and ancillary facilities.* | *Sections 6.2, 6.3* |
| *Key design elements of the project, including carriageway, tunnelling and bridging works.* | *Sections 6.2, 6.3* |
| *Ancillary operational components, including upgrades to the M2 Motorway's Intelligent Transport Systems, upgrades to toll facilities, park and ride facilities, cycle facilities, signals and connections with the surrounding road network.* | *Section 6.4* |
| *Operational traffic and transport implications – the assessment must also consider operational implications for public transport (particularly with respect to bus routes, interchanges and connections with the rail network), impacts on cyclists and cycle access, and any impacts on pedestrian access and safety (for those ancillary works around the M2 corridor, as relevant).* | *Sections 6.3.2, 9.1.2* |
| *Urban design and landscaping issues – the environmental assessment must include consideration of the urban design and landscape implications of the project, including identification of urban design and landscaping objectives to enhance the current road corridor and to demonstrate how the proposed urban design elements of the project would be consistent with the existing (and desired) character of the area.* | *Sections 6.5.2, 9.6.2, 9.6.3* |

## 6.1 Project overview

The M2 Upgrade project would extend for 14.5 kilometres along the M2 Motorway from Windsor Road, Baulkham Hills to Lane Cove Road, North Ryde. The project would be undertaken within a broader study area which extends from Abbott Road, Baulkham Hills, to the western portal of the Lane Cove Tunnel in North Ryde. An overview of the project location and alignment is provided in Figures 1 and 2.

The proposed upgrade would include the following key components:

- Widening and/or provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road.
- Provision of new on and off-ramps at Windsor Road, new on-ramp at Christie Road and new off-ramp at Herring Road.
- Widening and provision of a third lane eastbound and westbound in the Norfolk Tunnel.
- Restoration of the westbound breakdown lane and provision of 3.5 metre wide traffic lanes between Lane Cove Road and Beecroft Road.
- Removal of the Beecroft Road bus on and off-ramp.

- Upgrade to the intersection of the M2 Motorway/Windsor Road, and the Christie Road/Talavera Road and Herring Road/Talavera Road intersections.
- Upgrade to the M2 Motorway Intelligent Transport System.

More detail on the extent and specific components of the project is presented in Figure 5.

The project defined in this environmental assessment is based on a concept design, which is consistent with the principles of ecologically sustainable development. The concept design presents a general arrangement for the upgrade, based on current information. This differs slightly from the project declared by the Minister and presented in the Preliminary environmental assessment as further investigations have resulted in design refinements leading to the deletion and addition of project components such as:

- The deletion of the park and ride facility.
- The addition of works to improve functionality at Christie, Herring and Talavera Roads.

The concept design would be further developed as the project progresses. However, the nature of such variations would be generally consistent with the concept design. More detail regarding the design process is provided in Section 6.5.

The NSW RTA is seeking approval for the construction and operation of the project including all associated or ancillary works, activities, uses, structures and facilities.

## 6.2 Route alignment and key features

The Director-General requires a description of the route alignments of the project including an indication of areas for widened or new carriageways, on-ramps, off-ramps, breakdown lanes and associated and ancillary features to be included in the environmental assessment. This information is provided in this section.

The project would be undertaken between Windsor Road and Lane Cove Road, and within a broader study area that extends from Abbott Road to the Lane Cove Tunnel. The broader study area has been separated into five precincts. These precincts and the works proposed within each precinct are shown in Figure 5 and described below.

### 6.2.1 Precinct 1 – Abbott Road to Windsor Road (chainage 3300 – 4000)

Proposed upgrade works within Precinct 1 include new west facing on and off-ramps between the M2 Motorway and Windsor Road and modifications to the current grade separated interchange. To accommodate the new west facing ramps, the M2 Motorway would be widened on the approach to the Windsor Road interchange (from just west of the Watkins Road overbridge at approximately chainage 3400 to Windsor Road at chainage 4000 (600 metres)). The Windsor Road overbridge would be widened on the western side and modified to provide additional through lanes at the intersection and accommodate adequate ramp turning lanes for the new ramps. Windsor Road would be widened between Woodlands Street and Oakland Avenue.

New barriers in the median of the M2 Motorway would not be provided west of Windsor Road given the existing width of the median through this section, which is sufficient to provide the required clear width to comply with design standards.

Section 6.3.2 provides further description of the Windsor Road ramp configuration and Section 6.3.6 describes the proposed Windsor Road bridge modification works.

### 6.2.2 Precinct 2 – Windsor Road to Pennant Hills Road (chainage 4000 – 9000)

Proposed upgrade works within Precinct 2 include widening of the road pavement to create an additional 3.5 metre wide eastbound lane from the end of the Windsor Road entry ramp to the Pennant Hills Road exit ramp. As a result of the upgrade, the eastbound mainline carriageway would comprise three 3.5 metre wide lanes, a single 3.5 metre wide bus lane and a single 2.5 metre wide breakdown lane that could be used by bicycle users. Traffic entering from Windsor Road would not have to merge and would run into its own lane. Essentially, the modification would result in a lane gain at the Windsor Road on ramp and a lane drop at the Pennant Hills Road exit ramp

Proposed works include modifications to Darling Mills Creek Bridge, Barclay Road overbridge and Yale Close Bridge (refer to Section 6.3.3 for a description of these bridges).

Widening of the road pavement would occur on the northern side of the M2 Motorway over Darling Mills Creek (bridge structure) and east of the creek from approximately chainage 4550 to 5950 (1,400 metres).

The M2 Motorway through this section, at approximately chainage 5900, would be typically widened on areas of cut, as can be seen in the typical cross-section in Figure 6.

Widening of the road pavement would occur to south of the M2 Motorway from approximately chainage 5800 to 7700 (1900 metres), east of the Barclay Road overbridge. The existing cutting to the south would be widened between approximately chainage 5830 and 6000 (170 metres). A typical cross-section of a cutting is illustrated in Figure 6. The existing median would be shifted to the south to create the additional eastbound lane. A small section of widening would occur to the north of the M2 Motorway from approximately chainage 7600 to chainage 7820 (220 metres), tying the additional eastbound lane into the off-ramp at Pennant Hills Road.

To accommodate the widening of the road pavement there would be concrete retaining wall supporting a widened earth embankment, and battering works required at various sections of the carriageway on the northern and southern sides of the M2. The nature of battering work would be finalised during the detailed design phase of the project.

Emergency stopping bays would be provided on the widened carriageway to match the existing locations and median barriers would be in place for the length of this section.

### 6.2.3 Precinct 3 – Pennant Hills Road to Beecroft Road (chainage 9000 – 11900)

Proposed upgrade works within Precinct 3 include widening to create an additional 3.5 metre wide lane eastbound and westbound.

The additional eastbound lane would extend from the Pennant Hills Road entry ramp to the Beecroft Road entry ramp. As a result of the upgrade, the eastbound mainline carriageway would provide three 3.5 metre wide lanes, a single 3.5 metre bus lane (terminating approximately 1200 metres west of Beecroft Road interchange) and a single 2.5 metre breakdown lane.

The additional westbound lane would extend from the Beecroft Road interchange to the Pennant Hills Road exit ramp. This is a distance of approximately 1300 metres of an additional lane gain. As a result of the upgrade, the westbound mainline carriageway would comprise three 3.5 metre wide lanes, a single 3.5 metre wide bus lane (commencing approximately 650 metres west of Beecroft Road interchange) and a single 2.5 metre wide breakdown lane.

Where the bus lanes would terminate, both eastbound and westbound carriageways would provide three 3.5 metre wide lanes and a single 2.5 metre wide breakdown lane.

The M2 Motorway would be widened on the southern side to accommodate the additional westbound lane, from approximately chainage 9600 to 11360 (1760 metres), being west of the Kent Street footbridge. From the commencement of Devlins Creek Bridge at approximately chainage 9850, the gap between the eastbound and westbound carriageway bridge structures over Devlins Creek would be closed to accommodate a third lane eastbound. Modifications would also be required to Kirkham Street Bridge to accommodate widening works (refer to Section 6.3.6).

Earthworks embankment and battering works would be required at various sections of the carriageway along the alignment in this precinct. Emergency stopping bays would be provided on the widened carriageways to match the existing locations and median barriers would be in place for the length of this section. The nature of embankments and batters and the number and location of emergency stopping bays would be determined during the detailed design phase of the project.

### 6.2.4 Precinct 4 – Beecroft Road to Terrys Creek (including Norfolk Tunnel) (chainage 11900 – 13500)

Proposed upgrade works within Precinct 4 include widening of the road pavement to create an additional 3.5 metre wide lane eastbound from Beecroft Road to the Terrys Creek Bridge, including the 460 metre long Norfolk Tunnel. As a result of the upgrade, the eastbound mainline carriageway would comprise three 3.5 metre wide lanes and a single 2.5 metre breakdown lane.

Proposed upgrade works within Precinct 4 also include works to widen existing westbound lanes to 3.5 metres and reinstating the westbound breakdown lane from the Terrys Creek Bridge to the Beecroft Road interchange. As a result of the upgrade, the westbound mainline carriageway would provide three 3.5 metre wide lanes and a single 2.5 metre wide breakdown lane.

The bus ramp bridge near Beecroft Road bus bridge would be demolished and the existing eastbound bus lane would terminate west of Beecroft Road, convert to a normal traffic lane on the eastbound carriageway and the westbound bus lane would begin west of Beecroft Road. The outcome is the addition of a third lane in both directions without the need for widening of the carriageways (refer to Section 6.3.6). A central Beecroft Road bridge pier would replace the existing piers to facilitate the addition of the third lane and strengthening of the bridge would be required. Widening works would resume from approximately chainage 12200 at the western portal of the Norfolk Tunnel.

The Norfolk Tunnel would be widened to accommodate a third lane in the eastbound tube (widened to the north) and accommodate lane widening in the westbound tube to reinstate the breakdown lane (widened to the south). A typical cross-section of the Norfolk Tunnel is illustrated in Figure 7. The deep excavations in sandstone bedrock that form the tunnel approaches (the tunnel 'portals') would also be widened on the northern and southern sides to provide sufficient space for the additional road pavement. East of the eastern tunnel portal, the M2 Motorway would be widened on the southern and northern sides, to accommodate a third lane eastbound and reinstatement of the breakdown lane westbound. Widening to the north would extend from the tunnel portal to approximately chainage 13350, whilst widening to the south would extend to west of Terrys Creek.

Emergency stopping bays would be provided on the widened carriageways to match the existing locations and median barriers would be in place for the length of this section. The number and location of emergency stopping bays would be determined during the detailed design phase of the project.

### 6.2.5 Precinct 5 – Terrys Creek to Lane Cove Tunnel (chainage 13500 – 17700)

Proposed upgrade works within Precinct 5 include widening to create an additional 3.5 metre wide lane eastbound from the Terrys Creek Bridge to Lane Cove Road. As a result of the upgrade, the eastbound mainline carriageway would comprise three 3.5 metre wide lanes and a single 2.5 metre breakdown lane. One of the lanes would be marked as a T2 lane east of Terrys Creek Bridge to near Lane Cove Road. The exact location of the T2 lane commencement would be determined at the detailed design phase.

Proposed upgrade works within Precinct 5 also include widening of existing westbound lanes to 3.5 metres and reinstatement of the westbound breakdown lane from Lane Cove Road to the Terrys Creek Bridge. As a result of the upgrade, the westbound mainline carriageway would comprise three 3.5 metre wide lanes and a single 2.5 metre wide breakdown lane allowing the speed limit to be increased from 70 kilometres per hour at the Terrys Creek Bridge westbound tunnel entry to 100 kilometres per hour.

The M2 Motorway would be widened to the north from approximately chainage 13500, just west of Terrys Creek, to approximately chainage 15370, at the western approach to the toll plaza (1,870 metres). At Culloden Road, west of the toll plaza, widening is proposed to north and south of the M2 Motorway. The toll plaza would be reconfigured, giving greater priority to electronic toll collection (ETC), with one cash booth retained in either direction. There would be three eastbound lanes as well as a breakdown lane under the Christie Road bridge.

The M2 Motorway west of the toll plaza, near Vimiera Road at approximately chainage 14000, would typically be widened on areas of fill, as can be seen in the typical cross-section in Figure 8.

A small section of median adjoining the eastbound Christie Road off-ramp would be modified to accommodate an additional lane eastbound beneath Christie Road Bridge.

The M2 Motorway would be widened to the north from approximately chainage 16100, Christie Road, to approximately chainage 17100 (1,000 metres), east of Khartoum Road, to accommodate a new eastbound on-ramp at Christie Road and an additional eastbound lane. Traffic from the Christie Road ramp would merge with the left eastbound lane of the M2 Motorway.

The M2 Motorway would be widened to the south from approximately chainage 16100, west of the toll plaza, to approximately chainage 17570 (1,470 metres), to accommodate the third westbound lane and the new Herring Road westbound off-ramp. Traffic on the westbound entry ramp merges with the left westbound lane.

The intersections at Herring Road / Talavera Road and Christie Road / Talavera Road would be modified. Talavera Road would be widened to create five traffic lanes between the access to the School of Management (west of Christie Road) and Alma Road. There would be four through lanes and a dedicated right turn lane. Christie Road would be widened to five lanes (three southbound, two northbound) and there would be a new set of traffic signals provided at the northern ramps (the existing exit ramp and proposed new entry ramp).

Emergency stopping bays would be provided on the widened carriageways to match existing locations. Median barriers would be in place for the length of this section with the possible exclusion of the toll plaza.

There would be no widening of or modification to the M2 Motorway between Lane Cove Road and the eastern end of the M2 Motorway near the Lane Cove River.

### 6.2.6 Alternative cycle route

Due to the occupation of the breakdown lanes for construction of the M2 Upgrade project, an alternative cycle route would be developed and implemented as an ancillary activity prior to construction on the M2 Motorway commencing. It is anticipated that the alternative cycle route would be used by cyclists for the duration of the construction phase.

A preferred cycle route has been determined with specialist input from GTA Consultants and in consultation with appropriate stakeholders, including local councils and cyclist interest groups. The preferred route is located primarily along local streets and other non-motorway roads between Abbott Road, Baulkham Hills and Delhi Road, North Ryde. The process of evaluating and selecting this preferred route is detailed in the *Alternative Cycle Route – Preferred Route Analysis Report* (GTA Consultants 2010).

The preferred alternative cycle route is illustrated in Figure 27. This route is subject to refinement and may change in its final alignment during detailed design. The final alignment of the alternative cycle route on non-motorway roads would form part of the M2 Upgrade project construction footprint and extent of works. Section 9.2.2 provides more information with respect to the alternative cycle route.

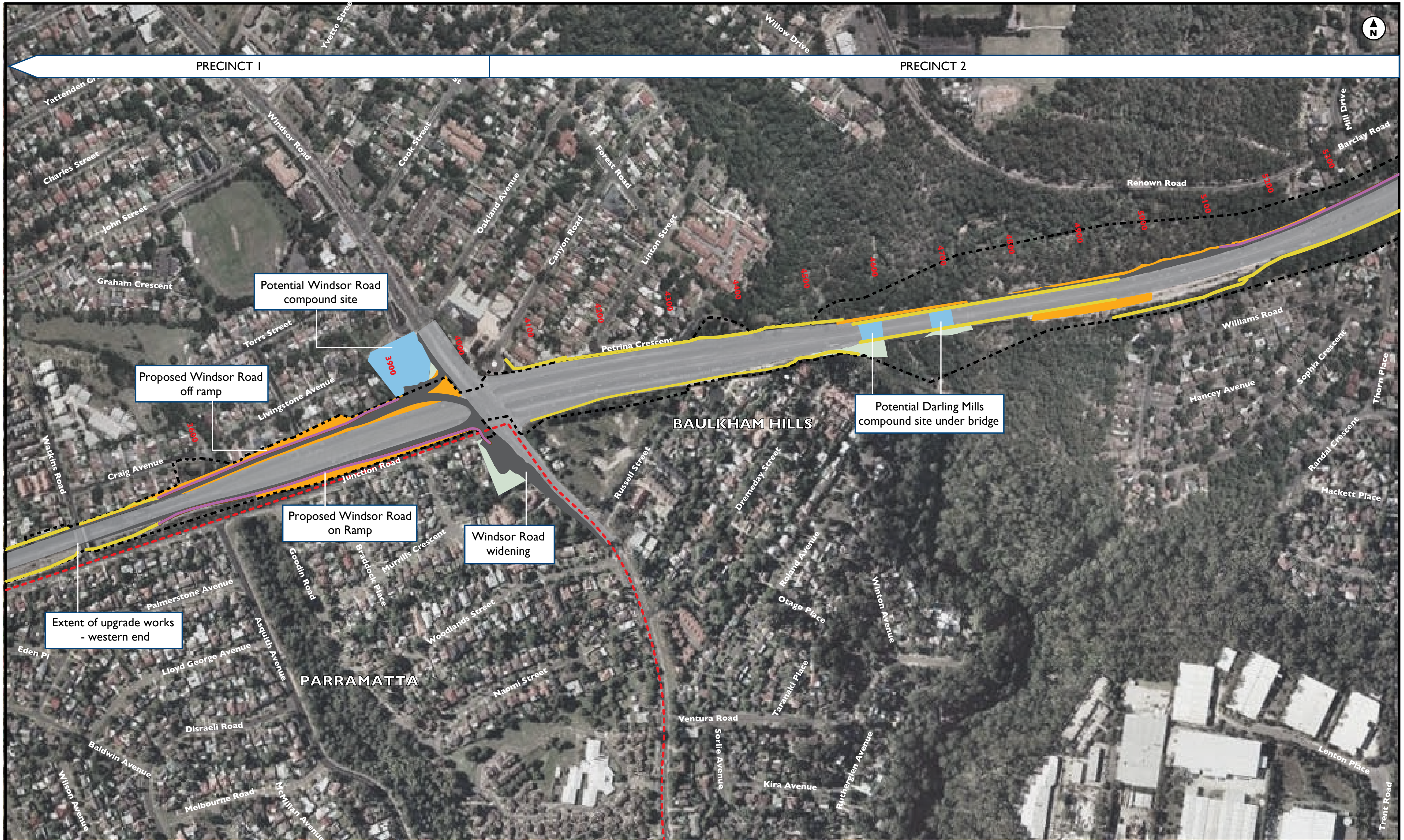



Figure 5: Map 1 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage

Source: RTA, 2010

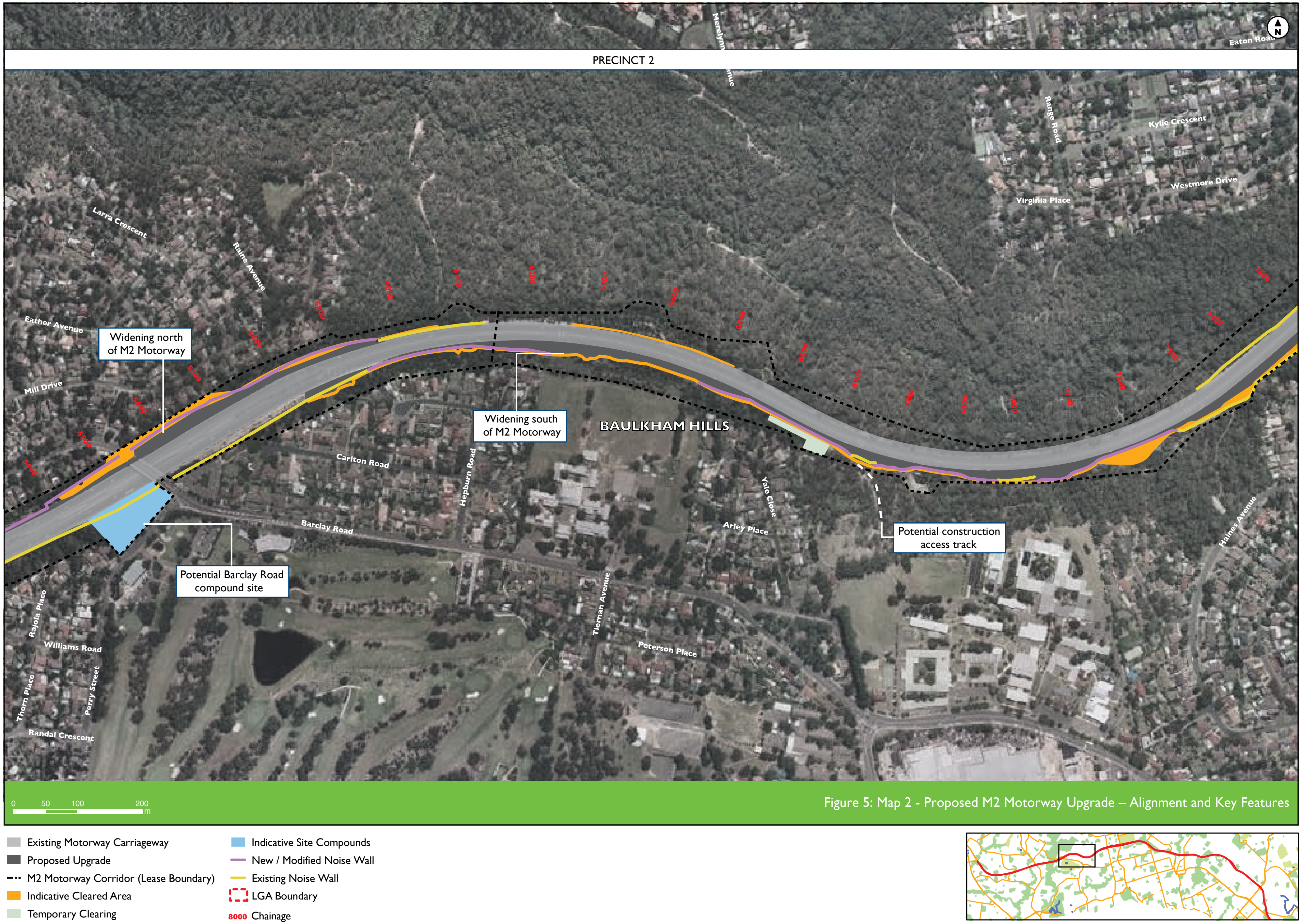



Figure 5: Map 2 - Proposed M2 Motorway Upgrade – Alignment and Key Features

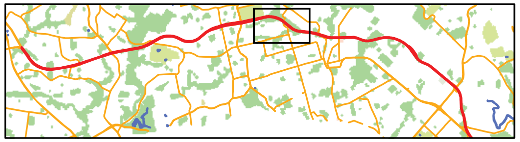
Source: RTA, 2010

Figure 5: Map 3 - Proposed M2 Motorway Upgrade – Alignment and Key Features

Source: RTA, 2010


Figure 5: Map 4 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage



Source: RTA, 2010


Figure 5: Map 5 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage

Source: RTA, 2010

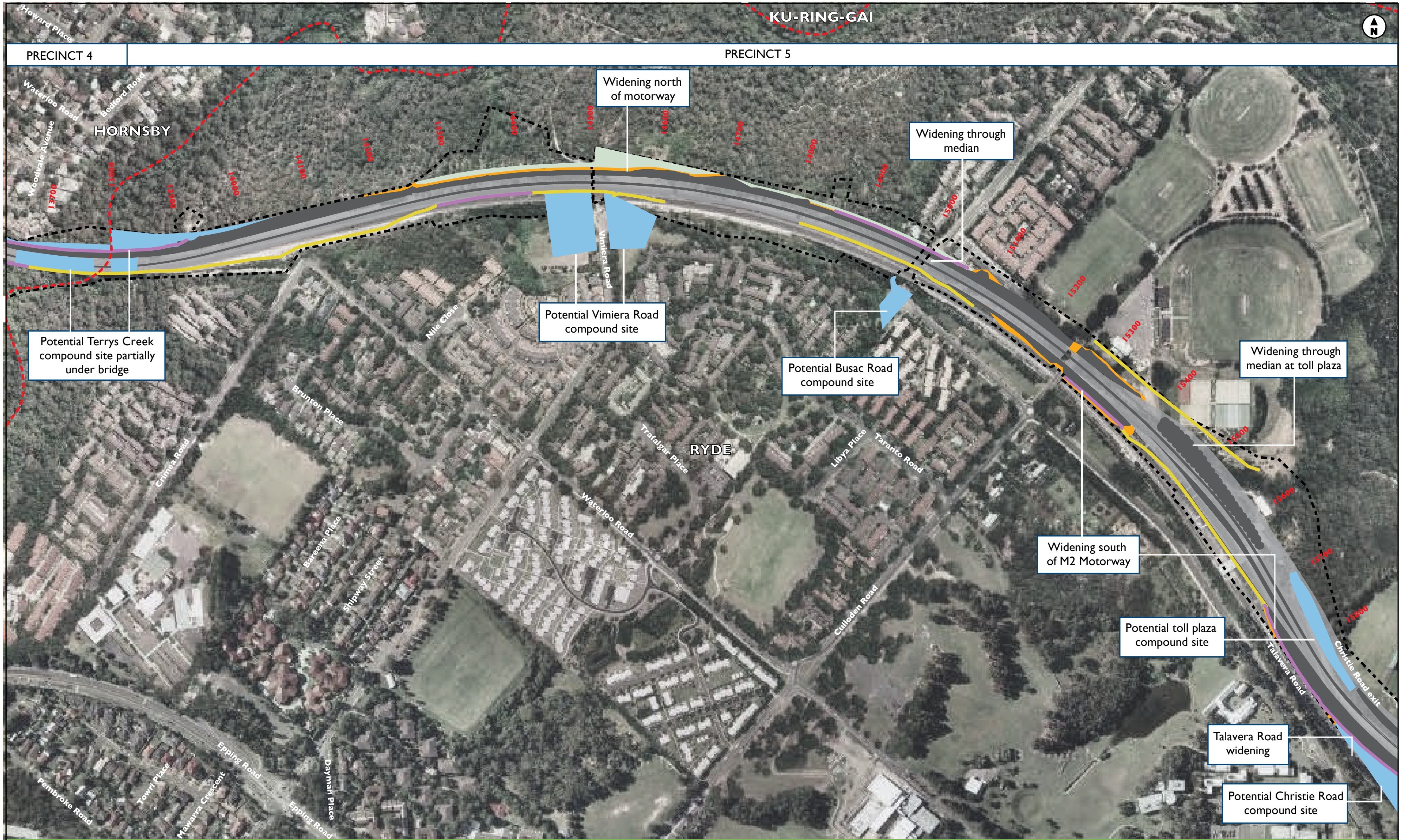



Figure 5: Map 6 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage

Source: RTA, 2010

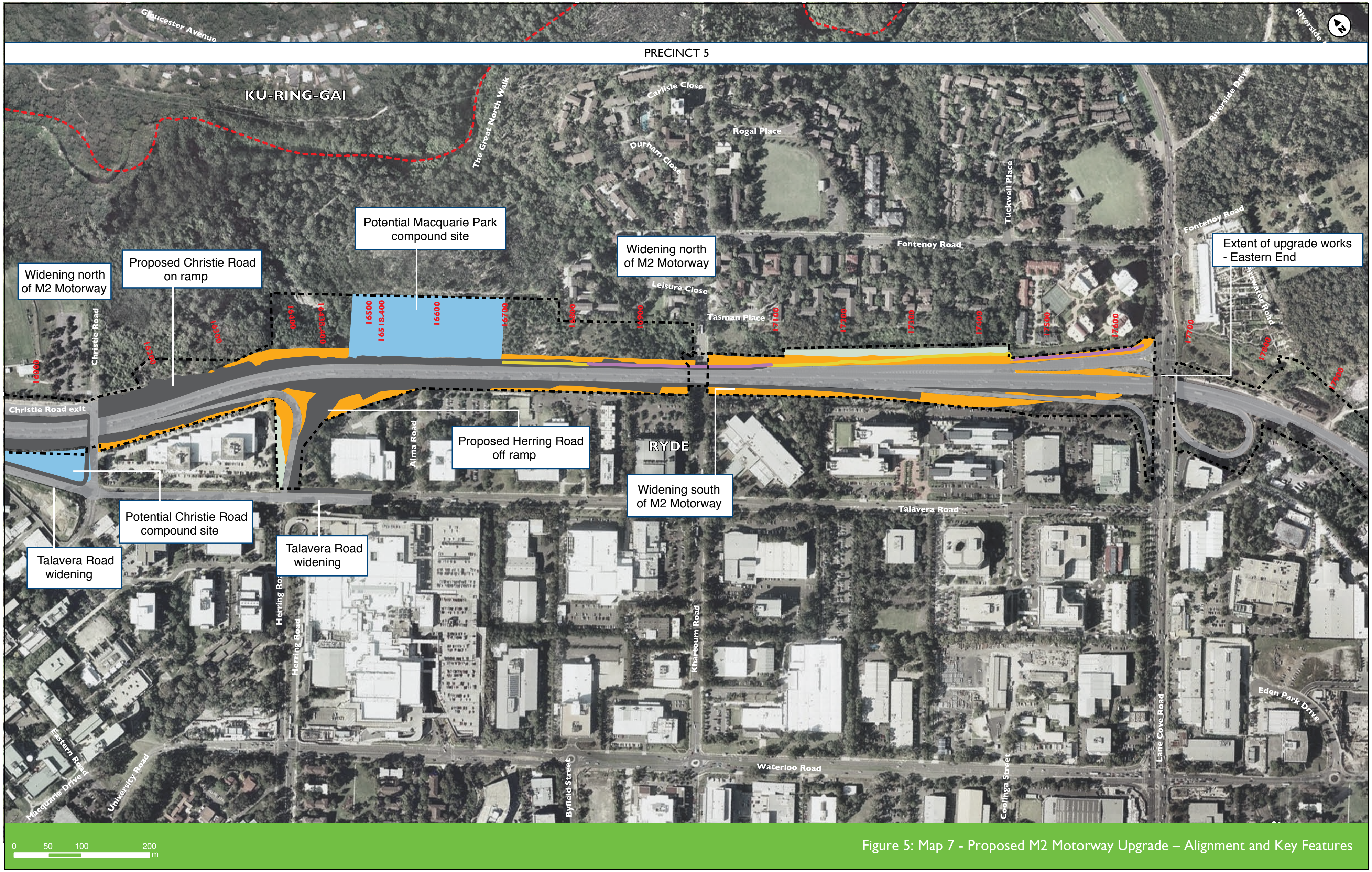


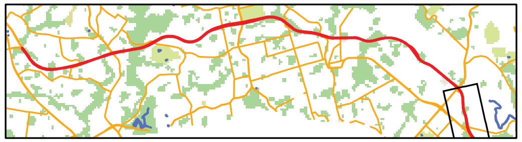

Figure 5: Map 7 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage

Source: RTA, 2010

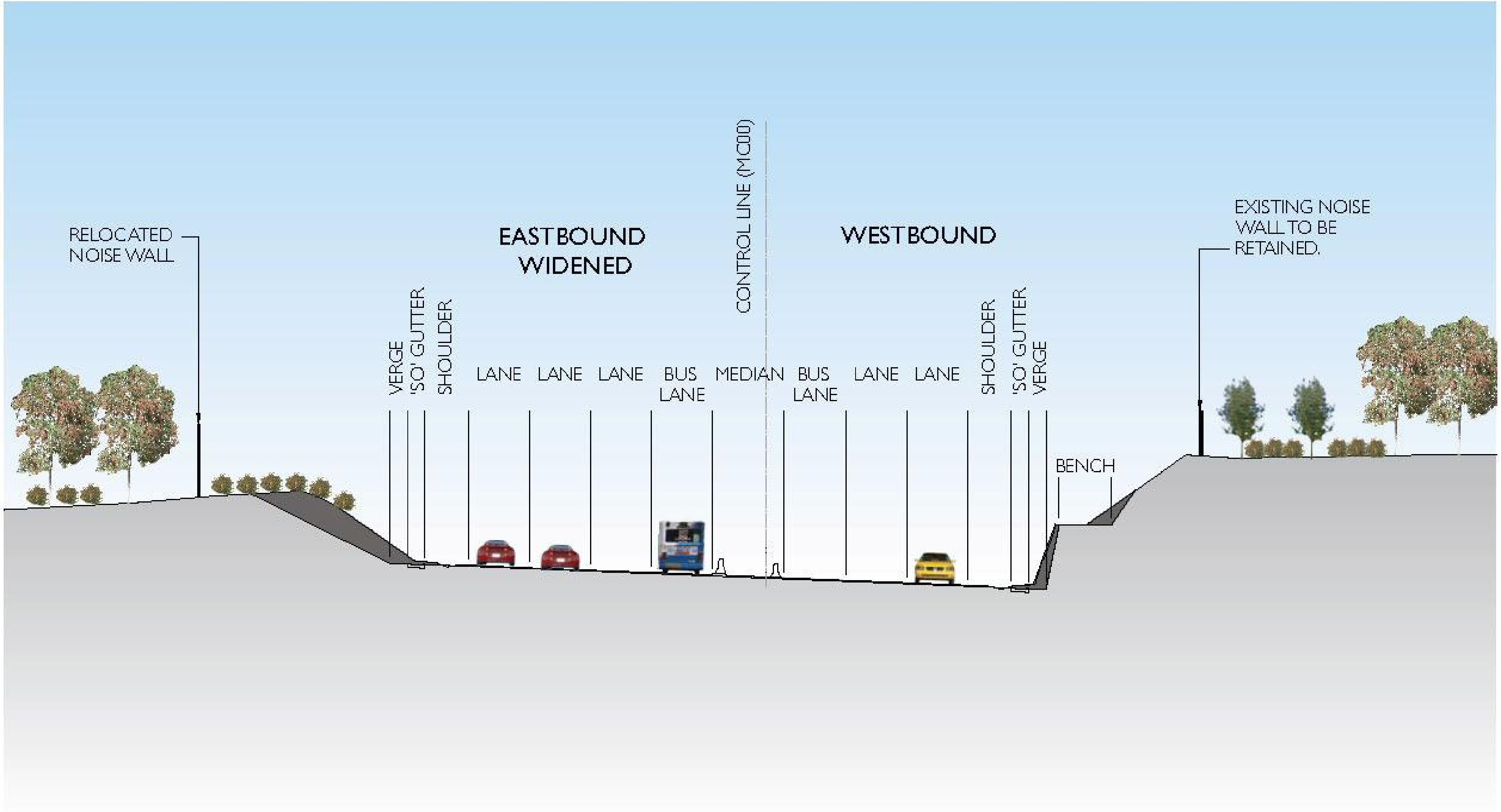

Figure 5: Map 8 - Proposed M2 Motorway Upgrade – Alignment and Key Features

- Existing Motorway Carriageway
- Proposed Upgrade
- M2 Motorway Corridor (Lease Boundary)
- Indicative Cleared Area
- Temporary Clearing
- Indicative Site Compounds
- New / Modified Noise Wall
- Existing Noise Wall
- LGA Boundary
- 8000 Chainage



Source: RTA, 2010

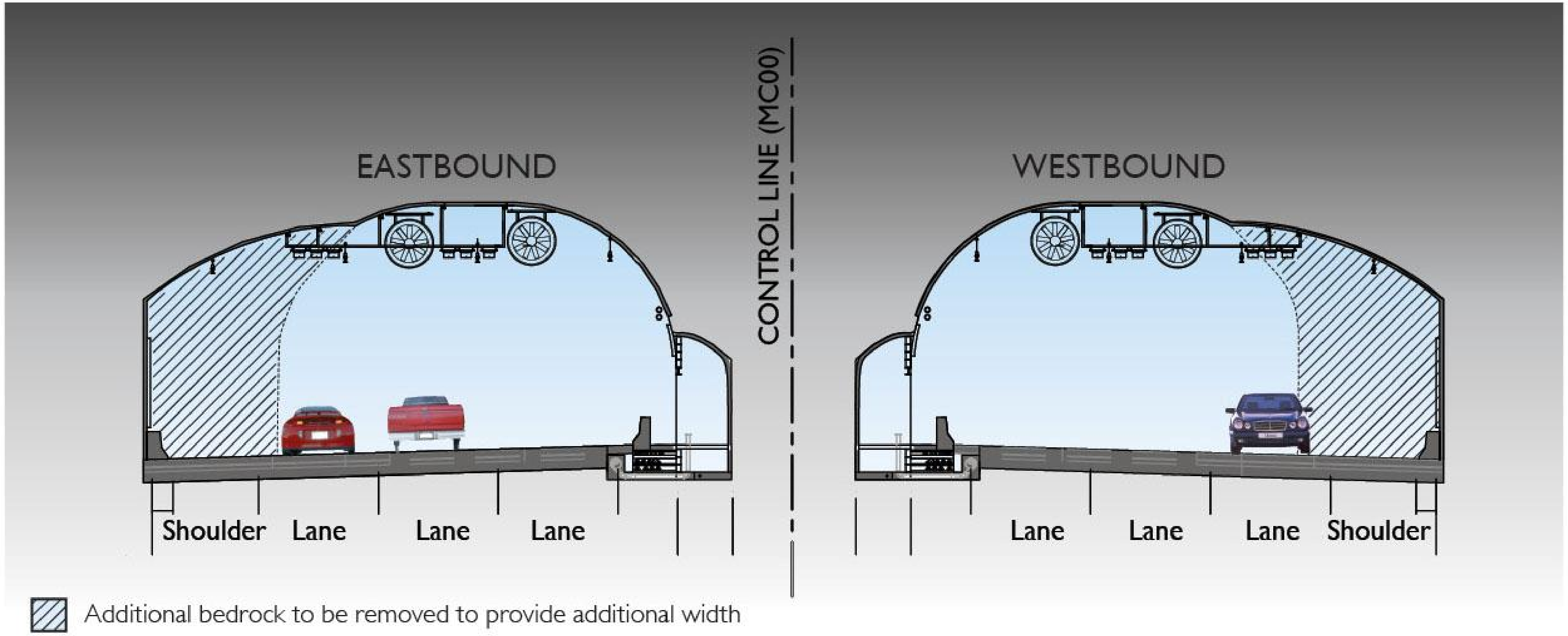
Figure 6 Typical cut cross section




*Source: Tract, 2010*

*Note: This cross section shows a typical arrangement of the M2 Motorway. The final arrangement is subject to detailed design and may vary due to site constraints.*

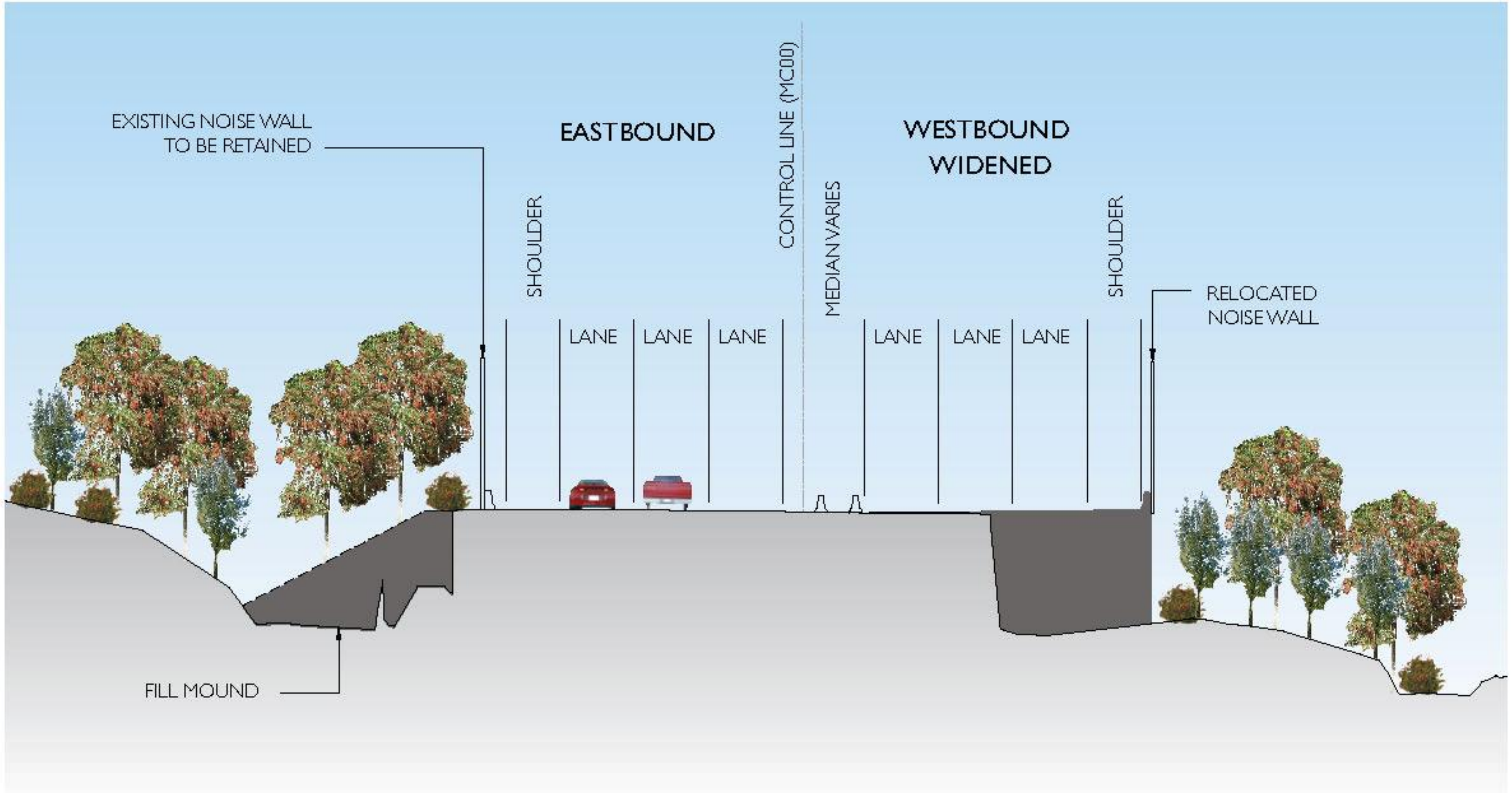
Figure 7 Typical Norfolk Tunnel cross section




*Source: AECOM, 2010*

*Note: This cross section shows a typical arrangement of the M2 Motorway. The final arrangement is subject to detailed design and may vary due to site constraints.*

Figure 8 Typical fill cross section




*Source: Tract, 2010*

*Note: This cross section shows a typical arrangement of the M2 Motorway. The final arrangement is subject to detailed design and may vary due to site constraints.*

## 6.3 Key design elements

The DGRs require a description of the key design elements of the project, including carriageway, tunnelling and bridging works. This section addresses this requirement.

### 6.3.1 Design parameters

The design on which this environmental assessment is based, is a preliminary functional layout developed as part of the concept design and environmental assessment phase. It addresses constraints and principles identified during investigations. The concept design is intended to define a robust concept that provides:

- A clear description of the design principles, extent of impacts and mitigation measures.
- A sound basis for later development of the detailed design to a standard required to support project delivery.

The concept design for the proposed upgrade works has been developed in accordance with the RTA of NSW and AustRoads Design Guidelines. The design parameters adopted for the project are provided in Table 7.

Table 7 Engineering design parameters

| Item | Element | Value |
|---|---|---|
| Length of M2 Motorway | | |
| Design speed | Horizontal alignment | 100 kilometres per hour |
| | Vertical alignment | 100 kilometres per hour |
| Lane width | Main carriageway traffic lanes | 3.5 metres |
| | Bus lanes | 3.5 metres |
| | Shoulder/ breakdown lane | 2.5 metres |
| Operation design life | Additional lane | Pavement configuration and details to match existing Motorway pavement |
| Grade | Main carriageway | To match existing |
| Drainage design life | New drainage structures | 100 years |
| | Replacement drainage structures | 100 years |
| Cycle access | Length of the M2 Motorway | Provided in the breakdown / shoulder lane |
| Stopping sight distance | Horizontal | 150 metres |
| | Reaction Time | 1.5 seconds |
| | Vertical | 175 metres |
| Ramps – on and off | | |
| Maximum vertical grade | On-ramps | 6.0 percent |
| | Off-ramps | 6.0 percent |
| Design speed | On | 100 kilometres per hour |
| | Off | 60 kilometres per hour |

| Bridges | | |
|---|---|---|
| Design speed | Horizontal alignment – overbridges | 60 kilometres per hour on local roads |
| | Horizontal alignment – underbridges | 100 kilometres per hour on M2 |
| | Vertical alignment – overbridges | 60 kilometres per hour on local roads |
| | Vertical alignment – underbridges | 100 kilometres per hour on M2 Motorway |
| Lane width | Traffic lanes | 3.5 metres |
| Shoulder width | Outside shoulder | 2.5 metres |
| | Inside shoulder | 0.5 metres |
| **Tunnel** | | |
| Headroom Clearances | Services | 5.3 metres |
| | Motorway carriageways | 4.6 metres for the working width envelope |
| **Cutting and batters** | | |
| Batter slopes | Cut batters and embankments | Cut slope angle varies to suit geological conditions and embankments generally at 1(V) to 2(H) |

### 6.3.2 M2 Motorway on and off-ramps

#### Windsor Road ramps

New west facing on and off-ramps would be constructed at the existing Windsor Road interchange. Various modifications are required to the existing intersection to accommodate the new ramps.

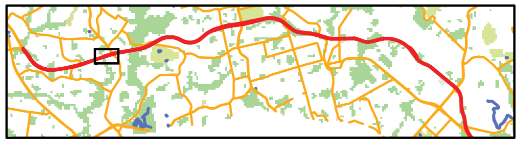
The new eastbound off-ramp alignment would commence as a single lane on the M2 Motorway for approximately 260 metres from Watkins Road to approximately chainage 3800, prior to splitting into three lanes. One lane would turn left onto Windsor Road northbound and two lanes would turn right onto Windsor Road southbound. To accommodate the new ramps and traffic lanes, the existing reinforced concrete retaining wall would be extended vertically and noise walls in this section would be relocated to the north and heightened.

The west facing on-ramp would be accessible to traffic travelling southbound and northbound along Windsor Road. The ramp would accommodate two lanes and would merge to one lane in the approach to the M2 Motorway. Both west facing on and off-ramp structures would be constructed on embankments connecting to the existing Windsor Road overbridge. Construction of the west facing on-ramp would require battering works in the approach to the M2 Motorway from Windsor Road northbound. The existing noise wall along the southern edge of the M2 Motorway along Junction Road would be relocated to the south, heightened and extended around the corner of Windsor Road but would not impact on Junction Road. The existing reinforced earth retaining wall would be extended vertically.

Refer to Figure 9 for an image of the Windsor Road ramp configuration.


Figure 9 – Proposed M2 Motorway Upgrade – Windsor Road Interchange

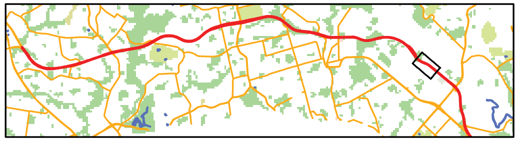
M2 Motorway Corridor (Lease Boundary)
Extent of Proposed Upgrade
Cadastral Boundaries
3500 Chainage



Source: RTA, 2010


Figure 10 – Proposed M2 Motorway Upgrade – Christie and Herring Road Interchange

- M2 Motorway Corridor (Lease Boundary)
- Extent of Proposed Upgrade
- Cadastral Boundaries
- 16000 Chainage



Source: RTA, 2010

### Christie Road and Herring Road ramps

An eastbound on-ramp would be constructed from Christie Road, which involves widening of the eastbound carriageway of the M2 Motorway from near chainage 16100, and cut and batter works. The new eastbound on-ramp has two traffic lanes at the Christie Road intersection departure side, and would merge to form one lane which would merge with the kerbside lane east of Christie Road.

A new east facing off-ramp would be provided to access Talavera Road at Herring Road. This would involve construction of a reinforced earth retaining wall and embankment to stabilise the new ramp. The ramp would consist of a diverge one lane exit before the ramp widens to three lanes at Talavera Road to accommodate left and right turn movements.

Figure 10 illustrates the configuration of the new Christie Road and Herring Road ramps.

### 6.3.3 Norfolk Tunnel widening

The Norfolk Tunnel (also known as the Epping Tunnel) would be widened to accommodate three trafficable lanes of 3.5 metres wide and a 2.5 metre wide breakdown lane. The two existing tunnel tubes would be widened on the northern (eastbound direction) and southern (westbound direction) sides to accommodate the additional road pavement. The sandstone bedrock would be cut away from within the tunnel tubes to provide the additional width. Road headers and excavators mounted with rock hammers would be used to cut the bedrock away. Existing support measures that are in place to stabilise the internal surfaces of the tunnels tubes such as rock bolts would remain in place as widening is progressed along the tunnel length. New support measures would be installed immediately following the widening so that structural integrity of the tunnel is maintained. A typical cross section of the widened tunnel is shown in Figure 7.

The deep excavations in sandstone bedrock that form the tunnel approaches (the tunnel 'portals') would also be widened to accommodate the additional road pavement. The large sloped cut faces on either side of the portals would be steepened to create the required space at the base of the cuttings for the additional road pavement without affecting the top of the cutting faces. The existing noise walls at the top of the cutting faces would remain unaffected by the proposed works. If necessary the faces may need to be stabilised, for example by using rock bolts.

The services currently installed on the slow lane side of each tunnel tube would need to be relocated to the opposite side of the tunnel tube in order to facilitate the proposed widening works. Additional tunnel supports would also need to be installed to support the additional width of the tunnel span. These works would need to occur prior to the commencement of the tunnel widening works. Full possession of a tube may be required during this process.

In addition to widening works and services relocation, the tunnel tubes would be lined and additional lighting installed to improve tunnel safety for road users. The existing cross passages between the tunnel tubes would also be modified. A new fire safety deluge system would be installed as part of the tunnel upgrade works. The lighting and deluge systems would be modified to meet the requirements of the wider tunnel.

There are no proposed changes to the tunnels' existing exhaust extraction system. The current system has excess capacity and would be sufficient for the widened tunnel. Further details of the proposed mechanical and electrical upgrades to the tunnel are provided in Section 6.4.2 (refer to Section 7.6.2 for further details regarding tunnel construction work hours).

### 6.3.4 M2 Motorway bridges

The project would require upgrades to bridge structures to accommodate the widening works. A typical cross-section of a bridge structure is illustrated in Figure 11.

The proposed bridge upgrades are discussed below in order of geographic location from west to east.

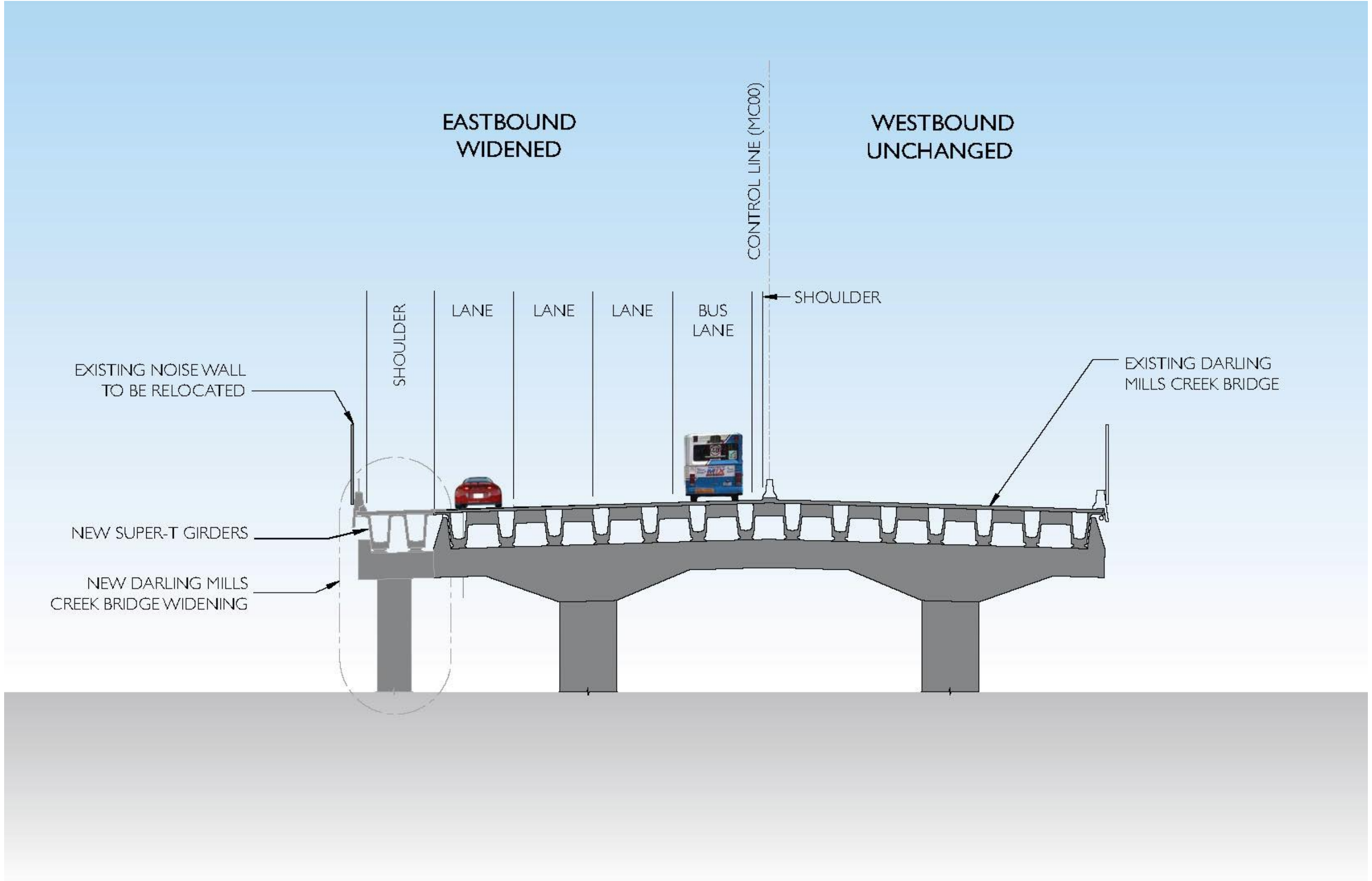
#### Darling Mills Creek Bridge

Darling Mills Creek Bridge is a five span Super-T bridge that extends approximately 161 metres in length over the valley at Darling Mills Creek. The bridge would be widened by approximately 3.5 metres on the north side. Works would involve widening the existing abutments by installing an additional pile and extending the existing reinforced earth retaining wall and extending the headstock. Each of the piers would be widened by constructing an additional column and foundation and extending the crosshead. The deck would also be widened by installing two Super-T beams across each span, removing the existing edge barrier, extending the deck slab and constructing a new edge barrier.

#### Yale Close Bridge

The Yale Close Bridge is a 35 metre long, single span Super-T bridge that extends over Blue Gum Creek. The bridge would be widened approximately 3.5 metres on the south side and the median barrier relocated to accommodate the eastbound widening. The works would require widening of the existing abutments by installing an additional pile, extending the existing reinforced earth retaining wall and extending the headstock. The deck would be widened by the addition of two Super-T beams, removing the existing edge barrier, extending the deck slab and constructing a new edge barrier.

Figure 11 Typical Super-T bridge structure




*Source: Tract, 2010*

*Note: This cross section shows a typical arrangement of the M2 Motorway. The final arrangement is subject to detailed design and may vary due to site constraints.*

## Devlins Creek Bridge

Devlins Creek Bridge is a two span Super-T bridge which extends over Devlins Creek valley. The eastbound bridge is a 383 metre long, 19 span structure and the westbound bridge is a 305 metre long, 15 span structure. The westbound bridge would be widened by 3.5 metres on the south side and the two bridge structures would be joined by infilling the central median.

Widening to the south (westbound), adjacent to the outer lane of the bridge, would require widening of the existing abutments by installing an additional pile, extending the existing reinforced earth retaining wall and extending the headstock. The piers would be widened by constructing an additional column and extending the crosshead. The deck would be widened by the addition of two Super-T beams each span, removing the existing edge barriers, extending the deck slab and constructing a new edge barrier.

The eastbound bridge would be widened by infilling the gap between the two bridge structures. The works would require connection of the existing abutments by installing an additional pile and infilling between the headstocks. The piers would be connected by constructing an additional column and foundation and infilling between the crossheads. The deck would be in-filled by the addition of two Super-T beams each span, removing the existing edge barriers, joining the deck slabs and constructing a new median barrier.

## Somerset Street Suspended Structure

The M2 Motorway (at the eastern end of Somerset Street) would be supported on a series of columns, each with a single pile footing, over the existing drainage basin. The deck consists of beams parallel to the roadway with concrete slabs spanning between the beams. The adjacent reinforced soil retaining wall at this location would not be relocated due to the presence of the existing basin.

## Terrys Creek Bridge

Terrys Creek Bridge is a five span Super-T bridge that extends 169 metres in length over Terrys Creek valley. The bridge would be widened approximately nine metres on the north side to accommodate widening of the eastbound and westbound carriageways, which would also involve shifting the median to the north. The works would involve widening of the existing abutments by installing additional piles, extending the existing reinforced earth retaining wall and extending the headstock. The piers would be widened by constructing an additional column and extending the crosshead. The deck would be widened by the addition of four Super-T girders each span, removing the existing edge barrier, extending the deck slab and constructing a new edge barrier.

## Khartoum Road Bridge

Khartoum Road Bridge is a single span Super-T bridge, which extends approximately 31 metres in length, carrying the M2 Motorway over Khartoum Road. The bridge would be widened by approximately 3.5 metres on the north side to accommodate the third lane eastbound. The bridge would also be widened by approximately 3.5 metres on the south side to accommodate widening of the westbound carriageway.

The works would involve widening of the existing abutments by installing additional piles, extending the existing reinforced earth retaining wall and extending the headstock. The deck would be widened by the addition of two Super-T girders on the north side and two Super-T girders on the south side, removing the existing edge barriers, extending the deck slab and constructing new edge barriers.

### 6.3.5 M2 Motorway cycle access

Cycle access would be provided within the breakdown lane for the length of the M2 Motorway. In particular, the upgrade would reinstate access to the breakdown lane westbound between Lane Cove Road and Beecroft Road. This westbound lane has been subject to an interim widening scheme to provide a third lane since 2007 to improve traffic flow. In addition, cycle access would be provided to the breakdown lane through the Norfolk Tunnel in both the eastbound and westbound direction.

New access points to the M2 Motorway would be available to cyclists given the provision of the new access ramps at Windsor Road, Christie Road and Herring Road. Cycle access to the breakdown lane would be reinstated to a level equivalent to that prior to the interim widening plus the additional accesses at Windsor, Christie and Herring Roads. Cycle access during construction is discussed in Sections 7.3 and 9.2.

### 6.3.6 Local Road Upgrades

A number of local (non-motorway) roads would be upgraded and widened as part of the project. These works are associated with new and upgraded on and off-ramps and would accommodate additional movement between local roads and the M2 Motorway.

The widening and upgrade works would occur on the following local roads:

- Windsor Road.
- Christie Road.
- Herring Road.
- Talavera Road.
- Somerset Street (minor modifications at the intersection with Gloucester Road).

#### Windsor Road

Windsor Road interchange has three northbound through lanes that currently provides one right turn lane on the east facing M2 Motorway on-ramp. An additional right turn lane would be created, to provide two right turning lanes onto the east facing Motorway on-ramp. Both right turning lanes would extend approximately 50 to 70 metres south. An additional northbound lane would be created as a left turning slip lane, to access the new west facing on-ramp, commencing approximately 100 metres from the southern edge of the M2 Motorway. Refer to Figure 9 for illustration of proposed Windsor Road interchange.

Windsor Road interchange consists of three through lanes southbound, which currently merge into two lanes, approximately 40 metres after the intersection of the east facing Motorway off-ramp. This lane configuration would be retained. Three through lanes would cross the Windsor Road Bridge in both the northbound and southbound directions.

To accommodate traffic movements associated with the new west facing ramps, Windsor Road would be widened south of the M2 Motorway, between the M2 Motorway and Woodlands Street, to both accommodate northbound Windsor Road traffic movements accessing the new west facing on-ramp and to add an additional right turning lane for the existing east facing on-ramp. There would also be widening north of the M2 Motorway to Oakland Avenue on the western side. The extent of the Windsor Road widening is shown in Figure 9.

The upgrade work would involve new line marking on Windsor Road and realignment of the median. Line marking would occur south of the M2 Motorway to accommodate movement from the new west facing off-ramp toward the south. North of the M2 Motorway, new line marking would occur northbound and southbound to accommodate the new west facing on and off-ramps. Southbound on Windsor Road, the median strip would be paved and re-marked to accommodate two right turning lanes for the west facing on-ramp.

### Christie Road

Christie Road, in its current configuration, consists of three lanes. One northbound lane begins at the intersection with Talavera Road and continues across the bridge and into Christie Park car park. Two southbound lanes originate from Christie Park and are joined by the two right turning lanes from the existing west facing off-ramp. The two lanes cross the bridge with one lane becoming a right turning lane onto Talavera Road and the second becoming a left turning lane onto Talavera Road.

Christie Road and the Christie Road Bridge would be widened from three existing lanes to five lanes between the Christie Park access and Talavera Road on the western side. The widening would accommodate northbound right turning lanes for the new east facing on-ramp and southbound turning lanes onto Talavera Road. There would be new traffic control signals at the existing off-ramp and new on-ramp.  Refer to Figure 10 for an illustration of proposed Christie Road / Herring Road interchange.

Two northbound Christie Road lanes would provide access to the new east facing on-ramp. The left lane also continues straight to provide access to the Christie Park car park. There would be three southbound lanes including, two left turning lanes onto Talavera Road and one lane for through traffic to Technology Place as well as traffic turning right onto Talavera Road.

### Herring Road

Herring Road would be widened on its eastern side between Talavera Road and the M2 Motorway to accommodate the new east facing off-ramp.

Herring Road currently comprises two lanes plus shoulder in this location accessing a west facing on-ramp (westbound), where the two lanes merge to one immediately after the road bends to be parallel with the M2 Motorway. This lane then becomes a single lane west facing Motorway on-ramp.

Widening of Herring Road would occur on the eastern side at the intersection with Talavera Road, with three additional lanes at the intersection approach from the new off-ramp. There would be two dedicated left turning lanes and one right turning lane from Herring Road onto Talavera Road.

### Talavera Road

Talavera Road would be widened to support movements associated with the new Christie Road and Herring Road on and off-ramps as well as to accommodate the reconfiguration of Christie Road and Herring Road intersections.

Currently, Talavera Road has one traffic lane in either direction and one parking lane on either side of the road between 140 metres west of Christie Road. Between Christie Road and Alma Road, Talavera Road has two eastbound lanes. An eastbound right turn lane is provided from Talavera Road into the Macquarie Centre car park that originates approximately 100 metres west of Alma Road.

Talavera Road has two westbound lanes from Alma Road to Herring Road, which merge to one lane west of Herring Road to Christie Road. At the Herring Road intersection, one westbound Talavera Road lane travels through the intersection and the second becomes the right turning lane onto the Herring Road on-ramp to M2. A left turning lane originates approximately 90 metres east of the Herring Road intersection and turns into the Macquarie Centre car park approximately 18 metres from the intersection.

Talavera Road would be widened to the north to accommodate:

- Two eastbound lanes between 140 metres west of Christie Road (access to Graduate School of Management) and Alma Road, and an eastbound right turning lane into Technology Place.
- An eastbound bus only right turning lane into Herring Road.
- An additional westbound lane between Alma Road and Herring Road.
- A westbound right turn lane into Christie Road.
- An additional westbound right turn lane into Herring Road on ramp (two right turn lanes).

### 6.3.7 Local Road Bridge Upgrades

A number of local road bridges (overpasses) would require upgrades to accommodate the widening of the M2 Motorway. These are:

- Windsor Road Bridge.
- Barclay Road Bridge.
- Kirkham Street Bridge.
- Beecroft Road Bridge.
- Beecroft Road Bus Bridge.
- Culloden Road Bridge.
- Christie Road Bridge.

Each upgrade is discussed below and a typical cross-section of an overbridge is illustrated in Figure 12.

#### Barclay Road Bridge

Barclay Road Bridge is a two span Super-T bridge, which extends over the M2 Motorway. The north span of the bridge would be lengthened to accommodate the eastbound carriageway widening works occurring under the bridge. The existing deck would be retained and lengthened by modifying the north abutment to cantilever over the widened carriageway to support the deck. The abutment would be modified in two halves, in order to maintain two traffic lanes on the bridge during construction.

#### Kirkham Street Bridge

Kirkham Street Bridge is a three span Super-T bridge that extends over the M2 Motorway (refer to Figure 12). The Kirkham Street Bridge becomes Kirkham Street as it extends over the width of the M2 Motorway. The north span of the bridge would be lengthened to accommodate eastbound widening of the carriageway under the bridge. The existing girders would be retained and lengthening would be achieved by modifying the north abutment to cantilever over the widened carriageway to support the existing girders. The bridge would be modified in two stages to maintain one traffic lane with an alternate lane working on the bridge during construction. This would be coordinated with the south span modification.

The south span of the bridge is to be lengthened to accommodate westbound widening of the carriageway under the bridge. The existing deck would be retained and the lengthening achieved by moving Pier 1 and replacing Span 1 with beams which cantilever over the widened carriageway to support the existing deck. The new Pier 1 would be constructed with three columns and a headstock. The deck would be modified independently to maintain one traffic lane with an alternate lane working on the bridge during construction. This would be coordinated with the south span modification.

### Windsor Road Bridge

Windsor Road Bridge is a two span Super-T bridge that extends over the M2 Motorway. The bridge is to be widened on the western side to accommodate the new west facing on-ramps. The widening works would require extending the abutment by installing additional piles, construction of a reinforced earth retaining wall and extending the headstock. The central pier would have additional columns and the headstock would be extended. The deck would be widened by adding Super-T beams and extending the existing deck.

### Beecroft Road Bridge

Beecroft Road Bridge is a 66 metre long three span pre-stressed beam and slab bridge over the M2 Motorway. The existing two rows of piers would be replaced by a single central row of piers to accommodate eastbound and westbound widening to three lanes plus the shoulder under the bridge. The new central piers would be constructed with new columns and headstocks at each beam position. The existing deck beams would be modified to suit the new pier positions and be strengthened with external post-tensioning.

### Bus Ramp Bridge near Beecroft Road

The Bus Ramp Bridge extends 196 metres in length and is an eight span pre-stressed concrete voided slab bridge. The bus ramp bridge currently provides bus access to Epping Station from the M2 Motorway. Under the proposed upgrade the Bus Ramp Bridge would be demolished.

### Culloden Road Bridge

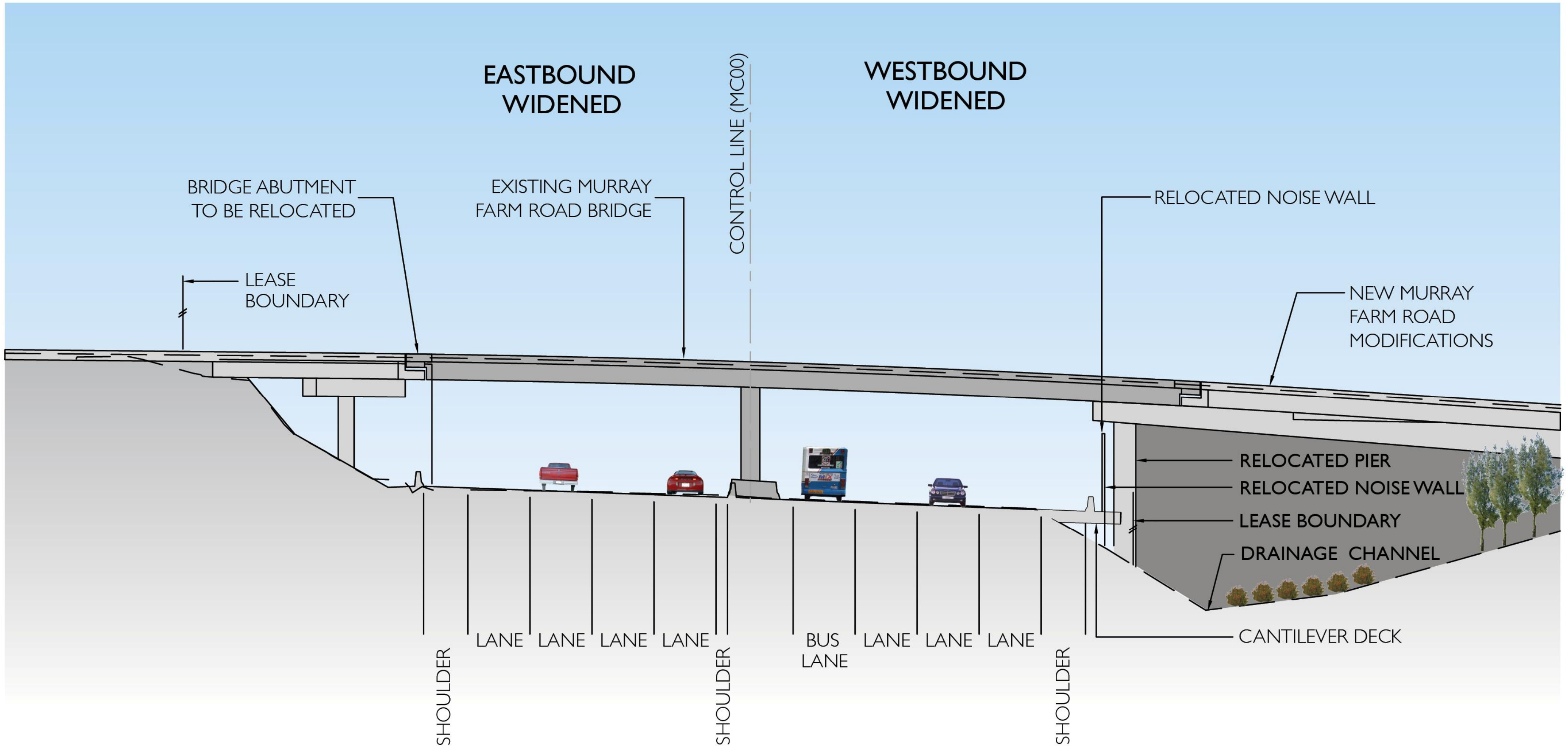
Culloden Road Bridge is a single span Super-T bridge that extends over the M2 Motorway. The existing rock slope at the northern and southern abutments would be cut and vertically supported by rock anchors to accommodate the M2 Motorway widening under the bridge.

### Christie Road Bridge

Christie Road Bridge is a two span Super-T bridge that extends over the M2 Motorway (Refer to Figure 12). The existing rock slope at the northern abutment would be trimmed and vertically supported by rock anchors to accommodate eastbound carriageway widening. The southern span would be lengthened to accommodate westbound carriageway widening under the bridge. The existing deck would be replaced and lengthened by shifting the southern abutment to the south.

Christie Road Bridge would be widened to provide two additional lanes over the bridge. The works would require widening of the existing abutments by installing an additional pile and extending the headstock. The pier would be widened by constructing an additional pier and extending the crosshead. Each span of the deck would be widened with the addition of Super-T girders, removing the existing edge barrier, extending the deck slab and constructing a new edge barrier.

Figure 12 Typical overbridge structure




*Source: Tract, 2010*

*Note: This cross section shows a typical arrangement of the M2 Motorway. The final arrangement is subject to detailed design and may vary due to site constraints.*

### 6.3.8 Pavement

#### M2 Carriageways

The existing M2 Motorway pavement is a Plain Concrete Pavement (PCP) with a Lean Mix Concrete (LMC) sub-base. New road pavement installed as a result of the widening works would be constructed using similar materials and typical composition to the existing pavement. A sub-surface drain would be provided between the existing and new pavements.

#### Ramps

The pavement structure proposed for the ramp works comprises deep-lift asphalt pavements with a design life of 40 years.

#### Bridge Decks

Asphalt overlay would be provided on the bridge widening sections in accordance with RTA bridge specifications. In order to achieve the appropriate design levels for the project, asphalt overlay would be applied to areas requiring some upgrade works, including toll plaza areas.

#### Local roads

The local roads would be asphaltic pavement which has a design life of 20 years. Details would be determined in conjunction with the appropriate road authority.

### 6.3.9 Noise barriers

The M2 Motorway has existing noise barriers (some on retaining wall structures) located along the alignment. As part of the upgrade some existing noise barriers and retaining walls located along the alignment would require relocation or modification to accommodate widening works. Proposed modifications to noise barriers along the M2 Motorway are described in Table 8 and illustrated in the route alignment figures (refer to Figure 5). A detailed description of noise barrier modifications, including heights, is provided in Section 9.3 and Technical Paper 2.

Table 8 Noise walls – location and associated works

| Noise Wall Ref. | Approximate Chainage | Location | Length (metres) | Reason | Approximate height of New Noise Wall[1] |
|---|---|---|---|---|---|
| Eastbound Carriageway | | | | | |
| NW-E-1001 | 3500-3900 | New Windsor Road off-ramp | 388 | Re-located | Same as existing noise wall at western end, reduced in height from 3 metres to 2.4 metres at eastern end |
| NW-E-1002 | 5100-5950 | Barclay Road | 849 | Re-located/Heightened | Same as existing noise wall for majority of wall. Increased in height from 4.2 metres to 4.8 metres between chainage 5400 and 5500 |
| NW-E-1003 | 7600-7700 | Westmore Drive | 132 | Re-located | Same as existing noise wall |
| NW-E-2001 | 10700-10800 | Kirkham Street | 92 | Re-located | Same as existing noise wall |
| NW-E-2002 | 12350-12500 | West Tunnel Portal | 134 | Re-located | Same as existing noise wall |
| NW-E-2003 | 13300-13900 | East Tunnel Portal | 606 | Re-located | Same as existing noise wall |
| NW-E-3001 | 14850-15050 | Busaco Road | 208 | Re-located | Same as existing noise wall |
| NW-E-3002 | 16700-17100 | Khartoum Road | 399 | Re-located | Same as existing noise wall |
| NW-E-3003 | 17450-17600 | Lane Cove off-ramp | 170 | New | 2.4 metres |
| Westbound Carriageway | | | | | |
| NW-W-1001 | 3500-4000 | New Windsor Road on-ramp | 491 | Re-located | Same as existing noise wall at western end, reduced in height from 4 metres to 2.4 metres at eastern end |
| NW-W-1002 | 5900-6200 | Hepburn Road | 287 | Re-located | Same as existing noise wall |
| NW-W-1003 | 6450-6700 | Yale Close | 264 | Re-located | Same as existing noise wall |
| NW-W-1004 | 6750-6950 | RIDBC | 207 | Re-located | Same as existing noise wall |
| NW-W-1005 | 7000-7200 | RIDBC | 245 | Re-located | Same as existing noise wall |
| NW-W-1006 | 7500-7650 | Boundary Road | 120 | Re-located | Same as existing noise wall |

| Noise Wall Ref. | Approximate Chainage | Location | Length (metres) | Reason | Approximate height of New Noise Wall[1] |
|---|---|---|---|---|---|
| NW-W-2001 | 9600-10150 | Lamorana Avenue | 560 | Re-located | Same as existing noise wall |
| NW-W-2002 | 10440-10450 | Ferndale Road | 16 | Re-located | Same as existing noise wall |
| NW-W-2003 | 10550-11150 | Kirkham Street | 634 | Re-located | Same as existing noise wall |
| NW-W-2004 | 11300-11350 | Kent Street Overpass | 76 | Re-located | Same as existing noise wall |
| NW-W-2005 | 12350-12500 | East Tunnel Portal | 144 | Re-located | Same as existing noise wall |
| NW-W-2006 | 13250-13650 | West Tunnel Portal | 417 | Re-located | Same as existing noise wall |
| NW-W-3001 | 14250-14400 | Vimiera Road | 140 | New | 3 metres |
| NW-W-3002 | 15250-15350 | Culloden Road | 110 | Re-located | Same as existing noise wall |
| NW-W-3003 | 15700-16050 | Christie Road | 368 | Re-located | Same as existing noise wall |

Note 1: Noise walls are built from modular 0.6 metre panels, therefore the noise walls are specified in 0.6 metre increments.

Other noise treatments to mitigate noise impacts are discussed in Section 9.3.

### 6.3.10 Drainage

Drawings showing the locations of detention basins and drainage works are provided in Technical Paper 6 and discussed in more detail in Section 9.8 and 10.1 of this environmental assessment.

#### Precinct 1 – Abbott Road to Windsor Road

Drainage works for Precinct 1 predominantly involve the adjustment of existing, and provision of additional, inlet pits with associated pipes to drain the pavement area of the new west facing ramps. This longitudinal drainage system would drain to the existing water quality basin (8b) located near chainage 3580 on the eastbound side of the M2 Motorway. It is proposed to modify the existing basin inlet/outlet to provide for changes to the drainage system. Alternatively, some earthworks may be required to increase the storage volume. There are no transverse culvert works proposed or required within Precinct 1.

#### Precinct 2 – Windsor Road to Pennant Hills Road

An existing 1200 millimetre diameter pipe culvert near chainage 5250 is to be extended by approximately six metres on the downstream outlet (eastbound) side. The works would incorporate a new headwall into the proposed retaining wall for the widening works with new energy dissipation and scour protection. At approximately chainage 7560 it is proposed to extend the inlet of an existing

(1500 millimetres x1200 millimetres) box culvert by up to five metres on the westbound side, along with replacement of the inlet scour protection.

A new culvert parallel to the M2 Motorway is proposed at the Barclay Road overbridge (approximately chainage 5520 to 5550), which would provide connectivity of catch drains to tie in with drains being relocated at the top of the cutting due to the road widening.

The existing M2 corridor is typically constrained in terms of width or available land space, which severely limits the opportunity for increasing basin footprints. Wherever possible or practical, it is therefore generally proposed to modify the basin inlet/outlet arrangements (by changing the inlet/outlet levels, dimensions or similar) to better utilise spare volume capacity that currently exists as freeboard (up to one metre of airspace). This approach would be dependent on the existing levels of key basin features compared to the elevation of the M2 Motorway and drainage system upstream. It is envisaged that some earthworks would be possible/required in some locations to obtain additional storage volume. This would be minimised to avoid impacts on the surrounding vegetation.

Within Precinct 2, there are eleven existing water quality basins which would require modification works to provide additional volume for treatment purposes. The additional volumes required vary considerably from zero up to approximately 600 cubic metres. A new basin may be required on the eastbound side at approximately chainage 4800 to minimise the need for upgrading the drainage system across the M2 Motorway, which would require enlarging an existing basin on the opposite side of the M2 Motorway.

### Precinct 3 – Pennant Hills Road to Beecroft Road

Within Precinct 3, Devlins Creek runs parallel to the M2 Motorway and crosses back and forth through large precast concrete arch structures on three occasions. Only the existing drainage structure (12.4 x 4 metres) near chainage 10550 would be affected by the widening works, which would require extension by approximately five metres. A gabion wall and open channel immediately downstream of the outlet would require reconstruction or modification to suit. A tributary creek near chainage 11640 is served by a four by 1350 millimetres diameter reinforced concrete pipe culvert which would require extending up to six metres at the inlet and reconstruction of the existing scour protection.

Two of the four existing water quality basins are likely to require earthworks to obtain additional storage volume (basins 23b and 27b). The existing basin 22b near chainage 9730 may be impacted (reduced) due to the widening works. If it is not possible to achieve the appropriate storage volume through earthworks modifications, it may be necessary to extend a retaining wall to limit the footprint of the widening. Basin 25b at chainage 11310 is likely to contain sufficient storage volume but may require modification of the inlet/outlet.

### Precinct 4 – Beecroft Road to Terrys Creek Bridge (including Norfolk Tunnel)

Within the vicinity of the bend in Somerset Street (at the projected intersection with Gloucester Road), the M2 Motorway widening is likely to impact on the existing local street drainage system. The works would involve relocation or reconfiguration of some pit and pipe elements away from the M2 Motorway.

The three cell box culvert outlet (2400 x 1800 millimetres) located near chainage 13500 is proposed to be extended approximately eight metres on the westbound side. Works would involve reconstructing the outlet scour protection measures and reconstruction of 30 metres of the existing concrete/rock mattress open channel from the local road drainage system.

There are two water quality basins in Precinct 4. The existing volume for basin 28f at chainage 12230 is likely to be sufficient, but, if minor augmentation is required, modification of the inlet/outlet may be required. Otherwise space is likely to be available to enlarge the footprint by earthworks.

Basin 30b near chainage 13470 is located at the end of the Norfolk Tunnel drainage system. The road widening is proposed to pass over this basin on a cantilevered roadway to avoid impact (reduction) on the existing basin volume. The basin inlet/outlet is proposed to be modified to better utilise the spare volume available. Additional modifications to the basin would also be required to capture and treat the tunnel wash prior to discharge either to the nearby sewer system or local drainage to Terrys Creek.

#### Precinct 5 – Terrys Creek to Lane Cove Tunnel

The upstream inlet of the existing three cell box culvert (2400 x 1800 millimetres) near chainage 16220 is proposed to be extended 2.4 metres on the westbound side and the downstream outlet is to be extended 17.1 metres under the new Christie Road on-ramp, on the eastbound side.

The Shrimptons Creek catchment drains to a large precast concrete arch (20 x 6 metres) under the M2 Motorway near chainage 16450. The M2 Motorway widening works at this location include the provision of a westbound off-ramp to Herring Road, which would necessitate an upstream extension of the arch by 18 metres.

There are six existing water quality basins in Precinct 5 with at least five requiring some form of augmentation. It is proposed that this would be achieved through modification of the inlet/outlet arrangement for three of the basins (33c, 34b and 35b) while earthworks would be involved for the remaining two (35, and 36b). All of the basins are located on the northern side of the M2 Motorway.

## 6.4 Ancillary operational components

The Director-General requires a description of the ancillary operational components of the project to be included in the environmental assessment. This description including upgrades to the M2 Motorway's Intelligent Transport Systems, upgrades to toll facilities, cycle facilities, signals and connections with the surrounding road networks. This section addresses this requirement.

It should be noted that the Park and Ride facility has been excluded from the project for reasons detailed in Chapter 3, and has not been discussed in this section.

### 6.4.1 Intelligent Transport System

The M2 Motorway Intelligent Transport System (ITS) comprises traffic control and monitoring equipment, plant control and monitoring equipment, communications equipment and tolling equipment that are deployed along the M2 Motorway to:

- Detect incidents and facilitate the effective management of incidents on the M2 Motorway.
- Monitor and control traffic systems and traffic movements on the M2 Motorway including the ramps.
- Monitor and control mechanical and electrical systems in the Norfolk Tunnel.

The existing ITS components would be relocated or upgraded for the widened Motorway, from Windsor Road to Lane Cove Road, including upgrades to:

- Cableway route.
- Driver Advisory Systems.
- Traffic monitoring and surveillance systems.
- Centralised control and monitoring systems.
- Tunnel monitoring and control systems.
- Tolling systems.
- Communications systems.

The proposed upgrades to the existing ITS equipment are described in the following sections.

### Cableway

A combination of upgrades to the existing cableway, a new cableway and backbone cable route would be constructed from approximately chainage 4300 to 18250 to service ITS requirements along M2 corridor. The cableway would be constructed (by trenching) in the sequence described in Table 9.

Table 9 Cableway upgrade locations

| Approximate chainage | Carriageway location | Upgrade details |
|---|---|---|
| 4300 – 6040 | ▪ Eastbound (northern) | ▪ Upgrade to backbone cableway with new conduits and pits. Additional power supply points would be provided along the M2 Motorway. |
| 6040 – 12000 | ▪ Westbound (southern) | |
| 12000 – 15000 | ▪ Eastbound (northern) | |
| 15000 – 17600 | ▪ Westbound (southern) | |
| 17600 – 18250 | ▪ Westbound (southern) | |

### Toll collection equipment

Existing toll collection equipment consists of Electronic Toll Collection (ETC) and cash at the following locations:

- Toll plaza – ETC and cash.
- Pennant Hills Road ramps – ETC and cash.

Proposed new toll collection equipment would consist of ETC only equipment mounted on gantries at the following locations:

- Windsor Road ramps – ETC points would be constructed on both west facing on and off-ramps at Windsor Road.
- Herring Road ramp – ETC point would be constructed on the new east facing off-ramp.
- Christie Road ramp – ETC point would be constructed on the new west facing on-ramp.

The existing toll plaza tolling equipment would be realigned located to suit the proposed road realignment.

### Closed Circuit Television

A Closed Circuit Television (CCTV) system currently exists to provide surveillance of the M2 Motorway. It comprises CCTV monitors and video equipment in the toll plaza control room and cameras primarily mounted on poles on either side of the M2 Motorway. The video equipment in the toll plaza control room would be modified to accommodate the new cameras.

Additional pan, tilt and zoom (PTZ) CCTV cameras would be installed at the new west facing entry and exit ramps at Windsor Road and at the new east facing exit ramp at Herring Road (two cameras in total).

Additional fixed head mounted CCTV cameras would be installed in each of the widened Norfolk Road tunnel tubes at approximately every 60 metres (16 cameras in total) to view the traffic from the rear and provide full CCTV coverage to the widened Norfolk Road tunnel.

### Motorist Emergency Telephone System (METS)

The M2 Motorway presently has a Motorist Emergency Telephone System (METS) consisting of telephone handsets mounted on stands. The METS are positioned at one kilometre intervals on both carriageways. The telephones would be re-located to accommodate the re-aligned sections of the M2 Motorway. Existing emergency telephones in the widened Norfolk Road tunnel must be removed and replaced with telephones at approximately every 60 metres (16 telephones in total).

### Variable Message Signs

There are currently four Variable Message Signs (VMS) on the M2 Motorway. The VMS are mounted on gantries positioned to the side of the M2 Motorway or above the tunnel portals and provide information messages to motorists. As part of the project, three additional VMS would be installed at the following locations:

- On the mainline carriageway before the new west facing Windsor Road exit ramp.
- At the eastbound entry of the Norfolk Tunnel.
- At the westbound entry of the Norfolk Tunnel.

### Variable Speed Limit Signs

Variable Speed Limit Signs (VSLS) on the M2 Motorway display regulatory speed limits. Four existing VSLS would be relocated and eight additional VSLS's would be provided, as follows:

- Existing VSLS upstream of the entry to each of the Norfolk Tunnel portals would be relocated to be mounted on the new overhead structure over the eastbound and westbound mainline carriageways of the M2 Motorway (a total of four).
- Two additional VSLS would be mounted at each of the eastbound and westbound entry portals of the Norfolk Tunnel tubes (a total of four).
- Two additional VSLS would be mounted inside each of the Norfolk Tunnels at approximately 300 metres from the entry portal (a total of four).

### Traffic monitoring

The traffic monitoring consists of vehicle detector systems that provide traffic data to be used for automatic incident detection, and congestion detection. The traffic data are acquired via vehicle detector loops embedded in the road. These loops are connected by electrical cabling to microprocessor-based equipment installed inside cabinets on the side of the road. Traffic monitoring sites are located at 500 metre intervals along the M2 Motorway and on-ramps. Existing systems would be relocated as required and additional loops added for new lanes and ramps.

### Tunnel Message Signs

The Norfolk Tunnel would have the following Tunnel Message Signs (TMS):

- One additional row of two TMS would be installed in a back to back configuration in each of the Norfolk Tunnels carriageways (a total quantity of four). The TMS must be located at a maximum spacing of 120 metres along the length of the Norfolk Tunnel carriageways.
- The existing two rows of back to back TMS are to be repositioned (a total quantity of eight).

### Lane Usage Signs

The Norfolk Tunnel would have the following Lane Usage Signs (LUS):

- Additional LUS would be installed allowing for an additional row in each tunnel and the additional lane in the eastbound tunnel. LUS are to be mounted over each lane in a back to back configuration (a total quantity of 18). The LUS must be located at a maximum spacing of 120 metres along the length of the Norfolk Tunnel carriageways.
- The existing three rows of back to back LUS are to be repositioned (a total quantity of 30).

### Other tunnel systems

The Norfolk Tunnels would be fitted with the following ITS equipment:

- Tunnel Public Address (PA) System.
- Radio Re-broadcasting (RRB) system installed inside the tunnel.
- Plant Monitoring and Control System (PMCS) consisting of PLC based equipment primarily located inside the tunnel and Eastern Portal Building.
- Existing Changeable Diversion Signs, one set located on each approach toward the tunnel to be relocated and upgraded allowing for the additional lane.

### Motorway Network Communications System

A Motorway Network Communications System (MNCS) comprising a new fibre optic cable backbone installed in an underground cableway and associated electronic transceiver equipment co-located in a number of roadside cabinets would be installed or relocated along the widened sections of the M2 Motorway.

### 6.4.2 Norfolk Tunnel services

The Norfolk Tunnel widening works would require mechanical and electrical (M&E) upgrades, including the relocation, modification, removal of existing tunnel services and the supply and the installation of new tunnel services.

The following works would be required for the tunnel upgrade:

- Incoming 11kV feeder cables would require relocation to accommodate the tunnel widening.
- Main switchboard would require modifications and Tariff Metering Panel would be relocated.
- Modifications to the UPS Distribution Board and extension floor support frame would be installed.
- Environmental monitoring instrumentation would require relocation.
- New distribution boards.
- New Tunnel Ventilation Motor Control Centres.
- New sub-main cabling.
- New lighting support systems and tunnel luminaires (upgraded to AS/NSZ 1158.5 Lighting for Roads and Public Spaces Part 5: Tunnels and Underpasses).Relocation of jet fans.
- Relocation of Intelligent Transport Systems (ITS) (refer to Section 6.4.1).
- Fire protection and detection systems.

### 6.4.3 Services and utilities

#### Existing services and utilities

The majority of the existing utility services in the M2 corridor were relocated during the initial construction of the M2 Motorway. The services that remained inside the M2 corridor were laid in a manner that considered future road work, at depth and perpendicular to the M2 corridor or concrete encased.

Where feasible, the project widening works would avoid or accommodate the existing services. The key work elements within the M2 corridor that would impact on the utility services include retaining walls, ramps and bridge adjustments. Widening works outside the M2 corridor on Talavera Road would require major changes to the utility services due to the provision of an additional lane.

Consultation is currently underway with utility providers who own services within the M2 corridor. The nature and extent of utility relocations would be finalised in consultation with relevant authorities and organisations through the detailed design and construction of the project. The key services that would be likely to require relocation (temporary or permanent) are summarised in Table 10.

Table 10 Existing utilities and services potentially affected by the project

| Section (Chainage) | Description | Service provider |
|---|---|---|
| 3620 | Goodin Avenue | ▪ Sydney Water (sewer/water) |
| 3730 | Horwood Avenue ducts | ▪ Telstra (telecoms)<br>▪ Jemena (gas)<br>▪ Integral Energy (elect) |
| 4000 | Windsor Road Bridge ducts | ▪ Telstra (telecoms)<br>▪ Jemena (gas)<br>▪ Integral Energy (elect)<br>▪ Sydney Water (water/sewer) |
| 4300 | Russell Street to Petrina Court | ▪ Sydney Water (water/sewer) |
| 4650 | Darling Mills Creek | ▪ Sydney Water (water/sewer) |
| 5260 | Rajola Place | ▪ Sydney Water (water/sewer) |
| 5540 | Barclay Road ducts | ▪ Telstra (telecoms)<br>▪ Integral Energy, Hutchison, Energy Australia (elect)<br>▪ Sydney Water (water/sewer) |
| 6020 | Hepburn Road | ▪ Sydney Water (water/sewer) |
| 6760 | Yale Close ducts | ▪ Optus (telecoms)<br>▪ Sydney Water (sewer/water) |
| 7000 | Gossell Grove | ▪ Sydney Water (water/sewer) |
| 7630 | Boundary Road (Kirkham Street) | ▪ Sydney Water (water/sewer) |
| 7930 | Carmen Drive | ▪ Sydney Water (water/sewer) |
| 9660 | Orchard Road | ▪ Sydney Water (water/sewer) |
| 9850 | Devlin's Creek / Burns Road | ▪ Sydney Water (water/sewer) |
| 10350 | Saracen Road | ▪ Sydney Water (water/sewer) |
| 10470 | Ferndale Road | ▪ Sydney Water (water/sewer) |
| 10640 | Murray farm Road/Kirkham Street duct | ▪ UEComm (telecoms)<br>▪ Jemena (gas)<br>▪ Energy Australia (elect)<br>▪ Sydney Water (sewer/water) |
| 11150 | Kerry Avenue | ▪ Sydney Water (water/sewer) |
| 11200 | Kent Street ducts | ▪ Telstra, Hutchison, Optus and Vodafone (telecoms)<br>▪ Sydney Water (water/sewer) |
| 12230 | Beecroft Road / Old Beecroft Road ducts | ▪ Telstra, Optus (telecoms)<br>▪ Energy Australia (elect)<br>▪ Sydney Water, Hills M2 (water/sewer) |
| 12380 / 12500 | Somerset Street ducts | ▪ Telstra (telecoms)<br>▪ Sydney Water (sewer/water) |
| 12430 | Derby Street ducts | ▪ Energy Australia |
| 12620 | Norfolk Tunnel ducts | ▪ Telstra, Optus, Vodafone and Telstra (telecoms) |

| Section (Chainage) | Description | Service provider |
|---|---|---|
| 13060 | Gillard Way / Devon Street / Somerset Street | ▪ Sydney Water (water/sewer) |
| 13120 | York Street ducts | ▪ Energy Australia (elect) |
| 13800 | Terrys creek west of Crimea Road | ▪ Sydney Water (water/sewer) |
| 14500 | Vimiera Road ducts | ▪ Telstra, Vodafone, Optus and Telstra (telecoms)<br>▪ Sydney Water (water/sewer) |
| 15000 | Busaco Road ducts | ▪ Telstra (telecoms)<br>▪ Jemena (gas)<br>▪ Energy Australia (elect)<br>▪ Sydney Water (water/sewer) |
| 15300 | Culloden Road ducts | ▪ Hutchison (telecoms)<br>▪ Sydney Water (water/sewer) |
| 16090 | Christie Road | ▪ Telstra, Optus (telecoms)<br>▪ Energy Australia (elect)<br>▪ Sydney Water (water/sewer) |
| 16100 | Talavera Road ducts | ▪ Telstra, Optus, PowerNet, UEComm and AARNet (telecomms)<br>▪ Jemena (gas)<br>▪ Energy Australia (elect) |
| 16230 | Herring Road to Alma Road | ▪ Sydney Water (water/sewer) |
| 16480 | Alma Road | ▪ Sydney Water (water/sewer) |
| 16980 | Khartoum Road ducts | ▪ Telstra (telecoms)<br>▪ Jemena (gas)<br>▪ Energy Australia (elect)<br>▪ Sydney Water (water/sewer) |
| 17670 | Lane Cove Road ducts | ▪ Optus (telecoms) |

There are no services owned by public utility providers within the M2 corridor that run parallel to M2 corridor. The only services that run parallel to the M2 Motorway are RTA or Hills M2 services that supply and control systems, including CCTV, VMS and tolling. These services are located in the existing road verge and would be affected by the works. The services would be re-laid in the new road shoulder.

### Service and utility relocations

The proposed upgrade does not provide a dedicated M2 corridor for new services for external utility providers. The proposed alignment is tightly constrained and widths have been kept to a minimum to reduce the footprint of the proposed upgrade and associated impacts.

Services required (either short or long term) for operation of the proposed upgrade would include power for lighting and traffic information systems and communications cabling. It is proposed that conduits for each of the required services would be located within the verge of the road, with provision made for compatibility or conversion requirements for the ultimate configuration.

### 6.4.4 Lighting and signage

The proposed upgrade would generally be unlit. As an exception, at particular areas, lighting would be required for safety reasons, such as converging and diverging traffic streams. The areas where lighting is required are as follows:

- Windsor Road ramps and interchange.
- Herring Road / Christie Road interchange.
- Existing toll plazas.
- Norfolk Tunnel.

A road signage strategy would be developed for permanent road signage for the proposed upgrade. The road signage strategy would include a combination of directional signage to provide clear guidance to local and Motorway traffic. The strategy would be considered further during detailed design and all road signage for the project would be in accordance with RTA requirements. Some of these signs would be located off the M2 Motorway on approaches to the entry ramps.

## 6.5 Staged opening

It is proposed to open sections of the M2 Upgrade project in stages. Staged opening would be determined as part of detailed design phase and would be generally consistent with the M2 Motorway precincts (as described in Section 1.5).

The indicative staged opening would likely be as follows:

- Windsor Road on- and off-ramps (approximate timing would be 14 to 15 months after commencement of construction).
- Christie Road on-ramp and Herring Road off-ramp, including associated local road widening (approximate timing would be 21 months after commencement of construction).
- Windsor Road to Pennant Hills Road eastbound (approximate timing would be 15 to 18 months after commencement of construction).
- The remainder of the M2 Upgrade project (approximate timing would be 24 months after commencement of construction).

To facilitate the staged opening of the M2 Upgrade project, associated works would be completed, such as noise walls, landscaping, signage and the like.

## 6.6 Design process

This section further describes the design process that has been undertaken to date and outlines how the concept design assessed in this environmental assessment would be developed and refined.

### 6.6.1 Urban and landscape design strategy

Urban design and landscape objectives were identified for the project, which aim to improve the presentation of the section of the M2 Motorway impacted by the M2 Upgrade project. The vision for the urban and landscape design outcomes of the upgrade of the M2 Motorway is to reflect the vegetated landscape and the uniqueness of the topography in the area while minimising potential adverse impacts. The seven objectives adopted for this project are as follows.

- Upgrade works are to improve the visual appearance and character of the road corridor and create a recognisable identity for the M2 Motorway – through the use of contextually appropriate design and materials, and by conserving and enhancing historically significant aspects.
- Motorway elements are to complement the surrounding setting – through the use of appropriate colour and form and emphasising the sandstone geology of the ridge lines.
- Maintain a safe and accessible corridor – designs are to encourage safe driver behaviour, emphasise road geometry and retain views for safety.
- Improve accessibility – for nearby communities for pedestrians, cyclists and public transport.
- Revegetation strategies need to relate to scale, composition and colour of the adjacent built form – planting to be robust and manageable with on-going weed management.
- Protect and enhance the natural systems and ecology of the Corridor – works are to strengthen the existing landscape by using soft engineering, enhancing natural vegetation, managing weeds.
- Maintenance of hard and soft landscape elements must be accessible and maintainable with minimal resources – designs to accommodate maintenance requirements.

Section 9.6 of this environmental assessment and Technical Paper 4 present the urban design and landscape strategy that has been formulated for this project. The strategy is based on the abovementioned objectives and the assessment of visual amenity and landscape impacts of the project. The concept urban and landscape design would be further refined during the detailed design phase.

Note only those areas that are proposed to be upgraded as part of this project are subject to the urban design and landscape measures outlined.

### 6.6.2 Concept design refinement and detailed design

#### General

The design on which this environmental assessment is based was developed as part of the concept design and environmental assessment project phase. The design responds to the constraints of the M2 corridor and the design and engineering principles identified and developed during investigations. The intent of the concept design is to provide:

- A clear description of the design principles, extent of impacts and impact management requirements.
- A flexible approach to detailed design hinging on the outcomes of the environmental assessment and subsequent conditions of approval.
- A definable construction footprint to determine temporary and permanent property access and acquisition requirements.
- A firm platform from which the concept design can progress into detailed design and beyond to a standard required to support project delivery.

The detailed design phase of the proposed upgrade of the M2 Motorway would involve survey, geotechnical investigations and design activities prior to the commencement of construction.

#### Key requirements for detailed design

The detailed design phase would be guided by key design and engineering principles developed during concept design and the outcomes of the environmental assessment process. Development of the detailed design would be required to:

- Address the principles of ESD.
- Ensure that there is consistency with the design criteria and the principles on which the concept design was based, as described in the environmental assessment.
- Ensure that issues associated with the development of the concept design as proposed in the environmental assessment are appropriately addressed.
- Ensure that Conditions of Approval arising from the approval process under Part 3A of the EP&A Act are met.
- Ensure that environmentally sensitive areas are avoided.
- Ensure that appropriate mitigation measures are implemented where impacts cannot be avoided.
- Ensure that risk management is appropriately addressed during both construction and operation.
- As indicated in Section 6.5, during the detailed design process, components of the concept design may be refined and optimised. For this reason, these elements may change in the future. Changes would be implemented in such a way that would improve or enhance the project.

# 7. Construction methodology and staging

This section provides an overview of the construction methodology and staging. It provides a description of proposed construction compound locations, site access and service relocations.

| Director-General's Requirements | Where addressed |
|---|---|
| *A description of the project including:*<br>*Construction facilities, including construction compounds, lay-down areas and spoil stockpiling/management areas.* | *Section 7.8* |
| *General construction impacts – the environmental assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed* | *Chapter 7, Chapter 9, Appendix F* |

## 7.1 Construction strategy

The construction strategy would be based on the principal objectives of constructing the project in a timely and efficient manner and ensuring impacts are minimised through the provision of appropriate management measures. The strategy for construction consists of the following key elements:

- Provision of an off-motorway cycleway to allow the breakdown lanes to be utilised for traffic movements or construction areas. Windsor Road, Christie Road / Herring Road ramps to be completed early in the construction program to facilitate early access for traffic in these areas.
- Completion of the new eastbound and westbound lanes, as early as practicable to facilitate access and returning efficient traffic flow to the M2 Motorway.
- Major construction works primarily accessed from the M2 Motorway to minimise effect on local roads and minimise site clearance works.
- Minimise impacts to traffic flow on the M2 Motorway and local roads.
- Eastbound tunnel to be completed first followed by the westbound tunnel to meet peak traffic flow conditions.
- Safe construction of the project works, for travelling motorists using the M2 Motorway and local roads, for the workforce and for stakeholders.

## 7.2 Construction phases and activities

A summary of the likely construction phases and activities for the project is provided in Table 11.

Table 11 Summary of construction elements and activities

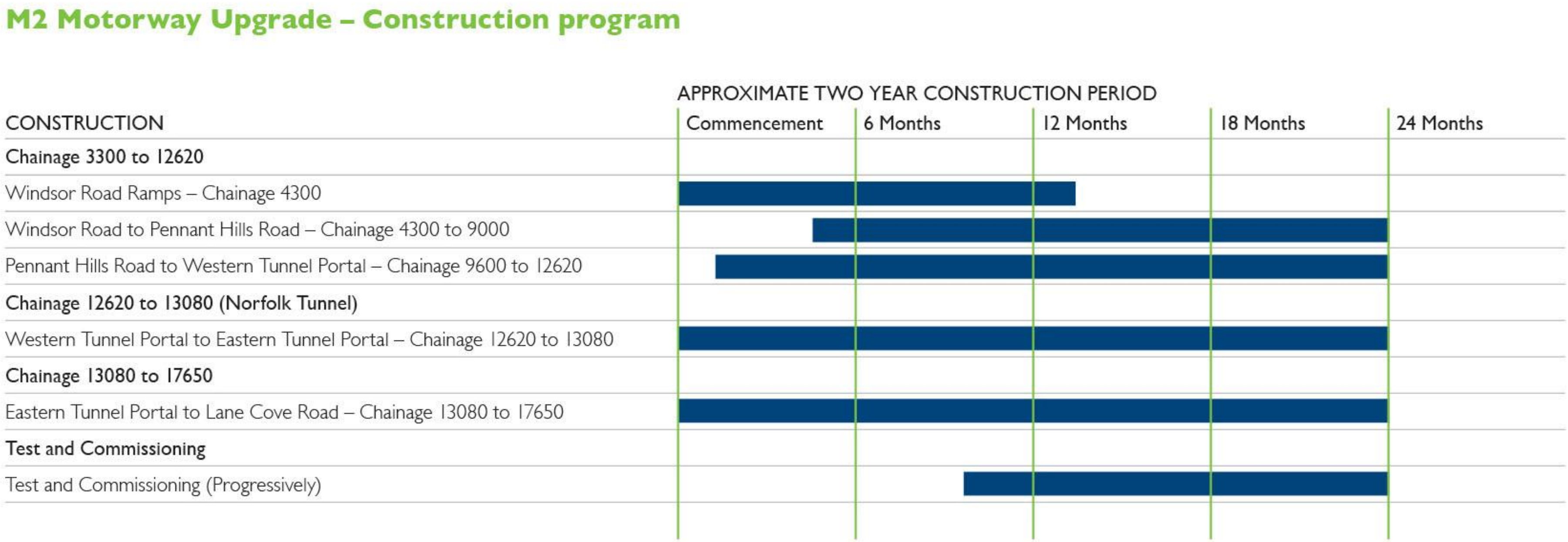
| Construction phase | Activity |
|---|---|
| Environmental management system set-up | ▪ Environmental management plans.<br>▪ Relevant licensing and approvals. |
| Site establishment | ▪ Site set out.<br>▪ Compound site and ancillary sites (stockpile and storage sites). |
| Relocation of services | ▪ Services location, identification and consultation with service provider.<br>▪ Relocation works. |
| Alternative off-motorway cycle route | ▪ Establishment of alternative cycle route.<br>▪ Signposting and line marking. |
| Site preparation | ▪ Clearing and grubbing.<br>▪ Removal of topsoil, spoil and stockpiling.<br>▪ Preparation of site access for construction.<br>▪ Installation of site fencing and safety barriers.<br>▪ Installation of temporary noise barriers.<br>▪ Traffic management setup and line marking.<br>▪ Temporary median works. |
| Demolition/Earthworks | ▪ Excavation of cuts.<br>▪ Spoil transport and processing.<br>▪ Fill embankments.<br>▪ Batter treatments.<br>▪ Demolition of Beecroft Road bus ramp. |
| Drainage | ▪ Preparation of construction diversion drains and sedimentation ponds.<br>▪ Extension of existing drainage systems (culverts and pipes) to accommodate widening.<br>▪ New drainage lines and pits.<br>▪ Extension of existing detention basins and new. |
| Pavement widening construction | ▪ Cross stitching of existing pavement.<br>▪ Excavation / boxing out and construction of trench drainage.<br>▪ Pavement construction including sub-base and base.<br>▪ Placement and compaction of select material.<br>▪ Pavement surfacing and resheeting (remove and replace surface layer). |
| Ramp works | ▪ New west facing ramps at Windsor Road.<br>▪ New east facing ramps at Christie / Herring Road. |

| Construction phase | Activity |
|---|---|
| Norfolk Tunnel Widening | ▪ Tunnel widening eastbound and westbound, including;<br>▪ Rock bolting.<br>▪ New drainage lines.<br>▪ Relocation of supply power lines.<br>▪ Lowering of cross passages.<br>▪ New switchboard niches.<br>▪ Tunnel lining.<br>▪ Lighting.<br>▪ Rock cutting.<br>▪ Shotcreting. |
| Bridge modification works | ▪ Abutment works on widened side.<br>▪ Additional piles.<br>▪ Extension to the deck slabs. |
| Ancillary works | ▪ Relocation and construction of noise walls.<br>▪ Property access and modifications.<br>▪ Existing Motorway works.<br>▪ Crushing plants, stockpile and storage sites. |
| Other works | ▪ Toll plaza realignment.<br>▪ ITS - backbone cabling.<br>▪ Installation of permanent noise walls and relocation of existing noise walls.<br>▪ Construction of new retaining walls. |
| Finishing works | ▪ Landscaping activities.<br>▪ Line-marking.<br>▪ Installation of road furniture, signposts, traffic barriers. |

The activities in Table 11 would be subject to refinement during the detailed design phase. A more detailed construction staging and methodology would be prepared in accordance with the detailed design prior to commencement of construction works and as part of the Construction Environmental Management Plan (CEMP). An outline of the CEMP is provided in the Construction Environmental Management Framework (refer to Appendix F).

An indicative construction program is shown in Figure 13.

Figure 13 Indicative construction program



## 7.3 Construction methodology overview

The construction methodology used on the roadwork elements of the project would be conventional techniques generally employed to construct additional carriageway lanes. Construction techniques would be adapted to account for various environmental constraints that occur along the M2 corridor.

The project would have a construction period of approximately two years. During the construction period, M2 Motorway traffic would be reduced to one lane in sections for limited periods of time during the night or in off peak day time periods, when traffic flow allows. The construction staging has been planned to minimise disruption to road users. However, safety of road users, neighbouring residents and construction staff is the main priority during the construction phase.

The construction strategy for the project may be subject to modification as a result of further design and construction method refinements throughout the detailed design phase. The staging of the project is not likely to have an impact on the construction environmental impacts.

### 7.3.1 Motorway functionality during construction

Functionality of the M2 Motorway would be maintained throughout the construction phase of the project. To ensure that M2 Motorway traffic flow is sustained where practicable, the following objectives have been developed as a benchmark:

- Two lanes would be maintained for morning peak flow in the eastbound direction.
- Three lanes would be maintained for afternoon peak flow in the westbound direction (between Lane Cove Road and west of Beecroft Road).
- Two lanes would be maintained for afternoon peak flow in the westbound direction west of Beecroft Road.
- One dedicated bus lane would be maintained for bus use in the peak direction by tidal flow (between Windsor Road and Pennant Hills Road, and between Pennant Hills Road and Kent Street footbridge). The other bus lane would be taken for use as a general traffic lane during traffic management operations.
- Alternative cycle provision would be adopted on local roads during construction.

For further discussion regarding traffic impacts and management during construction, refer to Section 9.2 and Technical Paper 1.

### 7.3.2 Pedestrian and cycle access during construction

#### Pedestrian crossing points

Pedestrian access in the vicinity of the M2 Motorway is currently provided via crossing points in the form of overbridges, underpasses and footbridges. Direct pedestrian access to the M2 Motorway is prohibited. During the construction period, works on some of the overbridges would be required. This would require the diversion of pedestrians. Table 12 describes the likely diversions of pedestrians at the bridges and intersections along the M2 Motorway.

Footbridges and pedestrian and cycle paths on surrounding roads would be re-instated following construction.

Table 12 Location and impact on pedestrian access during construction period

| Location | Facility type | Diversions (indicative) |
|---|---|---|
| Windsor Road | Bridge. | During construction of the new west facing ramps at Windsor Road it is likely that all pedestrians would be diverted to the east footpath. |
| Barclay Road | Road Bridge (and pedestrian ramp to M2 bus stop). | During construction there would be one of two footpaths closed for the lengthening works at the northern end. A temporary road crossing may be used to facilitate access. |
| Devlins Creek (from Allerton Road to Welham Street and Austral Avenue) | Paths under M2 Motorway Bridge. | During construction some local detours would be required to avoid construction areas. Access under the M2 Motorway from north to south would be maintained. |
| Kirkham Street / Kirkham Street | Bridge. | During construction, one of the two footpaths would be closed for the lengthening works at each end. A temporary road crossing may be used to facilitate pedestrian access. |
| Beecroft Road | Road Bridge. | During construction, the footpath on the west side may be altered. A temporary road crossing may be used to facilitate pedestrian access. |
| Christie Road | Road Bridge. | During construction the footpath on the eastern side may be altered. A temporary road crossing may be used to facilitate pedestrian access.<br>The access to the council car park may be closed for some periods. |
| Herring Road / Talavera Road | At Grade. | During construction the footpath on the east side may be altered. A temporary road crossing may be provided to facilitate pedestrian access. |
| Khartoum Road | Road Underpass. | During construction, one of the two footpaths would be closed. A temporary road crossing may be used to facilitate pedestrian access. |

### Cyclist access

The project would affect cycle use of the M2 Motorway from west of Windsor Road to east of Lane Cove Road due to the removal of the breakdown lane during construction. An alternative route would be provided using non-Motorway roads that stay close to the alignment of the M2 Motorway where practical. The alternative cycle route would be formulated in consultation with local councils and cycle groups during the detailed design phase. The alternative cycle route would be in place prior to the commencement of construction.

The underpass at Vimiera Road is part of a north-south route used by pedestrians and cyclists between Macquarie Park and South Turramurra. The structure would be extended to allow widening of the embankment on the northern side. Short term closures would be required for some construction activities, with advance notification provided to minimise disruption to users. When works are being undertaken on this underpass during normal working hours, access would be maintained for the public by means of personal escort or dedicated exclusion zone through works.

### Walking tracks

During construction, access to some bush walking tracks would be restricted, however, wherever possible an alternative path would be provided. In areas where the walking track passes below a M2 Motorway bridge structure, such as bridge structures at Terry's Creek, Devlins Creek and Darling Mills Creek, provision of an alternative path would not be possible as worksites under these bridges would cover the entire area. Access to bush walking tracks would be re-instated following construction.

## 7.4 Construction program and traffic management

### 7.4.1 Construction staging

Due to the integrated nature of the proposed upgrade and the need to undertake works under traffic conditions, it is anticipated that construction would be carried out concurrently in a number of areas. As indicated in Section 6.5 staged opening is envisaged.

### 7.4.2 Traffic management

Traffic management measures would be implemented in accordance with *Australian Road Rules AS1742.3: Traffic control devices for works on roads*, RTA's *Traffic Control at Worksites Manual* and other relevant standards or guidelines. Traffic Management Plans (TMPs) would be developed by the contractor and implemented for the duration of the construction of the project. TMPs would cover all aspects of construction that would require temporary changes to the M2 Motorway and local road layout using barriers or lane occupancies.

Reduced speed limits would be applied on the M2 Motorway during construction.

The communication of proposed changes to traffic conditions would vary depending on the extent and the nature of changes. The processes for advising the general public of changes would be included in the Community and Stakeholder Consultation Plan and, where appropriate, would include:

- Portable and permanent Variable Message Signs.
- Letter box drops and newsletters.
- M2 Upgrade project and RTA websites.
- Radio advertising.
- Metropolitan and local newspaper advertising.

Road user delays would be kept to a minimum and access would be maintained for road users. This would be achieved through the planning and consultation phases and implemented during the construction phase.

## 7.5 Construction plant and machinery

During the construction stage the following typical equipment may be used:

- Excavators and loaders.
- Bulldozers.
- Backhoes.
- Cranes.

- Drilling rigs / piling rigs.
- Graders.
- Concrete saws / cutters.
- Rock saws.
- Hydraulic hammers / rock breakers.
- Jackhammers.
- Rock Crushers.
- Asphalt laying machines.
- Transit mixers.
- Low loaders.
- Road headers.
- Shotcrete rigs.
- Rock drill rigs.
- Concrete boom pumps.
- Rollers and compaction equipment.
- Trucks (bogies, haul and dump trucks, etc).
- Line marking machines.
- Paving machines.
- Generators.
- Water carts.
- Elevated work platforms.

The above list is indicative only and the actual equipment used onsite would be further refined during the detailed design stage.

## 7.6 Workforce and working hours

### 7.6.1 Workforce

Construction personnel numbers would vary depending on the construction phase. The total workforce, including design and construction personnel is estimated to be up to 550 persons at any one time during the construction period. This includes 350 labourers working on-site and 200 engineering, design, environmental and management staff.

### 7.6.2 Construction work hours

Standard working hours for construction activity would be:

- 7.00am to 6.00pm Monday to Friday.
- 8.00am to 1.00pm Saturdays.

Construction for some activities would also be required outside of these standard working hours (including on Saturdays, Sundays and public holidays), subject to obtaining approval from DECCW. This would be required to minimise disruption to traffic and to ensure the safety of construction personnel and other road users. The start and finish times of construction activities undertaken on the M2 Motorway may also vary depending on the location of the works site relative to the peak traffic flows.

This flexibility of working hours between various project worksites would assist to minimise impacts on traffic resulting from construction vehicles entering sites during peak periods. Appropriate communication with potentially affected community and stakeholders would be made.

At certain stages, construction works on the M2 Motorway carriageway would be necessary outside standard construction hours (also referred to as night works) to minimise unacceptable impacts on daytime traffic flow and congestion. The types of activities that may be undertaken on the carriageway outside normal working hours include, but not limited to:

- Activities associated with the upgrade of the ITS system.
- Construction activities that require lane closures.
- General traffic management activities (relocating barriers and the like).
- The delivery of materials outside of approved hours as required by the Police or other authorities (including RTA) for safety reasons.
- Where it is required to avoid the loss of lives, property and/or to prevent environmental harm in an emergency.
- Where permitted in accordance with an environmental protection licence for licensable works issued by the DECCW.

Other than the construction activities associated with the widening of the Norfolk Tunnel, night works that are to occur would commence after the evening peak once the traffic volumes are confirmed by the M2 Motorway Control Room (MCR). A detailed assessment of the potential impact of night time work is provided in Section 9.4 and Section 10.7. Generally, the requirement for night works is related to providing a safe work environment and minimising impact to the motorway and local road users.

Targeted community consultation with residents in the vicinity of night works is proposed during the public exhibition period for the proposal and would continue for the duration of the night works should the proposal be approved.

Night works are described in the following subsections and assessed in Section 9.2 (construction traffic and transport) and Section 9.4 (construction noise and vibration).

### Pavement cross stitching

Cross stitching is needed to reinforce existing road pavement joints to ensure that, in areas where the motorway is being widened, the new pavement areas would be adequately supported. To achieve this, holes would be drilled across existing joints and steel rods installed to pin the road pavement sections together.

In some locations, because the cross stitching would take place behind temporary barriers that separate the construction works zones from motorway traffic, the work would be undertaken during standard working hours. However, where the pavement joints are inaccessible inside the separated work zones additional lane occupancies or contraflow traffic conditions would be needed. As such, in these locations, cross stitching would need to be undertaken during times of low traffic volumes to ensure the safety of road users and construction personnel.

Based on current information, it is estimated approximately half of the proposed cross stitching work would need to be undertaken during late evening and night time periods.

### Motorway median crossovers

To facilitate proposed traffic management measures such as contraflow, bus tidal flows and other traffic staging activities, cross over points in the motorway median would be required. To create cross over points it would be necessary to establish a working zone in the motorway median, which would potentially affect traffic flow.

To maintain the safety of road users and construction personnel as well as minimise the impact on motorway operations during periods of high traffic volumes, these works would need to be undertaken in the evening or during the night.

### Transverse drainage lines

In certain locations, water drainage lines would be required to cross the motorway and adjacent local roads (transverse drainage). Due to possible safety risks to road users and construction personnel as well as potential impacts on motorway operations, this work could not be undertaken during live traffic conditions.

As such, these works would need to occur at night, outside periods of high traffic volumes, to enable suitable alternative traffic arrangements to be safely implemented.

### Asphalting works

As a consequence of setting up alternative lane alignments and road marking, as part of traffic management activities, there is the potential for the existing road surface to be damaged. Once the road has been widened in each location, asphalting works would be undertaken to address potential road surface damage.

To enable this work to be undertaken, lane occupancies and contraflow conditions would be required to ensure the safety of road users and construction personnel. This means asphalting could not be undertaken during periods of high traffic volumes and would need to occur during evening and night time periods.

### Motorway connections to local roads

Where new or modified on- or off-ramp connections between the motorway and local roads are proposed (Windsor Road, Christie Road, Herring Road), lane occupancies and significant changes to local traffic conditions would be required at certain times to facilitate completion of the required construction work.

As such, this work would need to occur outside periods of high traffic flow to maintain the safety of road users and construction personnel as well as minimise potential traffic impacts.

### Demolition of Beecroft Road bus ramp

Removal of the Beecroft Road bus ramps would involve removing sections of the bus ramp that are directly above the motorway and the Beecroft Road off-ramp. For safety reasons it is not appropriate to remove, manoeuvre or lower the sections of ramp with live traffic passing underneath. Also, cranes and other equipment may need to be set up within the motorway and off ramp areas to facilitate the removal.

Undertaking these works during periods of high traffic volumes would pose unacceptable safety risks to road users and construction personnel. As such, it would be required to undertake certain activities associated with bus ramp removal during the late evening and night time periods.

### Intelligent transport system upgrade

As part of the motorway Intelligent Transport System (ITS) cables and other subsurface infrastructure are installed at various locations along the motorway. New cabling and other infrastructure are proposed. Where the ITS upgrade works are proposed outside the construction work zones (for example along the median) safe working areas would be required to facilitate the works without affecting the safety of road users and construction personnel. These works would therefore be required in the late evening and night time periods when traffic volumes are comparatively low.

### Bridge works

Certain works associated with the proposed modification of bridges along the M2 Motorway would be required outside standard working hours. These works include the delivery and installation of bridge girders. Contraflow traffic conditions are generally required in these circumstances as there is insufficient space within the motorway to facilitate the unloading of girders during live traffic conditions without creating unacceptable safety risks to road users and construction personnel. Similarly positioning and installing girders during live traffic conditions would create unacceptable safety risks to the traffic below. These works are required to be undertaken outside periods of high traffic volumes during the evening and night time periods.

In addition, for structural reasons concrete works associated with bridges must also occur during the night where a new structure requires connection to an existing structure. Vibrations associated with traffic movements over bridges can affect how the new concrete would effectively bond to existing concrete surfaces. High vibration levels in the existing concrete caused by high traffic volumes can result in poor quality bonding between the existing and new concrete. Warmer temperatures during the day can cause concrete to set and cure more rapidly, which can affect concrete strength characteristics and increase the chance of cracking, lessening the quality and durability of the concrete structures. As such, the concrete works associated with the proposed bridge modifications need to occur during the night to maintain structural integrity of the overall bridge structure.

### Tunnelling works

The construction activities associated with the widening of the Norfolk Tunnel and supporting works, including haulage of spoil to disposal, are proposed to occur continuously (24 hours a day, six days a week) over certain periods.

Full possession of the tunnel tubes would be required to facilitate preliminary works associated with the tunnel widening. Services relocations, rock bolt installation to support the additional tunnel span and the construction of a proposed barrier is required to isolate the work areas from the trafficable portions of the M2 Motorway. This could not be completed with live traffic operating within the same tunnel tube due to the potential for significant safety risks to road users and construction personnel. Similarly, the contraflow traffic arrangements required to maintain traffic flow in both directions along the motorway during a full tunnel tube possession could only occur safely during times of low traffic volumes. As such, full possession of a tunnel tube could only occur in the evening and night-time periods generally between 8.00 pm and 5.00 am when traffic volumes are low.

A key challenge associated with the proposed tunnel widening is maintaining the structural integrity of the tunnel. Excavation works within the Norfolk Tunnel are proposed on a 24 hours a day, six days a week basis for approximately four to six months in each tunnel tube. For safety reasons during tunnelling operations it is necessary to stabilise the newly cut surface as soon as possible to maintain ground stability. Stabilisation is achieved through the installation of rock bolts, shotcrete and other devices. A continuous tunnelling process (24 hours a day, six days a week) would reduce the duration between excavation and stabilisation and ensure tunnel integrity. This is required to enable the works within the tunnel to be completed within the proposed two year construction period and to minimise safety risks to motorists and the construction workforce.

## 7.7 Resource consumption

### 7.7.1 Construction materials

The project would require the following typical construction materials during the construction stage:

- Road base/fill.
- Sand.
- Aggregate.
- Asphalt.
- Precast concrete (drainage culverts, bridge girders and the like).
- Concrete (aggregate, cement, water).
- Steel (reinforcement, street furniture, and fencing).
- Timber (formwork, street furniture).
- Topsoil (for landscaping).

The above list is indicative only and the precise material types and quantities would be determined during the detailed design stage. It is expected that bulk fill material would not be required due to a likely surplus of material. Speciality products, such as pipe bedding sands, base material, general sand and concrete aggregates would be imported to the site.

Manufactured items, including reinforcing steel, pre-cast bridge components, and stormwater pipes and pits, would also be required for the project. Products imported would be sourced from existing commercial providers, and where possible, from local and regional providers as required.

### 7.7.2 Spoil disposal

The project would necessitate approximately 500,000 tonnes of material to be cut. Of the cut material, there is estimated to be 230,000 tonnes of general fill and the 270,000 tonnes of sandstone material, which can be used for retaining wall backfill and in the upper pavement layers. Sandstone would require processing (crushing) onsite before it can be reused.

It is estimated that 320,000 tonnes of fill would be required for the project, generating an indicative 180,000 tonnes of surplus material, which is largely made up of the general fill classified material.

Classification of material is based on preliminary rock mapping and is pending the full geotechnical investigation and detailed design. Excess spoil material would be made available for reuse as part of other major construction projects. Spoil found unsuitable for reuse would be disposed of in accordance with the Waste Classification Guidelines: Parts 1 and 2 (DECCW 2009c).

### 7.7.3 Water usage

Water would be used for various activities throughout the construction process. These uses may include for dust suppression, compaction and pavement stabilisation during earthworks, wash down of plant equipment, drinking water and for toilets. Water would be supplied from the following key sources including:

- Water main: Metered connections to the local water mains would be installed. Water extracted from the mains would be used for the potable water requirements throughout the construction period for drinking water requirements.
- Sediment basins: Water stored in the sediment basins installed for construction would be used for the non-potable water requirements of the construction process including activities such as dust suppression.

Temporary above-ground pipes may be used to deliver water across the construction site. These temporary pipes would be located to avoid impacts on the environment.

## 7.8 Construction compound sites

### 7.8.1 Potential compound locations

A number of compound sites would be required during the construction period. The exact location and size of the actual construction compounds would vary according to the staging and planning of the construction activities.

The compound sites would be used to store construction materials, equipment, plant, and would also be used to house site amenities, including toilet facilities. Site offices would also be contained within certain construction compound sites.

The locations of the construction compound sites are potential only at this point in time and the final location of the compounds would be determined during the detailed design phase. Construction compounds would be managed in accordance with a Construction Environmental Management Plan (refer to Appendix G for the Construction Environmental Management Framework).

Table 13 describes the potential locations for construction compounds, which are shown in Figure 5. An operational assessment would be carried out including safety audits leading the development of TMPs. The rationale for selecting the potential compound site locations are described in the following subsection.

#### Compound site selection

Potential compound sites are scarce, as the majority of the existing M2 corridor is made up of either dense urban development or vegetated (exotic and native vegetation) areas. Specific limitations include:

- Sections of the M2 corridor is characterised by native vegetation and watercourses that warrant protection and would not be suitable for a construction compound site.
- The topography of the M2 corridor is undulating, with large sections of the M2 Motorway being in cut or on bridge structures.  Compound sites necessitate areas relatively flat land of various sizes (larger areas for main compound sites) for activities such as amenities, laydown and heavy vehicle access.

- Large areas in proximity to the M2 corridor comprise low and medium density residential development, which is considered sensitive to construction noise.
- The only areas zoned for commercial or industrial use, which are less sensitive to amenity impacts in close proximity to the M2 corridor are the Macquarie Park and Wicks Road areas to the east and the Seven Hills industrial area to the west of the M2 Motorway.
- Preferred locations for potential compound sites are those immediately adjacent to the M2 Motorway, which facilitate use of the M2 Motorway for construction site access and minimise use of local roads where feasible.

Refer to Section 3.2.4 for description of the alternatives considered for the main compound sites.

### Approach for selection of additional compounds

Due to the existing M2 corridor constraints described above, there are few suitable locations available for compound sites. Where additional or replacement compounds sites are required, these would be identified during the construction planning phase. The considered approach to identifying potential alternative compound sites involves assessing potential locations against the following environmental criteria:

- More than 40 metres from waterways.
- Areas of low ecological and heritage conservation value.
- No significant clearing of native vegetation beyond that already required for the project.
- Minimises impact on amenity of the closest sensitive receiver (unless a negotiated agreement is in place).
- On relatively level ground.

It is preferable that the compound sites would be already cleared. However, some clearing and grubbing works may be required for the compound sites. Where clearing and grubbing works are required, revegetation works would be carried out in accordance with the detailed construction methodology of the project (to be determined during the detailed design stage).

## Description of potential compound sites

Table 13 describes the potential locations for construction compounds, which are shown in Figure 5.

Table 13 Indicative construction compound locations

| Compound name | Location | Approx size (m2) | Proposed use | Proposed access | Anticipated average daily works traffic movement (by vehicle type) |
|---|---|---|---|---|---|
| Main compound (optional locations) | | | | | |
| TIDC Compound (previously used for Epping to Chatswood Rail project) | Large site south of Motorway, immediately off Delhi Road westbound on-ramp. | 35,000 | Primary compound site, where Main Office, Welfare, Canteen, Laboratory, Traffic Management, Stores and main car park, stockpiling, rehandling and laydown area would be located. Potential for 24 hour operation at all compounds. | Left in / left out off Delhi Road westbound on-ramp, as well as Entry / Exit off Wicks Road. | Light – 800<br>Heavy – 92 |
| Construction compound site | | | | | |
| Windsor Road North | Windsor Road, North of M2 Motorway. | 5,800 | Bridge construction team office and laydown area. Potential for 24 hour operation. | Entry / Exit off Torrs Street, straight onto Windsor Road. | Light – 85<br>Heavy – 20 |
| Darling Mills Creek | Compound under bridge at eastern end of existing Windsor Slip Road. | 4,000 | Bridge construction welfare and laydown area. | Entry / Exit off existing Windsor Road Ramps (in same direction as traffic flow). | Light – 38<br>Heavy – 12 |
| Barclay Road | Between Barclay Road / Perry Street and M2 Motorway. | 6,600 | Stockpile / rehandling area and bridge crew. | Entry / Exit off Perry Street. | Light – 26<br>Heavy – 12<br>(Not intended to be in constant use) |
| Devlins Creek | Compound under bridge. | 16,000 | Bridge construction welfare and laydown area. | Entry / Exit (Bridge construction traffic only) off Allerton Road. | Light – 36<br>Heavy – 12<br>(Not intended to be in constant use) |
| Barombah Road | 200 metres west of Beecroft Road. | 3,500 | Stockpile / rehandling area. | Entry / Exit of Barombah Road. | Light – 38<br>Heavy – 12 |
| Beecroft Road (Old Bus Ramp) | Area directly below Old Bus Ramp adjacent to Derby Street. | 1,460 | Bridge construction welfare and laydown area. Potential for 24 hour operation. | Entry / Exit off Beecroft Road and Beecroft Road westbound off-ramp. | Light – 38<br>Heavy – 12 |

| Compound name | Location | Approx size (m2) | Proposed use | Proposed access | Anticipated average daily works traffic movement (by vehicle type) |
|---|---|---|---|---|---|
| Sutherland Road (Tunnel Compound) | Immediately north of M2 Motorway, adjacent to Sutherland Road. | 3,800 | Tunnel construction welfare and laydown area. Potential 24 hour operation. | Left in / Left out off eastbound carriageway, through existing Noise Wall. Entry / Exit off Sutherland Road. | Light – 46<br>Heavy – 12 |
| Somerset Street (Terrys Creek western end) | Small strip compound at end of Somerset Street | 2,850 | Bridge Construction Welfare and laydown area | Entry / Exit off Crimea Road. | Light – 26<br>Heavy – 12 |
| Terrys Creek | Long strip compound adjacent to westbound access at Crimea Road extending under bridge. | 20,500 | Bridge construction, welfare and laydown area. | Entry / Exit off (Bridge construction traffic only) off Somerset Road. | Light – 36<br>Heavy – 12 |
| Vimiera Road | Immediately South of Motorway, at end of Vimiera Road. | 8,200 | Stockpile, rehandling and laydown area. | Left in / Left out off westbound carriageway, with suitable ramps constructed<br>(Light vehicle access only off Vimiera Road). | Light – 60<br>Heavy – 18<br>(Not intended to be in constant use) |
| Busaco Road | Corner of Busaco Road and Talavera Road. | 1,300 | Bridge works. | Entry / Exit off (Bridge Construction Traffic Only) Talavera Road. | Light – 38<br>Heavy – 12 |
| Toll plaza | 50 metres east of eastbound toll plaza. | 2,200 | Stockpile, rehandling and laydown area. Potential 24 hour operation. | Entry 50 metres from eastbound toll plaza. Exit onto eastbound carriageway. | Light – 38<br>Heavy – 24 |
| Christie Road Compound | Compound on the western corner of Christie Road and Talavera Road. | 7,000 | Bridgeworks. Potential 24 hour operation. | Entry / Exit off Talavera Road. | Light – 46<br>Heavy – 12 |
| Macquarie Park | North of M2 Motorway | 49,800 | Stockpile rehandling and laydown and subcontractor roads. Potential 24 hour operation. | Left in / Left out (only) onto eastbound carriageway. | Light – 124<br>Heavy – 32 |
| North Ryde Station Compound | Behind the North Ryde Station, opposite the Macquarie Cemetery. | 11,500 | Operative car park for hourly shuttle bus pick up and drop off for construction personnel. | Access from traffic lights on Delhi Road. | Light – 580<br>Heavy - 26 |

*Note: All compound sites would require utilisation for the 24 month duration of the project.*

The use of certain compounds is proposed on a 24 hour per day basis to support proposed works that need to be undertaken. These compounds are described below and assessed in Chapter 9.

### TIDC main compound

The main compound would support most of the construction activities that would be required at night. These works include:

- Night-shift supervision and management.
- Traffic management activities.
- Bridge works (where there is no dedicated compound proposed, or where the proposed activities need to be undertaken from the main carriageway necessitating a lane closure).
- Night road works (median cross over installation and temporary pavement construction, asphalting, cross stitching and the like).
- Upgrading of the integrated traffic system and works at the toll plaza.
- Acting as the launch point for any other activities which require occupancy of the travelling lanes out of hours.

As there would be limited available space within the proposed work zones on the M2 Motorway, the construction work force would start their shifts, take breaks and finish their shifts in the main compound. Outside of standard construction hours the activities undertaken at this compound would include light and heavy vehicle movements in, out and around the compound to facilitate night time works along the M2 Motorway. An excavator, backhoe and/or crane would be used occasionally outside of standard construction hours to load vehicles with equipment as required.

Whilst the majority of deliveries to the main compound would occur during standard construction hours, special items (for example bridge beams and large plant or materials) would occur at times specified by the relevant road rules. Access to the main compound would be directly off the M2 Motorway on-ramp and via Wicks Road industrial area.

### Windsor Road compound

The Windsor Road compound supports activities that need to be undertaken outside standard working hours predominately at the western end of the M2 Motorway. In particular it would support the works that are proposed at the Windsor Road interchange and Darling Mills Creek viaduct that need to be undertaken at night. Workers and staff would park at this compound to commence or complete their shifts.

This compound would be used as a storage area for materials that would be required for the bridge modification work, as well as the launch point for traffic management installations that are required for works at the western end of the M2 Upgrade project. The activities that would occur at this compound outside of standard construction hours would include light and heavy vehicle movements in, out and around the compound to facilitate night time works along the motorway. An excavator, backhoe and/or crane would be used occasionally outside of standard construction hours to load vehicles with equipment as required.

### Beecroft Road (old bus ramp)

The Beecroft Road (old bus ramp) compound would be used to support proposed works associated with modification of the Beecroft Road bridge and removal of the Beecroft Road bus ramp. These works would occur within and above the trafficable parts of the existing M2 Motorway and Beecroft Road off-ramp. The alternative of undertaking these works during standard construction working hours would pose potential safety risks to road users and construction personnel. As such, the works would be required during periods of low traffic volumes in the late evening and night time periods when appropriate traffic management arrangements can be implemented.

As this compound would support works to the Beecroft Road bridge and removal of the Beecroft Road bus ramp, the use of the Beecroft Road (old bus ramp) compound outside of standard construction hours would be required. Outside of standard construction hours the compound would be used as a temporary equipment and material lay down and storage area for demolition works and construction, as well as a muster point for construction personnel. Light and heavy vehicle movements to and from this compound and some vehicle parking would also occur outside standard construction hours.

### Sutherland Road (tunnel compound)

As described in Section 7.6.2, works associated with tunnelling would be required outside of standard construction hours. The Sutherland Road compound would support tunnelling works. This compound is selected as it is the only available vacant land within close proximity to the Norfolk Tunnel portals, which would minimise inconvenience to local residents when compared to other sites.

Outside of standard construction hours, the Sutherland Road compound would be used as a staging point by construction personnel and as a location from which to implement traffic management activities to support the proposed tunnelling works. Outside standards construction hours there would be light and heavy vehicle movements to and from the site and some loading and unloading of equipment and materials required for traffic management and tunnelling works.

### Toll Plaza

The Toll Plaza compound would predominantly be used as temporary lay down area to hold large deliveries that are required to be transported outside standard construction hours (for example bridge beams, excavators and other plant transporting in or out) and potentially for the storage of temporary concrete barriers for traffic management. From this location the equipment stored would be deployed to the appropriate location along the motorway. This proposed compound is not within the vicinity of any residents and forms part of the larger Toll Plaza, which currently operates on a 24 hour basis.

### Christie Road

The Christie Road compound would be used exclusively to support works to the Christie Road bridge. Certain bridge works, such as girder erection and concrete works would need to be undertaken at night, requiring night time use of the compound to support those works activities. Outside of standard construction hours, the compound would be used as a staging location for bridge works. Light and heavy vehicle movements would occur to and from work site, as would loading and unloading of materials and equipment.

### Macquarie Park

The Macquarie Park compound would be allocated to sub-contractors for storage of equipment and for materials handling, such as temporary concrete barriers, concrete and asphalt waste and processing and recycling of project generated sandstone material.

Outside standard construction hours this compound would be used as a location to load and unload concrete barriers, tip concrete and asphalt wastes and tunnel spoil from night works activities such as tunnelling, asphalting, crossover construction and temporary pavement installation. Material processing or crushing would be restricted to daytime construction hours and would not be undertaken at night.

## 7.8.2 Compound site access

Routes to the construction compounds would be established to minimise impacts to residents. Where possible, construction traffic would primarily use arterial roads or sub arterial roads to access construction compounds and work sites. Local (collector) roads and residential streets would only be used when there is no alternative. Table 13 lists access roads that would be utilised for access to construction compounds sites and only the following sites would require the use of collector roads and some residential roads:

- Existing TIDC compound – off Wicks Road.
- Barclay Road – off Perry Street.
- Devlins Creek – off Allerton Road.
- Barombah Road – Barombah Road.
- Sutherland Road (Tunnel) – off Sutherland Road.
- Somerset Street – off Crimea Road.
- Terrys Creek – off Somerset Street.
- Vimiera Road – off Vimiera Road.

Temporary roads would be formed to access construction compound sites for bridge construction. These sites would be alongside and underneath the M2 Motorway, and would require clearing of vegetation and earthworks to enable vehicles to gain safe access. Generally, the accesses would be approximately five metres in width to enable crane access. Where such roads are not required for maintenance these would be rehabilitated in accordance with the measures outlined in Section 9.6 of this report.

The location of work sites adjacent to the existing M2 Motorway lanes would be required along the M2 corridor in sections during construction. These work sites may require lane closures to ensure traffic and construction safety is maintained. Reduced traffic speeds would also be required in these areas and signposting, traffic controls would be implemented.

# 8. Environmental risk analysis

This section details how environmental issues for the project were identified through an environmental risk analysis process, and documents the findings of that process.

| Director-General's Requirements | Where addressed |
|---|---|
| *An assessment of the key issues, with the following aspects addressed for each key issue (where relevant):*<br>• *Any residual impacts* | *Chapter 8, Chapter 9, Technical Papers* |
| *Environmental risk analysis – notwithstanding the above key assessment requirements, the environmental assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of the proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the environmental assessment.* | *Chapter 8* |

## 8.1 Overview

An analysis has been undertaken which:

- Identified environmental issues, including key issues in the DGRs and other issues.
- Examined potential impacts and proposed mitigation measures in relation to the identified issues.
- Examined impacts likely to remain after application of mitigation measures.

Based on this analysis, an environmental risk category was assigned to each impact. This enabled the identification of matters that may be considered as additional key issues and established the basis for an appropriately detailed assessment of those additional key issues to be included in this environmental assessment.

## 8.2 Risk analysis

The environmental risk categories assigned to each impact are described in Table 14. The environmental risk analysis is summarised in Table 15. Impacts that have been assigned a risk category of 'A' are considered to indicate key issues.

Table 14 Environmental risk categories

| Risk category | Description |
|---|---|
| A | May have high or moderate impacts. A detailed assessment is necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts. |
| B | May have high or moderate impacts. These impacts can be mitigated by the application of standard environmental management measures. |
| C | Has low level of impacts. These impacts are managed by standard environmental management measures. |

## 8.3 Findings

The environmental risk analysis did not identify any key issues additional to those included in the DGRs.

Table 15 Environmental risk analysis – summary table

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| Operational traffic and transport | Yes | ▪ Changed traffic patterns and flow, generating:<br>▪ Improved travel times.<br>▪ Reduced congestion.<br>▪ Potential increase in traffic volume.<br>▪ Localised changes in traffic flows at access points.<br>▪ Improved cycle access between CBD and Sydney's north west.<br>▪ Pedestrian access around intersections – potential impacts of increased traffic flows and additional crossings.<br>▪ Changes to bus lanes have the potential to affect travel efficiency and impact other commuters.<br>▪ Re-routing of buses to Macquarie Centre:<br>▪ Potential to impact local road network.<br>▪ Impact on businesses and institutions surrounding exiting bus route, including Epping interchange. | ▪ Widening of local roads and intersection capacity improvements to reduce impact of increased traffic flows at new access points.<br>▪ There would be further investigation during detailed design into sequencing and performance of intersections at new access points and where local roads are to be widened.<br>▪ Community and stakeholder engagement plan:<br>▪ Inform community of changes to road network.<br>▪ Transport industry, government and stakeholder consultation with regards to permanent changes and access.<br>▪ Pedestrian access would be addressed in detailed design.<br>▪ Residual impacts are generally positive, including improved traffic flow, road safety conditions and cycle access. | A | Section 9.1 and Technical Paper 1. |
| Construction traffic and transport | Yes | ▪ Impacts to traffic flow on the M2 Motorway through:<br>▪ Reductions in speed limits and incidents.<br>▪ Impacts on public transport (bus) services during construction.<br>▪ Temporary disruption to operational systems in tunnel may affect traffic flows.<br>▪ Emergency vehicle access disruption.<br>▪ Impacts to traffic flow on local roads during construction from:<br>▪ Avoidance of the M2 Motorway.<br>▪ Construction traffic accessing work | ▪ Development of TMPs to control the overall staging of management and provide details of sub plans including:<br>▪ Vehicle Management Plans.<br>▪ Pedestrian Control Plans.<br>▪ Traffic Control Plans (including speed management).<br>▪ Management strategy for vehicles.<br>▪ Management of Operational systems in tunnel.<br>▪ Cyclist and pedestrian alternative route plans.<br>▪ Manage safety through:<br>▪ Inductions and toolbox briefings.<br>▪ Community and stakeholder engagement plan. | A | Section 9.2 and Technical Paper 1. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| | | compounds. Potential safety impacts, including disorientation, affected traffic flows, increased signage, speed limit enforcement, narrow lanes.<br>▪ Short term disruption to pedestrian paths and cycle route – M2 Motorway bypass required during construction, potential for incident on alternative route and impacts on local traffic. | ▪ Driver education for bus drivers.<br>▪ No residual impacts anticipated after completion of upgrade. | | |
| Operational noise and vibration | Yes | Potential exceedances of noise goals due to changed road traffic conditions on the M2 Motorway, including:<br>▪ Increased speed.<br>▪ Increased number of carriageways, which brings noise closer to houses.<br>▪ Expanded traffic growth.<br>▪ New access ramps – cars and trucks braking to enter/exit Motorway.<br>Noise impacts from expansion joints and potential impact if pavement cracks.<br>Mechanical noise emissions from the tunnel ventilation fan system. | Mitigation measures to minimise noise impact for sections where noise goals are exceeded, include:<br>▪ Construction of new noise barriers.<br>▪ Modification of existing noise barriers.<br>▪ Property treatments.<br>▪ Improved signage to discourage compression braking.<br>Re-sheeting and improved maintenance, including:<br>▪ Replacement of expansion joints.<br>▪ Improved strategy for pavement cracking.<br>Net benefit to community due to improved noise conditions than currently experienced. No negative residual impacts would remain. | A | Section 9.3 and Technical Paper 2. |
| Construction noise and vibration | Yes | Noise impacts from increased traffic and plant noise:<br>▪ Loss of amenity.<br>▪ Health impacts.<br>▪ Temporary removal of existing noise walls.<br>Vibration impacts from construction activities:<br>▪ Loss of amenity.<br>▪ Health impacts.<br>▪ Perceived structural damage.<br>Impact to existing noise walls during widening process. | A Construction Noise and Vibration Management Plan (CNVMP) would provide mitigation measures to minimise noise and vibration impacts, including:<br>▪ Temporary noise walls.<br>▪ Appropriate scheduling of noise-intensive activities and respite periods.<br>▪ Location of noise-intensive activities away from sensitive receivers.<br>▪ Noise and vibration monitoring (impact validation).<br>Pre-construction activities that would be implemented to avoid or minimise impact from noise and vibration on the surrounding community, include:<br>▪ Dilapidation surveys. | A | Section 9.4 and Technical Paper 2. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| | | | ▪ Community consultation.<br>▪ Property treatments, where appropriate and feasible at this stage.<br>Relocation of existing noise walls during construction.<br>Residual impacts unlikely due to noise and vibration modelling and mitigation. | | |
| Ecology | Yes | ▪ Clearing of approximately 21 hectares of native and exotic vegetation [including 18 hectares of permanent clearing and 3 hectares of temporary clearing].<br>▪ Temporary loss of vegetation during construction would be rehabilitated.<br>▪ This vegetation supports communities *Epacris purpurascens var. purpurascens* which is listed as Vulnerable under the TSC Act.<br>▪ Potential impact to habitat of threatened species, populations or ecological communities, including Blue Gum High Forest.<br>Impact on fauna may include:<br>▪ Light and noise impacts during construction.<br>▪ Permanent habitat loss from bush rock removal.<br>▪ Risk of introduction and spread of weeds and pest species and pathogens.<br>▪ Alteration to natural flow regimes of rivers and streams and impact to water quality which would affect aquatic flora and fauna and riparian vegetation. | Formulating management measures, which may include:<br>▪ Vegetation clearing during construction would be minimised by retaining mature trees within compounds.<br>▪ Briefings to site personnel.<br>An Environmental Management Plan (EMP) would be developed to manage:<br>▪ Vegetation removal.<br>▪ Vegetation rehabilitation, including local provenance seed collection.<br>▪ Revegetation in areas bordering natural bushland.<br>▪ Introduced species.<br>▪ Identification and marking of potentially hollow bearing trees.<br>Additional Surveys for threatened frog species (such as Green and Golden Bell Frog and Red Crowned Toadlet surveys) would be carried out in areas likely to support such species prior to clearing.<br>Residual impact may arise as a result of permanent loss of vegetation and fauna habitat.<br>To avoid impact to riparian vegetation and aquatic flora and fauna, works around waterways would be managed to protect bank stability, prevent sedimentation and minimise impacts to waterways. | A | Section 9.5 and Technical Paper 3. |
| Urban design and landscaping | Yes | Visual impacts due to:<br>▪ Increased height and extent of noise walls and retaining walls.<br>▪ Increased proximity of noise walls to some | ▪ Design treatment of noise and retaining walls with texture and colour to reduce bulk and scale.<br>▪ Screen planting to soften presence of noise and mitigation walls. Vegetation palette to respond to local | A | Section 9.6 and Technical Paper 4. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| | | properties.<br>▪ Loss of screening vegetation.<br>▪ Road moving closer to properties (Windsor Road and Talavera Road).<br>Positive visual impact due to removal of the bus bridge at Beecroft Road.<br>A new high quality character and identity would be provided for the M2 Motorway. | plant communities.<br>▪ The urban design strategy would integrate new and existing design features and the surrounding environment to provide consistency and a unique character.<br>The project would provide an overall benefit to landscape of M2 Motorway. No negative residual impacts would remain. | | |
| Aboriginal cultural heritage | Yes | Potential to have direct and indirect impacts on sites of Aboriginal archaeological heritage significance, including objects, sites and landscapes during construction. | ▪ Induction for all on site personnel outlining responsibilities under *National Parks and Wildlife Act 1974*.<br>▪ Protective devices would be installed to protect sites within 50 metres of the construction area.<br>▪ Consultation with identified stakeholders and Local Aboriginal Land Councils (LALC).<br>▪ Should items of Aboriginal origin or Aboriginal skeletal remains be identified during construction, work in that part of the study area would cease and DECCW and the relevant LALC would be contacted immediately.<br>▪ No residual impacts would remain. | A | Section 9.7 and Technical Paper 5. |
| Construction surface water management and soils | Yes | ▪ Potential impacts to water quality and hydrology due to:<br>▪ Contamination from building and washing waste, chemical spills and disturbance of contaminated soils.<br>▪ Exposed soils create potential for increased erosion and sedimentation.<br>▪ Construction activity may obstruct flow and increase flood levels. | ▪ Standard mitigation measures employed for to erosion control, bank stabilisation, bunding and contamination prevention.<br>▪ A Soil and Water Management Plan (SWMP) would be developed as part of the Construction Environmental Management Plan (CEMP). Mitigation measures would be in accordance with:<br>▪ RTA's Water Policy and Code of Practice for Water Management (1999).<br>▪ Managing Urban Stormwater – Soils and Construction (Landcom, 2004).<br>▪ No residual impacts would remain. | A | Section 9.8 and Technical Paper 6. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| Non-Aboriginal heritage | No | ▪ 16 items of non-Aboriginal heritage significance within the vicinity of the M2 Motorway, 9 of which would be potentially impacted by the proposed works as a result of vibration.<br>▪ Works would take place in the immediate vicinity of two items of non-Aboriginal heritage significance, located at:<br>▪ Farmhouse at 266 Windsor Road.<br>▪ Sandstone causeway on Devlins Creek under the Beecroft Road bus ramp. | ▪ Archival and dilapidation surveys would be undertaken.<br>▪ Should any non-Aboriginal heritage items be identified during construction works would cease and the appropriate authorities would be contacted.<br>▪ Impacts would be avoided and minimised through measures formulated and adopted during the detailed design and construction staging phases.<br>▪ Residual impacts are unlikely. | A | Section 9.9 and Technical Paper 7. |
| Operational surface water management | No | ▪ Increased scouring potential from increased water flow.<br>▪ Impacts to water quality due to increases in pollutants washed off larger road surface.<br>▪ Potential stormwater impacts on waterways. | ▪ Modifications to energy dissipaters and scour protection at the end of extended culverts.<br>▪ Existing water quality basins would be modified to account for changes in contributing catchment area.<br>▪ Stormwater treatment and outlet works and erosion and sedimentation measures along creeks.<br>▪ Residual impacts are unlikely. | B | Section 10.1. |
| Groundwater management | No | ▪ Impacts on groundwater levels and quality are unlikely to be greater than impacts already sustained from the existing M2 Motorway. | ▪ Existing surface water mitigation measures, combined with the method of installation of piles / footings, are considered adequate and would be sufficient for limiting the impacts of the upgrade works on the groundwater system.<br>▪ Residual impacts are unlikely. | C | Section 10.2. |
| Contamination | No | ▪ Potential for contamination in areas of cut and fill along the corridor, detention and sedimentation basins, and point sources of contamination. | ▪ Standard procedures would be implemented to address potential contamination, including development of an 'Unexpected Finds Protocol' and risk identification and management procedures.<br>▪ Collection and testing/classification of sediments in sediment basins would be undertaken and appropriate management strategies would be implemented prior to works in sediment basins.<br>▪ Residual impacts are unlikely. | C | Section 10.3. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| Socio-economic | No | ▪ Impacts on the community through property acquisition, land use, access and accessibility.<br>▪ Impacts on amenity through noise and vibration, air quality, increased lighting and landscape and urban design.<br>▪ Improvement in traffic flows along M2 Motorway.<br>▪ Impacts on cyclist and pedestrian movement.<br>▪ Impacts on businesses and employment.<br>▪ Wider economic impacts such as improvements in economic welfare. | ▪ Minimise disturbance where possible by managing and minimising vehicle movements, providing noise attenuation measures, providing screening to minimise visual intrusion.<br>▪ Minimise operational amenity by minimising light spill from interchanges and providing vegetative planting.<br>▪ Implement local traffic management.<br>▪ Restore cycling access to M2 Motorway breakdown lane.<br>Localised residual impacts offset by benefit to wider community. | C | Section 10.4. |
| Greenhouse gas | No | ▪ Increases in greenhouse gas (GHG) emissions during construction.<br>▪ Reduction in GHG emissions during operation in comparison to existing scenario. | Responsibilities of construction personnel:<br>▪ To reduce GHG emissions during construction<br>▪ To ensure that construction plant is maintained and repaired in accordance with requirements.<br>▪ Where possible, fuel efficiency would be considered when selecting vehicles and the use of solar powered devices would be considered.<br>▪ Where possible and feasible, preference would be given to materials sourced from local suppliers, containing recycled content or with lower carbon intensity.<br>▪ Residual impact from increase in GHG emissions during construction.<br>▪ Net benefit of a reduction in GHG emissions once the upgrade is operational due to improved traffic flow and encouraged use of bus travel. | B | Section 10.10. |
| Land use and property | No | ▪ Permanent land use and property impacts on privately and publicly owned property.<br>▪ Temporary land use change and partial property acquisition of private and publicly owned land for construction compounds. | ▪ Property inspection would be conducted on all structures within 50 metres of construction activities.<br>▪ Where liable, damage directly or indirectly caused by the construction of the Upgrade would be rectified.<br>▪ Property acquisition would be carried out in accordance with *Land Acquisition (Just Terms Compensation) Act 1991* and RTA Land Acquisition | B | Section 10.5. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| | | | Policy.<br>▪ Property access would be maintained for the duration of construction.<br>▪ Residual impacts include partial property acquisition. | | |
| Air quality | No | Adverse air quality impacts on the community from:<br>▪ Dust generation during construction.<br>▪ Construction vehicle and plant emissions.<br>▪ Vehicle emissions during operation. | ▪ Implementation of a Construction Dust Monitoring and Management Plan and would be reviewed and audited on a regular basis.<br>▪ Road design would improve flow of traffic, reduce queuing and promote integrated transport use, leading to reduced emissions.<br>▪ Residual impacts are unlikely. | C | Section 10.6. |
| Construction lighting | No | Increased light levels during night time work around construction compounds, has the potential to impact on:<br>▪ Residential houses and public amenity.<br>▪ Transport system users.<br>▪ Transport signalling systems.<br>▪ Native flora and fauna.<br>▪ In some cases there is potential that lighting requirements set out in AS4282 may be exceeded particularly at the construction compounds. | ▪ Mitigation measures drawn from AS4282-1997: Control of the Obtrusive Effects of Outdoor Lighting would be implemented to minimise adverse affects of the compounds.<br>▪ No residual impacts would remain. | C | Section 10.7. |
| Waste management | No | Waste that may be generated during the construction and operation phases of the project include:<br>▪ Green waste.<br>▪ Demolition concrete.<br>▪ Inert spoil.<br>▪ Asbestos waste.<br>▪ Virgin excavated natural material (VENM).<br>▪ General office waste.<br>▪ Impact of litter and illegal dumping. | ▪ Prevention and avoidance of waste creation and maximisation of reuse and recycling.<br>▪ A Waste Management and Reuse Sub Plan would form part of the Construction Environmental Management Plan (CEMP). This plan would address:<br>▪ Waste identification.<br>▪ Handling.<br>▪ Storage.<br>▪ Transportation.<br>▪ Disposal. | C | Section 10.8. |

| Issue | DGRs – key issue? | Potential impacts | Analysis – proposed mitigation measures and impacts remaining after their application | Risk category | Environmental assessment reference |
|---|---|---|---|---|---|
| | | | ▪ Monitoring and auditing.<br>▪ Residual impacts unlikely. | | |
| Hazards and risks | No | ▪ Hazards and risks to environmental and human health through construction and operation. | ▪ Identification of hazards and risks prior to commencement of construction.<br>▪ Potentially contaminating activities would be conducted in storage areas that are bunded and located an adequate distance away from watercourses and stormwater systems.<br>▪ Residual impacts are unlikely. | C | Section 10.9. |
| Cumulative impacts | No | ▪ Combined impact of the M2 Upgrade project with the other projects being undertaken in the surrounding area, particularly at Macquarie Hospital and Macquarie University.<br>▪ These concurrent developments may specifically impact upon:<br>▪ Construction and operational traffic and transport, especially with regards to bus and vehicular traffic and parking in Macquarie Park.<br>▪ Noise and vibration. | ▪ Management and avoidance of combined impacts by ensuring that all mitigation measures for all projects within the area are followed.<br>▪ No residual impacts remain. | B | Section 10.11. |

# 9. Assessment of key issues

This section assesses the key issues as identified in the DGRs (refer Appendix B) which may be associated with the project. These issues include traffic and transport (operational and construction), noise and vibration (operational and construction), ecology, urban design and landscape, Aboriginal cultural heritage, construction surface water and soils, and non-Aboriginal heritage.

| Director-General's Requirements | Where addressed |
|---|---|
| *An assessment of the key issues, with the following aspects addressed for each key issue (where relevant):* | |
| • *Description of the existing environment.* | *Chapter 9, Technical Papers* |
| • *Assessment of potential impacts (direct and indirect) of the project for both construction and operation stages, in accordance with relevant policies and guidelines.* | *Chapter 9, Technical Papers* |
| • *Identification of how relevant planning, land use and development matters (including relevant strategic and statutory matters), have been considered in the impact assessment and/or in developing management/mitigation measures.* | *Chapter 4, Chapter 9, Technical Papers* |
| • *Description of measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the project.* | *Chapter 9, Technical Papers* |
| • *Any residual impacts* | *Chapter 8, Chapter 9, Technical Papers* |

## 9.1 Operational traffic and transport

An assessment of the transport and traffic impacts associated with the operation of the project has been undertaken and is presented below. This assessment constitutes a summary of *Technical Paper 1 – Transport and Traffic* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *Operational Traffic and Transport Implications:* | |
| • *The environmental assessment must include an assessment of the operational impacts of the project, including traffic levels on the M2 Motorway and the impacts on the surrounding road network, including any impacts on the Lane Cove Tunnel, the M7 Westlink Motorway, and the surrounding local and regional road network.* | *Section 9.1.2, Technical Paper 1* |
| • *The assessment must also consider operational implications for public transport (particularly with respect to bus routes, interchanges and connections with the rail network), impacts on cyclists and cycle access, and any impacts on pedestrian access and safety (for those ancillary works around the M2 corridor, as relevant).* | *Sections 6.3.2, 9.1.2, Technical Paper 1* |
| *Project justification – demonstrate that the project will enhance the use of public transport, demonstrate that the project will not unduly induce traffic and exacerbate congestion in the medium to longer term within the adjoining subregions.* | *Chapter 3, Section 9.1* |

## 9.1.1 Existing environment

### Existing conditions

The M2 Motorway is a dual carriageway motorway with two lanes in each direction for the majority of its length, except for the section between Lane Cove Road and Beecroft Road where three lanes are provided for the westbound movements.

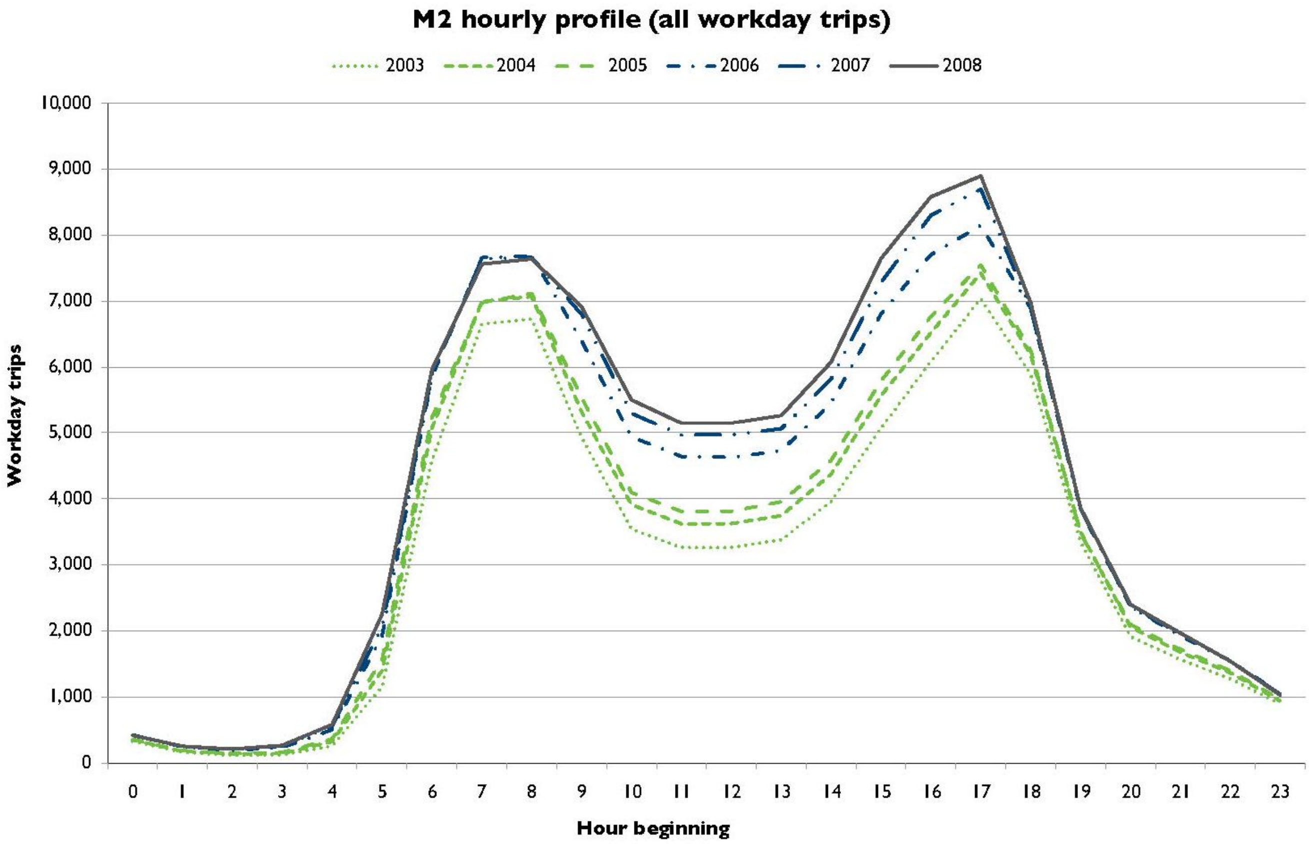
The M2 Motorway forms part of the Sydney Orbital network and is a vital link between Sydney's north-west and Sydney's lower north shore as well as the Sydney central business district. It also accommodates large volumes of heavy vehicles transporting freight between the M7 Motorway and Sydney Newcastle Freeway.

One of the features of the M2 Motorway is the dedicated bus lanes, located between Beecroft Road and Windsor Road. Median bus terminals allow buses to operate safely without interrupting the main flow of traffic, whilst providing convenient passageways for bus commuters via the overhead pedestrian walkways.

### Existing M2 Motorway traffic volumes

In the past ten years, the Average Annual Daily Traffic (AADT) on the M2 Motorway has increased from approximately 60,000 to 95,000, with the greatest increase experienced upon commissioning of the M7 Motorway in December 2005 and the Lane Cove Tunnel in March 2007. Figure 14 shows the historical hourly traffic profile on the M2 Motorway at the toll plazas.

Figure 14 Hourly traffic profile of the M2 Motorway




*Source: Transurban, 2010*

Figure 14 indicates that since 2006, traffic flow during the AM peak period (7.00 am – 9.00 am) is constrained at just fewer than 8,000 vehicles, while traffic volumes during the inter-peak and PM peak period (5.00 pm – 7.00 pm) volumes are continuing to increase.

Along the M2 Motorway, traffic volumes vary between the interchanges. The busiest section, by direction, during both the AM and PM peak hours occurs between Beecroft Road and Herring Road. Considering daily traffic volumes, the busiest section is identified between Windsor Road and Pennant Hills Road. Table 16 and Table 17 show the AM and PM peak hour and daily traffic volumes at the various sections of M2 Motorway on a typical workday. Table 18 shows the total traffic flow for the same time periods.

Table 16 Eastbound M2 workday flows (2009)

| From | To | AM Peak Hour | PM Peak Hour | Daily |
|---|---|---|---|---|
| Old Windsor Road | Windsor Road | 2,250 | 2,250 | 30,300 |
| Windsor Road | Pennant Hills Road | 3,150 | 2,800 | 39,000 |
| Pennant Hills Road | Beecroft Road | 3,400 | 2,100 | 33,950 |
| Beecroft Road | Christie Road | 4,200 | 2,300 | 38,050 |
| Christie Road | Lane Cove Road | 3,550 | 2,100 | 34,450 |
| Lane Cove Road | Delhi Road | 2,750 | 1,450 | 25,450 |
| Delhi Road | Epping Road | 1,900 | 1,050 | 17,350 |

Table 17 Westbound M2 workday flows (2009)

| From | To | AM Peak Hour | PM Peak Hour | Daily |
|---|---|---|---|---|
| Epping Road | Delhi Road | 850 | 1,950 | 17,400 |
| Delhi Road | Lane Cove Road | 1,400 | 2,900 | 26,750 |
| Lane Cove Road | Herring Road | 1,950 | 3,750 | 35,550 |
| Herring Road | Beecroft Road | 2,150 | 4,500 | 39,650 |
| Beecroft Road | Pennant Hills Road | 2,000 | 4,100 | 36,800 |
| Pennant Hills Road | Windsor Road | 2,650 | 4,050 | 42,550 |
| Windsor Road | Old Windsor Road | 2,050 | 2,950 | 32,750 |

Table 18 Total M2 workday flows (2009)

| From | To | AM Peak Hour | PM Peak Hour | Daily |
|---|---|---|---|---|
| Old Windsor Road | Windsor Road | 4,300 | 5,200 | 63,050 |
| Windsor Road | Pennant Hills Road | 5,800 | 6,850 | 81,550 |
| Pennant Hills Road | Beecroft Road | 5,400 | 6,200 | 70,750 |
| Beecroft Road | Christie Road | 6,350 | 6,800 | 77,700 |
| Christie Road | Lane Cove Road | 5,500 | 5,850 | 70,000 |
| Lane Cove Road | Delhi Road | 4,150 | 4,350 | 52,200 |
| Delhi Road | Epping Road | 2,750 | 3,000 | 34,750 |

## M2 operating performance

Level of Service (LoS) is defined as a qualitative measure describing operational conditions within a traffic stream. For motorways, where there is uninterrupted flow (no driveway accesses, traffic signals and the like), LoS is affected by traffic volume and merge arrangements.

A LoS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and safety. By definition, there are six LoS, designated from A to F, with LoS A representing the best operating condition (free flow) and LoS F the worst (flow break-down).

The following is a description of each LoS[1]:

- LoS A: is a condition of free flow in which drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and manoeuvre within the traffic stream is extremely high.
- LoS B: is in the zone of stable flow where most drivers still have reasonable freedom to select their desired speed and manoeuvre within the traffic stream.
- LoS C: is also in the zone of stable flow but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream.
- LoS D: is close to the limit of stable flow where all drivers are severely restricted in their freedom to select desired speed and to manoeuvre within the traffic stream. Small increases in traffic flow would cause operational problems.
- LoS E: Traffic volumes are at, or close to, capacity. There is virtually no freedom to select desired speed and manoeuvre within the traffic stream. Minor disturbances within the traffic stream would cause breakdowns in operation.
- LoS F: Forced Flow. The amount of traffic approaching a point exceeds that which can pass it. Flow breakdowns occur and queuing and delays occur.

All LoS calculations in this report are based on the procedures in the US Transport and Research Board 2000 Highway and Capacity Manual.

Table 19 lists theoretical hourly lane capacity by road type for LoS E. These theoretical capacities represent ideal conditions. In practice, higher traffic throughputs can be observed and local conditions such as narrow lanes, inadequate shoulders, parking and property access can also reduce these capacities.

[1] AustRoads (2009), "Guide to Traffic Management Part 3: Traffic Studies and Analysis", Sydney

Table 19 Theoretical mid-block lane capacities

| Description | Hourly capacity (single lane) passenger car units |
|---|---|
| Motorway | 2,000 |
| Ramps | 1,650 |
| Motorway to Motorway Ramp | 1,650 |
| Major Arterial | 1,800 |
| Arterial | 1,650 |
| Sub-arterial | 1,500 |
| Collector | 1,000 |
| CBD Street | 900 |
| Residential Street | 550 |

Comparing the existing traffic volumes identified in the previous section with the hourly theoretical capacities identified in Table 19, Table 20 and Table 21 provides a summary of the LoS for each section of the M2 Motorway.

Table 20 M2 Motorway eastbound hourly capacity and observed level of service

| To | From | Capacity (veh/hr) | AM Peak Hour1 | LoS AM2 | PM Peak Hour1 | LoS PM2 |
|---|---|---|---|---|---|---|
| Old Windsor Road | Windsor Road | 4,000 | 2,250 | C+ | 2,250 | B+ |
| Windsor Road | Pennant Hills Road | 4,000 | 3,150 | D+ | 2,800 | B+ |
| Pennant Hills Road | Beecroft Road | 4,000 | 3,400 | D+ | 2,100 | B+ |
| Beecroft Road | Christie Road | 4,000 | 4,200 | F+ | 2,300 | B+ |
| Christie Road | Lane Cove Road | 4,000 | 3,550 | D | 2,100 | C |
| Lane Cove Road | Delhi Road | 4,000 | 2,750 | C | 1,450 | B |
| Delhi Road | Epping Road | 4,000 | 1,900 | B | 1,050 | A |

*Note:1 – average hourly 7.00-9.00am; 2 – average hourly 5.00-7.00pm.*

*2 – Level of Service has been calculated using the AustRoad guidelines based on observed travel speeds.*

*LoS marked with + refer to HCM freeway ramp merge analysis.*

*3 – Westbound section between Lane Cove Road and Beecroft Road has three (narrow 3.1m) lanes hence increased capacity over the other 2 lanes segments.*

Table 21 M2 Motorway westbound hourly capacity and observed level of service

| To | From | Capacity (veh/hr) | AM Peak Hour[1] | LoS AM[2] | PM Peak Hour[1] | LoS PM[2] |
|---|---|---|---|---|---|---|
| Epping Road | Delhi Road | 4,000 | 850 | A | 1,950 | C |
| Delhi Road | Lane Cove Road | 4,000 | 1,400 | B+ | 2,900 | C+ |
| Lane Cove Road | Herring Road[3] | 5,200 | 1,950 | B+ | 3,750 | C+ |
| Herring Road | Beecroft Road[3] | 5,200 | 2,150 | B+ | 4,500 | D+ |
| Beecroft Road | Pennant Hills Road | 4,000 | 2,000 | B | 4,100 | E |
| Pennant Hills Road | Windsor Road | 4,000 | 2,650 | C+ | 4,050 | D+ |
| Windsor Road | Old Windsor Road | 4,000 | 2,050 | B | 2,950 | C |

*Note:1 – average hourly 7.00-9.00am; 2 – average hourly 5.00-7.00pm.*

*2 – Level of Service has been calculated using the AustRoad guidelines based on observed travel speeds. LoS marked with + refer to HCM freeway ramp merge analysis.*

*3 – Westbound section between Lane Cove Road and Beecroft Road has three (narrow 3.1m) lanes hence increased capacity over the other 2 lanes segments.*

Traffic from ramps entering motorways can cause congestion and delays as well as incidents and, in the case of the M2 Motorway, this is observed in the eastbound direction during the morning peak where traffic enters from Windsor Road, Pennant Hills Road and Beecroft Road. Similarly in the westbound direction in the afternoon peak traffic entering from Herring Road and Pennant Hills Road can cause disruption.

Table 20 shows that, during the AM peak hour, eastbound movements beyond Pennant Hills Road is near capacity with the section between Beecroft Road and Christie Road operating with peak traffic volumes above theoretical capacity. Queues regularly form back from this location and combine with queues back from the Windsor Road, eastbound merge, as far back as the M7 Motorway. The poor traffic conditions observed back to the M7 Motorway are due to demand exceeding capacity in these downstream sections rather than demand exceeding capacity in the section between the M7 Motorway and Windsor Road.

In the PM peak hour, the westbound movement, beyond Herring Road, operates at near capacity with the section between Beecroft Road and Pennant Hills Road operating at a LoS E (Table 21). Although a third traffic lane was recently designated by utilising the former emergency lane, the subsequent lane width reduction, reduced speed limits lack of road shoulder has reduced the throughput capacities.

## M2 heavy vehicles

In addition to the overall increase in traffic volumes, the proportion of heavy vehicles along the M2 Motorway has also risen. The annual proportion of heavy vehicle volumes along the M2 Motorway are summarised in Table 22. In 2005, prior to the opening of the M7 Motorway, heavy vehicles accounted for 5.9 percent (at toll locations) of the total traffic volumes on the M2 Motorway. Since the opening of the M7 Motorway, the proportion of heavy vehicles on the M2 Motorway has risen to above seven percent.

Table 22 M2 Motorway heavy vehicle proportions 2003 -2009

| Year | Proportion of heavy vehicles (percent) |
|---|---|
| 2003 | 4.2 |
| 2004 | 5.4 |
| 2005 | 5.9 |
| 2006 | 7.3 |
| 2007 | 7.7 |
| 2008 | 7.7 |
| 2009 | 7.2 |

Completion of M7 also resulted in doubling of heavy vehicle volumes on Pennant Hills Road ramps, as shown in Figure 15. Prior to M7, workday average heavy vehicle volumes were 2,000 vehicles, whereas after completion of M7 they increased to over 4,000 vehicles.

The M7 Motorway provides an efficient link for freight movements in the western Sydney region. In particular, the M7 Motorway has provided a key link for freight transport between Hume Highway and F3 Freeway via the M2 Motorway.

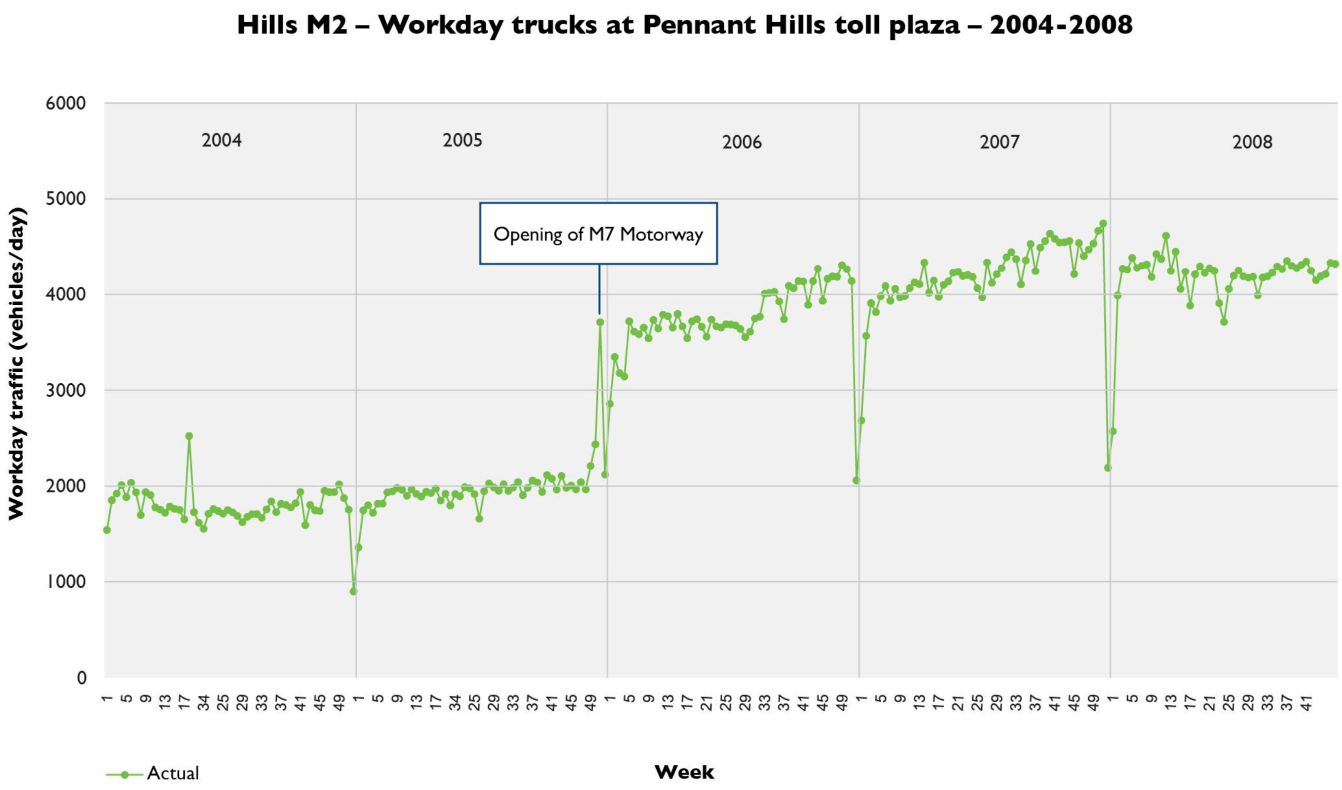
### Public transport

Both bus and rail infrastructure is located in the vicinity of the M2 Motorway. These include a number of rail stations in the M2 Motorway catchment serving the Epping to Chatswood Rail Line (ECRL) and the Northern Line as well as the numerous bus routes operating along the M2 Motorway to serve Sydney's north west regions.

The M2 Motorway forms part of the strategic bus corridor network; with routes from Castle Hill – City via Macquarie, Macquarie – City, Macquarie – Burwood, Parramatta – City via Macquarie using the M2 Motorway. The strategic bus corridors are shown in Figure 16. Numerous bus routes operate along the M2 Motorway to serve Sydney's north west regions. Combined, these bus routes carry over 17,000 passengers each weekday[2]. With increased development planned in the north west regions, it is likely that the demand for public transport within the region would increase in the future.

[2] Hillsbus, communications 2008. Assuming a bus-operating-day of 15 hours leads to peak flows of a bus every 4 minutes each with approximately 40 passengers.

Figure 15 Heavy vehicle volumes 2004 – 2008




*Source: Transurban, 2010*

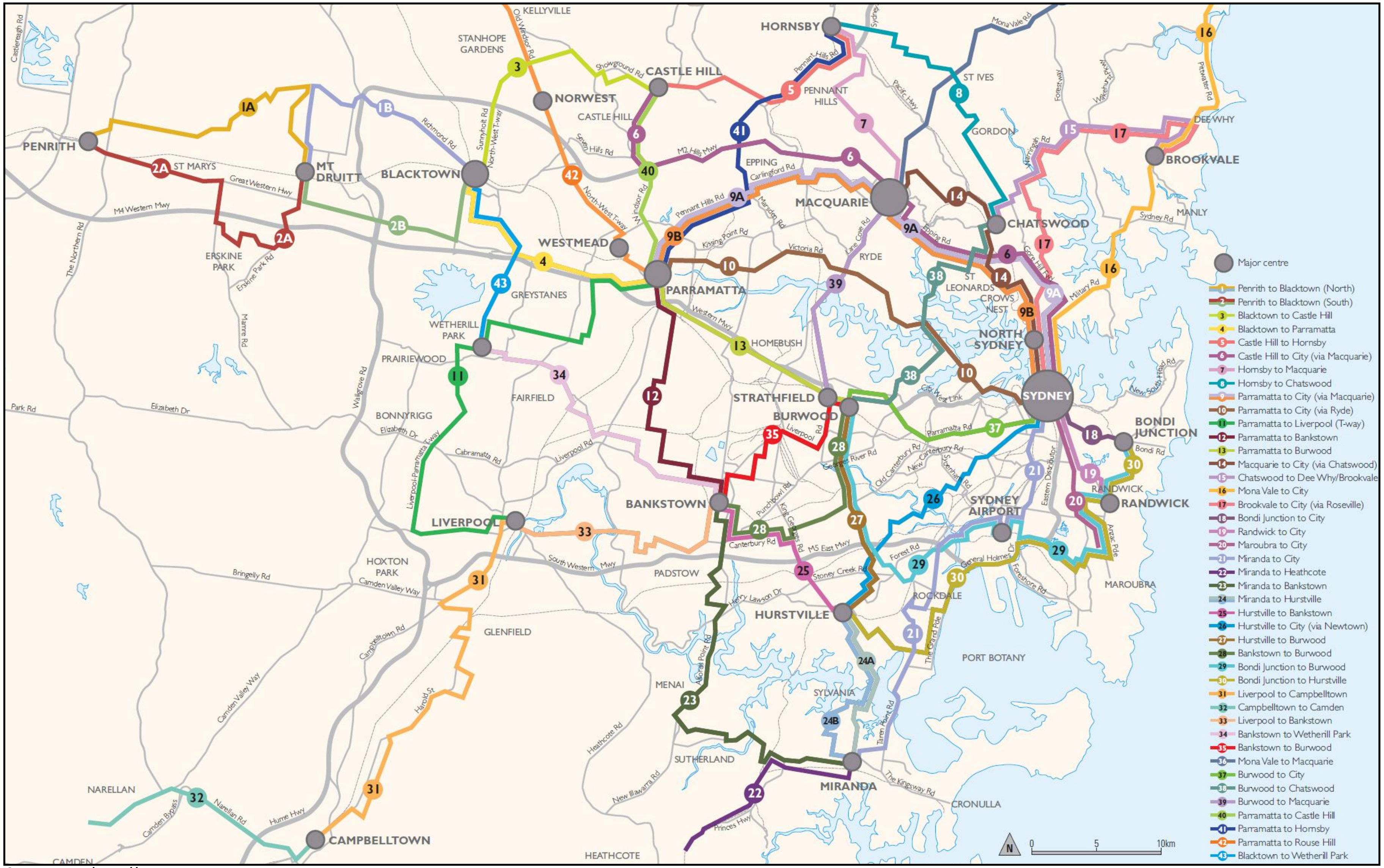
Buses using the M2 Motorway serve Sydney's north west, with routes to Sydney CBD and North Sydney and to a lesser extent Lane Cove, Epping and Macquarie Park. The M2 Motorway is also used by Busways' Route 750. Eastbound bus services on the M2 Motorway can be grouped according to their Motorway exit point, as follows:

M2 Motorway express routes – Routes 610, 610X, 612, 613, 613X, 614, 614X, 615, 615X, 616, 616X, 617X, 618, 620, 620X, 622, 642, 642X, 650X, 652X and 653 travel directly through and exit at the eastern end of the M2 Motorway and are known as the M2 Express Routes. A total of 230 eastbound services operate along these routes each weekday.

Christie Road off-ramp and Herring Road on-ramp routes – Routes 619, 621, and 651 exit via Christie Road Off Ramp and terminate at Macquarie Centre and Macquarie Park, or travel through to the Sydney central business district. These routes use the Herring Road on-ramp in the westbound direction. A total of 57 eastbound services operate along these routes each weekday.

Beecroft Road bus ramp routes – Routes 611 and 740 exit via the Beecroft Road bus only ramp and travel to Epping Station, Macquarie University and terminate at Macquarie Centre. A total of 23 eastbound services operate along these routes each weekday.

Figure 16 Sydney strategic bus corridor network




*Source:* *http://www.rta.nsw.gov.au*

Current bus facilities on the M2 Motorway include:

- Bus only lanes, in each direction, along the median between Windsor Road and Beecroft Road.
- Bus only east facing entry / exit ramp at the Windsor Road interchange.
- Bus only east facing entry / exit ramp at the Pennant Hills Road interchange.
- Bus only west facing flyover at Beecroft Road.
- Median bus stop near Barclay Road, North Rocks.
- Median bus stop near Oakes Road, West Pennant Hills.
- Kerbside bus stops near Gooden Reserve, Model Farms.
- Kerbside bus stops near Cropley Drive, Baulkham Hills.

Bus service level and reliability are dependent on traffic conditions on the M2 Motorway and the surrounding local road network. The dedicated bus lanes along the M2 Motorway allow a congestion free journey with reliable travel times along the M2 Motorway, between Windsor Road and Beecroft Road. However, buses that continue beyond Beecroft Road to the CBD encounter recurrent congestion, particularly in the section between Beecroft Road and Christie Road where peak traffic volumes are the greatest. In the westbound direction during the PM peak period, lengthy queuing can be experienced by buses until they reach the dedicated bus lanes.

Along the adjacent rail network, the largest passenger flows occur at the following locations:

- Epping Railway Station – where passengers can connect to the Northern Line services and Newcastle and Central Coast Line services that stop at Epping Station.
- Chatswood Station – where passengers can connect with North Shore Line services.

The Epping to Chatswood Rail Line was commissioned on 26 February 2009 and connects two stations listed above to provide rail connections to the growing North Ryde/Macquarie area. At the end of the fare free period (June, 2009), patronage along the line was approximately 12,000 passengers per day.

Epping rail station is also serviced by CityRail's Northern Railway Line as well as various Government and private bus routes. Table 23 shows the various bus routes providing connections to the Northern Rail Line in the vicinity of the M2 Motorway.

Table 23 Bus routes with connections to the Northern Rail Line

| Service | Origin | Via | Station | Operator | No. of services (arriving before 9.00am) |
|---|---|---|---|---|---|
| 546 | Parramatta | Oatlands, North Rocks,Carlingford | Epping | Sydney Buses | 6 |
| 548 | Parramatta | North Rocks,Carlingford | Epping | Sydney Buses | 6 |
| 549 | Parramatta | Carlingford | Epping | Sydney Buses | 5 |
| 553 | North Rocks | North Rocks,Carlingford | Beecroft | Sydney Buses | 1 |
| 611* | Blacktown | Seven Hills, M2 Motorway | Epping (continues to Macquarie Centre) | Hillsbus | 5 |
| 625 | Parramatta Interchange | North Rocks,Carlingford | Pennant Hills | Hillsbus | 5 |
| 626 | Dural | Cherrybrook | Pennant Hills | Hillsbus | 6 |
| 630 | Blacktown | Seven Hills, Baulkham Hills, Carlingford | Epping (continues to Macquarie Centre) | Hillsbus | 4 |
| 632 | Castle Hill | Cherrybrook | Pennant Hills (continues to Hornsby and also services Thornleigh, Normanhurst, Waitara stations) | Hillsbus | 8 |
| 633 | Castle Hill | West Pennant Hills | Pennant Hills | Hillsbus | 6 |
| 635 | Castle Hill | West Pennant Hills | Beecroft | Hillsbus | 4 |
| 637 | Glenorie | Galston, Round Corner | Pennant Hills | Hillsbus | 1 |
| 638 | Berrilee | Arcadia, Galston, Round Corner | Pennant Hills | Hillsbus | 2 |
| 639 | Kenthurst | Round Corner | Pennant Hills | Hillsbus | 1 |
| 651 | Castle Hill | West Pennant Hills | Beecroft (continues to Macquarie Centre and CBD) | Hillsbus | 5 |
| 740* | Plumpton | Quakers Hill, Stanhope Gardens, Glenwood, M2 Motorway | Epping (continues to Macquarie Centre) | Busways | 5 |

**Denotes services that would be rerouted as a result of the M2 Upgrade project.*

In addition to the services listed in Table 23, the bus services operating along the M2 Motorway are illustrated in Figure 17.

Passenger counts of bus services 740 and 611, which access the Beecroft Road bus ramps at the M2 Motorway, indicate low patronage with approximately 70 passengers departing and boarding these services daily. In addition to these passengers, there are approximately 40 students that utilise these services (DT&I, pers comm., 2010).

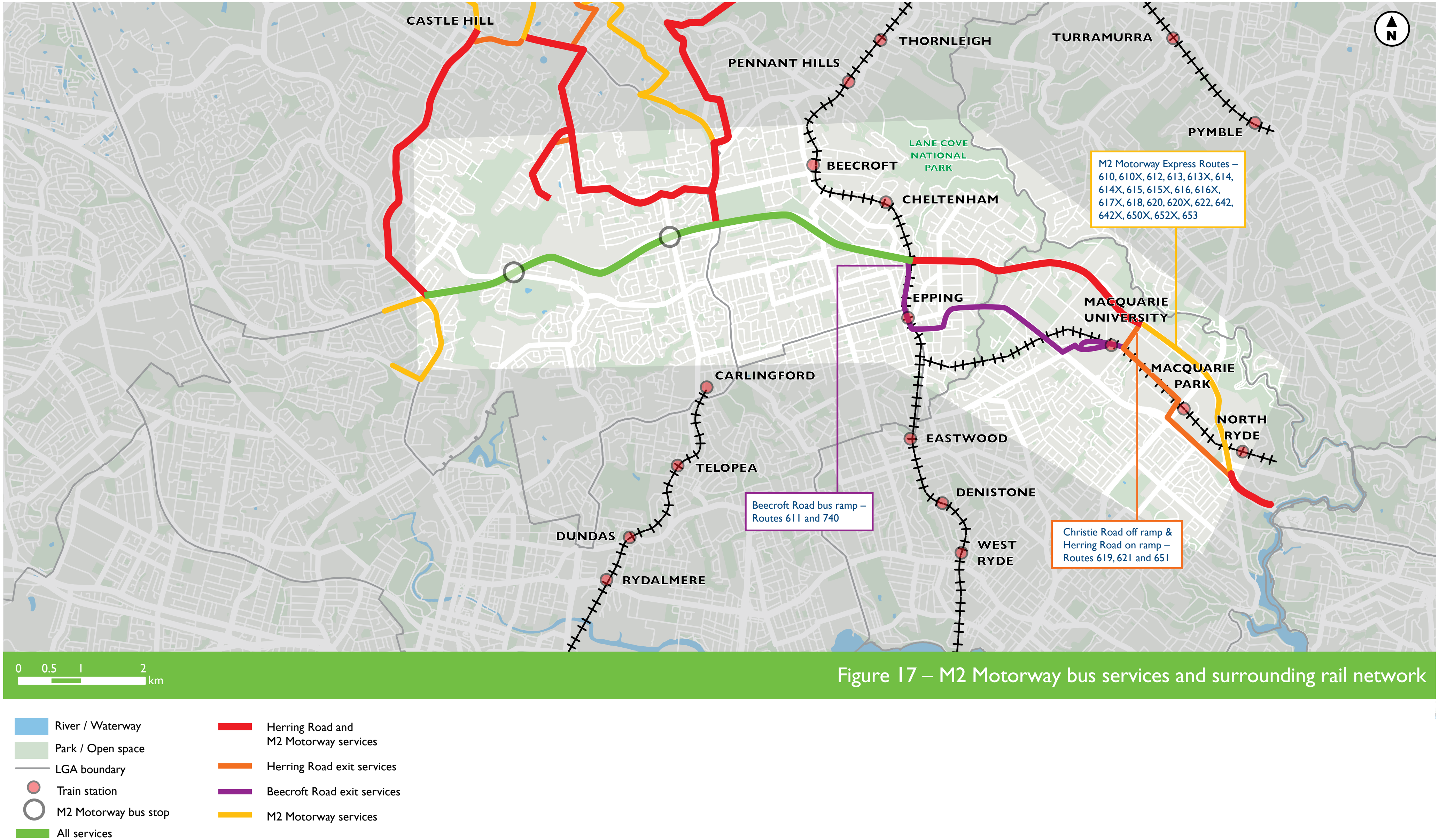


Figure 17 – M2 Motorway bus services and surrounding rail network

## Transport mode share

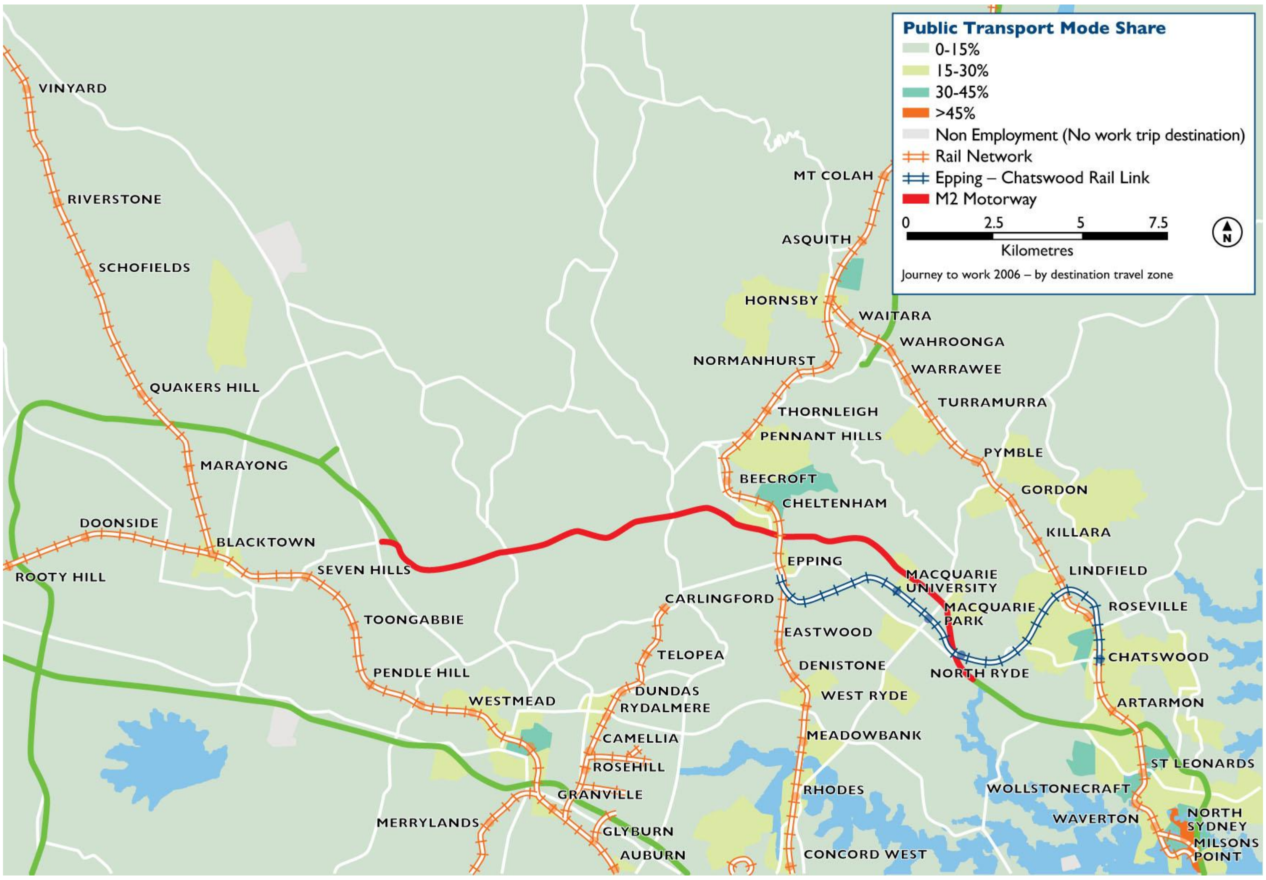
Existing proportion of Journey to Work (JTW) public transport trips originating in the vicinity of the M2 Motorway is between 0 to 30 percent of total trips. As shown in Figure 18, the public transport mode share west of Pennant Hills Road is 0-15 percent, whereas east of Pennant Hills Road it increases to 15-30 percent and corresponds to the alignment of the rail network.

With limited rail infrastructure along the M2 Motorway corridor, bus services are often the primary public transport alternative for most people within surrounding areas. As illustrated in Figure 39, the 2006 Census data indicate that Blacktown and Baulkham Hills LGAs having a higher proportion of people travelling to work by car at 67 percent and 70 percent respectively compared to 58 percent for the Sydney region. Comparatively, the public transport mode share for trips with destinations in the vicinity of the M2 Motorway is low, as shown in Figure 19.

Figure 18 Public transport mode share journey to work by origin


*Source: ABS 2006*

Figure 19 Public transport mode share journey to work by destination




*Source: ABS 2006*

The NSW Government has set relatively high mode share targets for public transport to Sydney CBD of 75 percent by 2016 and for Macquarie Park of 40 percent by 2031. The associated initiatives being implemented to achieve these targets, such as restricting parking availability, would continue to drive growth in public transport usage.

## Local road network

For urban and suburban arterial roads with interrupted flow (due to signalised intersections, driveways and the like), LoS is defined in terms of average travel speed of all through vehicles and is strongly influenced by the spacing of traffic signals and average intersection delay. The following is a description of each LoS (AustRoads (1988), "Guide to Traffic Engineering Practice, Part 2 - Road Capacity", Sydney):

- LoS A: Generally free flow conditions with operating speeds about 90% of free flow travel speeds. Vehicles are unimpeded in manoeuvring in the traffic stream and stopped delay at intersections in minimal.
- LoS B: Relatively unimpeded operation with average travel speed about 70% of the free flow speed. Manoeuvring in the traffic stream is only slightly restricted and stopped delays are low.
- LoS C: Stable operating conditions but with manoeuvring becoming more restricted and motorist experiencing appreciable tension in driving, longer queues and/or adverse signal coordination may contribute to lower average travel speeds of about 50% of the free flow speed.

- LoS D: Conditions border on a range which small increases in flow can significantly intersection delay and reduce travel speed. Travel speeds are about 40% of the free flow speed.
- LoS E: Conditions are characterised by significant intersection delays and travel speeds of 33% of free flow speed or lower. Contributing factors may be: adverse signal progression closely spaced signals and saturated intersection conditions.
- LoS F: Traffic flow at this level is very low speed – below 25% to 33% of the free flow speed. Signalised intersections would be over-saturated with extensive queuing.

To describe the performance of the surrounding local road network in the vicinity of the proposed M2 Upgrade project, four screen lines adjacent to the M2 Motorway have been defined as shown in Figure 20.

Table 24 summarises the AM and PM peak hour flows and LoS of the screenline points based on the procedures in the US Transport and Research Board 2000 Highway and Capacity Manual.

The analysis identifies several locations where the citybound movement operates at LoS F during the AM peak, including Norwest Boulevard east (1A), Old Windsor Road (1E), James Ruse Road (2D), Church Street (2E), Epping Road (3C) and Pennant Hills Road (4C) and Ryde Road (4F) along screenline 4. At these locations heavy congestion is experienced together with slower travel times.

During the PM peak, the outbound direction is the dominant movement. Relative to the inbound movement during the AM peak, improvements in congestion levels and LoS are indicated during the PM peak. However, heavy congestion is identified at Epping Road west of Vimiera Road (3C), with a LoS F.

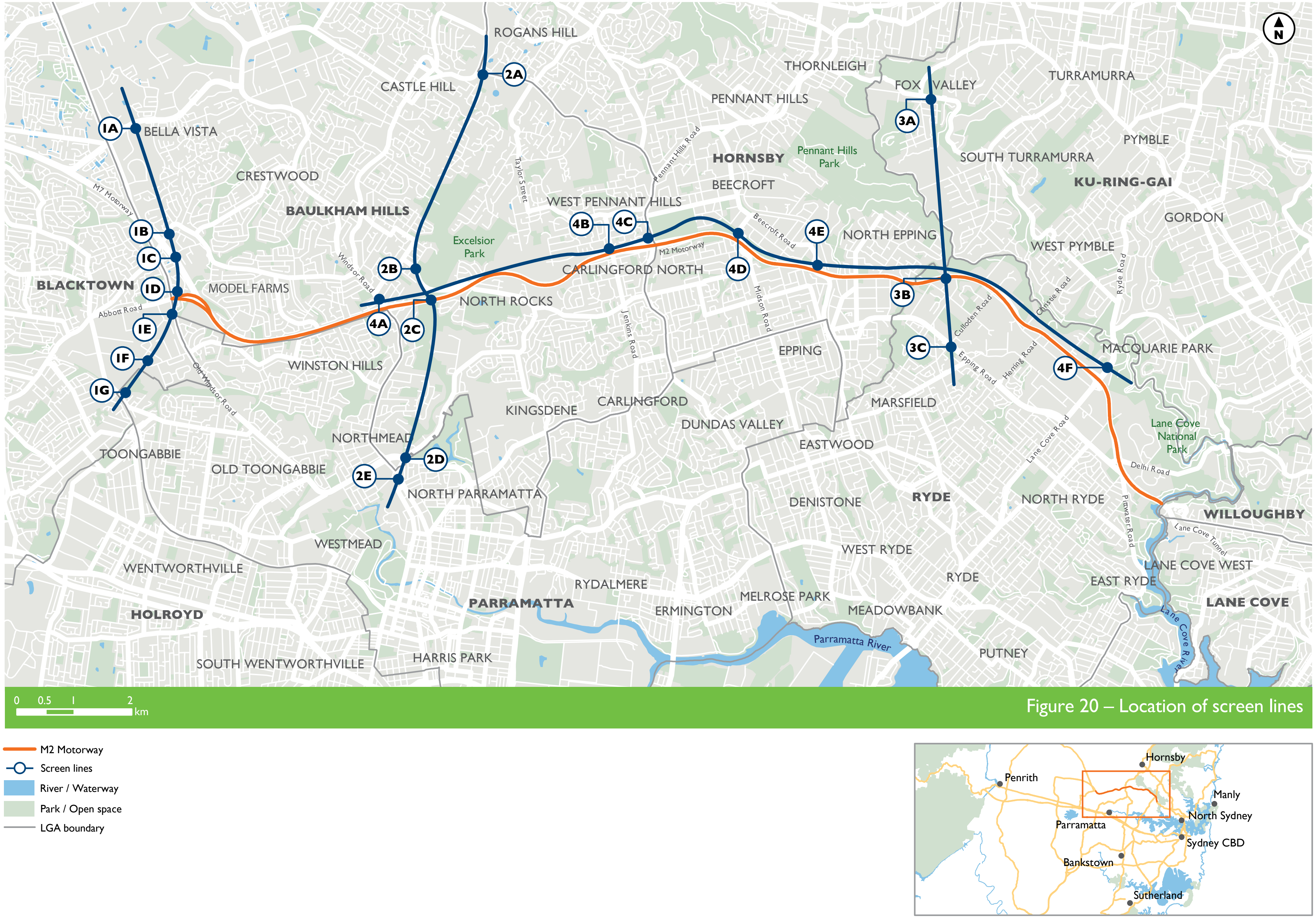



Figure 20 – Location of screen lines

Source: Transurban, 2010

Table 24 Performance based on screenline points

| Screenline | Location | Type | Inbound (Citybound) | | | | | | Outbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lanes | AM Peak | | PM Peak | | Daily | Lanes | AM Peak | | PM Peak | | Daily |
| | | | | Hourly Vehicle | LoS | Hourly Vehicle | LoS | | | Daily | Los | Hourly Vehicle | LoS | |
| 1A | Norwest Boulevard East of Old Windsor Road | Arterial | 2 | 1,200 | F | 1050 | B | 13,800 | 2 | 850 | A | 1,900 | B | 15,850 |
| 1B | Seven Hills Road East of Merindah Road | Arterial | 1 | 1,250 | B | 900 | B | 11,000 | 1 | 900 | B | 1,150 | B | 11,100 |
| 1D | Abbott Road East of Old Windsor Road | Major Arterial | 2 | 950 | A | 850 | A | 10,250 | 2 | 750 | A | 1,000 | A | 12,000 |
| 1E | Old Windsor Road North of Gibbon Road | Major Arterial | 2 | 2,850 | F | 2,250 | C | 31,250 | 2 | 1950 | C | 2,600 | C | 29,900 |
| 1F | Powers Road East of Station Road | Sub-Arterial | 2 | 700 | C | 450 | B | 6,150 | 2 | 400 | B | 550 | B | 5,200 |
| 1G | Station Road at Mc Coy Park | Sub-Arterial | 1 | 1,000 | C | 1,000 | B | 11,600 | 1 | 1,000 | C | 950 | B | 11,900 |
| 2A | Castle Hill Road East of Old Northern Road | Major Arterial | 2 | 1,800 | C | 1,800 | D | 22,450 | 2 | 1,900 | C | 2,050 | C | 23,500 |
| 2B | Renown Road East of Cook Street | Sub-Arterial | 2 | 1,150 | D | 500 | A | 8,200 | 2 | 550 | D | 1,150 | D | 8,600 |
| 2D | James Ruse Road East of Windsor Road | Major Arterial | 3 | 3,500 | F | 1,800 | B | 28,300 | 2 | 1,550 | E | 2,300 | C | 25,000 |

| Screenline | Location | Type | Inbound (Citybound) | | | | | | Outbound | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lanes | AM Peak | | PM Peak | | Daily | Lanes | AM Peak | | PM Peak | | Daily |
| | | | | Hourly Vehicle | LoS | Hourly Vehicle | LoS | | | Daily | Los | Hourly Vehicle | LoS | |
| 2E | Church Street South of Briens Road | Major Arterial | 3 | 2,250 | F | 1,100 | E | 19,800 | 3 | 900 | E | 2,050 | D | 20,800 |
| 3A | The Comenarra Parkway East of Fox Valley Road | Sub-Arterial | 1 | 500 | D | 950 | C | 7,650 | 1 | 900 | C | 450 | D | 6,650 |
| 3C | Epping Road West of Vimiera Road | Major Arterial | 2 | 2,500 | F | 1,050 | D | 21,900 | 2 | 850 | E | 1,950 | F | 21,350 |
| 4A | Windsor Road North of M2 Motorway | Major Arterial | 2 | 2,750 | E | 1,650 | D | 28,200 | 3 | 1,550 | A | 2,550 | A | 28,700 |
| 4B | Oakes Road North of M2 Motorway | Sub-Arterial | 1 | 1,150 | C | 650 | C | 8,350 | 1 | 750 | B | 1,350 | C | 9,500 |
| 4C | Pennant Hills Road North of M2 Motorway | Major Arterial | 3 | 3,550 | F | 2,400 | D | 38,350 | 3 | 2,150 | B | 3,200 | D | 38,700 |
| 4D | Kirkham Street at M2 Motorway | Collector | 1 | 1,000 | B | 400 | A | 4,700 | 1 | 400 | A | 500 | A | 3,650 |
| 4E | Beecroft Road North of M2 Motorway | Major Arterial | 2 | 2,100 | C | 950 | B | 17,800 | 2 | 850 | B | 1,600 | B | 17,750 |
| 4F | Ryde Road South of Lady Game Drive | Major Arterial | 3 | 4,000 | F | 3,750 | D | 45,400 | 3 | 3,150 | C | 3,650 | B | 43,500 |

## Intersection performance

The performance of intersections uses a LoS indicator. Grades A to F are once again used, so as to provide some tie-in with the link indicators and the LoS criteria specified by the RTA guidelines is shown in Table 25.

Two different traffic engineering software packages were used to estimate LoS for the intersections within the study area. The SCATES intersection analysis program has been used to assess the operation of closely spaced co-ordinated traffic signals, and SIDRA 3.2 has been used to assess isolated traffic signals.

Table 25 Intersection performance measures

| Intersection Level of service (LoS) | Average Delay per vehicle (sec/veh) including geometric delay | Conditions for signalised intersections |
|---|---|---|
| A | 0 – 14.5 | Good operation |
| B | 14.5 – 28.5 | Acceptable delays and spare capacity |
| C | 28.5 – 42.5 | Satisfactory |
| D | 42.5 – 56.5 | Operating near capacity |
| E | 56.5 – 70.5 | At capacity |
| F | > 70.5 | Extra capacity required |

*Source: NSW RTA Guide to Traffic Generating Development, Oct 2002.*

Based on historical surveys and SCATES data, the intersection LoS performances are estimated for the locations shown in Table 26.

Table 26 Intersection performance levels

| Intersection | LoS AM | LoS PM |
|---|---|---|
| Windsor Road – M2 Motorway ramps | B | B |
| Pennant Hills Road – M2 Motorway ramps | B | D |
| Christie Road – Talavera Road | C | A |
| Herring Road – Talavera Road | B | B |
| Lane Cove Road – M2 Motorway ramps | A | A |
| Herring Road – Waterloo Road | C | C |
| Khartoum Road – Talavera Road | B | B |
| Lane Cove Road – Talavera Road | B | F |
| Lane Cove Road – Waterloo Road | F | D |
| Lane Cove Road – Epping Road | E | F |
| Windsor Road – Cook Street | F | C |
| Herring Road – Epping Road | E | D |

As Table 26 shows, some of the intersections surrounding the M2 Motorway have a LoS of D, E and F, which indicate they are operating near or at capacity.

During the AM peak the only intersections operating at LoS F are Lane Cove Road, Waterloo Road and Windsor Road to Cook Street. In the case of the former, this is due to high proportion of traffic turning from Lane Cove Road accessing Macquarie Park via Waterloo Road. The latter is due to high volumes into and out of Cook Road. In the PM peak the intersections of Lane Cove Road – Talavera Road and Lane Cove Road/Epping Road are operating at LoS F. Similarly to the intersection of Lane Cove Road – Waterloo Road during the morning peak, the poor performance of Lane Cove Road – Talavera Road during the evening peak is attributable to high volumes of traffic leaving the Macquarie Park area via Talavera Road. The performance of Lane Cove Road – Epping Road reflects intersection of two heavily trafficked major arterial roads in the network.

### Travel speeds and travel times

Travel time surveys were conducted along the M2 Motorway and compared to an alternative route via parallel roads and is shown in Figure 21. Table 27 provides a summary of the travel time surveys along these routes.

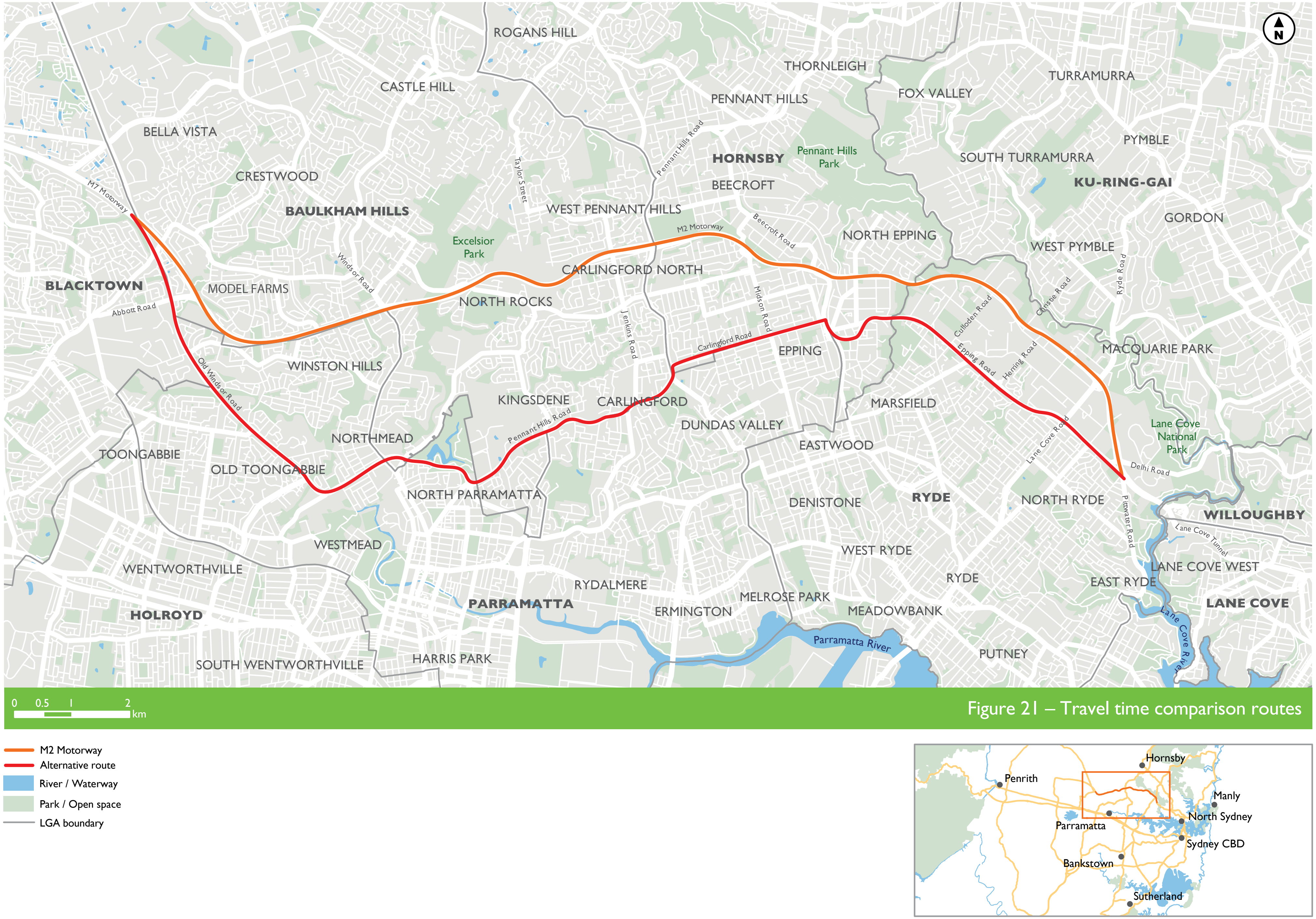



Figure 21 – Travel time comparison routes

Source: Transurban, 2010

Table 27 Existing travel times and speeds

| Route | Direction | Travel time (minutes) | Average speed (kilometres per hour) |
|---|---|---|---|
| M2 Motorway | Eastbound | 34 | 37 |
| Alternative | | 45 | 30 |
| M2 Motorway | Westbound | 27 | 45 |
| Alternative | | 46 | 29 |

Morning peak congestions on the M2 Motorway occur west of and at Norfolk Tunnel, average speeds in these sections can drop below 20 kilometres per hour and are the result of insufficient capacity to accommodate traffic entering M2 Motorway at Beecroft Road. The insufficient merge capacity at this location, coupled with conditions within the Norfolk Tunnel result in flow break down, leading to poor travel speeds and queuing which can extend to the M7 Motorway.

Whilst westbound travel times during the PM peak are relatively high compared to other times of the day, the congestion on both the M2 Motorway and the alternative local network is not as extreme as the AM peak. Average westbound speeds on the M2 Motorway during the PM peak are substantially higher than the eastbound speeds in the AM peak, interim westbound widening is likely to be a contributing factor to the relative difference in peak direction performance of the M2 Motorway.

### Road safety

Analysis of incidents that occurred on the M2 Motorway in 2008 indicates that the annual accident rate on M2 Motorway is lower than the NSW state average. Refer to Table 28. This is likely to be attributable to safety benefits of motorways associated with grade separated interchanges and physical separation between opposing traffic streams.

Table 28 Accident rates comparison (2008)

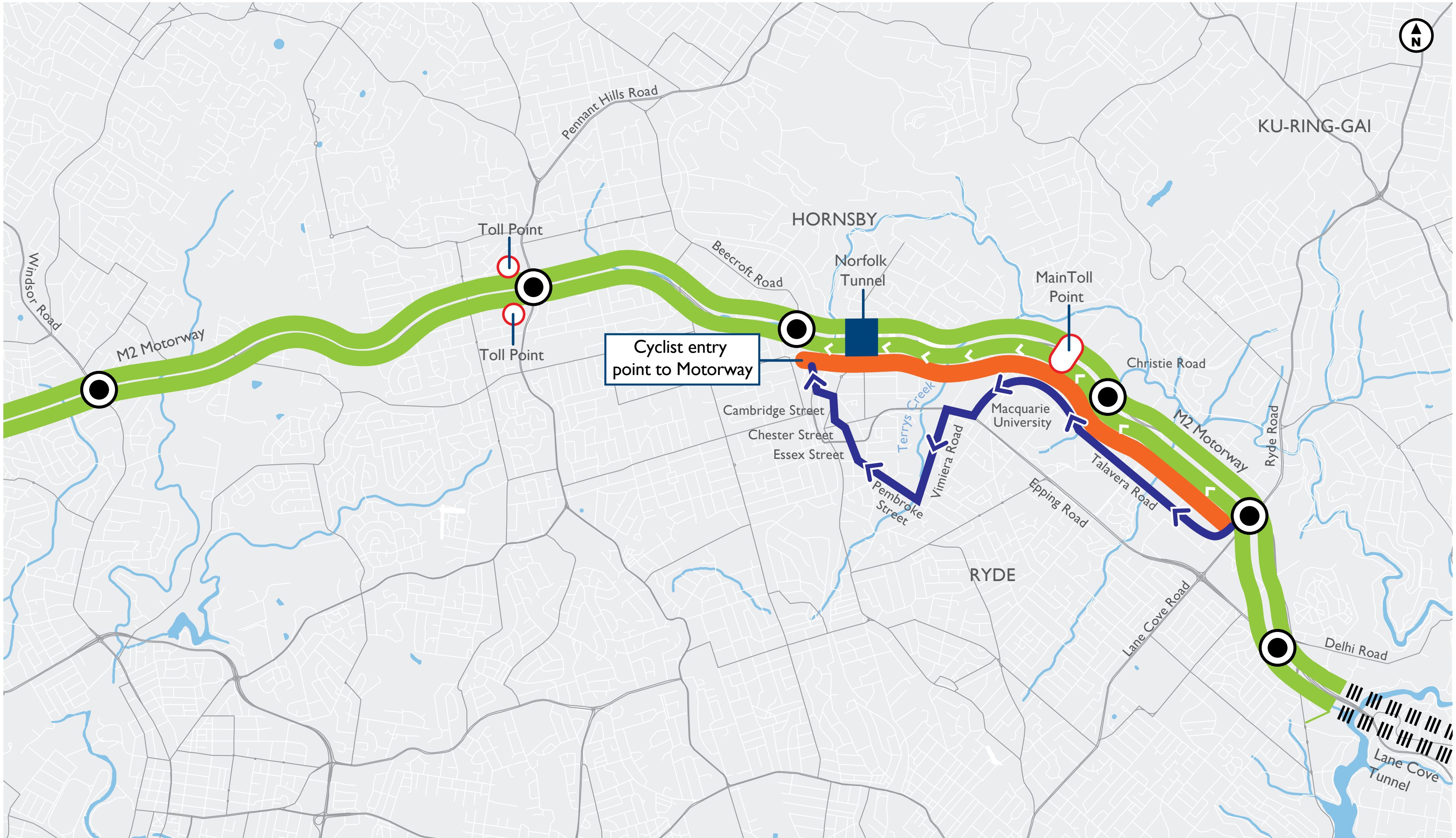
| | NSW Overall* | M2 Motorway* |
|---|---|---|
| Fatal | 0.5 | 0.0 |
| Injury | 28.5 | 6.7 |
| Non Casualty (tow-away) | 36.1 | 11.3 |
| Total | 65.1 | 18.0 |

Note: *accidents per 100 million VKT

The incidents that occurred on the M2 Motorway were generally adjacent to interchanges, decision point locations and the Norfolk Tunnel, where sun glare is an issue in the morning peak.

### Cycle facilities

Originally, the road shoulders located along the M2 were designated as breakdown lanes and used by cyclists. However, the removal of the westbound shoulder between Lane Cove Road and Beecroft Lane, to allow for a third traffic lane, has detoured the cycle route via the local road system from North Ryde to Epping as shown in Figure 22.




Not to scale

Figure 22 - Existing cycle facilities adjacent to the M2 Motorway

Existing M2 Motorway
Alternate Bike Route
Removal of westbound shoulder
Interchange
Toll plaza

Source: Transurban, 2010

### Pedestrian access

Existing pedestrian facilities on the M2 Motorway provide access between the bus stops, located along the median and kerbsides, and the adjacent local streets. Also located along the M2 Motorway are pedestrian overpasses and an underpass that allow safe pedestrian passage across the M2 Motorway. Section 7.3.2 and Table 12 indicated the pedestrian crossing points and changes during the construction period.

## 9.1.2 Impact assessment

### Basis for assessing current and future traffic conditions in the M2 Motorway

Transurban's Strategic Traffic Model (TUSTM) was used to forecast traffic network volumes in the corridor, including on M2 Motorway, with and without the proposed M2 Upgrade project for years 2011 and 2021. Turning volume forecasts from TUSTM were also used to model intersection performance using the intersection analysis software packages SIDRA and SCATES.

TUSTM uses demand forecasts of vehicle trips between origins and destinations obtained from Transport Data Centre (TDC). These are assigned on a model of the Sydney road network using appropriate modules from the CUBE suite of transport planning software packages. Vehicle trips are assigned on the basis the lowest cost route. This cost takes into account travel time, toll cost and varies depending on the socio-economic characteristics of the trip purpose.

Refer to Technical Paper 1 for full description of TUSTM and assessment contained in this section.

### Induced traffic

When the capacity of the road network is increased, traffic may occur that may not have otherwise resulted. This additional traffic can result from one or more of the following:

- Rerouting of traffic onto different roads to take advantage of travel time savings.
- Redistribution of trips so that some traffic switch to destinations that are now more easily accessed.
- Retiming of trips (particularly into peak times).
- Modal shifts from public transport to car driver.
- Additional trips that would otherwise not have been undertaken.
- Changes in the land use patterns to accommodate growth and in response to the improved accessibility resulting in additional trips.

These factors can result in an increase in vehicle kilometres of travel, known as 'induced traffic'.

The forecast of annual road network vehicle kilometres travelled (VKT) for the Sydney network has been modelled for 2011 and 2021 and is shown in Table 29 below. The modelling forecasts a slight reduction (less than 0.1 per cent) in the overall number of vehicle kilometres travelled on the Sydney road network as a result of the M2 Upgrade project in 2011 and 2021, while there would be a slight increase in vehicle kilometres travelled on the motorway itself (around 0.6 per cent). This net change on the network is considered to be marginal.

While there may be changes and increases in traffic numbers due to land use changes, population growth and/or changes in economic activity, it is noted that one of the project objectives include:

- Enhance the strategic road network in Sydney's north-west to support economic growth.
- To improve access to and accessibility between key residential, employment and educational precincts in Sydney's north-west.

The increased activity that M2 Motorway addresses is not considered to be a result of the project. Rather, the project addresses this need for an enhanced road network.

However, a new or substantially upgraded road can induce changes in trip patterns even when there is no growth in regional population or changes in economic activity. This can appear as induced traffic. Generally, changes to home and workplace trip patterns occur over several years after opening of the new or upgraded road whereas changes to shopping and recreational trip patterns can occur in a much shorter period. A key factor for induced trips is that improvements in travel times are experienced throughout the day, which, as an example, occurred upon opening of the M7 Motorway.

However, unlike the M7 Motorway and similar projects, the M2 Upgrade project is expected to provide only marginal improvements outside of peak periods and therefore provides much lower potential for induced trips at these times. More substantial travel time improvements are expected primarily during the morning and evening peak periods.  While this provides potential to induce traffic at these peak times, it is expected to be low as there would also be similar improved travel time for buses on the M2 Motorway.  Thus there would be no greater incentive for a mode shift. Further, while the east facing on-ramp at Christie Road and off-ramp at Herring Road would enhance accessibility to Macquarie Park, they are not likely to generate more than a marginal mode shift from rail (Epping to Chatswood Rail Link). This is because private vehicle travel to and from Macquarie Park and Sydney's Central Business Districts are most heavily influenced by parking costs and availability, and this is not going to change as a result of the M2 Upgrade project.

It should also be noted that proposed toll at the new access ramps, and increased toll upon opening, may act as a deterrent to discretionary travel, further reducing the potential for induced traffic.

On this basis, the project is not expected to unduly induce traffic.

## Strategic level changes in road network performance

The predicted change in travel demands on the Sydney network is shown in Table 29. The likely change in hours travelled are shown in Table 30 and average vehicle speeds on the future network are shown by Table 31[3].

While the overall change in network vehicle kilometres travelled is small, there is an expected shift in travel from arterial and local roads (between 0.2 percent - 0.5 percent to travel on Motorways and 0.6 percent on the network). The majority of this predicted change would be within the M2 corridor, influenced by the project.

There would be an overall reduction in vehicle hours travelled (Table 30), with up to 8.3 percent reduction on motorways as a result of the project. Likewise, when travel speeds are compared with the base scenario, representing the M2 Motorway with no upgrades, (Table 31), the project improves overall travel speed performance.

Table 29 Forecast annual road network vehicle kilometres travelled

| Facility | 2011 base scenario* | 2011 M2 with Upgrade* | Impact (percent) | 2021 base scenario* | 2021 M2 with Upgrade* | Impact (percent) |
|---|---|---|---|---|---|---|
| Motorway | 8,697 | 8,749 | 0.6 | 9,862 | 9,924 | 0.6 |
| Arterial | 14,379 | 14,347 | -0.2 | 16,407 | 16,368 | -0.2 |
| Local / Sub Arterial | 7,302 | 7,280 | -0.3 | 8,668 | 8,628 | -0.5 |
| Sydney Network | 30,379 | 30,376 | <-0.1 | 34,936 | 34,920 | <-0.1 |

*Note: * million kilometres*

Table 30 Future annual road network vehicle hours travelled

| Facility | 2011 base scenario* | 2011 M2 with Upgrade* | Impact (percent) | 2021 base scenario* | 2021 M2 with Upgrade* | Impact (percent) |
|---|---|---|---|---|---|---|
| Motorway | 113.0 | 112.51 | -0.4 | 156.89 | 143.82 | -8.3 |
| Arterial | 351.0 | 348.55 | -0.7 | 431.70 | 427.95 | -0.9 |
| Local / Sub Arterial | 209.9 | 209.05 | -0.4 | 276.62 | 274.30 | -0.8 |
| Sydney Network | 673.8 | 670.10 | -0.6 | 853.58 | 846.07 | -0.9 |

*Note: * million hours*

[3] The annual figures below have been calculated using the following methodology:

- Average workday VKT and VHT summed from TUSTM four model periods – AM, IP, PM, NT
- Annual VKT and VHT converted using an annualisation factor of 325

Table 31 Future annual road network annual average vehicle speeds

| Facility | 2011 base scenario* | 2011 M2 with Upgrade* | Impact (percent) | 2021 base scenario* | 2021 M2 with Upgrade* | Impact (percent) |
|---|---|---|---|---|---|---|
| Motorway | 77.0 | 77.8 | 1.0 | 62.9 | 69.0 | 9.8 |
| Arterial | 41.0 | 41.2 | 0.5 | 38.0 | 38.2 | 0.6 |
| Local / Sub Arterial | 34.8 | 34.8 | 0.1 | 31.3 | 31.5 | 0.4 |
| Sydney Network | 45.1 | 45.3 | 0.5 | 40.9 | 41.3 | 0.8 |

*Note: * kilometres per hour*

## Link Flows

The forecast change daily traffic flows for each section of the M2 Motorway is based on the modelling detailed in Technical Paper 1, and is summarised in Table 32. Generally, the forecasts indicate increased traffic volumes on the M2 Motorway. At 2021, the daily traffic flows increase in the order of 1,600 to 6,900 vehicles are indicated, the latter in the westbound section Lane Cove Road to Herring Road.

Table 32 Forecast M2 Motorway eastbound daily traffic volumes

| From | To | Eastbound | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2011 Impact | 2021 Base | 2021 Up-grade | 2021 Impact |
| Old Windsor Road | Windsor Road | 31,800 | 33,950 | 2,150 | 37,550 | 40,050 | 2,500 |
| Windsor Road | Pennant Hills Road | 41,200 | 42,400 | 1,200 | 49,750 | 51,330 | 1,580 |
| Pennant Hills Road | Beecroft Road | 36,150 | 37,850 | 1,700 | 44,750 | 46,830 | 2,080 |
| Beecroft Road | Christie Road | 40,350 | 42,500 | 2,150 | 49,250 | 51,830 | 2,580 |
| Christie Road | Lane Cove Road | 36,250 | 40,150 | 3,900 | 42,900 | 47,810 | 4,910 |
| Lane Cove Road | Delhi Road | 26,950 | 30,750 | 3,800 | 32,500 | 37,310 | 4,810 |
| Delhi Road | Epping Road | 19,200 | 22,000 | 2,800 | 25,850 | 29,810 | 3,960 |

Table 33 Forecast M2 Motorway westbound daily traffic volumes

| From | To | Westbound | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2011 Impact | 2021 Base | 2021 Up-grade | 2021 Impact |
| Epping Road | Delhi Road | 18,750 | 21,450 | 2,700 | 24,300 | 27,800 | 3,500 |
| Delhi Road | Lane Cove Road | 27,200 | 31,600 | 4,400 | 30,500 | 35,250 | 4,750 |
| Lane Cove Road | Herring Road | 36,150 | 42,350 | 6,200 | 40,200 | 47,100 | 6,900 |
| Herring Road | Beecroft Road | 40,800 | 44,500 | 3,700 | 47,250 | 50,920 | 3,670 |
| Beecroft Road | Pennant Hills Road | 37,750 | 41,850 | 4,100 | 43,600 | 47,720 | 4,120 |
| Pennant Hills Road | Windsor Road | 43,750 | 45,650 | 1,900 | 50,350 | 52,020 | 1,670 |
| Windsor Road | Old Windsor Road | 33,300 | 38,250 | 4,950 | 37,350 | 42,715 | 5,365 |

Further detail regarding traffic flows forecast during the AM and PM peak hours, is summarised in Table 34and Table 35. This is followed by LoS based on the M2 Motorway forecast traffic volumes summarised in Table 36 and Table 37.

Table 34 Forecast M2 Motorway eastbound peak hour traffic volumes

| From | To | AM | | | | PM | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade |
| Old Windsor Road | Windsor Road | 2,400 | 2,800 | 3,000 | 3,400 | 2,350 | 2,750 | 2,900 | 3,400 |
| Windsor Road | Pennant Hills Road | 3,350 | 3,830 | 4,200 | 4,800 | 2,950 | 3,270 | 3,700 | 4,150 |
| Pennant Hills Road | Beecroft Road | 3,600 | 4,430 | 4,350 | 5,400 | 2,250 | 2,620 | 2,900 | 3,450 |
| Beecroft Road | Christie Road | 4,450 | 5,380 | 5,250 | 6,400 | 2,450 | 2,870 | 3,150 | 3,750 |
| Christie Road | Lane Cove Road | 3,600 | 4,430 | 4,100 | 5,300 | 2,250 | 2,920 | 2,900 | 3,800 |
| Lane Cove Road | Delhi Road | 2,750 | 3,480 | 2,950 | 4,000 | 1,600 | 2,170 | 2,150 | 2,950 |
| Delhi Road | Epping Road | 1,900 | 2,430 | 1,900 | 2,800 | 1,200 | 1,670 | 1,800 | 2,500 |

Table 35 Forecast M2 Motorway westbound peak hour traffic volumes

| From | To | AM | | | | PM | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade |
| Epping Road | Delhi Road | 950 | 1,250 | 1,250 | 1,650 | 2,050 | 2,150 | 2,350 | 2,450 |
| Delhi Road | Lane Cove Road | 1,550 | 1,950 | 1,950 | 2,450 | 3,000 | 3,200 | 3,400 | 3,650 |
| Lane Cove Road | Herring Road | 2,150 | 2,650 | 2,900 | 3,550 | 3,900 | 4,350 | 4,400 | 5,000 |
| Herring Road | Beecroft Road | 2,350 | 2,500 | 3,150 | 3,400 | 4,750 | 5,170 | 5,350 | 6,000 |
| Beecroft Road | Pennant Hills Road | 2,200 | 2,400 | 2,950 | 3,250 | 4,300 | 4,670 | 4,700 | 5,100 |
| Pennant Hills Road | Windsor Road | 2,900 | 2,950 | 3,550 | 3,650 | 4,250 | 4,220 | 4,550 | 4,300 |
| Windsor Road | Old Windsor Road | 2,250 | 2,480 | 2,750 | 3,050 | 3,150 | 3,440 | 3,400 | 3,450 |

Table 36 Forecast M2 Motorway eastbound peak hour level of service scenarios

| From | To | AM | | | | PM | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade |
| Old Windsor Road | Windsor Road | C | C | D | D | C | C | D | D |
| Windsor Road | Pennant Hills Road | D+ | C | F+ | D | C+ | C | D+ | C |
| Pennant Hills Road | Beecroft Road | D+ | D | F+ | D | C+ | B | C+ | C |
| Beecroft Road | Christie Road | F+ | D+ | F+ | F+ | C+ | B+ | D+ | C+ |
| Christie Road | Lane Cove Road | D | C+ | E | D+ | C | B+ | D | C+ |
| Lane Cove Road | Delhi Road | C | D | D | E | B | C | D | D |
| Delhi Road | Epping Road | B | C | B | C | B | B | C | C |

*Note to table: '+' indicates LoS based on constraints at on-ramp merge point.*

Table 37 Forecast M2 Motorway westbound peak hour level of service scenarios

| From | To | AM | | | | PM | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Up-grade | 2011 Base | 2011 Up-grade | 2021 Base | 2021 Upgrade |
| Epping Road | Delhi Road | A | B | B | C | C | C | D | D |
| Delhi Road | Lane Cove Road | B+ | B+ | B+ | C+ | C+ | D+ | D+ | D+ |
| Lane Cove Road | Herring Road | B+ | B+ | C+ | C+ | C+ | D+ | D+ | D+ |
| Herring Road | Beecroft Road | B+ | B+ | C+ | B+ | D+ | D+ | D+ | D+ |
| Beecroft Road | Pennant Hills Road | C | B | D | C | F | D | F | D |
| Pennant Hills Road | Windsor Road | C+ | C+ | D+ | D+ | F+ | F+ | F+ | F+ |
| Windsor Road | Old Windsor Road | C | C+ | C | D+ | D | D | D | D |

*Note to table: '+' indicates LoS based on constraints at on-ramp merge point.*

Table 36 and Table 37 indicate that the project would improve the level of service on the M2 Motorway eastbound during the AM and PM peak between Windsor Road and Beecroft Road. The westbound level of service would also improve during the AM and PM peak between Beecroft Road and Pennant Hills Road.

The eastern end of the M2 Motorway is unlikely to experience improvements in level of service. The level of service during the AM peak for east bound motorists between Lane Cove Road and Epping Road would be adversely affected as a result of traffic growth and improved access to the M2 Motorway resulting from the M2 Upgrade project.

The assessment of the eastbound section between Beecroft Road and Christie Road is based on existing vehicle occupancy rates along the M2 Motorway and therefore may represent a conservative utilisation of the proposed T2 lane along this section. It is probable that the introduction of the T2 lane may potentially encourage car pooling and thus improve the LoS along this section. The assessment of the T2 lane would be further investigated using microsimulation during detailed design.

The LoS following the M2 Upgrade project are predicted to be generally no worse than LoS D by 2011. By 2021, only the afternoon peak westbound movement between Pennant Hills and Windsor Road would operate at LoS F. This would be the case with or without the M2 Upgrade project.

### Heavy vehicles

The M2 Upgrade project would improve travel conditions for M2 Motorway commercial vehicles and would continue to provide high levels of service for trucks. The M2 Upgrade project would offer reduced travel times for commercial vehicles and thereby potentially reduce truck volumes, consequent truck noise and emission impacts on the local road network.

### Public transport impact

The project would result in a number of benefits to bus services. The main benefits include:

- Reduced traffic congestion pinch points on the M2 resulting from increased capacity.
- Changes to bus access arrangements.

The provision of a T2 lane eastbound between Terrys Creek and Lane Cove Road would provide additional eastbound road capacity for both transit lane users and eastbound bus services along a section that currently experiences regular congestion during the AM Peak.

M2 Motorway buses, between Beecroft Road and Lane Cove Road, utilise the same lanes as general traffic. The widening of M2 Motorway within this section with an additional lane in each direction is expected to benefit both buses and private vehicles. This additional capacity would reduce traffic congestion for motorists and buses to provide improved bus travel times and reliability. The widening of the carriageways would also allow the speed limit to be restored to 100 kilometres per hour and potentially resolve queuing issues upstream.

The current delays experienced by buses entering the M2 Motorway, from Windsor Road, and accessing the median bus only lane would alleviated through the introduction of the additional eastbound lane. The additional lane would ease the congestion within the area and improve bus manoeuvrability between the Windsor Road on-ramp and the median bus only lane.

Bus travel times and reliability along the M2 Motorway would improve for services that exit to Macquarie Park as well as those that continue to the CBD. Services to the Macquarie Park area would benefit from widening of the Christie Road bridge and Talavera Road, as these upgrades would reduce delays currently experienced by buses exiting the M2 Motorway, crossing the Christie Road Bridge and accessing the Macquarie Bus interchange via Talavera Road. By increasing bus travel times and reliability, the M2 Upgrade project would support achieving NSW Government's mode share targets, as described above.

With the M2 Upgrade project, the forecast travel time saving for buses is approximately five minutes for eastbound services during the 2021 AM peak hour, which is important in that it is over a relatively short section of the M2 Motorway where travel time delay is currently experienced by bus users that this time saving would be realised. Removing this bottleneck would provide a free flow travel experience from end to end for bus users. Table 38 provides a summary of the bus travel times.

Table 38 Forecast bus travel times on M2 Motorway

| Direction | 2011 Base Travel Time[1] | 2011 With Upgrade Travel Time[1] | 2011 Travel Time Difference | 2021 Base Travel Time[1] | 2021 With Upgrade Travel Time[1] | 2021 Travel Time Difference |
|---|---|---|---|---|---|---|
| AM Eastbound | 16 | 12 | -4 | 18 | 13 | -5 |
| AM Westbound | 12 | 12 | 0 | 12 | 12 | 0 |
| PM Eastbound | 12 | 12 | 0 | 13 | 12 | -1 |
| PM Westbound | 25 | 20 | -5 | 26 | 22 | -4 |

*Note: 1 – Travel time assumes no stopping*

Given there were approximately 17,000 passengers using M2 Motorway bus services each workday in 2008, the annual travel time savings from the M2 Upgrade project for bus users would be in the order of 250,000 hours by the time the M2 Upgrade project is complete.

The existing two-way bus ramp near Beecroft Road was installed in anticipation of the potential demand of commuter transferring between the M2 Motorway buses and the heavy rail network at Epping Rail Station. However, historic patronage data shows that the number of people transferring from buses at Epping Railway station is small in comparison to the demand for direct city bound bus services along the M2 Motorway. Furthermore, with the opening of the Epping to Chatswood rail link, commuters have the ability to access Epping Railway Station via the heavy rail network from Macquarie Park.

The removal of the bus ramp between the M2 Motorway and Beecroft Road would require existing bus routes between the M2 Motorway and Epping Rail Station (611 and 740) to be re-routed.. In addition to the rail station, these services also provide connections to Macquarie University and the shopping centre. With the removal of the bus only ramps near Beecroft road, these bus routes would be re-routed via Christie Road, Talavera Road and Herring Road. Commuters using the bus routes 611 and 740 to access Macquarie Park would benefit from shorter travel times as a result of the using the Christie Road exit ramp.

The removal of the bus ramps would only require a change in the trip schedule for those commuters using bus routes 611 and 740 to access Epping or to connect with other services at Epping Railway Station. Those commuters departing Epping or connecting to other transport services to reach their final destination would have alternative options, such as catching alternate buses and trains. Some trips for those commuters currently using these bus routes are likely to result in longer travel times and or more transfers, while other trips are likely to result in fewer transfers and travel time savings.

As discussed in Section 9.1.1 passenger counts at Epping indicate there are approximately 70 passengers per day boarding and departing at Epping (source: DT&I). In addition, there are approximately 40 students from Epping Boys' High whose service could be re-routed.

Apart from bus routes 611 and 740, that access Epping via the Beecroft Road ramp, other existing public transport services provide connections to Epping Station and other stations on the Northern Railway Line from the north-western regions of Sydney.

Existing public transport options available to those users that would be required to change their trip schedule include:

- Utilising alternative bus services that travel between the north-west and Epping (refer to Table 23 for services with Epping as a destination).
- Utilising alternative bus services to Pennant Hills or Beecroft Station and catching a train to Epping (refer to Table 23 for services with these stations as their destination).
- Utilising potentially re-routed 611 or 740 bus services to Macquarie Centre and catching a train to Epping.

There would also be opportunities for operating new bus services that utilise the M2 Motorway with modified routes to access Epping if demand for these services was warranted.

Some of the existing 611 and 740 passengers that alight at Epping to connect to other Northern Railway Line stations would also be able to utilise alternative public transport services that exist, such as the North West T-Way and the Western Railway Line. Table 39 compares trip characteristics before and after removal of the bus ramps for users that would currently utilise the 611 and 740 services and alight at Epping.

Table 39 Bus routes 611 and 740 comparison with other public transport services

| Example Trip | Route Details | |
|---|---|---|
| | Beecroft Bus Ramp | Alternative |
| Castle Hill (Showground Road) to Epping Station | 2 buses (610x and 611)<br><br>Total Walking distance: ~1.4km<br><br>Travel time (door to door): 1 hour 4 minutes | 2 buses (T70 and 633) and<br>1 train (Pennant Hills to Epping)<br>Total Walking distance: ~200m walk<br><br>Travel time (door to door): 59 minutes |
| North Rocks (Barclay Road) to Pennant Hills Station | 1 bus (611) and<br>1 train (Epping to Pennant Hills)<br><br>Total Walking distance: ~300m<br><br>Travel time (door to door): 36 minutes | 2 buses (610x and 553) and<br>1 train (Beecroft to Pennant Hills)<br><br>Total Walking distance: ~500m walk<br><br>Travel time (door to door): 44 minutes |
| Stanhope Gardens (Stanhope Parkway) to Rhodes Station | 1 bus (740) and<br>1 train (Epping to Rhodes)<br><br>Total Walking distance: 600m walk<br><br>Travel time (door to door): 1hr 27 mins | 1 bus (T74 - T-Way) and<br>2 trains (Blacktown to Strathfield, Strathfield to Rhodes)<br><br>Total Walking distance: 500m walk<br><br>Travel time (door to door): 1hr 10 mins |
| Baulkham Hills (Windsor Road) to Eastwood Station | 2 buses (610x and 611) and<br>1 train<br><br>Total Walking distance: 1200m walk<br><br>Travel time (door to door): 53 mins | 1 bus (630) and<br>1 train (Epping to Eastwood)<br><br>Total Walking distance: 900m walk<br><br>Travel time (door to door): 1hr 4 mins |

There are also opportunities to develop new bus services that utilise the M2 Motorway as a consequence of the new Herring Road off-ramp, Christie on-ramp and Windsor Road on- and off-ramps. The additional capacity on the M2 Motorway would facilitate continued growth in bus use by improving bus travel times and service reliability. Improvements for buses would result from reducing delays at and on approach to existing pinch points where buses are not protected by bus lanes.

## Mode share impact

Given that M2 Motorway bus services are at or near capacity during peak periods, it is assumed that increased bus services would be required along the M2 Motorway to meet the NSW Governments mode share targets. The additional capacity provided by the M2 Upgrade project and improved accessibility provided by the new ramps would facilitate continued growth in bus use by improving bus travel times and service reliability. This additional capacity and the potential for greater buses services along the M2 Motorway corridor is consistent with the NSW Government's target of increasing public transport to Sydney CBD and the Macquarie Park.

As part of the recent *Metropolitan Transport Plan*, $2.9 billion has been allocated extra buses for strategic corridors and local routes as well as for upgrading bus depots. Under the plan the NSW Government will purchase an additional 1,000 buses.[4]

The additional buses and funding as part of the *Metropolitan Transport Plan* and the integration of the ECRL services is expected to increase public transport mode share in the area.

The widening and subsequent improvement in travel times for private vehicles is not expected to significantly impact these mode share targets for the following reasons:

- The east facing on-ramp at Christie Road and off-ramp at Herring Road would enhance accessibility to Macquarie Park, however they are not likely to generate more than a marginal mode shift from rail (Epping to Chatswood Rail Link) as private vehicle travel to/from Macquarie Park and Sydney CBD is most heavily influenced by parking costs and availability, and this is not going to change as a result of the M2 Upgrade project.
- The proposed toll at the new access ramps, and increased toll upon opening, may act as a deterrent to discretionary travel, further reducing the potential for mode shift from public transport to car.
- The proposal would also result in bus travel time improvements that would offset any incentive to shift mode as a result of the improved traffic conditions for private vehicles.

## Local road impact

Under existing conditions, midblock traffic volumes (traffic travelling on the M2 Motorway between interchanges) often exceed theoretical motorway lane capacities leading to congestion and increased travel times, particularly during peak periods. This also impacts on the surrounding arterial road network due to traffic seeking alternative routes. By providing additional lane capacity, the project would alleviate existing congestion along the M2 Motorway and provide relief for surrounding arterial routes.

The provision of new ramps at the Windsor Road interchange as well as at Christie Road and Herring Roads would result in the re-distribution of traffic in the vicinity of M2 Motorway. In particular, demand on roads leading to and from M2 Motorway entrances and exits are likely to increase with the proposed ramps. Figure 23 shows the resulting total daily traffic flow changes on the road network. Traffic volumes are expected to increase at the M2 Motorway access point to the M7 Motorway, Old Windsor Road, Windsor Road and Pennant Hills Road.

The local road network surrounding the M2 Motorway is likely to experience reduced traffic volumes, with lower traffic volumes indicated along Windsor Road, between Norwest Boulevard and M2

[4] Website: http://more.nsw.gov.au/news/all-buses-now-fitted-gps-linked-traffic-lights

Motorway, as well as Epping Road between Blaxland Road and Pittwater Road. This potential impact is illustrated in Figure 23 with total daily traffic volumes for the base and upgrade scenario summarised in Table 40.

A summary of peak hour 2011 and 2021 forecast traffic volumes is provided in Table 41 and Table 42 respectively, together with a level of service comparison of the 'Base 2021' against the 'M2 Upgrade Project 2021' for the screen lines previously identified.

The analysis indicates that the project is likely to reduce the traffic volumes on majority of the adjacent roads. However, traffic on the M7 Motorway east of Old Windsor Road, Abbot Road east of Old Windsor Road, Church Street south of Briens Road, Windsor Road north of the M2 Motorway and Renown Road east of Cook Street are likely to experience minor increases in demand (Table 43). However, general improvement can be seen in the LoS throughout the local network, including for the inbound direction. Improved LoS is identified at Windsor Road (4A) and several locations along Screen line 1 at Seven Hills Road, Powers Road and Station Road. Improved performance is also observed during the PM peak outbound along Screenline 2 on Castle Hill Road and James Ruse Drive.

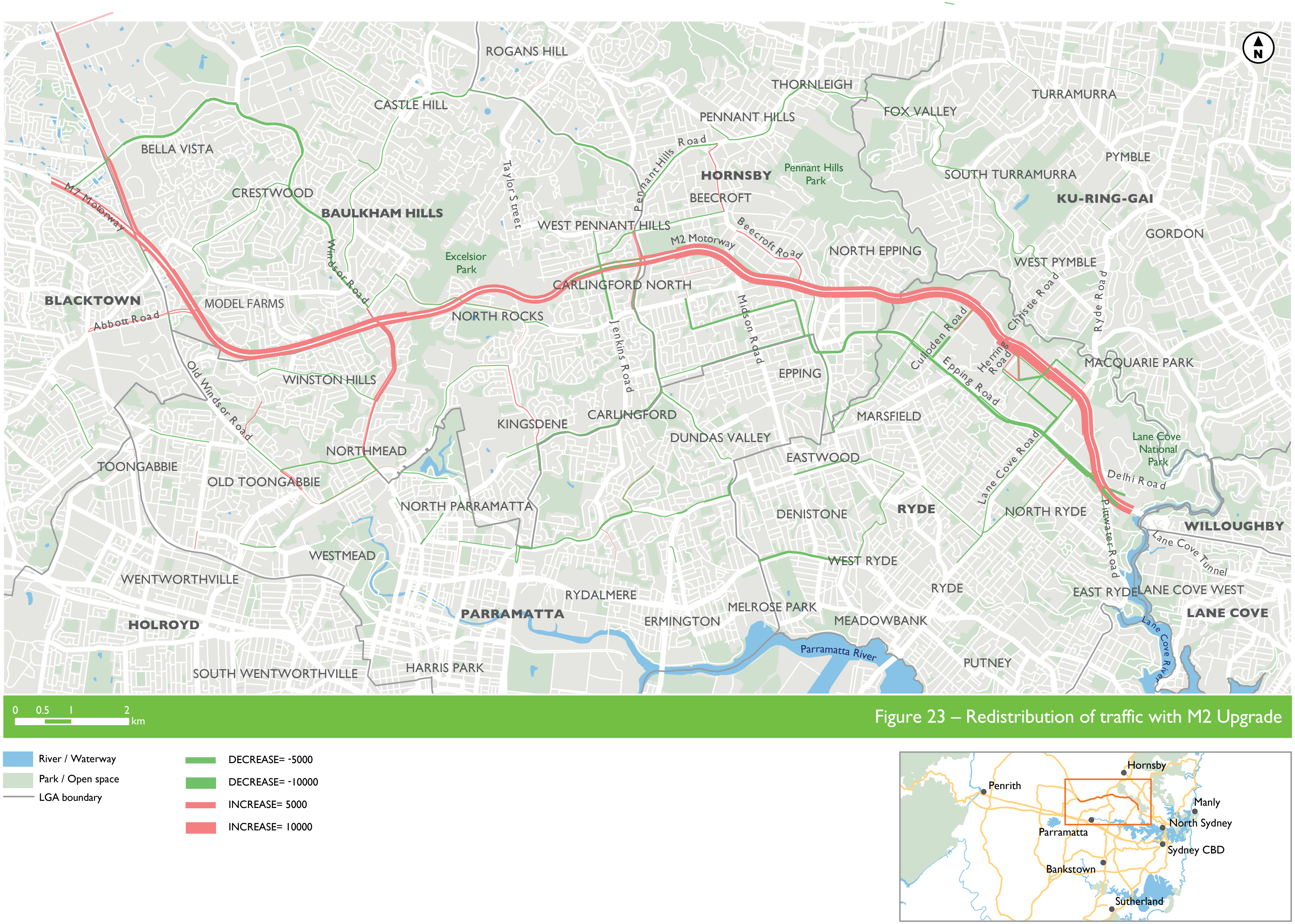



Figure 23 – Redistribution of traffic with M2 Upgrade

Source: MapData, 2010

Table 40 Forecast local road traffic volumes (Daily)

| SCL | Location | Type | Inbound (Citybound) | | | | Outbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 Base | 2011 Upgrade | 2021 Base | 2021 Upgrade | 2011 Base | 2011 Upgrade | 2021 Base | 2021 Upgrade |
| 1A | Norwest Boulevard East of Old Windsor Road | Arterial | 14,400 | 14,000 | 16,500 | 16,000 | 16,750 | 16,450 | 20,150 | 19,800 |
| 1B | Seven Hills Road East of Merindah Road | Arterial | 11,250 | 10,800 | 12,150 | 11,250 | 11,500 | 11,000 | 12,950 | 12,000 |
| 1D | Abbott Road East of Old Windsor Road | Major Arterial | 11,050 | 11,700 | 14,350 | 15,200 | 12,000 | 13,050 | 14,000 | 17,350 |
| 1E | Old Windsor Road North of Gibbon Road | Major Arterial | 33,400 | 31,600 | 41,800 | 39,450 | 31,800 | 31,300 | 39,150 | 38,550 |
| 1F | Powers Road East of Station Road | Sub-Arterial | 6,400 | 6,300 | 7,200 | 7,100 | 5,300 | 5,200 | 5,750 | 5,650 |
| 1G | Station Road at Mc Coy Park | Sub-Arterial | 11,750 | 11,500 | 12,200 | 11,800 | 12,100 | 11,850 | 12,700 | 12,400 |
| 2A | Castle Hill Road East of Old Northern Road | Major Arterial | 23,800 | 23,250 | 28,950 | 28,350 | 24,900 | 24,700 | 30,250 | 29,650 |
| 2B | Renown Road East of Cook Street | Sub-Arterial | 8,600 | 8,600 | 10,050 | 10,250 | 9,050 | 9,300 | 10,700 | 11,050 |
| 2D | James Ruse Road East of Windsor Road | Major Arterial | 28,450 | 27,650 | 29,050 | 28,250 | 25,150 | 24,800 | 25,650 | 25,300 |
| 2E | Church Street South of Briens Road | Major Arterial | 20,650 | 21,150 | 23,800 | 24,400 | 21,750 | 22,350 | 25,200 | 26,000 |
| 3A | The Comenarra Parkway East of Fox Valley Road | Sub-Arterial | 7,750 | 7,700 | 8,050 | 7,700 | 6,650 | 6,450 | 6,700 | 6,500 |
| 3C | Epping Road West of Vimiera Road | Major Arterial | 22,950 | 22,700 | 26,800 | 25,200 | 21,600 | 21,350 | 22,350 | 20,850 |
| 4A | Windsor Road North of M2 | Major Arterial | 29,050 | 32,450 | 32,100 | 35,950 | 29,350 | 32,700 | 31,750 | 35,950 |
| 4B | Oakes Road North of M2 | Sub-Arterial | 8,500 | 8,250 | 8,950 | 8,700 | 9,550 | 9,150 | 9,650 | 8,850 |
| 4C | Pennant Hills Road North of M2 | Major Arterial | 38,850 | 38,850 | 40,450 | 40,550 | 40,850 | 40,850 | 48,800 | 48,900 |
| 4D | Kirkham Street at M2 | Collector | 4,700 | 4,600 | 4,750 | 4,100 | 3,750 | 3,350 | 4,200 | 3,750 |
| 4E | Beecroft Road North of M2 | Major Arterial | 18,600 | 18,700 | 21,500 | 21,600 | 18,250 | 18,350 | 19,950 | 20,150 |
| 4F | Ryde Road South of Lady Game Drive | Major Arterial | 46,900 | 46,500 | 52,150 | 51,700 | 46,050 | 45,650 | 55,750 | 55,300 |

Table 41 Forecast local road traffic volumes (2011)

| SCL | Location | Type | Inbound (Citybound) | | | | Outbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | | | 2011 Base | 2011 Upgrade | 2011 Base | 2011 Upgrade | 2011 Base | 2011 Upgrade | 2011 Base | 2011 Upgrade |
| 1A | Norwest Boulevard east of Old Windsor Road | Arterial | 1,250 | 1,200 | 1,150 | 1,100 | 1,000 | 1,000 | 2,050 | 2,000 |
| 1B | Seven Hills Road East of Merindah Road | Arterial | 1,300 | 1,200 | 950 | 950 | 1,100 | 1,050 | 1,300 | 1,250 |
| 1D | Abbott Road East of Old Windsor Road | Major Arterial | 1,000 | 1,050 | 950 | 1,000 | 850 | 900 | 1,300 | 1,350 |
| 1E | Old Windsor Road North of Gibbon Road | Major Arterial | 3,200 | 3,050 | 2,450 | 2,300 | 2,000 | 1,900 | 2,800 | 2,550 |
| 1F | Powers Road East of Station Road | Sub-Arterial | 750 | 700 | 500 | 500 | 400 | 400 | 600 | 550 |
| 1G | Station Road at Mc Coy Park | Sub-Arterial | 1,050 | 1,000 | 1,050 | 1,050 | 1,050 | 1,000 | 950 | 950 |
| 2A | Castle Hill Road East of Old Northern Road | Major Arterial | 1,950 | 1,800 | 2,000 | 2,000 | 1,950 | 1,950 | 2,350 | 2,350 |
| 2B | Renown Road East of Cook Street | Sub-Arterial | 1,250 | 1,300 | 550 | 550 | 650 | 650 | 1,250 | 1,300 |
| 2D | James Ruse Road East of Windsor Road | Major Arterial | 3,550 | 3,450 | 1,800 | 1,750 | 1,550 | 1,550 | 2,300 | 2,250 |
| 2E | Church Street South of Briens Road | Major Arterial | 2,400 | 2,400 | 1,150 | 1,200 | 950 | 1,050 | 2,150 | 2,250 |
| 3A | The Comenarra Parkway East of Fox Valley Road | Sub-Arterial | 550 | 550 | 950 | 950 | 950 | 950 | 550 | 550 |
| 3C | Epping Road West of Vimiera Road | Major Arterial | 2,800 | 2,750 | 1,100 | 1,100 | 950 | 950 | 2,050 | 2,050 |
| 4A | Windsor Road North of M2 | Major Arterial | 3,000 | 3,350 | 1,800 | 2,000 | 1,550 | 1,750 | 2,550 | 2,750 |
| 4B | Oakes Road North of M2 | Sub-Arterial | 1,300 | 1,300 | 700 | 650 | 800 | 750 | 1,350 | 1,350 |
| 4C | Pennant Hills Road North of M2 | Major Arterial | 3,600 | 3,300 | 2,400 | 2,300 | 2,300 | 2,100 | 3,450 | 3,300 |
| 4D | Kirkham Street at M2 | Collector | 1,150 | 1,150 | 400 | 400 | 400 | 300 | 550 | 250 |
| 4E | Beecroft Road North of M2 | Major Arterial | 2,200 | 2,150 | 1,050 | 1,000 | 900 | 900 | 1,700 | 1,650 |
| 4F | Ryde Road South of Lady Game Drive | Major Arterial | 4,100 | 4,100 | 3,950 | 3,900 | 3,300 | 3,300 | 4,000 | 3,950 |

Table 42 Forecast local road traffic volumes (2021)

| SCL | Location | Type | Inbound (Citybound) | | | | Outbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | | | 2021 Base | 2021 Upgrade | 2021 Base | 2021 Upgrade | 2021 Base | 2021 Upgrade | 2021 Base | 2021 Upgrade |
| 1A | Norwest Boulevard East of Old Windsor Road | Arterial | 1,400 | 1,350 | 1,350 | 1,300 | 1,350 | 1,350 | 2,400 | 2,350 |
| 1B | Seven Hills Road East of Merindah Road | Arterial | 1,350 | 1,250 | 1,000 | 900 | 1,450 | 1,400 | 1,550 | 1,400 |
| 1D | Abbott Road East of Old Windsor Road | Major Arterial | 1,400 | 1,450 | 1,400 | 1,500 | 1,200 | 1,300 | 1,550 | 1,600 |
| 1E | Old Windsor Road North of Gibbon Road | Major Arterial | 3,850 | 3,650 | 2,800 | 2,600 | 2,100 | 2,000 | 3,250 | 3,000 |
| 1F | Powers Road East of Station Road | Sub-Arterial | 850 | 750 | 550 | 550 | 450 | 450 | 650 | 550 |
| 1G | Station Road at Mc Coy Park | Sub-Arterial | 1,100 | 1,050 | 1,100 | 1,050 | 1,100 | 1,050 | 1,000 | 1,000 |
| 2A | Castle Hill Road East of Old Northern Road | Major Arterial | 2,200 | 1,950 | 2,400 | 2,350 | 2,000 | 1,850 | 2,900 | 2,900 |
| 2B | Renown Road East of Cook Street | Sub-Arterial | 1,400 | 1,400 | 650 | 650 | 800 | 800 | 1,400 | 1,500 |
| 2D | James Ruse Road East of Windsor Road | Major Arterial | 3,600 | 3,400 | 1,850 | 1,800 | 1,600 | 1,600 | 2,350 | 2,300 |
| 2E | Church Street South of Briens Road | Major Arterial | 2,700 | 2,750 | 1,300 | 1,350 | 1,050 | 1,150 | 2,400 | 2,500 |
| 3A | The Comenarra Parkway East of Fox Valley Road | Sub-Arterial | 650 | 600 | 950 | 900 | 1,050 | 950 | 700 | 650 |
| 3C | Epping Road West of Vimiera Road | Major Arterial | 3,450 | 3,400 | 1,200 | 1,200 | 1,150 | 1,150 | 2,250 | 2,250 |
| 4A | Windsor Road North of M2 | Major Arterial | 3,450 | 3,850 | 2,050 | 2,300 | 1,550 | 1,850 | 2,600 | 2,800 |
| 4B | Oakes Road North of M2 | Sub-Arterial | 1,550 | 1,550 | 750 | 700 | 850 | 800 | 1,400 | 1,250 |
| 4C | Pennant Hills Road North of M2 | Major Arterial | 3,650 | 3,350 | 2,450 | 2,250 | 2,650 | 2,450 | 3,950 | 3,600 |
| 4D | Kirkham Street at M2 | Collector | 1,400 | 1,350 | 400 | 300 | 450 | 350 | 600 | 300 |
| 4E | Beecroft Road North of M2 | Major Arterial | 2,400 | 2,341 | 1,200 | 1,150 | 1,000 | 967 | 1,900 | 1,800 |
| 4F | Ryde Road South of Lady Game Drive | Major Arterial | 4,300 | 4,290 | 4,300 | 4,250 | 3,600 | 3,592 | 4,700 | 4,650 |

Table 43 Forecast local road impact comparison

| SCL | Location | Type | Inbound (Citybound) | | | | | Outbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hourly Capacity | AM Peak | | PM Peak | | Hourly Capacity | AM Peak | | PM Peak | |
| | | | | 2021 Base LoS | 2021 Upgrade LoS | 2021 Base LoS | 2021 Upgrade LoS | | 2021 Base LoS | 2021 Upgrade LoS | 2021 Base LoS | 2021 Upgrade LoS |
| 1A | Norwest Boulevard East of Old Windsor Road | Arterial | 3,300 | F | F | E | D | 3,300 | B | B | F | F |
| 1B | Seven Hills Road East of Merindah Road | Arterial | 1,650 | E | B | C | B | 1,650 | F | F | F | F |
| 1D | Abbott Road East of Old Windsor Road | Major Arterial | 3,600 | B | C | A | C | 3,600 | B | C | B | C |
| 1E | Old Windsor Road North of Gibbon Road | Major Arterial | 3,600 | F | F | F | F | 3,600 | F | E | F | F |
| 1F | Powers Road East of Station Road | Sub-Arterial | 3,000 | F | D | C | C | 3,000 | C | C | D | B |
| 1G | Station Road at Mc Coy Park | Sub-Arterial | 1,500 | E | D | C | B | 1,500 | E | D | C | C |
| 2A | Castle Hill Road East of Old Northern Road | Major Arterial | 3,600 | F | F | F | F | 3,600 | D | B | F | B |
| 2B | Renown Road East of Cook Street | Sub-Arterial | 3,000 | F | F | A | A | 3,000 | F | F | F | F |
| 2D | James Ruse Road East of Windsor Road | Major Arterial | 5,400 | F | F | C | B | 3,600 | F | F | E | C |
| 2E | Church Street South of Briens Road | Major Arterial | 5,400 | F | F | F | F | 5,400 | F | F | F | F |
| 3A | The Comenarra Parkway East of Fox Valley Road | Sub-Arterial | 1,500 | F | F | C | B | 1,500 | F | E | F | F |
| 3C | Epping Road West of Vimiera Road | Major Arterial | 3,600 | F | F | F | F | 3,600 | F | F | F | F |
| 4A | Windsor Road North of M2 | Major Arterial | 3,600 | *F* | *D* | E | C | 3,600 | A | C | A | C |
| 4B | Oakes Road North of M2 | Sub-Arterial | 1,500 | F | F | F | E | 1,500 | E | C | D | B |
| 4C | Pennant Hills Road North of M2 | Major Arterial | 5,400 | F | F | E | B | 5,400 | F | E | F | F |
| 4D | Kirkham Street at M2 | Collector | 1,000 | F | F | A | A | 1,000 | A | A | A | A |
| 4E | Beecroft Road North of M2 | Major Arterial | 3,600 | F | F | B | B | 3,600 | B | B | F | F |
| 4F | Ryde Road South of Lady Game Drive | Major Arterial | 5,400 | F | F | F | F | 5,400 | F | F | F | F |

### Intersection performance

As part of the M2 Upgrade project, the following modifications are proposed to mitigate the effects of additional traffic using the intersections of Windsor Road/M2 Motorway, Christie Road/M2 Motorway, Christie Road/Talavera Road and Herring Road/Talavera Road:

- Talavera Road Intersections
  - University Roundabout to Christie Road – (eastbound) increase from one to two lanes (starting just after roundabout), plus longer left turn lane, (westbound) increase from one to two lanes (merging just prior to roundabout). Parking to be removed in both directions.
  - Christie to Herring – (eastbound) same layout of two lanes and bus only right turn lane; (westbound) increase from two to three lanes westbound (one lane being a right turn lane to Christie Road).
  - Herring to Alma – (eastbound) same layout of two lanes plus one right turn lane; (westbound) increase from one to two through lanes, plus one additional right turn lane to M2 Motorway (from one to two lanes).
- Christie Road bridge
  - (Northbound) increase from one to two lanes, to accommodate a new right turn lane to the new ramp (with traffic control signals being provided); (southbound) increase from two to three lanes.
- Windsor Road Intersection
  - Oakland Ave to M2 Motorway – (southbound) existing layout of three lanes and left turn to M2 Motorway, plus two new right turn lanes to the new west-facing ramp; (northbound) same as existing layout of three lanes.
  - M2 Motorway to Woodlands Street – (southbound) same as existing layout of two lanes; (northbound) increase from two to three lanes for 175 metres to the south, plus one new left turn lane to the new west-facing ramp and one additional right turn lane to the M2 Motorway (increase from one to two lanes).

The additional ramps to and from the M2 Motorway, proposed as part of the M2 Upgrade project, would result in the redistribution of traffic as summarised above. The greatest impact arising from this would be on the intersection performance adjacent to the M2 Motorway access points.

Based on the above works, the intersection performance levels comparing with and without project works, for the intersections identified in Table 26 are summarised in Table 44.

Table 44 Forecast intersection performances

| Intersection | 2011 AM Base | 2011 AM M2 Upgrade project | 2011 PM Base | 2011 PM M2 Upgrade project | 2021 AM Base | 2021 AM M2 Upgrade project | 2021 PM Base | 2021 PM M2 Upgrade project |
|---|---|---|---|---|---|---|---|---|
| Windsor Road – M2 Ramps | B | B | B | B | E | C | C | B |
| Pennant Hills Road – M2 Ramps | C | B | E | D | E | C | F | F |
| Christie Road – Talavera Road | F | C | A | A | F | F | A | A |
| Herring Road – Talavera Road | C | E | B | B | C | F | C | C |
| Lane Cove Road – M2 Ramps | A | A | A | A | D | D | A | A |
| Herring Road – Waterloo Road | D | D | C | C | F | F | D | E |
| Khartoum Road – Talavera Road | C | C | A | B | C | C | E | F |
| Lane Cove Road – Talavera Road | E | B | F | F | D | A | F | F |
| Lane Cove Road – Waterloo Road | F | D | E | D | F | F | F | E |
| Lane Cove Road – Epping Road | F | D | F | C | F | F | F | C |
| Windsor Road – Cook Road | F | F | D | D | F | F | F | F |
| Herring Road – Epping Road | E | E | D | D | F | F | E | E |

The intersection performance levels summarised in Table 44 indicate that the performance of three intersections adjacent to the M2 Motorway access points; Herring Road – Talavera Road, Herring Road/Waterloo Road and Khartoum Road – Talavera Road, would decline with the M2 Upgrade project. These are indicated in bold in Table 44.

During the AM peak hour, delays at the intersection of Herring Road and Talavera Road are forecast to increase with the M2 Upgrade project works and result in the poorer LoS. However this intersection is located adjacent to the intersection of Christie Road and Talavera Road, and when the two intersections are examined together, there are material reductions in overall delay, as detailed in Technical Paper 1, during both 2011 and 2021.

Minor reductions in operation performance are forecast for the intersection of Khartoum Road and Talavera Road during the PM peak hours. However, potential improvements to the intersection performance may be permitted with modifications of the traffic signals.

Increased demand along the M2 Motorway is likely to result in traffic reduction along the competing parallel roads, this is evidenced by the improved intersection performances along the parallel corridor of Lane Cove Road.

## Travel Time

Table 45 provides a summary of the theoretical travel times for the routes identified in Figure 21 for the scenarios representing without M2 Motorway upgrades (base) and with upgrades (M2 Upgrade project) for years 2011 and 2021.

Table 45 M2 Upgrade project travel time comparisons

| Route | Direction | 2011 | | | 2021 | | |
|---|---|---|---|---|---|---|---|
| | | Base Travel Time (mins) | M2 Upgrade project Travel Time (mins) | Travel Time Difference (mins) | Base Travel Time (mins) | M2 Upgrade project Travel Time (mins) | Travel Time Difference (mins) |
| M2 Motorway | Westbound (PM Peak) | 29 | 22 | -7 | 36 | 30 | -6 |
| Alternative | | 48 | 45 | -3 | 52 | 50 | -2 |
| M2 Motorway | Eastbound (AM Peak) | 38 | 23 | -15 | 50 | 31 | -19 |
| Alternative | | 59 | 52 | -7 | 67 | 62 | -5 |

Table 45 indicates that the project would result in travel time savings during both the AM and PM peak hours along both the M2 Motorway and the alternative route.

Additional entry and exit ramps at Windsor Road and Macquarie Park interchange would allow alternative faster travel routes via the M2 Motorway as indicated by the green lines in Figure 24, Figure 25 and Figure 26. It is forecast that the travel times between the west facing ramps at Windsor Road would reduce travel times between Old Windsor Road and Windsor Road by approximately four minutes during both AM and PM peak hours (Figure 24). Travel time benefits of the new east facing Herring Road off-ramp and Christie Road on-ramp is forecast to be three minutes in the AM peak northbound direction, and five minutes in the PM southbound direction, when compared to alternative routes (Figure 25and Figure 26).

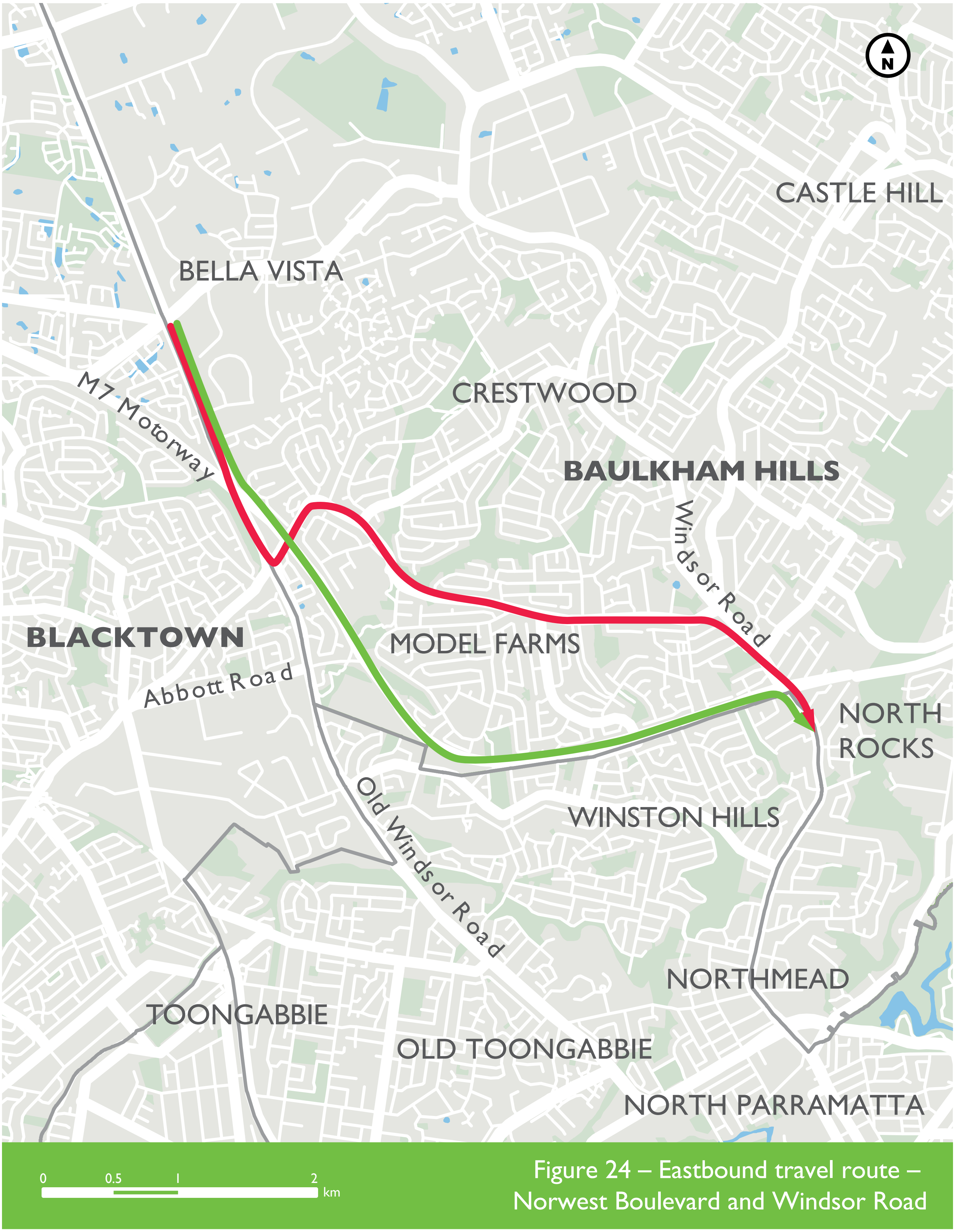



Figure 24 – Eastbound travel route – Norwest Boulevard and Windsor Road

Eastbound travel route
Eastbound travel route
River / Waterway
Park / Open space
LGA boundary

Source: Transurban, 2010

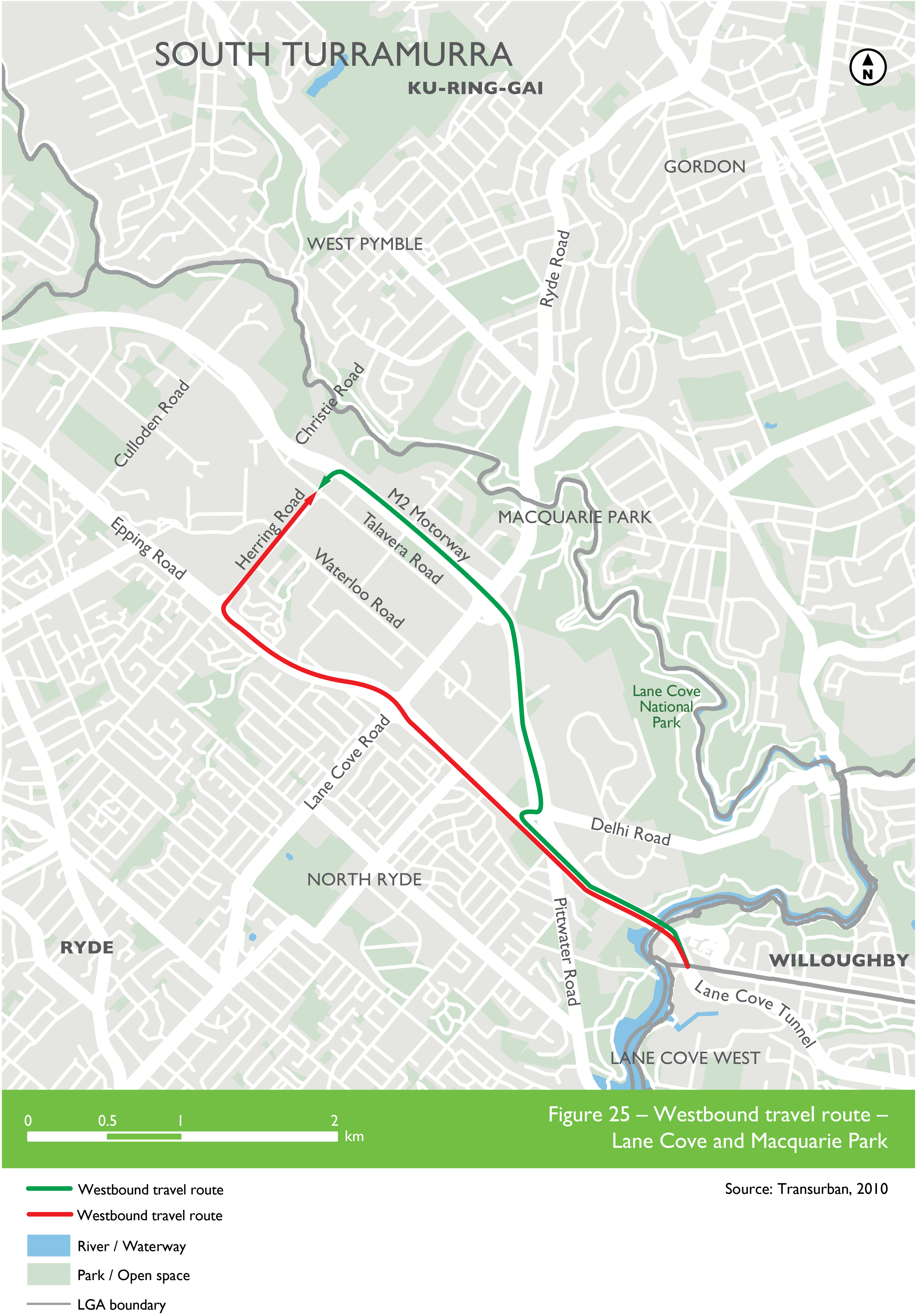
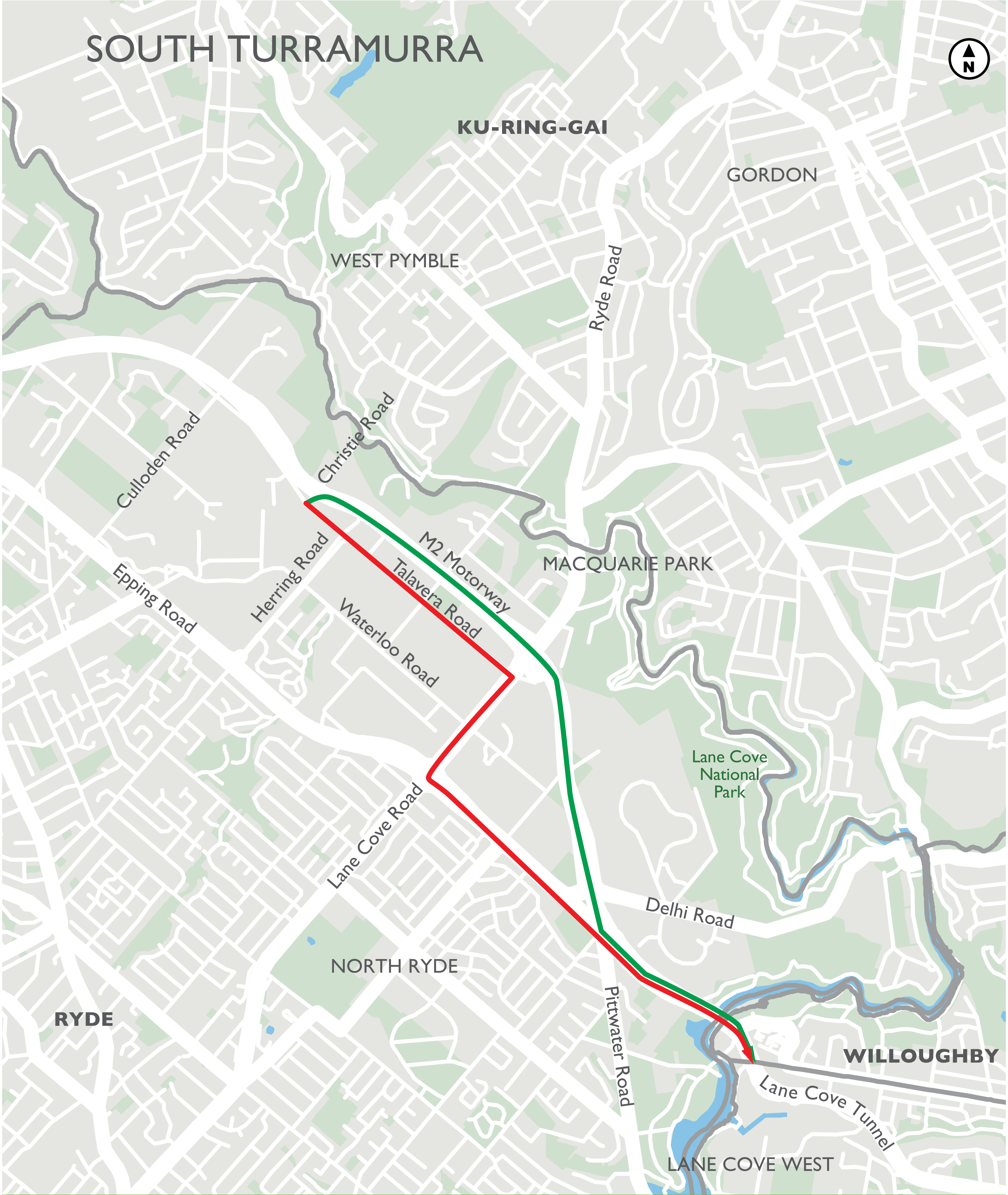



Figure 25 – Westbound travel route – Lane Cove and Macquarie Park

Source: Transurban, 2010




0 0.5 1 2 km

Figure 26 – Eastbound travel route – Lane Cove and Macquarie Park

Eastbound travel route
Eastbound travel route
River / Waterway
Park / Open space
LGA boundary

Source: Transurban, 2010

### New access

The additional ramps at Windsor Road (on- and off-ramps), Herring Road (off-ramp) and Christie Road (on-ramp) would improve accessibility to the M2 Motorway as well as the adjacent employment hubs. Table 46 summarises the forecast traffic volumes along the ramps during the peak hours.

Table 46 Forecast traffic volumes on Windsor Road and Herring/Christie Road ramps

| Ramps | Direction | 2011 AM Peak | 2011 PM Peak | 2011 Daily | 2021 AM Peak | 2021 PM Peak | 2021 Daily |
|---|---|---|---|---|---|---|---|
| Windsor Road | Eastbound | 420 | 230 | 3,800 | 450 | 250 | 4,120 |
| Windsor Road | Westbound | 230 | 420 | 3,800 | 250 | 450 | 4,120 |
| Christie Road | Eastbound | 150 | 300 | 2,320 | 200 | 350 | 2,680 |
| Herring Road | Westbound | 400 | 130 | 3,170 | 450 | 150 | 3,680 |

Traffic modelling of the additional ramps indicates that the majority of the trips would be local trips accessing the adjacent suburbs. Therefore, the additional ramps would reduce traffic on the nearby local road network.

### Road safety

The M2 Upgrade project would alleviate congestion along the M2 Motorway and it is expected that congestion related accidents would reduce along the M2 Motorway. In particular, additional lanes along the M2 Motorway would improve merging opportunities for vehicles entering the M2 Motorway from existing on-ramps located at Windsor Road, Pennant Hills Road and Beecroft Road due to entering an added lane rather than merging into heavy traffic flows.

Sun glare issues during the AM peak hour for eastbound traffic mounts adjacent to the Norfolk Tunnel would remain. However, improved lighting within the tunnel, as part of the upgrade works, would improve visibility within the tunnel and would allow motorists to better adapt to lighting conditions whilst entering and leaving the tunnel.

Furthermore, reinstatement of road shoulders through the westbound Norfolk Tunnel would allow vehicles to use the breakdown lane and reduce the risk of secondary accidents.

### Cycle facilities

The M2 Upgrade project would restore the road shoulder between Lane Cove Road and Beecroft Road, by removing the restriction for cyclists to detour between North Ryde and Epping, thus allowing cyclists to travel westbound on the M2 Motorway. Furthermore, the west facing Windsor Road and east facing Herring/Christie Road ramps would provide additional access points for cyclists.

### Pedestrians

The additional on and off ramps proposed at the M2 Motorway interchanges would be signalised to control the competing vehicle movements. The signals would also cater for pedestrians by inclusion of pedestrian phases to provide safe crossing opportunities. In particular, pedestrian movements through the reconfigured Windsor Road and the Christie/Talavera Road interchanges would be the subject of detailed design.

### Lane Cove Tunnel

The project is expected to increase traffic through this section in both directions and both peak periods. Of particular importance is the eastbound section during the AM peak, which already displays signs of congestion at the merge between Epping Road and the Lane cove Tunnel. The project is forecast to increase traffic through this section by up to 13 percent by 2021. However, despite this increase in peak hour volume, the merge performance of this section would remain satisfactory. This is due to reduced traffic volume on Epping Road improving the operation of this merge, and confirms the objective of the project to encourage longer distance travel along the M2 Motorway network (refer to Technical Paper 1).

### M7 Motorway

During the AM peak there is currently congestion and poor travel speeds eastbound at the M7/M2 Motorway interface which is caused by a lack of downstream capacity on the M2 Motorway at Windsor Road and points further east. The additional eastbound lane between Windsor Road and Terrys Creek is predicted to resolve this issue by providing additional capacity and remove the merging conflict at Windsor and Pennant Hills Roads.

On opening of the M7 Motorway, there was a large uplift in traffic in the western section of the M2 Motorway. This demonstrated that the M7 Motorway route, the M2 Motorway to the off-ramp at Pennant Hills Road was attractive against the alternative ‘cross-city’ route of Cumberland Highway and Pennant Hills Road with no use of M2 Motorway. The widening of eastbound section of the M2 Motorway from Windsor Road to Pennant Hills Road would again improve the M7 Motorway / M2 Motorway LoS and further entice transfer of traffic off the non-motorway route, providing an uplift to M7 Motorway volumes.

The new west-facing ramps at Windsor Road provide new opportunity and accessibility between M2 Motorway and M7 Motorway and vice versa. Traffic at the new Windsor Road ramps, over and above that diverting from Pennant Hills Plaza, would be new traffic to the M2 for its short section and would be coming from either the M7 Motorway (estimated to 80 percent) or Abbott Road (estimated to be 20 percent). However not all of the new trips between M7 Motorway and new Windsor Road ramps would be new as some exit/entry points would be further away (for example, Sunnyholt Road, Norwest Boulevard).

## 9.1.3 Mitigation measures

### Public transport

With the installation of additional ramps at the M2 Motorway, opportunities exist to re-route the bus services affected by the removal of the Beecroft Road bus ramp. These services, 611 and 740 may potentially be re-routed via the Christie Road and Herring Road ramps, for access between the M2 Motorway and the Macquarie University and Macquarie Shopping Centre, rather than Epping Station. Furthermore, a Transport Working Group has been established to allow stakeholders such as NSW Transport and Infrastructure, Hillsbus and Busways to work together at a greater level of detail in examining the M2 Upgrade project and construction issues.

With the ongoing development of the Macquarie Business Park, Hillsbus are also considering extending Route 611 into Macquarie Business Park. The potential re-routing and extended service is likely to be more attractive for workers in the area than the existing arrangement. Bus passengers accessing Epping Station would be required to utilise the Epping-Chatswood rail services to connect to the re-routed bus routes of 611and 740. Section 9.1.2 also discussed alternate public transport arrangements for those accessing Epping Station.

### Cyclists

There would be beneficial impacts associated with restoring the westbound breakdown lanes between Lane Cove Road and Beecroft Road thereby reinstating the original cycle facility along the M2 Motorway.

### Pedestrians

The additional on and off ramps proposed at the M2 Motorway would be signalised to control the competing vehicle movements. The signals would also cater for pedestrians by inclusion of pedestrian phases to provide safe crossing opportunities for the pedestrians. In particular, pedestrian movements through the reconfigured Windsor Road and the Christie/Talavera Road interchanges would be the subject of detailed design.

## 9.2 Construction traffic and transport impacts

An assessment of the transport and traffic impacts associated with the construction of the project has been undertaken and is presented below. This assessment constitutes a summary of *Technical Paper 1 – Transport and Traffic* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *General construction impacts – the environmental assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed. The environmental assessment must include consideration of, and a management framework for:* | *Chapter 7, Chapter 9, Appendix F* |
| • *Construction traffic including a considered approach to route identification and scheduling of transport movements, the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles), the nature of existing traffic on construction access routes (with 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. The environmental assessment must also present a strategy for managing 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 9.2, Technical Paper 1* |

### 9.2.1 Existing environment

#### Existing M2 Motorway conditions

Currently there are two general traffic lanes provided in the eastbound direction with a sign posted speed of 100 kilometres per hour on the M2 Motorway. In the westbound direction, there are three general traffic lanes provided between Lane Cove Road and Beecroft Road with an 80 kilometres per hour speed limit (70 kilometres per hour in the vicinity of Norfolk Tunnel) and two lanes beyond Beecroft Road with a 100 kilometres per hour speed limit. Between Windsor Road and Beecroft Road, two way bus only lanes are provided along the median. The M2 Motorway west of Windsor Road is signposted at 90 kilometres per hour.

#### Existing local road conditions

Information regarding the usage and performance of the local roads in the vicinity of the M2 Motorway is provided in Table 24 (Section 9.1). The peak capacities of the local roads in the vicinity of the M2 Motorway range from 1,000 vehicles per hour for collector roads through to 1,800 vehicles per hour for the major arterial roads. The information provided in Table 24 indicates that whilst some of the local roads show levels of usages approaching 80 percent capacity, in general the local roads have excess capacity during both the peak AM and PM periods.

Outside of peak periods, the performance of the local road network in the vicinity of the M2 Motorway would be expected to improve and excess capacity increase as overall traffic volumes decrease. As residential streets are expected to support local traffic only, which is travelling towards larger capacity roads, the performance of these roads is expected to be well below their respective capacities.

### Work site locations

The upgrade of the M2 Motorway is proposed to be divided into five separate work zones. Each work zone would be independent of each other to allow uninterrupted works. The sections for each work zone are detailed in Section 6.2. Also shown in Table 47 are the main worksites within each zones and the proposed method for access.

Table 47 Work zones and work sites

| Work zone | Work site | Compound name | Proposed access |
|---|---|---|---|
| 1 – Abbott Road to Windsor Road | Windsor Road Ramps including Windsor Road | Windsor Road North | Entry / Exit off Torrs Street, straight onto Windsor Road |
| | | Windsor Road South | Entry / Exit off Windsor Road |
| 2 – Windsor Road to Pennant Hills Road | Windsor Road to Barclay Road<br>Barclay Road to Pennant Hills Road | Darling Mills Creek | Entry / Exit (Bridge Construction Traffic Only) off existing Windsor Road Ramps (in same direction as traffic flow) |
| | | Barclay Road | Entry / Exit off Perry Street, opposite Golf Club |
| | | Yale Close (Royal Institute for Deaf and Blind – Private Land) | Entry / Exit off Baden Powell Place and Barclay Road |
| 3 – Pennant Hills Road to Beecroft Road | Pennant Hills Road East Bound Off Ramp<br>Pennant Hills Road to Beecroft Road | Devlins Creek | Entry / Exit (Bridge Construction Traffic Only) off Allerton Road |
| 4 – Norfolk Tunnel to Terrys Creek | Norfolk Tunnel Portal Areas<br>Norfolk Tunnel<br>Norfolk Tunnel to Terrys Creek | Barombah Road | Entry / Exit off Barombah Road |
| | | Sutherland Road (Tunnel Compound) | Left in / Left out off eastbound carriageway of M2, through existing Noise Wall, alternative access off Sutherland Road |
| | | Terrys Creek / Somerset Street | Entry / Exit off (bridge construction traffic only) off Somerset Street |
| 5 – Terrys Creek to Lane Cove Tunnel | Terrys Creek to Busaco Road<br>Western approach to the toll plaza<br>Eastern approach to the toll plaza<br>Herring Road to Lane Cove Road<br>Talavera Road (off M2 Motorway) | Vimiera Road | Left in / Left out off westbound carriageway of M2, with suitable ramps constructed, alternative access off Vimiera Road |
| | | Busaco Road | Entry / Exit off (bridge construction traffic only) Talavera Road |
| | | Toll Plaza | Entry 50 metres from eastbound Toll Plaza. Exit onto eastbound carriageway |
| | | Christie Road Compound | Entry / Exit off Talavera Road |
| | | Macquarie Park Site | Left in / Left out (only) onto E/B carriageway of M2 |
| | | TIDC Compound | Left in / left out off Delhi Road W/B on-Ramp, as well as Entry / Exit off Wicks Road |
| | | North Ryde Station Compound | Access from traffic lights on Delhi Road |

## Construction timing

The project is expected to be undertaken within 24 months of commencement with the first three work zones forecast to be completed within 15 months whereas construction activities at work zones 4 and 5 would be undertaken throughout most of the 24 month period.

During the construction phase, temporary amendments of the existing traffic configurations would be required at each of the work zones. These may include lane occupancies, including shoulders, road closures, speed reductions and contra flow configurations along both the M2 and the surrounding road network. To maintain the existing capacity of the M2 Motorway during peak hours, most of the network changes would be applicable during off-peak periods.

To minimise the impact on the local road network, where possible, the worksites are proposed to be accessed directly via the M2 carriageways, as detailed in Table 47. The access arrangements at these worksites would be detailed in the Traffic Management Plan. Where the worksites are located adjacent to the traffic lanes, these sites would require safety measures to separate it from the traffic movements and to provide appropriate access arrangements for construction vehicle movements. Vehicle storage facilities would not generally be provided at motorway sites.

The access arrangements to worksite types are summarised in Table 48.

Table 48 Worksite access arrangements

| Worksite | Access arrangement |
|---|---|
| Motorway sites | Left in/left out directly from the M2 Motorway with some local road access if necessary |
| Compounds | As detailed in Chapter 6. |
| Laydown areas | Left in/left out directly from the M2 Motorway with some local road access if necessary |
| Local road worksites (Predominantly bridge sites) | Local road access |
| Truck call-up areas | Left in/left out directly from the M2 Motorway |

Potential surrounding roads accessed during construction are listed in Table 49.

Table 49 Local road accessed during construction

| Work zone | Non Motorway roads used for access |
|---|---|
| Work zone1 – Abbott Road to Windsor Road | Junction Road, Torrs Street, Craig Avenue, Watkins Road, Windsor Road |
| Work zone 2 – Windsor Road to Pennant Hills Road | Windsor Road, Cook Street, Petrina Crescent, Russell Street, Dremeday Street, Renown Road, Perry Street, Barclay Road, North Rocks Road, Baden Powell Place, Carlton Road, Morton Avenue, Carmen Drive, Oakes Road, Coral Tree Drive, Pennant Hills Road |
| Work zone 3– Pennant Hills Road to Beecroft Road | Pennant Hills Road, Lamora Avenue, Orchard Road, Allerton Road, Kirkham Street, Kirkham Street, Meadow Close, Midson Road, Ray Road, Kent Street, Kandy Avenue, Barombah Road, Beecroft Road, Cheltenham Road, Sutherland Road |
| Work zone 4 – Norfolk Tunnel (including approaches) to Terrys Creek | Somerset Street, Norfolk Road, Grayson Road, Devon Street, Pembroke Street |
| Work zone 5 – Terrys Creek to Lane Cove Tunnel | Somerset Street, Crimea Road, Vimiera Road, Busaco Road, Talavera Road, Culloden Road, Christie Road, Alma Road, Khartoum Road, Lane Cove Road, Wicks Road, Epping Road, Delhi Road |

### 9.2.2 Impact assessment

#### Working hours

The standard work hours for the sites would be between 7.00 am to 6.00 pm, Monday to Friday, and 8.00 am to 1.00 pm on Saturdays. For construction activities proposed to be undertaken along the M2 Motorway or accessed via the M2 Motorway, work may be undertaken outside of the standard hours to reduce the overall construction period, providing that the impact on the M2 Motorway capacity does not result in increased traffic on alternate routes. Proposed works such as the Norfolk Tunnel widening would generally extend outside standard hours.

#### Network changes and scheduling

During the construction phase, temporary amendments of the existing traffic configurations would be required at each of the work zones. These may include lane occupancies, including shoulders, road closures, speed reductions and contra flow configurations along both the M2 Motorway and the surrounding road network. To maintain the existing capacity of the M2 Motorway during peak hours, most of the network changes would be undertaken during off-peak periods.

An initial schedule of motorway and local road lane occupancies has been developed and is generally as described in Table 50. These hours of lane occupancies would vary depending on the direction relative to peak flow volume, and would also occur on weekends. The hours would be determined by M2 MCR or RTA Transport Management Centre (TMC) and are based on historical and/or live data and also take into consideration special events, holiday periods and late night shopping.

Table 50 Motorway and local lane occupancies

| Motorway Lane Occupancies | Proposed volume restriction | Lane Occupancy period (indicative) |
|---|---|---|
| 1 of 2 | 1400 vehicles per hour | Night time<br>Saturday afternoon – Sunday |
| 2 of 3 | 1400 vehicles per hour | Night time |
| 1 of 3 | 2800 vehicles per hour | Off peak day time |
| **Local Road Lane Occupancies** | **Lane Occupancy period (indicative)** | **Local Road Lane Occupancies** |
| 1 of 2<br>1 of 3 | | Off peak day time<br>Night time<br>Saturday afternoon – Sunday |
| 2 of 3 | | Night time |

With vehicles turning in and out of work zones along the M2 Motorway, the speed limit is proposed to be reduced to 80 kilometres per hour. Some areas would be further reduced to 60 kilometres per hour, to maintain safety along the M2 corridor. The temporary speed reductions would be enforced by NSW Police as per normal operation.

A critical component of the M2 Upgrade project would be the widening of Norfolk Tunnel. Work at this site would generally be limited to evening off peak periods to ensure capacity is maintained during the peak hours.

Road widening work within the tunnel is proposed to be undertaken during the evening hours by allowing contra flow movements in one of the tunnels whilst work is undertaken in the other tunnel. During daytime inter-peak periods, the third lane in the westbound tunnel is proposed to be occupied as a work zone. However, during the afternoon peak period, all three westbound lanes would remain open to traffic. The eastbound and westbound shoulders would be closed by a wall from tunnel floor to roof to allow tunnel works to continue 24 hours a day. Contraflow lane reversal would be used to optimise traffic flow. A summary of works is provided in Table 51.

Table 51 Norfolk Tunnel lane utilisation

| Stage | Works | Duration | Proposed Lane Utilisation | |
|---|---|---|---|---|
| | | | Eastbound | Westbound |
| 1 | Eastbound Tunnel<br>Surveys,<br>Installation of Traffic Management,<br>Adjustment of portal transition areas<br>Service relocation<br>Installing rockbolts in tunnel<br>Installation of new service trench<br>Installation of barrier within tunnel and at each portal. | 6 Months | Daytime<br>2 lanes<br>Night time<br>Closure and contraflow in other tunnel tube | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>Contraflow |
| 2 | Eastbound Tunnel<br>Widening of the tunnel using roadheader<br>Drainage and pavement construction.<br>Westbound Tunnel<br>Service relocation<br>Installing rockbolts in tunnel<br>Installation of new service trench | 4 Months | Daytime<br>2 lanes<br>Night time<br>Contraflow | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>Closure and contraflow in other tunnel tube |
| 3 | Eastbound Tunnel<br>Drainage and pavement construction.<br>Services reinstallation | 3 Months | Daytime<br>2 lanes<br>Night time<br>Closure and contraflow in other tunnel tube | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>Contraflow |
| 4 | Westbound Tunnel<br>Service relocation<br>Installing rockbolts in tunnel<br>Installation of new service trench<br>Installation of barrier within tunnel and at each portal. | 5 Months | Daytime<br>2 lanes<br>Night time<br>Contraflow | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>Closure and contraflow in other tunnel tube |
| 5 | Westbound Tunnel<br>Widening of the tunnel using roadheader<br>Drainage and pavement construction | 4 Months | Daytime<br>2 lanes<br>Night time<br>2 lanes | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>2 lanes |
| 6 | Westbound Tunnel<br>Drainage and pavement construction.<br>Services reinstallation | 2 Months | Daytime<br>2 lanes<br>Night time<br>Contraflow | Daytime<br>2 lanes with 3 lanes in pm peak<br>Night time<br>Closure and contraflow in other tunnel tube |

Long term contraflow arrangements would be considered as part of the traffic management schemes where appropriate and where it would benefit the road users and construction planning. Contraflow traffic management allows a carriageway to be fully closed by running traffic in both directions on the other carriageway. This, in conjunction with tidal flow or other innovations, would be reviewed by the Traffic and Transport Liaison Group (TTLG).

### Construction vehicles

The M2 Upgrade project would involve cut and fill operations. Spoil haulage by heavy vehicles would need to occur in various sections of the M2 Motorway. The landscape setting of the M2 Motorway means that sandstone and spoil would need to be excavated to facilitate the road widening. The project proposes processing of excavated sandstone and spoil to be used as fill or sub-grade for retaining walls. However, approximately 70,000 cubic metres of excess material is expected to be generated by the project. It is estimated that that approximately 160 to 200 daily truck movements would be required to transport the excess spoil to a reclamation site located outside of the M2 Motorway.

Other non-earth moving activities such as concrete, paving materials, construction equipment and civil material deliveries would generate heavy vehicle trips. In total, the project is forecast to generate approximately 405 daily heavy vehicle and 2,840 light vehicle movements.

The daily traffic volumes generated by each of the compounds are summarised in Table 52.

Table 52 Forecast traffic generated by compound

| Work zone | Compound | Average daily heavy vehicle movements | Average daily light vehicle movements |
|---|---|---|---|
| 1 | Windsor Road North | 20 | 90 |
| 1 | Windsor Road South | 20 | 90 |
| 2 | Darling Mills Creek (on/off M2 Motorway) | 25 | 40 |
| 2 | Barclay Road (Not intended to be in constant use) | 25 | 30 |
| 2 | Yale Close | 25 | 40 |
| 3 | Devlins Creek (Allerton Road) (Not intended to be in constant use) | 25 | 40 |
| 4 | Barombah Road | 30 | 40 |
| 4 | Sutherland Road Tunnel Compound | 25 | 50 |
| 4 | Terrys Creek (Somerset Street) | 30 | 40 |
| 5 | Vimiera Road (Not intended to be in constant use) | 40 | 60 |
| 5 | Busaco Road (Not intended to be in constant use) | 25 | 70 |
| 5 | Toll Plaza (on/off M2 Motorway) | 25 | 40 |
| 5 | Christie Road (Talavera Road) | 20 | 50 |
| 5 | Macquarie Park Site (on/off M2 Motorway) | 65 | 125 |
| 5 | TIDC Compound | 190 | 800 |
| 5 | North Ryde Station Compound | 30 | 580 |

As indicated in Table 52, construction traffic levels on the local road network is generally quite low and would be unlikely to adversely affect local traffic movements. For those compounds likely to generate larger volumes of construction traffic, these compounds are generally accessed by more heavily utilised roads that already carry substantial levels of traffic.

The main compounds located at the eastern end of the corridor would have the largest volume of vehicle movements associated with them. These are located in the commercial and industrial areas of North Ryde with immediate access to the M2 Motorway and major arterial roads. Due to the early start times associated with construction work, the contribution of construction traffic to these roads (Wicks Road and Delhi Road) is unlikely to substantially affect traffic volumes or flow in the peak periods.

### Special loads

The M2 Upgrade project may require oversize material deliveries throughout the construction phase. These deliveries may require slow moving and/or police escorts, stop/slow procedures as well as road occupancies. These procedures would be undertaken in consultation with RTA's Traffic Management Centre (TMC) as detailed in the TMPs.

For example, beam installation works at Christie Road and Khartoum Road and lengthening of Kirkham Street and Barclay Road bridges would require temporary road closures with suitable detours. At Khartoum Road traffic flows would be directed using stop/slow bats during work hours only. At Kirkham Street and Barclay Road during construction periods, portable signals operating 24 hours a day would be used to direct traffic flows.

### Construction staff vehicles

The project is forecast to employ up to 500 staff over the duration of the construction period. To minimise the impact of staff vehicles on the M2 Motorway and the surrounding road network, sufficient private vehicle parking would be provided within the compounds and work sites.

For the worksites that are located adjacent to public transport services, such as the bus stops located along the M2 Motorway and the Macquarie University, staff are likely to utilise the existing bus and rail public transport services.

For staff working at areas outside of the public transport catchment area, off-site parking areas would be explored with the possibility of shuttle services between the off-site parking areas and the worksites to facilitate the movement of staff.

### Impacts to emergency vehicle access

Emergency service providers would be regularly informed on the staging, progress of works and the access arrangements instigated by the project, through Traffic and Transport Liaison Group (TTLG) meetings.

The road shoulder is also the emergency lane during normal circumstances and this would be removed during construction. Emergency services would have access to the tidal flow bus lane, and when required, through construction sites. Management Plans for incidents would be developed in consultation with the emergency services for each of the construction stages.

### Adjacent road network

Activities undertaken within the adjacent road network are listed in Table 53.

Table 53 Works at adjacent road network

| Location | Scope of works |
|---|---|
| Windsor Road | Widening of road south of M2 Motorway intersection to near Woodlands Street. Tie-in works for the new ramps plus traffic signal adjustment at the interchange. |
| Barclay Road | Lengthening of bridge spans over M2 Motorway. |
| Kirkham Street/Kirkham Street | Lengthening of bridge spans over M2 Motorway. |
| Somerset Street (east of Norfolk tunnel) | Realignment of kerbline and drainage near Gloucester Road. |
| Christie Road | Widening between Talavera Road and the M2 Motorway ramps including lengthening and widening of bridge spans over M2 Motorway, new traffic control signals at the northern ramps and traffic signals adjustment at the Talavera Road intersection. |
| Talavera Road | Widening carriageway between Macquarie School of Management access and Alma Road and traffic signal adjustments at Christie and Herring Roads. |

Some of the activities listed in Table 53 would require road occupancies with suitable detours or stop/slow procedures. Furthermore, work at Windsor Road, Somerset Street and Talavera Road may impact the property driveways. However, Construction Traffic Management Plans for each worksite would put measures in place to maintain access for residents and business. Furthermore, to minimise impact on the transport network, where possible, work would be scheduled outside of peak hours. The estimated construction traffic volumes (Table 52) are within the capacity of the road network during off-peak periods. It is considered that construction traffic would have a negligible impact on traffic network performance.

### Pedestrians

Construction activities in the vicinity of the bus stops on the M2 Motorway may require temporary diversion of pedestrians. However, access to the bus stops would be maintained at all times. Potential construction activities that may impact pedestrians are summarised in Table 54.

Table 54 Potential pedestrian access impacts

| Location | Facility type | M2 Upgrade project impacts |
|---|---|---|
| Windsor Road | Bridge | During construction of the new ramps on the west side it is likely that all pedestrians would be diverted to the east footpath. |
| Barclay Road | Bridge (and pedestrian ramp to M2 bus stop) | During construction there would be one of two footpaths closed for the lengthening works at the northern end. Temporary road crossing may be used to facilitate access. |
| Devlins Creek (from Allerton Road to Welham Street and Austral Avenue) | Bridge | During construction some local detours for pedestrians would be required to avoid working areas. Access under the M2 Motorway from north to south would be restricted. |
| Kirkham Street/Kirkham Street | Bridge | During construction there would be one of two footpaths closed for the lengthening works at the each end. Temporary road crossing may be used to facilitate access. |
| Beecroft Road | Bridge | During construction the footpath on the west side may be altered for the modifications to the central pier. Temporary road crossing may be used to facilitate access. |

| Location | Facility type | M2 Upgrade project impacts |
|---|---|---|
| Christie Road | Bridge | During construction the footpath on the east side may be altered for the widening/lengthening works. Temporary road crossing may be used to facilitate access.<br>Access to the council car park may be closed for some periods. An alternative car park at Talavera Road may be provided with pedestrian access across the bridge allowed. |
| Herring Road /Talavera Road | At Grade | During construction the footpath on the east side may be altered for the widening/lengthening works. Temporary road crossing may be used to facilitate access. |
| Khartoum Road | Underpass | During construction there would be one of two footpaths closed for the widening works at the each end. Temporary road crossing may be used to facilitate access |

### Cyclists

The construction activities would occupy the breakdown lane currently utilised by cyclists. At present there are approximately 250 daily bicycle trips along the M2 Motorway. To facilitate the cycling demand, an alternative route is proposed. The alternative cycle route would be implemented as a preconstruction ancillary activity prior to construction of the M2 Upgrade project commencing.

A preferred route has been determined with specialist input from GTA consultants and in consultation with appropriate stakeholders including Bicycle Interest Groups, Council and RTA. The preferred route is located primarily along local streets and other non-motorway roads between Abbott Road, Baulkham Hills and Delhi Road, North Ryde. The process of evaluating and selecting this preferred route is detailed in the *M2 Upgrade Alternative Cycle Route – Preferred Route Analysis Report* (GTA Consultants 2010).

The preferred alternative cycle route is illustrated in Figure 27, however this is subject to refinement and the final alignment may change as the detailed design progresses. The final alignment of the alternative cycle route on non-motorway roads would form part of the M2 Upgrade project construction footprint and extent of works.

### Bus operations

During construction, the existing two-way bus lanes are proposed to be reduced to one lane. This would entail buses travelling in the direction of peak movements to continue to travelling in a dedicated bus lane and the contra-peak direction buses to use the general traffic lanes. This would ensure that the existing bus routes remain unaffected during the construction phase.

The tidal bus flow arrangement would be applicable from Windsor Road to Pennant Hills Road and from Pennant Hills Road to a suitable merge point near the Kirkham Street bridge. This would allow buses travelling in the peak direction to travel as normal with access to the bus stops at Barclay Road and Oakes Road maintained. The contra-peak direction buses would use the general traffic lanes which are not congested. This arrangement would allow the existing bus routes to continue unaffected during the construction phase.

Throughout the construction phase, the existing bus stops along the M2 Motorway would remain open to all bus services. However, due to the tidal flow bus arrangements, express buses would no longer be able to by-pass the Barclay Road bus stop.

Bus stops located on the adjacent road network, such as Windsor Road and Talavera Road, may require temporary relocation or closures during the construction phase. Changes to the existing bus stops would be detailed in the TMPs.

The bus tidal flow would operate:

- Eastbound from 4.00 am to 12.00 pm.
- Westbound from 12.00 pm to 4.00 am.

As indicated earlier the removal of the two way bus ramp near Beecroft Road early in the construction period would require the re-routing of two bus routes which would be re-routed via Christie Road, Talavera Road and Herring Road.

### 9.2.3 Mitigation measures

The following presents a management framework for construction works to mitigate the impacts of the construction activities on the transport network surrounding the M2 Upgrade project worksites. A Construction Environmental Management Framework is provided in Appendix F. Based on this framework, detailed assessments would be undertaken as part of the development of the Traffic Management Plan, which would identify site specific measures to be implemented for each of the worksites.

#### Construction access

To minimise the impact on the local road network, where possible, the worksites that are located adjacent to the M2 carriageways would be accessed directly via the M2 Motorway, as detailed in Table 47. Traffic Management Plan for individual work zones would detail the temporary access arrangements for each of the work zones to allow vehicle access to the worksite whilst minimising traffic impact on the M2 carriageway. Potential measures include introducing temporary work zone speed limits adjacent to the worksites as well as limiting construction activities outside of the peak traffic times.

#### Local traffic access

Throughout the construction period, access to residential and commercial developments would be maintained. Furthermore, a TMP for each worksite would put measures in place to manage residents and business access arrangements and where possible, work would be scheduled outside of peak hours.

In selecting the travel route of construction vehicles, the following would be considered to reduce the impact on the local road environment:

- Preference for the motorway network, arterial roads and other higher order roads.
- Restrictions on size and load of vehicles.
- Sensitive communities especially schools, hospitals, places of worship, businesses.
- Hours of operation of the sensitive communities.
- Access needs for residents, pedestrians, emergency services and buses.
- Out of hours impact on residential areas.
- Consultation with the TTLG, residents and sensitive communities.
- Guidance from relevant documents and standards, such as *Guide to Traffic Control at Worksites* (RTA).

### Staff parking

To minimise the impact of staff vehicles parking on residential streets, off-site parking areas, located a strategic locations, would be explored with shuttle services transporting staff between the car parks and the worksites. Opportunities for such services would be explored for work sites that are not serviced by public transport.

Light vehicle works buses (approximately 15 – 20 seat vehicles) are proposed to ferry the workforce from the main compound area to the various work sites. As part of staff induction, all construction staff would be advised on suitable parking and transport arrangements.

### Traffic management plans

TMPs would be prepared for aspects of construction activities and staged opening that require temporary changes to the traffic environment to the motorway and non-motorway road layout.

The TMPs would provide descriptions of the overall staging (construction and opening) a detail traffic management and relevant sub plans. The content of the TMPs would include:

- Traffic Control Plans showing the detail of signs and devices required for each configuration.
- Vehicle Management Plans showing access to worksites, direction of travel and the like as well as management of staged opening.
- Pedestrian Control Plans.
- Management strategy for vehicles, for example, public transport, temporary bus stop relocation, tidal bus lane operation and staged opening.

Furthermore, the Project Traffic Manager would minimise the road user delays as well as maintain access for road users. The objectives for managing the impact of the project construction activities on traffic are:

- Safety of all road users and pedestrians.
- Minimise disruption to road users and pedestrians.
- Maintain the M2 Motorway and surrounding road network functionality.
- Limit impacts on public transport (buses).
- Minimise changes to traffic operation.
- Minimise access disruptions to adjoining properties.
- Minimise construction activities on non-motorway roads and residential areas wherever possible.
- Avoid heavy vehicle movements in peak traffic and out of hours.

These objectives are proposed to be achieved through the planning and consultation phases and implementation during the construction phase considering the following strategies:

- Identifying potential road user delays during the planning and consultation phases.
- Developing construction/opening staging and temporary works during the design phase to avoid conflicts with the existing road network whilst maximising separation between work areas and travel lanes.
- Maintaining existing road network capacities.
- Maintaining existing road characteristics and environment especially residential streets, schools, business operations, clearways, parking, places of worship and the like.
- Isolating work areas from general traffic using temporary safety barriers.
- Providing remote parking facilities for workforce with shuttle services to work areas.

- Developing alternative work methods to minimise impacts (for example, utilise more efficient plant / equipment, apply different design solution).
- Provisioning of CCTV coverage to observe traffic flow and incidents.
- Providing mechanism for the community to report incidents and delays, for example, an 1800 phone number.
- Planning of lane occupancies with the aim to: minimise the actual work area, limit obstructions and restrictions, maximise the roads capacity, and avoid peak traffic flow periods.
- Analysing traffic volume data to: identify the capacity requirements of the road and assess the potential impact on traffic flows, and identify the best time to minimise the inconvenience to road users.
- Developing clear and concise guidance and support amongst key stakeholders involved in the TTLG and its working groups.
- Developing traffic management solutions including long term contra flow arrangements.

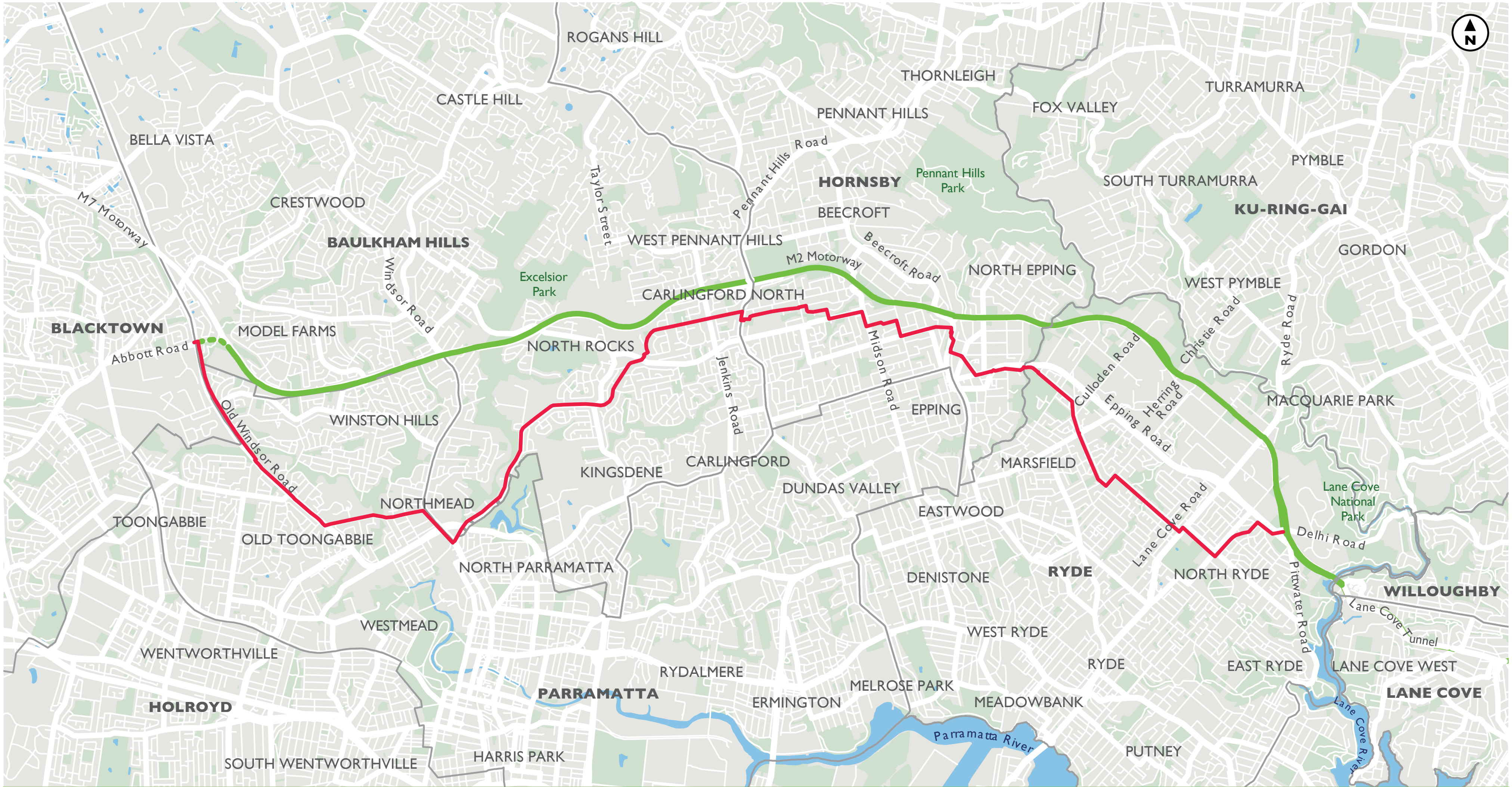



Figure 27 – Preferred temporary bicycle route

M2 Motorway
Preferred temporary cycle route
Abbott Road M2 Motorway entrance


Source: GTA Consultants, 2010; MapData, 2010

## 9.3 Operational noise and vibration

An assessment of the noise and vibration impacts associated with the operation of the M2 Upgrade project has been undertaken and is presented below. This assessment is supported by *Technical Paper 2 – Noise and Vibration* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *Operational noise impacts:*<br>• *The environmental assessment must include an assessment of the noise impacts of the project during operation, consistent with the Environmental Criteria for Road Traffic Noise (EPA, 1999). The assessment must include specific consideration of impacts to sensitive receivers (schools, hospitals, aged care facilities), as relevant.* | *Section 9.3,*<br>*Technical Paper 2* |

### 9.3.1 Operational noise assessment criteria

The M2 corridor runs through several areas of urban residential development. As a result the acoustical design of the M2 Upgrade project, as well as the design and management of potential residual noise impacts at dwellings in the vicinity of the M2 Motorway, introduces challenges with respect to achieving timely, efficient, balanced, equitable, reasonable and cost-effective outcomes for the M2 Upgrade project and the community.

Achieving a balanced acoustical design, especially in terms of feasibility and reasonableness, is guided primarily by the following two references:

- DECCW (formerly EPA), Environmental Criteria for Road Traffic Noise (ECRTN), May 1999.
- RTA, Environmental Noise Management Manual (ENMM), December 2001.

#### ECRTN classification of the project

In accordance with the DGRs, the assessment of operational noise has been performed in accordance with the requirements of the Department of Environment, Climate Change and Water (DECCW) ECRTN. This document provides guidance for assessing traffic noise impacts through setting design objectives for a range of development types and provides procedures for determining noise mitigation in situations where the exceedances of the objectives occur.

The M2 Upgrade project is classified as a '*Redevelopment of an Existing Freeway/Arterial Road*'. Based on this definition the appropriate criteria are presented in Table 55. As required by the DGRs, Table 55 also presents design noise objectives for the assessing noise impact upon sensitive receivers (for example, schools, hospitals, places of worship).

Table 55 DECCW operational traffic noise criteria

| Road type | Daytime criteria (7 am to 10 pm) | Night-time criteria (10 pm to 7 am) | Guidance when the existing ambient noise already exceeds the base criteria |
|---|---|---|---|
| Redevelopment of existing freeway/arterial road | LAeq(15 hour) 60 dB(A) | LAeq(9 hour) 55 dB(A) | In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB.<br>Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies, such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicles; greater use of public transport; and alternative methods of freight haulage |
| Redevelopment of existing collector roads | | | |
| Places of Worship | LAeq(1 hour) 40 dB(A) (internal) | LAeq(1 hour) 40 dB(A) (internal) | The most practicable mitigation measures to achieve internal noise goals often involve building (facade) treatments. Other mitigation options include regulation of vehicle exhaust noise, limiting access of heavy vehicles during sensitive times, limitations on exhaust brake use, etc.<br>When such treatments are not able to achieve the nominated target internal noise levels, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB |
| Hospital Wards | LAeq(1 hour) 35 dB(A) (internal) | LAeq(1 hour) 35 dB(A) (internal) | |
| Existing School Classrooms | LAeq(1 hour) 45 dB(A) (internal) | - | |
| Active Recreation (for example, Golf Courses) | Freeways and Arterial Roads: LAeq(15 hour) 60 dB(A) | - | |

The ECRTN recognises that there are generally limited resources to provide noise control on existing roads to meet the target criteria and that the noise minimisation strategies adopted need to take into account what is reasonable and feasible. The ECTRN also notes that in urban settings, background noise levels are elevated and generally increase incrementally over long periods of time. This affects the level of noise mitigation that is practicably achievable.

## ENMM classification of the project

The RTA's ENMM was issued in December 2001 and provides guidance in managing and controlling noise (and vibration) from all aspects of road traffic generated noise. Within the ENMM, properties which are subject to noise levels exceeding 60 dB(A) LAeq(15hour) or 55 dB(A) LAeq(9hour) are identified as being 'noise affected'. These levels correspond to the ECRTN criteria detailed in Table 55 as applying to the redevelopment of the M2 Motorway.

The ENMM however recognises that the base criteria recommended by the ECRTN are not always practicable, and that it is not always feasible or reasonable to expect that they should be achieved. This is particularly relevant to existing roads in urban environments. Guidance is provided when this situation is apparent.

The ENMM also uses the term ‘acute’. This refers to properties which are exposed to the following adverse levels of road traffic generated noise:

- Daytime: 65 dB(A) $L_{Aeq(15hour)}$; or
- Night-time: 60 dB(A) $L_{Aeq(9hour)}$.

In operational road traffic noise assessment, consideration for noise mitigation treatment is given to properties that experience acute levels of noise at the project design stage, even when there is no change in noise level due to the M2 Upgrade project.

The ENMM notes that the most effective way of minimising noise from vehicles and traffic is to control vehicle noise at the source. Examples of such measures may include:

- Reducing traffic volumes by promotion of public transport.
- Implementation of more stringent noise standards for new vehicles.
- The progressive replacement of older, noisier vehicles.
- Measures to ensure noise-control equipment on heavy vehicles and older cars is properly maintained.
- The selection and design of road routes and alignments so as to reduce gradients and achieve smooth traffic flows.
- The use of ‘low noise’ pavements.
- Restricted access to noisy vehicles.
- Traffic management measures to achieve smooth traffic flows.

Where the above source measures are not practical, or do not provide sufficient noise reduction, additional methods would be required to reduce levels to within acceptable margins. Such methods may include the use of noise walls or architectural treatment of properties.

For the M2 Upgrade project, preference would be given to the use of noise walls to mitigate noise levels. This is because all sensitive receivers behind a particular noise wall benefit from the resulting reduction in noise. Architectural property treatments are utilised to mitigate adverse noise only after all of the other mitigation options noted above have been considered.

### M2 Upgrade project road traffic noise objectives

In order to assess both predicted noise levels and the predicted changes in noise levels associated with the M2 Upgrade project, two scenarios were assessed, which are the Future Existing and the Future Design scenarios. These scenarios are described below:

- The 2011 Future Existing scenario represents the ‘baseline’ scenario and is used to determine the level of road noise predicted at the year 2011, in the absence of the M2 Upgrade project.. This scenario makes use of the M2 Motorway alignment in its existing geometry, with traffic volumes extrapolated to 2011 (the project opening year) by applying an incremental factor to measured existing flows. Thus, this scenario provides an assessment of the noise levels of the M2 Motorway without the proposed upgrade.
- The 2021 Future Design scenario represents the ‘assessment’ scenario for the M2 Upgrade project and uses the proposed new alignment for the M2 Motorway, together with future traffic volumes predicted to 10 years after the scheduled project opening year. Thus, this scenario provides an assessment of the noise levels of the M2 Motorway after the upgrade has been in place for 10 years.

Both the ECRTN and ENMM acknowledge that achieving the base objectives for existing roads in urban environments is sometimes not realistic. This is especially apparent in situations where the existing levels of background noise are already high and exceed the objectives.

Retrofitting of engineering-type noise controls to existing roads is also noted as having limited effectiveness. For example, additionally increasing the height of already high noise walls provides little additional noise benefit, whilst the associated visual impacts, shadowing, constructability and costs may reduce overall merit. These factors must be taken into account when determining appropriate and realistic noise objectives for any proposal.

The following summarises the noise objectives that have been adopted for the M2 Upgrade project, with consideration of the ECRTN and ENMM. Additional noise mitigation is to be considered where either:

- Scenario 1- The predicted 2021 Future Design noise level exceeds the ECRTN base criteria for redeveloped roads and the predicted noise level increase between the Future Design and Future Existing scenarios due to the M2 Upgrade project is greater than 2 dB(A); or
- Scenario 2 - The predicted 2021 Future Design noise levels are Acute (≥65 dB(A) $L_{Aeq(15hour)}$ or ≥60 dB(A) $L_{Aeq(9hour)}$ regardless of the incremental impact of the M2 Upgrade project.

The widening works associated with the M2 Upgrade project are proposed between chainage 3500 (just west of the proposed new Windsor Road access ramps) and chainage 17800 (just east of the Lane Cove Road intersection). As such, there are two sections of the M2 Motorway where no works associated with the M2 Upgrade project are occurring that would be subject to increased traffic and related traffic noise. These locations are:

- From the junction of the M7 Motorway with the M2 Motorway to just west of Windsor Road (chainage 0 – 3500).
- From east of Lane Cove Road to the Lane Cove Tunnel entrance (chainage 17800 – 20200).

In these locations, where no works associated with the M2 Upgrade project would occur, only the incremental criterion is applicable. This criterion requires that the predicted noise level increase between the Future Existing and Future Design scenarios is limited to 2 dB(A) or less.

Properties that are outside of the extent of the upgrade works and that currently experience acute noise levels would be subject to the original conditions of approval for construction of the M2 Motorway. Any assessment of noise impacts at these properties would occur separately to the M2 Upgrade project.

### Sleep disturbance and maximum noise level events

The DECCW's ECRTN and the RTA's ENMM provide guidance as to the likelihood of sleep disturbance resulting from road traffic related maximum noise level events (mainly associated with heavy vehicle movements).

The ECRTN document does not set explicit criteria for road traffic noise as no definitive quantitative correlation has been yet established between heavy vehicles noise levels and sleep disturbance. Notwithstanding the above, the ECRTN and ENMM suggests that:

- Maximum internal noise levels below 50 dB(A) to 55 dB(A) are unlikely to cause awakening reactions.
- One or two events per night, with maximum internal noise levels of 65 dB(A) to 70 dB(A), are not likely to affect health and wellbeing significantly.

A maximum noise event can be defined as any pass-by noise event for which the difference in the $L_{Amax}$ and $L_{Aeq(1hour)}$ noise levels is greater than 15 dB(A). Furthermore, the ECRTN recommends that the assessment of sleep disturbance should include a consideration of the maximum noise level exceedances occurring during the night-time period and the emergence of these exceedances above the ambient noise level.

### Noise criteria – operational phase: mechanical services

Operational noise from mechanical services plant is assessed against different criteria to those applying to operational noise from road traffic. For the M2 Upgrade project, items of mechanical plant are situated in the Norfolk Tunnel in the form of ventilation fans. The criteria used are taken from DECCW *Industrial Noise Policy* (EPA) (2000).

The procedures contained in the DECCW's NSW *Industrial Noise Policy* require a determination of the Rating Background Level (RBL) and ambient $L_{Aeq}$ noise levels during daytime, evening and night-time periods.

The assessment procedure for industrial (for example, mechanical) noise sources has two components:

- Controlling the intrusive noise impacts in the short-term for residents.
- Maintaining noise level amenity for residences and other land uses.

#### Intrusive criterion

The intrusive criterion for stationary noise sources limits the $L_{Aeq(15\ minute)}$ noise emissions levels to the RBL plus 5 dB(A).

#### Amenity criterion

The amenity noise goal depends upon the level of ambient 'industrial' $L_{Aeq}$ noise already existing within an area and how this level compares to the acceptable noise levels, as relevant to the M2 Upgrade project, specified in Table 56.

Table 56 NSW Industrial Noise Policy amenity criteria

| Type of receiver | Indicative noise amenity area | Time of day | Recommended $L_{Aeq}$ noise level | |
|---|---|---|---|---|
| | | | Acceptable | Recommended maximum |
| Residence | Suburban | Day (7 am-6 pm) | 55 dB(A) | 60 dB(A) |
| | | Evening (6 pm-10 pm) | 45 dB(A) | 50 dB(A) |
| | | Night (10 pm-7 am) | 40 dB(A) | 45 dB(A) |
| Active Recreation Area | All | When in Use | 55 dB(A) | 60 dB(A) |
| Commercial Premises | All | When in Use | 65 dB(A) | 70 dB(A) |

*Source: EPA (DECCW), 2000*

### 9.3.2 Existing noise environment

In order to characterise the existing noise environment adjacent to the M2 corridor and to establish the noise levels upon which to base the operational noise emission objectives, ambient environmental noise monitoring was performed at a number of representative locations along the length of Motorway corridor.

The monitoring was completed over two separate surveys. The first of these surveys was completed in March and April 2008 at 24 receptor locations along the M2 Motorway route; the second survey was performed in December 2008 at a further 13 locations (refer to Appendix B of Technical Paper 2 for noise monitoring locations).

The results of the ambient noise surveys are presented in Table 57. To represent overall day to day variations in road traffic noise emissions for freeways, use is made of the $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ noise indices. These indices represent the energy-averaged noise levels that prevail during the daytime (7.00 am to 10.00 pm) and night-time (10.00 pm to 7.00 am) periods. These indices, which are used for the operational assessment, are provided in Table 57.

Table 57 Summary of unattended noise logging – road traffic noise indices

| Receiver ID | Address | | Road traffic noise indices dB(A) | | |
|---|---|---|---|---|---|
| | | | LA10(18hour) 1 | LAeq(15hour) 2 | LAeq(9hour) 3 |
| S1-1 | 13 Sierra Place | Baulkham Hills | 52.5 | 51.5 | 47 |
| S1-2 | 89 Baulkham Hills Road | Baulkham Hills | 58.5 | 56.5 | 52.5 |
| S1-3 | 24 Lambert Crescent | Baulkham Hills | 60.5 | 59 | 55 |
| S1-4 | 15 Leatherwood Court | Baulkham Hills | 57 | 55.5 | 55.5 |
| S1-5 | 108 Junction Road | Baulkham Hills | 62 | 59 | 53.5 |
| S1-6 | 17 Livingstone Avenue | Baulkham Hills | 58 | 56 | 52 |
| S1-7 | 10 Murrills Crescent | Baulkham Hills | 55.5 | 54 | 50 |
| S1-8 | 13 Leatherwood Court | Baulkham Hills | 59.5 | 57.5 | 53.5 |
| S1-9 | 4 Craig Avenue | Baulkham Hills | 68 | 65.5 | 61 |
| S1-10 | 10 Petrina Close | Baulkham Hills | 66.5 | 65.5 | 60 |
| S2-1 | 12 Mill Drive | North Rocks | 48.5 | 51 | 45 |
| S2-2 | 10 Virginia Place | West Pennant Hills | 58 | 56 | 54 |
| S2-3 | 11 Wilshire Avenue | Carlingford | 61.5 | 59.5 | 56 |
| S2-4 | 70 Westmore Drive | West Pennant Hills | 60 | 58 | 54 |
| S2-5 | 3 Mundon Place | West Pennant Hills | 54 | 53 | 48 |
| S2-6 | 25 Coral Tree Drive | Carlingford | 55.5 | 53 | 50.5 |
| S2-7 | 5 Orchard Road | Beecroft | 58.5 | 56.5 | 50.5 |
| S2-8 | 24A Castle Howard Road | Cheltenham | 59.5 | 57.5 | 52.5 |
| S2-9 | 13 Williams Road | North Rocks | 63.5 | 61.5 | 58 |
| S2-10 | 8 Rajola Place | North Rocks | 63.5 | 61.5 | 58 |

| Receiver ID | Address | | Road traffic noise indices dB(A) | | |
|---|---|---|---|---|---|
| | | | LA10(18hour) 1 | LAeq(15hour) 2 | LAeq(9hour) 3 |
| S2-11 | 33 Carmen Avenue | Carlingford | 65 | 63.5 | 59 |
| S2-12 | 30 Austral Avenue | Beecroft | 64 | 62 | 57 |
| S3-1 | 30 Dunmore Road | Epping | 64 | 61.5 | 57.5 |
| S3-2 | 4 Somerset Street | Epping | 59.5 | 57.5 | 52.5 |
| S3-3 | 56 Somerset Street | Epping | 56 | 53.5 | 48 |
| S3-4 | 19 Woodvale Avenue | North Epping | 61 | 59 | 54 |
| S3-5 | 6.8 Nile Close | Marsfield | 53 | 51.5 | 46.5 |
| S3-6 | 40 Ashburton Avenue | South Turramurra | 56.5 | 55 | 50 |
| S3-7 | 45/147 Talavera Road | Marsfield | 61.5 | 60 | 52.5 |
| S3-8 | 3.3 Tasman Place | North Ryde | 57 | 56 | 50.5 |
| S3-9 | 21 Epping Road | North Ryde | 60 | 58.5 | 53 |
| S3-10 | 13 Stewart Close | Cheltenham | 60 | 58 | 53 |
| S3-11 | 140 Crimea Road | Marsfield | 59 | 58 | 52.5 |
| S3-12 | 150 Crimea Road | Marsfield | 54.5 | 53.5 | 48 |
| S3-13 | 2/4 Nile Close | Marsfield | 55.5 | 55 | 48.5 |
| S3-14 | 1A Busaco Road | Marsfield | 56 | 54.5 | 49.5 |
| S3-15 | 1 Fontenoy Road | Macquarie Park | 61.5 | 60 | 55 |

*Note 1: The $L_{A10(18hour)}$ level is the arithmetic average of the 18 hourly $L_{A10(1hour)}$ levels over consecutive hours between 6.00 am and 12.00 midnight during a normal working day.*

*Note 2: $L_{Aeq(15hour)}$ represents the Leq noise level for the period 7.00 am to 10.00 pm.*

*Note 3: $L_{Aeq(9hour)}$ represents the Leq noise level for the period 10.00 pm to 7.00 am.*

Table 57 indicates the noise levels depict through traffic with heavy and continuous traffic flows during peak periods, which is characteristic of a busy motorway.

### 9.3.3 Operational noise impact assessment

The M2 Upgrade project would require alterations to the existing alignment of the road in many areas along the length of the M2 Motorway. These alterations include the modification of various existing cuttings, embankments and batter slopes in areas where widening works are proposed.

Traffic noise from the M2 Motorway is currently mitigated through noise walls of various heights along almost the entire motorway length. These range from approximately 1.8 metres up to around 7 metres in height. The widening process would therefore affect a large number of the existing noise walls along the route of the M2 Motorway. Some of the affected noise walls are situated adjacent to the road carriageway and others are on top of embankments. All such affected noise walls would be required to be taken down and relocated as part of the M2 Upgrade project, although in most cases new walls would be built.

In certain areas, including some where residential receivers are in close proximity to the M2 Motorway, the proposed widening would bring the new outer running lane (and hence the overall noise emission source) closer to affected receivers.

### Governing criterion

The ECRTN stipulates 15-hour (daytime) and 9-hour (night-time) LAeq noise criteria of 60 dB(A) and 55 dB(A) respectively.

To determine the more stringent of the two criteria, a comparative exercise was performed using all baseline monitoring data to assess the difference between the daytime energy averaged noise level (LAeq(15hour)) and the night-time energy averaged noise level (LAeq(9hour)). This exercise showed that:

*Average daytime LAeq(15hour) noise level = Average night-time LAeq(9hour) noise level + 4.8 dB(A).*

The night-time criterion has therefore been taken as being the governing criterion.

Changes in road traffic noise levels associated with the M2 Upgrade project have therefore been calculated by considering the traffic conditions for the following scenarios:

- 2011 Future Existing – Night-Time LAeq(9hour) – refer results shown in Appendix D of the Technical Paper 2.
- 2021 Future Design – Night-Time LAeq(9hour) - refer results shown in Appendix E of the Technical Paper 2.

### 2011 and 2021 future traffic figures

All traffic data, in 18 hour format, used within the modelling of the future years was supplied to Heggies by Hills M2 and is based on the traffic figures in the transport and traffic impact assessment undertaken as part of the M2 Upgrade project environmental assessment. This included both M2 Motorway carriageway volumes along with data for the major surrounding arterial/secondary roads, and is presented in Table 34, Table 35 and Table 36.

The traffic data used as the basis for the operational noise impact modelling is presented in Tables 34, 35 and 36 of Technical Paper 2 and reproduced below in Table 58 (traffic on M2 Motorway), Table 59 (traffic on M2 Motorway on- and off-ramps) and Table 60 (traffic on intersecting roads).

Table 58 Future traffic figures (M2 Motorway carriageway)

| Location | Direction | LA10(18hour) Traffic Volumes | | |
|---|---|---|---|---|
| | | 2011 Future Existing | 2021 Future Design | %HGV |
| Old Windsor - Windsor Road | Eastbound | 29750 | 37480 | 17% |
| Windsor - Pennant Hills Road | | 38780 | 48360 | 14% |
| Pennant Hills - Beecroft Road | | 34140 | 44290 | 8% |
| Beecroft - Christie Road | | 38250 | 49190 | 8% |
| Christie - Lane Cove Road | | 34260 | 45300 | 8% |
| Lane Cove - Delhi Road | | 25250 | 35130 | 7% |
| Delhi - Lane Cove Road | Westbound | 26550 | 34390 | 7% |
| Lane Cove - Herring Road | | 35360 | 46060 | 9% |
| Herring - Beecroft Road | | 39940 | 49840 | 9% |
| Beecroft - Pennant Hills Road | | 36940 | 46690 | 9% |
| Pennant Hills - Windsor Road | | 42390 | 50430 | 13% |
| Windsor - Old Windsor Road | | 32140 | 41170 | 16% |

Table 59 Future traffic figures (M2 Motorway access ramps)

| Location | Direction | LA10(18hour) Traffic Volumes | | |
|---|---|---|---|---|
| | | 2011 Future Existing | 2021 Future Design | %HGV |
| Western end of M2 | Eastbound | 19390 | 23220 | 21% |
| Western end of M2 | Westbound | 20700 | 23320 | 20% |
| M2 Abbott Road Exit and Entrance | Eastbound | 10360 | 14260 | 8% |
| M2 Abbott Road Exit and Entrance | Westbound | 12680 | 18070 | 8% |
| Windsor Road - Off-Ramp | Eastbound | n/a | 3910 | 8% |
| Windsor Road - On-Ramp | Westbound | n/a | 3910 | 8% |
| Windsor Road - On-Ramp | Eastbound | 9030 | 14790 | 5% |
| Windsor Road - Off-Ramp | Westbound | 10250 | 13170 | 4% |
| Pennant Hills Road - Off Ramp | Eastbound | 13280 | 15590 | 23% |
| Pennant Hills Road - On Ramp | Westbound | 14140 | 15040 | 22% |
| Pennant Hills Road - On Ramp | Eastbound | 8640 | 11520 | 5% |
| Pennant Hills Road - Off Ramp | Westbound | 8690 | 11300 | 6% |
| Beecroft Road - On Ramp | Eastbound | 4110 | 4900 | 4% |
| Beecroft Road - Off Ramp | Westbound | 3000 | 3150 | 5% |
| Christie Road Off Ramp | Eastbound | 3990 | 6520 | 4% |
| Herring Road On Ramp | Westbound | 4580 | 7390 | 6% |
| Herring Road On Ramp | Eastbound | n/a | 2630 | 4% |
| Herring Road Off Ramp | Westbound | n/a | 3610 | 3% |
| Lane Cove Road - Off Ramp | Eastbound | 9010 | 10170 | 12% |
| Lane Cove Road - On Ramp | Westbound | 1980 | 4250 | 10% |
| Lane Cove Road - Loop On Ramp | Westbound | 6830 | 7420 | 15% |

Table 60 Future traffic figures (intersecting roads)

| Location | LA10(18hour) Traffic Volumes | | |
|---|---|---|---|
| | 2011 Future Existing | 2021 Future Design | %HGV |
| Windsor Road | 52578 | 59793 | 5% |
| Pennant Hills Road | 72433 | 73864 | 18% |
| Beecroft Road | 50253 | 51524 | 5% |
| Herring Road | 20739 | 29391 | 5% |
| Talavera Road (East of Herring Road) | 12860 | 21902 | 5% |
| Talavera Road (West of Herring Road) | 9936 | 15874 | 5% |
| Talavera Road (West of Christie Road) | 7156 | 9598 | 5% |
| Lane Cove Road | 85422 | 93534 | 11% |

A third 'base' scenario (2008) has also been modelled to allow for validation of the noise model against the ambient noise surveys carried out in 2008. The 2008 base $L_{A10,18hour}$ noise level predictions were compared with the results from the ambient noise monitoring surveys presented in Table 57. The comparison indicates that predicted noise levels provide a consistent, and slightly conservative, estimate of measured levels, with an average difference of +1.0 dB(A) for predicted versus measured levels. The results are within acceptable tolerances for road traffic noise predictions. Thus, it is anticipated that on average the modelling undertaken would slightly over-predict noise levels and potential impacts associated with the upgrade.

In the above scenarios, potentially significant road traffic noise sources have been taken into account, which is M2 Motorway traffic plus major arterial/secondary roads. For each of the above scenarios the facade maps predict noise levels at every facade of each floor of all buildings along the length of the M2 Motorway. All facade noise levels are evaluated at a distance of one metre from the centre of the facade in question, at a height of 1.5 metres for ground floor storeys and 4.3 metres (1.5 metres plus 2.8 metres for a typical floor to floor height) for first floor storeys. Noise levels have only been evaluated at ground and first floor storeys according to the general convention for assessments of the impacts from road traffic noise.

Re-sheeting of the M2 Motorway road surface with open graded asphaltic concrete (OGA) is proposed as part of the M2 Upgrade project. This pavement type is expected to provide a large noise benefit over the existing expansion cracked and substantially degraded surface. Under normal circumstances (and consistent with the guidance provided in the ENMM) a correction factor of -2.5 dB(A) would typically be applied to OGA low-noise pavement types. However, as there is potential for degradation of the M2 Motorway road surface over time, and to ensure a conservative assessment is achieved, the standard -2.5 dB(A) OGA correction factor has been entirely omitted from calculations in both the Future Existing and Future Design cases. This conservative approach is considered appropriate for the purposes of assessment of potential impacts associated with the upgrade.

### Road traffic noise associated with intersecting roads

The M2 Motorway is intersected at various points by a number of existing arterial/secondary roads. Residential receivers which are located close to these intersections are therefore exposed to road traffic noise from both the M2 Motorway and the roads in question. These include Old Windsor Road, Windsor Road, Pennant Hills Road, Beecroft Road, Lane Cove Road and Delhi Road. Where this occurs, and an exceedance of the relevant criteria is predicted, a detailed inspection of the particular receiver in question has been performed to determine which facade(s) and hence which road source was the cause of the exceedance.

Furthermore, inherent within the noise model is the ability to determine the relative contributions to a particular noise level at a single facade from the various sources in the vicinity. Where an exceedance of the noise criteria is apparent near to multiple sources (at M2 Motorway junctions with secondary roads) this process is used to determine the dominant contribution to that particular noise level. The facade maps in Appendix D and Appendix E of the Technical Paper 2 represent the traffic noise levels from M2 Motorway operations combined with all major secondary roads within the M2 corridor. Residential and other sensitive receivers which are deemed to be exceeding the relevant operational criteria as a result of the noise generated by the secondary roads are highlighted on the facade maps in Appendix E of the Technical Paper 2.

Accordingly, only those residential receivers which exceed the nominated criteria as a direct result of noise generated by the M2 carriageway, M2 Motorway on- and off-ramps and all associated upgrade works are included within the subsequent assessment of noise mitigation.

As part of the M2 Upgrade project it is also proposed to widen a number of the roads which intersect or feed on to the M2 Motorway. These include Windsor Road (north of Woodlands Street to the M2 Motorway), Christie Road (M2 Motorway exit ramp to Talavera Road) and Talavera Road (access to the School of Management to Alma Road). Of these, only Windsor Road has residential development fronting on to the road.

### Noise assessment

Noise emissions from the M2 Motorway are currently mitigated through noise walls along almost the entire length of the motorway of various heights (1.8 metres up to around 7 metres in height). The noise walls are generally located either at the side of the carriageway or at the crest of cuttings, depending on which location provides the optimal noise benefit for the sensitive receivers situated behind. The existing noise walls do not extend over the complete length of the M2 Motorway.

The opening of the M7 Motorway increased traffic volumes, particularly heavy vehicles, in the section of road between the M7 Motorway and Pennant Hills Road. An assessment of sensitive receivers adjacent to the M2 Motorway, both in sections with existing noise walls and in those sections currently without, has been undertaken with regard to the operational noise criteria for the M2 Upgrade project. The predicted noise levels have been evaluated against the noise management objectives described above.

The 2011 Future Existing facade plots in Appendix D of the Technical Paper 2 show that several residential precincts along the route of the M2 Motorway are subject to noise levels exceeding ECRTN base criteria. This is confirmed by the unattended ambient noise survey detailed in Table 57. The predicted noise levels for these properties have been evaluated against the noise management objectives described above.

### 2021 Future Design scenario assessment

The operational noise criteria for the M2 Upgrade project have been previously defined in Section 9.3.1 of this report. However, they are provided again below for reference.

- Scenario 1- The predicted 2021 Future Design noise level exceeds the ECRTN base criteria for redeveloped roads and the predicted incremental noise level increase between the Future Design and Future Existing scenarios due to the M2 Upgrade project is greater than 2 dB(A); or
- Scenario 2 - The predicted 2021 Future Design noise levels are Acute (≥65 dB(A) $L_{Aeq(15hour)}$ or ≥60 dB(A) $L_{Aeq(9hour)}$ regardless of the incremental impact of the M2 Upgrade project.

Where exceedances of noise criteria for future scenarios occur within the M2 corridor, additional noise mitigation measures would be considered. Preference is to be first given to the use of noise walls as a mitigation measure as all sensitive receivers behind a particular noise wall benefit from the resulting reduction in noise.

After the design and optimisation process of any such noise walls is complete, architectural property treatment would then be considered to mitigate the remaining properties within the M2 corridor where residual exceedances of the criteria are apparent. Evaluation of the incremental impact of the M2 Upgrade project (2021 – 2011 difference plot are provided in Appendix F of the Technical Paper 2) concludes a 2 dB(A) increase in noise is not apparent in any location along the length of the M2 corridor (excluding two properties immediately adjacent to the realignment of Windsor Road). As such, additional noise mitigation measures have only been considered where the predicted 2021 Future Design noise levels are found to be acute (Scenario 2 above). It is noted that noise levels at the two properties at Windsor Road are also predicted to be acute.

Proposed changes to noise walls and subsequent property treatments to address residual noise impacts are outlined in Section 9.3.5 below.

### Norfolk Tunnel widening

As part of the M2 Upgrade Project, it is proposed to widen both directions of the existing Norfolk Tunnel to provide an additional lane in the eastbound direction and an upgraded lane in the westbound direction. In the vicinity of the Norfolk Tunnel, two ground floor and seven first floor properties are predicted to be acute as a result of the upgrade, and are therefore eligible for consideration for property treatment. These properties are listed with other eligible properties in Table 68. Note that these properties are not subject to an increase of more than 2 dB(A) as a result of the project.

### Properties outside of M2 Upgrade project area

The widening works associated with the M2 Upgrade project start from approximately chainage 3500 and finish at around chainage 17800. In areas where no works are proposed, noise mitigation would only be considered where the noise level change as a result of the M2 Upgrade project is more than 2 dB(A) and the receivers experience noise levels above the criteria. Appendix F of Technical Paper 2 shows that all properties in areas outside of the M2 corridor are predicted to be subject to a noise level increase which is less than 2 dB(A) and therefore do not trigger the need for further mitigation to be considered as part of this proposal.

Properties which are outside the extent of the works associated with the M2 Upgrade project that currently experience acute noise levels would be subject to the original conditions of approval for construction of the M2 Motorway. Any assessment of noise impacts at these properties would occur separately to the proposed M2 Upgrade project.

### Areas of new housing developments

There are a number of newly built, planned or currently under construction residential developments along the route of the M2 Motorway that were unable to be represented by the 2011 scenario in the noise modelling exercise that has been performed to date. For these new areas, 'Future Design' noise levels have been predicted for the 2021 night time $L_{Aeq(9hour)}$ scenario only, as the ECRTN criterion for this assessment period is the more stringent of the criteria. The 2021 scenario includes the upgrades to the noise walls as discussed above. The increase in $L_{Aeq}$ noise levels as a result of the upgrade are made on the basis of the Future Existing (Year 2011) versus Future Design (Year 2021) scenarios comparison for other areas of the M2 corridor. A +2.5 dB correction factor has been included in all the contour data calculations to allow for the conversion of free field noise level to facade levels, as required by the ECRTN. The assessment of the new areas of residential development is summarised in Table 61. Reference is to be made to the noise contours in Appendix I of Technical Paper 2, where the red contours can be seen to represent the 'Acute' noise level boundary.

Table 61 New residential developments in proximity to M2 Motorway

| No. | Location | Storey | Future noise levels above ECRTN Criteria and Incremental Impact > 2dB(A) | Future noise levels Acute ? (≥60 dB(A) $L_{Aeq(9hour)}$) | Additional mitigation required? |
|---|---|---|---|---|---|
| 1 | 5 Petrina Crescent, Baulkham Hills | Ground | No | Yes | Yes |
| | | First | No | Yes | Yes |
| 2 | Baden Powell Place, Carlingford[1] | Ground | No | No | No |
| | | First | - | - | - |
| 3 | Devon Street, North Epping | Ground | No | No | No |
| | | First | No | No | No |
| 4 | Waterloo Road, Marsfield[2] | Ground | No | No | No |
| | | First | Yes | Yes | Yes |

*Note 1: These plots are currently vacant, therefore only ground floors require assessment.*

*Note 2: This is a multi-unit building.*

Table 61 indicates that a further two properties require architectural treatment.

## Sensitive land uses

The assessment of areas of sensitive land use (schools, churches, areas of active recreation and hospitals) is discussed in the following paragraphs. When considering sensitive land uses, the same operational criteria scenarios that have been adopted for residential receivers are applicable. Additional noise mitigation is therefore required to be assessed when either:

- Scenario 1- The predicted 2021 Future Design noise level exceeds the ECRTN base criteria for redeveloped roads and the predicted incremental noise level increase between the Future Design and Future Existing scenarios due to the M2 Upgrade project is greater than 2 dB(A); or
- Scenario 2 - The predicted 2021 Future Design noise levels are Acute (≥65 dB(A) $L_{Aeq(15hour)}$ or ≥60 dB(A) $L_{Aeq(9hour)}$ regardless of the incremental impact of the M2 Upgrade project.

It is noted that the ECRTN base criteria for these land uses is different to that applicable to residential properties. The appropriate assessment criteria for these uses are detailed in Table 55.

As has previously been discussed, in areas where no works are proposed, noise mitigation is only required to be considered where the noise level change as a result of the M2 Upgrade project is more than 2 dB(A).

The following assessment includes the predicted future noise levels at each of these land uses. Reference is to be made to the various grid noise maps regarding sensitive lands uses that are presented in the following appendices in the Technical Paper 2:

- Existing Schools – Appendix J.
- Churches – Appendix K.
- Active Recreation – Appendix L.
- Hospitals – Appendix M.

### Existing schools

The ECRTN noise goal for existing schools is a daytime $L_{Aeq(1hour)}$ noise level of 45 dB(A). It is noted that this noise criterion is based on $L_{Aeq(1hour)}$ internal noise levels. Any 'internal noise level' refers to the noise level at the centre of the habitable room that is most exposed to the noise source and applies with windows sufficiently open to provide adequate ventilation (notionally an open area equal to 5 percent of the floor area of the room).

When considering the correlation of internal noise criteria with externally predicted levels, Table 62, as taken from the RTA's ENMM (extract from Table 4.2 of ENMM), are considered.

Table 62 ENMM indicative noise reduction criteria

| Building type | Windows | Internal noise reduction |
|---|---|---|
| All | Open | 10 dB(A) |
| Light frame | Single glazed (closed) | 20 dB(A) |
| Masonry | Single glazed (closed) | 25 dB(A) |
| | Double glazed (closed) | 35 dB(A) |

*Note: adapted from FHWA, 1995.*

Therefore, as per the ENMM guidance, when assuming the typical (conservative) reduction of 10 dB(A) for a partially open window, to allow for natural ventilation on the noise exposed facade, the internal ECRTN noise criterion would correspond to an external $L_{Aeq(1hour)}$ noise level at the building facade of approximately 55 dB(A).

This criterion may be considered slightly conservative, since the morning and afternoon peaks of traffic would typically occur outside normal teaching hours.

Assessment of all 1-hour noise levels contained within the Technical Paper 2 has been performed using the appropriate noise corrections as derived from the unattended noise logging noise data described in Section 9.3.2, averaged during the corresponding period of the day (day or night).

Table 63 Assessment of existing schools

| School | ECRTN Criteria, dB(A) Daytime | Future Noise Levels above ECRTN Criteria and Incremental Impact >2dB(A) | Future Noise Levels Acute (>65dB(A) LAeq(15hour)) | Additional Mitigation Required? |
|---|---|---|---|---|
| Model Farms High School | LAeq(1hr) 45dB(A) (internal) | No | - | No |
| Winston Hills Public School | | No | - | No |
| Our Lady of Lourdes Primary School | | No | No | No |
| Muirfield High School | | No | No | No |
| Royal Institute for Deaf and Blind School Children | | No | No | No |
| Epping Heights Public School | | No | No | No |
| Macquarie University | | No | No | No |

*Note 1: Located outside of the M2 corridor, therefore only incremental impact required to be assessed.*

With reference to Table 63, the noise contours in Appendix J of Technical Paper 2, and the 2021 Future Design façade plots in Appendix E of the Technical Paper 2 provides conclusions as described in the following subsections.

### Model Farm High School and Winston Hills Public School

At Model Farm High School and Winston Hills Public School, which are both outside of the M2 corridor, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels and as such, there is no requirement for additional mitigation to be investigated.

Acute 2021 Future Design noise levels are not required to be assessed at these schools.

### Our Lady of Lourdes Primary School

At this school, where no modification to the existing noise walls are proposed, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels, neither are the 2021 Future Design noise levels predicted to be acute. As such, there is no requirement for additional mitigation to be investigated.

### The Royal Institute for Deaf and Blind Children

At the Royal Institute for Deaf and Blind Children (RIDBC), widening of the M2 Motorway is proposed and there is a requirement to relocate a number of the nearby noise walls. The heights of the proposed new noise walls are noted as being in-line with the heights of the existing noise walls (7.2 metres for the noise walls immediately north of the school).

The 2021 Future Design noise levels at this school are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels, nor are the 2021 Future Design noise levels predicted to be acute. As such, there is no requirement for additional mitigation to be investigated.

Notwithstanding the above, an assessment of the change in noise impacts at the RIDBC with the relocated noise walls in this location being increased in height to 7.8 metres has been performed. This assessment concluded that as only a marginal noise decrease was apparent with the higher height of noise walls, the additional small noise benefit that would be apparent from increasing the height of the noise walls was found to be insufficient to justify the extra cost.

### Epping Heights Public School

At this school, where no modification to the existing noise walls are proposed, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels, neither are the 2021 Future Design noise levels predicted to be acute. As such, there is no requirement for additional mitigation to be investigated.

### Macquarie University

At this institution, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels, neither are the 2021 Future Design noise levels predicted to be acute. As such, there is no requirement for additional mitigation to be investigated. It is noted that situated between the M2 corridor and the relevant Macquarie University campus buildings is a relatively busy section of Talavera Road, to the west of Christie Road.

### Places of worship

The ECRTN noise goal for places of worship is an internal $L_{Aeq(1hour)}$ noise level of 40 dB(A). This applies to both the day and night-time periods.

Again, to adequately assess internal noise levels from those predicted externally, a conservative noise reduction of 10 dB(A) has been applied to allow for windows along the noise exposed façade being partially open (as defined within the ENMM). This corresponds to an external $L_{Aeq(1hour)}$ noise level at the building facade of approximately 50 dB(A).

It is noted that, on average, the assessed 1-hour peak daytime noise levels are approximately 3 dB(A) higher than the night-time peak level and as such, the daytime is considered to be the governing criteria. This is as would be expected for road traffic generated noise, where the highest daytime peak hours (corresponding to either the morning or evening rush hours) experience far greater traffic volumes, and subsequently higher noise levels, than the night-time peak hours.

One place of worship has been identified as being affected by the M2 Upgrade project. This is detailed in Table 64 below. The relevant noise contours are presented in Appendix K of Technical Paper 2.

Table 64 Assessment of places of worship

| Place of Worship | ECRTN Criteria, dB(A) | | Future Noise Levels above ECRTN Criteria and Incremental Impact >2dB(A) | Future Noise Levels Acute (>65dB(A) LAeq(15hour)) | Additional Mitigation Required? |
|---|---|---|---|---|---|
| | Daytime | Night-time | | | |
| Our Lady of Lourdes Church | LAeq(1hour) 40dB(A) (internal) | LAeq(1hour) 40dB(A) (internal) | No | No | No |

*Note 1: The ECRTN defines the Daytime as 7:00am to 10:00pm and the Night-time ad 10:00pm to 7:00am.*

At Our Lady of Lourdes Church, where no modification to the existing noise walls are proposed, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels, neither are the 2021 Future Design noise levels predicted to be acute. As such, there is no requirement for additional mitigation to be investigated Inspection of the surrounding area to the church grounds also concludes that a 4.2 metre high noise wall is already in place along the site boundary on the sides that face towards the M2 Motorway.

### Areas of active recreation

A number of areas where active recreation occurs have been identified. These are listed in Table 65, and illustrated on the noise contours contained Appendix L of Technical Paper 2.

Table 65 Assessment of areas of active recreation

| Area of Active Recreation | ECRTN Criteria, dB(A) | Future Noise Levels above ECRTN Criteria and Incremental Impact >2dB(A) | Future Noise Levels Acute (>65dB(A) LAeq(15hour)) | Additional Mitigation Required? |
|---|---|---|---|---|
| | Daytime | | | |
| Gooden Reserve | Freeway/Arterial Roads: LAeq(15hr) 60dB(A) | No | No | No |
| Max Ruddock Reserve | | No | No | No |
| Muirfield Golf Course | | No | No | No |
| Pennant Hills Golf Course | | No | No | No |
| Cheltenham Oval | | No | No | No |
| Epping Oval Athletics Track | | No | No | No |
| Jim Campbell Field | | No | No | No |
| Roger Sheeran Oval | | No | No | No |
| Christie Park | | No | No | No |

*Note 1: The ECRTN defines the Daytime as 07.00 am to 10.00 pm and the Night-time as 10.00 pm to 07.00 am*

*Note 2: Located outside of the M2 corridor, therefore only incremental impact required to be assessed.*

The assessment of areas of active recreation shows that at all locations, the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels. The 2021 Future Design noise levels at the locations which are within the M2 corridor are also not predicted to be acute. As such, there is no requirement for additional mitigation to be investigated.

It is also noted that in these areas no alteration of the existing noise walls is proposed as part of the M2 Upgrade project.

### Hospital wards

The ECRTN noise goal for hospital wards is an internal $L_{Aeq(1hour)}$ noise level of 35 dB(A). This applies to both the day and night-time periods. One hospital has been identified as being affected by the M2 Upgrade project – the Macquarie University Hospital. It is anticipated that Macquarie University Hospital would open in the first half of 2010.

As the hospital buildings at the Macquarie University Hospital would be newly constructed it has been assumed that mechanical ventilation would be provided to all ward rooms and hence there would be no requirement to open windows. A conservative external to internal noise reduction of 20 dB(A) has therefore been applied which results in an external $L_{Aeq(1hour)}$ noise level at the building facade of approximately 55 dB(A).

It is noted that the Macquarie University Hospital is located near to proposed upgrade of the Christie Road interchange. The upgrade works include:

- A new eastbound on-ramp to the M2 Motorway at Christie Road.
- Widening of the Christie Road Bridge and Talavera Road (between Christie Road and Herring Road).

The assessment of Macquarie University Hospital is detailed in Table 66, and illustrated on the noise contours contained Appendix M of Technical Paper 2.

It is noted that re-surfacing of the Christie Road and Talavera Road intersection would be completed as part of the upgrade works. To be consistent with the main operational assessment, no correction factor has been applied to the re-surfaced Future Design model.

Table 66 Assessment of hospitals

| Hospital Ward | ECRTN Criteria, dB(A) | | Future Noise Levels above ECRTN Criteria and Incremental Impact >2dB(A) | Future Noise Levels Acute (>65dB(A) $L_{Aeq(15hour)}$) | Additional Mitigation Required? |
|---|---|---|---|---|---|
| | Daytime | Night-time | | | |
| Macquarie University Hospital | $L_{Aeq(1hr)}$ 35dB(A) (internal) | $L_{Aeq(1hr)}$ 35dB(A) (internal) | No | No | No |

*Note 1: The ECRTN defines the Daytime as 7:00 am to 10:00 pm and the Night-time ad 10:00 pm to 7:00 am.*

The above assessment of the potential noise impacts at the Macquarie University Hospital indicates that the 2021 Future Design noise levels are not predicted to rise by more than 2 dB(A) over the 2011 Future Existing levels. As the 2021 Future Design noise levels are also not predicted to be acute, there is no requirement for additional mitigation to be investigated.

### Upgrade to alignment at Windsor Road intersection

As part of the M2 Upgrade project it is proposed to add two additional on/off access ramp at the Windsor Road Intersection with the M2 Motorway. The current junction layout would therefore be required to be altered to allow efficient access to and from the M2 Motorway.

The properties that are located on Windsor Road in the vicinity of the proposed eastbound off-access ramp are of sufficient distance to not be affected to the realignment of this side of the intersection, however, the proposed layout for the westbound on-access ramp (to the immediate south of the junction) has the potential to impact on the residential receivers in this vicinity as they are situated much closer.

There are a number of properties on Windsor Road which are likely to be affected by the alignment change. Currently the buildings are set back by approximately 10 metres to 15 metres from Windsor Road. The proposed re-alignment would bring the road to within approximately 5 metres to 10 metres of some of the properties.

It is noted that three of the affected properties are multi-unit buildings (258 Windsor Road). These three multi-unit residencies are noted as being recently constructed and were not able to be included within the noise model. Assessment of noise impact due to the re-alignment of the Windsor Road junction has therefore been performed using noise contours at their footprint location.

The various contours are illustrated in Appendix N of the Technical Paper 2. Noise contours have been predicted at both ground floor and first floor heights (1.5 metres and 4.3 metres above the local ground respectively). Future Design noise levels have been predicted for the 2021 night time $L_{Aeq(9hour)}$ scenario only, as the criterion for this assessment period is the more stringent of the criteria. The 2021 scenario includes the upgrades to the noise walls as discussed in Section 6.3.9. A +2.5 dB correction factor has been included in all the contour data calculations to allow for the conversion of free field noise level into facade levels, as required by the ECRTN. Reference to the grid noise within Appendix O of the Technical Paper 2 shows that Future Design noise levels for six properties in the immediate vicinity of the re-alignment at Windsor Road are predicted to be acute (greater than 60 dB(A) $L_{Aeq(9hour)}$). As these properties are directly accessed from Windsor Road and the construction of a noise wall is subsequently not feasible, these properties are therefore to be considered for architectural treatment mitigation (and have been included in Table 68).

It is noted that 266 Windsor Road, which is affected by the re-alignment of the intersection, is a heritage listed building.

### Secondary roads – potential noise impacts

As the M2 Upgrade project has the potential to create additional traffic flows on the secondary roads which intersect with the M2 Motorway, an assessment of the likely impacts resulting from this has been completed. The roads which form part of this assessment include:

- Windsor Road.
- Pennant Hills Road.
- Beecroft Road.
- Lane Cove Road.

It is noted that impacts from the alterations to Christie Road, Herring Road and Talavera Road form part of the main assessment.

A comparison of the 2011 Future Existing and the 2021 Future Design traffic volumes has been undertaken to determine the potential noise increase. This assessment found that the highest increase was apparent on Windsor Road (as a result of the new west facing access ramps) where a 14 percent increase for the 2021 traffic flows is anticipated. This equates to a marginal noise level increase of around 0.6 dB(A).

### Sleep disturbance assessment

When assessing short term maximum noise levels from the M2 Upgrade project, the current sleep disturbance guidelines used in NSW have been considered (refer to Section 9.3.1).

The ENMM defines a maximum noise event as any pass-by for which the $L_{Amax}$ noise level exceeds the $L_{Aeq(1hour)}$ noise level by at least 15 dB(A) and is in excess of 65 dB(A).

As there is potential for heavy vehicles to use compression braking to slow upon exiting the M2 Motorway at the location of the proposed new eastbound Windsor Road off-ramp, a maximum noise level assessment has been performed in this location.

Background noise monitoring to determine the existing amount of maximum noise events was completed at 3 Horwood Avenue, Baulkham Hills, on the evening of 9 February 2010. Table 67 summarises the results of this noise monitoring.

Table 67 Maximum noise level assessment

| Date | Time period | Measured noise level $L_{Aeq(1\ hour)}$ dB(A) | Number of maximum noise events per hour |
|---|---|---|---|
| 09/02/2010 | 22:00 – 22:59 | 56.7 | 6 |
| | 23:00 – 23:59 | 56.1 | 12 |
| 10/02/2010 | 00:00 – 00:59 | 53.2 | 10 |
| | 01:00 – 01:59 | 53.9 | 9 |
| | 02:00 – 02:59 | 53.9 | 16 |
| | 03:00 – 03:59 | 55.6 | 3 |
| | 04:00 – 04:59 | 58.4 | 8 |
| | 05:00 – 05:59 | 60.1 | 4 |
| | 06:00 – 06:59 | 58.9 | 4 |
| Total number of maximum noise events 72 | | | |

Results of the analysis of the maximum noise levels show that a maximum noise event (as defined within the ENMM) occurred a total of seventy two times at 3 Horwood Avenue over the night of monitoring. The measured $L_{Amax}$ maximum noise level events varied between 68 dB(A) and 81 dB(A)

### Maximum noise level assessment – discussion

The assessment of maximum noise levels which are subject to the receivers in the vicinity of the proposed eastbound Windsor Road off- ramp concludes the following:

- The traffic data for the M2 Upgrade project shows an increase in traffic (2011 Future Existing and 2021 Future Design) on the M2 Motorway carriageway in this location which equates to a noise level increase of around 1 dB(A). The mix of light and heavy vehicles is noted as remaining the same.
- However, the construction of the proposed new Windsor Road off-access ramp is expected to result in a reduction in $L_{Aeq}$ noise levels at the sensitive receivers situated in the vicinity as a result of the proposed access ramp being required to be built up and hence effectively acting as a noise barrier to the road traffic on the main M2 Motorway carriageway (which is the dominant source of noise).
- Sensitive receiver $L_{Aeq}$ noise level reductions of around 2 dB(A) to 4 dB(A) have therefore been predicted between the 2011 Future Existing and 2021 Future Design scenarios in this location.
- The noise barrier effect of the new Windsor Road (west-facing) ramps would induce a comparable reduction for 2021 Future Design $L_{Amax}$ noise levels associated with road traffic on the main M2 Motorway carriageway. As such, the number of maximum noise events associated with heavy vehicles travelling on the main carriageway in this location is anticipated to either remain the same or potentially reduce slightly as a result of the additional attenuation provided by the construction of the proposed off-ramp.
- The proposed off-ramp would however bring vehicles (using the off-access ramp) closer to the sensitive receivers in this location: Currently, 3 Horwood Avenue is approximately 25 metres from the carriageway, the distance from the proposed off-ramp to this property would be approximately15 metres. Although the heavy vehicles on the proposed off-ramp are predicted to be an order of magnitude less than the number of heavy vehicles on the main M2 Motorway carriageway, their proximity to the nearest receivers to the north suggests there is potential for the number of maximum noise level events associated with heavy vehicles exiting the M2 Motorway via the proposed eastbound off-access ramp to increase slightly compared to current conditions.

### Stationary noise impacts from mechanical plant

The only mechanical plant items associated with the M2 Upgrade project are the exhaust fans located in the Norfolk Tunnel. The exhaust fans are attached in pairs to the centre of the crown of the roof of each of the tunnels. No additional exhaust fans are proposed as part of the tunnel upgrade works

Noise levels have been predicted to be below the target noise criteria.

## 9.3.4 Vibration impact assessment

Vibration generated from vehicles (in particular heavy vehicles) travelling along the M2 Motorway, including the main carriageway, on/off ramps and the Norfolk Tunnel, would not give rise to levels of vibration exceeding the daytime or night-time human comfort criteria recommended in AS 2670 – *Evaluation of human exposure to whole body vibration*. This is subject to regular maintenance of the roadway to repair large potholes or deformities as they occur.

### 9.3.5 Mitigation measures

#### General approaches to controlling road traffic noise

A range of noise mitigation options are available to reduce the effect of road traffic noise on the surrounding community. The general methods available are listed below.

- Low noise road surfaces: Such as Open Graded Asphaltic Concrete (OGAC) or Stone Mastic Asphalt (SMA). Such surfaces can produce noise level decreases of up to about 4 dB(A) when compared to standard road surface materials. A full re-sheeting of the existing M2 Motorway road surface with a low noise road surface within the boundaries of the proposed Upgrade works would take place concurrently with the upgrade proposal.
- Road maintenance: Maintaining the running surface condition of a road can be important in lessening the incidence of sleep disturbance, for example, sleep disturbance may result where noise is generated by pot holes that are allowed to remain for extended periods of time without repair.
- Traffic management: Such as limiting vehicle speed, signage, etc. These methods can generate noise level improvements of up to 5 dB(A), depending upon the carriageway of interest, however they are more suited to local roads than motorways. Compression brakes can be an important factor in the noise environment of roads used by heavy vehicles. While there are currently no statutory powers to limit the use of compression brakes, some success has been achieved on certain major arterial routes via the use of signage to promote awareness of their use in residential areas. In cases where inappropriate driving behaviour is identified as a significant source of annoyance (for example, excessive use of compression brakes), vehicle driver education strategies would be considered.
- Traffic Re-Routing: This option is particularly useful when applied to heavy vehicles using local and secondary roads in predominantly residential areas.
- Noise Barriers: Noise walls gain their effectiveness by extending the path length of noise over and around the barrier between the source and the receiver. Barriers are usually most effective where both the source and receiver are at a similar elevation.
  Increasing the height of already high noise walls provides limited attenuation. Noise walls are also ineffective when receivers are located at highly elevated positions, as would be the case for upper levels of a residential apartment building overlooking a noise source.
  The potential for using noise walls also depends upon other factors, including access to property, aesthetic impacts, daylight access, overshadowing, drainage, driver line-of-sight around sections of curved carriageway, maintenance access and safety (particularly for drivers and pedestrians).
- Architectural treatment of buildings: This method involves the upgrading of property glazing for windows and sliding doors, and the upgrading of access doors if they are found to be weak points for noise access into a particular building. Double glazing, for example, can reduce internal noise levels by up to 10 dB(A) or more compared to a standard residential grade window. Property treatments may also include the provision of mechanical ventilation if the closure of windows and other facade openings is used as a means of managing internal noise levels in selected spaces.

A range of options would be selected to deliver a noise strategy that aims to achieve the target noise goals for the M2 Upgrade project. Details of what noise mitigation measures would be feasible and reasonable to apply would be identified at the detailed design stage of a road project. This is because site specific details are important in selecting the final mix of noise mitigation measures and the detailed design phase may require small changes to project specifics (such as the level of the road way and staged opening). The process of obtaining feedback from the community may also identify a preference for a certain type of noise mitigation. During the design phase of the project, the project team would be required to assess all available noise options.

As preference is to be given to noise walls as the primary choice of noise mitigation, a discussion of how the noise walls were designed for the M2 Upgrade project follows.

### Alteration of noise barriers

The M2 Motorway has existing noise barriers (some on retaining wall structures) located along the alignment. As part of the upgrade, existing noise barriers located along the alignment would require relocation and/or heightening to accommodate widening works.

The relocation of noise walls is generally necessary to allow the widening process of the M2 Motorway to be completed. Where the horizontal alignment of the noise walls is required to be adjusted, an optimum location has been selected (taking constructability, maintenance, access, the extent of the site boundary and drainage issues into consideration) so as to ensure that the noise wall provides the maximum noise benefit possible to the areas situated behind.

In all sensitive receiver locations where future exceedances of the operational noise criteria have been predicted, new or increased height noise walls have been considered where three or more exceeding properties are situated within a catchment area. Where the number of exceeding receivers is found to be less than three, the specification of noise walls is not considered to be a reasonable or cost-effective approach, and architectural treatment of these receivers would be considered.

Where noise walls are required to be relocated by the upgrade works, consideration has been given to increasing the existing height of the walls if exceedances of the operational noise criteria are apparent in the 2021 Future Design scenario. Where no exceedances of the criteria are apparent, the height of the relocated noise wall has been specified as being the same as the existing wall which it is replacing.

To assist in maintaining the noise environment of affected areas during the construction phase of the M2 Upgrade project, it is planned that, in locations where noise walls are required to be relocated as part of the M2 Upgrade project, the new wall would be constructed prior to the existing one being demolished, subject to engineering and feasibility considerations. In areas where this is to happen, an offset distance of approximately 3.5 metres would need to be maintained between the new noise wall and existing noise wall to allow for construction access behind the existing wall.

### Noise walls not affected by proposed widening works

Height changes to noise walls that are not proposed to be relocated as part of the widening works have also been considered. Specifically, locations where three or more properties behind a noise wall are predicted to be subject to acute noise levels in the 2021 Future Design scenario have been assessed. In all cases the cost-effectiveness analysis rejected further increases in noise levels, primarily because very small additional benefits would be provided by the height increases. As such, no height changes are proposed for existing noise walls that are not proposed to be relocated as part of the M2 Upgrade project.

### Proposed changes to noise walls as part of the M2 Upgrade project

Based on the above assessment two new noise walls are proposed, one existing noise wall would be relocated and heightened, two existing noise walls would be relocated and partially reduced in height and the remaining 19 noise walls would be relocated and maintained at existing heights. Table 8 in Section 6.3.9 describes the affected noise walls that form part of the M2 Upgrade project as well as the rationale for requiring modification. The location of all affected noise walls is also illustrated in Appendix H of the Technical Paper 2.

### Residual architectural property treatments at noise wall locations

At some locations where the noise criteria are exceeded as a result of the M2 Upgrade project, the feasibility and reasonableness considerations discussed above have concluded that the construction, or modification, of noise walls is not feasible, reasonable or cost-effective. At such locations, where residual impacts remain after all feasible and reasonable approaches have been exhausted, noise mitigation in the form of acoustic treatment for existing individual dwellings is required to be assessed.

The details of the property treatments related to the M2 Upgrade project are summarised in Table 68, noting that a 'n/a' means that a property has no first floor, and that grey text represents no exceedance of the criteria at ground floor level (refer to Table 68). The changes in noise levels between the Future Existing and Future Design scenarios are predicted to be less than 2 dB(A) at all properties within the study area (with the exception of two properties at Windsor Road). As such, the need for property treatment is determined on the basis of whether 'acute' noise levels are predicted. It is noted that the two properties where a change in noise level of more than 2 dB(A) is predicted are also predicted to be acute and are therefore included in Table 68 below.

Table 68 Year 2021 exceedances and residual architectural property treatments

| No. | Address[1] | Approx Chainage | Predicted Noise Level $L_{Aeq(9hr)}$, (dB(A)) | | | |
|---|---|---|---|---|---|---|
| | | | Ground Floor | | First Floor | |
| | | | 2011 | 2021 | 2011 | 2021 |
| 1 | 52 Junction Road, Baulkham Hills | 3350 | 58 | 59 | 59 | 60 |
| 2 | 1 Watkins Road, Baulkham Hills | 3400 | 59 | 60 | n/a | n/a |
| 3 | 4 Craig Avenue, Baulkham Hills | 3450 | 62 | 63 | n/a | n/a |
| 4 | 10 Craig Avenue, Baulkham Hills | 3500 | 57 | 57 | 62 | 62 |
| 5 | 5 Linton Street, Baulkham Hills | 4100 | 56 | 57 | 63 | 64 |
| 6 | 14 Linton Street, Baulkham Hills | 4200 | 57 | 58 | 60 | 61 |
| 7 | 4 Petrina Crescent, Baulkham Hills | 4200 | 60 | 60 | 63 | 64 |
| 8 | 8 Petrina Crescent, Baulkham Hills | 4250 | 60 | 61 | n/a | n/a |
| 9 | 10 Petrina Crescent, Baulkham Hills | 4300 | 61 | 62 | n/a | n/a |
| 10 | 12 Petrina Crescent, Baulkham Hills | 4300 | 60 | 61 | n/a | n/a |
| 11 | 14 Petrina Crescent, Baulkham Hills | 4300 | 60 | 61 | n/a | n/a |
| 12 | 7 Petrina Crescent, Baulkham Hills | 4350 | 61 | 61 | n/a | n/a |
| 13 | 266 Windsor Road, Winston Hills | 4000 | 63 | 66 | n/a | n/a |
| 14 | 262 Windsor Road, Winston Hills | 4000 | 63 | 67 | n/a | n/a |
| 15 | 258a Windsor Road, Winston Hills | 4000 | These three properties are newly built two-storey multi-unit dwellings.<br>See discussion in Section 9.3.3 | | | |
| 16 | 258b Windsor Road, Winston Hills | 4000 | | | | |
| 17 | 258c Windsor Road, Winston Hills | 4000 | | | | |
| 18 | 254 Windsor Road, Winston Hills | 4000 | 64 | 66 | 66 | 68 |
| 19 | 17 Russell Street, Northmead | 4300 | 59 | 60 | n/a | n/a |
| 20 | 19 Russell Street, Northmead | 4300 | 59 | 60 | n/a | n/a |
| 21 | 1 Russell Street, Northmead | 4300 | 56 | 56 | 67 | 68 |
| 22 | 2 Russell Street, Northmead | 4400 | 59 | 59 | 65 | 66 |
| 23 | 37 Dremeday Street, Northmead | 4450 | 59 | 60 | n/a | n/a |

| No. | Address[1] | Approx Chainage | Predicted Noise Level LAeq(9hr), (dB(A)) | | | |
|---|---|---|---|---|---|---|
| | | | Ground Floor | | First Floor | |
| | | | 2011 | 2021 | 2011 | 2021 |
| 24 | 39 Dremeday Street, Northmead | 4450 | 60 | 61 | n/a | n/a |
| 25 | 41 Dremeday Street, Northmead | 4450 | 60 | 61 | 62 | 62 |
| 26 | 42-44 Dremeday Street, Northmead[2] | 4500 | 62 | 63 | n/a | n/a |
| 27 | 46 Dremeday Street, Northmead | 4500 | 65 | 66 | n/a | n/a |
| 28 | 46 Roland Avenue, Northmead | 4500 | 60 | 61 | 61 | 62 |
| 29 | 48 Roland Avenue, Northmead | 4500 | 60 | 61 | 61 | 62 |
| 30 | 41 Williams Road, North Rocks | 4950 | 59 | 60 | 60 | 61 |
| 31 | 39 Williams Road, North Rocks | 4950 | 59 | 60 | n/a | n/a |
| 32 | 33 Williams Road, North Rocks | 5000 | 59 | 60 | n/a | n/a |
| 33 | 31 Williams Road, North Rocks | 5000 | 59 | 60 | n/a | n/a |
| 34 | 29 Williams Road, North Rocks | 5100 | 59 | 60 | 61 | 62 |
| 35 | 25 Williams Road, North Rocks | 5100 | 61 | 62 | n/a | n/a |
| 36 | 23 Williams Road, North Rocks | 5150 | 60 | 61 | n/a | n/a |
| 37 | 21 Williams Road, North Rocks | 5200 | 60 | 61 | 63 | 64 |
| 38 | 11 Williams Road, North Rocks | 5250 | 57 | 58 | 59 | 60 |
| 39 | 8 Rajola Place, North Rocks | 5300 | 58 | 58 | 60 | 61 |
| 40 | 93 Barclay Road, North Rocks | 5250 | 58 | 59 | 59 | 61 |
| 41 | 2 Mill Drive, North Rocks | 5300 | 58 | 59 | 59 | 60 |
| 42 | 122 Barclay Road, North Rocks | 5400 | 57 | 57 | 59 | 61 |
| 43 | 120 Barclay Road, North Rocks | 5450 | 58 | 59 | 61 | 62 |
| 44 | 118 Barclay Road, North Rocks | 5450 | 58 | 59 | 61 | 62 |
| 45 | 26 Hepburn Road, North Rocks | 6000 | 55 | 57 | 58 | 60 |
| 46 | 24 Yale Close, North Rocks | 6500 | 58 | 59 | 60 | 62 |
| 47 | 14 Virginia Place, West Pennant Hills | 7000 | 58 | 59 | 59 | 60 |
| 48 | 15 Wilshire Avenue, Carlingford | 7400 | 54 | 55 | 62 | 63 |
| 49 | 13 Wilshire Avenue, Carlingford | 7400 | 57 | 57 | 60 | 60 |
| 50 | 96 Westmore Drive, West Pennant Hills | 7400 | 58 | 59 | 59 | 60 |
| 51 | 86 Westmore Drive, West Pennant Hills | 7400 | 58 | 59 | 59 | 60 |
| 52 | 82 Westmore Drive, West Pennant Hills | 7500 | 59 | 60 | 60 | 61 |
| 53 | 80 Westmore Drive, West Pennant Hills | 7500 | 60 | 61 | n/a | n/a |
| 54 | 78 Westmore Drive, West Pennant Hills | 7550 | 59 | 60 | n/a | n/a |
| 55 | 76 Westmore Drive, West Pennant Hills | 7600 | 58 | 59 | 59 | 60 |
| 56 | 74 Westmore Drive, West Pennant Hills | 7600 | 58 | 59 | 59 | 60 |
| 57 | 2 Morton Avenue, Carlingford | 7600 | 60 | 60 | n/a | n/a |
| 58 | 53 Carmen Drive, Carlingford | 7650 | 61 | 62 | n/a | n/a |
| 59 | 52 Carmen Drive, Carlingford | 7800 | 58 | 59 | 59 | 60 |
| 60 | 50 Carmen Drive, Carlingford | 7850 | 58 | 59 | 59 | 60 |

| No. | Address[1] | Approx Chainage | Predicted Noise Level $L_{Aeq(9hr)}$, (dB(A)) | | | |
|---|---|---|---|---|---|---|
| | | | Ground Floor | | First Floor | |
| | | | 2011 | 2021 | 2011 | 2021 |
| 61 | 33 Carmen Drive, Carlingford | 7850 | 60 | 61 | 67 | 67 |
| 62 | 31 Carmen Drive, Carlingford | 7850 | 61 | 62 | n/a | n/a |
| 63 | 29 Carmen Drive, Carlingford | 7900 | 60 | 61 | n/a | n/a |
| 64 | 27 Carmen Drive, Carlingford | 7900 | 58 | 59 | 61 | 62 |
| 65 | 20 Lamorna Avenue, Beecroft | 9450 | 55 | 56 | 59 | 60 |
| 66 | 16 Lamorna Avenue, Beecroft | 9450 | 58 | 58 | 60 | 61 |
| 67 | 16 Austral Avenue, Beecroft | 9950 | 58 | 59 | 59 | 60 |
| 68 | 18 Austral Avenue, Beecroft | 9950 | 58 | 59 | 59 | 60 |
| 69 | 20 Austral Avenue, Beecroft | 10000 | 58 | 59 | 59 | 60 |
| 70 | 22 Austral Avenue, Beecroft | 10000 | 58 | 59 | 59 | 60 |
| 71 | 24 Austral Avenue, Beecroft | 10050 | 58 | 59 | 59 | 60 |
| 72 | 28 Austral Avenue, Beecroft | 10050 | 58 | 60 | 59 | 60 |
| 73 | 30 Austral Avenue, Beecroft | 10050 | 60 | 61 | 61 | 62 |
| 74 | 34-2/3 Austral Avenue, Beecroft | 10100 | 59 | 60 | n/a | n/a |
| 75 | 36-1/2 Austral Avenue, Beecroft | 10100 | 57 | 58 | 59 | 60 |
| 76 | 36-3 Austral Avenue, Beecroft | 10100 | 59 | 60 | 60 | 61 |
| 77 | 6 Ferndale Road, Beecroft | 10500 | 56 | 57 | 61 | 62 |
| 78 | 24 Barombah Road, Epping | 11700 | 59 | 60 | n/a | n/a |
| 79 | 26 Dunmore Road, Epping | 11800 | 57 | 58 | 60 | 61 |
| 80 | 13 Stewart Close, Cheltenham | 12100 | 50 | 52 | 59 | 61 |
| 81 | 28 Old Beecroft Road, Cheltenham | 12150 | 52 | 53 | 59 | 61 |
| 82 | 28A Old Beecroft Road, Cheltenham | 12150 | 50 | 51 | 60 | 62 |
| 83 | 3 Constance Close, Epping | 12500 | 57 | 58 | 60 | 61 |
| 84 | 5 Callistemon Close, North Epping | 12600 | 56 | 58 | 59 | 61 |
| 85 | 3A Callistemon Close, North Epping | 12650 | 60 | 62 | 62 | 63 |
| 86 | 27 Somerset Street, Epping | 12650 | 62 | 63 | 63 | 64 |
| 87 | 16 Sussex Street, Epping | 12650 | 57 | 58 | 59 | 60 |
| 88 | 21 Sussex Street, Epping | 12650 | 56 | 56 | 59 | 60 |
| 89 | 83 Devon Street, North Epping | 13150 | 55 | 56 | 59 | 60 |
| | Total Number of Properties | 89 | | | | |

*Note 1: Exceedances are regarded as residential receivers that are subject to 'Acute' noise levels (≥65dB(A) $L_{Aeq(15hr)}$ or ≥60dB(A) $L_{Aeq(9hr)}$) OR the incremental impact of the project is greater than 2dB(A) (and the project noise goals are exceeded).*

*Note 2: This property consists of a number of units and would require further investigation during the detailed design phase to determine exactly how many of the units have exceedances.*

### Signage to limit use compression braking by heavy vehicles

As the M2 Motorway is subject to large volumes of heavy vehicles which have the potential to cause noticeable sensitive receiver noise impacts, a suitable strategy to help mitigate heavy vehicle noise may include the erection of signage which attempts to target the inappropriate use of engine/compression brakes. Some success has previously been achieved on certain major arterial routes in NSW with the use of such signage to promote awareness of their use in residential areas. The newly proposed Windsor Road west-facing access ramps are locations where this may be considered.

### Bridge expansion joints

The M2 Upgrade project would require modifications to several of the existing bridges which form part of the current alignment. As the impulsive noise from expansion joints in bridges can create localised impacts, it is therefore proposed that where expansion joints require replacement or modification as part of the M2 Upgrade project, the selecting of suitable components would consider the potential noise generating characteristics in an attempt to minimise the impact on the sensitive receivers which are, in some location, situated in very close proximity to some of the bridge joints.

## 9.4 Construction noise and vibration

An assessment of the noise and vibration impacts associated with the construction of the M2 Upgrade project has been undertaken and is presented below. This assessment is supported by *Technical Paper 2 – Noise and Vibration* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *General Construction Impacts – the environmental assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed. The environmental assessment must include consideration of, and a management framework for:* | |
| • *Construction noise and vibration, including a considered approach to scheduling construction works having regard to the nature of construction activities (including transport, blasting and tonal or impulsive noise-generating works, as relevant), the intensity and duration of noise and vibration impacts, the nature, sensitivity and impact to potentially-affected human receivers and structures, the need to balance timely conclusion of noise and vibration-generating works with periods of receiver respite, and other factors that may influence the timing and duration of construction activities (such as traffic management). The environmental assessment must also present a strategy for monitoring and mitigating construction noise and vibration, with a particular focus placed on those activities identified as having the greatest potential for adverse noise or vibration impacts, and a broader, more generic approach developed for lower-risk activities.* | *Section 9.4,*<br>*Technical Paper 2* |

### 9.4.1 Construction noise assessment criteria

A review of guidelines and current practices for the assessment and subsequent mitigation of construction noise was conducted. The assessment approach was undertaken in accordance with the DECCW *Interim Construction Noise Guideline* (2009) (ICNG).

The ICNG recommends that a quantitative assessment be carried out for *"major construction projects that are typically subject to the EIA process"*. A quantitative assessment, based on a likely 'worst case' construction scenario, has been carried out for the M2 Upgrade project.

The ICNG requires the determination of Noise Management Levels (NMLs) for noise affected receivers consistent with current practices to deal with construction noise in a transparent and consistent way. Table 69 sets out management levels for noise at residences and how they are to be applied. Table 69 presents noise management levels for sensitive land uses other than residential.

Ground-borne noise criteria as applicable to the works proposed for the Norfolk Tunnel are discussed in Section 9.4.5.

Table 69 Noise at residences using quantitative assessment

| Time of day | Management level LAeq (15min)[1] | How to apply |
| --- | --- | --- |
| Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays | Noise affected RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| | Highly noise affected 75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| Outside recommended standard hours | Noise affected RBL + 5 dB | A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements refer to section 7.2.2 of the ICNG |

*Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Table 70 Construction noise management levels – non-residential sensitive land uses

| Land use | Management level, $L_{Aeq}$ (15 min) (applies when properties are in use) |
|---|---|
| Classrooms at schools and other educational institutions | Internal noise level<br>45 dB(A) |
| Places of worship | Internal noise level<br>45 dB(A) |
| Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion) | External noise level<br>65 dB(A) |
| Passive recreation areas(characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation) | External noise level<br>60 dB(A) |
| Community centres | Depends on the intended use of the centre.<br>Refer to the recommended 'maximum' internal levels in AS/NZS 2107:2000 for specific uses. |

*Souorce: DECCW, 2009*

## Sleep disturbance criteria

The most recent guidelines in relation to sleep disturbance are those contained in the DECCW *Application Notes - NSW Industrial Noise Policy*. The Application Notes recommends that sleep disturbance be assessed based on the emergence of the $L_{A1}$ (1 minute) noise level over the corresponding $L_{A90}$ (15 minute) noise level. The following screening criterion for sleep disturbance is recommended in the Application Notes:

$$L_{A1}(1\ minute) < L_{A90}(15\ minute) + 15\ dB(A).$$

## Construction traffic criteria

The ECRTN provides relevant criteria applicable to assess the impact arising from traffic movements generated during the construction phase of the M2 Upgrade project.

The criteria for arterial, collector and local roads are set out in Table 71.

Table 71 DECCW road traffic noise criteria

| Development | Day (7.00 am to 10.00 pm) | Night (10.00 pm to 7.00 am) |
|---|---|---|
| Land use development with potential to create additional traffic on existing freeways/arterials | LAeq(15 hour) 60 dB(A) | LAeq(9 hour) 55 dB(A) |
| Land use development with potential to create additional traffic on collector roads | LAeq(1 hour) 60 dB(A) | LAeq(1 hour) 55 dB(A) |
| Land use development with potential to create additional traffic on local roads | LAeq(1 hour) 55 dB(A) | LAeq(1 hour) 50 dB(A) |

Where $L_{Aeq}$ noise levels already exceed the above targets, a 2 dB(A) increase in the overall traffic noise levels is normally regarded as an alternative target in order to maintain the general acoustic amenity of the area. In order to achieve this, it is necessary for the noise contribution from the additional traffic to be at least 2 dB(A) below the existing traffic noise level.

### 9.4.2 Existing noise environment

In order to characterise the existing noise environment adjacent to the M2 Motorway and to establish the noise levels upon which to base the construction noise emission objectives, environmental noise monitoring was performed at a number of representative locations along the length of M2 corridor.

The monitoring was completed over two separate surveys. The first of these surveys was completed in March and April 2008 at 24 receptor locations along the M2 Motorway, and the second survey completed in December 2008 at a further 13 locations (refer to Appendix B of Technical Paper 2 for noise monitoring locations).

The results of the ambient noise surveys are presented in Table 57. Representative $L_{A90}$ noise levels (background) during the DECCW's standard daytime construction hours (7.00 am to 6.00 pm), the evening period (6.00 pm to 10.00 pm) and the night-time period (10.00 pm to 7.00am) are provided in Table 72. These noise levels are used to set noise management levels in relation to the construction phase of the M2 Upgrade project.

Table 72 Summary of unattended noise logging – construction noise indices

| Receiver ID | Address | | Construction noise indices (RBL) | | |
|---|---|---|---|---|---|
| | | | Daytime period[1] | Evening period[2] | Night-time period[3] |
| S1-1 | 13 Sierra Place | Baulkham Hills | 44 | 45 | 38.5 |
| S1-2 | 89 Baulkham Hills Road | Baulkham Hills | 50 | 47 | 38 |
| S1-3 | 24 Lambert Crescent | Baulkham Hills | 52 | 47 | 39.5 |
| S1-4 | 15 Leatherwood Court | Baulkham Hills | 48.5 | 49 | 47 |
| S1-5 | 108 Junction Road | Baulkham Hills | 51.5 | 47.5 | 37.5 |
| S1-6 | 17 Livingstone Avenue | Baulkham Hills | 47.5 | 44 | 36.5 |
| S1-7 | 10 Murrills Crescent | Baulkham Hills | 46 | 43.5 | 38.5 |
| S1-8 | 13 Leatherwood Court | Baulkham Hills | 51 | 48 | 36 |
| S1-9 | 4 Craig Avenue | Baulkham Hills | 57.5 | 54 | 38 |
| S1-10 | 10 Petrina Close | Baulkham Hills | 59.5 | 56.5 | 41.5 |
| S2-1 | 12 Mill Drive | North Rocks | 37 | 38 | 34 |
| S2-2 | 10 Virginia Place | West Pennant Hills | 52 | 48 | 39.5 |
| S2-3 | 11 Wilshire Avenue | Carlingford | 56.5 | 52.5 | 42 |
| S2-4 | 70 Westmore Drive | West Pennant Hills | 53.5 | 50 | 38 |
| S2-5 | 3 Mundon Place | West Pennant Hills | 47 | 46 | 35.5 |
| S2-6 | 25 Coral Tree | Drive Carlingford | 46 | 49 | 41.5 |
| S2-7 | 5 Orchard Road | Beecroft | 51.5 | 47 | 36 |
| S2-8 | 24A Castle Howard | Road Cheltenham | 53.5 | 48.5 | 33 |
| S2-9 | 13 Williams Road | North Rocks | 57.5 | 53 | 38.5 |
| S2-10 | 8 Rajola Place | North Rocks | 58 | 52.5 | 41.5 |

| Receiver ID | Address | | Construction noise indices (RBL) | | |
|---|---|---|---|---|---|
| | | | Daytime period[1] | Evening period[2] | Night-time period[3] |
| S2-11 | 33 Carmen Avenue | Carlingford | 57.5 | 54.5 | 37.5 |
| S2-12 | 30 Austral Avenue | Beecroft | 57 | 52.5 | 39 |
| S3-1 | 30 Dunmore Road | Epping | 58 | 52 | 46 |
| S3-2 | 4 Somerset Street | Epping | 52 | 48 | 35 |
| S3-3 | 56 Somerset Street | Epping | 49 | 44.5 | 32.5 |
| S3-4 | 19 Woodvale Avenue | North Epping | 54.5 | 50 | 33 |
| S3-5 | 6/8 Nile Close | Marsfield | 44.5 | 42 | 36.5 |
| S3-6 | 40 Ashburton Avenue | South Turramurra | 45.5 | 47 | 38.5 |
| S3-7 | 45/147 Talavera Road | Marsfield | 50 | 46 | 35 |
| S3-8 | 3/3 Tasman Place | North Ryde | 51 | 48.5 | 41.5 |
| S3-9 | 21 Epping Road | North Ryde | 53.5 | 51.5 | 41 |
| S3-10 | 13 Stewart Close | Cheltenham | 54 | 50.5 | 33.5 |
| S3-11 | 140 Crimea Road | Marsfield | 53 | 49 | 36.5 |
| S3-12 | 150 Crimea Road | Marsfield | 49 | 45 | 31 |
| S3-13 | 2/4 Nile Close | Marsfield | 47 | 44.5 | 31.5 |
| S3-14 | 1A Busaco Road | Marsfield | 48.5 | 47.5 | 37 |
| S3-15 | 1 Fontenoy Road | Macquarie Park | 54 | 51.5 | 42 |

*Note 1: DECCW's standard construction hours: 7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm on Saturdays and no work on Sundays or Public Holidays.*

*Note 2: Evening hours: 6.00 pm to 10.00 pm.*

*Note 3: Night-time hours: 10.00 pm to 7.00 am Sunday to Friday, 10.00 pm Saturday to 8.00 am Sunday.*

### 9.4.3 Construction noise impact assessment

The following sections contain an assessment of the construction noise and vibration impacts associated with the M2 Upgrade project. Construction noise and vibration goals have been established based on the relevant government guidelines and industry standards. Noise and vibration emission levels have been determined based on expected activities. Where exceedances are predicted, impact mitigation measures would be implemented where reasonable and feasible as per relevant government and industry guidelines. The M2 Upgrade project represents a major infrastructure development project, constructed over two years, and as such there would be periods when impacts on the surrounding areas associated with construction noise would be expected. As it would be necessary for the M2 Motorway to, at least partly, remain open during the daytime, certain works would be required to be conducted during the less busy evening and night-time periods.

Ground-borne noise impacts from the works associated with widening of the Norfolk Tunnel are discussed in Section 9.4.5.

## Construction activities, equipment and sound power levels

For the M2 Upgrade project, a series of construction scenarios have been developed which represent the various construction phases of the upgrade process. Table 73 details the critical work activities for each scenario which are of relevance to construction impacts, together with the equipment required during each activity and the corresponding sound power levels for each item of plant. The expected location and duration of each of the key construction activities is presented in Table 13 of the Technical Paper 2 together with the period of the day in which the activity would be undertaken. It is noted that not all activities are required at all locations along the M2 Motorway.

Table 73 Construction activities and typical equipment involved

| Scenario | Activity | Equipment used | Sound Power Level dB(A) [2] | |
|---|---|---|---|---|
| | | | LAeq | LAmax |
| 1a + 1b | Road widening (Scenario 1b includes the additional equipment associated with Rocksawing/breaking) | Excavator 30t | 109 | 115 |
| | | Truck (delivery / removal) | 93 | 97 |
| | | Concrete Truck | 109 | 113 |
| | | Concrete Saw | 114 | 118 |
| | | Mobile Crane | 105 | 113 |
| | | Vibratory Roller | 106 | 114 |
| | | Plus at selected locations – Scenario 1b | | |
| | | Rocksaw | 114 | 118 |
| | | Rockbreaker | 117 | 124 |
| | | Compressor | 106 | 107 |
| | | Generator | 100 | 103 |
| 2 | Cross-stitching and temporary median works | Excavator 30t with Hammer | 109 | 115 |
| | | Jack Hammer | 115 | 117 |
| | | Truck (delivery / removal) | 93 | 97 |
| | | Concrete Truck | 109 | 113 |
| | | Concrete Saw | 114 | 118 |
| | | Mobile Crane | 105 | 113 |
| | | Vibratory Roller | 106 | 114 |
| 3 | Intelligent Transport System (ITS) works | Excavator 30t | 109 | 115 |
| | | Truck (delivery / removal) | 93 | 97 |
| | | Concrete Truck | 109 | 113 |
| | | Concrete Saw | 114 | 118 |
| | | Reinforcement Cutting | 109 | 118 |
| | | Mobile Crane | 105 | 113 |
| | | Generator | 100 | 103 |
| | | Lighting Tower | 87 | 88 |
| 4 | Re-surfacing asphalt works | Asphalt Paver | 108 | 110 |
| | | Vibratory Roller | 106 | 114 |
| | | Tip Trucks | 93 | 97 |

| Scenario | Activity | Equipment used | Sound Power Level dB(A) [2] | |
|---|---|---|---|---|
| | | | LAeq | LAmax |
| 5 | Traffic management, set-up and line marking | Truck (delivery / removal) | 93 | 97 |
| | | Generator | 100 | 103 |
| | | Lighting Tower | 87 | 88 |
| 6 | Hydroblasting | Drilling Rig | 104 | 104 |
| | | Truck (delivery / removal) | 93 | 97 |
| | | Compressor | 106 | 107 |
| | | Generator | 100 | 103 |
| | | Jackhammer | 115 | 117 |
| | | Mobile Crane | 105 | 113 |
| | | Lightning Tower | 87 | 88 |
| 7a | Bridgeworks (daytime bored piling, abutments and piers, deck and finishing) | Piling Rig (bored) | 107 | 110 |
| | | Rockbreaker | 117 | 124 |
| | | Excavator 30t | 109 | 115 |
| | | Backhoe | 106 | 111 |
| | | Truck (delivery / removal) | 93 | 97 |
| | | Generator | 100 | 103 |
| | | Compressor | 106 | 107 |
| | | Jackhammer | 115 | 117 |
| | | Crane (up to 70t) | 109 | 113 |
| | | Concrete Pump | 108 | 112 |
| | | Vibratory Roller | 106 | 114 |
| | | Lighting Tower | 87 | 88 |
| 7b | Bridgeworks (evening and night-time works) | Generator | 100 | 103 |
| | | Compressor | 106 | 107 |
| | | Concrete Truck | 109 | 113 |
| | | Concrete Pump | 108 | 112 |
| | | Concrete Vibrator | 105 | 112 |
| | | Truck (deliver/removal) | 93 | 97 |
| | | Mobile Crane | 105 | 113 |
| | | Boom Lift | 102 | 108 |

The majority of the proposed road widening construction works associated with the M2 Upgrade project would be undertaken during the standard (daytime) construction hours. Evening and night-time works would be required for certain activities where it is not appropriate to undertake these activities during live traffic conditions. This would be determined for safety reasons or to set up construction areas to facilitate day time construction activities. Furthermore, where evening and night-time works are required, such works would not necessarily be continuous at any one location for the full duration of the activities. Certain construction activities are proposed outside of the normal working hours (including on Sundays and Public holidays) to help reduce potential disruption to traffic and to maintain the safety of construction personnel and other road users. Construction activities undertaken outside of standard construction hours would be subject to approval from DECCW. Appropriate communication with affected community members would be undertaken prior to the commencement of out of hours activities.

### Construction noise predictions

Using the sound power levels in Table 73, construction noise levels have been predicted at the nearest receiver locations to the various Noise Catchment Areas for each of the construction scenarios detailed in Table 13 of the Technical Paper 2 (noting that not every scenario is apparent of each assessment location).

The resultant daytime, evening and night-time $L_{Aeq(15minute)}$ noise levels are presented in Table 74, Table 75, and Table 76 respectively (where appropriate) and compared with the relevant NMLs.

The predicted construction noise levels would inevitably depend upon the number of plant items and equipment operating at any one time and their precise location relative to the receiver of interest. A receiver would therefore experience a range of values, representing the variation in construction noise depending upon the location of the particular construction activity and the likelihood of the equipment of interest operating simultaneously. Where a range of values are apparent, the values presented in the assessment tables represent the predicted noise levels at several receivers within that Noise Catchment Area at various offset distances from the construction works. It is noted that the following predictions are representative of typical construction works situated on the carriageway of M2 in the vicinity of each of the assessment locations, and that for extended periods of time, noise levels would potentially be lower than the calculated levels as predicted for the construction scenarios evaluated.

In each construction scenario, all of the equipment belonging to a particular activity is assumed to be operating concurrently for the full 15 minute period. The following predictions relate to when the particular plant is approximately adjacent to the residences of interest and that as plant and equipment moves along the road of concern, noise levels would reduce.

### Noise impacts associated with noise wall relocations

There are locations along the motorway corridor where the construction of new noise walls would not be possible prior to the removal of the existing noise walls. These scenarios are mostly associated with locations where the widening of the motorway would require the construction of new retaining walls and the widening of bridge decks. At these locations, the existing noise walls would have to be removed to facilitate widening of the road. In these situations it is not physically possible to construct the new noise wall until after the road has been widened and the physical structure on which the new noise wall would be constructed (such as retaining wall or bridge deck) has been created. This is illustrated for a retaining wall in Figure 28.

For retaining walls, where access is available at the base of the wall it may be possible to commence construction at ground level, with the existing noise wall in place. However, at some point as the wall is increased in height, where access to the base of the wall is not physically possible or where the construction of new access to the base of the wall would cause undue environmental impact, construction of the wall would have to occur from the M2 Motorway itself at road level. In these instances sections of existing noise walls would need to be removed to provide access to carry out the work and to lower in equipment and/or materials where required. The new noise wall could not be constructed until the new road pavement is complete.

For bridge widening, other than column construction and the installation of new bridge girders, the majority of work required to widen the bridge deck road pavement would occur from the road way.

The existing noise wall would need to be removed to provide access and facilitate the pavement construction. The new noise wall could not be constructed until the widened bridge deck is complete.

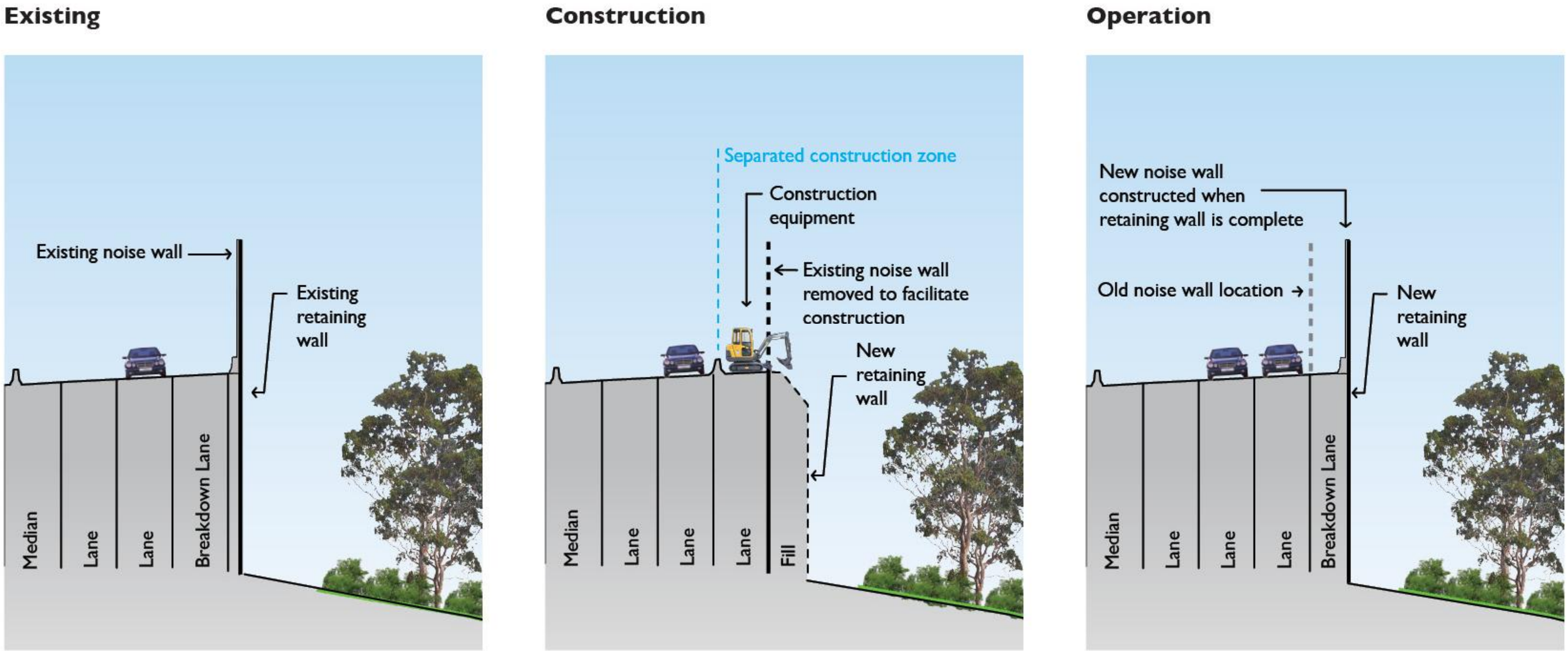
When this situation occurs, elevated noise levels from the operation of the M2 Motorway could be experienced at adjacent receivers. The relevant construction and operational noise guidelines do not provide specific advice in these circumstances. These guidelines are the DECCW *Interim Construction Noise Guideline* (2009) (ICNG), the DECCW (formerly EPA) *Environmental Criteria for Road Traffic Noise* (ECRTN) (1999) and the RTA *Environmental Noise Management Manual* (ENMM), (2001).

The extent of the noise impact would depend on many factors, including:

- The length of wall removed.
- The duration for which no noise wall is in place.
- The characteristics of the local area that would affect the propagation of noise from the motorway.

The length of noise wall that requires removal would be dependent on the final detailed design, but would be the minimum necessary for construction access. The duration for the period where there is no noise wall in place would be dependent on the construction methodology adopted. The construction methodology cannot be finalised until the detailed design is known. As such, it is not possible to accurately predict noise impacts associated with the removal and relocation of noise walls at this time. Further assessment would be undertaken as more details become known as per the methodology described in Section 9.4.6.

Figure 28 Typical noise wall relocation phasing



## Daytime construction noise

The assessment of the impacts of construction noise during the daytime period, for each of the construction scenarios, is provided in Table 74. Note that DECCW's governing periods for standard construction hours are: 7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm on Saturdays and no work on Sundays or Public Holidays.

Table 74 Construction noise predictions – daytime

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 1 | North | 62 | - | - | - | 57-63 | 49-52 | - | - | - |
| | South | 62 | - | - | - | 54 | 45 | - | - | - |
| 2 | North | 62 | - | - | - | 59 | 52-54 | - | - | - |
| 3 | North | 61 | - | - | - | 51-54 | 44-48 | - | - | - |
| | South | 61 | - | - | - | 56 | 49 | - | - | - |
| 4 | North | 61.5 | - | - | - | 57 | 53 | - | - | - |
| | South | 61.5 | - | - | - | 55 | 49 | - | - | - |
| 5[2] | North | 57.5 | 51-67 | 53-68 | - | - | 44-54 | - | - | 49-63 |
| | South | 56 | 54-66 | 52-67 | - | - | 49-53 | - | - | 50-63 |
| 6 | South | 69.5 | 54 | 56-60 | - | - | 46-48 | - | - | - |
| 7 | North | 67.5 | 52-54 | 57-59 | - | - | 48 | - | - | - |
| | South | 67.5 | 56 | 59-60 | - | - | 49 | - | - | - |
| 8 | North | 68 | 50 | 55 | - | - | 45 | - | - | - |
| | South | 68 | 51 | 53 | - | - | 42 | - | - | - |
| 9 | South | 68 | 53 | 57 | - | - | 47 | - | - | - |
| 10 | North | 62 | 51 | 55 | - | - | 44 | - | - | - |
| | South | 66.5 | 43 | 48 | - | - | 38 | - | - | - |
| 11 | North | 63.5 | 47 | 51 | - | - | 42 | - | - | - |
| | South | 67.5 | 58-62 | 67 | - | - | 56 | - | - | - |
| 12 | South | 61.5 | - | - | - | 61 | - | - | - | - |
| 13 | North | 67 | 59-61 | 61-64 | - | - | 50-53 | - | - | - |
| | South | 61.5 | 52 | 59 | - | - | 49 | - | - | - |
| 14 | South | 61.5 | 48-54 | 53-57 | - | - | 43-47 | - | - | - |
| 15 | North | 63.5 | 55-60 | 60-63 | - | - | 49-52 | - | - | 59 |
| | South | 68 | 49-53 | 54-59 | - | - | 44-47 | - | - | 54-59 |
| 16 | North | 63.5 | 53-55 | 59 | - | - | 47 | - | - | - |
| | South | 68 | 56-60 | 60-61 | - | - | 49-51 | - | - | - |

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 17 | North | 62 | 57-62 | 61-64 | - | 57-59 | 52 | - | - | - |
| | South | 62 | 57 | 59 | - | 55 | 48 | - | - | - |
| | Tunnel | 66 | 54 | 59 | - | 56 | 49 | - | - | - |
| 18 | North | 59 | 50-54 | 57 | - | 51-54 | 44-47 | - | - | 54-60 |
| | South | 59 | 52-55 | 54-58 | - | 51-55 | 44-49 | - | - | 48-55 |
| 19 | North | 55.5 | 47 | 51 | - | - | 41 | - | - | - |
| | South | 57 | 57 | 60 | - | - | 51 | - | - | - |
| 20 | North | 58.5 | 46-51 | 52-55 | - | - | 39-45 | - | - | 50-63 |
| | South | 60 | 42-51 | 53-55 | - | - | 37-45 | - | - | 56-61 |
| 21 | North | 64 | 49-53 | 63 | - | 59 | 52 | - | - | - |

*Note 1: Refer to Appendix B of the Technical Paper 2*

*Note 2: Location 5 presents the worst-case noise levels apparent when the existing noise walls are temporarily removed to construct the new Windsor Road access ramps.*

Construction noise during the daytime period is generally predicted to be in line with the NMLs at most of the assessment locations detailed in Table 74. Construction noise does not appear to be significant in most cases due to the high background noise levels which are apparent from existing traffic movements on the M2 Motorway.

A number of small exceedances (less than 5 dB(A)) of the NMLs are predicted for the scenarios associated with Road Widening and Bridgeworks. The largest exceedance is predicted at Noise Catchment Area 5 in the vicinity of the proposed new Windsor Road access ramps. This exceedance, however, represents the worst-case noise levels subject to the nearby properties when the existing noise barrier is removed to allow construction of the new ramps.

### Evening construction noise

The assessment of the impacts of construction noise during the evening period, for each of the construction scenarios, is provided in Table 75. Evening construction periods are from 6.00 pm to 10.00 pm Monday to Friday, as recognised by DECCW.

During the evening period exceedances are apparent for most of the construction scenarios assessed. Exceedance of the project NMLs in these scenarios typically range from zero (compliance) to around 15 dB(A).

The largest exceedance (of about 20 dB(A)) is predicted at Noise Catchment Area 5 in the vicinity of the proposed new Windsor Road access ramps. This exceedance represents the worst-case noise levels subject to the nearby properties when the existing noise barrier is removed to allow construction of the new ramps.

The proposed out of hours construction activities that are likely to cause substantial exceedances of noise management levels in the evening period are works associated with widening the Norfolk Tunnel, as well as cross stitching around the Winston Hills Mall and ITS works near the Windsor Road ramps.

It is noted that evening construction works would not be expected to be continuous at any one location for the full duration of the works within that section.

Table 75 Construction noise predictions – evening

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 1 | North | 52 | - | - | 59-65 | - | 49-52 | 50-55 | - | - |
| | South | 52 | - | - | 54 | - | 45 | 45 | - | - |
| 2 | North | 52 | - | - | 62 | - | 52-54 | 49-51 | - | - |
| 3 | North | 53 | - | - | 56 | - | 44-48 | 43-46 | - | - |
| | South | 53 | - | - | 59 | - | 49 | 48 | - | - |
| 4 | North | 52.5 | - | - | 61 | - | 53 | 50-52 | - | - |
| | South | 52.5 | - | - | 59 | - | 49 | 46-48 | - | - |
| 5[2] | North | 49 | - | - | 53-67 | 49-68 | - | 44-53 | 50-63 | 38-56 |
| | South | 48.5 | - | - | 52-67 | 49-67 | - | 46-54 | 51-63 | 57-66 |
| 6 | South | 61.5 | - | - | 55-57 | 51-57 | - | 46 | - | 44-63 |
| 7 | North | 58 | - | - | 55-57 | 52-54 | - | 45-47 | - | 44-69 |
| | South | 58 | - | - | 58 | 55 | - | 47 | - | 45-51 |
| 8 | North | 57.5 | - | - | 52 | 49-51 | - | 43 | - | - |
| | South | 57.5 | - | - | 56 | 48 | - | 42 | - | - |
| 9 | South | 57.5 | - | - | 55 | 54 | - | 43-45 | - | 44-51 |
| 10 | North | 53 | - | - | 53 | 51 | - | 42 | - | - |
| | South | 57.5 | - | - | 46 | 43 | - | 36 | - | - |
| 11 | North | 55 | - | - | 49 | 47 | - | 39 | - | - |
| | South | 59.5 | - | - | 62-64 | 59-63 | - | 50-52 | - | - |
| 12 | South | 52 | - | - | - | - | - | - | - | - |
| 13 | North | 57.5 | - | - | 60-62 | 59-61 | - | 49-51 | - | 52-58 |
| | South | 52 | - | - | 58 | 53 | - | 47 | - | 40-41 |
| 14 | South | 52 | - | - | 52-56 | 49-54 | - | 39-44 | - | 60-69 |
| 15 | North | 53.5 | - | - | 58-61 | 56-59 | - | 47-50 | - | - |
| | South | 57 | - | - | 52-56 | 49-54 | - | 42-44 | - | - |
| 16 | North | 53.5 | - | - | 56 | 55 | - | 45 | - | 46-50 |
| | South | 57 | - | - | 58-60 | 56 | - | 47-50 | - | 51-57 |

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A)) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 17 | North | 53 | 57-62 | 61-64 | 59-63 | - | 52 | 50 | - | - |
| | South | 53 | 57 | 59 | 57 | - | 48 | 45 | - | - |
| | Tunnel | 57 | 54 | 59 | 58 | - | 49 | 47 | - | - |
| 18 | North | 49.5 | 50-54 | 57 | 53-56 | - | 44-47 | 43-46 | - | 40-45 |
| | South | 49.5 | 52-55 | 54-58 | 53-57 | - | 44-49 | 43-47 | - | 39-53 |
| 19 | North | 52 | - | - | 50 | 47 | - | 40 | - | - |
| | South | 49.5 | - | - | 60 | 57 | - | 49 | - | - |
| 20 | North | 52.5 | - | - | 50-54 | 45-50 | - | 40-44 | - | - |
| | South | 51 | - | - | 50-53 | 50 | - | 35-44 | - | - |
| 21 | North | 56.5 | - | - | 61 | - | 52 | 50 | - | 41-48 |

*Note 1: Refer to Appendix B of the Technical Paper 2*

*Note 2: Location 5 presents the worst-case noise levels apparent when the existing noise walls are temporarily removed to construct the new Windsor Road access ramps.*

### Night time construction noise

The assessment of the impacts of construction noise during the night time period, for each of the construction scenarios, is provided in Table 76. Note that DECCW governing periods for night construction are 10.00 pm to 7.00 am Sunday to Friday and10.00 pm Saturday to 8.00 am Sunday.

Table 76 Construction noise predictions – night time

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A)) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| | North | 44.5 | - | - | 59-65 | - | 49-52 | 50-55 | - | - |
| 1 | South | 44.5 | - | - | 54 | - | 45 | 45 | - | - |
| 2 | North | 44.5 | - | - | 62 | - | 52-54 | 49-51 | - | - |
| | North | 41 | - | - | 56 | - | 44-48 | 43-46 | - | - |
| 3 | South | 41 | - | - | 59 | - | 49 | 48 | - | - |
| | North | 42.5 | - | - | 61 | - | 53 | 50-52 | - | - |
| 4 | South | 42.5 | - | - | 59 | - | 49 | 46-48 | - | - |
| | North | 41.5 | - | - | 53-67 | 49-68 | - | 44-53 | 50-63 | 38-56 |
| 5[2] | South | 43.5 | - | - | 52-67 | 49-67 | - | 46-54 | 51-63 | 57-66 |
| 6 | South | 46.5 | - | - | 55-57 | 51-57 | - | 46 | - | 44-63 |
| | North | 43.5 | - | - | 55-57 | 52-54 | - | 45-47 | - | 44-69 |
| 7 | South | 43.5 | - | - | 58/ | 55 | - | 47 | - | 45-51 |
| | North | 46.5 | - | - | 52 | 49-51 | - | 43 | - | - |
| 8 | South | 46.5 | - | - | 56 | 48 | - | 42 | - | - |
| 9 | South | 46.5 | - | - | 55 | 54 | - | 43-45 | - | 44-51 |
| | North | 44.5 | - | - | 53 | 51 | - | 42 | - | - |
| 10 | South | 47 | - | - | 46 | 43 | - | 36 | - | - |
| | North | 43 | - | - | 49 | 47 | - | 39 | - | - |
| 11 | South | 42.5 | - | - | 62-64 | 59-63 | - | 50-52 | - | - |
| 12 | South | 41 | - | - | - | - | - | - | - | - |
| | North | 44 | - | - | 60-62 | 59-61 | - | 49-51 | - | 52-58 |
| 13 | South | 41 | - | - | 58 | 53 | - | 47 | - | 40-41 |
| 14 | South | 41 | - | - | 52-56 | 49-54 | - | 39-44 | - | 60-69 |
| | North | 38 | - | - | 58-61 | 56-59 | - | 47-50 | - | - |
| 15 | South | 51 | - | - | 52-56 | 49-54 | - | 42-44 | - | - |
| | North | 39 | - | - | 56 | 55 | - | 45 | - | 46-50 |
| 16 | South | 51 | - | - | 58-60 | 56 | - | 47-50 | - | 51-57 |
| | North | 40 | 57-62 | 61-64 | 59-63 | - | 52 | 50 | - | - |
| | South | 40 | 57 | 59 | 57 | - | 48 | 45 | - | - |
| 17 | Tunnel | 44 | 54 | 59 | 58 | - | 49 | 47 | - | - |

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 18 | North | 37.5 | 50-54 | 57 | 53-56 | - | 44-47 | 43-46 | - | 40-45 |
| | South | 37.5 | 52-55 | 54-58 | 53-57 | - | 44-49 | 43-47 | - | 39-53 |
| 19 | North | 43.5 | - | - | 50 | 47 | - | 40 | - | - |
| | South | 36.5 | - | - | 60 | 57 | - | 49 | - | - |
| 20 | North | 42 | - | - | 50-54 | 45-50 | - | 40-44 | - | - |
| | South | 40 | - | - | 50-53 | 50 | - | 35-44 | - | - |
| 21 | North | 47 | - | - | 61 | - | 52 | 50 | - | 41-48 |

*Note 1: Refer to Appendix B of the Technical Paper 2*

*Note 2: Location 5 presents the worst-case noise levels apparent when the existing noise walls are temporarily removed to construct the new Windsor Road access ramps.*

### Discussion on exceedances

In the above assessment of the daytime, evening and night-time periods, the higher exceedances are generally related to the use of the following items of plant:

- Concrete saws (and reinforcement cutting).
- Rockbreakers.
- Jackhammers.

The proposed out of hours construction activities that are likely to cause substantial exceedances of noise management levels in the night time period are works associated with:

- Widening the Norfolk tunnel.
- Cross stitching along the length of the M2 Motorway.
- ITS works from Windsor Road to Lane Cove Road.
- Resurfacing works at a few locations.
- Some traffic management activities at certain locations.
- Hydroblasting west of Windsor Road.

Certain proposed night-time works have the potential to result in noise levels well above background noise levels. As such they have the potential to impact upon adjacent sensitive receivers causing possible disturbance and nuisance. Evening and night time works are only proposed for specific works on the M2 Motorway or on the major roads that intersect with the motorway. Undertaking these works during the daytime would have the potential to cause significant traffic disruption both directly at the works location and also extending out widely into the surrounding road networks. Due to the large number of people potentially affected by such works, it is therefore considered that night time works are appropriate in these instances.

Working on busy roads can pose safety risks to both construction personnel and the users of the roads if appropriate measures are not put in place. Most construction works associated with roads often require temporary modification to existing lane alignments and other traffic control measures which are different to the usual conditions experienced by road users at these locations. This increases the potential for traffic incidents that may affect the safety of construction personnel and other the road users. As such, certain activities are proposed at night-time to address these safety concerns. Some of these works involve short term activities such as making appropriate changes to the lane alignment and other intersection features to create safer daytime working environments for both construction personnel and road users.

In summary, whilst the noise associated with the proposed night time work activities may have the potential to impact upon the amenity of adjacent sensitive receivers, their justification is based on vital safety considerations and the potential for widespread traffic disruption.

Although the above assessment predicts the potential for significant exceedances, at times, the sensitive receiver noise levels presented above are all predicted during a worst-case scenario when all of the equipment within a particular scenario is operating concurrently, for the full 15 minute assessment period, in a location immediately adjacent to the residences of interest. Higher exceedances of the Noise Management Level associated with night-time works may therefore only be apparent at a particular receiver for a relatively short period of time. As the plant and equipment moves along the road of concern, the noise levels would be expected to reduce accordingly.

On the basis of the above, the following approach would be undertaken, in accordance with the ICNG:

- All reasonable and feasible work practices need to be applied to meet the noise goals.
- Where NMLs are likely to be exceeded (especially during the more sensitive evening and night-time periods), community liaison must be undertaken and negotiation take place to arrive at the final mitigation strategy.

Suitable methods for mitigating the impact of construction noise (and vibration) are discussed in more detail in Section 9.4.6.

### Sleep disturbance

The assessment of the predicted sensitive receiver $L_{Amax}$ noise levels during the night-time period is presented in Table 77, along with the corresponding Sleep Disturbance Screening Criterion (RBL +15 dB(A)) for each assessment location.

Many of the proposed noise generating construction activities are expected to exceed the project Sleep Disturbance Screening Criteria. These exceedances range from zero (compliance) to around 20 dB(A).

The largest exceedance is predicted at Assessment Location 5 which is in the vicinity of the proposed new Windsor Road access ramps. This exceedance represents the noise levels subject to the nearby properties when the existing noise barrier is removed to allow construction of the new ramps.

Again, the higher exceedances of the Sleep Disturbance Screening Criteria are generally related to the use of the following items of plant:

- Concrete saws (and reinforcement cutting).
- Rockbreakers.
- Jackhammers.

These highly-noise intensive activities would be closely managed in accordance with the ICNG to minimise night-time impacts.

Table 77 Construction noise predictions – sleep disturbance

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 1 | North | 54.5 | - | - | 60-65 | - | 54-57 | 54-62 | - | - |
| | South | 54.5 | - | - | 57 | - | 51 | 50 | - | - |
| 2 | North | 54.5 | - | - | 64 | - | 56-59 | 56-58 | - | - |
| 3 | North | 51 | - | - | 56-58 | - | 50-52 | 48-51 | - | - |
| | South | 51 | - | - | 61 | - | 55 | 53 | - | - |
| 4 | North | 52.5 | - | - | 63-66 | - | 58 | 58 | - | - |
| | South | 52.5 | - | - | 61 | - | 55 | 52-54 | - | - |
| 5[2] | North | 51.5 | - | - | 57-68 | 56-71 | - | 50-62 | 52-59 | 45-61 |
| | South | 53.5 | - | - | 63-72 | 63-75 | - | 58-61 | 55-67 | 64-71 |
| 6 | South | 56.5 | - | - | 58-61 | 58-62 | - | 50-52 | - | 50-67 |
| 7 | North | 53.5 | - | - | 58-60 | 58-60 | - | 53 | - | 51-73 |
| | South | 53.5 | - | - | 60 | 61 | - | 52 | - | 52-57 |
| 8 | North | 56.5 | - | - | 57 | 57 | - | 48 | - | |
| | South | 56.5 | - | - | 56 | 58 | - | 49 | - | - |
| 9 | South | 56.5 | - | - | 56-59 | 59 | - | 47-50 | - | 50-55- |
| 10 | North | 54.5 | - | - | 57 | 57 | - | 48 | - | - |
| | South | 57 | - | - | 49 | 50 | - | 43 | - | - |
| 11 | North | 53 | - | - | 53 | 53 | - | 44 | - | - |
| | South | 52.5 | - | - | 63-67 | 69 | - | 57-59 | - | - |
| 12 | South | 51 | - | - | 66 | - | - | - | - | - |
| 13 | North | 54 | - | - | 60-63 | 68 | - | 52-55 | - | 58-63 |
| | South | 51 | - | - | 59-61 | 65-67 | - | 55 | - | 45-47 |
| 14 | South | 51 | - | - | 52-57 | 58-60 | - | 45-49 | - | 65-72 |
| 15 | North | 48 | - | - | 62 | 54-58 | - | 52-54 | - | - |
| | South | 61 | - | - | 56-61 | 62-65 | - | 48-50 | - | - |
| 16 | North | 48 | - | - | 58 | 56-61 | - | 49 | - | 50-54 |
| | South | 61 | - | - | 61-64 | 59 | - | 53-55 | - | 55-61 |
| 17 | North | 50 | 64-68 | 69 | 64-67 | - | 57 | 55-58 | - | - |
| | South | 50 | 63 | 65 | 63 | - | 54 | 53-54 | - | - |
| | Tunnel | 54 | 60 | 65 | 60 | - | 54 | 52 | - | - |
| 18 | North | 47.5 | 57-60 | 63 | 57-59 | - | 49-52 | 51 | - | 47-50 |
| | South | 47.5 | 58-61 | 60-64 | 56-61 | - | 49-54 | 49-52 | - | 45-57 |

| Noise Catchment Area[1] | Side of Motorway | Daytime NML (dB(A)) (RBL +10 dB(A) | Predicted $L_{Aeq(15minute)}$ Noise Level for each Scenario dB(A) (Refer to Table 73 for descriptions) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1a Road Widening | 1b Road Widening | 2 Cross Stitching | 3 ITS Works | 4 Re-Surfacing | 5 Traffic Manage | 6 Hydro-blasting | 7a Bridge-works |
| 19 | North | 53.5 | - | - | 52 | 54 | - | 46-49 | - | - |
| | South | 46.5 | - | - | 61-63 | 64 | - | 54 | - | - |
| 20 | North | 52 | - | - | 54-57 | 52-58 | - | 48-50 | - | - |
| | South | 50 | - | - | 55-57 | 52-56 | - | 48 | - | - |
| 21 | North | 57 | - | - | 64 | - | - | 55 | - | 48-52 |

*Note 1: Refer to Appendix B of the Technical Paper 2*

*Note 2: Location 5 presents the worst-case noise levels apparent when the existing noise walls are temporarily removed to construct the new Windsor Road access ramps.*

## Construction noise impact – sensitive land uses

### Educational facilities

The above assessment concludes that at the existing educational facilities, the majority of the predicted construction noise levels are below the NMLs. The only exception is at Epping Heights Public School, where exceedances of around 9 dB(A) are predicted for a number of the scenarios. Noise mitigation measures in accordance with the ICNG would be adopted. The duration of works in the vicinity of the Epping Heights Public School are expected to last approximately three months. These works are mostly in association with minor works in the median of the M2 Motorway.

### Places of worship

Exceedances of the Noise Management Level at Our Lady of Lourdes Church are predicted when the widening works are in proximity to the church. Elevated construction noise levels would likely only be an issue during periods when the church was actively being used. Consultation with the church and works scheduling (where practicable) may be adopted to lessen potential impacts to the church from construction noise. Noise mitigation measures in accordance with the ICNG would be adopted. The duration of works in the vicinity of Our Lady of Lourdes Church are expected to last approximately 15 months. These works are mostly in association with the construction of the Windsor Road ramps.

## Construction compound sites

The M2 Upgrade project would require several temporary construction compound sites to be constructed along the length of the route. These compounds would be used for a variety of purposes including laydown areas, stockpiling, stores, team offices, and car parking.

The proposed locations of the construction compounds are immediately adjacent to the M2 Motorway (refer to Table 13 for location of construction compounds), and as such, are already subject to reasonably high levels of ambient (road traffic) noise.

It is noted that the smaller compound sites are intended to be used during the daytime periods, with only the major compounds intended to be used 24 hours a day.

Exceedances of the NMLs are predicted where sensitive receivers are situated in proximity to the compound sites. As such, it would be necessary to provide some form of noise mitigation to minimise the impact of noise generated by the compounds.

The following subsections describe potential impacts arising from key compound sites that are proposed to be used during night time hours (refer to Section 7.8.1 for description of compounds).

### TIDC main compound

The main compound is surrounded by a commercial complex on one side and the motorway on the other, limiting the potential for disturbance due to works outside standard construction hours. Some residents are present on the opposite side of Epping Road that might be subject to elevated noise levels during night time activities at the compound. However, the residents are located reasonable distances from this compound site and the compound would be set up so that loading and unloading areas and other activities likely to generate elevated noise levels would occur as far as practicable away from the residences. Supplementary noise controls, such as noise hoarding around the perimeter of the compound where sensitive receivers are located would be installed as required to minimise potential disturbance.

### Windsor Road compound

The Windsor Road compound is located at north west corner of the M2 Motorway and Windsor Road intersection, the compound is bordered by Windsor Road to the east, M2 Motorway to the South, Torrs Street to the north, and six private homes to the west. Residents immediately to the west would experience elevated noise levels from use of this compound.  Site specific procedural and physical controls to reduce noise generation and propagation from the proposed compound would be developed to ensure that any noise impacts to residents outside of standard construction hours are minimised. A noise hoarding would be installed immediately adjacent to neighbouring properties, and required floodlights would be directed away from close proximity sensitive receivers.

### Beecroft Road (old bus ramp)

There are residences in close proximity to the west across Beecroft Road, which would be affected by elevated noise levels associated with the use of the Beecroft Road (old bus ramp) compound.  Site specific procedural and physical controls to reduce noise generation and propagation from the proposed compound would be developed to ensure that any noise impacts to residents outside of standard construction hours are minimised.

### Sutherland Road compound (tunnel compound)

The Sutherland Road compound (tunnel compound) is  in close proximity to residences in the east, in Constance Close, and to the west in Sutherland Road, which may be affected by elevated noise levels associated with the use of the compound. Site specific procedural and physical controls to reduce noise generation and propagation from the proposed compound would be developed to ensure that any noise impacts to residents outside of standard construction hours are minimised. Such controls would include the installation of noise hoardings adjacent to neighbouring residents and a policy of strict education to all personnel engaged in nightwork activities in this location.

#### Toll Plaza

This proposed compound is not within the vicinity of any residences and forms part of the larger Toll Plaza, which currently operates on a 24 hour basis.

#### Christie Road

There are no residences in the vicinity of this compound, minimising the potential for noise impacts outside standard construction hours.

#### Macquarie Park

This proposed compound location is approximately 100 metres from residences to the east, which may be subject to elevated noise levels associated with the proposed use of this compound. Site specific procedural and physical controls to reduce noise generation and propagation from the proposed compound would be developed to ensure that any noise impacts to residents outside of standard construction hours are minimised.

### Construction traffic impact

The majority of compound sites are proposed to be accessed from the M2 Motorway carriageway, and as such, the impact of light and heavy vehicle movements associated with these sites would be negligible over existing ambient noise levels. Where possible, construction traffic would utilise major roads, including the M2 Motorway, Epping Road, Lane Cove Road or Windsor Road. However to access some of the compound sites, it is likely that construction vehicles would, at times, need to travel short distances on local roads.

### Local roads – light vehicles

The potential noise impact of construction related light vehicle movements on local roads at the smaller compound sites is considered to be negligible when considering the relatively small number of daily movements to these compounds. It is highly-likely that the noise from these vehicles would be perceived as part of the general road traffic. The TIDC compound contains large car parking facilities which are accessed from Lane Cove Road and Epping Road. As both of these roads are major arterial routes, which are already subject to high daily volumes of traffic, the additional construction traffic that the M2 Upgrade project would create is not expected to create additional noise impacts.

### Local roads – heavy vehicles

Heavy vehicle movements on collector and arterial roads are likely to be perceived as part of the general road traffic. However, once heavy vehicles move onto the local roads immediately adjacent to the compound sites, the community is likely to associate these heavy vehicle movements with the M2 Upgrade project construction works. For the smaller compound sites it is anticipated that during the worst-case hour, four heavy vehicle movements would occur during the daytime in busy periods, with lower numbers during quieter periods. No night time movements to smaller compound sites are expected along local roads. Heavy vehicle movements associated with the main TIDC compounds would access local roads with no residential receivers on them, and as such, there are anticipated to be no adverse impacts from heavy vehicles travelling to these compound sites.

### 9.4.4 Construction vibration impact assessment

Vibration targets vary primarily according to whether the particular activities of interest are continuous in nature or intermittent and whether they occur during the day or night time. The effects of vibration in buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed (human disturbance).
- Those in which the integrity of the building or the structure itself may be prejudiced.
- Those where the building contents may be affected.

Criteria relevant to the response of building occupants to vibration are more stringent than those relevant to building damage.

#### Human comfort goals for continuous and impulsive vibration

The DECCW's *Assessing Vibration: a technical guideline* is applicable to the M2 Upgrade project and is based on the guidelines contained in British Standard BS 6472-1992 *Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*. The DECCW guideline refers only to human comfort considerations and nominates preferred and maximum vibration goals for critical areas, residences and other vibration sensitive receivers. Whilst criteria in *Assessing Vibration: a technical guideline* are non-mandatory, the guideline states:

> *"they are goals that should be sought to be achieved through the application of all feasible and reasonable mitigation measures. Where all feasible and reasonable measures have been applied and vibration values are still beyond the maximum value, the operator would need to negotiate directly with the affected community".*

#### Vibration criteria – surface structures

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure(British Standard 7385: Part 2 - 1993 Guidelines). In terms of the most recent relevant vibration damage goals, Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives* recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* as they "*are applicable to Australian conditions*". The Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95 percent probability of no effect.

#### Construction vibration impacts

The major potential sources of construction vibration related to the M2 Upgrade project include the use of excavators, rockbreakers and vibratory rollers. In general, vibration produced by earthworks and road forming operations is expected to be less than structural damage criteria. Where vibration-intensive operations are being conducted in close proximity to the buildings nearest to the roadworks (for example, construction of the Windsor Road ramps), judicious selection of plant and equipment would be necessary as outlined above. Vibration may be perceptible for relatively short periods of time when construction activities are immediately adjacent to specific dwellings.

Given the distances of the nearest residences to the proposed construction works, a review of the construction plan would be required to confirm the extent of pre-construction building condition surveys.

### 9.4.5 Construction noise and vibration impact assessment of widening Norfolk Tunnel

During the widening of the Norfolk Tunnel, both airborne and ground-borne noise may potentially exceed the relevant criteria at certain times.

The construction activities associated with the widening of the Norfolk Road Tunnels and supporting works are proposed to occur continuously (24 hours a day, six days a week) over certain periods. This is required to enable the works within the tunnel to be completed within specified timeframes. Specific approval for these working hours is sought as part of the overall project approval.

#### Ground-borne noise criteria

Ground-borne (or regenerated) construction noise is usually present on tunnelling projects. Internal ground-borne NML of $L_{Aeq\ (15minute)}$ 40 dB(A) (evening) and $L_{Aeq\ (15minute)}$ 35 dB(A) (night-time) are specified within the ICNG. These goals are only applicable when the ground-borne noise levels are higher than the airborne noise levels inside residential dwellings. During daytime periods, only the human comfort vibration goals are applicable.

#### Ground-borne noise impact

The ground-borne noise impacts from tunnelling works would be greatest when a roadheader is situated immediately below the property in question. As the roadheader moves further along the tunnel, the impact from ground-borne noise would reduce for properties it has passed. It is anticipated that the roadheader would be underneath a particular receiver location for around 10 to 12 days.

The nearest affected receivers, with a slant distance of around 15 metres, the $L_{Aeq(15minute)}$ 35 dB(A) night-time noise goal would potentially be exceeded by around 5 dB(A). Properties that are less than 29 metres away from the widening works would potentially experience night-time exceedances, up to a maximum of around 5 dB(A), for a period of approximately two weeks (10-12 working nights).

Ground-borne noise from the operation of the roadheader at sensitive receivers would be neither impulsive nor intermittent, and, as a result, the potential for sleep disturbance at sensitive receivers in these locations during the night-time period is considered to be low.

Although potential exceedances of the night-time goals are predicted, the vibration levels associated with the use of roadheaders at the Norfolk Tunnel would be expected to be below the levels required to cause structural damage to the properties situated above.

Noise map predictions of ground-borne noise from tunnel works are shown in Figure 15 of Technical Paper 2. These illustrate that the following potential noise exceedances are likely from tunnel works:

- +1 to +2 dB(A) – two dwellings affected
- +3 to +4 dB(A) – six dwellings affected
- +5 to +6 dB(A) – ten dwellings affected

It should be noted that these results show the predicted worst-case ground-borne noise levels that may be experienced by nearby residences. These noise levels may occur when the roadheader is in the tunnel tube immediately below, or adjacent to, residences. As the tunnel widening works proceed, or move to the other tunnel tube, the distance between the roadheader and the residences would increase and consequently the ground-borne noise levels would be noticeably reduce.

### Airborne noise impact

The appropriate noise management levels and noise predictions for the proposed works outside the tunnel entrances, at the tunnel entrances and entirely within the tunnel with proposed mitigation measures in place are presented below in Table 78.

Table 78 Potential noise impacts arising from tunnel works

| Activity | Equipment | Proposed Mitigation | Predicted Noise Level LAeq(15min) (dB(A))1 | Noise Goals (dB(A)) | |
|---|---|---|---|---|---|
| | | | | Time Period Noise Management Level (Day/Eve/Night) | Sleep Disturbance LA1(60 sec) |
| A – Outside Portal Works | Excavator with hammer, rock drill | n/a | 62 | 59 / 49.5 / 37.5 | 47.5 |
| B – Widening Works at Tunnel Portal | Roadheader, rock drill, shotcrete rig | Acoustic Shed only | 51 | | |
| C – Widening Works Entirely Within Tunnel | Roadheader, rock drill, shotcrete rig | Acoustic Shed and Acoustic Curtain | 39 | | |

*Note 1: The predicted noise levels include a -5 dB(A) correction for the effect of the existing noise walls.*

The airborne noise impacts from tunnelling works would be greatest when works are occurring near the tunnel portals. Works outside of the tunnel portals are predicted to be 62 dB(A) and would exceed the noise management levels for all time periods, which are 59, 49.5 and 37.5 dB(A) for daytime, evening and night time periods respectively, with the most substantial exceedance predicted during the night. The sleep disturbance criteria of 48 dB(A) would also be exceeded. Work at the tunnel entrances prior to the installation of an acoustic curtain is predicted to be 51 dB(A). This is just above the evening NMLs, but exceeds the night time and sleep disturbance noise goals.

For the majority of the construction period, works would occur entirely within the Norfolk Tunnel and as the proposed works move inside the tunnel portals mitigation measures such as the use of acoustic sheds and acoustic curtains would result in negligible or no noise impacts. This is evidenced by the prediction of 39 dB(A) LAeq(15minute) from construction works occurring wholly within the Norfolk Tunnel. This is well below the noise goals for the daytime and evening periods and only just above the NML for the NML for the night time period. It would also be below the sleep disturbance noise goal of 48 dB(A).

It is also noted that there are only a few houses at each tunnel portal with a direct line of sight to the tunnel entrances and proposed work locations. The greatest exceedances of the NMLs are predicted at these locations. However, the works would occur within the deep existing excavations of the tunnel portals. This would provide noise attenuation for other properties in the vicinity that would have no line of sight to the proposed works.  The potential for exceedance of the NMLs would decrease significantly with increasing distance from the tunnel portals.

Based on the above assessment, widening of the tunnel portals is proposed during the day period, works at the tunnel entrances are proposed in the day and evening periods and 24 hour per day works are proposed entirely within the tunnels and only after the installation of the proposed acoustic curtain. This would substantially reduce the potential for exceedances of the NMLs associated with tunnel widening works. Slight exceedances only of the NMLs are likely at those properties with a direct line of vision to the proposed works locations.

Noise map predictions of airborne noise from tunnel works are shown in Figure 11 of Technical Paper 2. These illustrate that the following potential noise exceedances are likely from tunnel works:

- Activity A – Outside portal works: daytime only – no dwellings affected.
- Activity B – Widening works at Norfolk Tunnel portal: daytime and evening only – four dwellings affected.
- Activity C – Widening works entirely within Norfolk Tunnel: no restrictions. – two dwellings affected.

### 9.4.6 Construction noise and vibration mitigation measures

The construction scenario predictions have been examined to evaluate:

- Potential means for noise and/or vibration mitigation.
- Alternative methods to carry out specific construction activities.

In many instances, the options available for reducing noise emissions are limited, given the small range of plant and equipment able to carry out the tasks required. Furthermore, the mobility of much of the equipment limits the use of enclosures, which are otherwise effective in reducing noise emissions from fixed noise sources.

A considered approach to noise and vibration mitigation would be implemented through the CEMP, which is outlined in Appendix F, in the form of a Construction Environmental Management Framework.

#### Noise control with site planning

Certain 'baseline' mitigation strategies should be adopted along the route at sections where the noise goals are exceeded.

The construction contractor would, where reasonable and feasible, apply best practice noise mitigation measures including:

- Erecting temporary hoardings or other noise mitigation measures at site compounds, which are in proximity to residential receivers, where practicable as determined by detailed assessment of each location.
- Maximising the offset distance between noisy plant items and nearby noise sensitive receivers.
- The coincidence of noisy plants working simultaneously close together and adjacent to sensitive receivers would be avoided, where practicable.
- Where possible, equipment with directional noise emissions would be orientated away from sensitive receivers.
- Where practical, the layout of plant and equipment at the site compounds would be developed so as to minimise noise exposure.
- Where practical, external and internal access at work sites and compounds would be designed to promote forward vehicular and plant movements, in order to minimise the need for reversing.
- Loading and unloading would be carried out away from sensitive receivers, where practicable.
- Loading, unloading and other activities that require repeated reversing would be restricted during evening, night and early morning periods where practical.

- The selection of site access points would take into account the proximity of noise sensitive receivers.
- Maintenance work on construction plants with the potential to generate noise impacts would be carried out away from noise sensitive receivers and confined to standard daytime construction hours, where possible.
- Minimising consecutive works in the same locality, where practicable.

### Noise wall relocation planning

Each location where a new noise wall cannot be constructed prior to removing the existing noise wall would be assessed based on site specific conditions, final designs and proposed construction methodologies. The detailed design would be reviewed and amended as appropriate to minimise the removal of noise wall where possible, thereby reducing the exposure of receivers to operational road noise. The construction methodology would also be reviewed and amended to allow works to be staged so that time between removing the existing noise wall and constructing the new wall is minimised, thereby minimising the duration of the noise impacts associated with the project.

Specific noise controls and procedures would be developed for each location to minimise noise propagation from the motorway and to address any residual noise impacts at the adjacent properties. Suitable controls and procedures that would be considered include:

- Erection of temporary noise walls as close as possible to the edge of the trafficable lanes of the motorway to reduce the propagation of operational road noise.
- The progressive erection of temporary noise walls at the edge of the roadway as road widening occurs, prior to the construction of new permanent noise walls.
- Erection of temporary noise walls where practicable adjacent to sensitive receivers.
- Temporary hoarding around noisy plant.
- Limiting noise intensive construction activities to day-time construction periods wherever practicable.
- Traffic management strategies, including reduced speed limits during lane closures, to reduce potential road noise generation.
- Works staging programs and training programs for construction personnel to prevent the simultaneous operation of plant and/or operation of noise-intensive plant for extended lengths of time.

In addition, specific consultation would occur with residents in the vicinity of these locations during the public exhibition phase and extending into the construction phase.

### Noise control with planning of construction activities

In order to minimise noise impacts during the works, the construction contractor would make use of reasonable and feasible measures to mitigate noise effects. The contractor would also take reasonable steps to control noise from plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers. Operators of construction equipment would be made aware of potential noise issues and of techniques to minimise noise emission through a continuous process of operator education. For example:

- Large waste material would be ‘placed’ into dump trucks as far as practical (rather than dropped in from a height).
- Where vehicle and equipment queuing is required close to sensitive receivers, engines would be shut down if queuing for extended periods, where practicable.
- Warming up of vehicles would be carried out as far away as possible from noise sensitive receivers.

- Reversing of equipment would be minimised so as to prevent nuisance caused by reversing alarms.
- Activities requiring repeated reversing, such and loading and unloading, would be restricted where practical during evening, night and early morning periods.
- Horn signals would be kept to as low a volume as possible, given appropriate Occupational Health and Safety (OH&S) considerations.
- Relocate any vibration generating plant and equipment away from noise sensitive receivers in order to lower any potential vibration impacts.
- Use lower vibration generating items of excavation plant and equipment, for example smaller capacity rockbreaker hammers, wherever possible.

### Works scheduling

Works scheduling can often be adopted to effectively manage construction noise impacts and in particular to limit potential impacts during sensitive times of the day and night. However, given the constrained nature of the M2 Motorway corridor, the limited space available to establish work zones, and due to construction occurring during live traffic conditions, the options for works scheduling are limited.

Certain works are required outside of standard construction hours, to reduce potential safety risks to road users and construction personnel and to limit potential traffic disruption. These works potentially involve noise intensive activities and equipment during sensitive periods and it is not appropriate to undertake such works during live traffic conditions or periods of high traffic volumes. As such, there is limited scope to reschedule these activities during day time periods.

Works scheduling has been considered when developing proposed construction scenarios and methodologies associated with widening of the tunnel tubes and tunnel portals. For reasons of road user and construction personnel safety, it would be best to undertake these works at night. However, this would involve potentially significant exceedances of evening and night time noise management levels. The proposed methodology for the tunnel and portal widening outlined in Section 9.4.5 was developed to both limit number of houses affected and the potential noise exceedances of noise management levels in the evening and night time periods through the scheduling of the proposed work scenarios.

Scheduling of certain works could occur to ensure that the majority of noise intensive activities occur during standard construction hours. In particular, through the implementation of traffic management arrangements the construction contractor would set up work zones wherever practicable to facilitate general road widening and other works during the day, limiting the need for works outside of standard construction hours.

Other scheduling opportunities to limit noise impacts during sensitive periods include limiting concurrent activities and limiting work hours and implementing respite periods for key high noise impact activities. The options are discussed in the following sections.

#### Concurrent activities

There is some, albeit limited, scope for a proactive scheduling of equipment tasks to avoid ‘clustering’ of equipment close to sensitive receivers. This applies to the equipment within the individual construction crews.

### Limiting of hours

The assessment of the potential impacts from construction noise for the M2 Upgrade project found that the higher exceedances of the NMLs were generally associated with use of:

- Concrete Saws (and reinforcement cutting).
- Rockbreakers.
- Jackhammers.

It is proposed to reduce the potential noise impacts during the more sensitive periods by restricting such activities, where sensitive receivers are likely to be adversely affected, to daytime and evening periods, where feasible and reasonable.

## Respite periods

High impact noise activities, such as those likely to generate noise levels above LAeq 75 dB(A) and activities likely to generate noise with intermittent, impulsive, tonal or low-frequency characteristics have the potential to seriously affect the amenity of adjacent noise receivers. Examples of high noise impact activities proposed include saw and rock cutting, grinding, rock breaking, jack hammering, rock drilling and vibratory rolling. Notable construction scenarios where high impact noise activities are proposed would include widening of the existing cuttings through bedrock, widening of the tunnel portals, grinding works to widen the tunnel tubes, installation of rock bolts, saw cutting during pavement construction and excavation in rock for foundations for structures such as retaining walls and bridges.

When high noise impact activities are proposed that have the potential to affect the amenity of noise receivers in the vicinity of proposed work locations, appropriate respite periods would be implemented. Typically a minimum respite period of at least 30 minutes would be scheduled before the commencement of any high noise impact activity that would be undertaken for a continuous four hour period. Where high noise impact activities are proposed outside of standard construction hours with the potential to impact upon the amenity of adjacent sensitive receivers, specific consideration of appropriate respite periods would be considered and recommended as part of preparation of activity specific construction noise impact statements (see following subsection).

## Construction noise and vibration management plan and impact statements

To ensure the adequacy of the noise and vibration mitigation measures for the actual design and construction method, detailed Construction Noise and Vibration Impact Statements (CNISs) would be prepared for major noise-intensive construction activities, prior to and for inclusion into the Construction Noise and Vibration Management Plan (CNVMP) for that stage/activity (inclusive of both construction staging and staged opening). Both the CNVMP and individual supporting CNISs would be revised as required.

In particular, CNISs would be prepared for areas where:

- Construction of new noise walls is not possible prior to the removal of existing noise walls.
- Noise intensive activities occur during standard construction hours with the potential to exceed appropriate noise management levels.
- Works are required outside of standard construction hours.

### Source noise control strategies

Engines and exhausts, which are often the dominant noise sources on mobile plant, would be fitted with residential class mufflers. Wherever feasible, silenced air compressors, fitted with noise labels indicating a maximum ($L_{Amax}$) sound pressure level of not more than 75 dB(A) at seven metres would be used on site.

### Compound sites – noise mitigation

In order to minimise potential impacts, it is likely that noise barriers would be required in locations where sensitive receivers are situated in close proximity to the proposed construction compounds. Noise barriers would be dedicated and/or temporary noise walls, temporary hoardings, site sheds or the like. Correctly designed and constructed barriers (of solid construction using appropriate materials) would be expected to result in the following reductions in noise levels:

- Minor barriers (hoarding of indicative height of three metres): 5 dB(A) to 10 dB(A) reduction.
- Major barriers (hoarding of indicative height of six metres): 10 dB(A) to 15 dB(A) reduction.

The key control strategies involved for mitigating noise from the compound sites would include:

- Noise walls (enclosures) surrounding continuously operating plant (generators).
- Truck management (for example, limiting of 'queuing' adjacent to residential areas).
- Temporary noise barriers (through temporary noise walls, hoardings and the like) wherever feasible protecting residents adjacent to the relevant sites, especially surrounding maintenance work areas.
- Where practical, developing site access arrangements that encourage forward vehicular and plant movements, in order to minimise the need for reversing.
- For compounds where 24 hours use is proposed, activities that require repeated reversing would be limited to less sensitive periods of the day.

Close liaison with the local community and a proactive information protocol (information on the duration and likely intensity of upcoming works) is proposed for the management of noise emissions at these locations.

More detailed assessment of the noise impacts from compound sites would be performed during the detailed design phase, when the specifics of each site would be known. Specific noise management strategies for each compound would be developed at that time.

### Local roads – heavy vehicles noise mitigation

The following mitigation measures are proposed in order to minimise the impact of exceedances from heavy vehicles on local roads for the criteria at residential receiver locations:

- Trucks would be fitted with mufflers and any other noise control equipment in good working order.
- As far as practical, truck drivers would avoid:
  - heavy acceleration and braking.
  - compression braking.
  - high speeds.
- Truck movements are to be restricted to the daytime period to the furthest extent possible.

Noise from idling trucks near construction sites can also impact on amenity in some instances. To minimise impacts associate with idling trucks, it is proposed that queuing of trucks awaiting entry to the site outside normal construction hours be restricted to locations away from residences. If trucks are required to queue in such locations during construction hours, engines would be shut down. The finalised construction traffic arrangements would be reviewed during the detailed design phase of the M2 Upgrade project.

### Equipment selection and maintenance

The contractor carrying out the construction works would select equipment taking into account noise and vibration emissions, such as (but not limited to):

- Smaller equipment options or rubber-tracked equipment where equipment is fit-for-purpose and economically feasible.
- Equipment to be provided with residential grade mufflers.

Equipment would be maintained and operated in an efficient manner, in accordance with manufacturer's specifications, to reduce the potential for adverse noise impacts.

### Reversing alarms

The potential noise impact of reversing alarms would be minimised via a combination of proactive driver/operator training and operational procedures. The following mitigation strategies would be undertaken, taking into account that WorkCover OH&S requirements would need to be satisfied with respect to safety surrounding construction vehicles.

- The primary means for minimising reversing alarm noise would be through a dedicated effort on the part of construction equipment drivers to minimise, wherever feasible, the amount of reversing of their vehicles.
- Wherever feasible, turning circles would be created at the end points of vehicle work legs, which would allow trucks, compactors, water carts and the like, to turn and avoid the need for reversing.
- Emphasis would be placed during driver training and site induction sessions on the potential adverse impact of reversing alarms and the need to minimise their use.
- Using non-tonal reversing alarms or alternative devices where practical.
- Where it is not feasible to use these alternative devices, the construction contractor should consider traffic management practices to minimise reversing as far as tractable and arrange for construction vehicles and mobile plant to reverse predominantly away from noise-sensitive properties.

### Equipment noise compliance checks

Regular checks of equipment noise levels would be made to ensure that noise levels do not increase as a result of poor maintenance practice or say the replacement of individual items of equipment with alternatives which have higher noise emissions.

### Noise (and vibration) monitoring

A well-planned, noise monitoring programme would assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities as the works progress. Mitigation measures, including changes in work sequences or selection of smaller items of equipment, would then be put in place before significant disturbance occurs. The programme would include:

- Initial (pre-construction background) noise monitoring, and dilapidation surveys of properties determined as likely to be affected by ground borne noise and vibration prior to tunnelling works commencing.
- Ongoing monitoring of emissions at residences and other sensitive receivers during critical phases of the work.
- Ongoing compliance checks of critical plant and equipment.
- Investigation of complaints and follow-up monitoring to assess the effectiveness of adopted control strategies.
- The options for mitigating ground-borne noise generated from tunnel works are very limited, as physical attenuation devices are not available and procedural management measures are not feasible. It is therefore recommended that where exceedances are indicated, suitable consultation with affected residents take place accompanied by monitoring to confirm the predicted levels.

A targeted noise (and vibration if necessary) monitoring plan at nearest residential and sensitive receivers based, at least initially, on the predictions provided in this report, would be implemented to guide mitigation controls during critical stages of work.

### Temporary construction noise walls

Wherever practicable, the proposed new noise walls would be constructed prior to the existing walls being taken down. However, due to access restrictions and the limited availability of space required, in a number of areas the existing noise walls (or part of the existing wall) would be demolished before the new wall can be erected.

In such situations a detailed assessment would be undertaken to determine the reasonable and feasible noise mitigation measures. Options such as the use of temporary noise walls would be considered and implemented where appropriate. Where required, temporary noise walls would be erected as soon as practicable after the existing walls are removed to minimise potential impacts on receivers in the area.

### Moveable (temporary) noise barriers

Many activities associated with the M2 Upgrade project would involve large-sized plant travelling along the M2 Motorway, such as milling and asphalt laying. Temporary barriers for these types of activities are not generally practical.

The most noise-intensive activities associated with the M2 Upgrade project, namely concrete sawing, rockbreaking and the use of jackhammers, would be highly localised. Based on the outcomes of detailed assessments of potential noise impacts at each work location and scenario, the use of temporary and moveable noise barriers (for example, loaded vinyl ‘curtains’), would be implemented where reasonable and feasible. Such barriers are likely to generate noticeable decreases in the associated noise emissions to sensitive receivers.

### Ground-borne noise mitigation (Norfolk Tunnel)

The options for mitigating ground-borne noise, such as noise resulting from the operation of a road header, are limited, as physical attenuation devices are not available and procedural management measures are not feasible. It is therefore proposed that where exceedances are indicated, suitable consultation with affected residents take place accompanied by monitoring to confirm actual conditions against the predicted levels.

### Noise management versus noise control

The mitigation of noise impacts can often involve noise management as distinct from noise control. For example, the scheduling of noise-intensive activities may be an effective noise management strategy in the present instance.

To minimise noise impacts associated with the M2 Upgrade project, time restrictions would be placed on the most noise-intensive activities, especially concrete sawing, rockbreaking and the use of jackhammers in the vicinity of sensitive receivers. Where there is a definite requirement for such activities to be completed out of the normal construction hours, such activities would be restricted to the evening period in preference to the night period, where reasonable and feasible.

Similarly, with respect to the activities located in the vicinity of sensitive receivers, advanced notice of high noise activities would be provided and respite periods employed. In addition, concrete saws would not be used on two consecutive evenings in the same area where reasonably and feasibly practicable.

An important component of the noise management of the proposed works is comprehensive community consultation, which would continue throughout the construction programme. The community would be kept informed as to the nature, timing and duration of pending construction works, the nearest sensitive receivers likely to be affected and the monitoring programme associated with construction works.

### Community liaison

To keep the community informed of the progress of the construction programme, a combination of internet-based information, community meetings, local newsletters, leaflets, newspaper advertisements and community notice boards would be considered as part of the M2 Upgrade project consultation strategy. A contact person would be nominated within the CNVMP to directly address noise and/or vibration complaints that the community may have during the construction phase of the M2 Upgrade project.

Targeted community consultation with residents in the vicinity of the night works is proposed during the public exhibition period for the proposal and would continue for the duration of the night works should the proposal be approved. Refer to Chapter 5 for further description of community consultation.

The community liaison process would be progressively ‘fine-tuned’ to meet the specific requirements of the particular works under consideration. Equipment selections and work activities would be continuously coordinated and modified where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints and other issues of concern, should they arise.

### Vibration control

The following ‘baseline’ vibration mitigation measures would be implemented by the construction contractor where reasonably and feasibly practicable:

- Relocate vibration generating plant and equipment to areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of excavation plant and equipment, for example, smaller capacity rockbreaker hammers.
- Minimise consecutive works in the same locality (if applicable).
- Schedule a minimum respite period of at least half an hour before activities commence, which are to be undertaken for a continuous four hour period.
- Use only dampened rockbreakers and/or ‘city’ rockbreakers to minimise the impacts associated with rockbreaking works.
- The use of a roller class ‘II Light’ when operating as close as five metres from the closest buildings.
- Consider providing temporary alternative accommodation for affected residents during tunnelling works.

### Construction monitoring requirements

Noise monitoring would be undertaken as required for assessment against the adopted construction noise goals where, subsequent to project approval, detailed construction noise impact assessments indicate potential for significant exceedance at the nearest impacted noise sensitive receivers. It is also proposed that vibration monitoring be carried out for assessment against the transient vibration guidelines (BS 7385 and DIN 4150) when working within the safe working distances, and where the vibration levels are predicted to be greater than the maximum recommended values.

### Widening the Norfolk Tunnel

The potential noise impacts from the widening works, which are proposed to be performed entirely within the tunnel, would be mitigated with the use of acoustic sheds during the widening of the tunnel, together with an acoustic curtain at either end of tunnel at other times. The acoustic shed would only be in place for the excavation phase of the widening. Other night-time works within the tunnels would utilise a noise curtain at the tunnel portals/entrances. These measures would contribute to reducing noise generated from tunnelling works to acceptable levels.

For the early widening works (adjustment to the portal transition areas and breaking out of existing concrete barriers) there are limited mitigation measures available, as the options for physical noise attenuation devices and procedural management measures (such as scheduling of activities) would either not be effective or are not considered feasible. As described in Section 9.4.5, the predicted impacts of ground-borne and airborne noise is not expected to be significant when construction works are occurring entirely within the Norfolk Tunnel portals. It is proposed that where exceedances are predicted (or measured), suitable consultation with the affected land owners would take place to determine the appropriate feasible and reasonable management strategies, together with on-going monitoring to confirm predicted levels.

## 9.5 Ecology

An assessment of the impacts on flora and fauna associated with the M2 Upgrade project has been undertaken and is presented below. This assessment is supported by *Technical Paper 3 – Flora and Fauna* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *Impacts on ecology:* | |
| • *The environmental assessment must include an assessment of the potential ecological impacts of the project, with specific reference to the need for vegetation clearing, habitat and connectivity implications, edge effects, and stormwater and watercourse implications.* | *Section 9.5.2, Technical Paper 3* |
| • *The environmental assessment must make specific reference to impacts on threatened species, populations and communities, including the Sydney Turpentine-Ironbark Forest and Blue Gum High Forest Endangered Ecological Communities, and the native fauna that may utilise those communities.* | *Sections 9.5.1, 9.5.2, Technical Paper 3* |
| • *The environmental assessment shall demonstrate that the extent of vegetation clearing has been minimised through the design of the project, and shall include details of any off-set measures that may be proposed.* | *Section 9.5.3, Technical Paper 3* |

### 9.5.1 Methodology

The objectives of the ecological assessment are to:

- Produce an impact assessment of proposed works with respect to terrestrial and aquatic ecology based on existing information and additional field surveys.
- To assess potential impacts on flora and fauna in the area and determine the most appropriate mitigation measures to address flora and fauna impacts.
- Give particular attention to the impact on critical habitat, threatened species, populations and ecological communities, or their habitat (as defined under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), the *Threatened Species Conservation Act* 1995 (TSC Act), the Threatened Species Conservation provisions of the *Fisheries Management Act* 1994 and the *Fisheries Management Amendment Act* 1997 (FM Act).
- To follow the heads of consideration as outlined in the *Draft Guidelines for Threatened Species Assessment* by the Department of Environment and Conservation (now DECCW) and the Department of Primary Industries (now Department of Industry and Investment), 2005 (DEC and DPI, 2005) and the *Significant Impact Guidelines and Matters of National Significance* outlined by the Department of Environment and Heritage (now DEWHA) (DEH, 2006).
- To address the DGRs for the project.

Assessments of significance were conducted for threatened species listed under the TSC Act and followed the heads of consideration outlined in the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). For threatened species listed under the EPBC Act, assessments of significance were undertaken in accordance with the *Significant Impact Guidelines and Matters of National Significance* (DEH, 2006).

The results of field surveys, a review of previous studies, a review of published information sources including the Commonwealth Government Species Profile and Threats (SPRAT) database, the *NSW*

*Government Atlas of NSW Wildlife* and previous vegetation mapping undertaken in the locality were used to prepare the information presented in this report.

Several databases were searched to provide information on significant flora and fauna species that have been found in the study area, including:

- The EPBC Act Protected Matters Search Tool (DEWHA) online database for Matters of National Environmental Significance).
- The National Parks and Wildlife Service (NPWS) Atlas of NSW Wildlife.

Previous assessments for the study area were reviewed. Information on fauna habitat contained in the Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area (DECC 2008) has been incorporated where relevant. Field surveys were also undertaken through a variety of methods, including investigations for targeted flora and fauna. The survey effort is outlined below.

### Flora

Flora surveys were conducted over six days between 26 November 2008 and 24 March 2009 by two AECOM ecologists. The purpose of the surveys was to assess the likely impact of the proposed action on the vegetation communities and significant flora species present or likely to occur within the study area.

Survey sites were selected based on a preliminary investigation of the study area using aerial photography, topographic maps, vegetation mapping undertaken by Tozer *et al*. (2006) and the existing threatened species database searches (refer to section 2.1of Technical Paper 3). Flora surveys involved the recording of the structure, condition and composition of vegetation communities present and a targeted search for threatened flora species throughout the study area, targeting areas of greatest potential for the species to occur. The distribution of vegetation communities as per existing mapping (Tozer *et al*. 2006) was ground-truthed.

Plant species were identified within eight 20 metre x 20 metre survey plots and a random meander search for threatened flora species (refer to section 4.4.2 of Technical paper 3 for a list of targeted species) was conducted in the vicinity of each plot. Random meander transects targeting threatened flora species were also undertaken throughout the entire length of bushland potentially impacted.

### Fauna

Fauna surveys were conducted between November 2008 and March 2009 by two AECOM ecologists. The field survey methods used to detect and assess habitat for fauna species are listed in Table 1 of Technical Paper 3. The survey effort complies with the survey effort recommended by the *Draft Guidelines for Threatened Species Assessment* under Part 3A (DEC and DPI, 2005) for the study area size, habitat types available on the site and seasonal factors.

Fauna surveys including trapping were conducted during the preparation of the environmental impact assessment reports for the existing M2 Motorway and were not repeated in this study. Field survey methods for the project were chosen such that adequate information would be available to fully assess the potential impacts of the upgrade on fauna species of conservation significance. Based upon the availability of existing information, fauna survey methods such as cage-trapping of mammals, pitfall trapping and detailed aquatic surveys were not undertaken.

In addition to fauna surveys, the following habitat assessments were undertaken:

- Observation of the location, extent and density of key habitat features such as mature, potentially hollow bearing trees, waterways, seepages, rocky outcrops, vegetation types and soils.
- Assessment of the condition of aquatic habitats through noting factors such as turbidity, rubbish, exotic fish species, surface films, submerged and emergent vegetation and substrates.
- Assessment of the condition of vegetation as habitat for fauna species through observation of factors including weed infestation, structural layering, species composition, nectar and fruit resources and maturity and condition of trees.

#### Survey limitations

The environmental field surveys and assessments conducted are based on environmental conditions at the time of survey and therefore the absence of threatened species recorded is not indicative of the lack of threatened species inhabiting the study area. It is noted that species such as *Pimelea curviflora var. curviflora*, *Tetratheca glandulosa*, and *Hibbertia superans* are in flower in November, which is when survey was carried out. For those threatened flora species that are difficult to detect outside of their flowering time a precautionary approach was taken and species were assumed to be present if suitable habitat was observed. Therefore, assessments of significance are based on the appropriateness of habitat on the site for threatened flora and fauna species and the presence of key habitat features as listed in the relevant DECCW species profiles.

### 9.5.2 Existing environment

#### Landscape context

Much of the area surrounding the M2 corridor is highly urbanised and consists primarily of residential properties, parkland, weed-infested areas and riparian vegetation. Several larger areas of remnant native vegetation exist within and adjacent to the areas proposed to be directly, or indirectly, affected by the proposed upgrade works.

Several larger areas of remnant native vegetation exist within and adjacent to the study area. The most significant of these include:

- Bidjigal Reserve (formerly Excelsior Reserve and Darling Mills State Forest).
- Vegetation in the vicinity of Devlins Creek including Beecroft Reserve, Beecroft Reserve South, Chilworth Reserve and Cheltenham Park.
- Vegetation surrounding Terrys Creek between Lucknow Park, Berriwerri Reserve and Somerset Park.
- Parts of Lane Cove National Park adjacent to the M2 corridor in Macquarie Park.

These areas have greater potential as habitat for a wider variety of fauna species due to their larger size, greater habitat diversity, more natural vegetation condition and connectivity to other areas of wildlife habitat. These areas have more potential to support viable populations of flora and fauna species as they are larger and better connected. These features make these areas more resistant to local extinction of flora and fauna species due to events such as fires and disease outbreaks and processes such as changing vegetation characteristics and predation by feral animals.

As a result of the size, connectivity and complexity of these areas, populations eliminated from part of their range may become re-established from refugia that were unaffected. The conservation and management of these areas and the corridors that connect them is important to the conservation of biodiversity in the locality.

As much of the area surrounding the study area is highly urbanised, fauna habitat within these areas is largely limited to streams and streamside vegetation and the canopies of remnant and planted trees. Only native and exotic fauna species that are able to utilise highly modified habitat are likely to exist in this area.

Due to their mobility and ability to cope with habitat fragmentation, highly mobile native fauna species typical of open environments such as birds and bats would be able to exploit feeding, nesting and roosting opportunities that exist within these habitats. Highly adaptable native mammal species which are capable of utilising a wide variety of habitats such as the Brush-tailed Possum (*Trichosurus vulpecula*) and Common Ring-tailed Possum (*Pseudocheirus peregrinus*) persist here. Several bat species, such as the White-striped Mastiff Bat (*Tadarida australis*), Chocolate Wattle Bat (*Chanlinolobus morio*) and the threatened Grey-headed Flying Fox (*Pteropus poliocephalus*), are also found in these environments.

A larger diversity of native bird species inhabits urban areas such as the Noisy Miner (*Manorina melanophrys*), Pied Currawong (*Strepera graculina*), Laughing Kookaburra (*Dacelo novaeguineae*), Sulphur-crested Cockatoo (*Cacatua galerita*), Rainbow Lorikeet (*Trichoglossus haematodus*), Red Wattlebird (*Anthochaera carunculata*), Australian Magpie (*Gymnorhina tibicen*) and Tawny Frogmouth (*Podargus strigoides*). The threatened Powerful Owl (*Ninox strenua*) is also sometimes seen in urban areas in the vicinity of bushland.

Exotic mammal species such as the European Rabbit (*Oryctolagus cuniculus*), Black Rat (*Rattus rattus*), House Mouse (*Mus musculus*), European Red Fox (*Vulpes vulpes*) and feral Domestic Cat (*Felis catus*) are found in the study area, along with exotic bird species such as Common Myna (*Acridotheres tristus*), Spotted Turtle-dove (*Streptopelia chinensis*), Starling (*Turdus merula*) and Red-whiskered Bulbul (*Pycnonotus jocosus*).

As a result of habitat loss and competition, and predation by exotic and over-abundant native species, fauna species that require a diverse understorey, disturbance-sensitive species, species which are susceptible to predation by pets and feral animals, and species with very specific habitat requirements are unlikely to exist in urban environments.

The waterways in the vicinity of the study area are degraded as a result of a number of factors including increased erosion due to the concentration of stormwater flows, weed invasion, polluted catchment runoff and the presence of exotic fish species (such as *Gambusia holbrooki*). As a result, frogs, fish and aquatic invertebrates that are sensitive to disturbance are unlikely to persist in the waterways.

Nonetheless, a variety of disturbance tolerant frog species (for example, Striped Marsh Frog (*Limnodynates peronii*), Common Eastern Froglet (*Crinia signifera*), Eastern Dwarf Tree-frog (*Litoria fallax*), Green Stream Frog (*Litoria phyllochroa*) and Peron's Tree Frog (*Litoria peronii*)) are likely to use these habitats. A number of native fish species are also likely to persist.

Vegetated wildlife corridors within the urban environment are mainly confined to these waterways which connect the bushland remnants that are largely located in the steep sandstone valleys.

### Vegetation communities in the M2 Motorway study area

The following seven native vegetation communities are mapped as occurring in the areas adjacent to the M2 Motorway:

- Coastal Sandstone Ridgetop Woodland.
- Coastal Sandstone Gully Forest.
- Hinterland Sandstone Gully Forest.
- Sydney Hinterland Transition Woodland.

- Sandstone Riparian Scrub.
- Blue Gum High Forest.
- Sydney Turpentine-Ironbark Forest.

The distribution of these vegetation communities, as well as the other vegetation communities occurring in the region (as described in the predictive vegetation mapping datasets) is shown in Figure 29.

Appendix B in Technical Paper 3 shows detailed vegetation mapping for the entire M2 Upgrade project route in seven maps. The vegetation maps in Appendix B are derived from the existing vegetation mapping for the area (Figure 29) and field survey.

### Threatened vegetation communities

Of the vegetation communities mapped as occurring in the study area, Sydney-Turpentine Ironbark Forest and Blue Gum High Forest are threatened ecological communities under the TSC Act and EPBC Act. Field surveys found no Sydney-Turpentine Ironbark Forest present within the M2 corridor. Approximately 1.36 hectares of Blue Gum High Forest in moderate to poor condition was identified in the study area as detailed below.

#### Blue Gum High Forest

This community is listed as a critically endangered ecological community (CEEC) under the TSC Act as Blue Gum High Forest and under the EPBC Act as Blue Gum High Forest of the Sydney Basin Bioregion.

This is a moist tall open forest community in which Sydney Blue Gum (*Eucalyptus saligna*) is a dominant species together with a combination of other species including Smooth-barked Apple (*Angophora costata*), Grey Ironbark (*Eucalyptus paniculata*), Blackbutt (*Eucalyptus pilularis*) and Turpentine (*Syncarpia glomulifera*). This vegetation is referred to as Blue Gum High Forest (unit p153) in Tozer *et al.* (2006).

Trees within this vegetation community can form large hollows. Threatened fauna species known to occur in remnant Blue Gum High Forest include Sugar Glider (*Petaurus breviceps*), Powerful owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Glossy Black Cockatoo (*Calyptorhynchus lathami*), Swamp Wallaby (*Wallabia bicolour*) and Brush-turkey (*Alectura lathami*) (DECC 2008). Potential impacts upon threatened species with a moderate to high likelihood of occurrence within the study area are discussed in Section 9.5.3.

This vegetation type is restricted to ridgetop plateaus and upper slopes on clay soils derived from Wianamatta shales. Prior to previous clearing for urban development and road construction, a number of areas along the M2 corridor may have contained this vegetation community or the closely allied Sydney Turpentine-Ironbark Forest. The extent and condition of this community has been verified through on ground inspection and the present distribution within the study area is restricted to a narrow band between the M2 Motorway and Pennant Hills Golf Course to the north. This area is approximately 1.36 hectares in area and in moderate to poor condition.

The species composition of this patch shows affinities with Turpentine-Ironbark Forest. The dominance of Sydney Blue Gum and Grey Ironbark, the lack of Turpentine and the composition of the understorey and ground layers suggest that this vegetation patch is more closely aligned with the definition of Blue Gum High Forest. A gradation into vegetation more similar to Turpentine-Ironbark Forest occurs at the western extent of the patch as indicated by a drier understorey and an increasing dominance by Rough-barked Apple (*Angophora floribunda*).

The characteristic species of this Blue Gum High Forest community are described in Table 79.

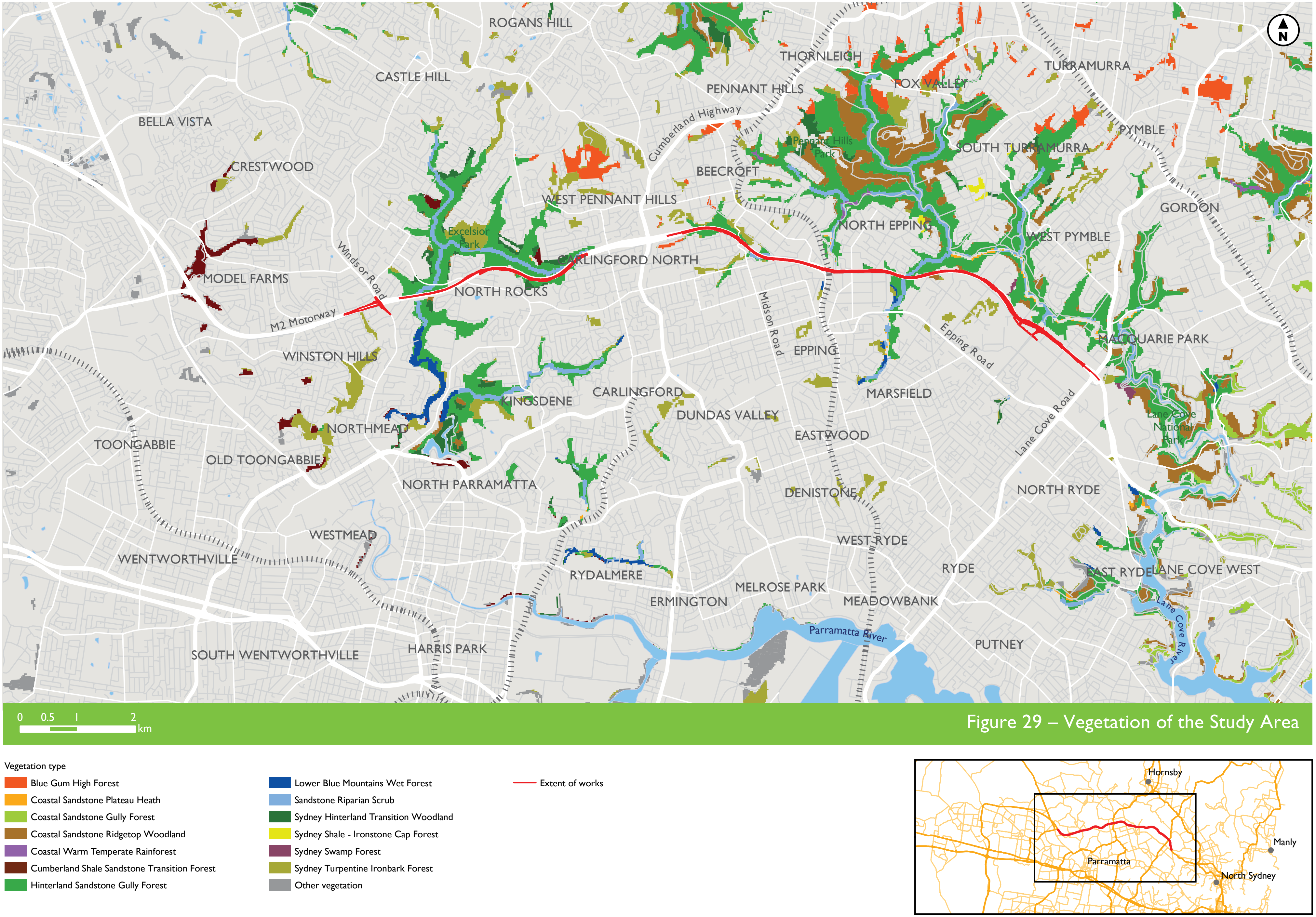



Figure 29 – Vegetation of the Study Area

*Source: RTA, 2009, Tozer et. al, 2006. The vegetation extents shown in these maps are from predictive vegetation mapping datasets and may not represent the vegetation actually present at these locations*

Table 79 Blue Gum High Forest canopy species

| Native canopy species | |
|---|---|
| Common name | Botanical name |
| +Smooth-barked Apple | Angophora costata |
| +Grey Ironbark | Eucalyptus paniculata |
| +Blackbutt | Eucalyptus pilularis |
| +Sydney Blue Gum | Eucalyptus saligna |
| +Turpentine | Syncarpia glomulifera |
| #Grey Gum | Eucalyptus punctata |
| #Red Mahogany | Eucalyptus resinifera |
| + = dominant canopy species, # = less frequent species | |

### Sydney Turpentine-Ironbark Forest

Sydney Turpentine-Ironbark Forest is listed as a CEEC (Turpentine–Ironbark Forest of the Sydney Basin Bioregion) under the EPBC Act and the TSC Act.

### EPBC Act Definition

Sydney Turpentine-Ironbark Forest is an open-forest of mixed and varying canopy species composition in which Turpentine (*Syncarpia glomulifera*) and ironbarks (*Eucalyptus spp.*) are dominant. Other tree species include Red Bloodwood (*Corymbia gummifera*), Sydney Blue Gum (*E. saligna*), Grey Gum (*E. punctata*), Narrow-leaved Ironbark (*E. crebra*), Mountain Grey Gum (*E. cypellocarpa*), Round-leaved Gum (*E. deanei*) and Red Ironbark (*E. fibrosa*) (DEWHA 2009).

Low tree and shrub species include Acacia parramattensis, Breynia oblongifolia, Dodonaea triquetra, Leucopogon juniperinus, Notelaea longifolia, Ozothamnus diosmifolius, Pittosporum revolutum, P. undulatum, Polyscias sambucifolia and Maytenus silvestris. Ground layer species include Adiantum aethiopicum, Austrostipa pubescens, Dianella caerulea, Dichondra repens, Entolasia stricta, Lomandra longifolia, Poa affinis, Pseuderanthemum variabile and Themeda australis. Climbers include Eustrephus latifolius, Glycine clandestina and Pandorea pandorana (DEWHA 2009).

The Commonwealth listing for the CEEC includes vegetation in the following condition:

- The vegetation contains some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey).
- Tree canopy cover is greater than 10% and remnant size is greater than one hectare. These areas have the greatest conservation value and their high quality and size makes them most resilient to disturbance.
- Remnants with tree canopy cover less than 10% are also included in the ecological community, if the fragments are greater than one hectare in size and occur in areas of native vegetation in excess of five hectares in area. These areas enhance the potential for connectivity and viability of the ecological community. They support native flora and fauna species by facilitating gene flow among remnants and buffering against disturbance (DEH 2005).

Areas mapped as Sydney-Turpentine Ironbark Forest within the M2 corridor were inspected and found to be:

- Less than one hectare in area, highly disturbed and lacking an intact ground layer or understorey; and/or
- Consistent with the floristic composition of the larger patches of the adjacent Hinterland Sandstone Gully Forest vegetation community.

### TSC Act Definition

Under the NSW TSC Act definition, Sydney Turpentine-Ironbark Forest is an open forest community and the dominant canopy trees are Turpentine (*Syncarpia glomulifera*) and Grey Ironbark (*Eucalyptus paniculata*). Common understorey shrubs include Sweet Pittosporum (*Pittosporum undulatum*), Hop Bush (*Dodonaea triquetra*), Elderberry Panax (*Polyscias sambucifolia*) and Sickle Wattle (*Acacia falcata*).

Sydney Turpentine-Ironbark Forest occurs on fertile soils in an area of moderate rainfall. It is transitional between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges. As a transitional community, the species composition varies according to the influence of sandstone and aspect.

The areas of vegetation within and adjacent to the M2 corridor that have been mapped as Sydney Turpentine–Ironbark Forest under the alternative vegetation classifications described below have been inspected and were subject to detailed flora surveys. The dominant canopy species in these areas are Blackbutt (Eucalyptus pilularis) and Turpentine (Syncarpia glomulifera) with only occasional specimens of other tree species including Smooth-barked Apple (Angophora costata) and Red Bloodwood (Corymbia gummifera) present. No ironbark species were detected within these areas.

The moderately dense understorey in these areas consists of a range of species that are found in a variety of soil types and vegetation communities. The sparse to moderately dense ground layer vegetation is a mixture of low shrubs, herbs, grasses and sedges.

### Vegetation Mapping Schemes

In the mapping of Tozer *et al* (2006) as shown in Figure 29, small isolated occurrences of this community are mapped in the Beecroft and Carlingford North areas.

Other vegetation mapping schemes have labelled vegetation as Sydney Turpentine-Ironbark Forest inconsistently across the locality of the M2 corridor. The Native Vegetation of the Cumberland Plain maps (NPWS 2002) show extensive areas (including developed areas such as roads, residences) as this community, however these maps have limitations in their applicability to fine scale assessment of vegetation due to a number of factors described in the associated interpretation guidelines (NPWS 2002).

A recently released draft vegetation community mapping scheme for the Sydney metropolitan catchment area (DECCW 2009 a) shows some areas as Sydney Turpentine–Ironbark Forest which are mapped as Hinterland Sandstone Gully Forest by Tozer *et al* (2006) and as Blackbutt Gully Forest by Smith and Smith (2008). The mapping scheme is currently a draft open to comment and subject to change.

Neither the TSC Act nor the EPBC Act Threatened Species Scientific Committee's advice regarding this community includes Blackbutt (*Eucalyptus pilularis*) as a dominant or frequently occurring species. While the understorey and ground layer vegetation observed shows a resemblance to that of Sydney

Turpentine-Ironbark Forest, its composition and structure are more closely aligned with the Hinterland Sandstone Gully Forest community.

In light of these factors, this vegetation within the study area is considered to be Hinterland Sandstone Gully Forest with a slightly higher than typical clay soil influence and not Sydney Turpentine-Ironbark Forest.

The results from flora surveys conducted within areas mapped as Sydney Turpentine-Ironbark Forest adjacent to the M2 Motorway is presented in Appendix D and summarised below in Table 80.

Table 80 Flora survey data within the M2 corridor

| Native Canopy and Shrub Species | | Location of flora quadrat | | |
|---|---|---|---|---|
| Common Name | Botanical Name | 5- (Bidjigal Reserve) | 11- (Devlins Creek Cheltenham) | 12- (Devlins Creek North Epping) |
| Narrow-leaved Apple | Angophora bakeri | X | | |
| Smooth-barked Apple | Angophora costata | X | X | X |
| Forest Oak | Allocasuarina torulosa | X | | |
| Old Man Banksia | Banksia serrata | X | | |
| Blackbutt | Eucalyptus pilularis | X | X | X |
| *Lantana | Lantana camara | X | X | X |
| Paperbark Tea-tree | Leptospermum trinervium | X | | |
| *Broad-leaf Privet | Ligustrum lucidum | | X | |
| *Small-leaf Privet | Ligustrum sinense | X | X | X |
| Sweet Pittosporum | Pittosporum undulatum | X | | |
| Turpentine | Syncarpia glomulifera | X | | |
| *=exotic species | | | | |

### Terrestrial plant species of conservation significance

Searches of the NPWS Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool were conducted to determine whether threatened plant species listed under the TSC Act or EPBC Act are likely to occur in the vicinity of the project. The database search revealed that there are a number threatened species recorded in the vicinity of the site (Figure 30).

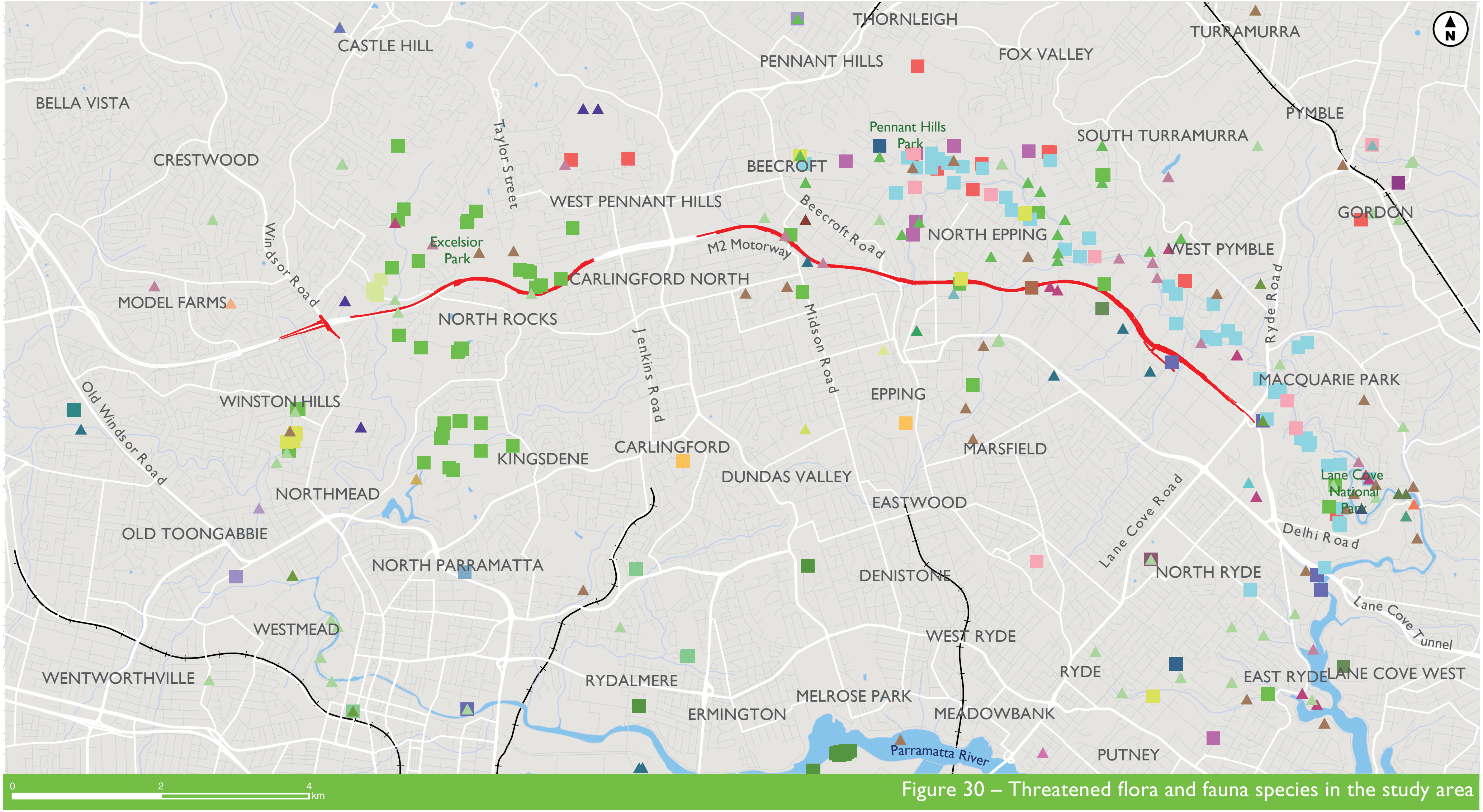



Figure 30 – Threatened flora and fauna species in the study area

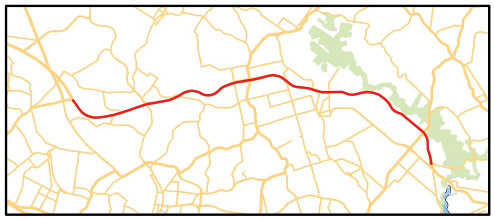
Extent of Works

**Threatened Fauna**

- Australasian Bittern
- Barking Owl
- Black Bittern
- Black-necked Stork
- Black-tailed Godwit
- Cotton Pygmy-Goose
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Gang-gang Cockatoo
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Little Lorikeet
- Osprey
- Pink Robin
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Southern Myotis
- Spotted-tailed Quoll
- Superb Fruit-Dove
- Superb Parrot
- Swift Parrot
- Yellow-bellied Glider

**Threatened FLora**

- Acacia pubescens
- Callistemon linearifolius
- Darwinia biflora
- Darwinia peduncularis
- Epacris purpurascens var. purpurascens
- Eucalyptus nicholii
- Genoplesium baueri
- Grammitis stenophylla
- Haloragodendron lucasii
- Hibbertia superans
- Leptospermum deanei
- Melaleuca deanei
- Persoonia hirsuta
- Persoonia nutans
- Pimelea curviflora var. curviflora
- Pimelea spicata
- Pomaderris prunifolia
- Prostanthera marifolia
- Syzygium paniculatum
- Tetratheca glandulosa
- Triplarina imbricata
- Wilsonia backhousei



*Source: DECC, 2009; MapData Sciences 2009; Tozer et.al, 2006 Native vegetation of southeast NSW*

The likelihood of occurrence of these species based on previous records and habitat attributes is summarised in Appendix C of Technical Paper 3. Those species which were considered to have a moderate to high likelihood of occurring within the study area on the basis of distribution and habitat requirements are shown in Table 81.

Table 81 Threatened flora species with potential to occur in the M2 corridor

| Scientific name | Common name | Type of species | TSC Act status | EPBC Act status | Likelihood of occurrence |
|---|---|---|---|---|---|
| Acacia bynoeana | Bynoe's Wattle | Shrub | E | V | Moderate |
| Callistemon linearifolius | | Shrub | V | - | High |
| Darwinia biflora | - | Shrub | V | V | Moderate – High |
| Epacris purpurascens var. purpurascens | - | Shrub | V | - | High-recorded |
| Persoonia hirsuta | Hairy Geebung | Shrub | E | E | Moderate |
| Pimelea curviflora var. curviflora | - | Shrub | V | V | High |
| Tetratheca glandulosa | - | Shrub | V | V | Moderate |
| V = Vulnerable, E = Endangered, - = Not listed | | | | | |

The threatened terrestrial plant species that are considered to have potential to occur within the study area are chiefly those species which are associated with sandstone soils, particularly where these soils are somewhat enriched due to their proximity to areas of shale-derived soil.

Of the above-listed species, the following species have been recorded in the locality and are associated with woodland or open forest on clay-enriched sandstone soils:

- Callistemon linearifolius.
- Darwinia biflora.
- Epacris purpurascens var. purpurascens.
- Pimelea curviflora var. curviflora.
- Tetratheca glandulosa.

Of these species, only *Epacris purpurascens var. purpurascens* was recorded during the recent field investigations. *Epacris purpurascens var. purpurascens* is an erect shrub, 50-180 centimetres high that is found in a range of habitat types, most of which have a strong shale soil influence (DECCW, 2009b). Within the M2 corridor, individuals of this species are located in translocated soils including earth mounds and rock armoured batter slopes.

*Pimelea curviflora var. curviflora* was recorded during the Environmental Impact Statement for the western section of the M2 Motorway (Mount King, 1992). However, this species was not identified in the M2 corridor during the current field surveys. The species has been recorded in Lane Cove National Park and in Epping near the M2 corridor (DECCW 2009). The species was not recorded during recent flora surveys however, it is possible that this species may exist within the M2 corridor.

*Callistemon linearifolius* is known to occur in the Hornsby, Lane Cove and Ryde local government areas and has been recorded near the M2 corridor at Marsfield (DECC, 2001). The species usually grows in dry sclerophyll forest on the coast and adjacent ranges. The species was not recorded during the flora survey of the M2 corridor however there is a high likelihood that it occurs here.

*Darwinia biflora* grows in heath on sandstone or in the understorey of woodland on shale-capped ridges. There are records of this species occurring in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai local government areas. The bushland of the M2 corridor and adjacent bushland (such as Bidjigal Reserve and Lane Cove Valley) are not included in the lists of known important populations. The species was not recorded during flora surveys however, it is possible that this species may exist within the M2 corridor.

*Tetratheca glandulosa* grows in sandy or rocky heath or scrub. The species was not recorded during recent flora surveys within the M2 corridor. Whilst it is considered possible that this species may exist within the M2 corridor, it is considered unlikely that a potentially important population exists.

Several parts of the M2 Motorway are located on ridgetop areas on or adjacent to areas underlain by shale-derived soils. *Persoonia hirsuta* and *Acacia bynoeana* are associated with woodland or open forest on sandstone soils but are not particularly associated with soils which have a clay influence. Important populations of these species are not considered likely to exist within the M2 corridor.

### Terrestrial fauna and fauna habitat of the study area

#### Large patches of native vegetation

Habitat for a variety of fauna species exists within the remnant vegetation occurring within the M2 corridor and surrounding bushland areas. Trees (for example, *Eucalyptus spp., Angophora spp., Syncarpia spp.* and *Corymbia spp.*), Wattles (*Acacia spp.*) and Banksias (*Banksia spp.*) in particular provide a food source in the form of leaves, sap, nectar, pollen and seed for a number of bird, mammal and insect species.

Threatened species known to use these resources include Grey-headed Flying-fox (*Pteropus poliocephalus*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*). The migratory nectar-feeding birds Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*) may use this resource sporadically or on a seasonal basis but are not considered likely to be regular or frequent visitors to the area based upon database records.

The Powerful Owl (*Ninox strenua*) is also known to hunt and roost in the bushland of the study area and contiguous areas of bushland in the locality and may nest in large tree hollows in the locality. Nest sites are considered most likely to be located in areas containing very large mature hollow-bearing trees, particularly in core bushland areas which are less subject to human disturbance.

Large and medium-sized tree hollows are likely to exist within the larger, more mature trees particularly in mature Blackbutt (*Eucalyptus pilularis*). These larger trees are chiefly found on lower slopes of gullies and along streams where soils are deeper, moister and enriched by silt and organic material that are not considered likely to be affected by the proposed works. Small hollows, fissures and decorticating bark also exist within the trees of the site. These hollows provide potential den, nest and roost sites for a number of small bird, mammal and reptile species.

Smaller hollows may be used by threatened hollow-roosting microbats including, Eastern Freetail-bat (*Mormopterus norfolkensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

In addition to the microbat species listed above, several other threatened, non hollow-roosting species may forage in the air spaces within and around the vegetation including Large-eared Pied Bat (*Chalinolobus dwyeri*), Little Bentwing-bat (*Miniopterus australis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and Large-footed Myotis (*Myotis adversus*).

The leaf-litter, fallen logs and ground layer vegetation of the ecology study area form potential habitat for ground-dwelling fauna including Echidna (*Tachyglossus aculeatus*), Long-nosed Bandicoot (*Perameles nasuta*), Swamp Wallaby (*Wallabia bicolor*) and a variety of reptile species. These habitat features are also likely to be used for sheltering and foraging for some locally occurring frog species.

#### Rocky outcrops

Rocky outcrops provide potential sheltering sites for reptiles (lizards and snakes), frogs and small terrestrial mammals. If environmental conditions are conducive, crevices within larger rock outcrops may provide roosting habitat for some species of cave-roosting microbats. Large rock outcrops are abundant within Bidjigal Reserve including some locations on the edge of the M2 corridor. Microbats are also known to use the bridge abutments and culverts associated with the M2 Motorway as roosting habitat.

#### Wildlife corridors and connectivity

The bushland of the Darling Mills Creek corridor is considered to be the most significant regional habitat link with Berowra Bushland Park in Hornsby and further on to Ku-ring-gai Chase National Park and Brisbane Waters (Upper Parramatta River Catchment Trust, 1999).

Due to its relatively large size and its connectivity with other bushland areas, the bushland of the Darling Mills Creek corridor retains high biodiversity value and potential for fauna movements and genetic exchange. The more intact bushland areas of the sandstone valleys are likely to have the greatest importance as corridors for terrestrial fauna, particularly for species which are less tolerant of disturbed environments.

Despite extensive weed invasion, the narrow bands of riparian vegetation that persist along creeks within cleared areas, are also important as they provide the continuous vegetation cover that is required by some fauna species which do not readily cross cleared lands. Narrow bands of vegetation, such as those often found along roadways, also have some value as movement corridors for more mobile fauna species.

The main wildlife corridors within the M2 corridor include the bushland and disturbed vegetation surrounding Blue Gum Creek, Devlins Creek, Darling Mills Creek and Terrys Creek.

### Rapid Fauna Habitat Assessment

In 2008, DECC completed the study 'Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Area'. The study provides a catchment-wide assessment of the value of remnant vegetation for native fauna conservation and ranked the larger sites in priority order. Within the M2 corridor there are four sites considered to be of moderate to very high fauna value (DECC 2008). These include:

- The vegetation north of the M2 Motorway to the Cumberland Highway which forms part of the Lane Cove Valley (Figure 29).
- Darling Mills Creek to the north-west (Bidjigal Reserve area).
- Devlins Creek to the north of the M2 Motorway at the Chilworth Recreation Reserve, Cheltenham.
- Quarry Branch Creek to the south-west of the M2 Motorway at Winston Hills.

In the DECC (now DECCW) study, the fauna significance of a site was determined by the following features:

- Habitat connectivity.
- Habitat state or condition.
- Presence of tree hollows.
- Below canopy structural attributes.
- Habitat present considered to comprise priority fauna habitat.
- Future prospects.
- Presence of threatened species and regionally significance species.
- Potential presence of further significant fauna.
- Presence of feral bird species.
- Presence of additional fauna attributes.

### Fauna species of conservation significance

Searches of the NPWS Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool were conducted to determine if any threatened fauna species listed under the TSC Act or EPBC Act have been recorded or are likely to occur in the vicinity of the M2 Motorway. The database revealed that there are a number threatened species recorded or predicted to occur within ten kilometres of the site.

The likelihood of these species occurring in the vicinity of the M2 Motorway was based on previous records, known habitat attributes and the application of the precautionary principle. Refer to Appendix C of Technical Paper 3 for further detail. Those species which were assessed to have a moderate to high likelihood of occurring on the site on the basis of distribution and habitat requirements are shown in Table 82. Assessments of Significance for these species are presented in Appendix F of Technical Paper 3.

Table 82 Potential threatened fauna species and populations in the M2 corridor

| Scientific name | Common name | Type of species | TSC Act status | EPBC Act status | Likelihood of occurrence |
|---|---|---|---|---|---|
| Anthochaera phrygia | Regent Honeyeater | Bird | E | E | Moderate |
| Callocephalon fimbriatum | Gang-gang Cockatoo | Bird | V | - | High - recorded |
| Callocephalon fimbriatum | Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas | Bird | E | - | High - recorded |
| Chalinolobus dwyeri | Large-eared Pied Bat | Mammal | V | V | Moderate |
| Calyptorhynchus lathami | Glossy Black-cockatoo | Bird | V | - | Moderate |
| Lathamus discolor | Swift Parrot | Bird | E | E | Moderate – seasonal migrant |
| Litoria aurea | Green and Golden Bell Frog | Frog | E | | Moderate |
| Miniopterus schreibersii oceanensis | Eastern Bentwing-bat | Mammal | V | - | Moderate to High |
| Mormopterus norfolkensis | Eastern Freetail-bat | Mammal | V | - | Moderate to High |

| Scientific name | Common name | Type of species | TSC Act status | EPBC Act status | Likelihood of occurrence |
|---|---|---|---|---|---|
| Myotis adversus | Large-footed Myotis | Mammal | V | - | Moderate to High |
| Ninox strenua | Powerful Owl | Bird | V | - | Moderate to High |
| Pseudophryne australis | Red-crowned Toadlet | Frog | V | - | Moderate to High |
| Pteropus poliocephalus | Grey-headed Flying-fox | Mammal | V | V | High - recorded |
| Saccolaimus flaviventris | Yellow-bellied Sheathtail-bat | Mammal | V | - | Moderate |
| Scoteanax rueppellii | Greater Broad-nosed bat | Mammal | V | - | Moderate to High |
| V = Vulnerable, E = Endangered, - = Not listed | | | | | |

The threatened fauna species listed in Table 82 above are discussed in further detail in Section 9.5.3.

### Aquatic vegetation communities and condition

The Sandstone Riparian Scrub vegetation type occurs along creeks within and adjacent to the M2 corridor with the most intact occurrences at Darling Mills Creek and Terrys Creek. Much of this vegetation is highly modified as a result of alteration to natural flow regimes, increased nutrients and especially weed invasion.

Native aquatic submerged and emergent vegetation is not abundant within the creeks of the study area. This is likely to be as a result of the chiefly rocky substrate found here, high water velocity during heavy rainfall and competition from introduced species.

The only commonly encountered native aquatic plants were Bull Rush (*Typha orientalis*) and knotweeds (*Persicaria spp.*), which were found in small patches along the creeks and primarily in disturbed areas. The detention basins within the M2 corridor contain an artificial assemblage of emergent native aquatic plants including *Eleocharis sphacelata*, Marsh Club-rush (*Bolboschoenus fluviatilis*) and Jointed Twig-rush (*Baumea articulata*), which were planted when the basins where constructed. No assemblages of native aquatic plants were found that could be described as native vegetation communities.

### Aquatic fauna habitat

#### Waterways

Prior to residential development in surrounding areas, the creeks of the locality are likely to have supported a diverse community of insects, fish, frogs, birds and mammals. The creeks are degraded to varying degrees as a result of a number of factors including increased erosion due to the concentration of stormwater flows, weed invasion, polluted catchment runoff and the presence of exotic fish species. As a result of this condition, frogs, fish and aquatic invertebrates that are sensitive to these forms of disturbance are unlikely to persist in these waterways. Nonetheless, a variety of disturbance tolerant fauna species remain.

The present condition of the creeks within the M2 corridor varies from highly modified to near-natural. Classification of the creeks within the study area is listed below in Table 83.

Table 83 Classification of waterway crossings within the study area

| Classification | Characteristics of waterway type | Creek/drainage line |
|---|---|---|
| Class 2 – Moderate fish habitat | Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area. | Darling Mills Creek |
| Class 3 – Minimal fish habitat | Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (for example, fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats. | Blue Gum Creek, Devlins Creek and Terrys Creek |

*Source: Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road?*

The section of Darling Mills Creek crossed by the M2 corridor appears to be in moderate condition, with low turbidity, little evidence of sedimentation and a low level of weed invasion. This drainage line is likely to provide habitat for a range of native fish species as listed below in Table 84, which identifies the fish species that were recorded during previous surveys or are considered likely to occur within the study area.

Table 84 Fish species considered likely to occur within the study area

| Scientific name | Common name | Conservation status (NSW) |
|---|---|---|
| Anguilla australis | Short-finned Eel | P |
| Anguilla reinhardtii | Long-finned Eel | P |
| Carassius auratus | Goldfish | U |
| Cyprinus carpio | Common carp | U |
| Gobiomorphus australis | Striped Gudgeon | - |
| Gobiomorphus coxii | Cox Gudgeon | - |
| Hypseleotris compressus | Empire Gudgeon | - |
| Hypseleotris galii | Firetail Gudgeon | - |
| Philypnodon grandiceps | Flathead Gudgeon | - |
| Galaxias maculatus | Common Jollytail | - |
| Gambusia affinis | Mosquito fish | U |
| Retropinna semoni | Australian Smelt | - |

*Note: P: Protected; U: Unprotected; –: Not classified.*

It is also likely to be inhabited by the introduced Plague Minnow (*Gambusia holbrooki*), though the population density of this species is likely to be relatively low due to the higher water quality and intact riparian vegetation which favour native fish species. The Eastern snake-necked Tortoise (*Chelodina longicollis*) is also likely to be found here.

Recent frog surveys conducted along this section of Darling Mills Creek detected common species such as the Green Stream Frog (*Litoria phyllochroa*), Peron's Tree Frog (*Litoria peronii*), Striped Marsh Frog (*Limnodynates peronii*) and Common Eastern Froglet (*Crinia signifera*).

The threatened Red-crowned Toadlet (*Pseudophryne australis*) usually lives close to non-perennial streams but previous ecological assessments conducted have recorded the Red-crowned Toadlet between Wicks Road and Epping Road, North Ryde, adjacent to the M2 corridor (Eco Logical Australia, 2009 and Biosphere, 2007) and also at Nile Close, Marsfield. The North Ryde area is occupied by Transport Infrastructure Development Corporation (TIDC) and is currently proposed as a compound site for the upgrade of the M2 Motorway.

The other creeks of the study area are more disturbed and are likely to contain a lower diversity and abundance of fish and frog species with the Plague Minnow becoming increasingly dominant in more disturbed areas.

A number of fish species likely to be found within the creeks of the study area are catadromous, meaning they spend their lives in freshwater and return to the ocean to spawn. Catadromous species likely to found in the creeks of the study area include:

- Shortfinned Eel (Anguilla australis).
- Longfinned Eel (Anguilla reinhardtii).
- Common Jollytail (Galaxias maculatus).

These species need to be able to move between freshwater and marine environments and thus may be susceptible to the obstruction of waterways. Other fish species which move into the smaller tributaries of river systems during the juvenile phase of their life cycles may also be susceptible.

Obstructions to fish movement within the M2 corridor exist where waterways pass beneath the M2 Motorway via culverts. During low flow conditions, the streams of water flowing through the culverts are broad but very shallow and may limit the passage of some fish species. Higher water velocity and turbulence during rainfall events and a lack of pooled areas for fish to rest between bouts of swimming may also limit fish movement through the culverts. The extremely low light level within culverts may also create a nonphysical barrier for some fish species that may avoid dark areas during daylight hours (Fairfull and Witheridge, 2003).

Larger in stream structures (for example, the retarding basin wall near Loyalty Road, North Rocks and weirs on the Lane Cove River) lower in the catchments of these creeks are also potential barriers to fish passage. Prior to the 1980's the Platypus (*Ornithorhynchus anatinus*) was regularly observed within Darling Mills Creek in Bidjigal Reserve but has not been seen in recent times. The Water Rat (*Hydromys chrysogaster*) has previously been recorded and may still occur in the waterways of the study area.

### Constructed water bodies (detention basins)

When constructed, the detention basins of the M2 corridor were planted with emergent aquatic native plants with the intention of providing wildlife habitat. This was in addition to the primary purpose of slowing stormwater flows to minimise water pollution and impacts to the hydrology of adjacent waterways.

Emergent aquatic plants currently found growing in the detention basins include *Eleocharis sphacelata*, *Bolboschoenus fluviatilis*, and *Typha orientalis*. Four frog species were recorded within the detention basins; *Litoria peronii, L. fallax, Limnodynastes peronii* and *Crinia signifera*.

The detention basins vary somewhat in the characteristics of the aquatic vegetation found within them, some having an almost complete cover of emergent vegetation whilst others have larger areas of open water. The height and structure of the vegetation surrounding the basins also varies with some overshadowed by tree regrowth and others in relatively open sunlit conditions. Water levels within these basins are likely to increase after rainfall and decrease during extended dry periods though it is likely that water is continually present in most, if not all, of these basins.

Water quality in the basins is likely to be relatively poor due to the influx of pollutants from the road surface. Basins that are isolated from other water bodies are unlikely to be inhabited by fish though other aquatic fauna such as tortoises, snakes and wading birds may be found in these locations. It is unknown whether or not the Amphibian Chytrid Fungus is found in any of these basins, but it is possible that it may have been introduced there by colonising frogs.

### Feral animals and over-abundant native species

Introduced feral and domestic predatory mammal species such as the European Red Fox (*Vulpes vulpes*), Domestic Cat (*Felis catus*) and Black Rat (*Rattus rattus*) compete with and prey upon native fauna and may have lead to the local depletion or extinction of small to medium-sized terrestrial mammals, ground-foraging birds and reptile species.

Other introduced species such as the European Rabbit (*Oryctolagus cuniculus*) may damage plants and fauna habitat through their feeding and digging activities. A number of introduced birds such as the Red-whiskered Bulbul (*Pycnonotus jocosus*) spread the seeds of environmental weeds. Common Myna (*Acridotheres tristus*), Starling (*Turdus merula*) and European Honey Bee (*Apis mellifera*) compete with native species for nesting hollows.

Several native bird species are believed to have increased markedly in their abundance and have been implicated in the decline of some common native species due to competition and predation. Noisy Miner (*Manorina melanophrys*), Rainbow Lorikeet (*Trichoglossus haematodus*) and Red Wattlebird (*Anthochaera carunculata*) are aggressive nectar-feeding species which may exclude other nectar-feeding birds from flowering trees and shrubs. Pied Currawong (*Strepera graculina*) have been implicated in the decline of populations of small birds as a result of the predation, particularly of eggs and nestlings and also spread the seeds of environmental weeds. Parrots such as Sulphur-crested Cockatoo (*Cacatua galerita*) and Rainbow Lorikeet (*Trichoglossus haematodus*) compete with other birds for scarce nesting opportunities in tree hollows.

Many of these species have been able to establish and proliferate in bushland areas as a result of human-induced changes to the environment such as vegetation clearing and the cultivation of introduced plant species.

## 9.5.3 Impact assessment

### Impacts on flora

#### Loss of native vegetation

The project would require clearing of native vegetation for:

- Areas occupied by the widened Motorway and fill batters.
- Establishment of construction access roads.
- Establishment of construction compound sites.
- Establishment of materials storage areas.
- Construction of new detention basins.
- Facilitation of access to detention basins.

The nature of these impacts is summarised in Table 85.

Table 85 Direct impacts on vegetation

| Element of upgrade | Nature of impact |
| --- | --- |
| Widened M2 Motorway including fill batters. | • Permanent removal of vegetation would occur in areas occupied by the widened M2 Motorway. Permanent alteration of the soils of the batter slopes would occur. |
| Construction access roads and materials storage areas. | • Partial clearing of vegetation would occur in the areas identified for construction access roads. Vegetation removal would be limited to that necessary for access. Mature trees and other fauna habitat features such as waterways and rock outcrops would be avoided where practicable.<br>• Access roads to compound sites and work locations associated with bridges over Darling Mills Creek, Devlins Creek and Terrys Creeks would be required.<br>• Darling Mills Creek would be accessed via access tracks off the M2 Motorway. Entry to the compound site would be via eastbound lanes and exits would be via westbound lanes.<br>• Devlins Creek would be accessed via Allerton Road (entry and exit).<br>• Terrys Creek would be accessed via access tracks provided off Somerset Street (entry and exit).<br>• Areas under the bridges would be utilised for access.<br>• Construction methodology would be determined during the detailed design phase. Cleared areas would be rehabilitated post construction. |
| Construction compound sites. | • Clearing of vegetation would occur in the areas identified for construction compound sites. The larger construction compound sites are located on filled areas. Vegetation in these areas is composed of trees and shrubs planted after the construction of the M2 Motorway with the ground layer consisting almost entirely of introduced species. |
| New detention basins including access roads. | • Permanent removal of vegetation in areas occupied by the new detention basins and access roads. Detention basins would be planted with emergent native aquatic plant species. |
| Access to existing detention basins. | • Permanent removal of vegetation for permanent access roads to access new and existing detention basins. Works would involve permanent removal of vegetation, much of which is weedy regrowth from the original construction of the basins. |

The proposed widening of the M2 Motorway has been designed to minimise the amount of vegetation removal required. Design options have been considered to reduce the amount of excavation and intensive earthworks that would be required and therefore minimise the potential impacts to the surrounding environment. Wherever practicable the proposed widening has been designed within the existing footprint of the M2 Motorway. This includes site compound locations (refer to Sections 7.8.1and 9.8 for further discussion regarding the approach to selecting preferred compound locations) and proposed access and egress routes. At the Devlins Creek viaduct, approximately 60 percent of the additional road width requirements are proposed to be provided by joining the two adjacent bridge decks. This would minimise disturbance in the riparian zone. An already stripped site previously used as a construction compound has been chosen for the proposed main construction compound, within the Macquarie Park precinct.

The amount of vegetation (native and exotic) estimated to be cleared is approximately 21 hectares in total. A conservative estimate of the amount of vegetation considered to be in good condition within the study area is approximately ten hectares. These areas are characterised by having a relatively intact understorey, shrub and canopy layer and are consistent with the floristic composition of the vegetation community as defined by the relevant native vegetation classification for each community.

Approximately 11 hectares of the total vegetation to be cleared is in poor condition as these areas are highly modified and characterised by high levels of weed invasion. Table 86 shows the breakdown of clearing required in each vegetation community. The vegetation communities are those described by the predictive vegetation mapping datasets within the M2 corridor. The local occurrence of the vegetation communities is defined as the ecological community that occurs within and adjacent to the study area.

Table 86 Vegetation clearing within the M2 corridor

| Vegetation community | A<br>Approximate local occurrence (hectares) | B<br>Approximate amount of vegetation removal (hectares) | C<br>Approximate amount of the vegetation in Column B that is disturbed/exotic (hectares) |
|---|---|---|---|
| Coastal Sandstone Ridgetop Woodland | 25.2 | 0.4 | 0.16 |
| Hinterland Sandstone Gully Forest | 379.6 | 17.5 | 9.3 |
| Sydney Hinterland Transition Woodland | 24.4 | 0.1 | 0.08 |
| Sandstone Riparian Scrub | 64.5 | 3 | 1.3 |
| Total | | 21 | 10.84 |

Potential impacts to threatened flora species considered to have a moderate to high likelihood of occurrence are summarised below.

### Acacia bynoeana

*Acacia bynoeana* occurs in heath or dry sclerophyll forest on sandy soils and generally prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leafed Apple. The total population is estimated to be only a few hundred plants. The closest records of the species to the M2 corridor are within two kilometres in Gordon and near the northern boundary of Bidjigal Reserve. No individuals of this species were recorded within the M2 corridor during recent flora surveys.

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. The M2 Upgrade project is unlikely to have a significant impact on a local population of *Acacia bynoeana*. As the potential habitat here is isolated from habitat containing known populations in the region as a result of urban development it is considered unlikely that any population here would be considered a key source population either for breeding or dispersal.

### Callistemon linearifolius

*Callistemon linearifolius* has been recorded within the M2 corridor at Marsfield (DECCW, 2001). The species was not detected during the flora survey of the M2 corridor. An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. The M2 Upgrade project is unlikely to have a significant impact on a local population of *Callistemon linearifolius* and with the implementation of the mitigation measures provided in Section 9.5.4 (such as pre-clearance surveys prior to construction), potential impacts to this species would be minimised.

### Darwinia biflora

There are 20 populations of *Darwinia biflora* within the Sydney Region that are not currently covered by the reserve system and have been identified as important and suitable to be targeted for conservation. None of these important populations are located within the bushland of the M2 corridor or adjacent bushland (for example Bidjigal Reserve, Lane Cove National Park).

The species was not recorded during flora surveys within the M2 corridor. Whilst it is considered possible that this species may exist within the M2 corridor, it is considered unlikely that a large population exists here.

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. The M2 Upgrade project is unlikely to have a significant impact on a local population of *Darwinia biflora* as it is considered unlikely that a large population exists here.

### Epacris purpurascens var. purpurascens

*Epacris purpurascens var. purpurascens* habitats which remain (particularly on ridgetops) are under increasing threat of clearance or habitat modification (DECCW, 2009b).

A conservative estimate of potential habitat for *Epacris purpurascens var. purpurascens* within the M2 corridor is approximately 30 hectares. Approximately 20 individuals of this species (observed in flora plots during flora surveys) are likely to be removed (refer to Figure 31). As these individuals of the species  are located in translocated soils and earth mounds within the M2 corridor, further regeneration of the species from soils translocated during the proposed project is considered likely.

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. Based on the above considerations and assessment conducted, the project is unlikely to have a significant impact on a local population of *Epacris purpurascens var. purpurascens*.

### Persoonia hirsuta

*Persoonia hirsuta* was not recorded during recent flora surveys within the M2 corridor. Whilst it is considered possible that this species may exist within the M2 corridor, the closest recent (post 1980) record of the species is approximately five kilometres from the M2 corridor and the species has not been detected within the adjacent bushland reserves.

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3.  The proposed works are unlikely to have a significant impact on this species as a potentially important population is not considered likely to exist within the M2 corridor.

### Pimelea curviflora var. curviflora

*Pimelea curviflora var. curviflora* was recorded during the EIS for the western section of the M2 Motorway (Mount King 1992) however the specific location and the population size of this species were not reported. It is found in two fairly small populations in Lane Cove National Park, North Ryde and a few plants were recorded in the Pages Creek area. The Field of Mars Reserve population was estimated to be greater than 300 plants. The species is known to also occur at Epping Oval (DECCW, 2001).

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. The M2 Upgrade project is unlikely to have a significant impact on a local population of *Pimelea curviflora var. curviflora*.

### Tetratheca glandulosa

*Tetratheca glandulosa* is associated with areas of shale-sandstone transition habitat. The vegetation varies from heaths and scrub to woodlands/open woodlands, and open forest. The species was not recorded during recent flora surveys within the M2 corridor. Whilst it is considered possible that this species may exist within the M2 corridor, it is considered unlikely due to the level of disturbance occurring in these areas.

An assessment of significance for the potential impact on this species has been undertaken and is presented in Appendix F of Technical Paper 3. The M2 Upgrade project is unlikely to have a significant impact on a local population of *Tetratheca glandulosa* as it is considered unlikely that a potentially important population exists within the development footprint.

### Indirect impacts and edge effects

The Blue Gum High Forest community is listed as a CEEC under the TSC Act and the EPBC Act. The extent and condition of this community has been verified through on ground inspection and the present distribution within the M2 corridor is restricted to a narrow band between the M2 Motorway and Pennant Hills Golf Course to the north. This area is approximately 1.36 hectares in area and in moderate to poor condition.

The design option for the proposed widening of the M2 Motorway was specifically chosen to avoid vegetation clearing or modification to this ecological community, however indirect impacts are possible.

The earthworks required for the construction of the project have the potential to spread weed seeds between locations along the length of the M2 corridor in soil adhered to vehicles and construction equipment and on the clothing of construction workers. Soil disturbance as a result of earthworks activities may also create a favourable environment for the proliferation of weed species already present.

Shading and the reduction in soil moisture due to the interception of rainfall by overbridges has the potential to alter the structure and composition of vegetation beneath these structures.

An assessment of significance for the potential impact on Blue Gum High Forest has been undertaken and is presented in Appendix F of Technical Paper 3. This assessment concludes that the M2 Upgrade project is not likely to result in significant impact on this community.


Figure 31 – Approximate locations of Epacris purpurascens var. purpurascens

Lease boundary

Proposed Design

Epacris purpurascens var. purpurascens

Source: RTA, 2009

## Impacts on fauna

Measures would be implemented to minimise the risk of harm to native fauna during construction activities. Detailed consideration of the impacts of the project on threatened species is provided in the Assessments of Significance in Appendix F of Technical Paper 3.

### Fauna species assessed

Species assessed include:

- Green and Golden Bell Frog (*Litoria aurea*).
- Red-crowned Toadlet (*Pseudophryne australis*).
- Gang-gang Cockatoo (Callocephalon fimbriatum).
- Glossy Black-cockatoo (*Calyptorhynchus lathami*)
- Powerful Owl (*Ninox strenua*).
- Regent Honeyeater (*Anthochaera phrygia*).
- Swift Parrot (Lathamus discolour).
- Grey-headed Flying-fox (*Pteropus poliocephalus*).
- Several species of microbats such as:
- Eastern Freetail-bat (*Mormopterus norfolkensis*),
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*),
- Greater Broad-nosed Bat (*Scoteanax rueppellii*),
- Eastern Bentwing-Bat (Miniopterus schreibersii oceanensis),
- Large-footed Myotis (*Myotis adversus*), and
- Large-eared Pied Bat (*Chalinolobus dwyeri)*.

Migratory species assessed include:

- Black-faced Monarch *Monarcha melanopsis*.
- Rainbow Bee-eater *Merops ornatus*.
- Rufous Fantail Rhipidura rufifrons.
- Satin Flycatcher Myiagra cyanoleuca.
- White-throated Needletail *Hirundapus caudacutus.*

These species are discussed in the following subsections.

### Green and Golden Bell Frog

While some of this area is considered to be potential foraging habitat for this species, most of this area is considered to be marginal or unsuitable as habitat due to a lack of suitable vegetation cover, dry surface conditions and distance from potential breeding habitat. Modification to these areas as a result of clearing may result in a reduction in available foraging habitat in the short-term but is not considered likely to prevent the species from using these areas as foraging sites in the medium to long term.

Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on the Green and Golden Bell Frog is unlikely.

### Red-crowned Toadlet

Although the Red-crowned Toadlet was not recorded during current surveys within the M2 corridor, this species has been recorded between Wicks Road and Epping Road, North Ryde, adjacent to the M2 corridor (Eco Logical Australia, 2009 and Biosphere, 2007), and also at Nile Close, Marsfield. The North Ryde area is occupied by Transport Infrastructure Development Corporation (TIDC) and is currently proposed as a compound site for the M2 Upgrade project.

Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Much of the widening works are not in close proximity to breeding areas of the Red-crowned Toadlet and are considered to be at best, marginal as habitat for the species.

Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on the Red-crowned Toadlet is unlikely.

### Gang-Gang Cockatoo

The Gang-gang Cockatoo was recorded during the current study flying overhead in the vicinity of the Terry Creek overpass near Crimea Road on the border of Epping and Marsfield.

A population of Gang-gang Cockatoos persists in the Hornsby and Kur-ing-gai Local Government Areas and is largely believed to be confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east (DECCW, 2009). The population encompasses, but is not restricted to, Pennant Hills Park and parts of Lane Cove National Park.

Given the proximity of the existing M2 Motorway to the vegetation that would be affected, it is considered unlikely that sites used for breeding by this species would be affected. Potential nesting hollows for the species are not known or considered likely to be abundant in the area affected by the proposed M2 Upgrade project. No hollows of sufficient size to accommodate the species were observed in any of the trees that would be removed.

An assessment of significance (provided in Appendix F) concluded the proposed M2 Upgrade is unlikely to have a significant adverse impact on the Gang-gang Cockatoo is unlikely.

### Glossy Black Cockatoo

This species depends on large hollow-bearing eucalypts for nest sites and feeds exclusively on the seeds of several species of She-oak (Casuarina and Allocasuarina species). No hollows of sufficient size to accommodate the species were observed in any of the trees that would be removed as a result of the M2 Upgrade project.

These birds are highly mobile species with large home ranges and the small linear patch of vegetation removal that is proposed would not significantly increase habitat fragmentation for these species.

Due to their ability to fly, the bird species may forage within the vegetation along the M2 corridor but most are likely only as occasional visitors to these areas with their core habitat being within larger more intact areas of vegetation in the locality.

An assessment of significance (provided in Appendix F) concluded a significant impact on the Glossy Black Cockatoo is unlikely.

### Grey-headed Flying Fox

The Grey-headed Flying-fox was recorded flying overhead in several locations during field surveys. Individuals feeding within the study area are considered most likely to roost in the Ku-ring-gai Flying-fox Reserve in Gordon.

Foraging habitat for this species is considered to be present throughout the study area wherever fleshy-fruited and nectar-producing trees are present and forages throughout the Sydney Metropolitan area. No camp sites are present within or in the bushland adjacent to the M2 corridor.

Modification and vegetation clearing as a result of the M2 Upgrade project would result in a reduction in available foraging habitat in the short-term but is not considered likely to prevent the species from using these areas as foraging sites in the medium to long term. Although this vegetation would be removed, upon completion of works the vegetation would be allowed to regenerate naturally and would be supplemented by revegetation and bushland regeneration works.

Assessments of significance (provided in Appendix F) concluded that a significant impact on the Grey-headed Flying-fox is unlikely.

### Powerful Owl

The Powerful Owl requires large tracts of forest or woodland habitat but can also occur in fragmented landscapes (DEC, 2006). This species is known to nest in large tree hollows (at least 0.5 m deep), in large eucalypts that are at least 150 years old (DECCW, 2009) and some of their prey also rely on tree hollows for refuge.

No hollows of sufficient size to accommodate the species were observed in any of the trees that would be removed. The majority of the trees to be removed are relatively small due to low nutrient and moisture levels, previous clearing for the existing M2 Motorway and the logging history of the area.

Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on the Powerful Owl is unlikely.

### Regent Honeyeater

The Regent Honeyeater generally inhabits dry, temperate woodlands and open forests of the inland slopes of south-eastern Australia (DECCW, 2009). There are only three known major breeding locations and two of these occur in NSW.

Breeding of the species has not been recorded in the Sydney area and breeding of the species in the vicinity of the M2 corridor is considered highly unlikely. A reduction in available foraging habitat in the short-term would occur but is not considered likely to prevent the species from using these areas as foraging sites in the medium to long term. Although this vegetation would be removed, upon completion of works the vegetation would be allowed to regenerate naturally and would be supplemented by revegetation and bushland regeneration works.

Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on the Regent Honeyeater is unlikely.

### Swift Parrot

Favoured feed trees of the Swift Parrot are wintering flowering eucalypts. Little of this vegetation remains however revegetation along the edges of the M2 Motorway has involved in the planting of some individuals of these species. This revegetation consists of narrow bands of immature trees between the edge of the M2 Motorway and adjacent residential lands.

Given the lack of breeding habitat and the relatively small amount of marginal potential foraging habitat that would be affected, the M2 Upgrade project is not considered likely to significantly disrupt the breeding cycle of any subset of the population of the Swift Parrot.

Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on the Swift Parrot is unlikely.

### Insectivorous (microchiropteran) bats

The study area does not contain any caves, or mines near or above water and is consequently unlikely to provide preferred roosting or maternity sites for many of the threatened microbat species listed above. Preferred habitat for the threatened microbat species is likely to be found lower within moister valleys of the locality rather than the upper slope areas in which the M2 Motorway is chiefly located. Species such as the Eastern False Pipistrelle are not considered to occur within the study area as they prefer moist habitats in vegetation characterised with tree species over 20 metres (DECCW, 2009).

The core likely foraging habitat for threatened microbats in the locality is concentrated in the larger areas of more mature vegetation that would not be substantially affected by the proposed works. The habitat affected by the proposed works is of marginal quality due to previous clearing, weed invasion and traffic noise. Due to the lack of suitable roosting habitat, and disturbance, this area is considered to be of relatively low value as potential habitat for the threatened microbat species listed above when compared to larger areas of vegetation at greater distance from the M2 Motorway.

The conclusions of the assessments are that a significant adverse impact on the above insectivorous microbat species is considered unlikely,

### Migratory Species

Migratory species are considered unlikely to rely on the affected areas as breeding, foraging or roosting habitat due to the level of disturbance adjacent to the M2 Motorway. Breeding habitat is more likely to be located in core bushland areas beyond the study area. Suitable foraging habitat is only considered to be marginal at best with preferred habitat more likely to be located in areas of less-disturbed habitat in the locality. Assessments of significance (provided in Appendix F) concluded that a significant adverse impact on migratory species is unlikely.

### Fauna habitat loss

The main direct impact on fauna is habitat removal. The works would cause a reduction in habitat available for native fauna species through the removal of native vegetation and habitat features such as rock outcrops and organic debris. The extent of habitat removal is likely to total approximately 21 hectares, of which, three hectares would be subsequently rehabilitated.

Vegetation removal (particularly native vegetation) has the potential to impact on fauna species through a reduction in the availability of feeding resources, shelter from environmental extremes, refuge from predators and breeding sites. Whilst removal of vegetation within the development footprint would be permanent, clearing for access and compound areas would be temporary as these areas would be rehabilitated post-construction.

No tree hollows of sufficient size to provide nesting opportunities for larger hollow-dependant species were observed within the areas potentially affected by clearing activities. Most of the trees removed are immature or semi-mature, but have the potential to develop hollows as they mature, providing opportunities for populations of hollow-dependent fauna to recover. The mitigation measures proposed include the installation of nest boxes to compensate for the loss of potential hollow-bearing trees.

#### Lighting impacts

Construction lighting would be required for works carried out at night-time (sunset-sunrise), especially during the winter months. Four proposed compound sites would be operational 24 hours per day. These compounds are discussed in detail in Section 10.8.

Light spill would occur at the locations of the proposed compound sites. Potential impacts to fauna resulting from light spill would be greatest adjacent to larger areas of bushland reserves, such as the proposed Terrys Creek Compound and the Darling Mills Creek Compound.

Nocturnal species are adapted to low light conditions to forage for food and may therefore be deterred from foraging areas as a result of excessive light spill. Nocturnal mammals and birds are also likely to be disturbed by artificial light at night-time as they are at an increased risk from predators.

The regular route of threatened bat species may also be affected as a result of light spill. The Grey-headed Flying-fox was recorded flying overhead in several locations and individuals feeding within the study area are considered most likely to roost in the Ku-ring-gai Flying-fox Reserve in Gordon. The study area does not contain camp sites for the Grey-headed Flying-fox and although vegetation in parts of the M2 corridor may be suitable for roosting, the presence of the M2 Motorway and walking trails with associated noise and light disturbances is considered likely to dissuade the species from roosting in these areas.

Potential impacts may occur to threatened insectivorous bat species, however species such as the Large-footed Myotis (*Myotis adversus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) are more likely to be found lower within the moister valleys of the locality rather than the upper slope areas in which the M2 Motorway and potential construction compound sites are chiefly located. Therefore, roosting and breeding habit for these species is considered unlikely to be affected by the increase in lighting as a result of the proposed project. The potential impacts to threatened bat species as a result of light spill are considered to be less likely during the winter months when foraging activities decline.

The increase in some species of insects attracted to light sources, such as moths, may be beneficial to some threatened insectivorous bat species that are high speed aerial foragers such as the Eastern Bentwing-Bat and Yellow-bellied Sheathtail-Bat.

Light mitigation would be addressed during the detail design stage to develop appropriate light spill management strategies, including measures such as correctly positioned and aimed floodlights and screening of compound areas for the control of construction vehicle headlamp impacts. Careful design and selection of luminaries is considered likely to minimise the impacts on fauna.

The existing M2 Motorway is lit and the proposed upgrade works would not result in significant additional light spill impacts beyond those already occurring.

### Indirect impacts and edge effects

A total of 21 hectares of vegetation would be cleared as a result of the project. Of the 21 hectares, 18 hectares would be within the development footprint and vegetation removal would be permanent. The remaining three hectares would be cleared for access and construction compound sites and would be rehabilitated post construction. Mature trees would be avoided where practicable in areas proposed for rehabilitation. Within this, the vegetation types that occur comprise Hinterland Sandstone Gully Forest and Sandstone Riparian Scrub. These communities are not listed as threatened ecological communities under the EPBC Act or TSC Act.

Alteration to fauna movement (wildlife) corridors may occur as a result of the works. The main wildlife corridors within the M2 corridor include the bushland and disturbed vegetation surrounding Blue Gum Creek, Devlins Creek, Darling Mills Creek and Terrys Creek.

Where bridge structures span Darling Mills Creek, Devlins Creek and Terrys Creek, the vegetation underneath forms the only habitat connection between bushland areas on opposite sides of the M2 Motorway. These areas are considered to be of particular importance to fauna movement. The vegetation underneath these structures is somewhat degraded due to previous earthworks, the impacts of shading and the interception of rainfall by the roadway overhead.

Closing the existing gap between the two bridge structures across Devlins Creek and widening to the south is the preferred option to minimise the potential impacts on the surrounding environment and avoid the need to construct two new culverts which would impact on the water quality of the Creek during construction.

Bridges and arch structures generally have the least impact on fish passage as they normally involve limited disturbance to the flow or the aquatic habitat of a waterway (Fairfull and Witheridge, 2003). The proposed widening of the bridge structures over each of these creeks has the potential to result in further degradation of riparian vegetation of these areas and hence limits their ability to act as movement corridors for terrestrial species due to shading and the reduction in soil moisture.

Fish passage can be adversely affected by the following conditions (Fairfull and Witheridge, 2003):

- Large scale turbulence resulting from bridge piers.
- Changes to in-stream and bank vegetation affecting water shading.
- Degraded aquatic habitat value.
- High water velocities and increased flood flow velocities.

The potential impact of the bridge piers may also result in localised changes to flow patterns and localised scour. Due to the sandy nature of soil under bridges, the construction of piers may result in increased erosion and sedimentation during the construction phase however erosion control plans would be implemented and these areas would be remediated (revegetated) or stabilised post-construction. The design and construction considerations for bridges and arches have been included in the mitigation measures detailed in Section 9.5.4.

The extension of culverts may also affect the passage of fish and other aquatic fauna. The most common fish passage problems associated with culverts include: excessive flow velocities within the culvert, inadequate flow depth within the culvert and debris blockage of the culvert (Fairfull and Witheridge, 2003). As the existing culverts present a potential constraint to fish movement, the extension of these barriers is unlikely to substantially alter the current situation.

Degradation of fauna habitat as a result of weed invasion and proliferation is a potential impact of the proposed works. Weed dominance may result in a reduction in plant species which are important as habitat for native wildlife. Weed thickets may harbour feral animals such as foxes and rabbits. With the implementation of the proposed weed management and vegetation rehabilitation measures it is considered that weed proliferation in relation to the project could be adequately managed.

#### Other operational impacts

Once constructed, there may be additional run-off from the upgraded M2 Motorway, which has the potential to result in indirect impacts to vegetation through erosion of soils, sedimentation of waterways and the potential movement of pollutants. As described in the Technical Paper 6, *M2 Upgrade Environmental Assessment – Surface Water Assessment* (AECOM, 2010), the existing water quality basins would be modified as required to account for significant changes in contributing catchment area or to meet the target pollutant reduction criteria. Due to the constrained project corridor, and in an effort to minimise further disturbance of the established vegetation, wherever practical it is proposed to modify the inlet/outlet details of the existing basins to better utilise the storage volume already available by increasing the ponded (extended) depth.

There are not expected to be other significant additional impacts above and beyond the current M2 Motorway operation.

### Significance of impacts

Assessments of significance were conducted for threatened flora and fauna species considered to have a moderate to high likelihood of occurrence, as described in Table 81 and Table 82. For those species listed under the NSW TSC Act, the significance of impact was undertaken in accordance with the heads of consideration as outlined in the *Draft Guidelines for Threatened Species Assessment* by the Department of Environment and Conservation and the Department of Primary Industries, 2005 (DEC and DPI, 2005). For those species listed as threatened or migratory under the provisions of the EPBC Act, potential impacts were assessed in accordance with the *Significant Impact Guidelines and Matters of National Significance* outlined by the Department of Environment and Heritage (DEH, 2006).

Based on assessments of significance conducted (refer to Appendix F of Technical Paper 3), it is not considered likely that the proposed works would have a significant impact on threatened flora or fauna species listed in Table 81 and Table 82.

Of the threatened terrestrial plant species that are considered to have potential to occur within the areas adjacent to the M2 Motorway, only *Epacris purpurascens var. purpurascens* was recorded during the field investigations conducted for the preparation of this report. Although this species is not listed as threatened under the EPBC Act, it is listed as vulnerable under the TSC Act. Individuals of this species found to be present were located in translocated soils including earth mounds and rock armoured batter slopes within the M2 corridor. An assessment of significance for the potential impact on this species concluded that the proposed works are unlikely to have a significant on this species.

The following species have also been recorded in the locality however were not recorded during recent flora surveys within the M2 corridor:

- Callistemon linearifolius.
- Darwinia biflora.
- Epacris purpurascens var. purpurascens.
- Persoonia hirsute.
- Pimelea curviflora var. curviflora.
- Tetratheca glandulosa.

Assessments of significance conducted, concluded that the potential impacts on the above listed species are not considered to be significant.

The M2 Upgrade project is not considered to have a significant impact on EPBC Act and TSC Act listed threatened ecological communities. The assessment of significance for the Blue Gum High Forest community has concluded that potential impacts on this community are not considered to be significant. The vegetation within the M2 corridor that is mapped (refer to Section 9.5.2 for description of mapping) as Sydney Turpentine – Ironbark Forest is considered to be Hinterland Sandstone Gully Forest, which is not a listed threatened community, therefore an assessment of significance has not been conducted for this community. Habitat for a variety of fauna species exists within the remnant vegetation occurring within the M2 corridor and surrounding bushland areas.

Threatened species with a moderate to high likelihood of using these areas include Grey-headed Flying-fox (*Pteropus poliocephalus*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Glossy Black Cockatoo (*Calyptorhynchus lathami*), Powerful Owl (*Ninox strenua*), Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolour*), Green and Golden Bell Frog (*Litoria aurea*), Red-crowned Toadlet (*Pseudophryne australis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern Bentwing-Bat (*Miniopterus schreibersii oceanensis*), Large-footed Myotis (*Myotis adversus*), Large-eared Pied Bat (*Chalinolobus dwyeri*).

Based on assessments of significance (including EPBC Matters of National Environmental Significance) conducted for the species listed above, the project is not considered to have a significant adverse affect on these threatened species.

The ten hectares of native vegetation required to be removed is chiefly found within the Hinterland Sandstone Gully Forest vegetation community that occurs throughout the M2 corridor. This vegetation community is not listed as an EEC under the EPBC Act or TSC Act and is widespread in the vicinity of the proposed M2 Upgrade project.

Approval under the EPBC Act is required where the DEWHA determines that there would likely be a significant impact on a matter of NES. A referral has been submitted to DEWHA for their determination. The referral illustrates that there are no significant impacts on matters of NES and therefore it recommends to DEWHA that the project is not a controlled action. On 19 February 2010 notification was received from DEWHA of the decision on referral (refer to Appendix G) concluding that. the proposed action is not deemed a controlled action and does not require further assessment or approval under the EPBC Act.

The amount of vegetation estimated to be cleared is approximately 21 hectares in total. Of the ten hectares of native vegetation removed by the proposal, approximately three hectares would be subsequently rehabilitated. Whilst removal of vegetation within the development footprint would be permanent, clearing for access and compound areas would be temporary as these areas would be rehabilitated post-construction. The final construction methodology for access and compound sites would be determined during the detailed design phase. As the widening of the M2 Motorway is alongside the existing M2 Motorway, vegetation fragmentation is not likely to be significantly increased.

Some of the areas affected by the upgrade (primarily areas near waterways) are currently infested with exotic vines and scramblers. Earthworks have the potential to spread these species. The proposed mitigation measures have been designed to minimise the likelihood of the introduction, spread and proliferation of weeds and to encourage the regeneration of native vegetation.

The presence of impervious surfaces such as roads within the catchments of the study area has resulted in alteration of the flow regime of creeks adjacent to the M2 Motorway. Detention basin works proposed are being designed with capacity for the additional stormwater (refer to Section 10.1) from the M2 Motorway, therefore the increased road surface as a result of the works is not considered likely to further alter the hydrology of the creeks of the study area.

### 9.5.4 Mitigation measures

Management measures for flora and fauna impacts were developed following the general principles, in order of preference, of:

- Avoiding impacts.
- Minimising impacts.
- Mitigating impacts.

The planning and route selection processes have, as far as possible, avoided impacts on flora and fauna habitats. The following section details the measures that would be implemented to minimise and mitigate flora and fauna impacts.

An Environmental Management Plan (EMP) would be developed that describes in detail how each of the management measures prescribed would be implemented during construction (CEMP) and operation (OEMP) of the works. This plan would be developed in consultation with DECCW, Industry and Investment (I&INSW) and other relevant stakeholders. The CEMP would be produced in accordance with the Construction Environmental Management Framework (refer to Appendix F).

The CEMP would include measures to minimise removal of vegetation in areas of construction throughout the extent and duration of the project, such as:

- Clearly marking and delineating the extents of required vegetation clearance in order to minimise the risk of over-clearing.
- Minimising clearing for construction compounds by retaining mature trees and other vegetation of conservation significance where feasible within compound sites.
- The demarcation of Blue Gum High Forest boundary to avoid potential indirect impacts to this CEEC.
- Prior to the commencement of construction, specimens of *Epacris purpurascens var. purpurascens* within areas identified for temporary clearing would be marked by an ecologist. Wherever feasible, the temporary clearing extents would be slightly modified to avoid the need to remove individuals of this species. Pre-clearance surveys prior to construction would also be conducted by a suitably qualified ecologist to avoid the need to remove other threatened flora species potentially occurring within the M2 corridor, as listed in Table 81.
- Potential hollow-bearing trees would be identified and marked, and targeted measures to minimise potential harm to fauna during clearing would be implemented.
- Stabilisation of the riparian zone against flow changes would be implemented as described in Technical Paper 6, *M2 Upgrade Environmental Assessment – Surface Water Assessment* (AECOM 2010). Riparian areas disturbed during the works would be reinstated and replanted as quickly as possible.

The CEMP would include measures to minimise the indirect impacts on flora and fauna as a result of vegetation removal in areas of construction throughout the extent and duration of the project, such as:

- Earth-working machinery would be received on-site free from excessive soil and vegetative matter to minimise the likelihood of introducing weed seeds and plant pathogens (for example Phytophthora root rot fungus) to project areas.
- Cleaning of equipment used for works within detention basins to minimise the likelihood of the transmission of any frog pathogens (for example Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)) would involve the use of a high pressure hose (or a suitable alternative method) to remove mud after use in a water body and allowing equipment to dry fully prior to use in the next water body.

Measures to minimise the direct impacts on flora and fauna would include:

- Prior to works which involve the clearing of vegetation and debris within detention basins and drainage lines, a suitable and targeted survey would be undertaken by an ecologist in order to allow for the detection of any Green and Golden Bell Frogs or Red-crowned Toadlets. If Green and Golden Bell Frogs or Red-crowned Toadlets are detected, no clearing works within these areas would commence until the threatened frog species response provisions in the EMP have been implemented.
- Weed control measures in known Red-crowned Toadlet occupation sites (TIDC site) should be avoided.
- Construction compound lighting would be directed towards the ground so that the angle between the beam and the vertical is kept as small as possible. Glare would be kept to a minimum by keeping the main beam angle less than 70 degrees wherever practicable.
- Non-translucent barriers should be positioned to shield sensitive locations located directly opposite access points to minimise disturbances to native fauna from vehicle headlights entering and exiting the site.
- Where feasible, site lighting should be directed away from sensitive locations such as potential foraging areas and movement corridors within the larger more intact areas of bushland such as Bidjigal Reserve, Lane Cove National Park and Pennant Hills Park. Wherever possible, trees would not be directly illuminated.
- Accessories such as light shields mounted at the front or back of the light source would be used where required to direct light to the intended area only and minimise excessive light spill.
- Where feasible, the mounting height of the lighting column would be lowered to reduce horizontal light spill.
- The use of high power lamps used for security at compound sites would be avoided where possible. Accessories such as glass protectors (glass glazing, preferred due to their UV filtration characteristics) would be considered during the design of light installations.

Measures to mitigate the loss of vegetation as a result of the project would include:

- Revegetation of disturbed areas as a result of construction activities, adjacent to the construction areas and bordering natural bushland, including fauna habitat removed for construction compounds, would be conducted by suitably qualified and experienced persons using local provenance plant species representative of the relevant vegetation communities. This strategy would be documented in a Landscape Plan or bushland rehabilitation section of the CEMP.
- In areas bordering adjacent urban development, revegetation works would be undertaken in accordance with a Landscape Plan.
- Where available, seeds would be collected from local understorey and ground layer vegetation prior to clearing and from felled trees and branches following clearing where feasible for use in revegetation.
- A revegetation strategy would be developed that takes into account the availability of light, moisture and the most suitable plant species.
- Reuse of felled native trees in habitat augmentation within revegetated areas and mulching of other native vegetation cleared for use in soil stabilisation and vegetation rehabilitation.
- Weed management as required in areas affected by construction throughout the extent and duration of the project (in a staged manner and for a minimum period of two year minimum following construction works).
- Reuse of the soil seedbank where practicable during revegetation works either within or outside the M2 corridor.

The CEMP would include measures to minimise the impacts on riparian vegetation and aquatic environments such as:

- Potential chemical pollutants (e.g. fuels, oils, lubricants, paints, etc.) would be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of pollution of aquatic environments.
- Works around waterways would be managed to retain bank stability and prevent erosion.
- Water quality would be protected through the implementation of suitable sediment control measures in relevant work areas.
- Where practicable and feasible, bridge piers or foundations located within the main waterway channel would be avoided.
- Where practical, culverts would be aligned with the downstream channel to minimise bank erosion.
- Works would be sited and carried out to avoid the clearing of riparian vegetation where practicable.
- Riparian areas disturbed during the works would be reinstated and replanted as quickly as possible with the aim of providing a net long term biodiversity benefit.
- Where practicable and feasible, temporary piers would be used to maintain flow throughout the construction phase.

### Biodiversity offset strategy

Although the ecological assessment concludes that the project would not have a significant impact on threatened flora and fauna species or ecological communities, there would be some residual impacts in relation to the clearing of vegetation. In order to offset the residual impacts to native fauna habitat and the residual impacts to *Epacris purpurascens var. purpurascens*, a biodiversity offset strategy would be developed in consultation with DECCW.

Of the approximately ten hectares of native vegetation proposed to be cleared by the project, approximately three hectares would be subsequently rehabilitated. The residual impacts of the project comprise the permanent clearing of some seven hectares of native vegetation. The offset strategy prepared for the project would aim to address the loss of this vegetation, consisting of the following vegetation types:

- Coastal Sandstone Ridgetop Woodland.
- Hinterland Sandstone Gully Forest.
- Sydney Hinterland Transition Woodland.
- Sandstone Riparian Scrub.

The offset strategy would focus on conservation and enhancement of habitat in the M2 corridor.

The biodiversity offset strategy would outline the process for identifying priority areas for habitat enhancement within the M2 corridor and measures that would be undertaken to enhance the value of habitat. The areas to be included in the biodiversity offset strategy and the specific measures to be implemented would be determined in consultation with DECCW.

In terms of identifying priority areas for habitat enhancement, it is anticipated that priority would be given to habitat within the M2 corridor that adjoins major waterway crossings, is along the edges of high quality native vegetation in which weed invasion is apparent and the edges of waterways. In addition, factors such as the condition of habitat, its connectivity and proximity to remnant native vegetation would also be considered when identifying areas for enhancement.

Management measures to enhance native fauna habitat within the M2 corridor would include bush regeneration throughout the M2 corridor, installation of nest boxes for birds and bats, and the use of boulders and felled timber to enhance the structural complexity of fauna habitat. The following management actions would also be considered:

- Control of weeds.
- Management of fire for conservation.
- Management of human disturbance.
- Retention of regrowth and remnant native vegetation.
- Replanting or supplementary planting where natural regeneration would not be sufficient.
- Retention of dead timber.
- Control of erosion.
- Retention of rocks.

## 9.6 Urban design and visual assessment

An assessment of the landscape, urban design and visual impacts associated with the project has been undertaken and is presented below. This assessment is supported by *Technical Paper 4 – Urban design, visual and landscape* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *Urban design and landscaping issues:*<br>*The environmental assessment must include consideration of the urban design and landscape implications of the project, including identification of urban design and landscaping objectives to enhance the current road corridor and to demonstrate how the proposed urban design elements of the project would be consistent with the existing (and desired) character of the area.* | *Sections 9.6.2, 9.6.3, 6.5.2, Technical Paper 4* |

This section and Technical Paper 4 have been prepared by RTA registered urban designers HBO+EMBT in accordance with the RTA Urban Design Policy, *Beyond the Pavement*. Key urban and landscape design objectives for the upgrade of the M2 Motorway were be considered throughout the phases of the project, and used to inform design decisions and to evaluate the success of design proposals.

The vision for the urban and landscape design of the M2 Motorway is that

> 'The vegetated landscape and the uniqueness of the topography in this part of Sydney should inspire the design of the future upgrade and development of the M2 Motorway. The project should reflect the corridor's role as an important north-west route linking Ryde, Blacktown and the M7 Motorway. Its design should be simple, well considered, elegant, refined, and robust, reflect the natural and cultural qualities of the region through which it passes and establish a clear and recognisable identity for the M2 Motorway.'

### 9.6.1 Existing environment

An analysis of the physical context of the M2 Motorway was documented to assist in understanding the environment surrounding the M2 Motorway and the existing conditions of the natural and urban setting. This analysis took the form of field surveys and a desktop study and was used to establish the key attributes of the M2 Motorway which in turn determine the urban and landscape character precincts and specific site constraints and opportunities. These were used to generate objectives and principles which form the urban and landscape design framework for the M2 Upgrade project.

Both the M7 Motorway and the Lane Cove Tunnel are recent high quality additions to the Sydney Orbital network. These links contrast strongly with the older M2 Motorway character which has a lower quality of urban and landscape design reflected not only in the appearance of the bridges, noise walls and retaining walls, but also in the vehicular travel experience due to the uneven road surface.

## Existing M2 Motorway Character

The distribution and frequency of key visual qualities, built elements and vegetation along the M2 corridor define the different character experiences. When combined with the adjoining land uses these form distinct precincts with specific visual qualities. The following five precincts have been identified through the contextual analysis (west to east, refer to Figure 32):

- Precinct 1: Cumberland Plains – Old Windsor Road to Windsor Road interchange.
- Precinct 2: Bushland Interface – Windsor Road to Pennant Hills Road.
- Precinct 3: Suburban Forest Interface – Pennant Hills Road to Beecroft Road / Devlins Creek.
- Precinct 4: Suburban Bushland Interface – Beecroft Road /Devlins Creek to Terrys Creek.
- Precinct 5: Urban Bushland Interface – Terrys Creek to Lane Cove Tunnel.

Each precinct has defining features that have been used to guide the urban design treatments for each Motorway section.

The M2 Motorway passes (from west to east) through the Local Government areas (LGAs) of the Hills Shire (Precincts 1 and 2), Hornsby (Precinct 3) and Ryde (Precincts 4 and 5), and is in close proximity to Blacktown and Parramatta LGAs. The M2 Motorway passes through the urban development of the north-western suburbs of Sydney (Precincts 1, 2, and 3) and the expanding commercial area around Macquarie Shopping Centre, Macquarie University and Macquarie Business Park (Precinct 5).

The topography of the site varies as the road traverses both ridges and valleys as the route heads east towards the centre of Sydney. The current road alignment is generally not responsive to the landform through which it passes. The alignment slicing through the landscape, with cuttings, tunnels, high embankments, retaining walls and bridges used to achieve the road design requirements (refer to Figure 33). This to some extent removes the road user from the contextual experience. Despite this there are a number of key topographical characteristics which remain evident and inform the user of their journey’s context.

The vegetation of the M2 corridor is a mix of stands of remnant vegetation, weeds and re-vegetation works that were undertaken as part of the original development. The natural vegetation of the region is preserved in National Park or Reserves along with isolated remnant stands within the urban fabric of the adjoining residential areas.

The M2 Motorway travels through a highly populated area of metropolitan Sydney with motorway built elements, such as noise walls, dominating most of the M2 corridor. Along many lengths of the M2 Motorway the views are confined to the road corridor, opening up only occasionally. In most cases, the motorist is unaware of the residential housing outside the road corridor as noise walls interrupt the flow of the landscape and restrict views from the M2 Motorway. The noise walls, despite efforts to camouflage the structures by painting them green, are visually dominant along much of the route.

The six major intersections create decision points for the motorists. These intersections are defined by large bridge infrastructure overpasses crossing the M2 Motorway, with on-ramps and off-ramps and increased directional signage and road furniture, such as street lighting. The man-made built structures dominate, with large cuttings and retaining walls visually limiting the M2 Motorway views.

Towards Pennant Hills Road (Precinct 2), the M2 Motorway alignment descends into the low lying landform of the creek valley. The Pennant Hills Road intersection is a strong, hard-edged built form. The M2 Motorway passes beneath the wide bridge resulting in high vertical retaining walls with finishes consisting of shotcrete and exposed rock bolts. Planting on top of the bridge structure softens and greens the wide expanse of asphalt.

The overbridge structures along the M2 Motorway are generally poorly resolved with the overall structural form and pier/headstock detailing creating a solid and overly bulky visual impression. At Beecroft Road intersection (Precincts 3 and 4), visual complexity is created with the additional crossing of the Northern Rail Line, the overpass structure for buses and a series of messy, complicated noise walls and cuttings.

Large sandstone cuttings run parallel to the M2 Motorway, where the road is lower than the surrounding topography. The natural sandstone is attractive and warmly coloured enriching the visual travel experience. The cuttings also create a hard edge, restricting the motorist views of the M2 Motorway. In multiple locations the cuttings have been stabilised with shotcrete creating a dull, colourless vertical or near-vertical wall. Often vegetation is visible at the top of the cuttings, softening the overall effect.

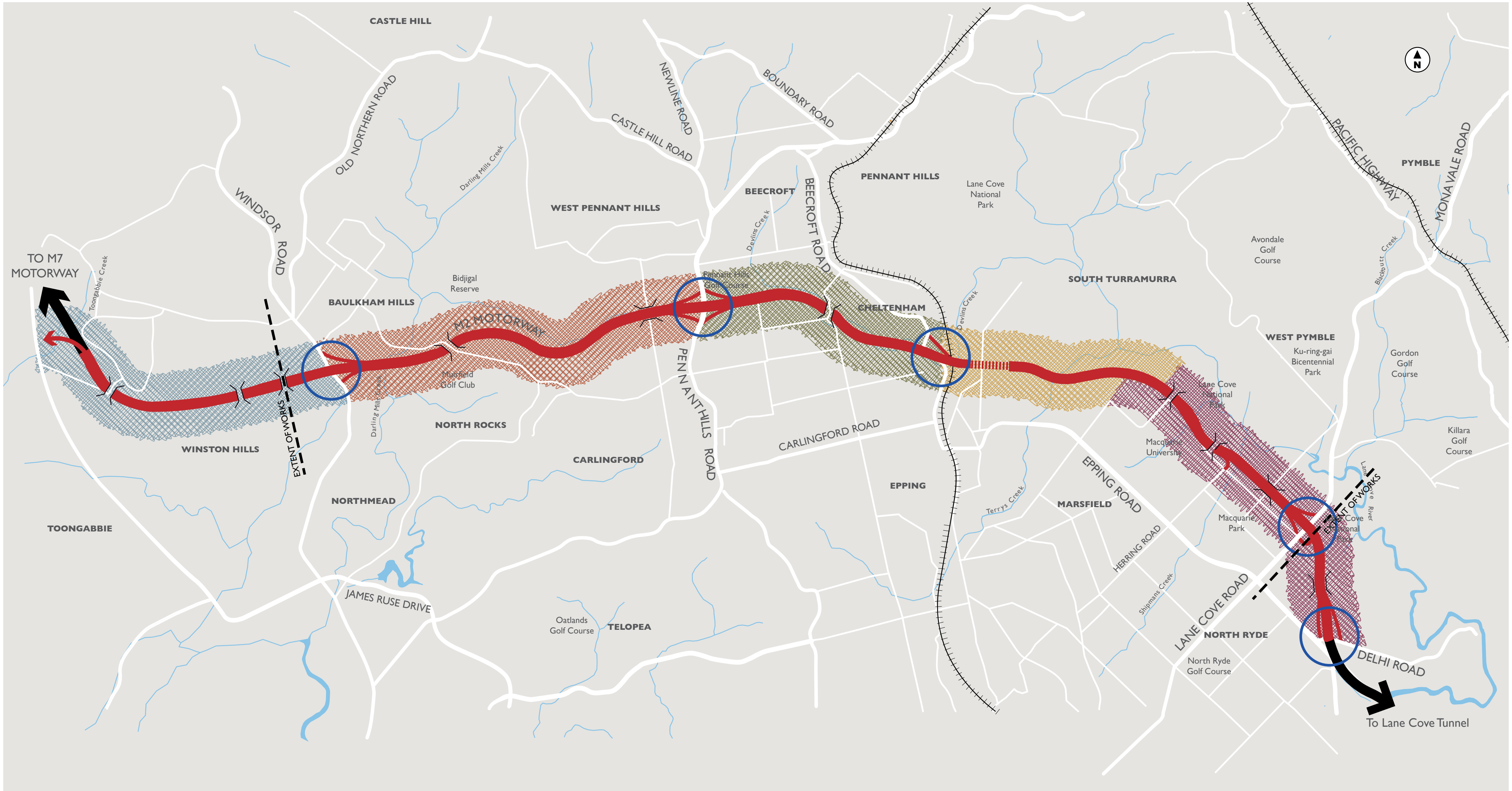



Figure 32 – Contexual analysis showing location of five precincts along M2 Motorway route

Source: HBO+EMTB

- M2 Motorway
- Norfolk Tunnel
- Overpass / Underpass
- Major Intersection

- Precinct 1: Old Windsor Road - Windsor Road Interchange: Cumberland Plain
- Precinct 2: Windsor Road - Pennant Hills Road: Bushland Interface
- Precinct 3: Pennant Hills Road - Beecroft Road: Suburban - Forest Interface
- Precinct 4: Beecroft Road/Devlins Creek - Terrys Creek/Crimea Road: Suburban Bushland Interface
- Precinct 5: Terrys Creek/Crimea Road - Delhi Road: Urban Bushland Interface

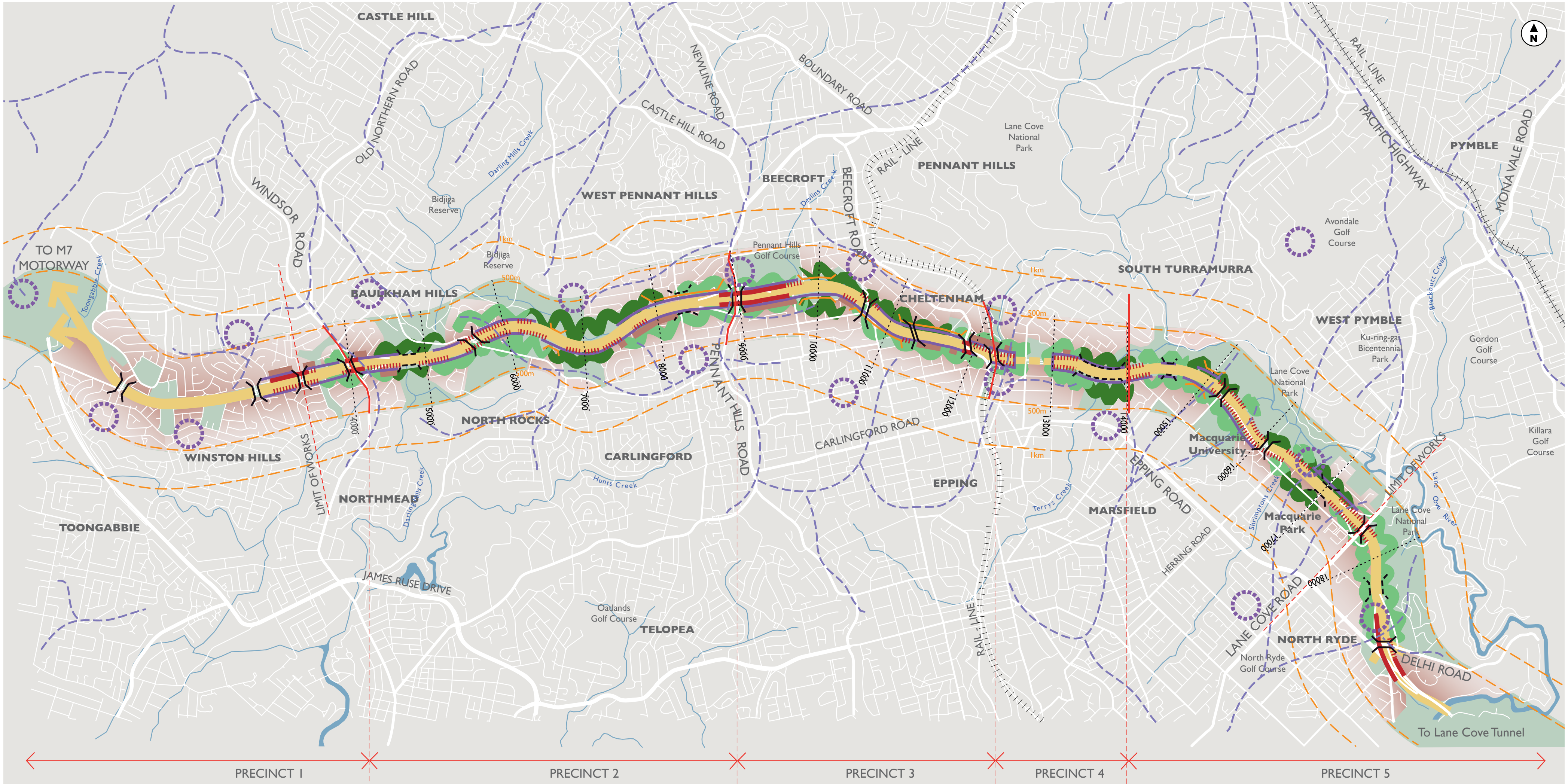



Figure 33 – Visual elements along the M2 Motorway

Source: HBO+EMTB

- M2 Motorway
- M2 Tunnel
- Properties immediately adjoining M2 corridor with minimal buffer
- Properties potentially overlooking corridor
- Parklands, golf courses and open spaces
- Low density vegetation
- Bridge overpass
- Underpass
- Embankments (fill)
- Cuttings
- Retaining walls
- Noise walls
- Ridge lines
- Views of M2 Motorway from local road or over-Bridge
- High points

### 9.6.2 Impact assessment

The undertaking of the visual assessment, landscape and urban design concept involved an iterative process in which preliminary information was provided to highlight key issues and constraints. Critical issues were then integrated into the engineering design. This process enabled the road designs to be refined as they develop, thereby minimising the potential visual impact.

As the works are an upgrade of an existing facility, rather than new infrastructure element, the visual impact of the upgrade is limited. The impacts are largely restricted to the immediate M2 Motorway neighbours, where the scale of change is most evident.

The road context is associated with natural communities, including the Lane Cove National Park, Devlins Creek Valley or the Darling Mills Creek Valley. The suburban development adjacent to the M2 corridor is also an environment in which trees are dominant native and exotic species. The upgrade nature of this project means that to some extent the ability to substantially influence the degree of change is minimal. As the general alignment is a given, the primary impacts are already experienced and the extents to which modifications can occur are limited.

#### Visual Assessment

Visual impacts are assessed in two ways, from the perspective of:

- The M2 Motorway viewer – the M2 corridor's neighbours.
- The M2 Motorway user – those travelling along the road.

The road viewer has been the primary consideration in terms of the assessment due to the permanent nature of the impacts experienced by this viewer. Visual impacts experienced as a result of the upgrade are associated with the following areas:

- Construction and/or realignment of noise walls, resulting in potential increases in scale, visual bulk of the structures when viewed from both within and outside the corridor.
- Changes to cutting profiles and their treatment.
- Changes to bridges involving the widening of existing structures and the support structures needed to facilitate this.
- Widening of pavement extents increase the expanse of road pavement, visible primarily from within the M2 corridor by the road user.
- Construction of retaining walls to fill embankments, minimising vegetation loss but introducing a built element.
- Loss of vegetation cover, potentially revealing more of the road and its structures to the adjoining residences which have become accustomed to the vegetative buffer.

In addition to these direct impacts there are short term indirect impacts caused by the need for construction compound sites both within and or adjoining the road corridor. Construction compound sites include the construction of temporary site sheds and amenities, provision of lay down areas for storage of structures such as bridge girders, culverts, car parking and the like.

Visual impacts associated with such facilities include:

- Clearing of lands of existing screening vegetation.
- Construction of temporary structures with potential to overlook or be overlooked by adjacent properties.

The visual assessment methodology comprised of three distinct parts, which are:

- Understanding of context, setting, and key view field – acknowledging the key physical attributes of the area and understanding the relationship of the M2 corridor to the nearby properties.
- Assessment of the proposed concept – visual sensitivity and visual magnitude are assessed using a rating system then combined to form an overall rating.
- Recommendations of opportunities/treatments to address impacts. Having identified the issue and the level of visual impact, designs were undertaken to avoid, reduce, and where possible remedy or offset, significant negative or adverse effects on the landscape.

The visual impact assessment summary is presented in Tables 87 to 96.

The following key was used in the assessment of impacts:

- Visual Sensitivity: Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High.
- Nature of Impact: A = Adverse; N = Neutral; B = Beneficial.
- Station: EB – East Bound – Works widened beyond east bound carriageway. WB – West Bound - Works widened beyond east bound carriageway.

Table 87 Precinct 1 visual impact assessment summary

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 3550–3640 (EB) | Windsor Road EB Off–Ramp (No. 14–22 Craig Avenue to 22 Livingstone Avenue) | | | | HM | H | H | • An existing 4–7 metre high wall would increase to 7–11 metres high + 4 metre noise wall along property boundaries.<br>• Loss of existing embankment and screen planting above retaining wall. | • Design treatment of noise walls and retaining walls may consider use of texture, materials and colour to reduce mass of new walls.<br>• Offset from boundary to be maximised to allow revegetation/ screen planting to occur. |
| 3600 EB/WB | Entry/exit to off ramps (M2 Motorway viewer) | | | | M | M | M | • Construction of Toll gantry may result in light spill beyond the corridor. | • Design gantry and associated lighting so that gantry is simple, clean structure and lighting is focused and is of a cut off type that minimises light spill. |
| | (M2 Motorway user) | | | | M | L | ML | • Structure may be visually obtrusive within the corridor | • Design gantry so that a simple, clean light profile is achieved. |
| 3640–3770 (EB) | Windsor Road EB Off–Ramp (No. 12–20 Livingstone Avenue to 3 Horwood Avenue) | | | | H | HM | H | • Between stations 3640–3770 the existing walls range between 0–7 metres high and would increase to 8.5–11 metres high + 4 metre noise wall, leaving a 3.5–4 metre wide green corridor behind noise wall.<br>• Loss of existing embankment and screen planting behind noise wall. | • Design treatment of noise walls and retaining walls may consider use of texture, materials and colour to reduce mass of new walls.<br>• Offset from boundary to be maximised to allow revegetation/ screen planting. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 3700 (WB) | Windsor Road WB On-Ramp (Junction Road and Goodin Road) | X | | | HM | H | H | • An existing 6 metre high wall would increase to 10 metres high + 4 metre noise wall.<br>• Loss of existing embankment and screen planting behind noise wall but potential to retain verge planting.<br>• There is no opportunity for additional screen planting to top of wall in current proposal. | • Acrylic noise walls may be considered where solar access is reduced to adjacent properties (subject to other project priorities).<br>• Potential to widen the verge, on the north side of Junction Road to allow the establishment of screen planting at the base of the retaining wall to be reviewed with agencies. |
| 3730 (WB) | Windsor Road WB On-Ramp (Junction Road) | X | | | H | H | H | • A new 3.5 metre high wall + 4 metre noise wall would move closer to adjacent properties.<br>• Loss of existing embankment planting behind noise wall. | • Provide additional vegetation behind noise wall for screening.<br>• Potential to widen verge, on north side of Junction Road to allow the establishment of screen planting at the base of the retaining wall to be reviewed with agencies. |
| 3770-3820 (EB) | Windsor Road EB Off-Ramp – 3 Horwood Ave to 8 Livingstone Ave Baulkham Hills | X | | | H | H | H | • A new 6-7 metre high wall + 4 metre noise wall would be introduced, leaving a 0 -3.5 metre wide green corridor behind wall.<br>• Loss of existing embankment planting behind noise wall. | • Design treatment of noise walls and retaining walls may consider use of texture, materials and colour to reduce mass of new walls.<br>• Provide additional vegetation behind noise wall for screening. |
| 3700- 4000 EB/WB | Adjacent on/off ramps<br>(M2 Motorway user) | | X | | M | M | M | • Construction of new retaining walls adjacent the main alignment both east and west bound.<br>• Expansion of M2 Motorway footprint. | • New alignment would see revisions to the existing shotcrete abutment which would improve the visual appearance of the abutment integrating it with the bridge.<br>• Landscape can be incorporated adjacent walls to create a distinct interchange character. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 3820–3880 (EB) | Windsor Road EB Off–Ramp – No. 2 to 8 Livingstone Avenue Baulkham Hills Model Farms | | | | H | H | H | • A new 7–7.5 metre high wall + 4m noise wall would be introduced along property boundary.<br>• Loss of green buffer zone between M2 Motorway. | • Design treatment of noise walls and retaining walls may consider use of texture, materials and colour to reduce mass of new walls.<br>• Potential to provide screen planting as part of property adjustments to minimise impacts. |
| 3550-4000 (EB and WB) | Verge of Motorway Corridor (M2 Motorway user) | | | | ML | M | M | • Construction of new noise wall and removal of patchy landscape | • Enhance noise wall treatment and simplification of landscape and barrier treatments would improve visual appearance. |
| 3900 (WB) | Windsor Road WB On–Ramp – Junction Road (Murrills Crescent) Model Farms | | | | H | H | H | • Existing embankment and screen planting would have to be removed.<br>• A new 3.5 metre high wall + 4 metre high noise wall would have potentially significant visual impact along Junction Road. | • Acrylic noise walls may be considered where solar access is reduced to adjacent properties (subject to other project priorities).<br>• Potential to widen verge, on north side of Junction Road to allow the establishment of screen planting at the base of the retaining wall to be reviewed with agencies. |
| 3900 (EB) | Windsor Road EB Off–Ramp | | | | HM | H | H | • A new 3.5 metre high wall + 4 metre noise wall would have potentially significant visual impact to properties on Livingstone Avenue.<br>• Existing corridor for screen planting visible from adjacent open space would be lost.<br>• Large level difference between off–ramp and adjacent land. | • Review grading to minimise scale of wall and provide usable space on adjoining land. |
| 4000 (WB) | Windsor Road On–Ramp/ Vacant Land Model Farms | | | | H | H | H | • Road alignment of on–ramp would be closer to adjacent properties.<br>• A new 2 metre high wall (approximately) + 4 metre noise wall have potentially significant impact to adjacent property. | • Provide additional planting for screening at base of new wall.<br>• Opportunity for surplus land to be used for noise wall housing or similar as a show case for housing adjoining arterial roads. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 4000 (EB) | Windsor Road Bridge widening | | | | L | L | L | • Increase in scale, width of the existing bridge. | • Provide a structure that is consistent with the proportions of the existing structure and its elements.<br>• Provides a smooth clean transition between the old and new structures. |

Table 88 Precinct 1 site compounds – temporary construction activities

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| 4000 (WB) | Windsor Road<br>(north) | | | | M | M | M | Site compound to be established for duration of works, including: team office and lay down area. | Siting of buildings to consider impact of overlooking of adjacent properties.<br>Siting of noise generating activities (lay down area) to be sited as far from adjoining residences as possible.<br>Temporary screening to minimise dust and noise impacts. |

*Visual Sensitivity*

*Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High*

*Nature of Impact*

*A = Adverse; N = Neutral; B = Beneficial*

*Station*

*EB – Eastbound – Works widened beyond east bound carriageway.*

*WB – Westbound – Works widened beyond east bound carriageway.*

Table 89 Precinct 2 visual impact assessment summary

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 4100–4500 (WB) | 257 Windsor Road Northmead | | | | M | M | M | • Existing noise walls replaced and increased in height. | • Alignment and supports to be considered in relation to adjoining residences. A simple, smooth, even alignment would be adopted and the impacts of the supports minimised.<br>• Potential to integrate design with the interchange character to be considered. |
| 4550 – 4750 (EB) | Darling Mills Creek Bridge<br>(M2 Motorway Viewer) | | | | M | L | ML | • Construction of bridge widening would conflict with existing vegetation under bridge.<br>• The EB widening, poses a low visual impact due to sufficient screening provided by the surrounding bushland from adjoining residences.<br>• Visual amenity under bridge would consider existing walking tracks. | • Care needs to be taken with the design of the bridge structure so that it does not detract from the natural environment and is consistent in character with the existing.<br>• Clearing for construction access would be limited and mature trees retained where practical |
| | (M2 Motorway User) | | | | M | L | ML | • Pavement area increased | • Detailing of existing bridge parapets retained to maintain visual character of existing structure. |
| 4850–4950 (EB) | Retaining wall | | | | L | L | L | • Construction of retaining walls in relatively steep and inaccessible terrain may result in loss of vegetation cover beyond work footprint. | • Design of retaining wall may consider use of texture and materials to reduce the scale of retaining wall.<br>• Vegetation to be reinstated where damaged by works. |
| 5100–5400 (EB) | Darling Mills Forest/ Renown Road Baulkham Hills | | | | L | L | L | • Existing retaining and noise walls are to be relocated approximately 3.5 metres closer to residential properties. | • Improve design treatment of noise walls<br>• Reinstate cleared vegetation behind noise walls to provide screening from residences. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 5400–5700 (EB) | Renown Road/ Mill Drive Baulkham Hills | | | | L (others)<br><br>HM (Property No. 27–31) | L (others)<br><br>HM (Property No. 27–31) | L (others)<br><br>HM (Property No. 27–31) | • Existing noise walls are at least 15m away from adjacent properties. The noise walls are being relocated closer to adjoining properties. No.27–31 Mill Drive are most impacted.<br>• Loss of buffer vegetation along embankment. | • Alignment and supports to be considered in relation to adjoining residences. A simple, smooth, even alignment would be adopted and the impacts of the supports minimised.<br>• Provide vegetation behind noise wall to provide screening to adjacent residences where space permits. |
| 5500 | Barclay Road Bridge<br>(M2 Motorway User) | | | | M | L | ML | • –Bridge is to be lengthened, requiring removal of existing abutment, and alteration to spans resulting in uneven spans. | • Structural detailing to consider the form of the leading edge of the new structure so that a consistent edge line is created.<br>• Bridge design is to integrate with that of the existing structures including, rails, throw screens parapets etc. |
| 5700–5950 (EB) | Mill Drive Baulkham Hills | | | | L | L | L | • Existing noise walls are being relocated up to 4 metres closer to adjacent property. | • Alignment and supports to be considered in relation to adjoining residences. A simple, smooth, even alignment would be adopted and the impacts of the supports minimised. |
| 5900–6230 (WB) | Dale Place/Muirfield High School North Rocks | | | | L | L | L | • Existing noise wall is being relocated up to 3 metres closer to adjacent property. | • Reinstate cleared vegetation behind noise wall to provide screening to adjacent residences. |
| 6220–6560 (WB) | Muirfield High School North Rocks (M2 Motorway viewer) | | | | L | NE | L | • New embankment is being proposed up to 5 metres closer to adjacent property. | • Provide additional vegetation along top of embankment. |
| | (M2 Motorway user) | | | | M | ML | ML | • Additional carriageway and widening of cutting | • Potential to steepen lower half of cut and flatten top to enhance revegetation and screening of walls |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 6480–6740 (WB) | Yale Close Bridge | | | | M | ML | M | • Retaining and noise walls, and bridge are being relocated up to 4 metres closer to adjacent properties in Yale Place. | • Reinstate cleared vegetation to provide additional screening of bridge from adjoining residences.<br>• Noise and retaining walls may be designed using either colour, materials or texture consistent with the existing bridge and which minimise impacts on adjacent residences |
| 6700–7270 (WB) | Bidjigal Reserve/Royal Institute for Deaf and Blind Children, North Rocks | | | | L | L | L | • Existing noise wall is being relocated along top of new embankment.<br>• 6850 – 6920 retaining wall is being constructed with noise wall attached. | • Reinstate cleared vegetation to provide additional screening of bridge from adjoining residences. Retaining wall /noise wall may consider use of colour, texture or materials to reduce visual bulk. |
| 7370–7640 (WB) | Wilshire Avenue/Morton Avenue/Carmen Drive Carlingford | | | | L | VL | L | • 3.5m lane widening with new embankment.<br>• Existing noise wall is being relocated up to 3.5 metres closer to adjacent property. | • Provide additional vegetation behind noise wall for screening. |
| 7600–7950 (EB) | Bushland | | | | L | NE | L | • Existing noise wall is being relocated into bushland. | • Reinstate cleared vegetation behind noise wall for screening. |
| 7630 (WB) | Morton Avenue Carlingford | | | | L | NE | L | • The widening of the EB lane would have some impact to views on Morton Avenue. There are currently filtered views of the M2 Motorway traffic through existing vegetation. | • Provide additional vegetation behind noise wall for screening. |
| 7700–8050 (WB) | 29–31 Carmen Drive Carlingford | | | | H (Property No.29–31)<br>L (others) | HM (Property No.29–31)<br>L (others) | H (Property No.29–31)<br>L (others) | • Existing noise walls are being increased in height.<br>• Increase in wall height walls may affect solar access into property No. 29 and 31. | • Acrylic noise walls may be considered where solar access is affected<br>• Provide additional vegetation behind noise wall for screening. |

Table 90 Precinct 2 site compounds – temporary construction activities

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| 4550 | Darling Mills eastern end of Windsor Road Slip Lane | | | | ML | M | M | • Site compound to be established for: site sheds and lay down area.<br>• Impact on existing vegetation cover for construction access. | • Limit footprint to a minimum maintaining as much canopy vegetation as possible.<br>• Minimise earthworks to retain natural topographical features. |
| 5500 | Barclay Road / Perry Street | | | | M | M | M | • Site compound to be established for: stockpile and handling area.<br>• Removal of existing mound and vegetation to Perry Street frontage. | • Potential to retain vegetation on periphery of site.<br>• Once complete area to be revegetated enhancing landscape character of area. |
| 6840 | Yale Close Bridge Compound (Duncan Place) | | | | H | M | MH | • Site Compound to be established for: stockpile and handling area.<br>• Access track along boundary.<br>• Potential loss of existing vegetation cover between property and M2 Motorway. | • Potential to retain vegetation on periphery of site.<br>• Once complete area to be revegetated enhancing landscape character of area. |

*Visual Sensitivity*

*Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High*

*Nature of Impact*

*A = Adverse; N = Neutral; B = Beneficial*

*Station*

*EB – Eastbound – Works widened beyond east bound carriageway.*

*WB – Westbound – Works widened beyond east bound carriageway.*

Table 91 Precinct 3 visual impact assessment summary

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 9650 – 9850 (WB) | Lamorna Avenue/Orchard Road Beecroft | | | | H | M | MH | • Existing noise wall backs onto houses with minimal offset from house wall.<br>• Noise wall may be relocated onto boundary potentially impacting existing screening. | • Improve treatment of noise walls and provide additional screen planting behind noise wall. This may be undertaken as property adjustments. |
| 9670–10260 (WB) | Recreation Reserve Beecroft/ Bridge | | | | M | M | M | • Existing noise wall is being relocated up to 3 metres into bushland. | • Revegetate in response to disturbance to natural bushland. |
| 9850–10350 (EB) | Chilworth Recreation Reserve Beecroft | | | | L | ML | ML | • Existing noise walls are to be replaced and increased in height. | • Acrylic noise walls may be considered to allow solar access and to improve connection with adjoining environment (subject to other project priorities). |
| 9900–10100 (EB and WB) | Devlin Creek Bridge | | | | M | M | M | • Devlins Creek Bridge widening to western side including construction of new piers, girders, deck and noise wall.<br>• Widened in centre lane removing light well. | • Consider design of bridge to be consistent with existing.<br>• Potential to improve linkages with natural environment with noise wall through use of acrylic panels where noise walls are replaced on bridge (subject to other project priorities).<br>• Maintain access under new bridge structure. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 10260–10550 (WB) | Allerton Road to Kirkham Street Bridge Beecroft (M2 Motorway user) | | | | ML | M | M | • Existing noise wall is retained and cutting steepened. Cutting has a substantial area if shotcrete which would need to be addressed in the new cutting. | • Provide additional vegetation behind noise wall for screening. • Where structural support needs to be provided to cut face this would be undertaken in accordance with RTA Shotcrete Guidelines. Extent of shotcrete is to be minimised and integrated with cut face. |
| 10550–10800 | Kirkham Street Bridge Beecroft to Meadow Close Roselea | | | | M | L | ML | • Existing noise wall is being relocated up to 2.5 metres closer to adjacent properties. • Lane widening over open canal and embankment. • Kirkham Street Bridge is to be lengthened, including removal and replacement of southern pier. | • Design of new structure over drainage canal to be carefully considered to reduce apparent scale of structure and maintain drainage capacity. • Bridge structure to be integrated with existing through use of common parapet and girder profile to leading edge. |
| 10800 (WB) | 7 Meadow Close Roselea | | | | HM | L | M | • Proposed widening would move 4 metre high noise wall closer to residential properties. • Existing noise wall and concrete drainage canal are presently visually dominant as they run past residential properties. | • Noise wall and retaining walls may consider the use of materials, colour and/or texture to minimise scale of walls. • Potential for improved screen planting. |
| 10800–11150 (WB) | Meadow Close to Kerry Avenue bushland Roselea | | | | L | L | L | • New noise wall and retaining walls are being relocated up to 2.5 metres closer to adjacent properties and bushland. | • Noise wall and retaining walls to consider the use of colour and/or texture to minimise scale of walls. |
| 11150–11300 (WB) | Wycombe Street Epping | | | | L | NE | L | • Lane widening occurs within existing footprint, no change in noise wall location required. | • Potential to improve vegetation cover and remove weeds. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 11300–11350 (WB) | Wycombe Street to Kent Street Bridge Epping | | | | ML | ML | ML | • Existing noise wall is being relocated up to 2m closer to adjacent property.<br>• Existing basin cleared and improvements made. | • Provide screen planting along property boundary to screen noise walls. |

Table 92 Precinct 3 site compounds – temporary construction activities

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| 9850–10200 | Devlins Ck Bridge | | | | ML | M | M | • Site compound to be established for: Site shed and lay down area.<br>• Loss of existing vegetation. Impacts on local pedestrian access. | • Maximise retention of mature canopy trees.<br>• Strip and stockpile site soil to retain soil seed bank.<br>• Reinstate pedestrian access improving accessibility where possible. |
| 11700–11800 | Barombah Road | | | | HM | ML | M | • Site compound to be established for: Site shed and lay down area.<br>• Loss of existing vegetation. | • Maximise retention of existing vegetation along street frontage.<br>• Reinstate and improve vegetation cover post construction |

*Visual Sensitivity*

*Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High*

*Nature of Impact*

*A = Adverse; N = Neutral; B = Beneficial*

*Station*

*EB – Eastbound – Works widened beyond east bound carriageway.*

*WB – Westbound – Works widened beyond east bound carriageway.*

PRECINCT 4 – Beecroft Road /Devlins Creek to Terrys Creek – suburban bushland interface

Table 93 Precinct 4 visual impact assessment summary

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 12000 to 12300 | Beecroft Road interchange (M2 Motorway User) | | | | ML | MH | M | • Removal of existing busway bridge.<br>• Expansion of detention basin in central island. | • Potential for enhanced landscape treatments.<br>• Removal of bridge enhances the skyline at this point by reducing visual clutter. |
| 12440–12600 (WB) | Somerset Street Epping (M2 Motorway Viewer) | | | | M | NE | NE | • Existing noise walls remain unchanged along Somerset Street. | • Maintain existing vegetation cover in front of noise wall |
| | (M2 Motorway User) | | | | ML | M | M | • Rock cutting below wall is steepened. | • Stabilisation treatments to be minimised. If shotcrete is to be used treatment would be in accordance with RTA design guidelines and part of an integrated treatment to the tunnel portal. |
| 12620–13080 | Norfolk Tunnel North Epping (M2 Motorway User) | | | | L | L | L | • Additional lane and cycle lane in Norfolk Tunnel requiring widening of tunnel including portals. | • Rework of tunnel lining and ventilation.<br>• Consider potential to create and strengthen character of tunnel portals. Portals to integrate requirements for rock fall and the like with the revised structure. |
| 13080–13250 (EB) | Devon Street Epping (M2 Motorway viewer) | | | | HM | NE | NE | • Existing noise walls remain unchanged along Devon Street. | • –Enhance screening of existing wall |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| | (M2 Motorway User) | | | | M | M | M | • Rock cutting below wall is steepened | • Stabilisation treatments to be minimised. If shotcrete is to be used treatment would be in accordance with RTA design guidelines and part of an integrated treatment to the tunnel portal. |
| 13080–13250 (WB) | Somerset Street Epping (M2 Motorway viewer) | | | | HM | NE | NE | • Existing noise walls are being retained unchanged along Somerset Street. | • –Enhance screening of existing wall |
| | (M2 Motorway User) | | | | M | M | M | • Rock cutting below wall is steepened. | • Stabilisation treatments to be minimised. If shotcrete is to be used treatment would be in accordance with RTA design guidelines and part of an integrated treatment to the tunnel portal. |
| 13250–13460 (WB) | Somerset Street Epping | | | | HM | M | MH | • Existing noise walls are being relocated closer to properties between 62 –76 Somerset Street.<br>• This potentially may impact existing road carriageway width and result in the loss of street trees and screen planting within the adjacent verge. | • Improve treatment of noise walls and provide additional screen planting behind noise wall.<br>• Potential to widen verge and reduce carriageway width to improve screening of noise wall. |
| 13460–13680 (WB)<br>13460 – 13540 (EB) | Terrys Creek Bridge approach | | | | M | M | M | • New bridge alignment would see both retaining and noise walls realigned with impacts on bushland on both side of bridge approach, due to a widened footprint. | • Revegetate bushland adjacent to bridge approaches, strengthening screen planting to reduce impact.<br>• Retaining walls may consider colour and/or texture to reduce mass of structure. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 13540–13680 (EB) | Woodvale Avenue North Epping | | | | H | HM | H | • New road alignment would require noise walls to be relocated closer to adjacent properties. Existing noise walls would move from approximately 10 metres way to 3 metres from property boundaries.<br>• Loss in buffer planting. | • Improve treatment of noise walls and provide additional screen planting behind noise wall. |
| 13680–13850 | Terrys Creek Bridge | | | | ML | L | ML | • Residential properties on both sides of bridge have filtered views of bridge and are almost at level with the bridge.<br>• Widening the bridge on the northern side would bring the bridge marginally closer to residential properties.<br>• Visual amenity under bridge would consider existing walking tracks and aim to minimise disturbance of bushland vegetation. | • Acrylic noise walls may be considered where noise walls are adjusted on bridge to reduce visual impact of solid noise walls and improve road user experience (subject to other project considerations).<br>• Care needs to be taken with the design of the bridge structure so that it does not detract from the natural environment and is consistent in character with the existing. |
| 13920–14250 (EB) | Bushland<br>(M2 Motorway User) | | | | L | L | L | • Road widening would create a new small embankment along edge of bushland. | • Revegetate embankment providing potential for weed removal and landscape improvement. |

Table 94 Precinct 4 site compounds – temporary construction activities

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| 12200–12300 | Area below old bus ramp parallel to Beecroft Road | | | | L | L | L | • Site compound to be established for: Site shed and lay down area.<br>• Loss of existing vegetation.<br>• Cannot be used until demolition is complete affecting staging. | • Potential to enhance landscape character and vegetation cover as a result of removal of Bus over bridge. |
| 12400–12500 (EB) | Adjoining Sutherland Road – former compound site | | | | L | L | L | • Site compound to be established for: Site shed and lay down area.<br>• Residential properties 30 metres plus from compound | • Potential to enhance landscape character and vegetation cover. Present area is derelict with heavy cover of grass and weeds. May be integrated with adjoining remnant of vegetation. |
| 13300 – 13500(WB) | Somerset Road<br>(Terrys Creek Approach) | | | | M | L | ML | • Site compound to be established for: Site shed and lay down area.<br>• Drainage channel which runs through site. | • Potential to enhance visual screening of M2 Motorway noise walls and improve connection with remnant bushland. |
| 13750–14050 (WB) | Terrys Creek | | | | M | M | M | • Site compound to be established for: Site shed and lay down area.<br>• Overlooked by apartment blocks.<br>• Utilises former access track. | • Potential to enhance visual screening of M2 Motorway noise walls and improve connection with remnant bushland. |

*Visual Sensitivity*

*Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High*

*Nature of Impact*

*A = Adverse; N = Neutral; B = Beneficial*

*Station*

*EB – Eastbound – Works widened beyond east bound carriageway.*

*WB – Westbound – Works widened beyond east bound carriageway.*

Table 95 Precinct 5 visual impact assessment summary

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 14090 (WB) | Crimea Road and Waterloo Road Marsfield | | | | L | NE | NE | There are existing distant views to the Norfolk Road tunnel from the corner of Crimea Road and Waterloo Road. Expansion of the road pavement and changes to tunnel portal would be visible.<br>No change in noise wall height or location is to occur here. | Handling of tunnel portal needs to be considered. |
| 14200–14550 (EB) | Vimiera Road | | | | ML | L | L | Retaining wall to be constructed to top of existing fill embankment, adjacent to widened East bound lanes, minimising footprint of works. | Retaining wall may consider use of materials and/or texture to minimise mass and scale of structure.<br>Revegetation of area cleared for construction would assist in mitigating impacts, screening structure from view. |
| 14260–14400 | Vimiera Road | | | | M | M | M | Construction of new section of noise wall 3 metres high at top of existing embankment over looked by residential apartments. | Potential to improve vegetation cover to embankment minimising visibility of wall. |
| 14260–14400 | Vimiera Road (M2 Motorway user) | | | | M | M | MH | Construction of close coupled noise wall reducing visual connection with context. | Potential to achieve a consistent maintenance edge treatment.<br>Potential to provide colour and texture in wall to reduce mass and provide interest. |
| 14550–14850 (EB) | Bushland | | | | L | L | L | Road widening would create a small to large embankment.<br>Ensure embankment is no steeper than 1 in 2 slope to allow planting. | Revegetate embankment. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 14850–15050 (EB) | Busaco Road Marsfield | | | | M | L | ML | Existing road and noise wall is being relocated closer to adjacent property.<br>Road to be supported by retaining wall due to steep topography and to minimise extent of impact. | Retaining and noise walls may consider use of materials, colour and/or texture to minimise mass and scale of structure. Walls would be integrated with the existing bridge structure.<br>Provide additional screen planting behind noise wall. |
| 15200–15280 (EB) | Culloden Road Bridge (M2 Motorway User) | | | | L | L | L | Existing spill through bridge abutment to be stood vertical to widen opening under bridge | Exposed shotcrete would be concealed by the use of cladding. Cladding is to be designed to present a smooth even abutment profile that ties in with the adjoining embankment. |
| 15260–15400 (WB) | Talavera Road Macquarie Park<br>(M2 Motorway user and viewer) | | | | L | L | L | Existing noise wall is being relocated closer to Talavera Road, requiring removal of some vegetation cover.<br>Cutting is to be steepened, potentially increasing visual presence and need for shotcrete type treatments. | Avoid the use of shotcrete on cutting where unavoidable use is to be in accordance with RTA design guidelines.<br>Provide additional screen planting to front and behind noise wall to minimise impacts of wall from within and outside of the corridor. |
| 15500–15700 | Main toll plaza, Talavera Road Macquarie Park (M2 Motorway user) | | | | L | L | L | Existing toll awning and booths to be substantially removed with new tolling gantries to be installed.<br>Lanes through toll plaza to be rationalised to enhance user legibility. | Tolling gantry would be a simple, functional slimline structure with lighting placement considered as part of the overall design.<br>Lighting to be cut off type lighting to minimise light spill. |
| 15700–16070 (WB) | Talavera Road Macquarie Park | | | | M | MH | MH | Existing noise wall is being relocated closer to Talavera Road.<br>Large cutting for lane widening.<br>Loss in street planting and buffer vegetation along Talavera Road. | Provide additional screen planting behind noise wall to maintain streetscape character.<br>Avoid the use of shotcrete on cutting where unavoidable use is to be in accordance with RTA design guidelines. |

| Station | Location | Nature of impact | | | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|---|---|
| | | A | N | B | | | | | |
| 16070–16170 (EB) | Christie Road Bridge | | | | L | M | ML | • Existing spill through bridge abutment to be stood vertical.<br>• Bridge is to be widened and lengthened. | • Exposed shotcrete is to be concealed by the use of cladding. Cladding is to be designed to present a smooth even abutment profile that ties in with the adjoining embankment. |
| 16820–17100 (EB) | Khartoum Road Macquarie Park (EB) | | | | ML | M | M | • Existing noise wall is being relocated closer to adjacent properties. | • Improve treatment of noise walls and provide additional screen planting behind noise wall. |
| 16900–17140 (EB) | Khartoum Road Bridge (EB) | | | | L | L | L | • Bridge is to be widened including reconstruction of abutments perpendicular to Khartoum Road. | • Bridge design is to present a simple, clean profile similar to existing which incorporates noise walls to parapet in an integrated fashion. |
| 17240–17650 (EB) | Fontenoy Road Macquarie Park | | | | ML | L | ML | • New noise wall is being relocated closer to adjacent properties. | • Additional screen planting to be undertaken behind noise wall to reinstate vegetation lost as part of construction works and to minimise impact. |
| 17200–17300 (WB) | West bound on ramp from Lane Cove Road | | | | M | L | ML | • Existing shale cutting, overlooked by residential tower, to be steepened potentially requiring stabilisation treatments. | • Treatment of embankment to be provided which is consistent with urban design strategy and minimises shotcrete. If shotcrete and bolting is required appropriate treatments need to be considered. |
| 17600 (EB) | EB Off-Ramp to Lane Cove Road Macquarie Park | | | | ML | ML | ML | • New noise wall to be constructed | • Provide screen planting along open corridor. |

Table 96 Precinct 5 site compounds – temporary construction activities

| Station | Location | Nature of impact | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|
| 14400–14600 (WB) | Vimiera Road | | ML | L | ML | • Site compound to be established for: Stockpile and lay down area.<br>• Overlooked by a number of apartment blocks.<br>• Divided by access associated with Vimiera Pedestrian Underpass. | • Potential to retain vegetation located on boundaries adjoining residences. |
| 15000 (WB) | Busaco Road | | M | M | M | • Site compound to be established for: Stockpile and lay down area<br>• Parkland adjoins creekline with some large trees. | • Potential to address privet infestation of creekline and improve usability of parkland. |
| 15400–15800 (EB) | Toll Plaza | | L | L | L | • Site compound to be established for: Stockpile and lay down area. | • Treatment of hoardings to consider site lines for safety and may address the character of the interchange. |
| 15900–16100 (WB) | Christie Road | | M | M | M | • Site compound to be established in informal car park for: Stockpile and lay down area.<br>• Some existing vegetation cover to be removed. | • Potential to maintain vegetation on perimeter of site to limit impact on street address. |
| 16500–16900 (EB) | Macquarie Park | | L | L | L | • Site compound to be established for: Stockpile and lay down area.<br>• Adjoins national park and is overlooked by some residences. | • Opportunities to screen and improve revegetation on previous compound area which is becoming weed infested. |
| 18200–18400 (EB) | Wicks Road | | L | L | L | • Site compound to be established for: Stockpile; lay down area; and overflow car park. | • Existing waste transfer handling site, potential to revegetate depending on owner end use. |

| Station | Location | Nature of impact | Visual sensitivity | Scale or magnitude of visual impact | Overall ranking of visual impact | Issues | Opportunities/Potential treatments |
|---|---|---|---|---|---|---|---|
| 18700–18900 (WB) | TIDC compound | | L | L | L | • Primary site compound including: main office; canteen; laboratory, traffic management stores, and main car park. | • Existing Chatswood to Epping Rail compound provides the perfect opportunity to continue this use with no significant change in impact. |

*Visual Sensitivity*

*Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High*

*Nature of Impact*

*A = Adverse; N = Neutral; B = Beneficial*

*Station*

*EB – Eastbound – Works widened beyond east bound carriageway.*

*WB – Westbound – Works widened beyond east bound carriageway.*

A number of areas are identified as having potential for significant visual change, these include:

- At the Windsor Road interchange, the addition of on-ramps and off-ramps to the west would mean higher visual impacts due to the increased height of noise and retaining walls and loss of screen planting. Mitigation measures would include design treatment of noise and retaining walls with texture and colour to reduce bulk and scale and screen planting of properties.
- The historic villa at 266 Windsor Road would lose several metres from its frontage. Property adjustment works would be required to both address the loss of curtilage and to provide a buffer between house and road. Key to this would be the establishment of screen planting to the front and the retention in some form of the side drive and turn-a- round.
- At Woodvale Road, North Epping, the new road alignment would require noise walls to be relocated closer to properties (existing is ten metres away, proposed is three metres away). Mitigation measures would include noise wall architectural design and screen planting.
- The proposed removal of the bus bridge, east of Beecroft Road, reflects the changes in the public transport system over the last decade and the implementation of better bus priority connections within the M2 corridor as a result of this upgrade. The removal of the bridge would provide an enhanced visual outcome with the loss of part of the visual clutter created within this zone by a range of elevated structures (illustrated in Figure 34).

### 9.6.3 Mitigation measures

The current M2 Motorway design does not take full advantage of its distinctive contextual setting. There is an opportunity through the functional upgrade of the M2 Motorway to capitalise on the bushland setting, through which the route passes, to improve the visual experience and provide a consistent and recognisable identity. Design solutions address the character of the existing M2 Motorway built elements and provide solutions that have been chosen to compliment and improve the visual outcome of the M2 Motorway built form.

In responding to the visual impacts, mitigation measures have been directed towards achieving an integrated and well considered design solution that reflects the desired future character and vision for the M2 Motorway.

This desired character would be applied to future works on the M2 Motorway and implemented gradually. This limited upgrade provides the opportunity to commence the process of improving the presentation of the M2 Motorway, but it is not within the scope of this project to improve the whole of the M2 Motorway. It is envisaged that as the road is developed and maintained, as part of the concession period, this design vision, objectives and principles would be progressively implemented.

Key considerations in terms of design for mitigation are to:

- Visually screen the built form entirely where possible and otherwise to whatever extent practicable.
- Reduce the apparent scale of the M2 Motorway structures, especially its noise walls.
- Add landscape elements where possible to assist the process of reducing noise impact and to obscure or reduce views from the surrounding areas towards the traffic stream.

The landscape and urban design concept for the alignment is one which builds on the existing natural assets of the alignment. In particular it strengthens the connection with the natural environment through the exposure of sandstone cuttings and strengthening of the vegetated back drop of the alignment. Built elements are handled with care so that details are simple and subtle.

The following key elements have been identified as key in enhancing the M2 road corridor character and providing a new higher quality character and identity for the M2 Motorway.

## Noise Walls

The existing noise walls lack consistency in colour, alignment and height. The same Hebel panel wall design with four metre post spacing is used for the entire length of the M2 Motorway showing no consideration of the adjacent context. The walls used in the bushland precincts are the same as those used in the more urban precinct. The green colour aims to camouflage the walls against the natural bush setting however in reality the walls contrast with the bushland.

As part of the M2 Upgrade project, noise walls would be the most visible and continuous built form elements on the M2 Motorway and provide an opportunity to create a recognisable identity for the M2 Motorway. The noise wall strategy therefore has an emphasis on both sensitivity towards integrating with the existing noise walls and also a strong focus on high quality urban design for the new noise walls. New walls would be constructed using light-weight aerated concrete panels (Hebel, or similar). The design features four different noise wall designs (Type B, Type L, Type H, and Type U).

Each of the identified precinct areas has a predominant panel pattern that is carefully designed to reflect and be sympathetic to the surrounding environment. With form and alignment playing a major role, a secondary layer of information in the form of patterns and colour on the new noise walls would reveal the changing environment for the M2 Motorway user. A better colour palette would complement the existing green walls to reference the surrounding bushland context and visually recede into that context (refer Figure 35), note different types of noise wall employed near the bridge and amongst the bush. Noise walls are also illustrated in Figure 34 and Figure 35.

Figure 34 Visual perspective of M2 looking westbound near Beecroft Road

Existing conditions


Proposed design after the M2 Upgrade project


*Source: HBO+EMTB, 2010*

Figure 35 Visual perspective of M2 looking eastbound near Windsor Road

Existing conditions

Proposed design after the M2 Upgrade project (Note: the location of signage would be determined during the detailed design phase)

*Source: HBO+EMTB, 2010*

Figure 36 Visual perspective of M2 looking west bound near Kent Street

Existing conditions

Proposed design after the M2 Upgrade project

*Source: HBO+EMTB, 2010*

## Bridges

Between Windsor Road and Delhi Road there are a total of 21existing bridges and one tunnel. In order to accommodate the additional traffic lanes, the M2 Upgrade project includes the widening of eight bridges plus the lengthening of two vehicular overbridges, one pedestrian overbridge and one pedestrian underpass. Bridge widening requires adjustment to the edges of some bridges. This would require modifications to throw screens, and a general expansion of the footprint. From the M2 Motorway the changes are most evident in the structures associated with the bridge including, abutment walls, bridge girders and parapets. To minimise the impact of these elements they would be designed to present a slim consistent profile that relates to the existing structure.

Most overbridges on the current M2 Motorway are Super-T girder structures. The strategy for the bridge design, where widening or lengthening of the bridge occurs, is to match existing construction methods as closely as possible and to match the existing detailing of parapets, piers, girder type and bridge furniture. Although, the M2 Upgrade project is unable to change the appearance of such bridges, it is intended that where practicable, some consideration would be given to improving the appearance of the bridge. New bridges would be designed to improve upon the appearance of the existing bridges.

## Retaining walls

Retaining walls are proposed in locations where the M2 Motorway is built on fill. The proposed use of retaining walls minimises the extent of disturbance to existing vegetation cover, and consequently minimises impacts on views from adjacent properties. The design of new retaining walls would consider the use of colour and texture to minimise its impact. Reinstatement of vegetation cover over the disturbed footprint would assist in mitigating against the impact of the walls (refer Figure 35, note retaining walls near ramps).

The existing retaining walls lack a consistent appearance along the length of the existing M2 Motorway. In many locations where ground stabilisation was required, rock anchors and shotcrete were used. A mix of cast in-situ concrete walls and shotcrete surfaces face the M2 Motorway, while walls facing away from the M2 corridor range from patterned precast concrete panels to stacked sandstone boulders with no real distinction made between bushland and urban areas. The end result is one in which the walls, particularly those facing the M2 Motorway, are unattractive and visually dominating.

The M2 Upgrade project would result in further cuttings and construction of, new or extended walls facing the M2 Motorway and new or extended walls facing outside the M2 corridor, towards the bushland or residential neighbourhoods. Some walls would not be altered. However, new walls would be built with an emphasis on high quality urban design and sensitivity towards the existing retaining walls. Because of the variable topography of the M2 Motorway alignment, there are a large number of retaining walls proposed. The longest wall stretches for approximately 455 metres and some are over ten metres high. With the intent of minimising their perceived impacts, the proposed design would differentiate the retaining walls on the basis of their location, orientation, role and consistency with existing M2 Motorway walls. With form and alignment playing a major role, a secondary layer of information in the form of patterning and finish on the new retaining walls would create some linear identity for the M2 Motorway. Vegetation would be planted in front of retaining walls wherever possible to soften their appearance and create a greener road corridor.

### Temporary structures

Compound sites, despite being temporary structures, still have the potential to have significant impacts on the visual character of the M2 corridor in the short term. The location of these elements therefore needs to consider the existing adjacent vegetation and aim to limit the scale of visual change. Planting at the perimeter of the proposed site would be preserved, where possible, to maintain a level of screening from the adjoining land uses. Where this is not possible, the re-establishment of vegetation cover would be prioritised.

### Landscape design

The landscape response is an integral element of the mitigation strategy. Landscape areas have focused on achieving vegetated buffers between the M2 Motorway structures and over looking residential properties in order to enhance both visual screening and the sense of a bushland corridor. In terms of the road user, landscape has been used only in front of walls where a substantial space is available to achieve long lasting, minimal maintenance landscape outcomes. Visual quality for the road user is enhanced by improved design quality of structures and enhanced back drop rather than attempts to soften the road appearance between carriageway and structure.

The key elements of the landscape design comprise:

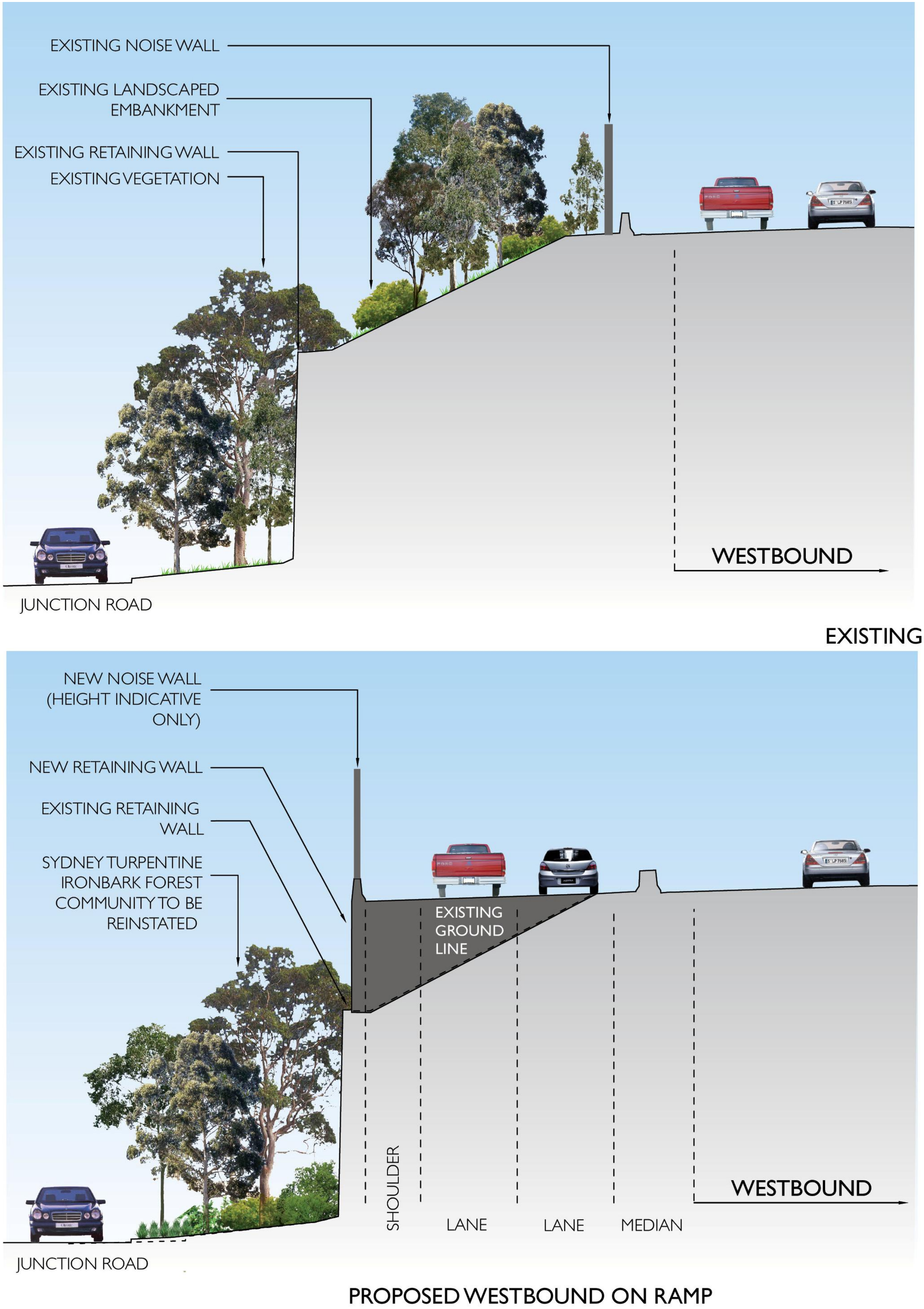
- Use of a landscape palette which is responsive to the differing vegetation communities through which the M2 corridor passes.
- Strengthening of the bushland character to reinforce the perception of the M2 Motorway being within a bushland corridor and provide a sense of separation from adjacent properties.
- Screening of noise and retaining walls where practicable, particularly where residences are in close proximity.
- Use of landscape only in zones where it can be established, maintained and make a meaningful contribution to the visual presentation of the corridor.
- Use of vegetation to enhance environmental outcomes of the project.

An example of the application of landscape treatments to a section of upgraded road is provided in Figure 37. Full details are available in Technical Paper 4.

Overall, the proposed works provide the opportunity to provide a positive impact on the visual appearance of the road. Some impacts would be unavoidable and these changes would be mitigated through the architectural design so that the detailing and the material qualities, texture, colour, and so on address the critical concerns of the adjacent use. The integration of new higher standard design elements would provide a new desired character and identity for the M2 Motorway.

Figure 37 Cross-sections of M2 Motorway near the new Windsor Road ramps

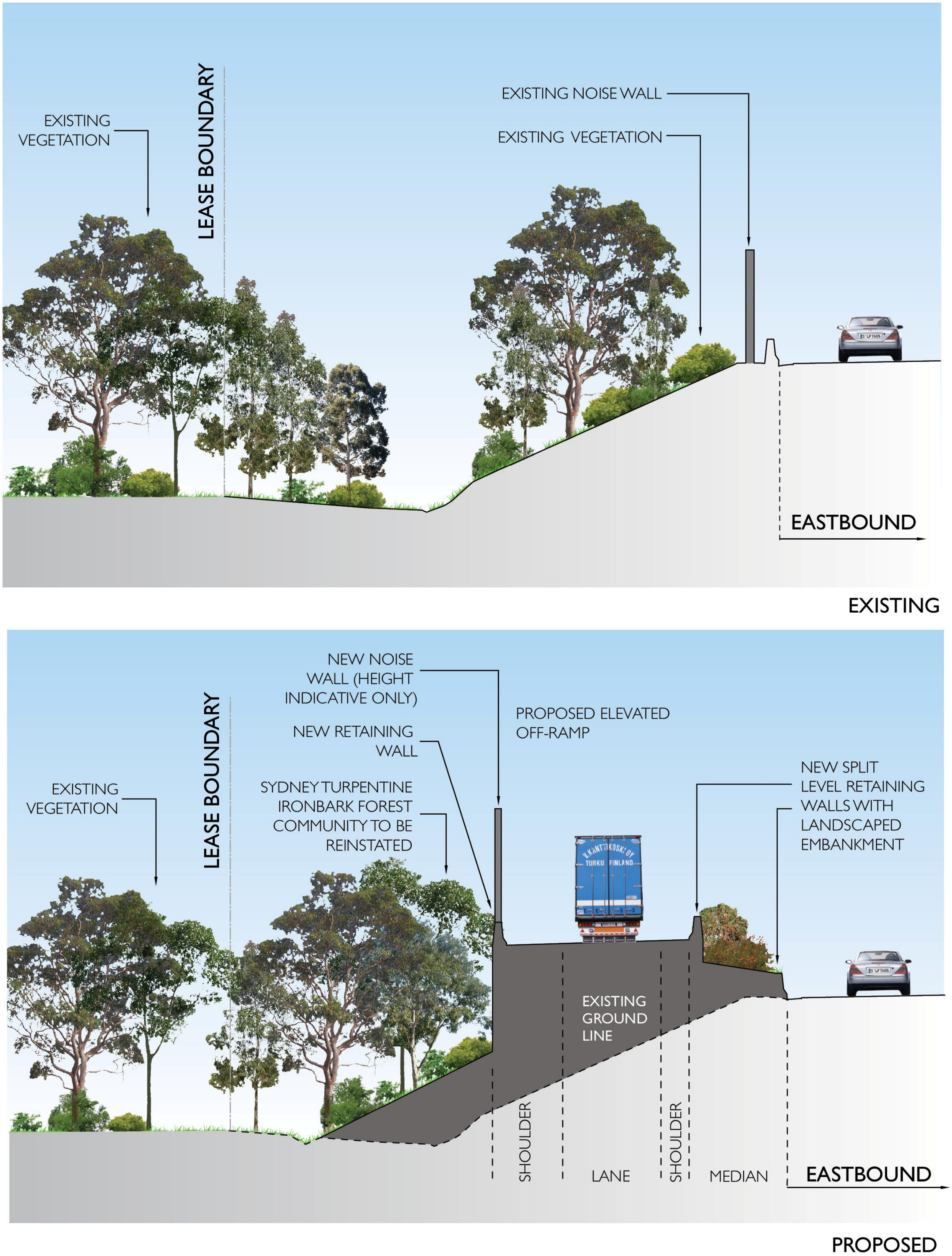
Figure shows examples of landscape treatments near new Windsor Road ramps




*Source: Tract, 2010*

Figure 37 (con't) Cross-sections of M2 Motorway near the new Windsor Road ramps

Figure shows examples of landscape treatments near new Windsor Road ramps.




Source: Tract, 2010

## 9.7 Aboriginal cultural heritage

An assessment of the impacts on Aboriginal cultural heritage associated with the project has been undertaken and is presented below. This assessment is supported by *Technical Paper 5 – Aboriginal heritage* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *Aboriginal cultural heritage:*<br>• *The environmental assessment must include an assessment of the potential Aboriginal cultural heritage impacts of the project, including an assessment of objects, places of significance, natural and landscape values of the corridor and surrounding area, taking into account the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, July 2005).* | *Section 9.7,*<br>*Technical Paper 5* |

### 9.7.1 Description of assessment methodology

The assessment of Aboriginal heritage consisted of desktop research, database searches, Aboriginal community consultation and archaeological field inspections. The assessment included the following elements:

- A search of the DECCW Aboriginal Heritage Information Management System (AHIMS) database.
- A review of previous archaeological surveys undertaken for the M2 Motorway.
- Identification, registration and consultation with Aboriginal stakeholders.
- An archaeological surface survey of the study area was conducted in March and April 2009 and December 2009.
- An assessment of Aboriginal cultural heritage was undertaken, consisting of both interviews and field inspections.

The field inspections were conducted in conjunction with the Aboriginal community, and included ground-truthing existing registered AHIMS sites, inspecting lands in proximity to known Aboriginal sites and in areas previously identified as having potential archaeological value. The inspections conducted in March and April 2009 were conducted in consultation with the Metropolitan Local Aboriginal Land Council (MLALC). The inspections in December 2009 were conducted in consultation with the Aboriginal community in accordance with DECCW's *Interim Community Consultation Requirements for Applicants* (DEC, 2004).

As required by the DGRs, the Aboriginal heritage assessment was conducted in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005). The RTA also has its own comprehensive guidelines: *RTA Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (RTA, 2008c). This investigation followed the process stipulated by both these documents, to undertake a two-part Aboriginal heritage assessment process and recommend that Aboriginal community consultation be undertaken in accordance with DECCW's *Interim Community Consultation Requirements for Applicants* (ICCRs) (DEC, 2004).

The ICCRs outline a process of inviting Aboriginal groups to register their interest in being party to consultation (including local newspaper advertising), seeking responses on proposed assessment methodology and seeking comment on proposed assessments and recommendations. The guidelines require proponents to allow ten working days for Aboriginal groups to respond to invitations to register, and then 21 days for registered Aboriginal parties to respond to a proposed assessment methodology.

Under the DECCW Part 3A guidelines (DEC, 2005) and the RTA Aboriginal heritage consultation guidelines (RTA, 2008c) consultation with the Aboriginal community is also a staged process. Where no constraints are identified in the preliminary assessment, there is no further requirement for consultation and assessment. However it is intended to allow the wider Aboriginal community to provide information on the socio-cultural values of the study area. A program of full Aboriginal consultation was instigated in late October 2009 to seek wider Aboriginal community input into the project.

The purpose of the full Aboriginal consultation is to seek information on the cultural (social) heritage values of the study area. The following processes were undertaken in accordance with the ICCRs and the RTA guidelines. These included:

- Notification and registration of interest. Appropriate organisations were notified of the project with requests for information on suitable Aboriginal stakeholders to be consulted. Specifically, notification included newspapers, letters to Aboriginal stakeholders and land councils, and direct communication with Aboriginal stakeholders and individuals.
- Briefing letter / methodology advice and focus group meeting. The briefing letters advised that a first round of field inspections had been conducted by AECOM archaeologists in March 2009 and no heritage constraints were identified. Stakeholders were also asked to provide information on the Aboriginal socio-cultural heritage values and also described the methodology used to conduct the field inspection. An Aboriginal Focus Group meeting was held on Friday 11 December 2009 and all registered Aboriginal stakeholder groups were invited to take part. The briefing letter also included a response form for stakeholders to endorse the methodology or to provide feedback on alternative methods, and to provide information on the cultural (social) values.
- Fieldwork. A second round of field inspections was conducted from 15 to 17 December 2009 by AECOM archaeologists in conjunction with registered Aboriginal stakeholders. Stakeholders who took part included: Deerubbin Local Aboriginal Land Council (DLALC), Darug Tribal Aboriginal Corporation (DTAC), Yarrawalk Enterprises, Darug Custodian Aboriginal Corporation (DCAC), Darug Aboriginal Cultural Heritage Assessments (DACHA), Darug Land Observations (DLO).
- Aboriginal stakeholder and field survey reports. Aboriginal stakeholder organisations that participated in the field inspections were requested to provide a written field survey report using the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* template (RTA 2008c). Copies of the reports provided by the Aboriginal stakeholders are provided in full in Appendix D of Technical Paper 5, and the recommendations have been incorporated into the final draft of this report.
- Circulation of the draft report. A complete draft copy of the preliminary Aboriginal heritage assessment report was circulated to the registered Aboriginal stakeholder groups seeking comments on the results of the preliminary assessment, as well as to seek information to inform a socio-cultural heritage significance assessment. Written responses were received from three of the registered Aboriginal stakeholder groups. A summary of responses is provided in Technical Paper 5. Recommendations made by the Aboriginal stakeholders were incorporated in to the final management commitments where relevant.

### 9.7.2 Existing environment

The environmental conditions of the study area consist mainly of temperate climate with rugged, rolling to very steep hills, hillcrests and ridges on Hawkesbury Sandstone, and medium density drainage net of waterways. The soils of the area are prone to erosion and in some instances water-logging. Large parts of the study area have been impacted by urban development, but relatively undisturbed landscapes and vegetation occurs in nature reserves and some steeper sections of the study area.

The study area lies in predominantly sandstone country with valleys and gullies with cliff margins. The predominant archaeological sensitivity of these areas is their suitability for the formation of sandstone-based sites such as rockshelters, grinding-grooves and, to a lesser extent, art sites (including both pigment and engravings). Rockshelters are covered areas that may have been used by Aboriginal people. Grinding grooves are depressions formed in rock from the sharpening of a stone hatchet head or use of a muller (topstone).

Areas that contain extant native vegetation, such as in the major creeklines and reserves, may also contain culturally modified (scarred) trees. A scarred tree is a tree that bears a scar or scars which are wounds formed from the deliberate removal of bark or wood exposing sapwood by Aboriginal people.

The generally rocky conditions within the landscape are less suitable for open camp sites compared to the flatter and low undulating country of the Cumberland Plain further west. Furthermore, the soils in the study area are generally shallow and skeletal. These soils have little potential for the formation of subsurface archaeological deposit due to the highly erodible nature of the soils.

Urban development, including the development of the M2 Motorway itself, has highly impacted the study area. However while some areas have been extensively disturbed, others have not. Areas of steep-sided valleys and gullies have not been developed due to their unsuitable geography, and retain a large portion of their original vegetation. Many of these areas have also been set aside as reserves and are exempt from development. It is these areas that are considered to hold the greatest archaeological sensitivity. Such areas include the Lane Cove Recreation Area, Berriwerri Reserve, Chilworth Recreation Reserve, Darling Mills State Forest and Bidjigal Reserve.

#### Registered Aboriginal sites

A search of the DECCW Aboriginal Heritage Information Management System (AHIMS) (undertaken March 2009) register indentified 53 sites within one kilometre of the M2 Motorway. However another site, Aboriginal rockshelter DC1, did not appear in the AHIMS search results despite the site being excavated by Haglund (1995) under a Section 87 permit (#653) issued by DEC (now DECCW) in 1994 (Corkill, pers. comm.).

This site occurs under the Devlins Creek bridge (it is not known why DC1 does not appear on the AHIMS database). Of the 54 known sites, two were identified as duplicates of other sites reducing the total of individual sites to 52 (45-5-0886 is a duplicate of 45-6-2548 and 45-6-2513 is a duplicate of 45-6-2472). Table 97 shows the relative frequency of different site types in the AHIMS search area.

Table 97 Summary of archaeological site types within the study area

| Site type | Number of sites | Percentage |
|---|---|---|
| Axe grinding grooves | 3 | 6 |
| Isolated find | 1 | 2 |
| Open camp site | 6 | 12 |
| PAD | 1 | 2 |
| Rock engravings | 3 | 6 |
| Shelter with art | 2 | 4 |
| Shelter with deposit | 31 | 58 |
| Shelter with midden | 2 | 4 |
| Unknown* | 3 | 6 |
| Total | 52** | 100 |

**Site card unavailable; site type unknown*

***Total includes 52 AHIMS-registered and one additional known site (DC1) less two duplicate site cards.*

Three site cards (AHIMS 45-5-2892, 45-6-0981 and 45-6-1887) were missing from the DECCW library and as a result the site types are unknown, although the site name for AHIMS 45-6-1887 suggests that it is a grinding groove site and discussions with archaeologist Mary Dallas confirmed that AHIMS 45-5-2892 is a rockshelter.

Many sites consist of multiple site types, particularly rockshelters which often have associated archaeological evidence such as art (either pigment or engraved), archaeological deposit, middens and/or axe grinding grooves. One open camp site, AHIMS site 45-5-0970, has an existing Section 90 - Aboriginal Heritage Impact Permit (AHIP) over it. Rockshelter sites AHIMS 45-6-2472, 45-6-2097, 45-5-0886, 45-5-2542, 45-5-2543 and 45-5-2544 have been excavated as has one PAD site 45-6-2653.

Two additional Aboriginal sites occur in the general vicinity but not within the study area. These sites are known to the Aboriginal community and were identified as a result of forestalled development proposal to construct an adventure playground facility within the Darling Mills Creek area. The sites consist of:

- Scarred tree on Excelsior Creek north of the M2 Motorway.
- Rockshelter with deposit, also several hundred metres north of the M2 Motorway.

These sites are not currently recorded within the AHIMS database (L. Watson, DTAC, pers. comm.).

### Registered sites within the study area

The sites identified in the AHIMS search were plotted on a map (see Figure F4 to Figure F6 of Technical Paper 5) and sites within the study area (within 100 metres of the M2 Motorway) were identified. Site DC1 (see above) also occurs within the study area. However, two registered sites (45-6-2472 and 45-6 2513) are separate recordings of the same site.

A total of 15 registered or known Aboriginal sites occur within a distance of 100 metres from the M2 Motorway carriageway. All sites were inspected during field inspections conducted during March and

April 2009 and December 2009, with the exception of one site which was found to have erroneous coordinates recorded in AHIMS and is well south of the M2 Motorway. Areas identified in 1989-1992 archaeological reports as being of potential archaeological constraint were also inspected, as were areas of construction impact in the vicinity of known Aboriginal sites.

### 9.7.3 Impact assessment

The potential impacts of the project on Aboriginal cultural heritage was undertaken, taking into account the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005). A total of 15 (14 AHIMS and 1 DC1) previously recorded Aboriginal sites and one newly recorded aboriginal site occur within 100 metres of the M2 Motorway (one site has been recorded twice). Two phases of field inspection re-identified all but two of the recorded sites. Of these two sites, one (45-6-2472(2513) was previously destroyed and another (45-6-1953) occurs much further south than AHIMS suggests and is not within the study area.

Of the 15 sites, three sites are considered to be potentially impacted. These sites are:

- AHIMS 45-5-1005 is an isolated artefact that lies in very close proximity to the Beecroft Road bus ramp. The current proposal to remove the ramp is likely to disturb the ground where the artefact is said to occur. However, the artefact is not considered to be in situ, is out of archaeological context and consequently is considered to hold low significance.
- Site M2A1 (45-6-2949), a set of grinding grooves that were identified during the Phase 1 field inspections and occur directly beneath the Terrys Creek bridges. While construction work is intended to occur on the northern side of the M2 Motorway, the current construction plan proposes to provide vehicle access from the southern side. Consequently, there is potential for indirect impact to the site through sedimentation and/or physical impacts through earthworks.
- In addition, Aboriginal stakeholders consider there is potential for indirect impact to one rockshelter (CF3; AHIMS 45-5-2161) through vibration impacts. Although previous monitoring suggests that such impacts are unlikely, it is proposed that technical advice from an expert in noise and vibration is sought. Aboriginal stakeholders request that monitoring take place during construction works in the vicinity.

It is considered that there would be no direct impacts and unlikely to be indirect impacts to the other sites resulting from the proposed M2 Upgrade project. However, it is considered prudent to erect some form of protective fencing at rockshelters within 50 metres of construction works to minimise the potential for indirect impacts resulting from access by construction workers.

The sites considered to be within 50 metres of construction works are:

- AHIMS 45-6-2097.
- AHIMS 45-6-2160.
- AHIMS 45-6-2161.
- AHIMS 45-6-2162.
- AHIMS 45-6-2163.
- AHIMS 45-6-2543.
- AHIMS 45-6-2544.
- DCl.

### 9.7.4 Mitigation measures

The design has, as far as possible, avoided impacts on Aboriginal heritage. The following management measures that are proposed to be implemented for identified sites of Aboriginal significance.

- If Aboriginal objects are identified during the course of construction, work would cease in that part of the study area and DECCW, MLALC and Deerubbin Local Aboriginal Land Council (DLALC) would be notified immediately.
- If Aboriginal skeletal materials are identified during construction, work would cease immediately and Police, DECCW and the relevant Local Aboriginal Land Council (LALC) notified immediately.
- An Aboriginal Heritage Management Plan (AHMP) would be prepared as part of the CEMP. An outline of the CEMP is shown in the Construction Environmental Management Framework (refer to Appendix F). The AHMP would be prepared for the 15 known sites within the study area would be prepared providing guidance on the management of these sites during the construction phase of the M2 Upgrade project and during the subsequent operational phase of the M2 Motorway. The AHMP would provide more detailed guidance than outlined in this report (for example, detailed location mapping, fencing specifications, and the like). The AHMP would include, but not be limited to, the following protective measures(measures do not include the sites that are impacted):
- Erecting temporary protective fencing at Aboriginal rockshelters within 50 metres of the M2 Upgrade project construction works, to minimise the potential for inadvertent damage by construction workers. The sites include: CF3; AHIMS 45-5-2161, AHIMS 45-6-2097, 45-6-2160, 45-6-2161, 45-6-2162, 45-6-2163, 45-6-2543, 45-6-2544 and DC1.
- Erecting temporary sedimentation barriers and fencing along the banks of Terrys Creek, on the southern side of the bridges, to minimise potential for indirect impacts to site M2A1(45-6-2949) through sedimentation and/or personnel access during construction.
- Regular toolbox talks conducted with emphasis on Aboriginal cultural heritage and the potential for impacts to the sites.
- Aboriginal community stakeholders have requested that monitoring take place at sites during construction works. However, this assessment considers that further impacts to, or identification of, Aboriginal objects is unlikely. Therefore further monitoring is not considered necessary.
- The Aboriginal community stakeholders have requested that an exclusion zone be placed around site M2A1 (45-6-2949) on the southern side of the M2 Motorway bridge. Construction activity would avoid this side of the bridge where practical and access to the area would be gained from the northern side of the M2 Motorway where possible. If this is not possible, and access is required on the southern side (passing under the bridge) then access would be made as close as possible to the concrete abutment.
- AHIMS 45-5-1005 is not considered to hold cultural heritage significance and the absence of the single artefact suggests that it has been lost from the area. Therefore, the site has already been effectively destroyed and the impact from the M2 Upgrade project is minimal as it is a destroyed site. The AHIMS register would be amended to reflect this status.

## 9.8 Construction surface water management and soils

An assessment of the surface water management and soils issues associated with the construction of the M2 Upgrade project has been undertaken and is presented below. This assessment is supported by *Technical Paper 6 – Water management* (Volume 2).

| Director-General's Requirements | Where addressed |
|---|---|
| *General construction impacts – the environmental assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed. The environmental assessment must include consideration of, and a management framework for:* | *Chapter 7, Chapter 9, Appendix F* |
| • *Erosion, sedimentation, water quality and riparian management issues for works in and around watercourse crossings. The environmental assessment must specifically consider how construction of the project would be undertaken and managed to minimise the potential for impacts on riparian vegetation, fish passage and water quality in watercourses for the duration of the construction works.* | *Sections 9.8.2, 9.8.3, Technical Paper 6* |

The purpose of this assessment was to identify potential impacts and mitigation measures pertaining to flooding, stormwater, erosion and sedimentation and water quality. The objectives of this assessment included:

- Quantify the nature and extent of potential impacts due to the construction phases of the project, including the identification of sources of polluted water at project sites during construction.
- Identify appropriate mitigation measures to address and ameliorate impacts.

### 9.8.1 Existing environment

#### Geology and soils

Within the length of the M2 corridor there are two major geological formations being Hawkesbury Sandstone and the overlying Ashfield Shale member of the Wianamatta Group. The interface between the two formations may be marked by the presence of the Mittagong Formation.

Relief in the Ashfield Shale occurs towards the west of the M2 Motorway, and is generally undulating with rounded ridges and hill crests. The Hawkesbury Sandstone relief to the east tends to be fairly rugged with rolling to very steep hills with steep or benched side slopes.

There are five major soil landscapes occurring throughout the corridor, namely:

- Glenorie Landscape (gn) soils developed on the Wianamatta Group Shales. Typical depth up to two metres with friable dark brown loam topsoil. The erodibility of the surface soils is low.
- West Pennant Hills Landscape (wp) on Wianamatta Group Shales which are generally less than two metres in depth. The erodibility of the surface soils is low.
- The Lucas Heights Landscape (lh) on the Mittagong Formation with the depth commonly less than one metre and a high soil erosion hazard.

- The Gymea Landscape (gy) in the southern section of the Lane Cove River valley and in the upper valley of Terrys Creek. The soils are shallow (less than one metre) and the erosion hazard is high to extreme.
- The Hawkesbury Landscape (ha) in the northern section as well as the rugged valleys of Devlins Creek, the soils are mostly within and less than 0.5 metres depth. These shallow soils in conjunction with the steep terrain have an extreme erosion hazard.

### Aquatic environment

The M2 Motorway traverses through three main catchment areas of Darling Mills Creek, Devlins Creek and Terrys Creek whilst a number of smaller tributaries located towards the eastern end of the M2 Motorway (including Mars, University, Shrimptons and Porters Creeks) also form part of the Lane Cove River catchment. Within the limits of proposed widening works the M2 Motorway is crossed by around 26 local drainage lines, which are served by transverse drainage structures comprising a combination of large concrete arches and box or pipe culverts. Large multi span bridge structures well above the normal water level are used to cross the three main creek waterways.

This section describes the aquatic environment, and is summarised from Section 9.5.1 and Technical Paper 3. Native aquatic submerged and emergent vegetation is not abundant within the creeks of the study area. This is likely to be as a result of the chiefly rocky substrate found here, high water velocities during heavy rainfall and competition from introduced species. During ecological surveys of the areas that would be affected by the proposed upgrade, the only commonly encountered native aquatic plants were Bull Rush (*Typha orientalis*) and knotweeds (*Persicaria spp.*), which were found in small patches along the creeks, chiefly in disturbed areas.

The detention basins within the M2 corridor contain an artificial assemblage of emergent native aquatic plants including *Eleocharis sphacelata*, Marsh Club-rush (*Bolboschoenus fluviatilis*) and Jointed Twig-rush (*Baumea articulata*) which were planted when the basins where constructed.

During ecological surveys of the areas that would be affected by the M2 Upgrade project, no assemblages of native aquatic plants were found during flora and fauna surveys (conducted for this environmental assessment) that could be described as native vegetation communities. No aquatic plant species of conservation significance were recorded or considered likely to occur within the M2 corridor or surrounds. A variety of aquatic weeds (for example, Water Milfoil (*Myriophyllum aquaticum*) and Watercress (*Rorippa nasturtiumaquaticum*)) are found along the waterways of the study area. Of these, three species are listed as noxious weeds. Noxious aquatic species recorded in the waterways include:

- Long-leaf willow primrose (*Ludwigia longifolia*).
- Ludwigia (Ludwigia peruviana).
- Sagittaria (Sagittaria platyphylla).

Prior to residential development in surrounding areas, the creeks of the locality are likely to have supported a diverse community of insects, fish, frogs, birds and mammals. The creeks are degraded to varying degrees as a result of a number of factors including increased erosion due to the concentration of stormwater flows, weed invasion, polluted catchment runoff and the presence of exotic fish species. As a result of this condition, frogs, fish and aquatic invertebrates that are sensitive to these forms of disturbance are unlikely to persist in these waterways. Nonetheless, a variety of disturbance tolerant fauna species remain.

The present condition of the creeks of the M2 corridor varies from highly modified to near-natural. The section of Darling Mills Creek crossed by the M2 corridor appears to be in relatively moderate condition, with low turbidity, little evidence of sedimentation and a low level of weed invasion. This area is likely to be inhabited by many species of native fish. It is also likely to be inhabited by the introduced fish, the Plague Minnow (*Gambusia holbrooki*) though the population density of this species is likely to be relatively low due to the higher water quality and intact riparian vegetation which favour native fish species. The Eastern snake-necked Tortoise (*Chelodina longicollis*) is also likely to be found here. Recent frog surveys conducted along this section of Darling Mills Creek detected the Green Stream Frog (*Litoria phyllochroa*), Peron's Tree Frog (*Litoria peronii*), Striped Marsh Frog (*Limnodynates peronii*) and Common Eastern Froglet (*Crinia signifera*).

The other creeks of the study area are more disturbed and are likely to contain a lower diversity and abundance of fish and frog species with the Plague Minnow becoming increasingly dominant in more disturbed areas.

The potential for viable fish habitat and fish passage along the majority of non-perennial and semi-perennial watercourses crossed by the M2 Motorway is considered to be low, for reasons outlined above. Additional obstructions to fish movement within the M2 corridor exist where waterways pass beneath the M2 Motorway via culverts. During low flow conditions, the streams of water flowing through the culverts are broad but very shallow and may limit the passage of some fish species. Higher water velocity and turbulence during rainfall events and a lack of pooled areas for fish to rest between bouts of swimming may also limit fish movement through the culverts. The extremely low light level within culverts may also create a non-physical barrier for some fish species that may avoid dark areas during daylight hours (Fairfull and Witheridge 2003). Larger in stream structures (for example, the retarding basin wall near Loyalty Road, North Rocks and weirs on the Lane Cove River) lower in the catchments of these creeks are also potential barriers to fish passage.

No threatened or protected aquatic invertebrate or fish species have been recorded in the waterways of the M2 corridor. Introduced fish species recorded in the locality include Goldfish (*Carassius auratus*), Common Carp (*Cyprinus carpio*) and Plague Minnow (*Gambusia holbrooki*). Goldfish and Common Carp are not likely to be abundant in the small rocky streams of the study area, but the Plague Minnow is found in all of the creeks, especially in disturbed areas. This species is listed as a Key Threatening Process due to its detrimental impacts upon tadpoles and frog eggs.

### Water quality

Water quality monitoring for the M2 Motorway site began between July and December 1994 (prior to the original Motorway construction). Water samples collected downstream of the M2 Motorway were used to established background total suspended solids (TSS) averages for wet (128 mg/l) and dry (8 mg/l) conditions (sampling conducted by Bill Rooney, 1994). A water quality monitoring program was initiated in 1997-98 following the commencement of the operation of the M2 in May 1997. The objectives of the monitoring program were to examine water quality to check for conformance with recommended quality limits and to quantify changes in water quality so as to identify long term impacts that may be associated with the M2 Motorway construction.

Subsequent long term sampling results following original construction of the (post M2 Motorway construction) by HLA Envirosciences (2008) have calculated the median and average values to range between 5 milligrams/litre to 13 milligrams/litre (median) and 11 milligrams/litre to 32 milligrams/litre (average). Comparison of these results for the two alternative periods suggests that construction of the existing M2 Motorway has not had significant impact on the water quality of downstream receiving waters.

While TSS is only an indicator of potential contaminants and water quality, the long term monitoring results tend to suggest minimal discharge or transfer of suspended solids from the M2 Motorway, which may exacerbate sedimentation of the downstream receiving waters. The current operational M2 Motorway activities are therefore having minimal impact on the general water quality of the various tributary watercourses through which it traverses.

Within the limits of the proposed project widening, 31 water quality basins were originally provided to treat the low flow runoff draining from the existing M2 Motorway pavement surface via the stormwater pipe drainage networks. Low flow runoff (first flush) or contaminated spills washed from the road surface are directed through bifurcation pits which separate and divert the water into the basins for containment and treatment. The first flush of runoff typically contains the higher concentration of sediments and larger particulate matter (waste materials from vehicles such as brake pad wear and metals) which tend to settle out of the water more readily when temporarily stored in the basin. Fluid type materials washed from the surface (such as fuels and oils) are less dense and tend to float on the water surface allowing them to also be contained in the basin by use of special outlet arrangements. The locations of the basins are shown in Figures 1 to 5 of Technical Paper 6.

The sampling of the existing water quality basins, which are meant to treat the 'first flush' of runoff from the pavement surfaces, also suggest that the basins are performing their intended function in helping to protect the quality of the receiving waters. The July 2007 HLA Envirosciences report detailing the sampling of water downstream of the basins found marginal exceedances of the Australian and New Zealand Environment Conservation Council (ANZECC) freshwater criteria for zinc and copper at eight of the ten locations sampled. However, the report considered it was likely (but subject to further confirmation) that these exceedances were actually representative of regional water concentrations. The elevated readings within the basins for some elements such as copper and zinc as well as the polycyclic aromatic hydrocarbons (PAHs) suggest that these pollutants are being captured and retained in the basins in accordance with the design functional intent (SESL, 2008).

The M2 Motorway operator has indicated that the existing basins are generally working satisfactorily and aside from the ongoing build up of litter requiring regular cleaning, the basins were drained and de-silted once (in 2005) since the M2 Motorway became operational in 1997. The excavated sediment material was retained in a suitable storage area of the works depot within the M2 corridor.

With regards to spill incidents, the M2 Motorway operator advises that there have not been major spill incidents on the M2 Motorway with the potential to threaten the surrounding environment since operations began. There have been some minor instances of contaminants falling from trucks (such as chemicals or paints etc) and obviously some small oil and fuel leaks resulting from motor vehicle accidents. Such spills/incidents are quickly dealt with by the M2 Motorway response team, which has a special action plan and spill containment kit to deploy so that the potential for any contaminants to reach the drainage system and downstream environment is minimised. As a further safeguard, the existing M2 Motorway drainage systems have been designed to direct low flows, including fluid spills or wash down volumes, into the water quality basins where the contaminated runoff can be retained and appropriately dealt with.

The existing flooding environment is described in Section 10.1.1, and in Technical Paper 6.

### 9.8.2 Impact assessment

#### Proposed upgrade works

A brief description of the proposed upgrade works pertaining to surface water drainage elements structures within each of the Precincts is outlined below. A full description is provided in Section 6.3.9 and Technical Paper 6.

Prior to construction commencing, it is also proposed that, if required, the existing basins would be drained to allow for cleaning and de-silting to ensure the full capacity and effectiveness is available. A similar maintenance exercise would then be undertaken at the completion of construction so that the basins would be properly prepared for ongoing operational conditions.

### Precinct 1 – Abbott Road to Windsor Road

Drainage works for Precinct 1 predominantly involve the adjustment of existing inlet pits with associated pipes to drain the pavement area of the new west facing ramps at Windsor Road.

### Precinct 2 – Windsor Road to Pennant Hills Road

In this precinct the following works are proposed:

- Inlets and pipe culverts would be extended.
- New retaining walls built.
- New culverts are to be built parallel to and across the M2 Motorway.
- Eleven water quality basins require modification.
- One or two additional bridge piers may be required within or adjacent to a tributary of Darling Mills Creek or Darling Mills Creek itself.

### Precinct 3 – Pennant Hills Road to Beecroft Road

In this precinct the following works are proposed:

- A gabion wall and open channel requires re-construction or modification.
- Culverts require extending.
- Reconstruction of the existing scour protection after works.
- Two water quality basins require modification.
- One or two additional bridge piers may be required within or adjacent to a tributary of Devlins Creek.

### Precinct 4 – Beecroft Road to Terrys Creek

In this precinct the following works are proposed:

- Relocation or reconfiguration of parts of the local street pit and pipe elements away from the M2 corridor.
- A box culvert is to be extended.
- Reconstruction of scour protection measures as well as 30 metres of the existing concrete/rock mattress open channel.
- Modifications to a water quality basin to capture and treat the tunnel wash down water.

### Precinct 5 – Terrys Creek to Lane Cove Tunnel

- A box culvert is to be extended.
- A vertical retaining wall must be built in a concrete channel.
- Reconstruction of a new concrete channel to reduce flood levels.
- A precast concrete arch under the M2 Motorway requires extending by 12 metres.
- Six existing water quality basins require augmentation.

Temporary stream crossings may be required for some work sites. However, the need for temporary stream crossings and locations for these have not yet been determined.

### Soils

Erosion and sedimentation impacts were considered through an assessment of the proposed works in relation to soil characteristics. The proposed works involve excavation and soil disturbance in many locations, resulting in exposure of underlying soils, which has the potential to lead to erosion and sedimentation in downstream water bodies. Such excavation and soil disturbance would be required for widening works, construction of new piers for bridges, retaining walls, installation of stormwater drainage infrastructure and the augmentation of culverts and water treatment basins.

These construction activities pose the greatest risk where they occur near waterways, on steep slopes or on land subject to high flow or flooding. The potential for sediment transport and sedimentation issues is influenced by factors such as severity of storm events, the slope and footprint of disturbed area and the management controls that are implemented.

A preliminary assessment of areas more likely to be prone to erosion due to the construction works has been undertaken. Maps showing the results of the assessment are included in Appendix D of Technical Paper 6. The potential erosion risk has been categorised as either high or medium or low depending on the nature of the site conditions and the type of construction works being undertaken. Most of the corridor has been identified as either a low or moderate erosion risk.  Areas of high risk have generally been identified where bridge widening works are proposed in steep land or works are required in or adjacent to the creek waterways.

Other factors that were considered in the assessment include; ground conditions (rock or soil), erodibility, slope, extent of clearing required, location of works relative to sensitive receiving environments, piers/piling works, fill earthworks or retaining wall. In this instance, a proportion of the project involves widening of existing cut batters/faces. These cut batters are typically comprised of rock and the disturbed face would drain down to the motorway. The dirty water runoff can then be readily managed with a treatment train of appropriate measures to reduce the risk of sediments being transported to the downstream receiving environment.

### Water quality

The M2 Motorway’s existing surface water collection and management system for the M2 Motorway would be modified as part of the proposed upgrade.

Soil is the most likely potential contaminant of water quality and can impact water quality during the construction phase if runoff is allowed to mobilise exposed underlying soils. This can result in increased erosion and sedimentation, which is influenced by the severity of a storm event, the slope and footprint of the disturbed area, in conjunction with the management measures being implemented. Management techniques employed to control and deal with runoff from the site works during construction also have the potential to concentrate flows and increase erosion leading to water quality issues for the receiving waters downstream. Other potential construction contaminants may include:

- Building waste and litter.
- Acids and chemicals from washing processes.
- Accidental spills of construction fuels or chemical materials.
- Disturbance of contaminated soils.

Water quality impacts would be primarily due to:

- General work –sediment would be collected by the existing M2 Motorway drainage system and directed into the basin.
- Basin works – inlet and outlet modifications.
- Culvert and bridge works – these works around watercourses may affect water quality outside of the existing drainage system.
- Earthworks associated with local road network connections – which may not be captured by the existing drainage system.

### Flooding

Potential impacts to flooding from the proposed widening construction works may result from site establishment and preparation works as well as earthworks and drainage works. As the existing culvert structures are the only means to convey upstream catchment flows across the M2 Motorway, facilitation of the construction works is likely to result in some temporary obstruction of the waterway flow path. This obstruction may be caused by temporary bunding or diversions of the waterway, the placement of construction equipment or materials within the flow area, stockpiles or access roads and work platforms. There is the potential for such obstructions to result in the localised redistribution or concentration of flows (increased velocities) and depending on the circumstances this may increase flood levels upstream and temporarily impact on adjoining properties. Where piers may be required to be constructed in Darling Mills Creek or a tributary of Devlins Creek, the Piers would not adversely increase hydraulic impacts (flood levels or velocities).

### Fish passage

The impacts of construction on fish passage are considered to be minimal. Fish passage across the M2 Motorway is currently highly restricted in many places due to the presence of culverts. Additionally for the Lane Cove River, a retarding basin and weirs further restrict fish passage.

The M2 Upgrade project would not introduce more culverts to the waterways, but would lengthen or extend culverts in seven of the 26 locations where culverts occur. Given the existing highly restricted nature of fish passage on site, and the short-term nature of obstructions across water flow paths during the construction works period, it is considered unlikely that fish passage would considerably worsen.

### Riparian vegetation

The impacts of construction for works in and around watercourses on riparian vegetation are considered in Section 9.5.3 and Technical Paper 3.

### High erosion risk compound locations – bridge works

Four of the proposed compounds are located within areas where the risk of potential erosion and sedimentation impacts is considered to be high. These high risk compounds include the three proposed compounds at Darling Mills Creek, Devlins Creek and Terrys Creek immediately beneath the three main viaducts at and the tunnel compound at Sutherland Road. These proposed compounds are considered to be high risk as they are in immediate proximity of watercourses.

The proposed compounds at Darling Mills Creek, Devlins Creek and Terrys Creek are required to support the proposed bridge widening works. At these locations worksites are required to facilitate piling works, pier construction and the widening of the bridge decks. As work to construct the bridge piers must occur from the ground level beneath the bridges, work sites must be established at these locations, in the immediate vicinities of the watercourses. The use of these locations for works areas would therefore be unavoidable.

Due to the nature and limited accessibility of these proposed work locations, compounds would be established around these work sites to support the bridge works. These compounds would potentially include lay down and storage areas, site offices and temporary ablution facilities for use by the construction personnel involved in the works.

The proposed Darling Mills Creek and Terrys Creek compound sites are located within valleys with steep sided slopes. This topography limits the potential locations where works areas and compounds could be established. The small areas of relatively level or gently sloping ground immediately adjacent to the watercourses at the proposed work locations provides the only suitable potential locations for these compounds.

The proposed Devlins Creek compound site is characterised by gentler slopes. However, the available area for potential compounds locations is still constrained. The work site must be located immediately underneath the existing bridge decks and adjacent to the creek. As with the other bridge works locations, a compound would be set up around the work site.

Due to the proximity of these compound locations to the watercourses and the works that would occur at these locations there would be a high potential for erosion and sedimentation of the adjacent watercourses. Ground disturbance would occur during establishment of the work areas, whilst undertaking the proposed construction work and due to the movements of vehicles and plant within the compounds. Some riparian vegetation would also require clearing to create the necessary space in which to undertake the proposed works. Stable hard stands would be installed at these locations to facilitate the safe movement of the heavy construction equipment needed to undertake the proposed construction work. The potential for ground disturbance at the proposed sites would increase the potential for soil erosion and sedimentation of the adjacent watercourses.

The adjacent topography would also increase the risks associated with erosion and sedimentation at these locations. The steep surrounding areas would potentially deliver surface water run-off from adjacent areas to the site perimeters in significant quantities, increasing the potential for erosion within the proposed compounds. Surface water run-off within the sites would have the potential to transport sediment and other contaminants, such as fuel and oils spills from construction vehicles and plant, into the adjacent watercourses. Detailed site specific management strategies would be required to manage these potential impacts.

### High erosion risk compounds – the tunnel compound

The proposed Sutherland Road tunnel compound would be located immediately adjacent to Devlins Creek. As such there would be an elevated risk of erosion and sedimentation in the creek due to the use of this compound.

To facilitate the tunnel widening works, a compound is required with potential access to and from the motorway in close proximity to the tunnel. This compound would be used as a staging point for tunnel widening activities, mechanical/ electrical modifications to tunnel and other associated works. Site facilities and offices, temporary spoil stockpile areas, equipment and materials storage and lay down areas and mechanical and electrical workshops would also be required at this proposed compound.

Due to the specific requirements of this compound, there are limited options for potential site selection. This site is considered to be the only viable option in close proximity to the proposed tunnel widening works. Furthermore, this site has previously been disturbed and utilised as a construction compound.

The erosion and sedimentation risks associated with this site are largely due to the close proximity to Devlins Creek. Whilst the site is relatively flat and has a limited upstream catchment area, the site would be cleared and graded, a hardstand would be installed and the site would be subject to vehicular and construction plant movements. As such there would be the potential to disturb the soil, liberate sediment and alter the hydrology of the area during compound establishment and use, all of which may increase the risk of erosion and sedimentation of Devlins Creek. Detailed site specific management strategies would be required to manage the potential impacts.

#### Other compounds

Other potential construction compounds are outlined in this document. A preliminary analysis of these potential locations indicates that none are in areas that are considered to be particularly high risk in terms of potential erosion and sedimentation impacts. This is largely due to the fact that they are not in close proximity to watercourses. However, these sites still have the potential to be in close proximity to entry points to the local stormwater system. Site establishment, the use of the compounds for stockpiling, vehicular and plant movements around the site have the potential to create ground disturbance. If sediment from these proposed compound sites was to enter the adjacent stormwater system there would be the potential for sedimentation issues in downstream waterways.

### 9.8.3 Mitigation measures

#### Soils and water quality

Construction activities would be undertaken and managed to minimise the potential for construction impacts on soils and water quality. Soils and water quality are considered together for this purpose, since the management measures are often the same.

As a general guiding principle for both design and construction, soil erosion and water quality mitigation and management measures would be implemented in accordance with the requirements of:

- Water Policy and Code of Practice for Water Management (RTA 1999).
- Managing Urban Stormwater - Soils and Construction Volumes 1 and 2 (often referred to as The Blue Book - Landcom 2004 and 2006).

A summary of measures likely to be implemented for both the construction phases is provided below. The control and mitigation of potential surface water quality impacts during the construction phase would be defined in a Soil and Water Management Plan (SWMP) prepared as part of the CEMP. An outline of the CEMP is provided in the Construction Environmental Management Framework (refer to Appendix F).

The SWMP would be developed to incorporate the most appropriate or ‘best practice’ controls and measures in accordance with *The Blue Book* requirements. The SWMP would be continually updated to suit the changing needs as the project works progress. Due consideration would also be given to the extent of works and situation relative to the sensitivity of the surrounding environment in relation to the construction activity. Typical mitigation measures to be considered and implemented where relevant include:

- Minimising disturbed areas and re-vegetating or stabilising such areas as soon as practical as the works progress.
- Utilising cleared vegetation for mulching wherever possible to minimise erosion and filter runoff to trap coarse sediments.
- Installation of appropriate erosion control measures such as silt fencing, straw bales, check dams, temporary ground stabilisation, diversion berms or site regrading.

- Divert clean water runoff away from the works or disturbed areas wherever possible.
- Utilisation of existing water quality basins or installation of new temporary sediment basins as appropriate.
- Installation of permanent scour protection measures required for the operational phase as soon as practical.
- Providing bunded areas for storage of hazardous materials such as oils, chemicals and refuelling areas.
- Work platforms or access tracks required through waterway areas would be constructed of large clean rock material wrapped or underlain with geofabric.
- Employ a qualified soil conservationist to advise on appropriate controls and to monitor the implementation and maintenance of such measures.
- Engage site staff through tool box talks or similar with appropriate induction on soil and water management practices.
- Work method statements would be prepared for waterway works with particular emphasis on the early implementation of erosion and scour protection requirements.
- If the construction of piers is required within or near waterways, these would be shaped and oriented with the direction of flow, where practical.
- To reduce the potential for erosion, permanent diversion of small channels in localised areas might be considered for situations where the permanent works (such as bridge piers) may be required adjacent to or partially obstructing the waterway.
- If temporary stream crossings are required, these would be built in accordance with *Managing Urban Stormwater - Soils and Construction* (Landcom 2008).

Erosion and sediment loads would gradually diminish after construction as the disturbed areas are remediated and the revegetation of batters starts to establish and hold the soils.

### Flooding

Managing potential flooding impacts during construction needs to minimise the risks to the surrounding environment as well as the works themselves. Appropriate mitigation measures to be implemented would vary depending on the nature of the risks and sensitivity of the particular situation but would include consideration of the following:

- Temporary diversion or pumping of low flows around the works area.
- Minimising the need or extent of obstructions required to be placed within the waterway area.
- Programming or staging construction associated with creek/channel works or the transverse culverts to minimise the total time that works are undertaken in the vicinity of watercourses and thereby minimise the risk exposure.
- Ensuring construction equipment (or excess materials) is removed from the waterway or floodplain areas if wet weather is approaching and at the completion of each day's work activity.
- Strategically placing temporary levees or bunds to contain potential impacts and minimise the risk to surrounding properties, which may otherwise be affected.
- Installation of erosion and sediment control measures, in accordance with a CEMP across work areas, where potential flooding and diverted stormwater flow may create a risk of sedimentation or contamination from works in progress.

### Fish passage

Managing the impacts of construction works on fish passage is closely linked to those employed for the management of flooding impacts as described above.

### Riparian vegetation

The mitigation measures for construction of works in and around watercourses pertaining to the management of riparian vegetation are considered in Section 9.5.4 and Technical Paper 3.

### High erosion and sedimentation risk compound and work locations

Due to the increased potential from erosion and sedimentation impacts at the identified high risk compound and work sites, detailed erosion and sediment control plans (ESCPs) containing specific management strategies and control measures would be prepared for each of these sites. These plans would be developed prior to the commencement of construction with the assistance of a soil conservation officer. These plans would be reviewed throughout the duration of works at these locations and updated as required to address any management strategy deficiencies or to adapt to changing site use and conditions.

These plans would be developed with consideration of the following principles, strategies and controls:

- Erosion and sediment controls would be installed prior to or simultaneously with clearing and site establishment activities.
- Clearing extents would be limited where practicable to minimise ground disturbance and maintain soil stability.
- Clearing limits would be delineated, signposted and shown on site plans prior to the commencement of clearing activities .
- Stabilisation measures would be implemented for disturbed ground or areas with high erosion potential immediately up-slope for proposed compound and work locations wherever practicable .
- Clean water from upslope areas would be intercepted and diverted around the compound and work locations wherever practicable.
- Dirty water would be collected from the compound and work locations and filtered or appropriately treated prior to leaving the site perimeter.
- Options for capture and reuse (for dust suppression and the like) of surface water run-off from the proposed compound and work locations would be investigated at each location and implemented where practicable.
- Discharge/outlet points for diverted clean water would be stabilised to prevent scour, erosion and sedimentation.
- Revegetation and stabilisation of disturbed areas as soon as practicable following the disturbance (and completion of works) to promote surface stability and minimise erosion potential.
- Any temporary creek crossing required would be designed and constructed in accordance with *Managing Urban Stormwater - Soils and Construction* Volumes 1 and 2 (often referred to as The Blue Book - Landcom 2004 and 2008).
- The storage of any potential contaminants at compound or work locations would be in an appropriately bunded and covered area and would be located as far as practicable from the waterways.

## 9.9 Non-Aboriginal heritage

A *Non-Aboriginal Heritage Assessment for M2 Upgrade project* report was undertaken by HBO+EMTB (2010). The report identified three items of heritage significance with the potential to be impacted by the proposed works. A Statement of Heritage Impact (SOHI) has been prepared to assess the impacts associated with the Windsor Road heritage items. These impacts are considered in more detail in Technical Paper 7 (7a and 7b).

| Director-General's Requirements | Where addressed |
|---|---|
| *No specific requirement in respect of non-Aboriginal Heritage is specified within the DGRs. Notwithstanding this, the Department of Planning has determined that, for the purposes of this environmental assessment, the potential impacts of the proposal on non-Aboriginal heritage should be assessed as a key issue.* | *Section 9.9, Technical Paper 7* |

The assessment was undertaken in accordance with the principles of the Australia ICOMOS Burra Charter, the *NSW Heritage Act 1977*, the *National Parks and Wildlife Act 1974* and RTA statutory obligations under these Acts. The assessment has also been prepared in accordance with the NSW Heritage Office and DUAP (1996) *NSW Heritage Manual* and NSW Heritage Office (2002) *Statements of Heritage Impact*.

The assessment considers the non-Aboriginal heritage assessment prepared by Conybeare Morrison and Partners in April 1992 for the original construction of the M2 Motorway construction, the *Windsor Road and Old Windsor Road Conservation Management Plan* (CMP) prepared by Clive Lucas Stapleton + Partners (2005), local historical consultation, a field survey and a review of the following registers and schedules:

- NSW Roads and Traffic Authority – Section 170 Heritage and Conservation Register
- State Rail Authority (Rail Heritage Unit) – Section 170 Heritage and Conservation Register
- NSW Heritage Office – The State Heritage Register
- NSW Heritage Office – The State Heritage Inventory
- Parramatta City Council – Local Environmental Plan (Heritage and Conservation) 1996
- Parramatta City Council – Parramatta Local Environmental Plan 2001
- Baulkham Hills City Council – Baulkham Hills Local Environmental Plan 2005
- Ryde City Council – Ryde Local Environmental Plan, Gazetted 4 August, 2006
- Hornsby Shire Council - Hornsby Local Environmental Plan 1994
- The Register of the National Estate
- The Commonwealth Heritage List
- The National Heritage list.

The objectives of the non-Aboriginal assessment are to:

- Identify heritage items and values in the vicinity of the proposed upgrade works.
- Establish their current level of significance.
- Identify potential impacts to the heritage items due to the proposed work.
- Identify appropriate mitigations measures and strategies to minimise the potential for adverse impact to those items.

### 9.9.1 Existing environment

Literature research, local historical consultation and a field survey of the M2 Motorway identified 16 sites of non-Aboriginal heritage significance in the vicinity of the M2 Motorway. These sites included several historic residences, a rare stone causeway, a former school and several historic gardens and plantings. Technical paper 7b describes these items in more detail. None of the identified items are listed on State or Commonwealth heritage registers.

Table 98 Sites of non-Aboriginal heritage

| Item | Identified item | Statutory listing |
|---|---|---|
| H-01 | Northern Suburbs Cemetery | Ryde LEP 2008. LEP No. 105. Locally listed heritage item. |
| H-02 | Lane Cove National Park, Marsfield | Ryde LEP 2008. LEP No. 105. Locally listed heritage item. |
| H-03 | Christie Park | Not listed as a heritage item. Located within Ryde City Council. |
| H-04 | 266-268 Windsor Road, Model Farms | Parramatta LEP 1996 (Heritage and Conservation) Locally listed item |
| H-05 | Epping Park, North Epping | Hornsby LEP 1994. Locally listed heritage item. |
| H-06 | No. 57 Norfolk Road, North Epping Residence | Hornsby LEP 1994. Locally listed heritage item. |
| H-07 | 61 Norfolk Road, North Epping Residence | Hornsby LEP 1994. Locally listed heritage item. |
| H-08 | Garden – The Poplars, 64-66 Norfolk Road, North Epping | Hornsby LEP 1994. Locally listed heritage item. |
| H-09 | No. 70 Norfolk Road, North Epping Residence | Hornsby LEP 1994. Locally listed heritage item. |
| H-10 | Beecroft / Cheltenham Conservation area | Hornsby LEP 1994. Locally listed heritage item. |
| H-11 | Chilworth Recreation Reserve | Hornsby LEP 1994. Locally listed heritage item. |
| H-12 | Devlin Creek, Epping Stone Causeway | Hornsby LEP 1994. Locally listed heritage item. |
| H-13 | Pennant Hills Golf Course | Hornsby LEP 1994. Locally listed heritage item. |
| H-14 | Road Reserve – Street Trees (south end) Sutherland Road, Epping | Hornsby LEP 1994. Locally listed heritage item. |
| H-15 | Former Baulkham Hills Public School | Baulkham Hills LEP 2005, Locally listed heritage item |
| H-16 | Old Windsor Road and Windsor Road Heritage Precincts | RTA Section 170 Register |

The following specific sections of Windsor Road and Old Windsor Road are listed on the RTA's Section 170 Register:

- McGraths Hill Archaeology Site and Cemetery.
- Old Hawkesbury Road.
- Vineyard Alignment.
- First Ponds Creek Alignment.
- Box Hill Vergescape.
- Rouse Hill Road Cutting.
- Caddies Creek Alignment.
- Strangers Creek Alignment.
- Excelsior Way Alignment.
- Stanhope Farm Alignment.
- Meurants's Lane Alignment.

While the CMP for Windsor Road / Old Windsor Road identifies the earliest alignments as being of state historical significance, statutory listing was restricted to sections that had been bypassed or retained elements of their original roadside setting. None of the listed sections are close to the M2 Motorway intersection.

### 9.9.2 Impact assessment

Of the 16 sites of non-Aboriginal heritage significance in the vicinity of the M2 Motorway, nine sites have been assessed as having the potential to be impacted by the project, which are:

- H-04 266-268 Windsor Road, Model Farms.
- H-06 No. 57 Norfolk Road, North Epping Residence.
- H-07 61 Norfolk Road, North Epping Residence.
- H-09 No. 70 Norfolk Road, North Epping Residence.
- H-10 Beecroft/Cheltenham Conservation Area.
- H-11 Chilworth Recreation Reserve.
- H-12 Devlin Creek, Epping Stone Causeway.
- H-15 Baulkham Hills Public School (Former).
- H-16 Old Windsor Road and Windsor Road Heritage Precincts.

#### Items H-06, H-07 and H-09

Three of the nine items, H-06, H-07 and H-09, are Local Environmental Plan (LEP) listed heritage houses located in the vicinity of the Norfolk Tunnel. No direct impacts to these houses are anticipated. However, vibrations associated with proposed tunnel widening and associated works may be perceptible at these locations.

Potential vibration issues associated with the proposed tunnel widening have been considered in the noise and vibration impact assessment (Technical Paper 2). Based on this assessment, the vibration levels would be expected to be below the level at which structural damage would occur, largely due to vertical and horizontal distances of the houses from the vibration source. However, the closest properties H-06 and H-07 may experience ground-borne (regenerated) noise associated with the vibration from the proposed tunnelling. Whilst the ground-borne noise may be perceptible at these residences, the associated vibrations are not expected to impact on the structural integrity or heritage significance of these heritage items.

#### Item H-10 and H-11

The M2 Motorway runs along the boundary of H-10 (Beecroft Conservation Area) and H-11 (Chilworth Reserve). The heritage significance of the Beecroft Conservation Area is its distinct visual identity as a federation garden suburb, whereas the heritage significance of Chilworth Reserve is the indigenous bushland. The M2 Upgrade project would result in the introduction of an additional lane to the roadway in these areas, requiring additional supporting structures to the road. Although this would result in a change to the visual appearance of the M2 Motorway, the change would only result in a slight alteration to the motorway footprint and would not impact upon the aspects of heritage significance associated with these two items. Such impacts can be adequately managed through appropriate landscaping and revegetation measures.

## Item H-15

Site H-15 (Former Baulkham Hills Public School) is adjacent to the intersection with Windsor Road and the M2 Motorway. However, works are not proposed in the immediate vicinity of this item and no impacts to the heritage significance of this item are anticipated.

The visual link between the school site and the Windsor Road alignment is not adversely impacted.

## Item H-12

The rare sandstone causeway over Devlins Creek (H-12) is located directly beneath the existing bus ramp between the M2 Motorway and Beecroft Road. The item has been substantially impacted by previous service crossings (sewer and water mains) cut into the bedrock of the creek and is likely to have been impacted by creek flooding. Despite these characteristics, the item retains heritage significance and is listed on the Hornsby LEP 1994. The project would result in the bus ramp, approximately 10-12 metres above the causeway, being removed. With appropriate management measures being developed and refined during the construction planning phase the risk of any permanent physical impacts to this item is considered to be minimal.

A Statement of Heritage Impact (SOHI) is provided in support of the above statement. The SOHI is consistent with the Heritage Office *Statements of Heritage Impact Guidelines* (2000). Specific questions have been posed to indentify how heritage impacts upon the item have been considered. Further archaeological survey and recording would take place, in conjunction with removal of vegetation and other recent material covering the causeway remains, prior to the demolition of the bus ramp. Measures for undertaking demolition works to avoid impacts to the causeway may include identifying access areas, exclusion zones, protective coverings over the causeway and careful selection of equipment required for the bus ramp demolition.

### Statement of Heritage Significance (Item H-12)

The sandstone causeway over Devlins Creek is of local significance for its historical, archaeological and rarity values. The causeway was constructed circa 1831 by convict labour as part of the New Line Road, a shorter route to the Blue Mountains and beyond, developed by Surveyor General Thomas Mitchell. It is a significant remnant of the Great North Road, which opened the local area for settlement. The causeway is rare as one of the few remnants left within the metropolitan area.

Table 99 Statement of Heritage Impact for Item H-12

| SOHI question | SOHI response |
|---|---|
| Will the proposed action [removal of the bus ramp] be sympathetic to the heritage significance of the item? | Yes. The demolition of the bus ramp would remove an earlier intrusive and unsympathetic service from the setting of the causeway, and reduce the risk of damage from falling objects. The removal of the bus ramp would enhance the ability to read the plan and layout of the Causeway and to understand its significance and would have a positive impact on the item. It is noted that the demolition of the bus ramp involves removal of the bridge deck only, and does not include removal of the reinforced earth abutment. |
| Will the Causeway be affected by the demolition of the bus ramp? | It is possible that the Causeway would be affected during the removal of the bus ramp if adequate measures are not taken to protect it. The following measures are proposed:<br>• Supplement existing recordings of the causeway with an archaeological survey prior to commencement of work, identifying visible fabric relating to the causeway, illustrating the relationship with Devlin Creek and local tributaries, the rail embankment, existing access ways and the bus ramp structure that would be removed, and earlier road alignments.<br>• Develop and implement appropriate physical and procedural measures to protect the causeway and its curtilage from damage caused by the removal of the bus ramp.<br>• Prepare an access plan to control access and movement of vehicles in the vicinity of the causeway. The plan would be implemented restricting the use of heavy demolition equipment to within three metres of the set boundary.<br>• Mitigate impacts from demolition by providing protective barriers around the causeway, utilising the existing service road to demolish the structure, utilise heavy lifting equipment when removing ramps in segments and heavy equipment to remain minimum three metres away from the causeway, where practicable.<br>• Develop and implement a site-specific erosion and sediment control plan to reduce potential negative impact from the works to the physical features of the causeway.<br>In the long term the removal of the bus ramp would have a positive impact on the significance of the Causeway by removing an intrusive and unsympathetic service from the vicinity of the heritage item. |

In summary, the demolition of the bus ramp would have a positive impact on the significance of the Causeway by removing an unsympathetic service from its vicinity. Adequate care needs to be taken during the demolition process to ensure the Causeway is not impacted. A series of measures (Table 99) have been developed to minimise this risk.

## Item H-16

In 2005 the RTA prepared a CMP for Windsor Road and Old Windsor Road to manage heritage precincts and items identified on the RTA's Section 170 Register (Clive Lucas Stapleton + Partners 2005). The CMP identified that Windsor and Old Windsor Roads, as first laid out in 1794 and realigned in 1812-13, are of state and national significance (CLSP 2005: 57). However, it was recognised that later use of the road had resulted in the loss of physical evidence, which reflected this earliest phase. Specific sections of the alignment that were more intact and contained older buildings relating to historical use of the road were identified and included in the RTA Section 170 Heritage and Conservation Register. None of these sections are close to the intersection with the M2 Motorway, or are likely to be affected by the development, the nearest being Excelsior Way Alignment Precinct, approximately 3.5 kilometres north of the M2 Motorway.

While the project is not within the immediate vicinity of any of the identified precincts and none of these areas would be directly or indirectly affected by the project, it was deemed necessary to consider the cumulative impact the proposed works would have on Windsor Road. A SOHI is included in Technical Paper 7b and is summarised below.

#### Statement of Significance (Item H-16)

The Windsor Road alignment is noted for its historical significance as one of Greater Sydney's early examples of a major road and for its contribution to the development of the settlement of the Hawkesbury farming lands. While some sections of the Road is considered to retain sufficient fabric and setting to be listed as state-significant heritage precincts, the remainder is principally considered to be historical important when assessed within the context of the entire alignment of the road.

Considered by itself, the section of Windsor Road to be impacted by the M2 Upgrade project does not exhibit any significance beyond the road continuing to represent the general location of the original alignment.

Table 100 Statement of Heritage Impact Item H-16

| SOHI question | SOHI response |
|---|---|
| Have other options been considered? | Yes. Alternatives for the project are documented in Chapter 3 of the environmental assessment. Construction of new on- and off-ramps at Windsor Road for access to the M2 Motorway are required in this location to improve current traffic access to/from the M2 Motorway and to plan for future increased development in Sydney's north west. |
| How is the impact of the upgrades on the heritage significance of the item to be minimised? | The construction of the required access ramps to the M2 Motorway would have minimal impact to the heritage significance of this portion of Windsor Road. Only approximately 2,000 square metres of Windsor Road will be impacted, to a depth of three metres. It should be noted that the road has been upgraded many times over the course of its establishment, most recently in 2006 as part of a four lane upgrade of the arterial road).<br>During these upgrades, the original alignment of the road has remained the same although the width has greatly expanded, which has removed most or all of the original road fabric, and altered the appearance of cuttings and the road setting.<br>During the M2 Upgrade project, the heritage significance of the road's original alignment would not be substantially impacted any further and the visual appreciation of the road's relationship to identified roadside heritage items - the cottage (266-268 Windsor Road) and Baulkham Hills Primary School - and the greater Cumberland Plain will not be affected. |
| Will the additions visually dominate the heritage item? | While the Windsor Road upgrades would involve some visual changes, they would not dominate this portion of the Windsor Road/M2Motorway overpass as it is understood in the greater context of its place within the Cumberland Plain road network. |
| Is there any potential for archaeological deposits/features to be disturbed? | There is negligible potential for archaeological deposits/features to be disturbed. No archaeological features were identified during inspection of the area and the assessment of the entire length of Old Windsor and Windsor Road by the RTA did not identify this portion of the road as containing any areas of archaeological significance. |
| Are the additions sympathetic to the heritage item? | The upgrades required for improved access to the M2 Motorway are sympathetic to the heritage item as they would not involve substantial change to the historical context of Windsor Road. The existing alignment of 14 kilometres would be maintained and only approximately 2,000 square metres would be impacted. The on- and off-ramps to be built would be constructed using similar materials and methods to the existing road and would not significantly change the character of Windsor Road. |

The portion of Windsor Road directly adjacent to the M2 Motorway intersection has previously been heavily impacted by the construction of the M2 Motorway. The M2 Motorway and Windsor Road meet on a natural crest, which has been cut for the creation of the M2 Motorway. Windsor Road, at this point, is formed by an overpass across the M2 Motorway. Substantial works have been undertaken in the area during construction of the overpass and the alignment appears to have been altered at that time as sections on either side of the overpass are reasonably sinuous, while the overpass is straight. The upgrades required for improved access to the M2 Motorway are sympathetic to the Road, as they would not involve substantial change to the historical context of Windsor Road. The on and off-ramps to be built would be constructed using similar materials and methods to the existing road and would not significantly change the character of Windsor Road. The section of Windsor Road that may be impacted by the M2 Upgrade project does not exhibit any exceptional significance and has previously been impacted by the construction of the overpass. The proposed upgrade would therefore have minimal impact on the heritage significance of the Road.

In addition to identifying elements of the road that have heritage significance, the CMP identifies a number of items that have heritage significance along Windsor Road. Specific management actions are identified for these items and a range of conservation policies are suggested for consideration if these items are affected.

One of the properties identified in the CMP as an item of heritage significance is 266-268 Windsor Road, Model Farms. The treatment of the property, as proposed, is consistent with the identified significance and policy recommendations in the CMP (2005: 90), which makes a single specific recommendation that it *"feature in published information as a place of interest along the Windsor Road route"*. The revision of the Windsor Road CMP and preparation of an associated interpretation plan is scheduled for 2010. It is appropriate to review this recommendation and general conservation policies for managing the Road's significance as part of the CMP review, and consider a range of options for interpretation of the Road's heritage that may apply to 266-268 Windsor Road. These would supplement any specific recommendations in the SOHI for the property and applicable general policies.

### Item H-04

Item H-04 at 266-268 Windsor Road, Model Farms, is identified in the Windsor and Old Windsor Roads CMP as a heritage item, and separately as a heritage item in Parramatta LEP 1996. Number 266-268 is privately owned, and is located directly adjacent to the proposed west-bound M2 Motorway on-ramp. The heritage significance of this item derives from its demonstration of the pattern of development in the rural margins of the Cumberland Plain. The house is a remnant of a period when the area was a series of small scale farms and market gardens with modest farmhouse / cottages. The relative viability of smaller farms here was made possible by the access to markets along Windsor Road.

The land on which this item is situated was originally granted in 1862. The date of construction for the cottage is unknown, but is thought to have been built between 1862 and 1918. From 1913 onwards, the property was used for market gardening. The property is in good condition and is undergoing renovations by the current owners,

Given the proximity of the residence to Windsor Road, there is potential for the residence to be subject to vibration levels associated with road construction and increased noise levels during operation of the new M2 Motorway on-ramp. The potential for noise and vibration impacts to this property has been considered in Technical Paper 2 undertaken for this environmental assessment. Technical Paper 2 indicated that while vibrations associated with plant may be perceptible at the residence, the levels are generally expected to lie below structural damage criteria and safeguards such as the judicious selection of construction plant to minimise risk of impact would be required. The realignment of Windsor Road to feed into the proposed M2 Motorway on-ramp would result in traffic being in closer proximity to the residence. The property is identified in Technical Paper 2 for further noise mitigation consideration as part of the noise and vibration impact assessment due to the realignment. Consideration of any noise mitigation measures for this property would be in consultation with the property's owners and take into consideration the heritage values of this residence.

While the residence itself would not be directly impacted by the project, it is proposed to resume approximately 370 square metres of the property adjoining Windsor Road for the creation of a new west M2 Motorway on-ramp. Existing garden plantings between the residence and Windsor Road would also be removed. An assessment of this impact in accordance with the NSW Heritage Office and DUAP (1996) *NSW Heritage Manual*, and NSW Heritage Office 2002 *Statements of Heritage Impact* has been undertaken to assess the level and nature of the impact to 266-268 Windsor Road, Model Farms. The assessment uses a series of questions considered most appropriate to the proposed works are those relating to the subdivision. The following Statement of Heritage Impact is summarised from Technical Paper 7.

The following SOHI has been based on the Statement of Significance provided below and meets the requirements of Policy 6.6 in the CMP for Windsor Road and Old Windsor Road.

#### Statement of Heritage Impact (Item H-04)

No. 266-268 Windsor Road is of local heritage significance as it demonstrates the pattern of development in the area during the mid-19th century. It reflects the pattern of land occupancy in the mid-19th century, when the area was a series of small scale farms and market gardens with modest farmhouse/cottages. The modifications and extensions to the cottage are representative of the evolution of the area from rural to urban setting. It is a typical cottage from the mid 19th century and representative of its type. The cottage is of local aesthetic significance for its historical appeal and as an exemplar of the farm cottage style within the Parramatta LGA.

Table 101 Statement of Heritage Impact for Item H-04

| SOHI question | SOHI response |
|---|---|
| How is the proposed curtilage allowed around the heritage item appropriate? | During the design phase minimising the impact to the cottage's curtilage was a design objective. The excision of 370m² from the frontage represents the minimum requirements to create an on ramp that complies with safety guidelines and allows for future increases in usage.<br>The project would affect part of the curtilage and result in the loss of shrubs and trees around the residence. However, the relationship between the property frontage and the road would be truncated, the relationship would be maintained.<br>While the reduction in curtilage and loss of vegetation around the cottage may affect the appearance of the property, it would not impact on aspects of its heritage significance, which is invested in the historical and representative values of the cottage's built fabric. The current lot on which the dwelling sits has been assessed as being not significant as it has been substantially modified and reduced through previous subdivision, impacting on its heritage significance. |
| Could future development that results from this subdivision compromise the significance of the heritage item? | The construction of the M2 Motorway westbound onramp maintains the current and historical land use. The residence was constructed on Windsor Road to take advantage of this transportation route and its relationship with the road would be preserved. There are unlikely to be future developments resulting from the additions of the onramp, therefore the residence's significance would not be further compromised. |
| Could future development that results from this subdivision affect views to, and from, the heritage item? How are negative impacts to be minimised? | Construction and operation of the proposed M2 Motorway on ramp would result in the loss of vegetation from the front of the property. Mature plantings along the front boundary of the property currently screen views of the residence from Windsor Road. Suitable landscape plantings in the property would be reinstated to establish a suitable setting for the building on that side of the property. Suitable species would be selected in consultation with a heritage landscape specialist to be appropriate for a house of the late 19th century period.<br>Noise management is being investigated through a separate SOHI (see Technical Paper |

| SOHI question | SOHI response |
|---|---|
| | 7b) that is investigated several options, including 'do nothing', architectural treatments and erection of a 2.5 metre noise wall. The Technical Paper recommends the latter option be adopted, as it would have the least impact on the heritage significance. It is also fully reversible, which is in keeping with the Burra Charter, unlike architectural treatments. If a noise wall is considered to provide the most acceptable heritage solution, in consultation with the property owners, it is to be designed to minimise its visual impact to and from the property as much as possible, consistent with achieving its design purpose. Refer to Sections 9.3 and 9.4. It is noted that noise wall construction is likely to be the preferred option over architectural options. |
| Have other options been considered? | Yes. Other options to expand traffic capacity from Sydney's north-east to the CBD have been considered within this document. The construction of an additional eastbound lane on the M2 Motorway, necessitating the upgrade to the Windsor Road on-ramp has been determined to be the most efficient option. Refer to Chapter 2 for further discussion.<br>Options to avoid and minimise impacts to 266-268 Windsor Road were considered during the design phase of the project. However the construction a new M2 Motorway on-ramp necessitates the widening of Windsor Road immediately south of the motorway intersection.<br>The only other possible option for providing access to the new M2 Motorway on ramp at this location was to widen Windsor Road on the opposite side (eastern) of 266-268 Windsor Road.<br>Widening on the eastern side of Windsor Road to allow for the M2 Motorway on-ramp would have resulted in direct impacts to the former Baulkham Hills Public School buildings, potentially requiring their demolition. The option chosen to widen on the western side of Windsor Road would result in less heritage impacts than the only other alternative option available. |

In conclusion, although the project would require resuming approximately 370 square metres of land from the frontage of the 266-268 Windsor Road, Model Farms, it is not considered that this would impact on the significance of the property. The heritage significance of this item is associated with the property demonstrating Parramatta's changing land-use history and as a representative of a mid 19th century cottage. While the project would affect the curtilage and result in the loss of tree around the residence, it would not affect the heritage significance of the item, which is invested in its historical and representative values.

### 9.9.3 Mitigation measures

Measures to be implemented to minimise risk of impacts to the causeway (Item H-12) include, but are not limited to:

- Supplement existing recordings of the causeway with an archival survey prior to commencement of work, illustrating the relationship with Devlin Creek and local tributaries, the rail embankment, existing access ways and the bus ramp structure that would be removed.
- Develop and implement appropriate physical and procedural measures to protect the causeway and its curtilage from damage caused by the demolition of M2 Motorway bus ramp.
- Prepare an access plan to identify the location of the causeway. The plan would be implemented restricting the use of heavy demolition equipment to within three metres of the set boundary.
- Mitigate impacts from demolition by providing protective barriers around the causeway, utilising the existing service road to demolish the structure, utilise heavy lifting equipment when removing ramps in segments and heavy equipment to remain minimum three metres away from the causeway where practicable.
- Develop and implement a site-specific erosion and sediment control plan to reduce potential negative impact from the works to the physical features of the causeway.

Item H-04 is a residence of heritage significance that is located at 266-268 Windsor Road, Model Farms. Mitigation measures to be implemented to minimise impacts to this property include, but are not limited to:

- Use of heavy equipment and vibration equipment would not be permitted within three metres of the Farmhouse's front veranda.
- A detailed dilapidation (condition) survey would be undertaken of the building prior to the commencement of work at this location.
- Suitable landscape plantings in the property would be reinstated to establish a suitable setting for the building on that side of the property. Suitable species would be selected in consultation with a heritage landscape specialist to be appropriate for a house of the late 19th century period.
- Suitable vehicular and pedestrian access would be provided during construction and in the final design.
- It is advised that archival recording be undertaken of the relationship between the cottage and Windsor Road be undertaken before and after the removal of the vegetation in the front yard.
- It is recommended that the construction of a noise wall to ameliorate noise concerns would have the least impact on the heritage significance of the cottage. If architectural treatment is required then double glazing should be of a standard and type that is appropriate to the building's farm cottage aesthetic, and any ventilation system should be carefully located so as to minimise the visual impact of these services on the cottage.
- It is recommended the noise wall be rendered and finished in an appropriate colour. It is suggested that a cream colour similar to the house be used on the interior of the wall, as this would tone with the house and would not add to the darkening of the area. It is suggested that the exterior section of wall, that which faces Windsor Road, be rendered in a colour in keeping with the surrounds – either brick red, green or two toned brick red and green to blend with the adjacent property.

Item H-16 is Windsor Road, sections of which have been accessed as having National and State level significance. However, the section of Windsor Road that intersects with the M2 Motorway is not ascribed significance except within the context of the broader road alignment.

The M2 Upgrade project, including works to the interface between Windsor Road and the M2 Motorway, would not impact on the heritage significance of Windsor Road.

# 10. Other environmental issues

## 10.1 Operational surface water management

An E*nvironmental Assessment – Surface water assessment* report was prepared by AECOM, dated February 2010 and this section presents a summary of that assessment.

The assessment includes the identification of potential impacts and mitigation measures pertaining to flooding, stormwater and water quality, and implications for watercourses.

The objectives of this assessment included:

- Define the existing environment with respect to surface water aspects such as
  - The interaction of the M2 Motorway and its transverse culvert drainage structures on flooding for surrounding areas.
  - The quality of surface water runoff from the M2 Motorway and the receiving water environment from operation.
- Quantify the nature and extent of potential impacts on the above elements due the operational phases of the project.
- Identify appropriate mitigation measures to address and ameliorate impacts.

The following key issues were considered and addressed as part of the environmental assessment. These address the stormwater and watercourse implications component of the DGRs listed above:

- Description of the stormwater treatment and outlet works.
- Measures to minimise the potential erosion impacts on watercourses
- Identification of sources of polluted water at project sites on surface roads and in tunnels during operation.

### 10.1.1 Existing environment

The existing soils, aquatic and water quality environments are described in Section 9.8.1 and in Technical Paper 6.

#### Flooding

The original design of the existing M2 Motorway was undertaken in 1995-96 with construction completed and the M2 Motorway opened to traffic in May 1997. Detailed information relating to the assumptions and basis for the original Motorway design of drainage elements are limited. Copies of the design drawings and some work as executed information have been obtained but the supporting design calculations, reports or technical models were not available for review. The investigations undertaken for this current assessment have therefore relied upon the limited details that were already available along with some new information specifically gathered while developing the upgrade concept.

The following survey information was initially available for the purposes developing the design concept and associated investigations:

- Two metre topographical mapping contours for the surrounding region.
- Photogrammetric survey within the corridor, excluding the pavement area, obtained from Ausimage (SKM).
- Detailed survey of the M2 Motorway surface between the existing barriers and from previous studies.
- Additional surveys obtained by surveyors for the project team in January 2009 to specifically assist with the hydraulic investigations and the detail design process in general.

To quantify the existing general flood conditions and to establish the relative impacts of the proposed upgrade works, hydrologic and hydraulic analyses were undertaken. To accommodate for increased variability in rainfall that may result from climate change, the performance of the affected structures was conservatively assessed. A 20 percent increase in flows was allowed for, to accommodate significant issues or risks should the future situation be different to existing or the assumed designed conditions as a result of climate change.

The analyses and results are considered suitable for the intended purposes of quantifying the existing situation and the potential impacts attributable to the widening works.

To quantify if the proposed upgrade works would impact on flood levels and flow velocities, local surface water catchments draining to and across/through the M2 Motorway were hydrologically modelled to determine peak flow estimates applicable for design and hydraulic modelling. The hydrologic modelling of the urbanised catchments has been based on the XP-Rafts runoff-routing software. Hydrologic models were established for the Devlins Creek, University and Shrimptons Creek catchments.

Hydraulic modelling has involved a combination of headwater calculations for the smaller culvert structures which primarily operate under inlet control, while detailed HEC-RAS modelling has been undertaken for the larger waterways where structures are more influenced by hydraulic gradients or potential downstream tailwater conditions. The waterways modelled hydraulically include Devlins Creek, University Creek and Shrimptons Creek.

For the purposes of this study, existing flood conditions in the 1 in 100 year ARI design event have been estimated for the seven transverse culvert structures which are to be extended due to the widening works. A long reach of Devlins Creek extending from Beecroft Road to just upstream of Kirkham Street and the upper M2 Motorway crossing (Culvert 23), effectively runs parallel to the M2 Motorway and incorporates or influences a number of culvert structures. Additionally, sections of the M2 Motorway adjacent to the creek are to be widened. Consequently this entire reach was modelled using HEC-RAS. The structures and adjoining reaches immediately upstream and downstream of the M2 Motorway at University (Culvert 35) and Shrimptons Creeks (Culvert 36) were modelled separately also using HEC-RAS. Culverts 13, 18, 26 and 30 were analysed using HY-8 culvert analysis software.

The estimated 1 in 100 year ARI flood extent for the upper and lower reaches of Devlins Creek under existing conditions is presented in Figures 13 and 14 of Technical Paper 6. Along the entire length of the reach modelled, the flood extent is typically contained within the riparian bush zone which is bounded by the M2 Motorway embankment on one side and residential development on the other. Large precast concrete arch culvert structures are used for the main M2 Motorway crossings of Devlins Creek (Culverts 23, 24, 27 and 28) with only Culvert 23 to be extended by 4.9 metres due to the widening works.

The existing flood behaviour for University Creek in the vicinity of the M2 Motorway (refer Figure 15 of the Technical Paper 6) appears to be influenced by a number of manmade features. Flows from the upper catchment are initially controlled by a large diameter pipe and inlet structure immediately upstream south of Talavera Road. The pipe flows are conveyed under the road and the building on the property located upstream of the M2 Motorway to discharge into an open channel near the inlet of the existing Motorway culvert (Culvert 35). Excess flows that surcharge across Talavera Road, drop over a concrete weir (wall) where they are then directed overland through the property car park into another drop inlet structure and large box culvert which discharges into an overgrown gabion and rock mattress lined channel running eastwards alongside the westbound (southern) side of the M2 Motorway. The channel drops one metre into the M2 Motorway culvert inlet. Whilst this culvert was designed to convey a 1 in 100 year ARI design flood during original construction, preliminary results of the hydraulic analyses conducted as part of this assessment have indicated that the 1 in 100 year ARI flood levels in this area may be higher than the adjoining motorway, which may then be overtopped in the existing situation.

Further modelling would be required to confirm the existing hydraulic conditions at this location, which are outside the scope of this assessment. The current assessment is considered adequate for the purpose of predicting relative changes in culvert performance due to the proposed upgrade works.

At Shrimptons Creek, the hydraulic profile and results summarised in the Technical Paper 6 indicates that the existing property access bridge, located just upstream of the M2 Motorway boundary, is constricting the waterway and appears to be controlling flood levels in this area. Downstream of the bridge as the channel drops quickly through the large arch culvert structure (nearly three metres in elevation difference from the bridge to the arch outlet), the steep nature causes flow in the reach to the inlet of the arch to become super-critical (below the normal water level based on the geometric properties of the waterway area). The 20 x 6 metre arch itself has sufficient capacity to convey the 1 in 100 year ARI design flow.

### 10.1.2 Impact assessment

#### Proposed upgrade works

A brief description of the proposed upgrade works pertaining to surface water drainage elements structures within each of the precincts is in Section 9.8.2. A full description is provided in Section 6.3.9 and Technical Paper 6.

#### Flooding

The flooding impacts of the proposed upgrade works for the project have been assessed. The varying nature and extent of the proposed widening along the route means that only seven of the 26 existing transverse culvert drainage structures are affected by the widening to such an extent that they require extension. The lengths of these extensions vary from a minimum of 2.4 metres to a maximum of 17.1 metres (both for the same Culvert 35) with the remainder generally falling in the range of 4.9 metres to 8.5 metres.

Each of the affected structures has been modelled to establish 1 in 100 year ARI flood levels for both the existing and proposed conditions. A summary of the flood level and velocity results is presented in Table 102.

Table 102 Hydraulic impacts – 1 in 100 year ARI event

| Culvert | | Analysis | Design Flow | Upstream Flood Level (mAHD) | | Relative Impact (metres) | Outlet Velocity (metres/s) | | Relative Impact (metres/s) |
|---|---|---|---|---|---|---|---|---|---|
| ID | Chainage | | (m³/s) | Existing | Proposed | | Existing | Proposed | |
| 13 | 5250 | HY8 | 4.5 | 78.84 | 78.84 | 0.00 | 6.36 | 6.44 | 0.08 |
| 18 | 7560 | HY8 | 5.3 | 73.05 | 73.05 | 0.00 | 6.66 | 6.66 | 0.00 |
| 23 | 10550 | Hecras<br>HY8 | 110 | 85.56<br>86.11 | 85.56<br>86.12 | 0.00<br>0.01 | 1.34<br>2.93 | 1.34<br>2.93 | 0.00<br>0.00 |
| 26 | 11640 | HY8 | 14.8 | 78.81 | 78.83 | 0.02 | 2.58 | 2.58 | 0.00 |
| 30 | 13500 | HY8 | 19.3 | 48.02 | 48.02 | 0.00 | 3.91 | 3.96 | 0.05 |
| 35 | 16220 | Hecras | 41 | 41.51 | 41.41 | -0.10 | 2.96 | 4.49 | 1.53 |
| 36 | 16450 | Hecras | 190 | 32.91 | 32.91 | 0.00 | 3.68 | 3.68 | 0.00 |

There are no significant increases in flood levels that would potentially impact on upstream or adjoining properties (results documented in Table 102). Culvert 26 (refer Figure 9 of Technical Paper 6), is the only location where a potential impact has been identified and this is limited to maximum increase is only 0.02 metres, which should not adversely affect surrounding properties. At University Creek (Culvert 35), the proposed channel works (refer Section 2.7 of Technical Paper 6), would reduce flood levels at the culvert by 0.1 metre and in the upstream reach by between 1.0 to 1.5 metres thereby improving the existing situation and reducing the risk of the M2 Motorway being overtopped.

It is not proposed to alter the waterway area (cross sectional dimensions) of the existing culvert structures and as such the changes in outlet velocity are typically less than 0.1 metres per second. Such small changes are considered to be negligible relative to the velocities already prevailing at the existing outlets and in the adjoining downstream creek sections. The only exception is for University Creek/Culvert 35, where increasing the length of the relatively steep existing culvert grade with improvements to the channel upstream has increased the outlet velocity. An energy dissipater at the relocated outlet together with other possible detail design measures (channel and inlet configurations, grade changes, increased culvert roughness or downstream dimensions) would be provided to address this increase.

In addition to the individual transverse culvert crossings, the M2 Motorway is to be widened along the reach running parallel to Devlins Creek. For the reach between Chainage 10580 to 11100 (refer Figure 8 of Technical Paper 6) the proposed design concept is to construct the carriageway supported on piers and as a structurally cantilevered section to overhang the creek. This concept has been modelled in HEC-RAS and found to have minimal impact (<0.01 metres) on flood levels.

### Water quality of stormwater runoff

During the operational phase, the potential water quality impacts attributable to the widening works would be an increase in pollutants associated with changes in the contributing catchment characteristics (increase in percentage of imperviousness or the overall total surface area resulting in larger volumes of runoff to be treated).

The pollutant types associated with the operation of the M2 Motorway contained in this runoff include:

- Gross pollutants (such as litter).
- Sediments and suspended solids.
- Nutrients.
- Heavy metals.
- Organics, oils and surfactants.
- Accidents/chemical spills.

Minimising the transportation and discharge of sediments, suspended solids, heavy metals and PAHs from the M2 Motorway is the key objective for the operational phase.

In order to assess the potential impacts associated with the M2 Motorway widening, preliminary computer modelling using the MUSIC software (Version 3, 2005) has been undertaken for a selection of the existing basins affected by the works. MUSIC is a quantitative model used to determine the impacts of catchment change on the water quality of runoff. Nine basins were selected to provide a representative sample of the range of changes in contributing catchment areas including those with the largest percentage increases. For the 22 others they are either not affected by the widening works or the increase in area is less than 10 percent.

Models defining the existing catchment characteristics were initially set up for each of the selected basins to establish a baseline performance representative of current Motorway conditions. The models were then modified to reflect changes in percentage imperviousness or increase in catchment area and thus quantify what potential impacts may be created by the widening works alone.

The pollutant loads estimated from the MUSIC model for the current and proposed widened Motorway conditions are summarised in Table 103. The base parameters adopted for purposes of the MUSIC modelling along with more detailed results are presented in Technical Paper 6.

Table 103 Estimated catchment pollutant loads pre and post M2 Upgrade project

| Basin | Chainage | Change in total Area percent | Existing Catchments | | | Proposed Widened Catchments | | |
|---|---|---|---|---|---|---|---|---|
| | | | TSS | TP | TN | TSS | TP | TN |
| 8b | 3580 | 51.5 | 5610 | 9.67 | 34.7 | 9600 | 16.2 | 56.1 |
| 12b | 4770 | 10.4 | 8840 | 14.9 | 52 | 9760 | 16.6 | 57.5 |
| 13b | 5360 | 12.9 | 10100 | 17.2 | 60.8 | 11000 | 18.5 | 66.7 |
| 23b | 10510 | 5.8 | 9490 | 16 | 54.7 | 10100 | 16.9 | 57.6 |
| 25b | 11310 | 5.9 | 8990 | 15.2 | 51.5 | 9690 | 16.3 | 55.3 |
| 30b | 13470 | 38.3 | 7190 | 12.1 | 41.8 | 9930 | 16.7 | 57.2 |
| 33b | 14860 | 17.6 | 4720 | 7.92 | 27.4 | 5630 | 9.48 | 32.6 |
| 35c | 16285 | 43.3 | 3120 | 5.28 | 18.1 | 4660 | 7.84 | 26.9 |
| 36b | 16500 | 58.8 | 5150 | 8.69 | 30.1 | 8040 | 13.6 | 47.4 |

*Note: TSS = Total Suspended Solids, TP = Total Phosphorus, TN = Total Nitrogen; pollutant loads expressed in kg/year.*

Further model changes were then introduced to demonstrate the resultant treatment effectiveness (reduction in potential pollutant load impacts) following implementation of proposed basin modification works. The proposed works primarily involve changes to the inlet and outlet details in order to better utilise the existing storage volume available. All of the basins currently have a one metre freeboard above the top water level (TWL – the normal operating level for capturing and treating the low flow events) and at least 0.5 metres freeboard above the maximum water level (MWL – the highest water level reached in the basin before excess overflows are discharged directly from the basin itself).

Initial modelling results suggest that increasing the ponded (extended) depth by approximately 0.2 metres to 0.3 metres would generally cater for treating the increase in runoff volumes generated by the changes in catchment area. Given that a majority of basins are situated below the M2 Motorway level in downstream bushland areas, it should be feasible to accommodate such relatively small increases in depth without adversely affecting the hydraulic performance of the upstream drainage systems whilst still maintaining some freeboard of 0.2 metres to 0.3 metres.

A comparison of the treatment effectiveness results (percentage reduction of pollutant loads discharged) is included in Table 104 with more details available in Technical Paper 6 have not been included as the current and proposed basin arrangements provide 100 percent capture.

Table 104 Water quality treatment train effectiveness

| Basin | Percentage Reduction | | | | | | Relative Difference (percent) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Existing Basin | | | Proposed Basin | | | | | |
| | TSS | TP | TN | TSS | TP | TN | TSS | TP | TN |
| 8b | 85.4 | 68.8 | 20 | 85.4 | 68.9 | 18.7 | 0 | 0.1 | -1.3 |
| 12b | 80.3 | 64.5 | 16.1 | 80.9 | 64.6 | 16.4 | 0.6 | 0.1 | 0.3 |
| 13b | 71.3 | 56.1 | 14.2 | 72.3 | 57 | 14.9 | 1.0 | 0.9 | 0.7 |
| 23b | 77.2 | 61.8 | 15.9 | 77.6 | 62.1 | 16.2 | 0.4 | 0.3 | 0.3 |
| 25b | 81.5 | 65.8 | 17.1 | 81.3 | 65.9 | 17 | -0.2 | 0.1 | -0.1 |
| 30b | 84.8 | 68.6 | 17.6 | 84.8 | 68.8 | 17.4 | 0 | 0.2 | -0.2 |
| 33b | 85 | 69.1 | 21.1 | 84.9 | 69.1 | 20.6 | -0.1 | 0 | -0.5 |
| 35c | 81.8 | 65.9 | 17.1 | 81.5 | 65.6 | 16.8 | -0.3 | -0.3 | -0.3 |
| 36b | 87.9 | 72.1 | 23.8 | 87.7 | 71.7 | 23.3 | -0.2 | -0.4 | -0.5 |

*Note: TSS = Total Suspended Solids, TP = Total Phosphorus, TN = Total Nitrogen. Negative values indicate that treatment train effectiveness is reduced after the upgrade.*

The modelling results in Table 104 indicate that the existing basins are performing well and except for TN appear to be achieving treatment efficiency levels (or percentage pollutant reductions) which are generally greater than or in accordance with the stormwater treatment objectives for NSW, which are also outlined in Australian Runoff Quality (ARQ Table 1.2) being:

- TSS reduction of 80 percent.
- TP reduction of 45 percent.
- TN reduction of 45 percent.
- Gross Pollutants 100 percent.

The City of Ryde has also set out pollutant reduction objectives in the March 2009 Development Control Plan for Water Sensitive Urban Design which targets 85 percent for TSS, 60 percent for TP, 45 percent for TN and 90 percent for gross pollutants. These objectives are greater than those required by ARQ but the modelling results suggest that with the exception of TN these values are also mostly being achieved under existing conditions. Following the proposed widening of the M2 Motorway, the modelling results suggest that the existing basins would still have sufficient capacity/performance to be able to satisfy the treatment objectives of ARQ without substantial modification.

There are some situations where a large reduction in Total Nitrogen is not practical to achieve due to the size of basin which would be required. Nitrogen loads are often due to atmospheric fall-out rather than being sourced from M2 Motorway activities and typically large water surface areas (such as wetlands) are required for treatment purposes. In this instance, the potential size or footprint of basins are more often constrained by the prevailing topography and limited corridor area available whilst trying to minimise disturbance of the surrounding environment and established vegetation. A reduction in TN in the order of 15 – 25 percent has been found to be generally achievable given the prevailing constraints and this is also consistent with the existing level of treatment efficiencies (the current situation is not exacerbated).

Overall, the various analyses undertaken using MUSIC modelling indicate that the pollutant loads are proportionally related to the changes in catchment area. The results also show that these impacts are manageable through modifications to the existing basins and it is possible to achieve the treatment efficiency objectives required by ARQ for TSS and TP. Additionally, the treatment performance levels achieved would be similar to the existing situation including TN.

### 10.1.3 Mitigation measures

#### Flooding

The options for managing potential increases in upstream flood levels are largely constrained by the existing size and location of the previously constructed transverse culvert structures. The typical presence of retaining walls and a narrow corridor width is also a limiting factor. The concept design therefore generally proposes to construct new, or modify existing, retaining walls over inlets/outlets affected by the widening works to minimise the need for extending the culvert structure. This approach would ensure there would be minimal additional upstream impacts (increase in flood levels) created and the need for disturbance of the surrounding environment is also reduced.

For the few culvert structures that are to be extended and may cause flood level impacts, the proposed mitigation measures include modifying the inlet details to ensure hydraulic efficiencies are optimised and therefore losses and upstream impacts are minimised, thereby keeping the length of required extensions to an absolute minimum.

Energy dissipaters and scour protection measures downstream of the culvert outlets would be modified and/or reconstructed to suit. Depending on the extent or nature of modification to the existing outlet structures, these scour protection works would largely reproduce the existing measures which generally comprise either concrete dissipaters, rock mattress and/or dumped rock rip rap.

Just downstream of Kirkham Street, between Chainage 10580 to 11100 (refer Figure 13 of Technical Paper 6) the M2 Motorway is to be widened on the westbound (southern) side where it would potentially impose on Devlins Creek and its floodplain, which runs in parallel along the M2 corridor. In order to minimise impacts on the waterway area of the creek and floodplain, the concept design proposes to construct a concrete deck carriageway structure supported on piers (10880 to 11100) and as a cantilevered section (10580 to 10880) overhanging the floodplain area. Consequently, there would be little to no change in flood behaviour along this reach.

At University Creek (Culvert 35), the property immediately upstream of the M2 Motorway is currently affected by overland flooding from upstream and in a 1 in 100 year ARI event and the M2 Motorway may be overtopped.

The proposed works include replacing the existing overgrown gabion and rock mattress lined channel, which runs along the upstream (westbound) side of the M2 Motorway, with a concrete lined channel. The new channel would provide greater flow capacity than is currently available which would be sufficient to mitigate the impacts of the proposed widening as well as improve the existing flood situation. An open traffic barrier, such as wire rope or guard rail, would be utilised along this reach to allow for potential overtopping of the M2 Motorway in the larger flood events. Special attention would be afforded to transitioning the channel into the culvert inlet in order to ensure hydraulic losses are minimised and the potential culvert performance is optimised. Increased velocities within the channel and at the culvert outlet would require additional consideration, such as energy dissipation, during detail design to reduce the hazard and prevent scouring of the downstream reaches.

Where piers are required for widening of the main bridges (Darling Mills, Devlins or Terrys Creeks) these are generally located out of the main creek waterway and unlikely to create additional hydraulic impacts and wherever possible the new piers would be aligned with the existing to minimise the potential to interfere with stream flows. Appropriate scour protection in the form of dumped rock rip rap would be provided where required.

### Water quality of stormwater runoff

As a general guiding principle for both design and construction, water quality mitigation and management measures would be implemented in accordance with the requirements of:

- Water Policy and Code of Practice for Water Management (RTA 1999).
- *Managing Urban Stormwater - Soils and Construction* Volumes 1 and 2 (often referred to as The Blue Book – Landcom 2004 and 2008).

A summary of measures likely to be implemented for the operational phase is provided below.

The existing water quality basins would be modified as required to account for material changes in contributing catchment area or to meet the target pollutant reduction criteria. Due to the constrained project corridor, and in an effort to minimise further disturbance of the established vegetation, wherever practical it is proposed to modify the inlet/outlet details of the existing basins to better utilise the storage volume already available by increasing the ponded (extended) depth. The majority of existing basins appear to have been designed with up to one metre of freeboard above the top water level (TWL) and 0.5 metres above the maximum water level (MWL). The required increases in depth are typically directly proportional to the percentage increase in catchment area.

The change in contributing area is less than 15 percent for more than half of the existing basins and storage depths are in the order of one to two metres, so the required increase in depth would mostly be in the range of 0.15 metres to 0.3 metres, which should not present major problems or issues to achieve. In a number of instances however, it would be necessary to enlarge the basin to cater for the additional volume of runoff requiring treatment. In some instances the solution would involve a combination of increasing area and depth so as to minimise the actual disturbance footprint for the basin. The final solution would ultimately be determined during the detailed design phase once the additional survey information has been obtained and further modelling/investigations are undertaken.

The basins would be used to treat the low flow runoff ‘first flush’ from the M2 Motorway pavement surfaces. Basin 30b which is located just to the east of the Norfolk Tunnel would additionally be modified to incorporate measures for dealing with tunnel wash down water from maintenance activities.

The spill containment capability afforded within the existing basins would be retained and upgraded or enhanced as appropriate to minimise the risk of accidental spills or contaminants discharging freely to the downstream environment. Operational procedures would be reviewed to ensure the relevant incident response plans are updated to address changes or issues attributable to the upgrade works. Maintenance plans and schedules would also be reviewed and updated as appropriate.

### Protection of watercourses

Watercourses would be protected from changes to the hydrology of their catchments through the appropriate design of culverts and the re-design of the water quality basins. Appropriate energy dissipation and scour protection measures would be provided at bridge waterways and culvert inlets/outlets as necessary. Permanent scour protection requirements particularly at culvert outlets would be implemented as soon as practical. Surface areas disturbed by the construction works would be re-established with landscaping.

The re-design of the water quality basins would ensure that water of an appropriate quality is delivered downstream to the watercourses.

## 10.2 Groundwater management

An *Assessment of Groundwater Impacts – M2 Upgrade project* report was prepared by Coffey Geotechnics, dated December 2009 and a summary is presented below.

This assessment included the identification of potential impacts to groundwater due to both the construction and operational phases of the proposed upgrade. Potential impacts were assessed at key locations where the groundwater table could be intercepted or affected by activities associated with the project. Potential impacts were based on the activities proposed at each of the following key locations:

- Norfolk Tunnel.
- Long cuts of mostly Hawkesbury Sandstone at four reaches along the M2 Motorway.
- Darling Mills Creek Bridge.
- Barclay Road Bridge.
- Devlins Creek Bridge.
- Kirkham Street Overbridge.
- Beecroft Road Overbridge.
- Terrys Creek Bridge.
- Christie Road Overbridge.
- Khartoum Road Underbridge.
- Somerset Street Bridge.
- Windsor Road Bridge.
- Certain detention basins.

As the project involves the upgrade of an existing M2 Motorway with no known groundwater issues, a qualitative analysis only has been conducted to identify and assess potential impacts associated with the current scope of works.

### 10.2.1 Existing environment

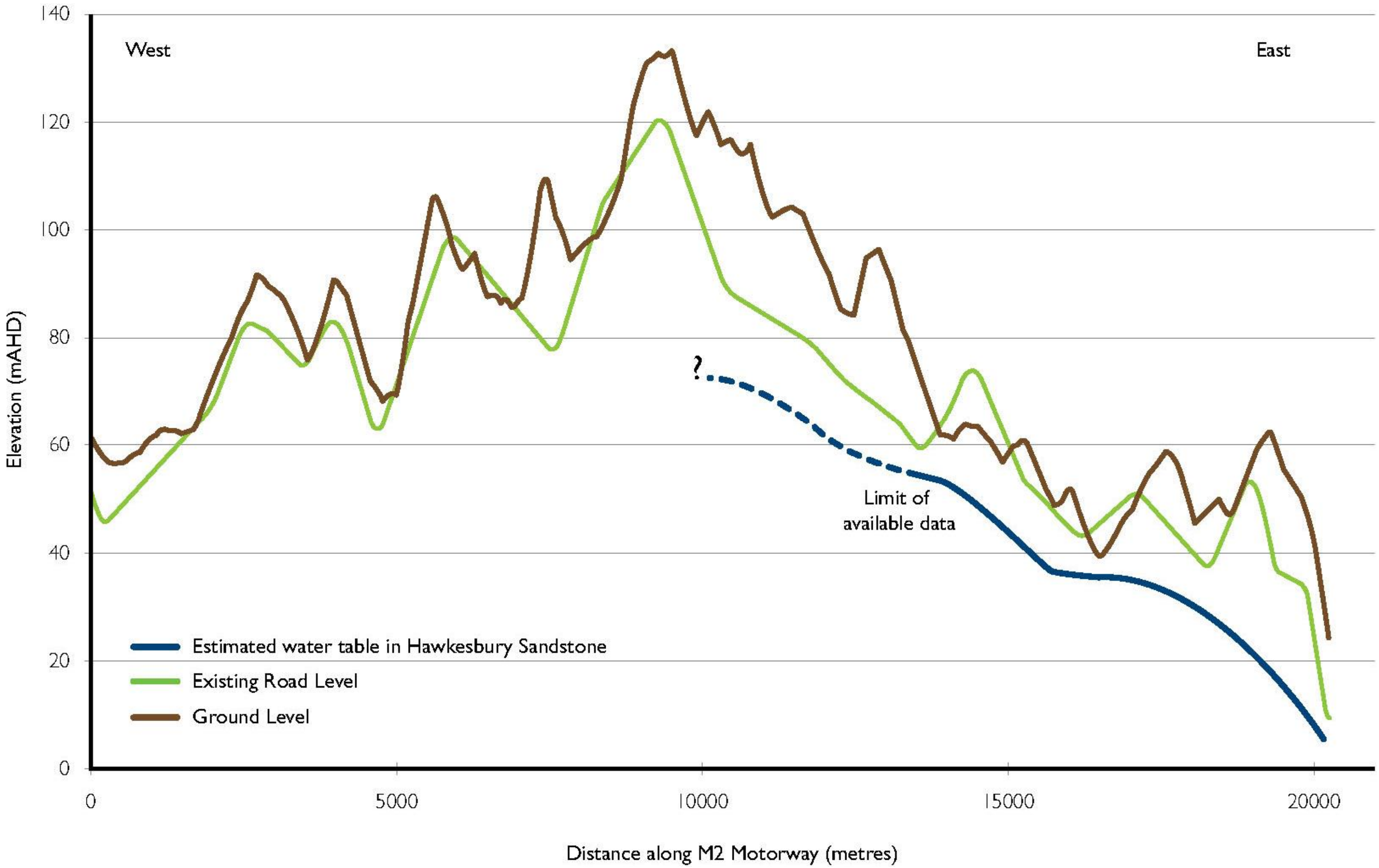
The M2 Motorway alignment crosses ground comprising mostly Hawkesbury Sandstone, overlain by varying thickness of alluvium at creeks or residual soils on higher ground. Ashfield Shale of the Wianamatta Group is present in some elevated areas. The major aquifers comprise:

- Hawkesbury Sandstone.
- Limited parts of alluvium associated with the main drainage channels.

The M2 Motorway is located entirely within the Parramatta River / Sydney Harbour catchment. The most important subcatchments are Darling Mills Creek, Devlins Creek, and Terrys Creek.

Figure 38 displays a long section along the existing M2 Motorway which shows the height of the groundwater table where known from other infrastructure projects. Water level data for the western part of the alignment is not yet available and is expected to be collected during geotechnical drilling prior to commencement of construction.

Figure 38 Long section of groundwater depth along M2 Motorway




Source: Coffey Geotechnics Pty Ltd, 2010

Groundwater levels in the vicinity of the M2 Motorway (2 kilometres either side) vary between sea level at Lane Cove River to around 70 metres Australian Height Datum (AHD) further west (where known). Typically groundwater slopes downwards around 30 metres per kilometre towards the Lane Cove River. However the groundwater level is uneven due to the variable topography created by the Hawkesbury Sandstone landforms. The shallowest groundwater levels occur at or near the surface at creek systems such as Terrys Creek and Shrimptons Creek. The deepest groundwater levels are expected to occur around the centre of the M2 Motorway in the vicinity of Pennant Hills Road where the ground surface is highest.

Groundwater flow direction in the upper Hawkesbury Sandstone is generally towards the Lane Cove River (to the northeast) in the eastern region of the M2 Motorway. The Ashfield Shale is likely to be unsaturated in the vicinity of the M2 Motorway, except where it may reach an appreciable thickness and thereby be more likely to maintain some saturation at the base.

The presence of seepage faces at existing cuts and in the Norfolk Tunnel is not apparent from visual inspection, nor is their presence expected, based on available information on groundwater levels in the area.

Groundwater quality within the Hawkesbury Sandstone is generally good. Electrical conductivity, which is an indicator for salinity, is generally low in comparison with groundwater in shale-based parts of the Sydney Basin. The pH is slightly acidic or close to neutral which generally indicates good water quality. The sandstone tends to have naturally elevated iron concentrations.

There are no known groundwater dependent ecosystems in the vicinity of the M2 Motorway (refer to Section 9.5).

### 10.2.2 Impact assessment

It is not anticipated that the groundwater table would be encountered for the majority of works associated with the project. The situations in which groundwater may be encountered include excavations in close proximity to the major watercourses in the study area (for example, bridge footings) or where substantial subsurface works are proposed well below the existing ground surface levels (for example, tunnel widening). Groundwater impacts may also occur at locations where surface water is intercepted and collected, such as the sediment basins along the road alignment. Potential impacts to groundwater are discussed in the following sections.

#### Potential excavation into the groundwater table

Given the known groundwater levels in the fractured rock aquifer and its low permeability, groundwater seepage to each excavation during installation is likely to be minimal.

Where the groundwater level is above the base of a pile or footing, the impact of the piles and footings on the groundwater regime in the long term is expected to be negligible given:

- The size of each pile or footing compared to the available subsurface cross-sectional flow area (meaning that they would not provide significant barriers to groundwater flow).
- The relatively inert material (concrete).

#### Groundwater recharge

Runoff from the M2 Motorway is diverted to 31 detention basins whose primary function is management of runoff water quality. The widening works would increase the amount of paved area of the M2 Motorway by approximately 20 percent (based on calculations of changes to the areas of micro-catchments associated with the detention basins). This area of paved M2 Motorway represents less than two percent of the catchment areas of the local waterways thus the catchment area for the local waterways is reduced by less than two percent. Overall, groundwater recharge from infiltration from the basins is not expected to change significantly from current conditions.

The increased area of the M2 Motorway would decrease the rainfall recharge to the catchments of the local waterways by a negligible amount. Stormflows of local waterways (accepting water from the detention basins) would increase slightly. The increased stormflow may increase recharge near the waterways by a very small amount. Recharge to the groundwater system from current detention basins is considered to be very small and is not expected to change from enlargement of some of the basins. Groundwater quality of the Hawkesbury Sandstone is therefore not expected to be impacted by the development beyond the current impact of the detention basins.

### Groundwater flow

Additional cutting in the Norfolk Tunnel is not expected to significantly change the geometry of the seepage face at the tunnel wall, given the small change relative to the size of the sandstone hill.

No groundwater extraction is expected to be undertaken during construction or operation, and no waste water would be disposed to groundwater systems.

Due to the method and relative extent of pile / footing installation, and the small magnitude of widening of the tunnel and existing cuts (being relatively small in comparison to potential recharge galleries for the seepage faces where they may be present), existing groundwater levels and flow are not expected to be impacted by the upgrade either during construction or operation.

### Groundwater quality

M2 Motorway runoff that is diverted to the detention basins would eventually evaporate (with only minor infiltration from some basins) or continue flowing downstream during subsequent storm events after mixing with additional runoff. Existing surface water quality control measures (including monitoring) would be sufficient to ensure that the impact to groundwater would be low.

### Existing groundwater users

A review of existing groundwater bores in the vicinity of the M2 Motorway was conducted by referencing the NSW State Government Groundwater Works website, where records of individual bores can be obtained. Some registered bores were identified in the vicinity of the M2 Motorway. Most of these bores are screened in the sandstone. The closest bore (GW105547) is located just over 200 metres from the M2 Motorway, which is 306 metres deep and is cased to two metres depth, its water supply is from sandstone.

Since the bridge footings would mostly penetrate sediments only, the upgrade is unlikely to impact groundwater levels and quality above impacts already sustained from the existing M2 Motorway, therefore it is expected that there would be negligible impact on groundwater users.

### 10.2.3 Mitigation measures

Impacts to groundwater from the M2 Upgrade project are likely to be limited to widening of existing cuts and the Norfolk Tunnel. However, the presence of seepage faces is not apparent from inspections undertaken, nor is their presence expected.

Groundwater systems most at risk would be perennially saturated high permeability sediments, with shallow groundwater levels, associated with drainage channels, however previous work for the Chatswood to Epping Rail Link indicated no such systems to the east. As such groundwater monitoring bores are not planned.

Table 105 identifies mitigation and management measures that would be implemented for the management of potential groundwater issues. Provided they are managed appropriately these measures would be sufficient to ensure that the impact of the project on groundwater is negligible.

Table 105 Groundwater mitigation and management measures

| Potential impact | Mitigation and management measure |
|---|---|
| Instability of excavation walls and higher groundwater inflow, particularly where higher permeability sediments are encountered. | Temporary casing is installed to limit groundwater inflow, because the pile is usually installed in a hole without water.<br>Where required, applications would be made and licences obtained, prior to groundwater being pumped from footing excavations. |
| Inflows to the footing /pile excavation occurring in the fractured rock aquifer. | Temporary casing would be installed to seal off the hole.<br>Where required, applications would be made and licences obtained, prior to groundwater being pumped from footing excavations. |
| Damage to the local environment from inappropriate disposal of groundwater. | Where necessary, groundwater would be pumped out and, depending on disposal method, appropriately treated prior to discharge. |
| Infiltration to groundwater from sediment basins. | The basins are generally lined with concrete or clay, however this depends on the nature of the foundation and some basins may allow some minor infiltration, which would have a negligible effect on the groundwater aquifer. |
| Contamination of groundwater from sewage disposal. | Sewage from amenities blocks (during construction) would be disposed of appropriately. |
| Adverse impacts to groundwater including interception of the groundwater table and contamination of groundwater from construction work. | Existing surface water mitigation measures, combined with the method of installation of piles / footings, are considered adequate to manage the increase in run-off and would be sufficient for limiting the impacts of the upgrade works on the groundwater system to negligible levels above current impacts. |

## 10.3 Contamination

A *Phase 1 Contamination Assessment* report was prepared by Coffey Environments Pty Ltd, dated December 2009 and a summary is presented in this section.

### 10.3.1 Existing environment

The M2 Motorway comprises areas of cut, retaining walls and fill embankments. The project would require the development of existing areas of bushland and urban areas. Whilst the majority of the activities associated with the M2 Upgrade project would not impact existing structures, several detention and sedimentation basins located along the M2 Motorway may be impacted. These basins may be redeveloped or relocated and existing retaining walls within the M2 Motorway may require reconstruction.

The *'Groundwater in New South Wales Assessment of Pollution Risk'* (1987) compiled by the Hydrogeological Unit, Department of Water Resources NSW (scale 1: 2,000,000) indicates that the subsurface of the site corridor comprises sandstone with a low to medium potential for groundwater movement. This indicates a low to medium potential for pollution risk. Groundwater salinity was indicated to be less than 1,000 milligrams per litre which is considered suitable for stock use, domestic and some irrigation purposes.

The Acid Sulfate Soil (ASS) Risk Map for the area (Prospect / Parramatta River, Sheet 90) indicates that there is no known occurrence of acid sulfate soils along the proposed route.

A review of the DECCW contaminated land register was undertaken for sites adjacent or within close proximity to the site corridor. No registered contaminated sites were identified within close proximity of the site corridor. A review of past and present aerial photography indicated that the land use surrounding the site corridor comprised mainly of bushland, farming properties and minor residential properties. The construction of the now Macquarie Park was evident and commercial development within this area has continued until present day. The review of potential contamination indicates minimal potential for widespread contamination in the assessment area.

### 10.3.2 Impact assessment

The *Phase 1 Contamination Assessment* indicates that there is likely to be a low potential for widespread or significant contamination to be encountered within the M2 corridor and there is not considered to be a duty to report contamination under the *Contaminated Land Management Act 1997* (CLM Act). However, construction activities undertaken may potentially encounter localised areas of contamination which may require reporting to the DECCW in accordance with the *'Duty to Report Guidelines'* (2009) under the CLM Act. If identified, these are likely to be related to point sources and / or activities.

The available data was assessed using a risk assessment process consistent with the risk matrix approach described in AS/NZS 4360:2004 which comprises:

- Hazard: Identification of the hazard.
- Consequences: Identification of consequences or impacts.
- Likelihood: Assessment of the likelihood of the consequence through a qualitative assessment of the probability of the impact and the frequency of the event.

The level of risk was assessed using the consequence and likelihood in a risk matrix. The outcome of the contamination assessment of contamination risk for the site corridor identified the main hazards associated with the project to be:

- Areas of cut and fill along the length of the M2 Motorway.
- Detention and sediment basins at various locations along the length of the M2 Motorway.
- Point sources of contamination, for example, transformer substations, spills and other contaminating incidents.

Based on available knowledge of the land use history along the M2 corridor it is considered that the potential for contamination associated with fill material sourced from cuttings undertaken during the construction period is likely to be low. Potential contaminant sources are likely to be point sources and be related to herbicides and pesticides. If contamination is present, it would be mostly confined to immediate surface soils, which are generally not geotechnically suitable for construction and often stripped and disposed of offsite.

The Porters Creek landfill site is in the vicinity of the M2 Motorway corridor east of Lane Cove Road. There is no widening proposed as part of the M2 Upgrade project east of Lane Cove Road and there are no construction compounds located within the vicinity of the landfill. There would be no impact on or from the landfill site as a result of the project.

Sediment and detention basins collect surface water run-off from the M2 Motorway. These basins provide an indication of the potential for contamination along the M2 Motorway. A water quality assessment of 30 detention basins along the M2 corridor was undertaken in 2008 and indicated that of twenty nine water samples collected, contaminant concentrations generally complied with *'ANZECC and ARMCANZ Guidelines for Fresh and Marine Water Quality'* (ANZECC and ARMCANZ, 2000). Overall, it is considered that the results of the monitoring are generally consistent with water quality in developed urban environments and are not considered indicative of significant widespread contamination. Appropriate testing and classification of sediments would be undertaken prior to works being carried out on the basins. The potential for significant widespread contamination of surface water or sediments within detention and sedimentation basins is considered to be low.

Current information available indicates that there are currently seven electrical switch boards located within the M2 Motorway. As the M2 Motorway was constructed between 1993 and 1997 it is considered unlikely that older transformer units would contain polychlorinated biphenyls (PCBs). The potential for significant contamination associated with electrical switch boards and transformer units is considered to be low.

### 10.3.3 Mitigation measures

The results of the *Phase 1 Contamination assessment* indicate that there is a low potential for widespread contamination. The following mitigation measures are proposed to address the issues discussed in this assessment:

- Undertake a visual assessment for evidence of contamination along the site corridor and in the boreholes during the geotechnical investigations. Evidence of contamination encountered should be noted and its significance and implications assessed.
- Development of risk management measures to address potential contamination conditions along the site corridor during construction activities.
- Collection and testing / classification of sediments in sediment basins and development of appropriate management strategies prior to works in sediment basins to mitigate potential adverse risks to the environment.

It is considered that the development and implementation of an *Unexpected Finds Protocol* and *Activity Specific Procedures* would be appropriate tools for the management of the risks identified above. The *Unexpected Finds Protocol* is a protocol which describes the actions to be undertaken should conditions or materials be found that are different to those described (unexpected materials). An unexpected finds protocol means that as soon as anything not expected is encountered the protocol can be immediately implemented and the unexpected conditions can be managed appropriately and efficiently. *Activity Specific Procedures* are developed on the basis of the risk posed by the activities within an area where a higher level of risk has been assessed. These management measures would be best undertaken prior to commencing and during construction activities.

## 10.4 Socio-economic impact assessment

A *Socio-economic Impact Assessment* report was prepared by AECOM dated February 2010 and a summary is presented below. This section should be read in conjunction with the assessment of land use and property impacts provided in Section 10.5.

### 10.4.1 Existing environment

Areas peripheral to the M2 Motorway are characterised by residential, commercial and retail land uses and areas of bushland reserves. In surrounding areas, Hornsby and Baulkham Hills, located to the north of the M2 Motorway, are characterised predominantly by residential development and urban bushland reserve areas. Blacktown (west), Ryde (north) and Parramatta (south) are also principally residential but also hold substantial commercial, industrial and institutional areas, notably the Macquarie Centre, Ryde and the North Ryde industrial area.

Hornsby, Baulkham Hills and Ryde residents tend to be comparatively more affluent than residents in the rest of the study area and Sydney as a whole. They have a larger proportion of people with higher incomes, more professionals and managers, higher levels of employment, higher education attainment and tend to live in larger houses. In contrast, Blacktown and Parramatta are more disadvantaged than Sydney as a whole and the other areas surrounding the M2 Motorway.

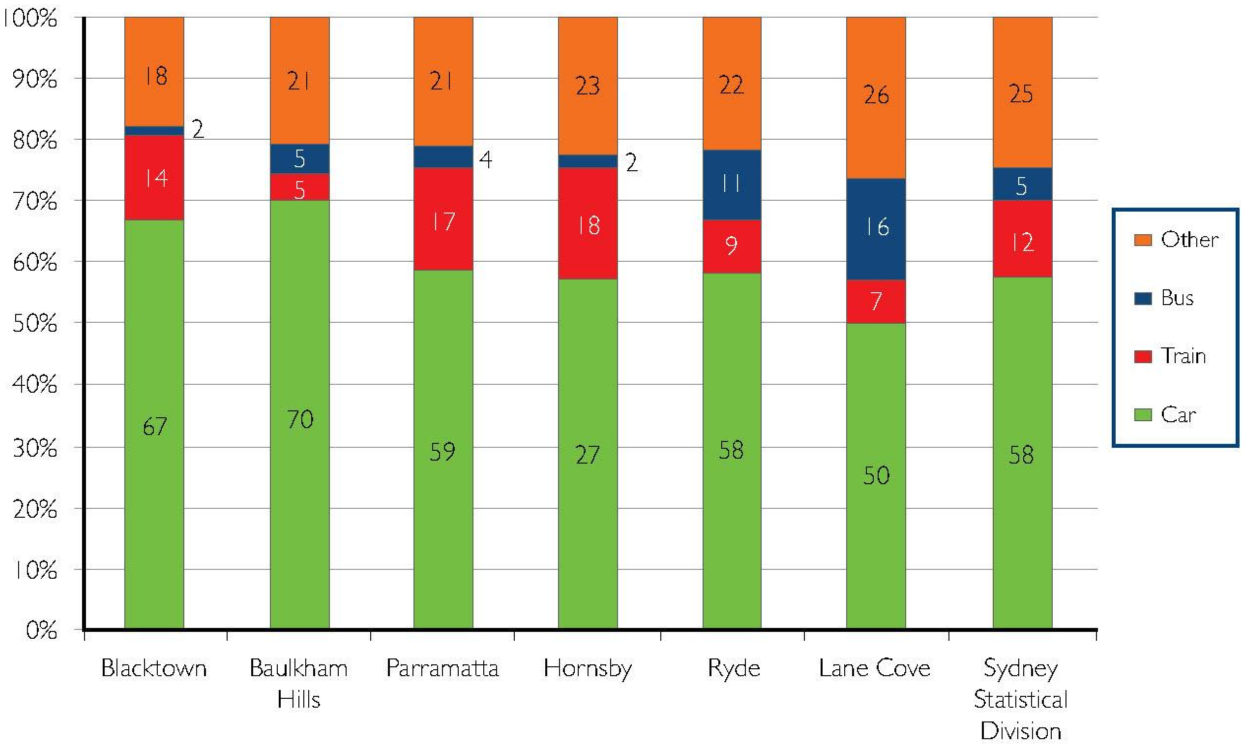
The eastern end of the M2 Motorway is included within the North Sydney to Macquarie Park Strategic corridor and is part of the large ‘Global Arc’ reaching from Macquarie Park to Sydney Airport. The strategy for the M2 corridor is to ‘protect and strengthen’ its role as a focus for commercial activity. The focus is on further employment related development (and restricting residential development) and making jobs and services within the M2 corridor more accessible to people in the metropolitan area.

Macquarie University and Macquarie Shopping Centre are key regional land uses that depend on access to the M2 Motorway. Macquarie Business Park is designated as a nationally significant research and employment centre that includes Macquarie University as well as businesses specialising in high technological enterprises, pharmaceuticals, medical and services and communications.

With a comparative lack of rail infrastructure within much of the M2 Motorway study area, bus services are often the primary public transport alternative for most people within surrounding areas. As illustrated in Figure 39 the 2006 Census data shows travel to work by car is the same or more than the Sydney Statistical Region, with Blacktown and Baulkham Hills having a substantially higher proportion of people travelling to work by car at 67 percent and 70 percent respectively compared to 58 percent for the Sydney region. These statistics reflect the low availability of public transport and the distance from employment hubs, such as Norwest and Macquarie Park.

Bus services are an important public transport service for many people within the study area. Towards the eastern end of the M2 Motorway study area, residents have access to Government operated buses and train services, which provide relatively frequent access to major destinations such as Macquarie Park, Sydney CBD and Ryde. Towards the western end of the M2 Motorway study area, apart from M2 Motorway buses and a T-Way, public transport is provided by private bus operators that typically provide bus connections to train services. Without these connecting bus services, much of the western end of the M2 Motorway study area is not within convenient reach of existing rail infrastructure.

Figure 39 Travel to work in the M2 Motorway study area




*Source: Australian Bureau of Statistics, Census of Population and Housing, 2006*

*Note: 'Other' includes travel by tram, ferry, taxi, truck, motorbike, on foot, and those who did not work or worked at home.*

### 10.4.2 Impact assessment

The assessment of the M2 Upgrade project considers potential socio-economic impacts and suitable mitigation measures both during construction and operation and within the following categories:

- Community impacts, such as: property acquisition (also refer to Section 10.5), land use (also refer to Section10.5), employment, connectivity and severance, and access.
- Amenity impacts, such as: traffic and transport, noise and vibration, visual, landscape and urban design, and air quality.
- Direct employment and business impacts, such as, job opportunities.
- Wider Economic Impacts not captured in the Road User Cost Benefit Analysis (RUCBA) (Transurban, 2009. Refer to Appendix E).

As the M2 Motorway is an existing major road transport corridor, many of the socio-economic impacts that would typically be expected from construction of a major road, such as changes to the social profile, and impacts on local businesses, accessibility and severance, have already occurred. In this regard, this assessment considers only the socio-economic potential impacts generated by the proposed upgrade works. Therefore, this study aggregates additional impacts identified in other specialist studies undertaken as part of the environmental assessment in the context that a concentration of minor impacts has the potential to create more substantive impacts on a community or individuals. The most noteworthy economic impact associated with the project relates to the value of large travel time savings for road users and is covered under the RUCBA (Transurban, 2009).

## Road User Cost Benefit Analysis

Based on a Road User Cost Benefit Analysis (RUCBA) undertaken for the M2 Upgrade project, the economic worth of the project case relative to the base case has been estimated to be:

- $1.2 billion in net present value terms; and
- A benefit cost ratio value of 3.4.

On both measures, it would be considered economically worthwhile to proceed with the project case. A series of sensitivity tests to the above results was carried out by varying the discount rate, construction costs, benefits and diminishing travel time savings. Under these conditions, the Benefit Cost Ratio ranges between 2.3 and 4.9 and the Net Present Value between $629 million and $2.1 billion.

The provision of additional capacity on an existing and congested road provides large economic benefits from reduced travel time in return for low additional travel costs. Capital costs are relatively low in comparison to construction of a new link, which results in a high benefit cost ratio.

Although the value of the travel time experienced by the road users would be reduced by the cost of increased or new tolls, this cost transfers as a benefit to the road operator. Therefore, the RUCBA includes zero net effect for toll charges

## Construction

Potential socio economic impacts during construction may include impacts on community, amenity and local employment and business and are summarised in Table 106.

The M2 Upgrade project is not expected to generate significant community impacts during construction as there would not be additional severance or access impacts arising. The primary community impact is likely to be stress due to uncertainty during the construction process.

Residents in the vicinity of the M2 Upgrade project may experience minor disruption due to loss of amenity during temporary and short term construction impacts such as noise, visual amenity, air quality (dust) and light spill. Five properties in the vicinity of the Windsor Road ramps would experience a concentration of amenity impacts.

It is expected road capacity and average vehicle speed would decrease on the M2 Motorway during construction due to temporary closure or diversion of lanes; this would result in increased travel times for users. The disruption would also have other impacts, such as:

- Potential to cause disruption to emergency service access.
- Potential delays to public transport (bus) services.
- Increased congestion on surrounding arterial road network due to diversion of existing users and additional construction site traffic.
- Additional heavy vehicles on surrounding arterial road network.
- Restrictions and disruptions to cycle access.

While some traffic and transport impacts may affect road users, some, such as the increased congestion on local arterial roads, would particularly impact local communities during their daily travel activities.

Although there may be some benefit to the local economy from expenditure by construction workers and from job opportunities, local residents may experience undesirable impacts during construction of the project for the benefit of the M2 Motorway users. Mitigation measures seek to address the undesirable construction phase impacts without reducing wider benefits to M2 Motorway users.

### Operation

Potential socio-economic impacts during operation may include community and amenity impacts as well as Wider Economic Benefits. The potential impacts that are expected to result from the operation of the M2 Motorway are summarised in Table 107.

Community impacts as a result of operation of the M2 Upgrade project are unlikely to include changes to land use, access and connectivity and would be limited to property acquisitions. There is expected to be partial land acquisition from five properties on Windsor Road due to the new access ramps. Two properties at Talavera Road would also be impacted by land acquisition.

Negative impacts may be experienced by local residents through increased noise from additional traffic on the M2 Motorway and approach routes (refer to Section 9.3 for assessment of operational noise and vibration impacts). Reduced visual amenity for residents may arise as a result of changes to the scale and location of existing noise walls and due to new access ramps. Seven properties adjacent to the new Windsor Road, Herring Road and Christie Road ramps would be subject to partial land acquisition.

The M2 Upgrade project would result in reduced congestion and a corresponding reduction in journey time for users of the M2 corridor. In addition, crash rates on the M2 Motorway may decrease as capacity increases, congestion decreases and emergency shoulders are reinstated. It is expected that there would be less congestion on the surrounding arterial road network as vehicles transfer from alternative routes, although some users on the local network in the vicinity of the new access ramps at Windsor Road, Christie Road and Herring Road may experience increased congestion. The M2 Upgrade project would provide also better access to the employment market and businesses for local residents and users of the M2 corridor. The provision of a new transit lane eastbound between Terrys Creek and Lane Cove Road may result in increased public transport use along the M2 corridor and the replacement of the alternative westbound cycle route between Lane Cove Road and Beecroft Road with access to the M2 Motorway shoulder would result in a faster, more amenable trip for cycle commuters.

In addition to the economic effects identified in the RUCBA (refer to Section 10.5.2), Wider Economic Benefits (WEBs) are improvements in economic welfare that are acknowledged but which have not been typically captured in traditional cost benefit analyses. In this regard, WEBs generally refer to four specific additional benefits, which are:

- Improved agglomeration economies.
- Increased competition.
- Increased output under imperfect competition.
- Improved labour supply.

Given the M2 Motorway already exists as a major road transport corridor, it is likely that most of the WEBs have been realised and the widening would not generate significantly more benefits. Some WEBs may result from agglomeration and improved labour supply. Over the longer term it is expected that the reduced travel time may encourage agglomeration benefits within the 'Global Arc' from North Sydney to Macquarie Park. In addition, job opportunities along the M2 corridor may become more accessible as a result of reduced travel costs inducing more people into the workforce or to move to more productive jobs.

As indicated in Table 107 the majority of the impacts of the M2 Upgrade project during operation are positive, but positive and negative impacts generated by the M2 Upgrade project may not be equally distributed between the project stakeholders. Overall, the M2 Upgrade project is expected to provide benefits for the M2 Motorway users and the adjacent communities through reducing congestion on the M2 Motorway and arterial roads, improving access to markets, improving public transport usage, and reinstating amenities for cyclists. Local residents would also benefit from reduced travel times on arterial roads.

### 10.4.3 Mitigation measures

Mitigation measures are proposed to seek to reduce the impact on local residents. Table 106 and Table 107 summarise the impacts and recommended mitigation measures, which are consistent with the measures recommended within other specialist reports.

Table 106 Summary of construction impacts and mitigation measures

| Category | Impact | Mitigation |
|---|---|---|
| Community | • Uncertainty surrounding the project and impacts on property.<br>• Stress due to anticipated or real prospect of land acquisition. | • Provide regular and transparent information and updates to potentially affected residents in accordance with the adopted communications strategy. |
| Amenity | • The construction of the project is likely to cause a loss in amenity due to the following impacts: | |
| | • Potential noise, visual amenity (construction lighting, vegetation clearance and temporary noise walls), air quality and traffic impacts to properties surrounding construction compound sites. | • Implement mitigation measures discussed through Chapter 9 and Chapter 10 at construction compound sites, particularly the Windsor Road, Beecroft Road (old bus ramp), Beecroft Road (tunnel) and existing TIDC compound sites. |
| | • Impact on local resident amenity through increased noise and vibrations during construction (traffic and equipment). The combined amenity impacts are particularly disruptive to five properties located adjacent to the new Windsor Road ramps. | • Minimise adverse noise and vibration impacts during construction by adopting mitigation measures recommended by this environmental assessment (refer to Section 9.2). |
| | • Potential visual impacts on adjacent properties. | • Provide temporary screening to minimise visual intrusion (refer to Section 9.6.3). |
| | • Potential for dust generation during excavation works and movement of construction vehicles/equipment. | • Use management measures to minimise dust (refer to Section 10.6.3). |
| | • Increased lighting during night time as construction occurs. | • Minimise lighting impact by selecting appropriate design and work practices (refer to Section 10.7.3). |
| | • Potentially reduced road capacity and or operating speed due to temporary closure/diversion of lanes resulting in increased travel times. | • Plan construction around off peak times to minimise impact on journey times (refer to Section 9.2.3). |
| | • Disruption to emergency service access. | • Consultation with emergency services. |
| | • Restrictions and or disruption to cyclist access to the M2 Motorway during construction. | • Plan temporary route to optimise amenity for cyclists within the topographical constraints of the corridor (refer to Section 9.2.3). |
| | • Localised pedestrian route diversions. | • Provide safe temporary pedestrian crossings and routes (refer to Section 9.2.3). |
| | • Disruption to some local trips brought about by the need to extend Barclay Road and Murray Farm/Kirkham Street bridges, requiring the closure of these links across the M2 Motorway. | • Sign posting and pamphlets to advise local residents of closures (refer to Chapter 5). |
| | • Possible delays to public transport (bus) services during construction.<br>• More congestion on surrounding arterial road network due to construction vehicles and slower trips on M2 Motorway. | • Manage movement of construction vehicles to avoid peak periods and provide access to compounds and work sites via Motorway (refer to Section 9.2.3). |

| Category | Impact | Mitigation |
|---|---|---|
| Direct employment and business impact | • Direct construction job creation.<br>• Construction expenditure may have flow on effects to other businesses in the area. | • To maximise these benefits, products and services would be sourced as locally as possible, and construction job opportunities advertised in the local area. |

Table 107 summarises operation impacts and mitigation measures.

Table 107 Summary of operation impacts and mitigation measures

| Category | Impact | Mitigation |
|---|---|---|
| Community | • Negative impact on wellbeing due to property loss through acquisition.<br>• Access to new job and business opportunities along the M2 corridor. | • Explain the land acquisition process through the consultation program (refer to Chapter 4).<br>• Compensation to landowner in accordance with the RTA Land Acquisition Policy and the Land Acquisition (Just Terms Compensation) Act 1991. |
| Amenity | • The project is expected to create both positive and negative amenity impacts as follows: | • |
| | • Impact on adjacent residents through increased noise from increased traffic volume and the widening changing the noise attenuation provided by existing noise walls. | • Change noise attenuation to meet the project's noise objectives based on the *Environmental Criteria for Road Traffic Noise* (DECCW, 1999) (refer to Section 9.3.3). |
| | • Potentially reduced amenity impacting adjacent properties where noise walls may be closer to the boundary.<br>• Potential changes in scale or design of relocated/new noise walls may affect visual amenity.<br>• Removal of existing vegetation or construction/altering of infrastructure may change character of surrounding streetscape increasing visual impact on local roads.<br>• Relocated/ noise walls and new access ramps at Windsor Road may affect solar access. | • Provide screening of noise walls and new ramps to minimise visual intrusion (refer to Section 9.6.3).<br>• Use materials that reduce the visual intrusion of new infrastructure (refer to Section 9.6.3). |
| | • Increased lighting on M2 Motorway and additional access points. | • Design and locate new lighting to minimise light spill in direction of homes. |
| | • Construction and operational noise and visual amenity impacts to schools and institutes surrounding the M2 corridor. | • Minimise impacts to sensitive receivers such as schools by implementing mitigation measures recommended in this environmental assessment (refer to Section 9.3.3 and Section 9.6.3). Management of impacts is of particular importance at Epping Heights Public School, the Royal Institute for the Deaf and Blind, Our Lady of Lourdes School and Macquarie University. |
| | • Impact of increased traffic on pedestrians at Our Lady of Lourdes School on Windsor Road. | • Proposed pedestrian arrangements at the Windsor Road crossings would be subject to detailed design and assessment by RTA Road Safety Group. |
| | • Reduced air pollution from alleviation of 'stop and start' effect.<br>• Increased accessibility to Sydney orbital Motorway | • M2 Upgrade project would be an improvement to the existing condition. |

| Category | Impact | Mitigation |
|---|---|---|
| | network, Macquarie Centre, Regional city centres, commercial centres.<br>• Reduced congestion on the M2 Motorway and some arterial routes.<br>• Reduced journey time on the M2 Motorway and some arterial routes.<br>• Increased journey time reliability on the M2 Motorway and some arterial routes.<br>• Improved access for emergency services (for M2 Motorway and surrounding roads).<br>• Replacement of the interim cyclist detour for westbound cyclists between Lane Cove Road and Beecroft Road with access to the breakdown lane on the M2 Motorway, resulting in a faster trip.<br>• Increased public transport use along M2 Motorway through provision of a new transit lane eastbound between Terrys Creek and Lane Cove Road. | |
| | • Less congestion on surrounding arterial road network (currently traffic seeks alternative, less congested routes). | • Modify intersections and approaches to increase capacity for critical movements (refer to Chapter 6). |
| Direct employment and business impact | • No additional jobs or direct business effects are expected to be created by operation of the M2 Motorway. | • No mitigation measure required. |
| Wider Economic Benefits (WEBs) | • The majority of WEBs are already realised following construction of the M2 Motorway but the project is expected to bring:<br>– agglomeration effects within the Global Arc from North Sydney to Macquarie.<br>– improved labour supply as job opportunities become more accessible. | |

## 10.5 Land use and property

An assessment of the land use and property impacts associated with the project has been undertaken and is presented below.

### 10.5.1 Existing environment

The existing land uses along the M2 Motorway, in the vicinity of the proposed upgrade, include a combination of residential, commercial and industrial developments, bushland, recreational areas, schools and universities. The perimeter of the M2 corridor is also referred to the M2 lease boundary for the purpose of this assessment.

The M2 Motorway provides an important connection to Sydney's north west which houses a rapidly growing business park and large tracts of new residential development. The M2 Motorway also provides an important connection to Norwest Business Park, Macquarie Park and Macquarie University. Norwest Business Park, located north of the M2 Motorway at Old Windsor Road, and Macquarie Park, located adjacent to the M2 Motorway at its eastern extent, are prominent commercial and industrial precincts.

Dominant features of the natural landscape along the M2 Motorway include Darling Mills State Forest in the west and Lane Cove National Park in the east. The M2 Motorway ends at its eastern extent approximately 200 metres from the Lane Cove River before the western entrance to the Lane Cove Tunnel.

The land uses within each precinct are described in the following sections.

#### Precinct 1 – Abbott Road to Windsor Road

South of the M2 Motorway between Old Windsor and Junction Road there is a large industrial area. To the north of the M2 Motorway the land use predominantly comprises of residential development interspersed with recreational areas and sporting fields. Travelling east towards Windsor Road there is a residential belt (north and south of the M2 Motorway), which is characterised by low density suburban development and detached dwellings.

Model Farms High School is located to the north of the M2 Motorway near Langdon Road. Winston Heights and Winston Hills Public Schools are located to the south of the M2 Motorway along Junction Road. Other community facilities in Precinct 1 include sporting facilities such as Gooden Reserve and Yattenden Park.

#### Precinct 2 – Windsor Road to Pennant Hills Road

The dominant feature of Precinct 2 comprises large tracts of vegetation that form part of Bidjigal Reserve and Darling Mills State Forest. These tracts are interspersed with pockets of low density residential development. East of Windsor Road to Darling Mills Creek is an area of low density suburban residential development characterised by detached dwellings consistent with the land use west of Windsor Road. Adjacent to the north eastern corner of Windsor Road and the M2 Motorway is Our Lady of Lourdes School and its associated church. The block adjacent to the south eastern corner of Windsor Road and the M2 Motorway is under development as medium density housing and was cleared in late 2009.

Ted Horwood Reserve is a large recreational facility located west of Darling Mills Creek on Renown Road which contains sporting fields and netball courts.

East of Darling Mills Creek is Bidjigal Reserve where a band of native vegetation surrounds the creek line to the north and south of the M2 Motorway. Bidjigal Reserve joins with Darling Mills State Forest to the east, on the northern side of the M2 Motorway. The two reserve areas are split by a cluster of detached residential dwellings. The area east of Darling Mills Creek to the south of the M2 Motorway is characterised by low density residential development which surrounds Muirfield Golf Course, Muirfield High School and the Royal Institute for Deaf and Blind Children.

Residential and education developments through this section are shielded from the M2 Motorway through the use of screening vegetation. This screening vegetation is typical of the section between Barclay Road and Pennant Hills Road where predominantly residential developments are interspersed with parkland and bushland areas to the north and south of the M2 Motorway.

Recreational facilities in this area include Murray Farm Park, which contains sporting fields, and West Pennant Hills Reserve, an area of open space with a playground utilised by the local community, both of which are located to the south of the M2 Motorway.

### Precinct 3 – Pennant Hills Road to Beecroft Road

Devlins Creek is a dominant feature of the landscape in Precinct 3. It runs to the north of the M2 Motorway from Pennant Hills Golf Course until it crosses to the southern side at Kirkham Street. East of Kirkham Street, Devlins Creek crosses from the north to the south of the M2 Motorway numerous times before crossing permanently to the northern side of the M2 Motorway at Beecroft Road.

North of the M2 Motorway the land use is dominated by recreational facilities and open space or bushland areas. The Pennant Hills Golf Course is between Pennant Hills Road and Burns Road. Chilworth Recreation Reserve is east of Burns Road. Beecroft Park and Cheltenham Oval are located between Burns Road and Kent Street. Residential development between Pennant Hills Golf Course and Beecroft Road is characterised by low density detached dwellings, which are separated from the M2 Motorway by Chilworth Recreation Reserve and Cheltenham Oval.

South of the M2 Motorway, residential development runs adjacent to the M2 Motorway for the majority of Precinct 3. The residential development is low density and characterised by detached dwellings. Generally, the residential development is screened from the M2 Motorway by Chilworth Recreation Reserve, riparian vegetation surrounding Devlins Creek and the presence of other vegetation. Epping Heights Public School is located south of the M2 Motorway, just east of the Kent Street footbridge.

### Precinct 4 – Beecroft Road to Terrys Creek

The Northern Rail Line crosses over the M2 Motorway between Beecroft Road and the western tunnel portal approximately 300 metres east of the Beecroft Road interchange.

The western end of the land above the tunnel comprises detached residential dwellings. Epping Park, which includes two sporting fields, and Poplars Private Hospital are located above the central portion of the tunnel. Above the eastern end of the tunnel is a new residential development with detached dwellings and a new private road, Sunden Way.

From the eastern tunnel portal to Terrys Creek the dominant land use is low to medium density residential development north and south of the M2 Motorway. The development to the north is shielded from the M2 Motorway by a pocket of vegetation that runs adjacent to the M2 Motorway. Berriwerrie Reserve and Lucknow Park are located to the east of this cluster of houses to the north and south of the M2 Motorway respectively. Terrys Creek runs through both of these reserves, with connectivity between them provided by Terrys Creek bridge.

### Precinct 5 – Terrys Creek to Lane Cove Tunnel

The primary land uses within Precinct 5 are notably different from Precincts 1 to 4. Precinct 5 is dominated by commercial and educational land uses, with Macquarie Business Park and Macquarie University being key features of the landscape.

North of the M2 Motorway is a large tract of vegetation and open space which extends from Terrys Creek to Khartoum Road. The land is a relatively flat area of fill created during the construction of the M2 Motorway with a slope leading down to an area of moderately disturbed native forest. The Great North Walk, which is a walking track that links Sydney and Newcastle, runs roughly parallel to the M2 Motorway through this bushland.

Macquarie University sporting fields located off Culloden Road, and Christie Park located off Christie Road are situated on the filled area, adjacent to the M2 Motorway. There is a small pocket of medium density residential housing situated at Culloden Road, west of the Macquarie University sporting fields. The M2 Control Centre is located between the M2 Motorway and the Macquarie University sporting fields.

There is a pocket of medium density residential development north of the M2 Motorway between Khartoum Road and Lane Cove Road, north of the M2 Motorway. There are two recreation areas, Fontenoy Park and Tuckwell Park located within this pocket of houses. Between Lane Cove Road and Delhi Road the primary land use is the Macquarie Park Cemetery.

South of the M2 Motorway, from Terrys Creek to Culloden Road is a section of low to medium density residential housing, which includes Macquarie University Village student accommodation along Waterloo Road. Macquarie University is located between Culloden Road and Herring Road.

Macquarie Centre is a large commercial complex which is located on the corner of Herring Road and Talavera Road. Macquarie Park is a growing commercial and industrial precinct which has become a hub for specialised technology firms. It spans the area bordered by Herring Road, Epping Road, Delhi Road and the M2 Motorway.

## 10.5.2 Impact assessment

The M2 Upgrade project would support surrounding land uses and encourage future growth and development. Given that the M2 Motorway is existing infrastructure, impacts to surrounding land uses are expected to be minimal. There would be no long-term adverse impacts on land use when upgrade works occur within the existing M2 corridor. Where the proposed footprint extends outside the existing corridor, there are individual properties which would experience partial acquisition and would therefore experience some negative impact. Construction impacts would be temporary.

The following section discusses the impact the upgrade would have on the broader land uses within the M2 Motorway region and the specific impacts on individual properties. These impacts would be mitigated as described in this section and in the Statement of Commitments (Section 11). It should be noted that many of the land uses described in Section 10.6.1 would not be impacted by the M2 Upgrade project.

### Land use impacts

The M2 Upgrade project would increase accessibility between Sydney's north west and the Sydney Orbital network, improving access to new regional growth centres for people, goods and services. Increased accessibility supports the future development of land use within regions such as the north west and Macquarie Park. Growing land uses surrounding the M2 Motorway include commercial, industrial, residential and educational activities.

#### Commercial land use

Once it is operational, the M2 Upgrade project is expected to have a positive impact on the commercial land uses in the immediate vicinity of the M2 Motorway and further afield, within the M2 Motorway's larger catchment area. The key commercial and industrial developments surrounding the M2 Motorway are the Norwest Business Park and Macquarie Business Park.

There would be temporary positive impacts associated with the construction of the M2 Upgrade project on surrounding commercial land uses. The influx of construction workers and their expenditure throughout the two year construction period may be profitable to local businesses. This would, to some degree, compensate for loss of business that may be experienced as a result of decreased accessibility during construction, although construction would be managed to minimise impacts to vehicular access.

Following the completion of the project, access to commercial precincts such as Norwest Business Park and Macquarie Park would be improved benefiting those precincts and improving the movement of people and goods to and from the north west. Decreased congestion and reduced travel times would give workers in their existing locations easier and quicker access to their place of employment. Improved public transport and accessibility would make these regions more attractive for firms looking to relocate which, in turn, would increase job opportunities within the region. These opportunities would be more accessible for employees and would provide employers with access to larger labour markets. Further information regarding the labour supply can be found in Section 10.4.

The M2 Upgrade project would provide benefits to commercial enterprises by improving the efficiency of freight transport and accessibility which, in turn, would allow them to access more markets and improve their overall competitiveness. The project would increase the catchment area of individual businesses as well as the business parks as a whole. The full impact of the M2 Upgrade project on commercial enterprises is described in Section 10.4.

The new on and off-ramps at Herring and Christie Roads are of particular importance to the continued development of Macquarie Park as a commercial precinct. These ramps would facilitate increased movement between Sydney's north west, Macquarie Park and Sydney CBD. However, a number of commercial properties (listed in Table 108) would be directly affected by the upgrade to Herring Road, Christie Road and Talavera Road. Details of these disturbances are described below.

#### Residential land use

Some residential development surrounding the M2 Motorway would be impacted during the construction and operation of the M2 Upgrade project.

Temporary amenity impacts such as noise, air quality and visual impacts would occur during construction of the M2 Upgrade project as described in Section 10.4. These impacts would not affect residential land use or the value of residential properties surrounding the M2 corridor. There are no residential properties located at the proposed sites for the construction compounds, therefore no leases of residential properties would be required.

Impacts on residential development that would continue following completion of construction include:

- Permanent property acquisitions.
- Amenity issues including visual impacts and improvements to traffic noise and air quality.

Amenity impacts on residential properties would not affect land use or property value and are discussed in Section 10.4.

Residential property acquisition for the project would be minimal with only partial acquisition of properties required and no need for demolition of residential dwellings. Details of the required acquisitions are described further below, summarised in Table 108.

#### Educational land use

There are a number of schools and educational facilities that would experience amenity impacts during and following construction of the M2 Upgrade project such as increased noise levels, loss of visual amenity and pedestrian and traffic impacts. These amenity impacts are discussed in Section 10.4. There is no need, however, for permanent acquisition or temporary leasing of land from within their property boundaries.

#### Natural resources and recreational land use

Open space and bushland constitute a large portion of the land use setting along the M2 corridor. Through the concept design process, bushland and reserve areas have been preserved as much as is feasibly possible by minimising the construction footprint (refer to Section 9.5). The greatest impact on recreational land use would occur during construction. Temporary construction compounds and access to these compounds would require use of some of this open space as well as removal of some vegetation. Figure 5 illustrates the required permanent and temporary vegetation removal. Impacts to flora and fauna are discussed in Section 9.5.

### Property impacts

The majority of the widening of the M2 Motorway would occur within the existing M2 lease boundary. A small amount of partial property acquisition would be required. This permanent partial acquisition of property would be needed to accommodate the new ramps at Windsor Road, Christie Road and Herring Road as well as the widening of Talavera Road. Permanent substratum acquisition would also be required in areas where works below the ground surface would be necessary. Temporary lease of land would be required for construction compound sites that lie outside of the M2 lease boundary.

There would also be indirect impacts to properties along the M2 Motorway due to changes to existing noise walls. While these noise walls would not require property acquisition, as they would be located within the M2 lease boundary, the movement or modification of the noise walls may impact on the visual amenity of surrounding properties. This amenity impact would not affect land use or property value and is discussed further in Section 10.4.

#### Permanent land acquisition

There are seven privately owned properties that would require permanent partial land acquisition. These are illustrated in Table 108. Five of these properties are located on Windsor Road and are associated with the new west facing on ramp. Two of these properties are located on Talavera Road and are associated with the new Christie Road on ramp, Herring Road off ramp and widening of Talavera Road. The locations of these properties are shown in Figure 40.

Table 108 Permanent partial land acquisition requirements

| Address | Land use | Required adjustment |
|---|---|---|
| Baulkham Hills 2153 | | |
| 266 Windsor Road | Residential | Driveway and fence adjustment |
| 264 Windsor Road | Residential | Driveway adjustment only (strip of land already acquired by RTA) |
| 262 Windsor Road | Residential | Driveway and fence adjustment and new gate |
| 260 Windsor Road | Residential | Driveway location and grade subject to survey confirmation |
| 258 Windsor Road | Residential | As above – shared driveway with 260 Windsor Road and batter adjustment |
| 256 Windsor Road | Residential | As above – shared driveway with 260 Windsor Road and batter adjustment |
| Macquarie Park 2113 | | |
| 112 Talavera Road | Commercial | Approximately three driveway adjustments subject to negotiation with owner |
| 84-92 Talavera Road | Commercial | Minor boundary adjustment – to be confirmed by survey |

The impacted properties would require partial acquisition only and buildings on these properties would be retained during the M2 Upgrade project. Adjustments to property boundaries would generally be limited to modifications of driveways, fence lines and front gardens.

The impacted land of particular concern would be the residential property at 266 Windsor Road and the commercial property at 112 Talavera Road. 266 Windsor Road is listed as a heritage item on the *Parramatta Local Environmental Plan 1996*. Further information regarding the impact to this property is contained in Section 9.9. The owner of 112 Talavera Road has proposed a major development for this property at its western end. The development would involve construction of a new six storey commercial office building which has been approved by the City of Ryde's Planning and Environment Committee (City of Ryde, 2009).

There are also a number of properties, currently utilised as open space, owned by public authorities that would need to be acquired permanently. These areas include land owned by Hornsby Shire Council near Devlins Creek and land owned by the RTA at Windsor Road and Talavera Road.

Permanent land acquisition would also be required at the eastern end of Somerset Street which would be narrowed at the point opposite Gloucester Road to allow for the widening of the M2 Motorway. Somerset Street, which is a residential street, is currently owned by the RTA. No private land would need to be acquired to accommodate the works in this area.

### Lease of land

A number of properties would be leased during the construction of the M2 Upgrade project where the construction compounds are located outside of the M2 lease boundary. This land would not be acquired but would be leased for part or all of the construction period. Table 109 lists the construction compounds that currently lie outside the M2 lease boundary. The final location of these compound sites is subject to further assessment as well as consultation with landowners and would be determined during the detailed design phase.

Table 109 Leases required at this time

| Compound name / location | Compound size (square metres) | Ownership details |
|---|---|---|
| Windsor Road north | 5,800 | NSW RTA |
| Devlins Creek | 16,000 | Hornsby Shire Council |
| Sutherland Road (Tunnel) | 3,800 | Partially owned by NSW RTA<br>Partially privately owned |
| Vimiera Road | 8,200 | Privately owned |
| Busaco Road | 1,300 | City of Ryde |
| Christie Road | 7,000 | Department of Planning |
| Existing TIDC | 35,000 | Transport Infrastructure Development Corporation (TIDC) |
| North Ryde Station | 11,500 | TIDC |

#### Substratum acquisition

Permanent acquisition would be required in the substratum of a number of properties to allow for the insertion of subsurface rock anchors. The acquisitions would occur:

- South of the M2 Motorway just west of the Pennant Hills Road west facing on ramp.
- To the south of Devlins Creek bridge just west of Kirkham Street.
- At the eastern and western portals to Norfolk Tunnel, north and south of the M2 Motorway.

These acquisitions would not impact the ownership of the properties and would require no change to the dwellings situated on those properties. Figure 41 provides the locations of the required substratum property acquisitions. The construction vibration impacts that may be associated with substratum property acquisitions are discussed in Section 9.4.

### 10.5.3 Mitigation measures

Where possible, works have been contained within the M2 lease boundary. Where land acquisition is required, it would be negotiated in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991 (NSW)* and the RTA's Land Acquisition Policy. Consultation with affected stakeholders would continue to be carried out in accordance with DoP *Guidelines for Major Project Community Consultation* through the detailed design phase. Property access would be maintained for the duration of the two year construction period. Impacts from both the construction and operation of the M2 Upgrade project on the different land uses surrounding the M2 Motorway would be minimised through the implementation of reasonable and feasible mitigation measures for each of the individual areas. Mitigation measures to minimise negative changes in land use or property value would include:

- Noise and vibration.
- Visual amenity.
- Traffic and transport.
- Construction lighting.
- Air quality.

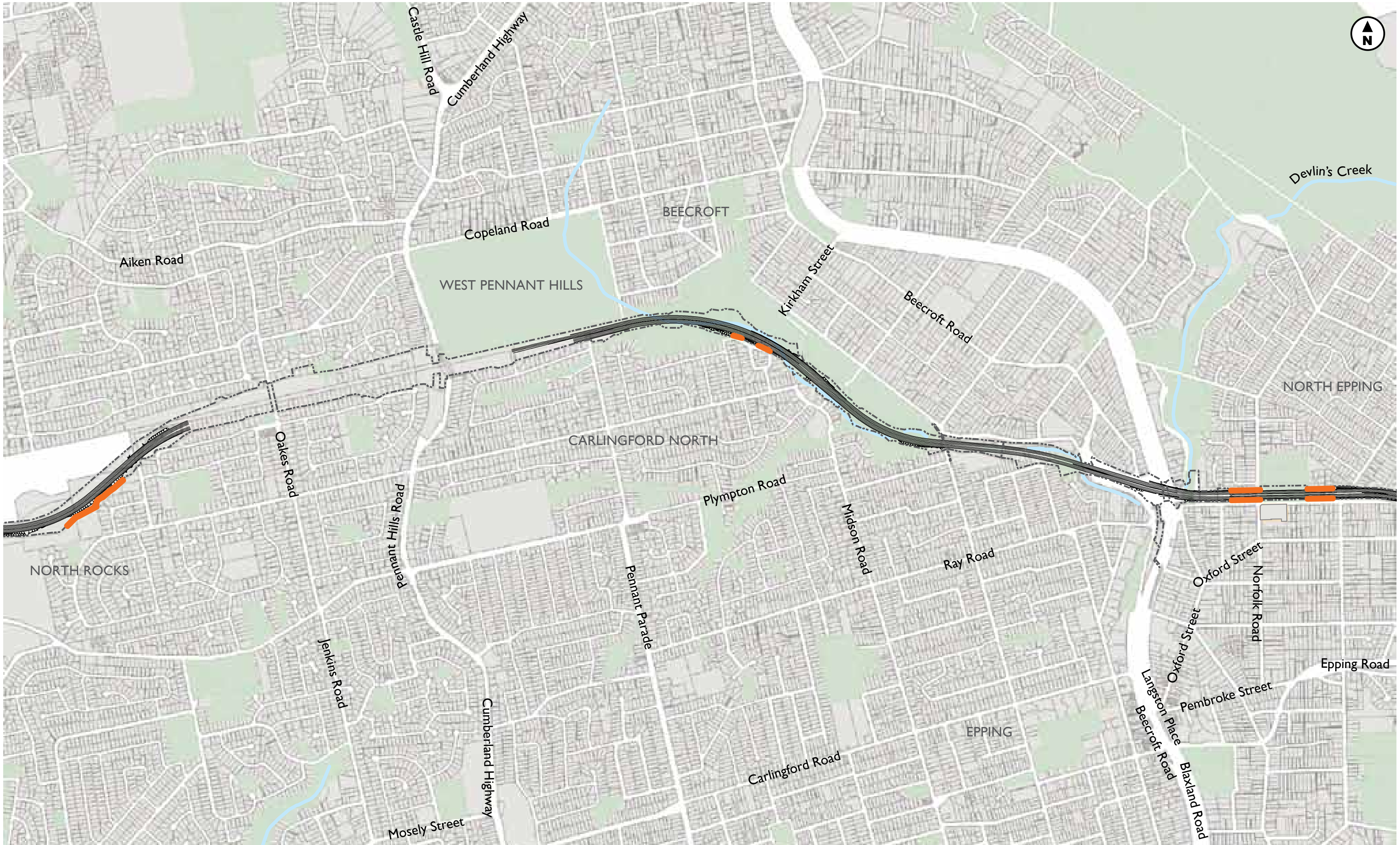
Where land use is temporarily modified during the construction period (particularly at construction compound sites), the land would be rehabilitated to similar or better condition to enable the land use to be reinstated after construction. These mitigation measures are described throughout this report and in the Statement of Commitments (Chapter 11).


Figure 40 – Location of private properties that require permanent land acquisition

M2 Motorway Corridor (Lease Boundary)

Proposed Design

Property Acquisition (Windsor Road)




0 195 390 780 m

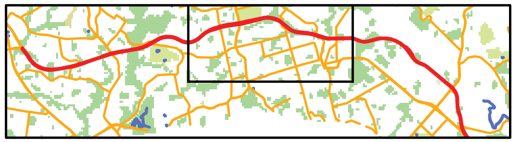
Figure 41 - Location of substratum property acquisition

M2 Motorway Corridor (Lease Boundary)

Extent of Proposed Upgrade

Cadastral Boundaries

Substratum Acquisition



Source: MapData, 2010

## 10.6 Air quality

A *M2 Motorway widening – Air quality impact assessment* report was prepared by Heggies Pty Ltd, dated February 2009 and a summary is presented below.

### 10.6.1 Existing environment

The M2 Motorway spans approximately 21 kilometres from Baulkham Hills to North Ryde and is, in several sections, in close proximity to a number of medium density residential areas mainly in the form of suburban detached dwellings with a small number of multi-unit developments. The eastern end of the M2 corridor also has light industrial uses. The M2 Motorway traverses a largely urban environment. As such background air quality in the vicinity of the M2 Motorway is largely governed by regional background air quality. Regional air quality is subject to factors such to seasonal variations, wind and temperature effects, varying potential pollutant sources such as vehicular emissions and industry and event type pollutant loads such as bushfires. Consequently, regional air quality can be highly variable in nature.

The contribution of vehicular emissions to atmospheric pollutant loads in the urban environment has been decreasing in recent years and is expected to continue to do so. Fuel and vehicle emissions standards have been becoming progressively more stringent due to government regulations and would continue to do so into the future. This is expected to lead to a large fall in vehicular emissions, which would have a follow on effect on overall air quality, particularly in urban environments such as the current study area.

NSW DECCW Action for Air (2009) sets out the NSW Government's 25-year air quality management plan for Sydney, the Illawarra and the Lower Hunter, and introduces a wide range of measures to reduce air pollutants from a wide range of sources. Vehicle exhaust emission standards for motor vehicles are prescribed under the Australian Design Rules (ADR), which implemented via the *Motor Vehicle Standards Act 1989*. Australian emission standards are now aligned with international standards (referred to as 'Euro standards').

Objective 3 of Action for Air: Make cars, trucks and buses cleaner, outlines the implementation timetable for vehicle emission standards in Australia as set out in Table 110.

Table 110 Implementation timetable for vehicle emission standards in Australia

| Emission standards for light duty petrol vehicles | | Emission standards for heavy duty diesel vehicles | |
|---|---|---|---|
| Standard | Implementation dates | Standard | Implementation dates |
| Euro 2 | 2003-2004 | n/a | n/a |
| Euro 3 | 2005-2006 | Euro 3 | 2002-2003 |
| Euro 4 | 2008-2010 | Euro 4 | 2007-2008 |
| Euro 5 | n/a | Euro 5 | Proposed 2010-2011 |

*Source: DECCW 2009*

The development of ADRs, is summarised below, which is taken from the RTA website:

- ADR 79/00 (Emissions Control for Light Vehicles) introduced Euro 2 emission standards for new light vehicles operating on diesel from 1 January 2002, and for new light vehicles operating on petrol, Liquefied Petroleum Gas (LPG) and Natural Gas (NG) vehicles from 1 January 2003.
- ADR 80/00 (Emission Control for Heavy Vehicles) introduced Euro 3 emission standards for new heavy vehicles operating on diesel, LPG and CNG from 1 January 2002; for new heavy vehicles operating on petrol from 1 January 2003.
- ADR 79/01 introduced Euro 3 emission standards for light vehicles operating on petrol, LPG or NG from 2005 and for light vehicles operating on diesel fuel from 2006.
- ADR 80/01 introduced Euro 4 emissions standards for heavy vehicles operating on petrol from 2005 and for heavy vehicles operating on diesel, LPG and NG from 2006.
- ADR 80/02 (Euro 4) was implemented for heavy vehicles which run on diesel, liquefied petroleum gas or natural gas from January 2007 for new model vehicles and from 29 February 2008 for existing models of vehicle.
- ADR 79/02 (Euro 4) was implemented for new model light petrol, LPG and NG vehicles from July 2008 and from July 2010 for light vehicles.
- ADR 80/03 (Euro 5) will be implemented for new model heavy vehicles with a GVM greater than 3.5 tonnes, which run on diesel, liquefied petroleum gas, petrol or natural gas from 2010 and from 2011 for heavy vehicles.

Table 111 Euro emission standards for passenger cars (Category M1), g/VKT

| Tier | CO | Hydrocarbons | NOx | Particles |
|---|---|---|---|---|
| Diesel | | | | |
| Euro 3 | 0.64 | - | 0.50 | 0.05 |
| Euro 4 | 0.50 | - | 0.25 | 0.025 |
| Euro 5 | 0.50 | - | 0.18 | 0.005 |
| Euro 6 | 0.50 | - | 0.08 | 0.005 |
| Petrol | | | | |
| Euro 3 | 2.3 | 0.20 | 0.15 | |
| Euro 4 | 1.0 | 0.10 | 0.08 | |
| Euro 5 | 1.0 | 0.10 | 0.06 | 0.005 |
| Euro 6 | 1.0 | 0.10 | 0.06 | 0.005 |

*Source: http://www.dieselnet.com*

Action for Air makes the following comment in regard to effect of implementing vehicle emission standards and fuel standards:

> *"Taken together, the new fuel and vehicle emission standards are expected to lead to a significant fall in emissions."*

Despite the expected increases in VKT, motor vehicle emissions of carbon monoxide, VOCs and NOX in the Greater Metropolitan Region are forecast to fall by 62%, 40% and 55%, respectively, from 2002 to 2020 (DOTARS, 2004).

The emission factors provided by DECCW used in this assessment for light and heavy vehicles assume no improvement in vehicle exhaust standards to the assessment year of 2021. In reality, improvements in engine and fuel technology, together with the continued implementation of the vehicle exhaust emission standards across Australia would deliver a substantial reduction in vehicle exhaust emissions. In view of the foregoing, it is considered that this assessment represents a highly conservative scenario for the 2021 roadway emissions.

DECCW has established ground level air quality impact assessment criteria for key air pollutants to achieve appropriate environmental outcomes and to minimise associated risks to human health as published in the 2005 document, the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (the Approved Methods). A summary of the impact assessment criteria is given in Table 112 and Table 2 of Technical Paper 11.

For the purposes of this assessment, the key pollutants of interest are:

- Nitrogen dioxide (NO2).
- Carbon monoxide (CO).
- Particulate matter less than 10 microns in aerodynamic diameter (PM10).

A discussion of other potential air pollutants and their relevance to the current assessment is provided below.

Sulphur dioxide ($SO_2$) is generated by road related sources. $SO_2$ emissions from road traffic exhaust emissions is primarily controlled by the regulation of the sulphur content in diesel fuels, which has been systematically reduced since 2001 under the *Fuel Standard (Automotive Diesel) Determination 2001* DEWHA (2001). Under this determination, sulphur content in diesel fuel is now regulated to 10 parts per million (ppm), from 500ppm in 2002 and 50ppm in 2006.

Air pollution associated with lead-based fuels has historically been of concern in urban environments. However, since the removal of lead from fuel, lead is no longer likely to be a pollutant of concern and is not considered in this assessment.

Table 112 Air quality impact assessment criteria specified by DECCW

| | Averaging Period | Concentration | | Source |
|---|---|---|---|---|
| | | pphm | µg/m³ | |
| Sulphur dioxide (SO2) | 10 minutes | 25 | 712 | NHMRC (1996) |
| | 1 hour | 20 | 570 | NEPC (1998) |
| | 24 hours | 8 | 228 | NEPC (1998) |
| | Annual | 2 | 60 | NEPC (1998) |
| Nitrogen dioxide (NO2) | 1 hour | 12 | 246 | NEPC (1998) |
| | Annual | 3 | 62 | NEPC (1998) |
| Photochemical oxidants (as ozone) | 1 hour | 10 | 214 | NEPC (1998) |
| | 4 hours | 8 | 171 | NEPC (1998) |
| Lead | Annual | - | 0.5 | NEPC (1998) |
| PM10 | 24 Hours | - | 50 | NEPC (1998) |
| | Annual | - | 30 | EPA (1998) |
| PM2.5 | 24 hours | - | 25 | DECCW (2004) - NEPM |
| | Annual | - | 8 | DECCW (2004) - NEPM |
| Total suspended particulates (TSP) | Annual | - | 90 | NHMRC(1996) |
| | | Maximum Increase (g/m2/month) | Maximum Total (g/m2/month) | |
| Deposited dust | Annual | 2 | 4 | NERDDC (1998) |
| | | ppm | mg/m³ | |
| Carbon monoxide (CO) | 15 minutes | 87 | 100 | WHO (2000) |
| | 1 hour | 25 | 30 | WHO (2000) |
| | 8 hours | 9 | 10 | NEPC (1998) |

Ozone is commonly associated with photochemical smog in urban environments. Ozone is not specifically considered in this assessment because it is a secondary pollutant, formed by the action of sunlight on $NO_2$ and volatile organic compounds. Hence, the measurement of $NO_2$ would reveal if ozone concentrations are likely to be a concern. Ozone is also a regional rather than a local phenomenon.

Total Suspended Particles (TSP) and dust are both measures of airborne particulates, like $PM_{10}$. Hence, the modelled $PM_{10}$ air quality would reveal if it is likely that TSP or dust are likely to exceed their criteria. Additionally, the criteria for these larger particles (TSP and Dust) are set only for nuisance prevention rather than health protection. Consequently, only the pollutants $NO_2$, CO and $PM_{10}$ have been examined in this assessment.

Particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$) is generated by road related sources. Such particulates are increasingly of concern due to potential inhalations and respiratory system impacts. At this time there are no set standards or goals for particulate matter as $PM_{2.5}$. Advisory goals only are provided in the Air NEPM (DECCW 2004). Similarly there is limited data for atmospheric $PM_{2.5}$

levels and emissions factors for vehicles. Given the increasing focus of $PM_{2.5}$ it is included in this assessment. The air quality standards for pollutants relevant to this assessment are summarised in Table 113.

Table 113 Project ambient air quality goals

| Pollutant | Averaging Time | Maximum Allowable Level |
|---|---|---|
| $NO_2$ | 1-hour | 12 pphm |
| CO | 8-hours | 9 ppm |
| $PM_{10}$ | 24-hour | 50 µg/m$^3$ |
| $PM_{2.5}$[1] | 24-hour | 25 µg/m$^3$ |

*Note 1: Advisory goals only*

*Abbreviations: pphm = parts per hundred million ($1x10^{-8}$)*

*ppm = parts per million ($1x10^{-6}$)*

*µg/m3 = microgram (g x 10-6) per cubic metre*

For the purposes of assessing the potential cumulative air quality impacts from the project, an estimation of ambient air quality concentrations is required. The closest DECCW monitoring station to the M2 Motorway is located in the grounds of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Lindfield Laboratories at West Lindfield, approximately 1.5 kilometres east-southeast of the intersection of Lane Cove Road and the M2 Motorway. Hourly monitoring data from the most complete calendar year available, 2004, was sourced from the DECCW. In accordance with advice from the DECCW Atmospheric Science department, data recorded at the Lindfield station was deemed to be the most appropriate to quantify the existing air quality environment in the vicinity of the M2 Motorway, regardless of the large spatial distance the roadway covers.

No specific data for $PM_{2.5}$ is available from the CSIRO Laboratories at West Lindfield. $PM_{10}$ and $PM_{2.5}$ data from other locations in Sydney has been assessed (Liverpool and Lucas Heights, and Magdala Park in North Ryde). From this data a factor has been developed to apply to $PM_{10}$ data to estimate an approximate background level for $PM_{2.5}$ for the purpose of this assessment. The site-specific ambient air quality concentrations adopted for the purposes of this assessment are summarised in Table 114.

Table 114 Ambient air quality environment

| Air Quality Parameter | Averaging Period | Assumed Background Ambient Level |
|---|---|---|
| $NO_2$ | 1-hour maximum | 1.4 pphm[1] |
| CO | 8-hour maximum | 4.7 ppm |
| $PM_{10}$ | 24-hour maximum | 42.3 µg/m$^3$ |
| $PM_{2.5}$ | 24-hour maximum | 19.0 µg/m$^3$ |

*Note 1: Assumed to be the 75$^{th}$ percentile of hourly measured concentrations, refer Section 10.6.1.*

Within the tunnel itself, operator experience, based on monitoring of CO levels in the tunnel, indicates that CO concentrations in the eastbound tunnel can typically be 7 – 8 ppm and up to 9 – 10 ppm in the morning peak. Concentrations of CO can reach 20 ppm, at which point ventilation is required. However, this occurs very rarely and these concentrations are not sustained. Examination of in-tunnel carbon monoxide monitoring data for a typical traffic week day shows that maximum 1 minute CO concentrations experienced were 10 ppm.

### 10.6.2 Impact assessment

#### Operation impacts

An assessment of the potential impacts of the project was undertaken. The proposed upgrade is designed to accommodate an increased volume of traffic and therefore would affect air quality in proximity to the M2 Motorway. Air quality modelling has primarily been used in this study to predict incremental contributions of pollutants from the M2 Motorway at sensitive receptors based on provided future traffic projections for 2021. A number of residential, commercial, institutional and recreational receptors locations along the length of the M2 Motorway have been selected as suitably representative sites for input in the dispersion modelling process (total 65 sites). A list detailing the receptors adopted in this assessment is provided in Table 1 of the *Air Quality Impact Assessment* (Heggies 2010).

Two modelling scenarios have been undertaken to determine the air quality impact of the proposed project, specifically:

- Scenario 1 - 2021 'Do Nothing' configuration – current M2 Motorway configuration with corresponding predicted 2021 traffic predictions.
- Scenario 2 - 2021 'Upgrade' configuration – M2 Motorway post-upgrade configuration with corresponding predicted 2021 traffic predictions.

Cumulative concentrations of pollutants have also been assessed using background air quality data collected in the local area.

Air quality within the tunnel and associated with emission from the tunnel openings have also been assessed and are discussed in this section.

In order to adequately characterise the dispersion meteorology likely to be experienced along the M2 Motorway, meteorological observations recorded at the CSIRO Lindfield air quality monitoring station during 2004, concurrent with the $NO_2$ monitoring dataset, were obtained and processed using a dispersion model. The Air Pollution Model (TAPM) meteorological model (Version 3), developed by CSIRO, was used. The modelling revealed diurnal variations in average mixing depths (the height above the ground to which pollutants are mixed by turbulence in the air).

In order to determine the potential impact on air quality along the extent of the M2 Motorway, the transportation dispersion model CAL3QHCR, developed by the United States Environmental Protection Agency (USEPA), was used. Predicted daily total work-day traffic figures were provided for the M2 Upgrade project environmental assessment for both Scenario 1 and Scenario 2. Furthermore, the predicted distribution between passenger vehicles and heavy goods vehicles for each section of the M2 Motorway and an hourly traffic distribution profile, recorded at the M2 Motorway Toll Plaza in 2008, were provided by the M2 Motorway operator.

A highly conservative assessment of air quality impacts at key receptor locations has been undertaken. This assessment is likely to overestimate pollutant concentrations and air quality impacts associated with the M2 Upgrade project. A list of the conservative assumptions for the modelling assessment is presented in Table 115.

Table 115 Modelling assessment assumptions

| Conservative assumption | Potential impact on assessment results |
|---|---|
| No vehicle emissions reductions applied between present day and 2021 | In reality, technological and fuel efficiency improvements as currently implemented through government regulation would reduce emissions. As these emission improvements have not been factored in, the resultant predictions would likely be higher than actual future emission levels. |
| $NO_X$ to $NO_2$ conversion assumed to be 10 percent of $NO_X$ at distances up to 15 metres from kerbside and 20 percent at distances beyond 15 metres from kerbside. | In reality, this value is approximately 7.5 percent at source increasing to 20 percent at distances of several hundred metres from the roadway. |
| Elevation differences between roadway and receptors not accounted for[1] | This assumption would result in unobstructed flow of pollutants to receptors. In reality, topographical features and barriers such as noise walls or vegetation screens would act to obstruct the flow of pollutants to receptor and result in lower concentrations[2]. |
| Tunnel portal emissions distributed along a 200 metre section of roadway | The assessment methodology assumes that pollutants emitted within the tunnel are released at the tunnel exits in the direction of travel. In reality, emissions in the tunnel would not be released from the tunnel exit.<br>Also, the assessment methodology does not account for mixing of emissions from the tunnel exits with the ambient air for a distance of 200 metres past the tunnel exits, which in reality would cause some dilution of the pollutants present. |

*Note 1: With the exception of R46 and R47, which are elevated above the road at the eastern tunnel portal and are dealt with as a special case in the Air Quality Impact Assessment.*

*Note 2: Unquantifiable within the dispersion modelling assessment.*

The predictions indicate that all modelled pollutant concentrations would meet current DECCW and NEPM air quality criteria as adopted by the NSW State Plan at the selected sensitive receptor locations. Due to the highly conservative nature of the assessment conducted, it is considered that the actual concentrations would be lower than those predicted under actual road operation. The targets adopted by the NSW State Plan require meeting the national air quality goals as specified in the NEPM for ambient air quality. The concentrations of air pollutants at all receptors are predicted to meet the NEPM standards even under the adoption of worst case assumptions. The maximum incremental 1-hour $NO_2$ concentration, due to the operation of the proposed upgrade, is predicted to be no greater than 7.3 pphm in Scenario 1 and 7.8 parts per hundred million (pphm) in Scenario 2 at selected receptor locations. With the addition of the assumed background concentration of 1.4 pphm, taken from the monitoring data from Lindfield for 2004, cumulative 1-hour maximum concentrations of $NO_2$ are likely to be 7.5 pphm for Scenario 1 and 7.8 pphm for Scenario 2, which are below the relevant DECCW criterion of 12 pphm (1-hour).

In the vicinity of the Norfolk Tunnel, predicted concentrations of air pollutants are higher than at any other point across the M2 Motorway. Indeed, the maximum predicted cumulative concentrations of NO2 in this area are approximately 65 percent of the DECCW criterion. However, it is considered that the method adopted to replicate portal emissions within this assessment is highly conservative. Conservative vehicle emission factors and assumptions have been used in the assessment methodology that would result in poor dispersion of airborne pollutants. Due to the combination of these factors, it is considered that the predicted pollutant concentrations at this location are higher than those likely to be experienced in reality.

The maximum incremental 8-hour CO concentration due to the operation of the proposed upgrade is predicted to be no greater than 0.6 ppm in either Scenario 1 or Scenario 2 at selected receptor locations. This is then added to the assumed background concentration of 2.8 ppm, taken from NSW DECCW Sydney Metropolitan area monitoring data for 2004, to give likely cumulative 1-hour maximum CO concentrations of 3.4 ppm for both scenarios, which is below the relevant DECCW criterion of 9ppm.

$PM_{10}$ concentrations are also likely to be less than DECCW guideline concentration of 50µg/m3 (24-hours). Background maximum incremental 24-hour $PM_{10}$ concentrations during the operation of the proposed M2 Upgrade project are predicted to be less than 5.5 micrograms per cubic metre and 5.0 micrograms per cubic metre during Scenario 1 ('no upgrade') and Scenario 2 ('upgrade') M2 configurations. With Scenario 1, the maximum 24-hour $PM_{10}$ concentration of 5.5 micrograms per cubic metre is predicted at R47 (Devon Street, North Epping) and with Scenario 2 the maximum 24-hour $PM_{10}$ concentration of 5.0 micrograms per cubic metre is predicted at R18 (Craig Avenue, Baulkham Hills) and R35 (Pennant Hills Golf Course).

With the addition of the assumed background $PM_{10}$ concentration of 42.3 micrograms per cubic metre taken from the monitoring data from Lindfield for 2004, the predicted cumulative 24-hour maximum concentrations of $PM_{10}$ are 47.8 micrograms per cubic metre for Scenario 1 and 47.3 micrograms per cubic metre for Scenario 2. These predictions are marginally below the DECCW criterion for $PM_{10}$ of 50 micrograms per cubic metre. Relative contributions to the predicted overall concentrations in both scenarios are small compared to background levels. Also, the contributions due to the M2 Motorway are also likely to be over stated due to the conservative assumptions used in the modelling process.

Due to the limited data available regarding vehicle emissions PM2.5, it has not been specifically modelled in this assessment. Instead, a qualitative assessment has been undertaken to compare anticipated concentrations of $PM_{2.5}$ particles against the 24-hour National Environment Protection Council Measure for Air Toxics (NEPM, 2004) advisory standard of 25 micrograms per cubic metre averaged over 24 hours. A ratio of $PM_{2.5}$ to $PM_{10}$ ratio of 0.45 was chosen, based on data measured at Magdala Park, North Ryde. This is considered to be worst case because the ratio is higher than other longer term monitoring data collected by the Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney.

Calculations indicate that incremental concentrations of $PM_{2.5}$ arising from the M2 Upgrade project would be in the order of 2.5 micrograms per cubic metre (45 percent of 5.5 micrograms per cubic metre $PM_{10}$) during Scenario 1 and 2.3 micrograms per cubic metre (45 percent of 5.0 micrograms per cubic metre $PM_{10}$) during Scenario 2. Furthermore, adding the M2 Upgrade project component to the maximum 24-hour $PM_{2.5}$ background concentration of 19 micrograms per cubic metre results in a cumulative $PM_{2.5}$ concentration of 21.5 micrograms per cubic metre, which is still 3.5 micrograms per cubic metre below the NEPM advisory standard. It is background levels and not predicted emissions associated with the M2 Upgrade project that make the dominant contribution to the predicted $PM_{2.5}$ levels.

The results of the dispersion modelling of the M2 Motorway emissions of NO2, CO and $PM_{10}$ show that for both the 2021 'Do Nothing' and 'Upgrade' scenarios, emissions generated by M2 Motorway traffic are unlikely to exceed relevant DECCW assessment criteria. Also, the results indicate that changes in air quality in the vicinity of the M2 Motorway as a result of the M2 Upgrade project are expected to be minor. Further, in accordance with the requirements of Action for Air, more stringent vehicle exhaust emission standards are likely to result in more efficient vehicles resulting in a decrease in emissions on a per vehicle basis.

Finally, the Scenario 1 'Do Nothing' configuration predictions are routinely lower than those for the Scenario 2 'Upgrade' configurations (by up to approximately 10 percent). However, it is predicted that traffic congestion in Scenario 1 would be greater than in Scenario 2 ('upgrade'), due to widening of the

M2 Motorway. Vehicle emissions from free flowing traffic are generally of better quality than the emissions during congested situations. Intermittent traffic congestion was not accounted for as such finer-scale traffic data cannot readily be handled by this screening level dispersion model. It is considered probable that, if the effect of congestion on air quality could be taken into account, air pollution concentrations for Scenario 2 ‘Upgrade’ would be more comparable and potentially lower than for Scenario 1 ‘Do Nothing’.

In addition, although the M2 Motorway traffic volumes would increase, the traffic modelling (refer to Section 9.1) indicates that there would be a reduction in traffic on the surrounding arterial road network. Hence, any increased air emissions from vehicles travelling on the M2 Motorway would be offset in part by the reduction in emission on other routes due to less vehicles and improved driving conditions (reduced congestion) on these routes.

Within the Norfolk Tunnel, motorists may be exposed to elevated concentrations of pollutants for approximately one minute (the approximate maximum duration of time spent inside the tunnel). It is noted that pollutant emissions would vary depending on traffic flow, congestion and driving conditions within the tunnel. The continuous monitoring and the provision for ventilation controls maximum concentrations of CO in the tunnel. Thus, these are kept below the relevant DECCW criteria. No specific monitoring data for the other pollutants is available. However, due to the provision of ventilation it is considered that these pollutants would also be below DECCW criteria.

Whilst specific quantitative modelling has not been undertaken for CO or other key pollutants in the tunnel in the 2021 scenarios, it is considered unlikely this situation would change significantly due to the proposed upgrade and it is therefore unlikely that the DECCW criteria would be exceeded.

### Construction impacts

Construction activities have the potential to impact on local air quality for sensitive receptors in proximity to project-related construction works. The air pollutants of main concern are fugitive dust emissions. Aspects of the upgrade with the potential to generate dust include:

- Demolition works.
- Civil engineering works.
- Road upgrades.
- Construction traffic.

Emissions from construction-associated traffic and equipment are expected to increase during the construction phase of the project. An increase in traffic is expected during the construction phase of the project, particularly heavy vehicle movements to, from and around the project work sites. A large amount of plant and equipment would also be required to facilitate construction, which have the potential to increase air emissions either directly or indirectly. Such emissions are expected to have only minor, localised and short-lived impacts of air quality in the study area.

### 10.6.3 Mitigation measures

No additional mitigation for operational air quality is required, since predictions for air quality indicate that modelled pollutant concentrations would meet current DECCW or NEPM air quality criteria at the selected sensitive receptor locations.

Mitigation measures for construction-associated activities are as follows. Dust emissions arising from construction activities can largely be controlled through operational and physical measures, which are routinely adopted as common practice during similar construction projects.

A number of safeguards and management practices can be used to protect the environment during construction activities. These include:

- Regular watering of unsealed access roads and exposed surfaces.
- Minimisation of exposed surfaces.
- Wind breaks composed of earth banks and other screens to protect small areas by reducing capacity of the wind to raise dust.
- Dust screening between construction activities and residential receptors.
- Progressive rehabilitation of exposed areas.
- Amending of dust-generating activities construction activities during adverse wind conditions.
- Installation of truck wheel washes, rumble grids or other measures to minimise tracking of dirt and generation of dust off site.
- Minimising the drop heights between front end loader buckets and the truck(s) being loaded.
- Introducing speed restrictions and designated transport routes for project traffic on unsealed surfaces.

The potential emissions from construction-associated traffic and equipment can be managed by:

- Limiting the amount of truck movements on- and off-site wherever practicable.
- Ensuring that vehicle queuing does not occur in local roads and adjacent to sensitive receptors such as residences.
- Ensuring adequate maintenance of trucks entering and leaving the site and emitting plant and equipment to reduce adverse impacts. Maintenance would be in accordance with the manufacturer's specification.

In order to manage the potential emissions during the project, an appropriate and adaptable air quality management strategy would be developed to support the various stages of construction and areas of work. The strategy would also outline air quality targets and the monitoring activities that would be conducted. Details of this overall air quality management strategy would be documented in the Construction Environmental Management Plan (CEMP) for the project. An outline of the CEMP is provided in the Construction Environmental Management Framework (refer to Appendix F).

## 10.7 Construction lighting impacts

A *Lighting Impact Assessment* report was prepared by Heggies Pty Ltd, dated January 2010 and a summary is presented below.

The objective of the assessment was to establish lighting levels at construction compound locations that are reasonably cost effective, provide sufficient illuminance levels and do not cause adverse light spill.

The assessment included the following elements:

- Establishment of relevant lighting criteria.
- Identification of surrounding sensitive receivers, such as residences, roads and traffic signalling systems.
- Assessment of impact on areas adjoining the compounds during the construction phase of the project, including:
  - Construction night-time light spill at residential properties.
  - Disability glare for road users.
  - Obtrusive glare from construction vehicle headlights at access points.
- Development of mitigation options to manage potential adverse effects of construction compound lighting.

The exact locations of the proposed compounds and the site boundaries may still be altered during the detailed design process.

### 10.7.1 Existing environment

The existing M2 Motorway interchanges and access ramps are currently lit during night time periods. The light is focussed on the carriageways and is often shielded from residences by noise walls and screening vegetation.

The current environment at the majority of the proposed compound sites is characterised by low levels of lighting. These sites are generally undeveloped areas with no lighting requirements. The exceptions are the Talavera Road and existing TIDC compounds which have either been developed or have previously been used as construction sites. These potential compound sites currently require or have recently required illumination.

Many of the construction compound sites are bordered by or are in close proximity to residential developments.

### Assumptions and assessment criteria

#### Assumptions

Following the M2 Upgrade project, there would be additional lighting requirements at the new interchanges at Windsor Road, Christie Road and Herring Road only. Given that there is existing lighting along the M2 Motorway and at these interchanges, the increase in lighting would be negligible as a result of the M2 Upgrade project. This assessment therefore relates only to the lighting impacts during the construction phase.

The assumption has been made that lighting would be required during the winter months and during night-time periods (pre-sunrise and post-sunset) at certain compounds. Twenty-four hour construction activities have been proposed at 7 out of the 16 construction compounds assessed in this report. These compound sites include the Windsor Road, Beecroft Road (old bus ramp), Beecroft Road (tunnel), Toll Plaza, Christie Road, Macquarie Park and the existing TIDC compound. It is assumed that the remaining compound sites would be lit with localised security lighting during night time periods.

Where possible, lighting would be positioned away from residential development. This assumption has been used to determine the likely lighting arrangements assessed for each compound.

It is assumed that primary site lighting would consist of lighting towers. It is likely that each tower would be fitted with two or three 1500 Watt Metal Halide Floodlights, meaning each tower would produce 3000 or 4500 Watts of light.

### Construction lighting criteria

Acceptable levels of light spill and glare at residential properties are governed by Australian Standard: *AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting*. AS4282 also specifies acceptable glare for other road users. The Standard states that the following assessment should be used to determine compliance:

*Step 1: Time of Operation* – much of the construction work for the project would be carried out during standard construction hours (7.00 am to 6.00 pm on weekdays and 8.00 am to 1.00 pm on Saturdays). Some work would be carried out at night time and there is the potential for nine compounds to be operational for 24 hours per day. These compounds are discussed in detail in Section 10.7.3.

*Step 2: Relevant lighting limits* – lower maximum lighting values would apply during curfew hours (11.00 pm – 6.00 am) for the construction compounds that operate 24 hours per day. The remaining compounds must comply with pre-curfew values.

*Step 3: Calculation of light technical parameters* – it is not possible to carry out such calculations and confirm compliance at this stage of the project without the provision of available photometric data for the specific luminaires to be used at the construction compounds.

*Step 4: Determination of compliance* – calculations are used to show whether or not residential receivers adjacent to the proposed construction compounds are likely to comply with the lighting criteria specified in Step 2.

*Step 5: Documentation of installation* – luminaires likely to be used for the installation are documented to the extent known.

### 10.7.2 Impact assessment

Outdoor lighting has the potential to have an adverse impact on the following:

- Residential houses – through both increased ambient light from light spill and glare from direct view of the light source.
- Transport system users – by a reduction in visibility caused by disability glare.
- Transport signalling systems – through disability glare.
- Astronomical Observations – due to sky glow from scattering of light from the installation and from direct light falling on the observatory.
- Native flora and fauna habitat intrusion.

The M2 corridor runs through areas of urban residential development located close to the M2 Motorway alignment. Obtrusive spill light from the night-time lighting required for safety reasons at the construction compounds has the potential to affect nearby residences and road users.

The effect of lighting impacts on native fauna is considered in Section 9.5. There are no astronomical observatories located close to the proposed construction compounds and hence are not covered within this report.

#### Assessment of light spill on residential areas

Without careful luminaire selection and, in some cases, further detailed modelling, there is potential that the lighting requirements set out in AS4282 may be exceeded at a number of locations impacted by construction compound lighting as summarised in Table 116.

Table 116 Potential lighting impacts at construction compounds

| Proposed construction compound location | Potential obtrusive light spill | Potential for 24 hour operation | Details of impact |
|---|---|---|---|
| Windsor Road Compound | Yes | Yes | There exists potential for adverse light spill for certain residential properties north west and west of the compound from construction lighting and vehicle headlights. |
| Darling Mills Creek Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Barclay Road Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Devlins Creek Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Barombah Road Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Beecroft Road (Old bus ramp) Compound | Yes | Yes | There is potential for excessive light spill for surrounding residential properties, particularly those located to the south and east of the compound, from construction lighting. |
| Sutherland Road (Tunnel) Compound | Yes | Yes | There is a potential that the residential areas east and west of the compound may to be subjected to excessive light spill from the proposed compound lighting. |
| Somerset Road (Terrys Creek western end) Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |

| Proposed construction compound location | Potential obtrusive light spill | Potential for 24 hour operation | Details of impact |
|---|---|---|---|
| Terrys Creek Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Vimiera Road Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Busaco Road Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Toll Plaza Compound | No | Yes | There are no residential properties located in the vicinity of the compound, therefore, there is no potential for adverse light spill. |
| Christie Road Compound | No | Yes | There are no residential properties located in the vicinity of the compound, therefore, there is no potential for adverse light spill. |
| Macquarie Park Compound | No | Yes | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |
| Existing TIDC Compound | Yes | Yes | The residential area south of the compound has the potential for obtrusive spill light from the proposed construction lighting. |
| North Ryde Station Compound | No | No | Limited potential for construction lighting or vehicle headlights to impact on residential properties. |

Impacts would occur at construction compound sites that have both the potential for obtrusive light spill and where 24 hour operations have been proposed. Therefore, compounds where surrounding residences are likely to experience an impact from lighting during construction include the Windsor Road, Beecroft Road (old bus ramp), Beecroft Road (tunnel) and existing TIDC compounds. These impacts would be mitigated as described in this report.

The impact at compound sites where 24 hour operation has not been proposed would be low, given that they would be lit only with localised security lighting through the night time period. The proposed security lighting would be limited to four 500 watt lights. These lights would not have sufficient luminance to impact on surrounding residences assuming that lights are positioned in suitable locations and directed away from residential properties.

### Assessment of glare on the M2 Motorway

In some instances, lighting at the construction compound sites may be directed towards the M2 Motorway to avoid light spill onto residential receivers located behind the lighting installation. In such instances, there is potential to cause disability glare for users of the M2 Motorway. Adverse effects of light spill onto the M2 Motorway may include a reduction in the ability of drivers to discern objects and other road users.

### 10.7.3 Mitigation measures

#### Construction compound lighting

*AS4282-1997: Control of the Obtrusive Effects of Outdoor Lighting* sets out general principles that should be applied when designing outdoor light to mitigate adverse effect of the light installation. These would include, but are not limited to:

- Switch off lights when not required.
- Direct lights downwards as much as possible.
- Use luminaires that are aimed to minimise light spill, for example, full cut off luminaire where no light is emitted above the horizontal plane.
- Do not waste energy and increase light pollution by over-lighting.
- Minimise glare by keeping the main beam angle less than 70 degrees wherever practicable.
- Where possible, use floodlights with asymmetric beams so that front glazing can be kept at or near parallel to the surface being lit.
- Where practicable, direct site lighting away from sensitive receivers such as residential properties.
- Where possible, position site lighting away from the site boundary.

It is proposed that these standard mitigation measures be used when choosing and positioning floodlights for the construction compound sites to minimise the risk of light spill from the construction lighting. During the design stage of the project, this preliminary analysis would then be reviewed and sites would be identified where detailed modelling may be required to assist in the development of appropriate light spill management strategies.

#### Glare from construction vehicles

Excessive glare from vehicles entering and exiting the construction compounds would be minimised by utilising:

- Non-translucent barriers to shield residential developments located directly opposite access points.
- Hessian matting attached to the construction compound fencing to eliminate the potential of glare from vehicle headlamps. The minimum height of such matting would be based on the local topography and the distance of the closest sensitive receiver from the site.

#### Glare on the M2 Motorway

General mitigation measures that would be applied to manage glare from construction compound sites lighting on the M2 Motorway would include directing the floodlight towards the ground so the angle between the beam and the vertical is kept as small as possible.

Directing the floodlight in a perpendicular direction to the road axis and hence perpendicular to the line of sight of drivers on the M2 Motorway.

## 10.8 Waste minimisation and management

This section provides an assessment of waste minimisation and management measures associated with the project.

### 10.8.1 Existing environment

As described in Section 1.5, the M2 Motorway is fully operational and is characterised by different environmental features. Waste is currently generated from ongoing road maintenance and repair activities and by users of the M2 Motorway. Maintenance wastes would include green wastes from trimmed vegetation, landscape areas, windblown leaves and debris, and vehicle oils and greases from maintenance vehicles. General litter can also be generated by road users utilising the M2 Motorway.

### 10.8.2 Impact assessment

The following section details types of solid and liquid waste expected to be generated during the construction and operation of the project. Inadequate collection, storage and disposal of waste generated during construction and operational activities may potentially lead to pollution of the surrounding environment, including soil and water. Solid waste, such as plastic bags, has the potential of being blown onto the M2 Motorway from neighbouring areas and causing litter nuisance and traffic disruption.

Activities that would generate waste during the construction period would include earthworks, drainage works, clearing and grubbing, associated upgrade works, bridge demolition and concrete trimming, restoration works on existing pavement, equipment maintenance, and site office activities. The key waste streams generated during these activities are summarised and presented in Table 117.

Waste streams that would be generated during the construction phase are:

- Green waste.
- General construction waste.
- Demolition concrete.
- Inert spoil.
- Potentially hazardous waste (including asbestos waste).
- Virgin Excavated Natural Material.
- General office waste such as paper, used printer cartridges, food waste, etc.

The management of waste is not considered a key issue given that standard measures are available to address waste generation, disposal and reuse in order to minimise potential impacts (refer to Section 10.8.3).

The Porters Creek landfill site is in the vicinity of the M2 Motorway corridor east of Lane Cove Road. There is no widening proposed as part of the M2 Upgrade project east of Lane Cove Road and there are no construction compounds located within the vicinity of the landfill. There would be no impact on or from the landfill site as a result of the project.

Table 117 Potential waste generated during construction

| Waste | Quantity (t) | Classification per DECCW waste classification guidelines | Potential recovery/reuse | Disposal |
|---|---|---|---|---|
| Green waste from clearing and grubbing of vegetation | 9,500 | General Solid Waste (Non-Putrescible) | Timber would be collected and transported to nearby timber logging industry.<br>Green waste would be sent to nearby composting facility or may be used as mulch onsite, where required and if appropriate. | Clear and grub subcontractor would remove timber and excess mulch to licensed facilities. |
| Demolition concrete | 25,500 | General Solid Waste (Non Putrescible) | Stockpiled and transported to on-site recycling centre and recycled for the project construction activities. | Stockpiled waste concrete would be transported to recycling centre as and when required for recycling and reuse. |
| Inert spoil | 45,800 | General Solid Waste (Non Putrescible) | Collected in designated collection areas and reused as much as practically possible.<br>Where possible, excess spoil material would be transported to other projects that require suitable fill material. | Dedicated stockpile areas would be identified where excess material may be stored and after requirements of the project have been met, excess spoil would be transferred to other projects that require spoil. |
| Building rubble, demolition materials | 4,603 | General Solid Waste (Non Putrescible) | Collected in designated collection areas and reused as much as practically possible.<br>Where possible, excess material would be transported to other projects that require it. | Dedicated stockpile areas would be identified where excess material may be stored and after requirements of the project have been met, excess material would be transferred to other projects that require it. |
| Asbestos | 78 | Special Waste | Would be recovered in sealed bags/containers and disposed by licensed contractors. | Waste must be stored on premises in an environmentally safe manner.<br>Bonded asbestos material must be securely packaged at all times.<br>Friable asbestos material must be kept in a sealed container.<br>Asbestos-contaminated soils must be wetted down.<br>Asbestos waste must be transported in a covered, leak-proof vehicle.<br>Asbestos waste must be disposed of at a landfill site that can lawfully receive this waste. |
| Inert general solid waste (non-recyclable) | 3,544 | General Solid Waste (Non Putrescible) | Collected in bins. | General waste (non-putrescibles) would be stored in separate bins depending on the waste disposal method and waste collection contractor requirements.<br>Bins/skips would be emptied on a regular basis such to prevent overflow of materials. |

| Waste | Quantity (t) | Classification per DECCW waste classification guidelines | Potential recovery/reuse | Disposal |
|---|---|---|---|---|
| Virgin Excavated Natural Material (VENM) – residual soil and shales | 32,445 | General Solid Waste (Non Putrescible) | VENM would be clearly identified and kept separated from other materials to ensure its potential for use is not affected. | Wherever possible, VENM would be used on the project and excess material would be transferred to other projects requiring VENM. |
| General office waste – paper, cardboard, used printer cartridges, and the like. | Cannot estimate at this point | General Solid Waste (Non Putrescible) | Office waste like paper, cardboard boxes, used printer cartridges would be recycled.<br>Recycle computers and florescent bulbs, unless they are managed as a hazardous waste. | Recyclable office waste like paper, cardboard boxes, used printer cartridges would be segregated and stored separately from organic waste. A licensed waste collection contractor would collect the recyclable and organic waste.<br>Bins/skips would be emptied on a regular basis to prevent overflow of materials. |
| Small quantities of hazardous waste from equipment and building maintenance activities. | Cannot estimate at this point | Hazardous | Hazardous waste would be clearly identified and stored separate from other waste materials for selective disposal. | Refer Hazardous Waste Management in Section 10.8.3. |

### 10.8.3 Mitigation measures

#### General waste management

In order to minimise waste and maximise use of available resources, earthworks material would be reused on-site, as far as practically possible. Fill embankments, subgrade layers and other material would be reused on-site for batter extensions or in other suitable construction tasks. Topsoil would be reused for landscaping.

The total volume of green waste generated from clearing and grubbing activities is difficult to estimate as the vegetation cover varies along the different precincts of the proposed upgrade, and it is dependent upon the time of year within which this activity takes place. The proposed clearance area is approximately 145,000 square metres and at an average yield of around 0.09 cubic metres per square metre (based on clearing activities for similar projects). This would approximate to 13,050 cubic metres of green waste or 9,500 tonnes in total. It is proposed to transport timber to appropriate facilities such as the timber logging industry that can accept raw materials. Unsuitable material would be mulched, chipped or reused on-site for sediment filter fences and landscaping where appropriate. Suitable logs would be used to prevent access to construction areas.

Although contaminated waste is not expected to be encountered, waste that does not fall into any of the categories described in Table 117 would be chemically assessed to determine its classification. If any waste is deemed to be hazardous, restricted or general (non-putrescible) solid waste, the waste would be managed and disposed off in accordance with the DECCW Guidelines (refer to Table 117 for measures).

Waste generated during the operational phase would be limited to waste generated from road maintenance and road users. Maintenance wastes may include green waste (from adjacent vegetation and landscaped areas), demolition materials from pavement remediation, and oils and greases from maintenance vehicles. Litter may also be generated by road users using the M2 Motorway.

Maintenance wastes generated would be disposed of to an appropriate licensed facility. Waste generated by road users would be collected by the relevant maintenance organisation. Wastes would either be recycled or disposed of to an appropriate facility.

A Waste Management and Reuse sub plan would be prepared prior to the commencement of the construction period. This plan forms part of the CEMP, which is outlined in the Construction Environmental Management Framework (refer to Appendix F). These plans would address appropriate waste identification, handling, storage and disposal in accordance with the DECCW Guidelines.

#### Hazardous waste management

Hazardous waste would be stored so as to prevent or control accidental releases to air, soil, and water resources in the area. Storage provisions would include:

- Sufficient space between incompatibles or physical separation such as walls or containment bunds.
- A requirement that hazardous materials be stored in closed containers away from direct sunlight, wind and rain.
- A requirement that secondary containment systems be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment.

- Designing the available volume for secondary containment to be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location.
- Providing adequate ventilation where volatile wastes would be stored.

Hazardous waste storage activities would also be subject to special management actions, conducted by licensed contractors who have received specific training in handling and storage of hazardous wastes. Management actions would include:

- Provision of readily available information on chemical compatibility to employees, including labelling each container to identify its contents.
- Limiting access to hazardous waste storage areas to employees who have received proper training.
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan.
- Conducting periodic inspections of waste storage areas and documenting the findings.
- Preparing and implementing spill response and emergency plans to address their accidental release.

### Transportation

On-site and off-site transportation of waste would be conducted so as to prevent or minimise spills, releases, and exposures to employees and the public. Waste containers designated for off-site shipment would be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (manifest) that describes the load and its associated hazards.

### Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste would include:

- Regular visual inspection of waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labelled and stored. Monitoring would include:
  - Inspection of construction plant and machinery for leaks, drips or other indications of loss.
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors.
  - Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied).
  - Documenting results of testing for integrity, emissions, or monitoring stations (air, soil vapour, or groundwater).
  - Documenting changes to the storage facility, and any significant changes in the quantity of materials in storage.
- Regular audits of waste segregation and collection practices.
- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments.
- Characterising waste at the generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes.
- Keeping manifests or other records that document the amount of waste generated and its destination.

- Monitoring records for hazardous waste collected, stored, or transported would include:
  - Name and identification number of the material(s) composing the hazardous waste.
  - Physical state (solid, liquid, gaseous or a combination of one, or more, of these).
  - Quantity by weight, volume or number of containers.
  - Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported and date received, record of the originator, the receiver and the transporter.
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste.
  - Location of each hazardous waste within the facility, and the quantity at each location.

The environmental manager (or equivalent nominated by the site manager) would be responsible for waste monitoring, data collection and reporting as identified above.

## 10.9 Hazards and risks

Hazards and risks may be experienced during both construction of the project. An assessment of the hazards and risks to people and facilities that may be generated by the M2 Upgrade project is summarised in this section. A separate risk assessment has been prepared for potential impact to the environment (refer to Chapter 8).

### Assessment methodology

Hazards and risks that may be generated by the project are related to:

- Storage and handling of dangerous goods.
- Construction activities.

There are a number of study approaches that may be used for the assessment of hazards and risks. In order to determine the most appropriate approach for the M2 Upgrade project, a preliminary assessment is made in accordance with the following published hazard and risk assessment guidelines:

- Multi level risk assessment
- *State Environmental Planning Policy No.33 – Hazardous and Offensive Developments* (SEPP 33).
- *Hazardous Industry Planning Advisory Paper* (HIPAP) No.6.

This preliminary assessment indicated that the likelihood of an incident occurring during construction is low, and that a qualitative hazard and risk assessment is the appropriate level of assessment for this project. The key reasons for this are:

- The quantity of dangerous goods that would be stored is relatively low and the threshold levels under SEPP 33 are unlikely to be exceeded.
- The operations associated with construction activities are well understood and have been demonstrated to be well managed on similar projects.

It should be noted that this assessment did not address hazard and risk associated with road safety or general public safety with regard to road traffic other then dangerous goods transportation.

### 10.9.1 Hazard identification

#### Dangerous goods

Table 118 details the type and quantity of dangerous goods expected to be stored on site during the construction stage of the project.

Table 118 List of dangerous goods stored by the project

| Dangerous goods stored | Quantity stored* |
|---|---|
| Diesel fuel | 3x25kL tanks |
| Oils greases and lubricants | <500 L |
| Acetylene, dissolved (cylinders) – Class 2.1 | eight cubic metres greater than ten metres from site boundary |
| Oxygen, compressed (cylinders) – Class 2.2 (5.1) | eight cubic metres |
| Bitumen – Class 3 PGIII (drums) | 500 L |
| Paint and paint related materials – Class 3 PGII and III flammable liquid | 500 L |
| Hydrated lime – non DG (Drums) | 500 kg |
| Herbicides – Class 6.1 PG II | <100 L |

** Note: the quantities indicated in the table represent the maximum amount that may be stored at individual sites. Individual sites are sufficiently separated such that each site can be considered as a separate facility for assessment purposes.*

It is anticipated that the storage and handling of dangerous goods (as listed in Table 118) would primarily occur within the main construction compound sites. Minor storage items would be located at other construction compound sites. Dangerous goods stored at other construction compound sites would comply with the minor storage provisions listed in the applicable Australian Standard for each specific dangerous good.

Hazard and risk associated with the storage and handling of dangerous goods has been assessed in Section 10.9.2.

#### Construction activities

The construction of the proposed M2 Upgrade project would require a number of potentially hazardous activities to be undertaken including, but not limited to, lifting of components and equipment using cranes, working at heights, working over carriageways on bridges, excavation activities and tunnel expansion.

As it is likely that these activities would be undertaken at a number of locations along the length of the M2 Motorway that is being upgraded, the hazards and risks associated with these activities were assessed based on the particular activity, rather that the location at which the activity may occur.

### 10.9.2 Hazard and risk assessment

A detailed hazard assessment was conducted using the hazard word diagram approach recommended in HIPAP No.6. The analysis assessed both dangerous goods and construction activities. The outcome of the assessment is summarised below.

#### Dangerous goods

The assessment considered potential hazard and risk resulting from bulk storage of dangerous goods at the main project compound and minor storage of dangerous goods at other construction compounds. The majority of potential hazards were determined to be of low risk with no off-site impact expected in the event of an incident.

The following incidents were identified as having the potential to impact off-site:

- Bulk fuel deliveries (diesel) – transfer of diesel fuel from road tanker to bulk tanks, fuel spill, ignition and fire.
- Dangerous goods deliveries – incident involving transport vehicle during minor deliveries to site, spill of dangerous goods and impact to the environment.
- Bulk fuel deliveries (diesel) – incident involving delivery truck and spill of fuel to the environment.
- Bulk fuel deliveries (diesel) – incident involving delivery truck and spill of fuel, ignition and fire.

A risk assessment was conducted for each of these potential incidents. The outcomes of the risk assessment are presented below.

##### Bulk fuel deliveries – fuel transfer incident

Diesel fuel would be stored and handled at the main project compound in three tanks, each of 25,000 litre capacity. The tanks would be double walled with a vapour space between the two walls of the tank. The vapour space would be fitted with leak detection such that an alarm would indicate when liquid is present within the annular space between the inner and outer walls. Hence, it would not be necessary to bund the tanks as the proposed design meets the requirements of AS1940.

In addition to the storage of diesel fuel it would be necessary to transfer the fuel from delivery road tankers to storage tanks and to fuel vehicles using a bowser type fuelling pump. In the event of fuel transfer, hose failure or premature coupling release, there is a potential for fuel to spill to the ground and escape offsite into the adjacent areas. Failure of the bowser hose is unlikely to occur, as filling nozzles are fitted with a number of safety features which include fuel shut off if the nozzle is dropped or turned upside down, and overpressure shut off if the vehicle tank is full.

Although the likelihood of an incident occurring is low, in the event that an incident did occur, it is likely that it would involve failure of a fuel tanker transfer hose. This would result in the spillage of diesel fuel and the formation of a pool at the spill point. In the unlikely event of ignition (noting that the flash point of diesel is well above ambient temperature), a pool fire would form. This may radiate heat to the surrounding areas causing damage and injury if sensitive land uses are close by.

By implementing the mitigation measures described in Section 10.9.3, fire impacts as a result of a fuel transfer incident would not exceed the acceptable risk criteria (DoP, 1992). In any event the site would be characterised as a low risk because the fuel transfer facilities would be located at least 18 metres from the site boundary fence, which is considered to be a sufficient distance to prevent heat radiation from impacting off-site.

### Dangerous goods transport – truck incident (minor storage quantities)

Two forms of dangerous goods transport would be required to deliver goods to the site; package deliveries and bulk deliveries. Minor quantities of dangerous goods would be supplied in packages on smaller vehicles (for example, utilities, flat bed trucks, and the like), bulk deliveries of fuel would be supplied in 20,000 litre road tankers.

Potential for truck accidents, where smaller quantities of dangerous goods (packaged goods such as herbicides) are involved, would result in a localised impact and be low risk. Herbicides used at the sites for weed control are packaging group II materials, however, the quantities of these materials used are very small (less than100 litres) and the risk is therefore low.

The number of vehicles delivering minor quantities of dangerous goods to site would be low and the project construction period is limited. It is anticipated that the number of vehicles delivering minor quantities of dangerous goods to site would not exceed one per week on average. The increase in risk on the roads around the site would be negligible, based on the existing traffic delivering minor quantities of dangerous goods to industry in the areas adjacent to the M2 Motorway.

### Dangerous goods transport – truck incident (bulk deliveries)

Bulk deliveries of diesel fuel would be transported to site as part of the requirements for site operations. It is noted that diesel fuel is not subject to SEPP 33 requirements and, therefore, may be eliminated from this assessment. However, for completeness, diesel transport has nevertheless been included in this assessment.

Diesel fuel would be transported to the main project site by 20,000 litre bulk tankers. The tankers would travel from the fuel supply depots in Sydney to the project site using local highways and roads. Fuel would not be transported on the M2 Motorway. The number of vehicles proposed for use in the project would only require diesel deliveries to the main project site around one to two times per week, which is a negligible increase in vehicle transportation.

In the event of an incident involving a road tanker, there is a potential for a spill of fuel leading to fire and heat radiation impact to the areas surrounding the spill. The quantity of fuel transported (20,000 litres) is considerable in volume and release of the full contents of the tanker would result in an extremely large pool surrounding the tanker. However, it is noted that fuel tankers are designed and constructed with compartments to minimise the total quantity of fuel that may be released in the event of an incident. The probability of the diesel igniting is also very low.

A review of the types and quantities of dangerous goods proposed to be stored at the site indicates that:

- The threshold levels published in SEPP 33 are unlikely to be exceeded.
- The types of dangerous goods are classified in the low risk category by the *Australian Dangerous Goods Code* (ADG, Ref.4).
- There is a low likelihood of incidents during construction.

Hence, the potential for impact to areas adjacent to the project area or to vehicles on the M2 Motorway, as a result of dangerous goods, is low. Standard mitigation measures would be implemented to reduce the risk of an incident. Specific mitigation measures are proposed where an incident has the potential to impact off-site. Mitigation measures are outlined in Section 10.9.4.

### Construction activities

The proposed upgrade would require a number of potentially hazardous activities to be undertaken during construction. Although, the undertaking of these activities may result in potential incidents that may result in impact to people, facilities and adjacent public uses, the application of known risk reduction measures for road construction would minimise potential impacts. It is noted that during the original M2 Motorway construction, and during previous upgrades, there have been no major incidents recorded whereby impact to people and facilities occurred.

A risk assessment was conducted in relation to potentially hazardous construction activities. The results of the risk assessment are presented below.

The risk associated with accidents or incidents involving major construction activities are considered low and include:

- Crane operations have a potential risk to onsite personnel should there be an incident which involved a load falling from height.
- Working on bridges creates a potential hazard to construction personnel working at heights and to the general public in the event that objects fall from the bridge onto the carriageway and vehicles travelling along the M2 Motorway.
- A reduction in the lane width and changes to traffic management has the potential to cause collisions and impact on travellers of the M2 Motorway and construction personnel.
- Tunnel excavation has the potential to cause a hazard to travellers of the M2 Motorway during the use of the road header.

Standard mitigation measures and practices would be implemented to manage hazard and risk associated with construction activities. These measures are outlined in Section 10.9.4.

## 10.9.3 Mitigation measures

A number of mitigation measures have been considered to reduce the potential for risk and hazards to occur during the construction of the project. A summary of the key mitigation measures are addressed in this section.

### Dangerous goods – general

Standard mitigation measures would be implemented to minimise general risks associated with the storage and handling of dangerous goods. These include:

- Dangerous goods risk assessments would be conducted for each storage area.
- Each storage area would be bunded to contain spills and isolated to contain fire to a localised area.
- Spill clean-up kits, including personal protective equipment, would be available at storage areas.
- Spill response personnel would be included in the incident response team.
- Regular inspections and audits of storage areas would be undertaken.
- Fire extinguishers would be available at storage areas and personnel would be trained in the use of this equipment.
- Storage would be designed to comply with the requirements of AS1940-2004 where relevant.

### Dangerous goods – specific

Specific mitigation measures that would be implemented to manage and mitigate hazard and risk associated with dangerous goods related incidents that have the potential to impact off-site include diesel fuel and dangerous goods transport.

#### Diesel fuel

To prevent the spread of diesel fuel beyond the immediate spill area, the transfer point would be constructed with a concrete pad which includes a 'speed-hump' type bund to retain spill incidents. Hence, spills would be retained in the immediate area and would not escape offsite.

It is also proposed that the diesel fuel tank refuelling point and spill retention pad be no closer to the boundary of the main project compound than 18 metres. In addition, to assist with emergency response, in the event of a leak and fire incident, it is proposed that two fire extinguishers be installed close to the fuel transfer and fuelling area. One extinguisher would be of the dry powder type and one foam.

#### Dangerous goods transport

The analysis conducted in this study identified that:

- Each vehicle transporting the dangerous goods to site would contain the appropriate emergency response provisions (required under the *Australian Dangerous Goods Code*).
- Quantities of dangerous goods transported for minor stores would be low (both in total volume and package size).
- Drivers would be trained in emergency incident response.
- The number of vehicles delivering to site would be approximately one per week.

Based on this analysis the risks to roads around the project, from incidents involving the transport of minor quantities of dangerous goods, are considered low and there would be a negligible increase in the existing risk profile for the roads in the area adjacent to the project sites.

To reduce the potential for truck incidents, the works would maintain a limited number of deliveries and the project would only use registered fuel delivery companies for the supply of diesel fuel to the project. All companies would be required to demonstrate that they have the appropriate safety management systems in place, including compliance with the *Australian Dangerous Good Code*. This includes vehicle placarding, appropriate emergency procedure guides in the emergency information holder in the vehicle, driver training and emergency drills.

Based on the analysis conducted in this study, the risks to roads around the project, from incidents involving the transport of bulk diesel fuel, is considered low and there would be a negligible increase in the existing risk profile for the roads in the area adjacent to the main project site.

### Construction hazards

The hazards and risks associated with accidents or incidents involving major construction activities are considered to be manageable through the implementation of standard mitigation measures and practices, including:

- Lift areas, excavations and areas under bridgeworks would be barricaded off to prevent access to hazardous areas.
- Equipment would be inspected in accordance with regulatory requirements.
- Loads would not be lifted over operating carriageways.
- Personnel would be required to wear personal protective equipment. This would include the use of harnesses when operating at height.
- Job safety analysis, safe work method statements and safety management plans would be developed and implemented.
- Traffic management measures would be undertaken to separate construction zones from operating carriageways and to control speed limits in the vicinity of the construction site.
- Relevant on-site personnel would be required to undertake an induction providing awareness of the key hazards associated with construction activities.

Based on the analysis and with implementation of the mitigation measures identified in this section, the potential hazards and risk that would be generated as a result of construction of the project are considered to be low and manageable.

## 10.10 Climate change

An *M2 Upgrade project Greenhouse Gas Inventory (Construction and Operation)* report was prepared by AECOM Pty Ltd, dated February 2010 and a summary is presented below.

### 10.10.1 Assessment framework

Rising concern of the likely impending climate change impacts in Australia has resulted in numerous national and state policy commitments addressing both mitigation and adaptation initiatives. This is reflected in the introduction of the *National Greenhouse and Energy Reporting Act 2007* (NGERS), the Carbon Pollution Reduction Scheme Bill and the potential introduction of a National Emissions Trading Scheme (NETS). During the environmental approvals process for infrastructure projects, the DoP increasingly requires that emissions are estimated to determine the impact of the project on the environment and provide some indication of whether the project would reduce long term operational emissions. During the approvals process it is prudent to consider climate change adaptation and mitigation to:

- Understand the impact that the project may have on climate change through the greenhouse gas (GHG) emissions associated with construction and operation.
- Understand the impact that projected climate changes may have on the project and how the project may respond to these changes through adaptation.
- Respond to community concerns about climate change and the environment.
- Ease the approvals process by providing transparent information about short-term increases and long-term potential decreases in GHG emissions that the project can deliver.

GHG emissions would be generated during the construction and operation of the project. A GHG emissions assessment was undertaken to estimate emissions associated with the construction and operation of the M2 Upgrade project (AECOM). Emissions associated with the following scenarios were assessed:

- Base case option – the project does not proceed.
- M2 Upgrade project option – the project is constructed.

Similarly, climatic changes would affect the M2 Upgrade project and associated infrastructure during its design life. A high level desktop assessment of projected climate changes and potential impacts to the upgrade is presented, based on the latest available information from the Intergovernmental Panel on Climate Change (IPCC, 2007), from the *Climate Change in Australia: Technical Report* (CSIRO and BOM, 2007), and resources such as the *Infrastructure and Climate Change Risk Assessment for Victoria* (Holper, P. et al., 2007).

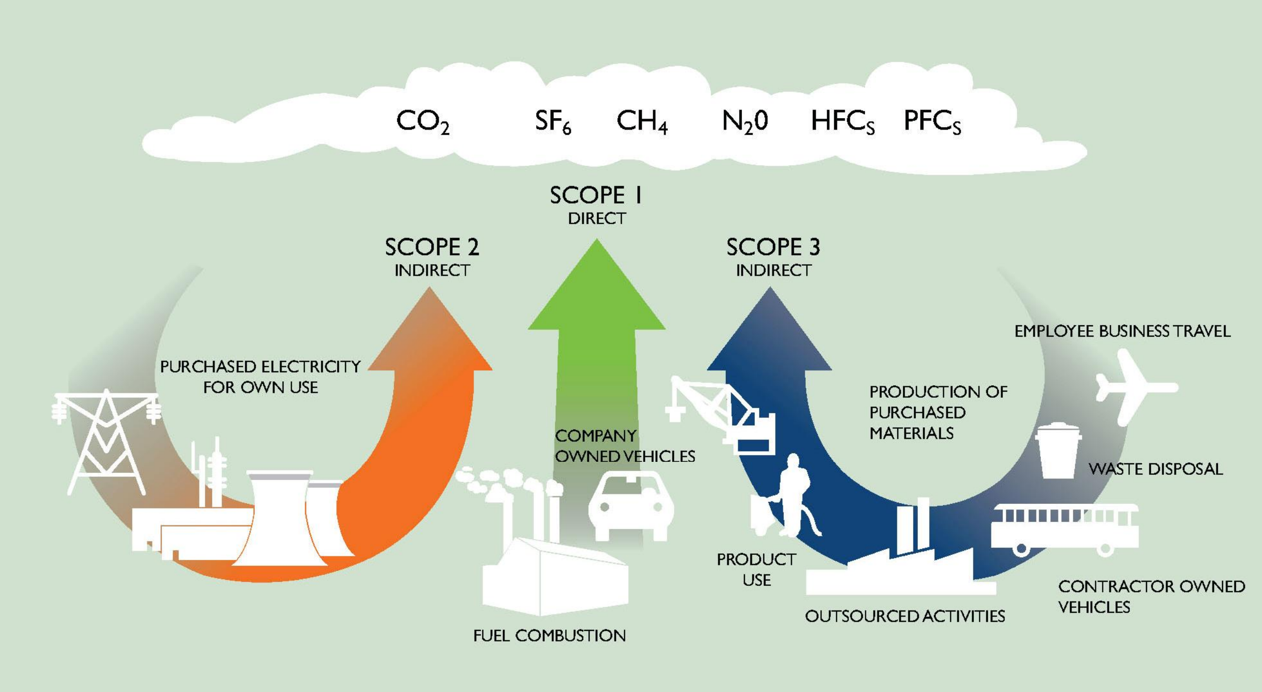
Climate change refers to both changed average conditions, such as temperature increases, and extreme events, such as increased frequency and intensity of storms. This assessment identifies new infrastructure items that would be affected in the future and recommends adaptation measures that would reduce asset damage.

### 10.10.2 Existing environment

Reducing GHG emissions is a key public concern and transport is a major contributor to GHG emissions in Australia. In 2006, Australia's net greenhouse gas emissions using the Kyoto accounting provisions were 576 million tonnes of $CO_2$-equivalent (Mt $CO_2$-e) (DCC, 2008). A relatively high level of car ownership in Australia has meant that transport contributes around 14 percent of Australia's emissions and is the second fastest growing source of emissions (Future Fuels Forum, 2008).. Of this, road travel contributes 89 percent of total transport GHG emissions.

The Intergovernmental Panel on Climate Change (IPCC) and Australian Government GHG accounting/classification systems categorises GHG emissions into three different scopes. In the context of this project, Scope 1 emissions are direct emissions generated by the project, Scope 2 emissions are indirect emissions generated outside of the project's boundaries to provide energy to the project and Scope 3 emissions are indirect, upstream emissions associated with the use of resources and the emissions generated by vehicles travelling on the road. These scopes are illustrated in Figure 42.

Figure 42 GHG emission scopes




*Source: WBCSD and WRI, 2004*

In the context of this project, the 'existing environment' for GHG emissions is the same as the 'do nothing' option where the project does not go ahead. This option constitutes the base case for emissions assessment and comparison. There would be no construction emissions under the base case 'do nothing' option. GHG emissions associated with the operation of the M2 Motorway without upgrade were calculated as part of the GHG assessment (AECOM, 2009). Emissions from the Greater Sydney network were estimated to be 13,878,664 tonnes $CO_2$-e per year (based on Sydney wide vehicle kilometres travelled). This figure is used to compare whether the project would result in emission savings.

## Climate change

Australia and NSW have already experienced a range of observable climate changes and these changes are projected to continue. Under a ‘do nothing’ option, the M2 Motorway would be affected by future climate changes. This would require an increase in maintenance to respond to changed average conditions and may include emergency repairs in extreme events. The impacts discussed below would be the same for the ‘do nothing’ and the M2 Upgrade project options. Under the M2 Upgrade project, the proponent would have the opportunity to design and manage infrastructure so that it can withstand projected future conditions and reduce ongoing costs for more frequent maintenance or emergency repairs.

### 10.10.3 Impact assessment

## Construction GHG emissions

Total predicted emissions associated with the construction phase of the project are approximately 113,000 tonnes $CO_2$-e. A summary of the factors that were considered in this calculation and the relative contributions of various sources to the total amount are described in Table 119 along with the GHG emissions generated from the construction of the project under each of the emission scopes.

Table 119 Construction to GHG emission sources

| Scope | Description | Emissions (t $CO_2$-e) | Percentage of total emissions* (percent) | |
|---|---|---|---|---|
| Scope 1 – Direct Emissions | The onsite use of fuel by construction plant/equipment. The vegetation permanently cleared. | ~19,400 | 17 | |
| Scope 2 – Indirect Emissions | The onsite use of electricity purchased from the grid. | 53 | <1 | |
| Scope 3 – Upstream Indirect Emissions | The embodied energy of construction materials. | ~93,500 | 83 | 89 |
| | The use of fuel for the transportation of construction/waste materials to/from the site. | | | 9 |
| | The indirect emissions associated with the generation of electricity purchased. | | | 0.01 |
| | The indirect emissions from the extraction, production and transport of fuels used by construction plant/equipment. | | | 2 |
| Total | | ~113,000 | 100 | |

** Note to table: Scope 3 emissions split to show percentage emissions for each sub type.*

Table 119 demonstrates that Scope 3 emissions constitute the majority of emissions associated with the construction of the project and of these the majority represents embodied energy in construction materials. Of the embodied energy contained in construction materials, the use of concrete and steel materials contributes to approximately 68 percent of the total construction GHG emissions.

### Operational GHG emissions

It is estimated that the project would result in emission savings of approximately 46,000 tonnes $CO_2$-e per year compared to the base (do nothing) option for the first few years of operation. At this rate, by 2013, the estimated savings in operation emissions would be greater than the estimated emissions generated during construction. Over a thirty year period, total operational emission savings of around 1.75 Mt $CO_2$-e are estimated. A discussion of these results is provided below.

For operation emissions, two scenarios were considered:

- Base (do nothing) option – the project does not proceed.
- M2 Upgrade project option – the project is constructed.

The difference between estimated emissions under these two options would be the GHG emissions/reductions associated with the operation of the project.

Whilst the overall vehicle kilometres travelled in Sydney are not expected to change significantly as a result of the project, there are expected to be reduced travel times as peak period congestion is eased. By reducing congestion and stop-start driving on the M2 Motorway fuel consumption is expected to be reduced. New ramps under the M2 Motorway allow for more direct routes to be taken, reducing trip distances and associated GHG emissions. Sources of GHG emissions associated with the operational phase of the project are shown in Table 120.

Table 120 Operational GHG emission sources

| Scope 1 – Direct Emissions | Scope 2 – Indirect Emissions | Scope 3 – Upstream Indirect Emissions |
|---|---|---|
| Fuel consumption by the M2 Motorway operator maintenance vehicles and equipment. | The onsite use of electricity purchased from the grid:<br>• Lighting.<br>• Traffic signals.<br>• Communications.<br>• Toll equipment.<br>• Speed cameras. | • Full fuel cycle consumption by road users driving on the Sydney network (private vehicles).<br>• Fuel consumption by maintenance vehicles and equipment other than those of the M2 Motorway operator.<br>• Extraction, production and transport of fuel used by maintenance vehicles and equipment.<br>• The indirect emissions associated with the generation of electricity purchased.<br>• Embodied energy of materials used in repairs and maintenance works. |

*Source: AECOM, 2009*

Table 121 shows the estimated savings of emissions generated by vehicle travel across the Sydney network resulting from the project, calculated from a comparison of the Base and M2 Upgrade project options in 2013. The results indicate that upgrading the M2 Motorway is expected to generate emissions savings of approximately 46,000 tonnes $CO_2$-e per year for the first few years of operation. Operational emission savings would balance out the construction emissions within the first few years of operation.

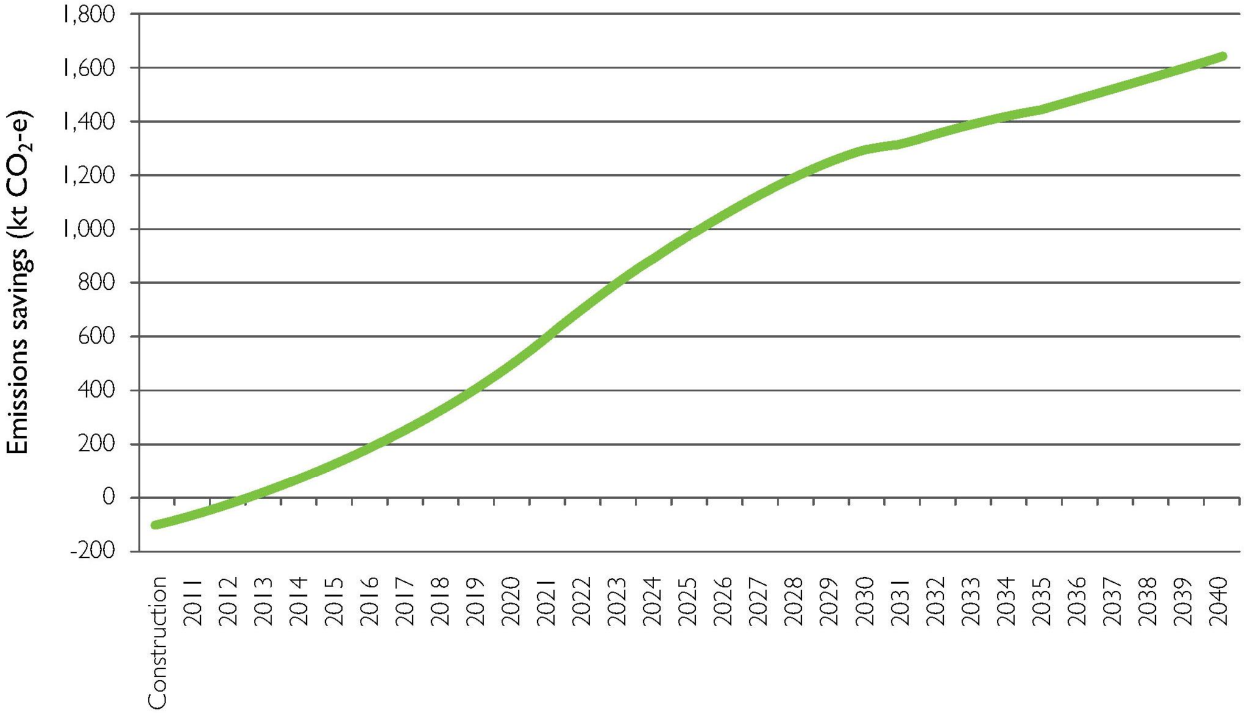
Table 121 Operational GHG emissions for each GHG scope in 2013

| GHG Scope | Savings Emissions (t CO2-e) |
| --- | --- |
| 1(direct emissions) | -2 |
| 2 (indirect emissions) | -541 |
| 3 (upstream indirect emissions) | 46,181 |
| Total | ~45,600 |

*Source: AECOM based on data provided by Hills M2, 2009*

Cumulative GHG emissions and savings are shown in Figure 43 including construction emissions. The annual operational GHG savings are expected to decrease over time as vehicles become more fuel efficient and the M2 Motorway becomes congested and conditions become more like the current situation once again. Over a thirty year period, estimated cumulative operation emission savings total approximately 1.75 mega tonnes $CO_2$-e.

Figure 43 Cumulative GHG emissions savings including construction




*Source: AECOM based on data provided by Hills M2, 2009*

The majority of GHG emissions in the Sydney region are generated by private vehicles using the Sydney road network. Emissions from the combustion of fuels make up the bulk of Scope 3 emissions, whilst the emissions associated with electricity use and the embodied energy of materials/fuel used are relatively small in comparison.

Under the project the GHG emissions associated with the operation are reduced by approximately 1.75 mega tonnes $CO_2$-e over a thirty year period. This is primarily due to reduced peak period congestion and stop-start driving on the M2 Motorway, which reduces fuel consumption. This outweighs GHG emissions associated with electricity consumption (for additional lighting, tolls, traffic signals) and increased maintenance (fuel for vehicles and equipment and embodied energy in construction material).

### Climate change projections

The project would have a 100+ year design life. The precise effects of climate change are unknown. However, research indicates a demonstrated change in Australia's climate and there is evidence that this change would continue despite carbon mitigation measures that may be adopted. The project would include road upgrade, tunnel widening, bridge widening and new access ramps. These items would be affected by projected changes in climatic conditions.

Climate projections prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BOM) in 2007 (CSIRO and BOM, 2007) suggest that the future climate of eastern Australia would generally be characterised by:

- Higher average temperatures.
- More frequent occurrence of extreme temperatures (days over 35°C).
- Lower average rainfall.
- More intense extreme rainfall events.
- Higher evapotranspiration.
- Higher sea level and storm surge events.
- More frequent extreme fire danger days.

Projected climate changes from CSIRO and BOM are summarised in Table 122.

Table 122 Climate change projections

| Variable | 2007 | 2030 | 2070 | Trend |
|---|---|---|---|---|
| Average annual mean temperature | - | Increase of annual mean temperature 1°C | Increase in annual mean temperatures of between 1.8°C and 3.5°C | Warmer average temperatures |
| Number of extremely hot days (over 35°C) | 3.5 days per year | 4.4 days per year | 8.2 days per year | More extremely hot days |
| Rainfall – annual average | - | Decrease between two to five percent | Decrease between five and ten percent | Decreased precipitation |
| Evapotranspiration – annual average | - | Increase 2 percent | Increase between sixand ten percent | Increased evapotranspiration |
| Bushfire annual return period | 5.5 years | 3.3 years | 1.0 years | More frequent bushfires |

Small changes in annual and seasonal temperature and rainfall conditions can be associated with large changes in extreme weather events, such as heatwaves, storms, stronger winds, increased lightning and higher intensity rainfall, which are potentially of greater significance to infrastructure design, construction and operation than changes in average conditions. Changes in extreme weather events that are projected for eastern Australia include:

- An increase in the frequency of hot days and warm nights, and a decrease in the frequency of cold nights.
- An increase in both daily precipitation intensity (rain per rain-day) and the number of dry days, leading to longer dry spells interrupted by heavier rainfall events.
- El Niño events becoming drier and La Niña events becoming wetter (CSIRO and BOM, 2007).

Consistent with scientific literature on climate change risks, it can be expected that there would be changes in the flood, bushfire, and storm risk associated with the above changes in average climate conditions and extreme weather events.

### Impacts to infrastructure

The *Infrastructure and Climate Change Risk Assessment for Victoria* (Holper, P. *et al.*, 2007), (CCRA) provides some insight into potential impacts from climate change. Given the global proximity and similarity in infrastructure design and construction techniques, the findings from this report are considered comparable to events that would occur in NSW as a result of projected climatic changes. Findings from the Report are shown in Table 123 below. The table indicates the level of risk for each infrastructure type for the 2030 and 2070 time horizons under low and high emission scenarios.

Risks to road, tunnel and bridge infrastructure associated with climate change in the 2030 and 2070 time horizons are generally moderate to high. Moderate risk issues would require change to design standards and increased ongoing maintenance of assets. High risk issues would require detailed research and planning at senior management level.

The CCRA found that road infrastructure would generally suffer moderate risk from climate change within the 2030 and 2070 time horizons under both low and high emissions scenarios. Under a high emissions scenario, road foundations would be at high risk of degradation by 2070. Roads would likely suffer asphalt degradation, road foundation degradation and flood damage. Bridges and tunnels would generally suffer moderate to high risks from climate changes within the 2030 time horizon and high risks within the 2070 horizon. Bridge structures would be at high risk under a high global emission scenario by 2030.

In general, impacts to road infrastructure are related to accelerated degradation of materials or one-off damages from extreme events including damages to infrastructure and property. These impacts lead to increase maintenance or repair costs. In catastrophic situations such as infrastructure failure related to extreme events, impacts may include major road accidents or loss of life. Given the above risk profile, these catastrophic events are considered unlikely in the timeframe considered (to 2070).

- Higher winds, increased intensity of storm events and extreme temperature events would cause damage to infrastructure, resulting in increased maintenance costs.
- Increased rainfall, which may exceed the capacity of the existing stormwater system and affect areas near existing waterways, would lead to flooding and associated damage to infrastructure and property.
- Extreme events may reduce road safety conditions and lead to higher likelihood of vehicle accidents.

Table 123 Transport infrastructure risk summary

| Transport | Risk Scenario | Climate Variable | Rating | | | |
|---|---|---|---|---|---|---|
| | | | 2030 | | 2070 | |
| | | | Low | High | Low | High |
| Roads | Asphalt degradation | Increased solar radiation.<br>Increased temperature and heatwaves. | Moderate | Moderate | Moderate | Moderate |
| | Road foundations degradation | Increased variation in Wet/dry spells.<br>Decrease in Available moisture. | Moderate | Moderate | Moderate | High |
| | Flood damage to roads | Increase in extreme daily rainfall.<br>Increase in frequency and intensity of storms. | Moderate | Moderate | Moderate | Moderate |
| Bridges | Bridge structural material degradation | Increased Temperature and Heatwaves.<br>Increased Solar Radiation. | Moderate | High | High | High |
| | Storm damage to bridges | Increase in extreme daily rainfall.<br>Increase in frequency and intensity of storms.<br>Increase in intensity of extreme wind. | Moderate | Moderate | High | High |
| Tunnels | Tunnel flooding | Increase in Extreme Daily Rainfall.<br>Increase in frequency and intensity of storms. | Moderate | Moderate | High | High |

*Souorce: Holper. P, et al, 2007*

### 10.10.4 Mitigation measures

## Construction

### Procurement

To reduce the environmental impact of the project, a sustainable procurement policy would be implemented during the construction and operational stages of the project. The M2 Motorway operator has developed a sustainable procurement policy and this may be reviewed and where applicable applied/tailored to the project to guide the procurement of materials for the construction and operation of the project.

A sustainable procurement policy would be developed for the project that considers the following factors during the purchasing decision making process:

- Whole life cycle of a product (maintainability, recyclable components).
- Environmental impacts.
- Social impacts (for example, OH&S of workers, labour conditions).
- Value for money.

Where appropriate and feasible, options that would be considered to reduce the GHG emissions associated with the upgrade during procurement include:

- Plan construction works to avoid double handling of materials where possible.
- Preferential use of locally sourced goods and services.
- Consider fuel efficiency when selecting construction plant and equipment and procure fuel efficient plant and equipment where feasible.
- Ensure construction equipment used is maintained to reduce energy efficiency losses associated with damaged or poorly maintained equipment.
- Assess the emissions intensity of the construction materials specified in the design of the project.
- Where practical, preferentially use/specify materials with lower GHG emissions factors.
- Use recycled aggregates in road pavement and surfacing (including crushed concrete, granulated blast furnace slag, glass, slate waste and fly ash).
- Consider purchasing Green Power.

#### Materials selection

A number of decisions can impact on the materials used for the upgrade. As 68 percent of the estimated construction GHG emissions are related to the use of concrete and steel, these materials in particular would be carefully selected. Consideration is needed for the availability of resources, use of finite resources, related waste reuse/recycling opportunities and landfilling and associated material embodied energy. Materials selection would focus on the availability of local and recyclable materials in order to minimise the energy requirements over the life cycle of these materials.

#### Recycling aggregates

Where possible, concrete waste and milled asphalt would be processed for incorporation back into the pavement construction (expected to be approximately 30,000 tonnes of material).

Recycled aggregates used in asphalt pavements can include crushed concrete, milled asphalt, granulated blast furnace slag, glass and fly ash.

#### Energy management

Energy management in construction has the objective of finding and implementing methods to reduce the total energy consumption in construction and operation. Energy efficiency measures that would be investigated include:

- Achieving a cut and fill balance, which would avoid significant energy consumption both directly in the form of haulage and indirectly in the form of embodied energy.
- Priority would be given to low embodied energy materials or recycled materials sourced from the construction site.
- Management of the energy consumption by design and construction teams. Specifically energy used to power operations including site offices' power and vehicle fleets' fuel.

### Operation

Whilst it is estimated that the project would reduce GHG emissions by reducing congestion and fuel usage, there are still large volumes of GHG emissions generated from vehicles using the M2 Motorway. Reducing overall operational emissions would depend largely on improved vehicle fuel efficiency standards, which are implemented through increasingly stringent government regulation. The project includes measures to encourage the reduction of GHG emissions, such as transit lanes, which encourage higher occupancy in vehicles and the use of public transport.

Electricity emissions may be reduced through:

- Implementation of equipment with improved energy efficiency, for example, ensuring installation of the energy efficient lighting.
- Management of electricity consumption at tolling stations, such as reducing the number of lanes during off-peak periods.

#### Potential climate change adaptation responses

As road infrastructure can have a design and effective operational life of up to 100 years, planning, design, construction and maintenance would consider climate change adaptation measures to reduce the risks associated with impacts from projected climatic changes. Proactive consideration of adaptation strategies can decrease the risk of asset damage which would represent an economic and social cost. Specific climate change impacts and consequent design, construction and operation adaptation strategies would be considered during detailed design. Generally, adaptation strategies can be expected to fall into one of six categories:

- Suitable material selection.
- Design standards.
- Maintenance regimes.
- Technologies.
- Planning.
- Cultural change.

#### Mitigation and management

Measures to mitigate the impact of the project on climate change are discussed in Section 10.10.3 along with the GHG assessment. The following mitigation measures relate to adaptation of the project to mitigate and manage the effects of climate change on the project.

- Design standards would be reviewed in light of projected changes over the design life of the road upgrade. In particular, standards related to flooding and drainage, material selection and foundation materials would be reviewed and more stringent standards considered. This would reduce degradation and the cost of maintenance requirements and emergency repairs.
- It would be beneficial to hold a workshop with the design team prior to detailed design to identify areas where materials, design standards, maintenance and new technologies would be considered to improve the adaptability of the new infrastructure for changed climatic regimes over the projects design life.
- A value for money assessment would be undertaken on the project to determine whether each adaptation measure is worthwhile implementing at the design stage or whether it would be more beneficial to undertake ad-hoc repairs.

## 10.11 Cumulative impacts

### 10.11.1 Approach to assessment

Cumulative impacts occur when the potential impacts associated with an upgrade interact with other developments and activities to create combined effects.

A cumulative impact assessment has been undertaken to determine the combined effect of the project with other proposed activities within the region. It is difficult to assess the integrated impacts of different projects and the synergies through their construction phases in the context of this environmental assessment as the timing for construction of the relevant projects is unknown at this stage. Therefore, a higher level assessment has been performed which looks at impacts from a strategic perspective rather than on a project-by-project basis.

In order to assess the cumulative impacts associated with the project it is important to understand:

- The impact of the project.
- The other proposals in the region that may interact with the project.
- The spatial and temporal scale and limits of the assessment.

The potential impacts of the project are identified and assessed in detail in Chapters 9 and 10 and in the various Technical Papers (Volume 2). There are a range of other proposals in the region that have the potential to interact with the project. These proposals are listed in Section 10.11.2.

Given the extent of the project, only proposals that are located within the suburbs that lie adjacent to the M2 Motorway have been included in this assessment. Proposals outside these suburbs have only been considered if they are major developments within a broader regional context.

The proposals assessed were generally large-scale developments. Smaller proposals were considered if they lay directly adjacent to the M2 corridor. Proposals were considered if they were likely to be constructed at some point during the construction phase of the project or if the operational phase of the project would interact with the strategic aim of a proposal.

### 10.11.2 Other proposals and activities

Known proposals located in the vicinity of the M2 Motorway are listed in Table 124. These projects are in different stages of development and form the basis of the cumulative impact assessment.

Table 124 Proposals in the vicinity of the project

| Proposal | Location | Brief description |
|---|---|---|
| North West Growth Centre | North western suburbs from Marsden Park to Kellyville | Water related services:<br>• Drinking water distribution.<br>• Wastewater pipelines.<br>• Water Treatment Plant. |
| 63-77 West Parade, West Ryde – Concept Application | West Ryde | • Residential development.<br>• Commercial and retail areas.<br>• Parking.<br>• Services. |
| Northern Sydney Freight Line project (reference: *Metropolitan Transport Plan*) | Beecroft Road (rail overbridge) | Key features include:<br>• Potential for widening of existing rail overbridge as part of Northern Sydney Freight Line project.<br>• Timing of construction is unknown, unlikely to be within construction timeframe of M2 Upgrade project. |
| West Ryde Station | West Ryde | Key features include:<br>• Demolition of existing structures.<br>• Construction of four new residential buildings.<br>• Car parking.<br>• Landscape works. |
| Macquarie University – Concept Plan | Macquarie Park | Approval over a 25 year period for:<br>• 400,000 square metre commercial space.<br>• 61,200 square metre academic space.<br>• 3,450 beds within the University Housing Precinct.<br>• Upgrades to infrastructure and road network.<br>• Landscaping.<br>• Pedestrian and cycle network.<br>• Additional car parking. |
| Macquarie University Private Hospital | Macquarie Park | Key features include:<br>• Demolition of existing building on site.<br>• Construction of new five storey building.<br>• One storey underground car park.<br>• Retail shops.<br>• Loading dock area. |
| Macquarie University – Cochlear global | Macquarie Park | Development of purpose-built Cochlear Global Headquarter including:<br>• A six or seven storey building.<br>• Car parking.<br>• Landscaping and associated amenities.<br>• Rehabilitation of University Creek corridor within site. |
| Macquarie University – Library | Macquarie Park | Development of a new five storey library building. This project should be completed in Feb 2010 but has been included in case the project ran over time. |

| Proposal | Location | Brief description |
|---|---|---|
| Eastwood Shopping Centre – Mixed Use Development | Eastwood | Key features include:<br>• Demolition of existing structures.<br>• One commercial development of two storeys.<br>• Four residential developments of four to eight storeys.<br>• A childcare centre. |
| 112-128 Talavera Road | Macquarie Park | A six to nine storey development. |

### 10.11.3 Cumulative impact assessment

The proposed developments in the vicinity of the project can generally be characterised as commercial and residential developments with the majority being centred around Macquarie Park. There are no other known major road or transport developments proposed in the vicinity of the project.

The cumulative impacts of the project and other proposals within the region have been estimated, however, they remain relatively undefined given the uncertainty with regards to the timing of construction of the surrounding proposals. Therefore, further impact assessment would be required at such time that construction timeframes have been determined.

For the purpose of this assessment, the following issues are important in determining the potential cumulative impacts associated with the project and other known proposed developments:

- Traffic and transport:
  - Impacts during construction.
  - Impacts for the greater region once operational.
- Construction noise and vibration.
- Other issues:
  - Socio-economic.
  - Greenhouse gas and climate change.
  - Air quality.
  - Construction lighting.

Key issues not included in this assessment (such as surface water management, Aboriginal heritage, operational noise and vibration, flora and fauna and urban design and landscape) are not considered to have potential for cumulative impacts, as mitigation measures included in this environmental assessment are considered sufficient to avoid impact from the project.

#### Traffic and transport

Section 9.2 describes the construction traffic and transport impacts associated with the project. During construction, traffic impacts would occur as a result of construction vehicles utilising local roads as well as traffic disruptions caused by construction activities and lane closures.

The main area of impact from construction traffic would be around Macquarie Park. The project requires the widening of Talavera Road and the bridge over Christie Road. These works would require utilisation of local roads around Macquarie Park by construction vehicles.

Once the project is operational, there would be improved traffic flow and travel times for motorists along the length of the M2 Motorway. This would improve accessibility between Sydney's north west and the Sydney CBD thereby improving access to new residential developments in Sydney's north west. It would also facilitate access to new commercial precincts at West Ryde, Eastwood and Macquarie University.

Operational traffic impacts and broader scale impacts, such as the affect of the project on the Sydney Orbital network have been addressed in the Chapter 2 and Section 9.1.

## Construction noise and vibration

Noise impacts to sensitive receivers during construction have been addressed in Section 9.4. While the impacts assessed in this section would be mitigated through measures discussed in Section 9.4.3, there is the potential for these impacts to be heightened if they coincide with noise impacts from other construction activities within the region.

Of particular interest in this instance would be the noise impact at Macquarie University. The University is an educational precinct and would be highly sensitive to noise impacts from construction activities. Students and staff at the University may be subject to noise impacts from construction of the project, Macquarie University Library and the Cochlear Global Headquarters.

It is also important to consider the noise impacts on proposed developments such as the Macquarie University Private Hospital. Consultation with the proponents of the proposed developments would be required to determine the construction staging of those proposals. In the event that the proposed developments are constructed and become operational during the M2 Upgrade project construction period, then these developments would become sensitive receivers and noise impacts would need to be addressed and mitigated at that time.

## Other impacts

### Socio-economic

Socio-economic impacts associated with the project have been discussed in Section 10.4.

Once the project is operational, decreased congestion and reduced travel times would increase accessibility of new and existing residential and commercial developments within the Sydney's north west. The new access ramps at Windsor Road would provide an integral link between these new large-scale residential development areas, the growing commercial precinct at Macquarie Park and the CBD. This would increase the accessibility of job opportunities for residents situated in the Sydney's north west.

The project would also improve the accessibility between the proposed commercial developments within Macquarie Park and West Ryde and the expanding residential areas in Sydney's north west. These proposed developments would be provided with an increased catchment area and greater accessibility to larger labour and trade markets.

### Climate change and greenhouse gas emissions

Greenhouse gas emissions produced during construction of the project have been documented in Section 10.11. Resource use during construction of adjoining proposals would increase emissions from local resource suppliers. Transport of materials and workers would have a greater combined impact compared to each individual project.

### Air quality

Dust emissions from the project have been discussed in Section 10.6. Cumulative impacts may be generated from dust emissions should the construction periods of the project and the proposed developments around Macquarie Park coincide. This impact would be of particular concern in the educational precinct of Macquarie University.

## 10.11.4 Mitigation measures

Liaison with relevant councils, project proponents and land holders would be required to determine the timing and location of developments that may coincide with the project. Specific mitigation measures would be determined at a later stage following this consultation. These may include:

- The preparation of TMPs, in consultation with local councils and project proponents, which address other proposed changes to traffic conditions that are likely to occur during construction.
- Coordination and management of construction traffic through the construction phase of the project. Measures to minimise construction traffic impacts would include:
  - Combined construction vehicle parking sites to minimise the loss of on-street parking and/or the size of construction sites.
  - Targeted communication with road users likely to be affected by multiple changes to traffic conditions (this would be done by radio broadcasts, signage, and the like).
  - Further consideration of measures to minimise congestion on local traffic routes, loss of parking spaces and changes to traffic conditions.
- Targeted consultation with sensitive receivers identified as noise-affected by the construction of the project and likely to be simultaneously affected by the construction of other projects.
- Discussions with proponents of nearby developments to identify measures to minimise cumulative noise impacts. Measures would include:
  - Undertaking particularly noisy activities at the same time (to minimise the duration of noise impacts) or at different times (to minimise the overall noise levels).
  - Consideration during the detailed design phase of measures to further reduce noise emissions from construction sites.
- Adjustment of construction staging to enable, where reasonable and feasible, construction not to occur in the same locations of other developments at the same time.
- Further consideration during the detailed design phase of measures to reduce noise impacts during construction of the project.
- Consideration by developers of the integration of mitigation measures for one project with another. For example, hoardings and noise barriers would be extended over time to minimise disruption and further reduce amenity or visual impacts.

# 11. Draft statement of commitments

This section outlines the draft Statement of Commitments proposed by the RTA to minimise, manage and mitigate impacts identified in the environmental assessment.

| Director-General's Requirements | Where addressed |
|---|---|
| *A draft Statement of Commitments incorporating or otherwise capturing measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the impact assessment sections of the environmental assessment. The Statement of Commitments must clearly articulate the desired environmental outcome of the commitment. The Statement of Commitments must be achievable, measurable (with respect to compliance), and time-specific, where relevant.* | *Chapter 11* |

## 11.1 Overview

From an early stage, the environmental assessment considered the project's potential environmental issues and identified the desired environmental outcomes. This influenced development of the concept design for the M2 Upgrade project and highlighted the management measures required to avoid or reduce the environmental impacts of the project. The draft Statement of Commitments specifies certain environmental outcomes to be achieved. Greater detail as to how those outcomes would be achieved is provided in the mitigation and management measures in Chapter 9 and 10. The draft Statement of Commitments is presented in a format that is readily auditable and transparent.

The draft Statement of Commitments may be revised in response to stakeholder and community input during the display of the environmental assessment. Following approval of the proposed upgrade, the revised commitments would guide subsequent phases of design development to minimise impacts on the environment. All future planning approvals, design, construction and/or operation phases of the proposed upgrade would be required to undertake all works in accordance with this Statement of Commitments.

## 11.2 Draft commitments

The draft Statement of Commitments is provided in Table 125. The draft Statement of Commitments includes:

- An outcome.
- Details of the commitment.
- Reference to the timing of when the commitment applies (pre-construction, construction and post construction).
- Reference to any guiding principle influencing the objective and implementation of the commitment.

Table 125 Draft Statement of Commitments

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| Environmental Management | | | | |
| Compliance and continuous improvement in environmental management. | EM1 | The head contractor for the project will have an Environmental Management System (EMS). | Pre-construction and construction | *ISO 14001:2004 Environmental Management Systems — requirements with guidance for use.*<br>*ISO 19011:2003 Guidelines for Quality and/or Environmental Management Systems Auditing.*<br>*RTA QA specification G36 — environmental protection.* |
| | EM2 | Environmental management plans will be developed and implemented by suitably qualified and experienced personnel and will incorporate as a minimum the mitigation and management measures adopted in the environmental assessment. | Pre-construction and construction | *Guideline for the Preparation of Environmental Management Plans* (DIPNR 2004)<br>*RTA QA specification G36 – environmental protection* |
| Provide a consistent method for managing environmental issues. | EM3 | Environmentally sensitive areas (such as native vegetation, cultural heritage and sensitive land uses) within or immediately adjacent to the construction site boundary will be marked on sensitive area maps as well as being demarcated and signposted where relevant. Maps will be made available during on-site briefings to applicable construction personnel. | Pre-construction and construction | |
| | EM4 | All construction personnel will receive training regarding environmental management during project induction. Additionally, targeted environmental task specific training will be provided to appropriate personnel. | Pre-construction and construction | |
| Community Engagement | | | | |
| Informed community. | CE1 | The community will be informed with measures such as:<br>• Letter box drops, media releases and community updates.<br>• An internet site established and maintained for the duration of the project.<br>• Road signs (electronic and static).<br>• Targeted consultation with affected individuals or groups.<br>• Information to be provided will include:<br>• Changes to access and traffic conditions.<br>• Details of future works programs.<br>• General construction progress. | Pre-construction and construction | *Community Involvement and Communications. Draft: A resource manual for staff* (RTA 2008h). |

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| | CE2 | An Enquiries and Complaints Management System to be implemented and maintained throughout construction, including:<br>• A 24 hour, 1800 telephone number.<br>• A system to receive, record, track and respond to enquiries or complaints within a specified timeframe.<br>• Acknowledgement of complaints within 24 hours and a process for responding to the complainant within 10 days.<br>• A mediation system for complaints not able to be resolved. | Pre-construction and construction | *Community Involvement and Communications. Draft: A resource manual for staff* (RTA 2008).<br>AS 4269 Complaints Handling. |
| Construction Traffic and Transport | | | | |
| Minimised traffic disruption on the M2 Motorway. | T1 | Impact on traffic flow during construction will be minimised by restricting lane occupancies to off peak periods. | Construction | AS 1742, Part 3 *Manual of uniform traffic control devices*.<br>Scope of Works and Technical Criteria (SWTC). |
| | T2 | Maintain a minimum of two traffic lanes available every weekday during peak periods (three lanes westbound from Lane Cove Road to Beecroft Road during PM peak period). | Construction | AS 1742, Part 3 *Manual of uniform traffic control devices*.<br>Scope of Works and Technical Criteria (SWTC). |
| Minimised traffic disruption on non Motorway roads. | T3 | Impact on non Motorway roads will be minimised by using the M2 Motorway to access worksites where possible. | Construction | AS 1742, Part 3 *Manual of uniform traffic control devices*<br>Scope of Works and Technical Criteria (SWTC) |
| Minimised disruption to bus services on the M2 Motorway. | T4 | Disruption of bus services will be minimised by appropriate traffic management arrangements. Access to M2 Motorway bus stops will be maintained during the construction phase. | Construction | Scope of Works and Technical Criteria (SWTC) |
| Minimised impacts on cyclists. | T5 | An off-motorway alternative route for cyclists will be available and sign posted prior to commencement of construction. The cycle route will be formulated in consultation with cyclist user groups and councils. | Pre-construction and construction | Scope of Works and Technical Criteria (SWTC) |
| Operational Traffic and Transport | | | | |
| Improved reliability and efficiency for M2 Users | T6 | The operation of M2 will be monitored following completion of the project and compared to predicted outcomes. Where feasible and reasonable, operational refinements will be made if required to optimise traffic condition | Operation | |

| Outcome | Referenc e | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| Construction Noise and Vibration | | | | |
| Minimised noise and vibration impacts during construction. | CN1 | All feasible and reasonable mitigation and management measures to minimise construction noise and vibration at sensitive receivers will be implemented. | Pre-construction and construction | DECCW *Interim Construction Noise Guidelines 2009* |
| | CN2 | Noise and vibration monitoring will be undertaken at key locations along the M2 Motorway to assess noise levels and the effectiveness of adopted noise mitigation measures. | Pre-construction and construction | *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZECC 1990).<br>German Standard DIN 4150 Part 3 *Structural Vibration in Buildings*<br>DECCW *Interim Construction Noise Guidelines 2009* |
| | CN3 | Prior to undertaking out of hours works, noise mitigation and management measures would be implemented where feasible and reasonable to minimise the potential impacts at nearby sensitive receivers. This would involve notification to affected communities. | Pre-construction and construction | DECCW *Interim Construction Noise Guidelines 2009* |
| Operational Noise | | | | |
| Operational noise and vibration managed. | ON1 | All feasible and reasonable mitigation measures will be developed and implemented to meet the noise criteria applicable to the project. Where property treatments are considered they would be undertaken in consultation with the affected sensitive receiver. | Pre-construction and construction | RTA *Environmental Noise Management Manual* (RTA 2001)<br>NSW Government's *Environmental Criteria for Road Traffic Noise* |
| | ON2 | Operational noise will be monitored within one year of project opening. If monitoring indicates that traffic noise levels exceed those predicted, further feasible and reasonable measures will be implemented in consultation with affected sensitive noise receivers. | Operation | RTA *Environmental Noise Management Manual* (RTA 2001)<br>NSW Government's *Environmental Criteria for Road Traffic Noise* |
| Flora and Fauna | | | | |
| Manage impacts on flora and fauna. | FF1 | Native vegetation will be retained where possible. Areas of vegetation to be retained will be clearly marked in order to reduce the risk of over-clearing. | Pre-construction | *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)<br>*Threatened Species Conservation Act 1995* (TCA Act)<br>Threatened Species Conservation provisions of the *Fisheries Management Act 1994*.<br>*Native Vegetation Act 2003* |

| Outcome | Referenc e | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| | | | | *National Parks and Wildlife Act 1974*<br>*Water Management Act 2000*<br>*Noxious Weeds Act 1993* |
| | FF2 | Clearing for construction compounds will be minimised by retaining mature trees where feasible within compound sites. | Pre-construction and construction. | Same as FF1 |
| | FF3 | Prior to any clearing of native trees, a suitably qualified and experienced ecologist will conduct a pre-clearing fauna survey. Potentially hollow-bearing trees within the clearing extents will be identified and marked. A two stage clearing and tree felling process will be implemented to reduce the risk of injury to ant nesting fauna from clearing. An ecologist will be present to supervise the removal of hollow bearing trees. | Pre-construction and construction. | Same as FF1 |
| | FF4 | Prior to any works in detention basins, a survey will be undertaken by an ecologist to determine if the basins contain potential habitat for frogs. If potential habitat is present a survey will be undertaken for threatened frog species. Any threatened frogs would be appropriately managed prior to basin works commencing. | Pre-construction and construction. | Same as FF1 |
| | FF5 | Prior to the commencement of construction in the area containing *Epacris purpurascens ssp. purpurascens* would be marked by an ecologist. Clearing would aim to avoid this species. | Pre-construction and construction. | Same as FF1 |
| Water crossings designed to incorporated best practice principles. | FF6 | All works adjacent to waterways will be developed in accordance with the fish habitat classification of each waterway. | Pre-construction and construction. | Same as FF1<br>*Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings'* – NSW Fisheries (DPI) Publication |
| Enhance existing habitat. | FF7 | Revegetation of areas disturbed as a result construction activities will be conducted by suitably qualified and experienced persons. Suitable felled native trees will be used for habitat. Seeds will be collected in the corridor prior to and during clearing and used as part of the landscape plan. | Pre-construction and construction. | Same as FF1 |
| Manage the spread of weeds and plant pathogens. | FF8 | Weed management will occur throughout the extent and duration of the project. | Pre-construction and Construction. | *Noxious Weeds Act 1993* |
| Offset residual impacts | FF9 | The Proponent will develop an offset strategy in consultation with DECCW with the overall aim of offsetting residual impacts to seven hectares of native habitat that is proposed to be cleared permanently. The strategy would focus on conservation and enhancement of habitat in the M2 corridor.<br>The offset strategy would outline the process for identifying priority areas for habitat enhancement within the M2 corridor and management measures that would be | Pre-construction | |

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| | | undertaken to enhance habitat value.<br>The offset strategy would be agreed with the Director-General prior to the commencement of construction. | | |
| Urban Design, Visual and Landscape | | | | |
| Minimised the visual impact and enhance the character of the road corridor. | UD1 | The detailed design, implementation of built elements will be undertaken with consideration of the visual and urban design objectives and principles for the project. | Pre-construction and construction | RTA Urban and Regional Design Practice Notes, *Beyond the Pavement* (RTA 1999)<br>*Bridge Aesthetics* (RTA 2003)<br>*Shotcrete Design Guidelines* (RTA 2005)<br>*Noise Wall Design Guidelines* (RTA 2006)<br>*Landscape Guidelines* (RTA 2008) |
| Aboriginal Heritage | | | | |
| Minimise potential for impacts on Aboriginal heritage in accordance with the strategies described in the environmental assessment. | AH1 | Project induction will include responsibilities under the *National Parks and Wildlife Act 1974*. Site-specific briefings will be given to relevant personnel when working in the vicinity of identified heritage items. | Pre-construction and construction | *National Parks and Wildlife Act 1974* |
| | AH2 | If any skeletal remains are encountered, all works that would potentially impact the find will stop immediately. Works will not re-commence until appropriate clearance has been received. | Pre-construction and construction | *Skeletal remains — Guidelines for the management of human skeletal remains under the Heritage Act 1977* (NSW Heritage Office 1998). |
| | AH3 | Aboriginal heritage items and sites within 50 metres of work will be managed as environmentally sensitive areas. | Pre-construction and construction | |
| | AH4 | Should any previously unidentified Aboriginal objects or items be located during the works, all work will cease in the vicinity of the find until specialist Aboriginal heritage advice is received. | Construction | *National Parks and Wildlife Act 1974* |
| Non-Aboriginal Heritage | | | | |
| Minimised impacts on non-Aboriginal heritage. | NH1 | If previously unidentified non-Aboriginal heritage items are encountered during construction, all works that would potentially impact the find will stop immediately. Works will not recommence until appropriate clearance has been received. | Construction | RTA Heritage Guidelines and *Heritage Act 1977* |

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| | NH2 | Physical and procedural measures to mitigate potential impacts upon the heritage significance of the ‘Farmhouse’ at 266 – 268 Windsor Road, Model Farms will be developed and implemented prior to and during construction at this location. | Pre-construction | *Heritage Act 1977*<br>*Australia Burra Charter* |
| | NH3 | Reasonable physical and procedural construction management measures will be developed and implemented to minimise adverse heritage impacts on the heritage causeway beneath Beecroft Road bus ramp. | Pre-construction and construction | *Heritage Act 1977*<br>*Australia Burra Charter* |
| Water management and soils | | | | |
| Minimised erosion and sedimentation. | WS1 | Management measures will be designed and installed in consultation with a soil conservation specialist. A maintenance and inspection program will be developed and implemented to ensure ongoing effectiveness. | Pre-construction and construction | *Managing Urban Stormwater: Soils and Construction* (Landcom 2005, 2008)<br>RTA *Code of Practice for Water Management* |
| Minimised contamination risk for receiving waters. | WS2 | Bunded areas will be used for storage of oils, chemicals, toxic substances, flammable and combustible liquids and potentially hazardous or contaminating activities, including, but not limited to refuelling stations and washing construction vehicles. | Pre-construction and construction | |
| Minimised impacts on waterways. | WS3 | New bridge piers will be configured to be consistent with the existing structures to minimise hydraulic impacts and potential scour issues. | Construction | *Managing Urban Stormwater: Soils and Construction* (Landcom 2005)<br>RTA *Code of Practice for Water Management* |
| Minimised scour impacts. | WS4 | Permanent stream protection and/or energy dissipation measures as appropriate will be provided at affected culverts downstream of transverse culvert outlets to minimise scour and erosion of the natural waterways, if required and where sufficient space is available. | Construction and operation | RTA QA Specification G38 *Soil and Water Management* |
| Contamination | | | | |
| Protection of the environment, workers and the public. | C1 | Risk management measures will be followed to address potential contamination in the site corridor during construction. | Pre-construction and construction | |
| | C2 | Collection, testing and classification of sediments in sediment basins will be undertaken. Appropriate management strategies will be implemented prior to works in sediment basins. | Pre-construction and construction | |
| | C3 | An ‘Unexpected Finds’ Protocol will be developed and implemented. | Pre-construction and construction | |

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| Socio-Economic | | | | |
| Avoid, minimise and manage adverse amenity impacts on residents during construction. | S1 | Minimise disturbance to adjacent residents by managing:<br>• Movement of vehicles (especially outside of standard working hours);<br>• Construction noise attenuation, where feasible and reasonable;<br>• Visual intrusion, dust and light spill. | Construction | |
| Minimise amenity impacts on residents during operation. | S2 | Provide vegetative planting, where appropriate at key locations, to screen the M2 Motorway. | Construction and operation | |
| Air quality | | | | |
| Minimise air quality impacts. | AQ1 | Feasible and reasonable mitigation and management measures will be adopted to minimise windblown, traffic generated or equipment generated dust and emissions. | Construction | |
| | AQ2 | Dust generating activities will stop where visible dust is being emitted outside the construction corridor with the potential to affect significant receivers and areas and when dust suppression methods are ineffective. | Construction | |
| | AQ3 | Dust monitoring will be undertaken at a number of locations along the M2 Motorway. These will be compared to pre-construction levels. | Construction | |
| Waste Management | | | | |
| Waste production minimised. | W1 | The 'waste hierarchy' will be maximised during construction and incorporated into work programs, purchase strategies and site inductions, and will be assessed quarterly to identify opportunities for improvement. | Pre-construction | NSW *Waste and Resource Recovery Strategy 2007* (NSW WARR) |
| Hazards and risks | | | | |
| Minimised risk of an incident during construction. | H1 | All storage areas for hazardous materials will be located an adequate distance away from watercourses and entry points to the stormwater system. Spillages will be contained and collected for disposal. | Pre-construction and construction | AS 1940 *The Storage and Handling of Flammable and Combustible Liquids* |
| | H2 | Appropriate controls will be put in place for all hazardous and potentially contaminating activities to prevent contamination of watercourses. | Construction | |
| | H3 | Site specific safety issues and personnel responsibilities will be included in the project induction. Safety issues and responsibilities shall be included in activity specific briefings as required. | Construction | *Occupational Health and Safety Act 2000*<br>*Occupational Health and Safety Regulation* |

| Outcome | Reference | Commitment | Timing | Guiding principle |
|---|---|---|---|---|
| Climate change | | | | |
| Minimise greenhouse gas (GHG) emissions and energy consumption. | GHG1 | Energy efficient equipment and management measures will be used where feasible and reasonable to reduce greenhouse gas. | Pre-construction / post construction | |
| Property and land use | | | | |
| | P1 | Conduct property inspections, subject to landowner agreement, on all structures within 50 metres of construction activities that generate vibration impacts or any other locations identified by the proponent in a targeted property risk analysis. | Pre-construction | AS 4349.1 *Inspection of Buildings* |
| | P2 | Give a copy of the property inspection report to the owner of each property inspected at least one week before construction that could affect the property commences. | Pre-construction | |
| | P3 | Maintain a register of all properties inspected, indicating whether the owner accepted or refused the property inspection offer. A copy of the register will be provided to the Director-General upon request. | All stages | |
| | P4 | Where liable, rectify any property damage (at no cost to the property owner) caused directly or indirectly by construction or operation. Alternatively, the RTA may negotiate compensation for the property damage with the property owner. | Construction and operation | |
| | P5 | All property acquisitions will be negotiated in accordance with RTA *Land Acquisition Policy*, and compensation will be assessed under the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991.* | Pre-construction | RTA *Land Acquisition Policy*<br>*Land Acquisition (Just Terms Compensation) Act 1991* |
| | P6 | Property access will be maintained for the duration of construction. Temporary access requirements will be assessed, designed, managed and rehabilitation prepared in consultation with affected landholders. | Pre-construction and construction | |
| Ancillary facilities | | | | |
| Minimise adverse impacts associated with ancillary facilities. | AF1 | Ensure the sites for ancillary facilities satisfy the criteria provided in the environmental assessment unless otherwise approved though the CEMP. | Pre-construction and construction | |

# 12. Conclusion

This section summarises the strategic need and justification for the project and presents a conclusion for the environmental assessment.

| Director-General's Requirements | Where addressed |
|---|---|
| *Project justification – the environmental assessment must justify the project and its components taking into consideration the objects of the Environmental Planning and Assessment Act 1979.* | *Chapter 12* |

## 12.1 Strategic justification

The need and justification for the M2 Upgrade project relates to the need to service Sydney's north west. Upon opening over a decade ago, the M2 Motorway provided much needed accessibility and capacity for commuter, commercial and freight traffic, and road-based public transport to and from the north west, thereby reducing travel times and peak hour congestion.

Today, land use density has increased within the M2 Motorway catchment and the ongoing expansion of the wider motorway network has resulted in further traffic growth. To this end, the need and justification for the proposed upgrade is focused on five key strategic themes, which are identified in NSW State Plans and strategies. These themes and the project's response to them are:

- *To address existing constraints and traffic congestion* – The project would alleviate significant existing congestion along the M2 Motorway and provide relief to surrounding sub-arterial and arterial routes.
- *To support economic growth* – The project would provide better access to the employment hubs in Sydney's west and north west and improved accessibility of the specialised centre at Macquarie Park to the Sydney Orbital motorway network..
- *To provide for population growth* – The project would facilitate access between residential and employment lands and educational and recreational facilities. In particular, the proposed new west facing ramps at Windsor Road would enhance the accessibility to the Rouse Hill town centre.
- *To enhance accessibility* – Key benefits of the enhanced accessibility that would be provided by the new ramp connections proposed as part of the project include:
  - Reduced congestion on surrounding arterial roads.
  - Reduced vehicle kilometres travelled (VKTs).
  - Increase accessibility to Sydney Orbital motorway network.
  - Reduced travel times.
- *To enhance public transport* – The project provides an opportunity to increase the public transport accessibility of the Macquarie Business Park precinct by providing more efficient access via Christie and Herring Roads to Macquarie Centre Bus Interchange. The provision of rear access ramps at Windsor Road as well as those at Macquarie Park provides an opportunity for new public transport services.

## 12.2 Project justification

The following critical capacity constraints have been identified on the M2 Motorway:

- Westbound, Lane Cove Road to Pennant Hills Road in the PM peak.
- Eastbound, M7 Motorway/Abbott Road to Christie Road in the AM peak.

Currently, midblock traffic volumes (traffic travelling on motorway between interchanges) often exceed theoretical motorway lane capacities leading to congestion and increased travel times, particularly during peak periods. Adverse impacts are also experienced on the surrounding arterial road network as traffic seeks alternative routes. As planned development of the north west growth centre progresses, existing congestion problems would increase in severity, further reducing the level of service provided by the M2 Motorway.

The M2 Upgrade project would provide additional lane capacity where analysis of traffic demand and traffic conditions demonstrates it is necessary. This would:

- Alleviate the existing congestion along the M2 Motorway.
- Provide relief to surrounding arterial routes.
- Provide future M2 Motorway and wider network users with improved accessibility to a greater number of destinations.
- Improve travel conditions during peak periods.

Without these improvements, traffic conditions in the corridor would deteriorate significantly and delays to users would increase.

An environmental risk analysis was undertaken to identify the key risks of the project. A summary of this analysis is provided in Chapter 8. The results of that analysis, in conjunction with the DGRs, guided the assessment of the project's potential impacts.

Key environmental issues have been addressed in Chapter 9 and other issues have been addressed in Chapter 10. Justification of the project in the context of the identified key environmental, social and economic issues is provided below.

### 12.2.1 Key issues

Consideration of impact on the natural and cultural environment has been fundamental to the design process for the project. As far as possible, impacts have been avoided.

#### Operational traffic and transport

Detailed analysis of the potential operational transport and traffic impacts in Section 9.1 has determined that standard mitigation measures could be implemented to manage impacts during operation.

#### Construction traffic and transport

Construction traffic impacts would be incurred throughout the 24 month construction period as indicated in Section 9.2. A number of measures would be implemented to minimise the impacts of construction to both traffic flow and nearby residents and business owners. These include road occupancies, road closures, speed reductions and contra flow configurations along both the M2 and the surrounding road network. To maintain the existing capacity of the M2 Motorway during peak hours, most of the network changes would be applicable during off-peak periods. Further details of construction traffic management and mitigation would be included in a Traffic Management Plan.

### Operational noise and vibration

Operational noise would largely be managed through the modification or relocation of existing noise walls and the installation of new noise walls as indicated in Section 9.3. At locations where this is not viable and residual impacts remain after all feasible and reasonable approaches have been exhausted, noise mitigation in the form of architectural acoustic treatment for existing individual dwellings would be required. Solutions for other sensitive receivers would be determined in consultation with these receivers and the RTA.

Vibration generated from increased traffic levels is not anticipated to have a significant impact on adjacent land uses.

### Construction noise and vibration

Construction noise during the daytime period is generally predicted to be in line with the NMLs, although a number of small exceedances are predicted during road widening bridgeworks as indicated in Section 9.4.3. During the evening and night-time periods, varying levels of exceedance of the project NMLs are predicted for most of the construction scenarios assessed.

Prior to undertaking significant 'out of hours' works, reasonable and feasible noise mitigation and management measures would be determined in consultation with affected stakeholders and implemented where required to minimise the potential impacts at nearby noise sensitive receivers.

Residences in the vicinity of the proposed works may be exposed to the impacts of vibration from some construction activities. Where deemed necessary, pre-construction building condition surveys and vibration monitoring would be carried out.

### Ecology

A total of approximately 21 hectares of vegetation, including ten hectares of native vegetation and approximately 20 individuals of the species *Epacris purpurascens var. purpurascens*, would be removed as indicated in Section 9.5. The loss of native vegetation would also lead to loss of fauna habitat, some severance of fauna movement corridors and increased edge effects. Notwithstanding, no significant impact on *Epacris purpurascens var. purpurascens* or any threatened species or community is anticipated.

### Urban design and landscape

Visual change resulting from the M2 Upgrade project would be experienced by both surrounding land users and by road users. Key changes would result from interchange construction, modifications to noise walls and vegetation removal. Some impacts would be unavoidable and these changes would be mitigated through the architectural design. The integration of new higher standard design elements would provide a new desired character and identity for the M2 Motorway. Further detail is provided in Section 9.5.

### Aboriginal heritage

There are 15 sites of Aboriginal cultural heritage within 100 metres of the site. An Aboriginal Heritage Management Plan would be prepared to providing guidance on the management of these sites during the construction phase of the M2 Upgrade project as indicated in Section 9.7. Subject to implementation of this plan, there is potential for three only of these sites to be impacted by the proposal. Potential impact would be by way of ground disturbance, sedimentation and vibration. Measures to minimise or avoid impact to these sites would be identified during the detailed design phase of the project.

### Construction surface water management and soils

Potential impacts to surface water flows as a result of the proposed widening works could be caused during site establishment and preparation works, earthworks and drainage works. A soil and water management plan would be prepared as part of a CEMP and would contain measures to manage and mitigate potential flooding, erosion, sedimentation or contamination of surface water that may result from altered surface conditions during construction. Further detail is provided in Section 9.8.

### Non-Aboriginal heritage

There are 16 items of non-Aboriginal heritage significance within the vicinity of the M2 Motorway, nine of which have the potential to be impacted by the proposed works as a result of vibration. Measures to be implemented to minimise impacts to heritage items within the vicinity are identified in Section 9.9.

## 12.3 Objects of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the project can be considered. Table 126 outlines those objects and provides comment on their relevance to the project.

Table 126 Objects of the EP&A Act and relevance to the project

| EP&A Act Object | Comment |
|---|---|
| To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, waters, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment. | The project design and impact mitigation and management measures detailed in this environmental assessment allow for the proper management, development and conservation of natural and artificial resources. The main objective of the project is to improve accessibility to economic growth areas in Sydney's north west and measures would be implemented to ensure the impact of this development on the natural and built environs is minimised. |
| To encourage the promotion and co-ordination of the orderly economic use and development of land. | Over the next 25 to 30 years, the Sydney Metropolitan Strategy, titled *City of Cities: A Plan for Sydney's Future*, predicts that 99,000 jobs will be created in Sydney's north west, with over 55,000 new jobs being created in the immediate vicinity of the M2 corridor. The project would provide better access to these areas, thereby supporting the planned economic use and development of land |
| To encourage the protection, provision and co-ordination of communication and utility services. | Communication and utility services would not be affected by the project. |
| To encourage the provision of land for public purposes. | This project is designed to meet the transport needs of the public. |
| To encourage the provision and co-ordination of community services and facilities. | The project provides improved access to communities along the length of the M2 Motorway through better traffic movement and increased number of access ramps to the M2 Motorway. Consequently, access to community services and facilities in the north west would be improved as a result of the project. |

| EP&A Act Object | Comment |
|---|---|
| To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats. | The project has been designed to minimise or mitigate significant identified impacts on the environment, including impacts to native flora and fauna, threatened species, populations and ecological communities and their habitats. |
| To encourage ecologically sustainable development. | Ecologically sustainable development has been considered in Section 12.4 |
| To encourage the provision and maintenance of affordable housing. | Not relevant to the project |
| To promote the sharing of responsibility for environmental planning between different levels of government in the State. | The responsibility for environmental planning and approval in relation to the project rests with the State Government. Consultation has however occurred across all levels of government. |
| To provide increased opportunity for public involvement and participation on environmental planning and assessment. | The project development process has involved extensive consultation with relevant parties and this would continue in the detailed design, construction and operation phases. |

## 12.4 Ecologically Sustainable Development

The EP&A Act, in part, encourages Ecologically Sustainable Development (ESD). In justifying the carrying out of a development in the manner proposed, the *Environmental Planning and Assessment Regulation 2000* sets out the principles of ESD that should be considered. In this regard, the following addresses each of the ESD principles as they relate to the project.

### 12.4.1 The precautionary principle

*"If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."*

No threats of serious or irreversible environmental damage have been identified as being directly attributable to the undertaking of the project. Precaution has nevertheless been exercised in the following ways:

- Precaution has been exercised in regard to impacts on climate change by taking measures to reduce emissions associated with construction and operation. Although emissions would be generated during construction, the project would achieve long-term operational emission savings compared with the 'do-nothing' option. Furthermore, the flood impact assessment assumes an increase of 20 percent rainfall to accommodate climate change impacts within the engineering timeframes for flooding.
- Precaution has been exercised in the protection of aboriginal and non-aboriginal heritage items such as the Model Farms 'Farm house' and three sites of Aboriginal cultural heritage that may be impacted by construction of the project.
- The project would involve clearing (some permanent and some temporary) of native vegetation that is potential habitat for a number of threatened and migratory species. However, no impacts to threatened ecological communities are anticipated as a result of the project. Approximately ten hectares of native vegetation would be removed and three hectares would be subsequently revegetated.

### 12.4.2 Inter-generational equity

*"The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations."*

A major benefit of the project would be improved travel time, reduced traffic congestion leading to improved air quality and a better quality road for motorists. The upgrade would also enhance the welfare of future generations in a variety of other ways, which are:

- The upgrade would reduce local traffic congestion, improving air quality.
- The upgrade would reduce long-term operational emissions through improved grades and faster travel times for motorists.
- The upgrade would improve amenity for local road users by decongesting local roads.
- The upgrade would improve access for markets and labour force and therefore improve economic outcomes for local businesses.
- Revegetation of disturbed areas adjacent to the construction areas and bordering natural bushland would improve connectivity and providing wildlife corridor links.
- Revegetation would be conducted under bridge structures and measures would be implemented (for example, lighting and moisture) to improve growth conditions for plants in these locations, thereby improving their potential functioning of these areas as fauna movement corridors.
- Noise walls are to be retained and/or revised to address the new impacts experienced by the widened roadway. The design of these elements would be in accordance with the current design standards applicable to road development.
- Inert spoil, demolition concrete and other building materials would be reused as much as practically possible, thus reducing demand on raw materials and associated costs and energy.

### 12.4.3 Conservation of biological diversity and ecological integrity

*"Conservation of biological diversity and ecological integrity should be a fundamental consideration."*

Much of the area surrounding the M2 corridor is highly urbanised and consists mainly of residential properties, parkland, weed-infested areas and riparian vegetation. The project design, construction and operation would incorporate a number of net benefits to biological diversity and ecological integrity including:

- A bushland regeneration program would be implemented (subject to agreement) throughout the core bushland areas within the M2 corridor.
- Providing habitat connectivity to larger areas of bushland through vegetation rehabilitation in areas suffering from habitat modification and high levels of weed invasion.
- Net improvements to degraded vegetation along the corridor through:
  - Intensive treatment of environmental weeds.
  - Introducing planting under bridges where none currently exists by installing a system of system of gravity fed perforated stormwater pipes to distribute water during rainfall and an artificial lighting system under bridges to provide sufficient additional light at suitable wavelengths for plant growth. This system would be designed to provide light to plants during daylight hours such that it augments existing light and does not impact on nocturnal animal species.
  - Revegetation strategy that reinstates the natural plant communities which would have existed along the corridor prior to construction disturbance.
- Net improvements to habitat opportunities for fauna species along the corridor through:
  - Intensive treatment of environmental weeds.

- Installation of nest boxes in order to replace hollows that may be lost through vegetation clearing works.
- Installation of bat boxes suitable for suitable for cave-dwelling bat species would be retro-fitted to overbridges adjacent to bushland along the route (for example, Terrys Creek and Darling Mills Creek).
- Installation of boulders and large woody debris underneath existing bridge structures to increase the structural complexity of habitats in these locations and provide suitable cover for species which may use these areas as movement corridors.
- Creation of rough surface finishes on the underside and inner surface of bridge structures over Terrys Creek and Darling Mills Creek that would enable Fairy Martins Hirundo ariel to create their bottle-shaped mud nests. A wide variety of native fauna species (including the threatened Large-eared Pied Bat *Chalinolobus picatus* have been recorded using the abandoned nests of Fairy Martins attached to artificial structures such as bridges and culverts.
- Flood and water quality treatments to ensure no additional impacts on the aquatic environment.

### 12.4.4 Improved valuation, pricing and incentive mechanisms

*"Environmental factors should be included in the valuation of assets and services."*

The improved amenity, increased speed limit and reduced congestion provide improved value for money for motorists on the M2 Motorway. The project's asset valuation, construction costs, operation costs and product charges would include environmental factors and externalities such as:

- A minimum waste policy recognising that waste discharge, whether solid, liquid or gaseous represents a cost to production and an opportunity loss to income.
- Landscape rehabilitation using native species to create low maintenance vegetated areas. Ongoing management of vegetation would be undertaken including one year maintenance for establishment after construction, then integration into existing maintenance regimes. The vegetated back drop is identified as a key asset within the urban design framework for instilling a distinct character for the route.
- Appropriate compensation for acquired properties and temporary leases during construction.

## 12.5 Conclusion

The project addresses DGRs, which include issues raised by key state government agencies. The environmental assessment also includes consideration of the issues raised by the community and stakeholders during the development of the project.

If approved and implemented, the project would fulfil its design intent of:

- Addressing existing constraints and traffic congestion.
- Supporting the economic development of the region by facilitating commercial activity.
- Providing for population growth in the north western corridor.
- Enhancing accessibility between residential areas and centres of commercial activity.
- Enhancing public transport.

There are some anticipated impacts on the local environment, particularly during construction. Key environmental issues have been examined throughout the project development and construction planning processes. Consultation with affected stakeholders has been undertaken to ensure that key potential impacts were identified and discussed at an early stage, and, where possible, appropriate mitigation agreed in principle.

The key issues identified comprise:

- Operational and construction traffic and transport implications.
- Operational and construction noise and vibration impacts.
- Impacts on ecology.
- Urban design and landscaping issues.
- Aboriginal cultural heritage.
- Surface water impacts during construction.
- Non-Aboriginal heritage.

Many impacts would be temporary and need to be considered within the context of the overall objectives of the project and the benefits it would produce.

The project is of significance to the State as it provides essential improvements to a key link in the Sydney Orbital motorway network and integrated efficient public transport (bus) facilities, which would support the significant growth planned in Sydney's north west and the 'global arc'. The project is consistent with the goals and objectives described in key NSW Government strategy documents, including the State Plan and Metropolitan Strategy. The project would provide:

- An integrated M2 Motorway transport solution significantly improving accessibility for cars, freight vehicles, public transport and bicycles.
- Improved capacity and efficiency of existing commuter, commercial, freight and road-based public transport infrastructure.
- Reducing peak hour travel times.
- More attractive and reliable public transport options.

In meeting the primary objectives of the project, the design development process has sought to minimise the potential environmental, social and economic impacts.

As with any motorway development, the project would result in some adverse impacts. The development of mitigation and management measures to reduce the scale of these impacts has been a key feature of project development and has been reflected through this environmental assessment. The RTA has made firm commitments to implement appropriate mitigation and management measures.

There is the potential for a degree of cumulative impacts associated with this and other projects that may occur within the same time and area. The precautionary approach taken in the development of mitigation and management measures proposed for this project would provide sufficient mitigation to minimise both immediately-identified impacts and potential additional or cumulative impacts that may arise.

The project achieves acceptable environmental, social and economic outcomes, and delivers substantial road safety and wider economic and road-user benefits. The project is considered justified.

# 13. References

ABS (2006) *2006 Census of Population and Housing*, Australian Bureau of Statistics

ANZECC and ARMCANZ (2000) *Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No 4*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, Australia

Biosphere Environmental Consultants (2007) *Monitoring Survey for Red-crowned Toadlet*, M2 Site, North Ryde

BOM (2008) www.bom.gov.au, Bureau of Meteorology, Commonwealth of Australia

City of Ryde (2009) *Development Control Plan – Water Sensitive Urban Design*

City of Ryde (2002) *Macquarie Park Structure Plan*

City of Ryde (2007a) *Ryde Local Environment Plan No. 137*

City of Ryde (2007b) *Ryde Integrated Transport*

City of Ryde (2007c) *Land Use Strategy*

City of Ryde (2008) *Macquarie Park Traffic Study*

Corkill, T. (2001) *Monitor of Aboriginal Archaeological Sites along M2 Motorway*

CRC for *Catchment Hydrology* (2005 Version 3) MUSIC User Manual

CSIRO and BOM (2007) CSIRO, and the Australian Bureau of Meteorology. *Climate change in Australia: technical report 2007*. Commonwealth Scientific and Industrial Research Organisation

Conybeare Morrison and Partners (1992) *North West Transport Links East, Environmental Impact Statemen*t, Working Paper European Heritage Survey

DCC (2006) *National Greenhouse Gas Inventory*, Department of Climate Change

DCC (2008) *Green Paper on the Carbon Pollution Reduction Scheme*, Department of Climate Change

DEC (2004a) *Air Quality and meteorological monitoring data conducted at Lindfield*, NSW Department of Environment and Conservation

DEC (2004b) *National Environment Protection (Ambient Air Quality) Measure (NEPM) NSW Annual Compliance Report 2004*, Department of Environment and Conservation

DEC (2004c) *Interim Community Consultation Requirements for Applicants*

DEC (2005) *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*

DEC (2005a) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, Department of Environment and Conservation

DEC (2005b) *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea).* Department of Environment and Conservation NSW, Hurstville

DEC (2006a) *Assessing Vibration: a technical guideline*, Department of Environment and Conservation (now Department of Environment, Climate Change and Water)

DEC (2006b) *Guidelines for the NSW Site Auditor Scheme 2nd edition, Health-based investigation levels for Commercial or Industrial land use*, Department of Environment and Conservation (now Department of Environment, Climate Change and Water)

DECCW (2007) *Waste Avoidance and Resource Recovery Strategy 2007*

DEC and DPI (2005) *Draft Guidelines for Threatened Species Assessment*. Department of Environment and Conservation (now Department of Environment, Climate Change and Water) and Department of Primary Industry, NSW

DEC(2004. *Interim Community Consultation Requirements for Applicants*

DECCW (2009a) *Interim Construction Noise Guideline*

DECCW (2009b) *Threatened species, populations and ecological communities of NSW*. Threatened species Website. NSW Department of Environment and Climate Change. Available from: http://www.threatenedspecies.environment.nsw.gov.au/index.aspx NSW Department of Environment and Climate Change

DECCW (2009c) *Waste Classification Guidelines*: Parts 1 and 2

DECCW (2009d) *Action for Air*

DECCW (2009e) *Draft Vegetation Community Mapping Scheme for the Sydney Metropolitan Catchment Area*

DEH (2005) *Turpentine–Ironbark Forest of the Sydney Basin Bioregion Nationally threatened species and ecological communities information sheet*, Department of the Environment and Heritage

DEH (2006) *Significant Guidelines and Matters of National Significance*, Department of Environment and Heritage, Australia

DEWHA (2001) *Fuel Standard (Automotive Diesel) Determination 2001*, Legislative Instrument Compilation (current) – F2009C00145

DEWHA (2009) *Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat

DIPNR (2004) Guideline for the Preparation of Environmental Management Plans

DMR (1987) *Roads 2000*, Department of Main Roads (now Roads and Traffic Authority)

DoP (1992a) *Hazardous Industry Planning Advisory Paper No.4 – Risk Criteria for Land Use Safety Planning*

DoP (1992b) *Hazardous Industry Planning Advisory Paper No.6– Guidelines for Hazard Analysis*

DoP (1994) *Applying SEPP 33 Hazardous and Offensive Development Application Guidelines*

DoP (1997a) *Guidelines, Hazard Industry Planning Analysis Paper No.6* (HIPAP)

DoP (1997b) *Multi-Level Risk Assessment*

DoP (2005) Sydney Metropolitan Strategy, titled *City of Cities: A Plan for Sydney's Future*

DoP (2007a) *Inner North Subregional Strategy*

DoP (2007b) *North Subregional Strategy*

DoP (2007c) *North West Subregional Strategy*

DoP (2007d) *West Central Subregional Strategy*

DoP (2008) *New South Wales State and Regional Population Projections, 2006-2036*

Eco Logical Australia (ELA) (2008) *Constraints and Opportunities Assessment M2 Site and Bundarra reserve North Ryde, NSW.* Report to Transport Infrastructure development Corporation (TIDC), Chatswood, NSW

EPA (1999a) *Environmental Criteria for Road Traffic Noise*

EPA (1999b) *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes*

EPA (2000) *Industrial Noise Policy*

Fairfull, S. and Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla

Federal Office of Road Safety (2007) *The Australian Code for the Transport of Dangerous Goods by Road and Rail* (known as the Australian Dangerous Goods Code or ADG), 7th ed., Canberra, ACT

Future Fuels Forum (2008) Fue*l for Thought The Future of Transport Fuels: challenges and opportunities*

Gunninah, X (2000) *M2 Hills Motorway Fauna Monitoring Report*

Haglund, L., 1995. *The Proposed M2 Motorway: Investigation of Aboriginal Heritage Significance Test Excavation of Rock Shelter PAD1/DC1on Devlins Creek, Pennant Hills – Beecroft*. Report to the Roads and Traffic Authority.

HLA Envirosciences Pty Ltd (2007) *M2 Motorway Water Quality Monitoring Report – 21 May to 1 June 2007*

HLA Envirosciences Pty Ltd (2008), *M2 Motorway Construction Water Quality Environmental Monitoring Report. 6 January 1998 – 14 April 2008*.

HLA Envirosciences Pty Ltd (6 January 1998 – 14 April 2008) *M2 Motorway Construction Water Quality Environmental Monitoring Report*

Holper, P., Lucy, S., Fox, P., Nolan, M., Senese C., Hennessy, K. (2007) *Infrastructure and Climate Change Risk Assessment for Victoria*. Consultancy Report to the Victorian Government prepared by CSIRO, Maunsell AECOM and Phillips Fox. http://www.greenhouse.vic.gov.au/CA256F310024B628/0/2021C307264A6473CA2572DD00055CBB/$File/Climate+change+and+Infrastructure+Final.pdf

Institution of Engineers Australia (2000) *Australian Rainfall and Runoff*

Institution of Engineers Australia (2005) *Australian Runoff Quality*

IPCC (2007) Intergovernmental Panel on Climate Change. *Fourth Assessment Report: Climate Change 2007 (AR4)*

Landcom (2004 and 2006) *Managing Urban Stormwater – Soils and Construction* Volumes 1 and 2

Lees, F.P. (1996) *Loss Prevention in the Process Industries*, Butterworth-Heinemann, London

Mount King Ecological Surveys (1992a) *North West Transport Links Western Section Flora and Fauna Evaluation*. Report prepared by Mount King Ecological Surveys for Manidis Roberts Pty Ltd. And Snowy Mountains Engineering Corporation Pty Ltd on behalf of the Roads and Traffic Authority, NSW

Mount King Ecological Surveys (1992b) *North West Transport Links East Environmental Impact Statement Working Paper Flora and Fauna Evaluation* (Bushland Effect and Management) Report (Eastern Section) prepared by Mount King Ecological Surveys for Maunsell Pty Ltd on behalf of the Roads and Traffic Authority, NSW

NEPM (2004) *National Environmental Protection (Air Toxics) Measure*

NPWS (2002a*) Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain,* Western Sydney, Final Edition, NSW National Parks and Wildlife Service, Sydney

NPWS (2002b) *Native Vegetation of the Cumberland Plain – Final Edition*, NSW National Parks and Wildlife Service, Sydney

NSW Government (2006a) *State Plan – A New Direction for Sydney*

NSW Government (2006b) *Urban Transport Statement – Responding to the Challenges of Travel and Transport within and across Sydney*

NSW Heritage Office and DUAP (1996) *NSW Heritage Manual* (now Heritage Branch, Department of Planning)

NSW Heritage Office (2002) *Statements of Heritage Impact* (now Heritage Branch, Department of Planning)

NSW Treasury (2006) *State Infrastructure Strategy* New South Wales 2006-07 to 2015-16

Rooney, B. (1994) *Water sampling data conducted downstream of the M2 Motorway*

RTA (1989) F2 – *Castlereagh Freeway – Section: Pennant Hills Road to Land Cove River Environmental Impact Statement*

RTA (1992) *North West Transport Link – Pennant Hills Road to Old Windsor Road*

RTA (1999) *Water Policy and Code of Practice for Water Management*

RTA (2001) *Environmental Noise Management Manual*

RTA (2002) *Guide to Traffic Generating Development*

RTA (2003) *Bridge Aesthetics*

RTA (2005) *Shotcrete Design Guidelines*

RTA (2006) *Noise Wall Design Guideline*

RTA (2008a) *Community Involvement Policy and Community Involvement and Communication Resource Manual*

RTA (2008b) *Landscape Guidelines*

RTA (2008c) *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*

RTA (2009) *Preliminary environmental assessment for the M2 Upgrade project*

SESL (2008) *Detention Basin Water Sampling – M2 Motorway, Sydney Environmental and Soil Laboratory*

Sinclair Knight Merz (2008) *Transurban M2 Upgrade project – Environmental Scoping Study*

SMEC Australia (2006) *Review of Environmental Factors for M2 Motorway Westbound Third Lane Conversion*

SMEC Australia (2006) the *M2 Environmental Review*

Smith, J. and Smith, P. (2008) *Native Vegetation Communities of Hornsby Shire 2008 Update*. Report prepared for Hornsby Shire Council

Standards Association of Australia AS1940-2004 *The storage and handling of flammable and combustible liquids*

Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. and Pennay, C. (2006*) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*. Version 1.0 NSW Government Department of Environment and Conservation and Department of Natural Resources

Transurban (2009) *Road User Cost Benefit Analysis*

Upper Parramatta River Catchment Trust (1999) *Green corridors Management Strategy for Upper Parramatta River Catchment*. Oculus Environmental Planning Consultants

US Federal Highway Administration (2009 Version 7.2) *HY-8 Culvert Hydraulic Analysis Program*

Unsworth, B. (2004) *Review of Bus Services in New South Wales* http://www.transport.nsw.gov.au/sites/default/file/inquiries/unsworth-final-bus-report_full.pdf

World Business Council for Sustainable Development and World Resources Institute (WBCSD and WRI) (2004) *The Greenhouse Gas Protocol A Corporate Accounting and Reporting Standard, Revised Edition*

XP Software (2008 Version 7) *XP-Rafts User Manual*

# 14. Glossary of terms and abbreviations

| Terminology | Description |
|---|---|
| AADT | Average Annual Daily Traffic |
| AHD | Australian Height Datum |
| AHIMS | Aboriginal Heritage Information Management System |
| ALARP | As Low As Reasonably Practicable |
| alternative cycle route | Describes the cycle route provided on local roads because cyclists would be diverted off the M2 Motorway during construction |
| ARQ | Australian Runoff Quality |
| BOM | Bureau of Meteorology |
| CAL3QHCR | The transportation dispersion model CAL3QHCR, developed by the USEPA for the modelling of air quality impacts |
| CBD | Central business district |
| CCTV | Closed Circuit Television |
| CEEC | critically endangered ecological community |
| CEMP | Construction Environmental Management Plan |
| Chainage | An imaginary line used to measure distance |
| CLM Act | Contaminated Land Management Act 1997 |
| CO | Carbon Monoxide |
| Contractor | Leighton Contractors Pty Ltd |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DCC | Department of Climate Change |
| DEC | Department of Environment and Conservation (now Department of Environment, Climate Change and Water) |
| DECC | Department of Environment and Climate Change (now Department of Environment, Climate Change and Water) |
| DECCW | Department of Environment, Climate Change and Water (previously known as DECC) |
| Deep lift asphalt | Thick asphalt over heavily bound material |
| DEH | Department of Environment and Heritage |
| DEWHA | Department of the Environment, Water, Heritage and the Arts |
| DGR's | Director-General's environmental assessment requirements |
| Director-General's Requirements | Reference to the Director-General's environmental assessment requirements under Part 3A of the EP&AEP&A Act. Can be shortened to 'DGRs' |
| DoP | Department of Planning |
| DPI | Department of Primary Industries |
| DUAP | Department of Urban Affairs and Planning (now Department of Planning) |
| DWE | Department of Water and Energy |
| ECRTN | Environmental Criteria for Road Traffic Noise |
| EEC | Endangered Ecological Community |

| Terminology | Description |
|---|---|
| EIS | Environmental Impact Statement |
| ENMM | Environmental Noise Management Manual produced by the RTA |
| Environmental assessment (EA) | The document prepared under Part 3A to assess environmental impacts for seeking Project Approval. Can be shortened to ‘EA’. |
| Environmental assessment | Generic term for describing the undertaking of an assessment of impacts |
| EPA | Environmental Protection Authority (part of the Department of Environment, Climate Change and Water) |
| EP&A Act | Environmental Planning and Assessment Act 1979 |
| EPBC Act | Environment Protection and Biodiversity Conservation Act 1999 |
| EPI | environmental planning instruments |
| ESD | Ecologically Sustainable Development |
| ETC | Electronic Toll Collection |
| Full depth asphalt | Asphalt layer over selected material |
| GHG | Greenhouse Gas |
| ‘Global Arc’ | A strategic employment related development corridor stretching from Sydney Airport to Macquarie Park |
| Hills M2 | The Hills Motorway Limited, the company responsible for the operation and maintenance of the M2 Motorway. Hills M2 is a wholly owned subsidiary of Transurban Limited. |
| IAP2 | International Association of Public Participation |
| ICNG | Interim Construction Noise Guideline prepared by the Department of Environment, Climate Change and Water |
| ICOMOS | Australian International Council on Monuments and Sites |
| IPCC | Intergovernmental Panel on Climate Change |
| ISEPP | State Environmental Planning Policy (Infrastructure) 2007 |
| ITS | Intelligent Transport System |
| Level of Service (LoS) | Level of Service (LoS) is defined as a qualitative measure describing operational conditions within a traffic stream |
| LCPL | Leighton Contractors Pty Ltd |
| LCT | Lane Cove Tunnel |
| LEP | Local Environmental Plan |
| LGA | Local Government Area |
| LUS | Lane Usage Signs |
| the M2 corridor | The site, generally bounded by the Hills M2 Motorway lease boundary |
| M2 environs | The area inclusive of the M2 corridor and the area of influence |
| M2 Motorway | M2 Motorway, which extends from the M7 Motorway/Abbott Road to the Lane Cove Tunnel including carriageways, ramps and associated structures and infrastructure |
| M2 Motorway catchments | The area or population from which the M2 Motorway attracts users |
| M2 Motorway operator | Hills M2 |
| M2 Upgrade project | The proposed works |
| M2 Upgrade project Project Team | The name of the project team delivering the M2 Upgrade project. This includes Leighton Contractors Pty Ltd, Hills M2, AECOM, and KMH Environmental |

| Terminology | Description |
| --- | --- |
| M7 Motorway | M7 Motorway, which extends from end of M2 at Abbott Road interchange |
| MCR | Motorway Control Room |
| METS | Motorist Emergency Telephone System |
| mm | Millimetres |
| MNCS | Motorway Network Communications System |
| the M2 Motorway | M2 Motorway, which extends from the M7 Motorway/Abbott Road to the Lane Cove Tunnel including carriageways, ramps and associated structures and infrastructure, abbreviated to 'the M2 Motorway'. |
| Mt $CO_2$-e | Million tonnes of $CO_2$-equivalent |
| MUSIC | Model for Urban Stormwater Improvement Conceptualisation, used to simulate urban stormwater systems operating at a range of temporal and spatial scales |
| NEPM | National Environmental Protection (Air Toxics) Measure |
| NES | National environmental significance |
| NETS | National Emissions Trading Scheme |
| NGERS | National Greenhouse and Energy Reporting Act 2007 |
| NMLs | Noise Management Levels |
| $NO_2$ | Nitrogen dioxide is the chemical compound with the formula $NO_2$, and is a prominent air pollutant |
| $NO_x$ | $NO_x$ is a generic term for mono-nitrogen oxides (NO and $NO_2$), both prominent air pollutants |
| NPW Act | National Parks and Wildlife Act 1974 |
| OGA | open graded asphaltic concrete |
| PAD | Potential Archaeological Deposit |
| park and ride facility | Describes the previously proposed park and ride facility at Herring Road |
| PCBs | polychlorinated biphenyls |
| $PM_{10}$ | Particulate matter less than 10 microns in aerodynamic diameter, a parameter used to measure air quality |
| $PM_{2.5}$ | Particulate matter less than 2.5 microns in aerodynamic diameter, a parameter used to measure air quality |
| ppm | Parts per million |
| the project | M2 Upgrade project works |
| the proponent | Roads and Traffic Authority (RTA) |
| t $CO_2$-e | tonnes of $CO_2$-equivalent |
| RIDBC | Royal Institute for Deaf and Blind Children |
| RTA | NSW Roads and Traffic Authority |
| RUCBA | Road Users Cost Benefit Analysis |
| $SO_2$ | Sulphur dioxide is the chemical compound with the formula $SO_2$. It is produced by industrial processes and is a prominent air pollutant. |
| 'SO' gutter | A gutter type used by the RTA |
| SCATS | Sydney Coordinated Adaptive Traffic System is a management system for traffic signals that gathers data on traffic flows in real-time at intersections. |

| Terminology | Description |
|---|---|
| SCATES | Scates Computer Aided Traffic Engineering System is a traffic signal optimisation prgrams |
| SEPP | State Environmental Planning Policy |
| Super-T Bridge | A bridge formed from pre-cast conctret girders with a cast in-situ concrete deck. |
| SWMP | Soil and Water Management Plan |
| Sydney's north west | The area within Sydney that the M2 Motorway serves |
| Sydney's North West Growth Centre | As defined under Metropolitan Strategy |
| TAPM | 'The Air Pollution Model' |
| TMC | RTA Transport Management Centre (TMC) |
| Sydney Orbital Motorway network or 'Sydney Orbital' | the M2 Motorway network orbiting Sydney metropolitan area |
| TMPs | Traffic Management Plans |
| TMS | Tunnel Message Signs |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| TSC Act | Threatened Species Conservation Act 1995 |
| TSP | Total Suspended Particles |
| TSS | Total Suspended Solids |
| UPS | Uninterruptible Power Supply |
| USEPA | United States Environment Protection Authority |
| VENM | Virgin excavated natural material |
| VKT | Vehicle Kilometres Travelled |
| VMS | Variable Message Signs |
| VSLS | Variable Speed Limit Signs |
| WEBS | Wider economic benefits |
| Note: project description terminology is contained in the project description. | |

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# Appendix A Ministerial Declaration

**ORDER DECLARING DEVELOPMENT TO BE A PROJECT UNDER PART 3A OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979**

I, the Minister for Planning, in pursuance of section 75B(1) of the *Environmental Planning and Assessment Act 1979* (the Act), do, by this Order declare that the development described in Schedule 1 is a project to which Part 3A of the Act applies.

In my opinion, the development described in Schedule 1 is of State and regional environmental planning significance.

Dated, this 24 day of Feb , 2009

Kristina Keneally, M.P.,
Minister for Planning,
Sydney.

---

**SCHEDULE 1**

Development for the purposes of the M2 Upgrade (the 'Project'), extending along the M2 Motorway approximately from Windsor Road, Baulkham Hills to Delhi Road, North Ryde and generally involving:

- Widening of sections of the eastbound and westbound carriageways.
- Provision of west facing on and off ramps at Windsor Road.
- Provision of east facing on and off ramps at Herring Road.
- Widening of the Norfolk road tunnel and provision of a permanent cycle facility.
- Provision of a park and ride facility and bus interchange facility at Herring Road.

The Development also includes associated or ancillary works, activities, uses, structures or facilities for the purposes of the Project, including (but not limited to) any of the following:

(a) Construction and associated demolition works.
(b) Access for construction of the Project.
(c) Environmental management and pollution control for the Project.
(d) Upgrades to the Motorway's operational management and control systems.

The Development does not include preliminary works (such as surveys, test drilling, test excavations, preliminary geotechnical investigations, contamination investigations, utility identification and location and pavement investigations) associated with the design and/or environmental assessment of the Project occurring prior to the commencement of construction.

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## ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

## DECLARATION OF CRITICAL INFRASTRUCTURE PROJECT

I, the Minister for Planning, declare under section 75C of the *Environmental Planning and Assessment Act* 1979, that the project referred to in the Schedule is a critical infrastructure project, having formed the opinion that the project is essential for the State for economic, environmental and social reasons.

Dated, this 24 day of Feb, 2009

Kristina Kenneally
**Minister for Planning**

---

### SCHEDULE

Development for the purposes of the M2 Upgrade (the 'Project'), extending along the M2 Motorway approximately from Windsor Road, Baulkham Hills to Delhi Road, North Ryde and generally involving:

- Widening of sections of the eastbound and westbound carriageways.
- Provision of west facing on and off ramps at Windsor Road.
- Provision of east facing on and off ramps at Herring Road.
- Widening of the Norfolk road tunnel and provision of a permanent cycle facility.
- Provision of a park and ride facility and bus interchange facility at Herring Road.

The Development also includes associated or ancillary works, activities, uses, structures or facilities for the purposes of the Project, including (but not limited to) any of the following:

(a) Construction and associated demolition works.
(b) Access for construction of the Project.
(c) Environmental management and pollution control for the Project.
(d) Upgrades to the Motorway's operational management and control systems.

The Development does not include preliminary works (such as surveys, test drilling, test excavations, preliminary geotechnical investigations, contamination investigations, utility identification and location and pavement investigations) associated with the design and/or environmental assessment of the Project occurring prior to the commencement of construction.

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# Appendix B Director-General's Requirements

NSW GOVERNMENT
**Department of Planning**

COPY

**Office of the Director General**

Y09/988

Mr Michael Bushby
A/Chief Executive
Roads and Traffic Authority
Locked Bag 928
NORTH SYDNEY NSW 2059

Dear Mr Bushby

**Director General's Requirements for the Environmental Assessment of Proposed M2 Upgrade**

The Department has received your application for the proposed M2 Upgrade project (Application Number: 09-0049).

I have attached a copy of the Director-General's requirements (DGRs) for the environmental assessment of the Project. These requirements have been prepared based on consultation with the relevant government agencies.

It should be noted that the Director-General's requirements have been prepared based on the information provided to date. Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the proponent seeking approval for the Project.

I would appreciate it if you could contact the Department at least two weeks before you propose to submit the Environmental Assessment for the Project to determine:

- the fees applicable to the application;
- relevant land owner notification requirements;
- consultation and public exhibition arrangements that will apply;
- options available in publishing the Environmental Assessment via the Internet; and
- number and format (hard-copy or CD-ROM) of the Environmental Assessment that will be required.

Prior to exhibiting the Environmental Assessment, the Department will review the document to determine if it adequately addresses the DGRs. The Department may consult with other relevant government agencies in making this decision. If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require the proponent to revise the Environmental Assessment to address the matters notified to the proponent. Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days.

If your proposal includes any actions that could have a significant impact on matters of National Environmental Significance, it will require an additional approval under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). This approval would be in addition to any approvals required under NSW legislation and it is your responsibility to contact the Department of Environment, Heritage, Water and the Arts to determine if an approval under the EPBC Act is required for your proposal (6274 1111 or http://www.environment.gov.au).

Please note that the Commonwealth Government has accredited the NSW environmental assessment process for assessing impacts on matters of National Environmental Significance. As a result, if it is determined that an approval is required under the EPBC Act, please contact the Department immediately as supplementary Director-General's requirements will need to be issued.

If you have any enquiries about these requirements, please contact Diane Fajmon, Senior Environmental Planning Officer, Major Infrastructure Assessments on 02 9228 6370 or via email (diane.fajmon@planning.nsw.gov.au).

Yours sincerely

SHaddad

Sam Haddad
**Director General**
6/4/2009.

# Director-General's Requirements

**Section 75F of the *Environmental Planning and Assessment Act 1979***

| | |
|---|---|
| **Application number** | 09_0049 |
| **Project** | Upgrade of the M2 Motorway between Windsor Road, Baulkham Hills, and Dehli Road, North Ryde |
| **Location** | In and around the existing M2 Motorway corridor, in the Ryde, Hornsby and Baulkham Hills local government areas |
| **Proponent** | NSW Roads and Traffic Authority |
| **Date issued** | 6 April 2009 |
| **Expiry date** | 6 April 2011 |
| **General requirements** | The Environmental Assessment must include the following:<br>1. an **executive summary**.<br>2. a **description** of the project including:<br>▪ route alignment of the project, including an indication of areas for widened or new carriageways, on/ off ramps, breakdown lanes and associated and ancillary facilities;<br>▪ key design elements of the project, including carriageway, tunnel and bridging works;<br>▪ ancillary operational components, including upgrades to the Motorway's Intelligent Transport Systems, upgrades to toll facilities, park and ride facilities, cycle facilities, signals and connections with the surrounding road network; and<br>▪ construction facilities, including construction compounds, lay-down areas and spoil stockpiling/ management areas.<br>3. an **assessment of the key issues**, with the following aspects addressed for each key issue (where relevant):<br>▪ description of the existing environment;<br>▪ assessment of the potential impacts (direct and indirect) of the project for both construction and operation stages, in accordance with relevant policies and guidelines;<br>▪ identification of how relevant planning, land use and development matters, (including relevant strategic and statutory matters), have been considered in the impact assessment and/ or in developing management/ mitigation measures; and<br>▪ description of measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the project; and<br>▪ any residual impacts.<br>4. a **draft Statement of Commitments** incorporating or otherwise capturing measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the impact assessment sections of the Environmental Assessment. The Statement of Commitments must clearly articulate the desired environmental outcome of the commitment. The Statement of Commitments must be achievable, measurable (with respect to compliance), and time-specific, where relevant.<br>5. **certification** by the author of the Environmental Assessment that the information contained in the Assessment is neither false nor misleading. |
| **Key issues** | ▪ **Strategic Justification** – the Environmental Assessment must outline the strategic need and justification for the project, taking into account existing and proposed transport infrastructure and services within the adjoining subregions, and as relevant the outcomes and objectives of the *State Plan* (2006), *City of Cities: A Plan for Sydney's Future* (2005) (the "Metropolitan Strategy") and the accompanying draft subregional strategies, and the NSW Government's *Urban Transport Statement* (November, 2006).<br>▪ **Project Justification** – the Environmental Assessment must justify the project and its components taking into consideration the objects of the *Environmental Planning and Assessment Act 1979.* This justification must include an assessment of alternatives considered, demonstrate that the project will enhance the use of public transport and that the project will not unduly induce traffic and exacerbate congestion |

| | |
|---|---|
| | in the medium to longer term within the adjoining subregions. The assessment must specifically address how the proposed park and ride facility will enhance public transport patronage, including a cost benefit analysis.<br>▪ **Operational Traffic and Transport Implications** – the Environmental Assessment must include an assessment of the operational impacts of the project, including traffic levels on the M2 Motorway and the impacts on the surrounding road network, including any impacts on the Lane Cove Tunnel, the M7 Westlink Motorway, and the surrounding local and regional road network. The assessment must also consider operational implications for public transport (particularly with respect to bus routes, interchanges and connections with the rail network), impacts on cyclists and cycle access, and any impacts on pedestrian access and safety (for those ancillary works around the Motorway corridor, as relevant).<br>▪ **Operational Noise Impacts** – the Environmental Assessment must include an assessment of the noise impacts of the project during operation, consistent with the *Environmental Criteria for Road Traffic Noise* (EPA, 1999). The assessment must include specific consideration of impacts to sensitive receivers (schools, hospitals, aged care facilities), as relevant.<br>▪ **Impacts on Ecology** – the Environmental Assessment must include an assessment of the potential ecological impacts of the project, with specific reference to the need for vegetation clearing, habitat and connectivity implications, edge effects, and stormwater and watercourse implications. The Environmental Assessment must make specific reference to impacts on threatened species, populations and communities, including the Sydney Turpentine-Ironbark Forest and Blue Gum High Forest Endangered Ecological Communities, and the native fauna that may utilise those communities. The Environmental Assessment shall demonstrate that the extent of vegetation clearing has been minimised through the design of the project, and shall include details of any off-set measures that may be proposed.<br>▪ **Urban Design and Landscaping Issues** – the Environmental Assessment must include consideration of the urban design and landscape implications of the project, including identification of urban design and landscaping objectives to enhance the current road corridor and to demonstrate how the proposed urban design elements of the project would be consistent with the existing (and desired) character of the area.<br>▪ **Aboriginal Cultural Heritage** – the Environmental Assessment must include an assessment of the potential Aboriginal cultural heritage impacts of the project, including an assessment of objects, places of significance, natural and landscape values of the corridor and surrounding area, taking into account the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, July 2005).<br>▪ **General Construction Impacts** – the Environmental Assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed. The Environmental Assessment must include consideration of, and a management framework for:<br>  ▪ construction noise and vibration, including a considered approach to scheduling construction works having regard to the nature of construction activities (including transport, blasting and tonal or impulsive noise-generating works, as relevant), the intensity and duration of noise and vibration impacts, the nature, sensitivity and impact to potentially-affected human receivers and structures, the need to balance timely conclusion of noise and vibration-generating works with periods of receiver respite, and other factors that may influence the timing and duration of construction activities (such as traffic management). The Environmental Assessment must also present a strategy for monitoring and mitigating construction noise and vibration, with a particular focus placed on those activities identified as having the greatest potential for adverse noise or vibration impacts, and a broader, more generic approach developed for lower-risk activities;<br>  ▪ construction traffic including a considered approach to route identification and scheduling of transport movements, the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles), the nature of existing traffic on construction access routes (with 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. The Environmental Assessment must also present a strategy for managing 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; and<br>▪ erosion, sedimentation, water quality and riparian management issues for works in and around watercourse crossings. The Environmental Assessment must specifically consider how construction of the project will be undertaken and managed to minimise the potential for impacts on riparian vegetation, fish passage and water quality in watercourses for the duration of construction works.<br>▪ **Environmental Risk Analysis –** notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the Environmental Assessment. |
| **Consultation** | The Environmental Assessment must reflect an appropriate and justified level of consultation with relevant stakeholders during the preparation of the Environmental Assessment, including:<br>▪ the Department of Environment and Climate Change;<br>▪ the Department of Water and Energy;<br>▪ the Department of Primary Industries;<br>▪ Ryde City Council, Hornsby Shire Council and Baulkham Hills Shire Council; and<br>▪ relevant public stakeholders, including special interest groups and affected landowners.<br><br>The Environmental Assessment must outline the consultation process, document all community consultation undertaken to date and identify the issues raised (including where these have been addressed in the Environmental Assessment). |

# Appendix C Director-General's Requirements Checklist

| Requirement | Where addressed |
|---|---|
| **General Requirements** | |
| An executive summary | Executive Summary |
| A description of the project including: | Chapter 6 and Chapter 7 |
| ▪ Route alignment of the project, including an indication of areas for widened or new carriageways, on/off ramps, breakdown lanes and associated and ancillary facilities. | Sections 6.2, 6.3 |
| ▪ Key design elements of the project, including carriageway, tunnelling and bridging works. | Sections 6.2, 6.3 |
| ▪ Ancillary operational components, including upgrades to the M2 Motorway's Intelligent Transport Systems, upgrades to toll facilities, park and ride facilities, cycle facilities, signals and connections with the surrounding road network. | Section 6.4 |
| ▪ Construction facilities, including construction compounds, lay-down areas and spoil stockpiling/management areas. | Section 7.8 |
| An assessment of the key issues, with the following aspects addressed for each key issue (where relevant): | Chapter 9, Technical Papers. |
| ▪ Description of the existing environment. | Chapter 9, Technical Papers |
| ▪ Assessment of potential impacts (direct and indirect) of the project for both construction and operation stages, in accordance with relevant policies and guidelines. | Chapter 9, Technical Papers |
| ▪ Identification of how relevant planning, land use and development matters (including relevant strategic and statutory matters), have been considered in the impact assessment and/or in developing management/mitigation measures. | Chapter 4, Chapter 9, Technical Papers |
| ▪ Description of measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the project. | Chapter 9, Technical Papers |
| ▪ Any residual impacts | Chapter 8, Chapter 9 and Technical Papers |
| A draft Statement of Commitments incorporating or otherwise capturing measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the impact assessment Chapters of the environmental assessment. The Statement of Commitments must clearly articulate the desired environmental outcome of the commitment. The Statement of Commitments must be achievable, measurable (with respect to compliance), and time-specific, where relevant. | Chapter 11 |
| Certification by the author of the environmental assessment that the information contained in the Assessment is neither false nor misleading. | Statement of validity. |
| **Key Issues** | |
| Strategic justification: | |
| the environmental assessment must outline the strategic need and justification for the project, taking into account existing and proposed transport infrastructure and services within the adjoining subregions, | Sections 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6 |
| and as relevant the outcomes and objectives of the *State Plan* (2006), *City of Cities: A Plan for Sydney's Future* (2005) (the "Metropolitan Strategy") and the | Sections 2.2.1, 2.2.2, 2.2.3, 2.2.4 |

| Requirement | Where addressed |
|---|---|
| accompanying draft subregional strategies, and the NSW Government's *Urban Transport Statement* (November, 2006). | |
| Project justification: | |
| the environmental assessment must justify the project and its components taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*. | Chapter 12 |
| This justification must include an assessment of alternatives considered, | Chapter 3 |
| demonstrate that the project will enhance the use of public transport, | Sections 3.1, 9.1 |
| demonstrate that the project will not unduly induce traffic and exacerbate congestion in the medium to longer term within the adjoining subregions. | Sections 3.1, 9.1 |
| The assessment must specifically address how the proposed park and ride facility will enhance public transport patronage, including a cost benefit analysis. | Section 3.1.3 |
| Operational traffic and transport implications: | |
| ▪ The environmental assessment must include an assessment of the operational impacts of the project, including traffic levels on the M2 Motorway and the impacts on the surrounding road network, including any impacts on the Lane Cove Tunnel, the M7 Westlink Motorway, and the surrounding local and regional road network. | Section 9.1.2, Technical Paper 1 |
| ▪ The assessment must also consider operational implications for public transport (particularly with respect to bus routes, interchanges and connections with the rail network), impacts on cyclists and cycle access, and any impacts on pedestrian access and safety (for those ancillary works around The M2 corridor, as relevant). | Sections 6.3.2, 9.1.2, Technical Paper 1 |
| Operational noise impacts: | |
| ▪ The environmental assessment must include an assessment of the noise impacts of the project during operation, consistent with the *Environmental Criteria for Road* Traffic *Noise* (EPA, 1999). The assessment must include specific consideration of impacts to sensitive receivers (schools, hospitals, aged care facilities), as relevant. | Section 9.3, Technical Paper 2 |
| Impacts on ecology: | |
| ▪ The environmental assessment must include an assessment of the potential ecological impacts of the project, with specific reference to the need for vegetation clearing, habitat and connectivity implications, edge effects, and stormwater and watercourse implications. | Section 9.5.2, Technical Paper 3 |
| ▪ The environmental assessment must make specific reference to impacts on threatened species, populations and communities, including the Sydney Turpentine-Ironbark Forest and Blue Gum High Forest Endangered Ecological Communities, and the native fauna that may utilise those communities. | Sections 9.5.1, 9.5.2, Technical Paper 3 |
| ▪ The environmental assessment shall demonstrate that the extent of vegetation clearing has been minimised through the design of the project, and shall include details of any off-set measures that may be proposed. | Section 9.5.3, Technical Paper 3 |
| Urban design and landscaping issues: | |
| ▪ The environmental assessment must include consideration of the urban design and landscape implications of the project, including identification of urban design and landscaping objectives to enhance the current road corridor and to demonstrate how the proposed urban design elements of | Sections 9.6.2, 9.6.3, 6.5.2, Technical Paper 4 |

| Requirement | Where addressed |
|---|---|
| the project would be consistent with the existing (and desired) character of the area. | |
| Aboriginal cultural heritage: | |
| ▪ The environmental assessment must include an assessment of the potential Aboriginal cultural heritage impacts of the project, including an assessment of objects, places of significance, natural and landscape values of the corridor and surrounding area, taking into account the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, July 2005). | Section 9.7, Technical Paper 5 |
| General construction impacts – the environmental assessment must consider the potential impacts associated with the construction of the project, and present a management framework for construction works to ensure that impacts are mitigated, monitored and managed. The environmental assessment must include consideration of, and a management framework for: | Chapter 7, Chapter 9, Appendix F |
| ▪ Construction noise and vibration, including a considered approach to scheduling construction works having regard to the nature of construction activities (including transport, blasting and tonal or impulsive noise-generating works, as relevant), the intensity and duration of noise and vibration impacts, the nature, sensitivity and impact to potentially-affected human receivers and structures, the need to balance timely conclusion of noise and vibration-generating works with periods of receiver respite, and other factors that may influence the timing and duration of construction activities (such as traffic management). The environmental assessment must also present a strategy for monitoring and mitigating construction noise and vibration, with a particular focus placed on those activities identified as having the greatest potential for adverse noise or vibration impacts, and a broader, more generic approach developed for lower-risk activities. | Section 9.4, Technical Paper 2 |
| ▪ Construction traffic including a considered approach to route identification and scheduling of transport movements, the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles), the nature of existing traffic on construction access routes (with 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. The environmental assessment must also present a strategy for managing 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 9.2, Technical Paper 1 |
| ▪ Erosion, sedimentation, water quality and riparian management issues for works in and around watercourse crossings. The environmental assessment must specifically consider how construction of the project will be undertaken and managed to minimise the potential for impacts on riparian vegetation, fish passage and water quality in watercourses for the duration of the construction works. | Section 9.8.2, 9.8.3, Technical Paper 6 |
| Environmental risk analysis – notwithstanding the above key assessment requirements, the environmental assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of the proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the | Chapter 8 |

| Requirement | Where addressed |
|---|---|
| environmental assessment. | |
| **Consultation** | |
| The environmental assessment must reflect an appropriate and justified level of consultation with relevant stakeholders during the preparation of the environmental assessment, including:<br>▪ The Department of Environment and Climate Change.<br>▪ The Department of Water and Energy.<br>▪ The Department of Primary Industries.<br>▪ Ryde City Council, Hornsby Shire Council and Baulkham Hills Shire Council.<br>▪ Relevant public stakeholders, including special interest groups and affected landowners. | Chapter 5 |
| The environmental assessment must outline the consultation process, document all community consultation undertaken to date and identify the issues raised (including where these have been addressed in the environmental assessment). | Chapter 5 |

# Appendix D Consultation summary

# 1 Introduction

## 1.1 Purpose of appendix

The purpose of this appendix is to provide supporting documentation and further detail on community and stakeholder engagement and consultation activities undertaken for the M2 Upgrade during the preparation of the environmental assessment. The appendix also provides an overview of consultation planned for future project phases. This document should be read in conjunction with Chapter 4 of the Environmental Assessment.

# 2 Consultation activities and outcomes

As detailed in Chapter 4, the M2 Upgrade's engagement program proactively informs and involves stakeholders and community members at each stage of the project. By maximising public access to information and feedback channels, the engagement approach aims to increase awareness and understanding of the project and encourage participation in consultation activities.

In summary, the engagement approach enables the project to benefit from greater insight into the community's issues, priorities and perspectives on mitigation strategies and opportunities to improve project outcomes.

During preparation of the environmental assessment, phase one of the engagement program has focused on engaging with state and local government authorities and targeted stakeholders identified by the DGRs including interest groups and affected landowners. In conjunction with targeted stakeholder consultation, the M2 corridor community and general public have also been engaged.

Section 3 provides details of how feedback data has been managed.

The following tables provide an overview of stakeholder and community consultation to date, including:

- A consultation timeline – Table 2.1.
- A summary of activities undertaken with each stakeholder group – Table 2.2.
- A qualitative summary of consultation activities – Table 2.3.
- A quantitative summary of consultation activities – Table 2.4.

Table 2.1 Phase one consultation timeline

| Timing | Milestone |
|---|---|
| February 2009 | |
| February | Commencement of project declaration process |
| March 2009 | |
| 19 Mar | Planning focus meeting |
| April 2009 | |
| 6 Apr | Director General's Requirements issued |
| October 2009 | |
| 13 Oct | Media release on in-principle agreement for M2 Upgrade |
| November 2009 | |
| 10 Nov – 11 Dec | Briefings to interest groups |

| Timing | Milestone |
|---|---|
| 12 Nov – 19 Nov | Briefings to councils |
| 13 Nov | Website launched for M2 Upgrade |
| 13 Nov | Telephone number established for M2 Upgrade |
| 16 Nov | Letterbox drop – M2 corridor community |
| 17 Nov – 13 Jan 10 | Working groups for transport and cyclists |
| 18 Nov – 17 Dec | Briefings to MPs |
| 26 Nov 09 | Shopping centre display - Macquarie Shopping Centre, Marsfield |
| 28 Nov 09 | Shopping centre display - Winston Hills Shopping Centre, Winston Hills |
| 30 Nov 09 – 17 Dec | Meetings with interest groups |
| December 2009 | |
| 2 Dec – 4 Jan 10 | Meetings with affected landowners |
| 10 Dec – 29 Jan 10 | Council cycle way meetings |
| 11 Dec | Meetings with Aboriginal heritage groups |
| 15 – 17 Dec | Site visits with Aboriginal heritage groups |

Table 2.2 Phase one stakeholder groups and consultation activities

| Category | Stakeholder | Consultation activity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning focus meeting | Letter | Telephone | Advertising | M2 corridor community letterbox drop | Briefing | Site visit | Working group | Council cycle way meeting | Display | Affected landowner meeting | Other meeting |
| Government | | | | | | | | | | | | | |
| | State Agencies | | | | | | | | | | | | |
| | NSW Dept of Planning | x | | | | | | | | | | | |
| | Department of Environment and Climate Change | x | | | | | | | | | | | |
| | Department of Primary Industries | x | | | | | | | | | | | |
| | NSW Dept of Transport and Infrastructure | | | | | | x | | x | | | | |
| | NSW Dept of Education and Training | | | | | | x | | | | | | |
| | Roads and Traffic Authority | | | | | | | | | | | | |
| | Ministers of Parliament | | | | | | | | | | | | |
| | Victor Dominello MP, Member for Ryde | | x | x | | | | | | | | | |

| Category | Stakeholder | Planning focus meeting | Letter | Telephone | Advertising | M2 corridor community letterbox drop | Briefing | Site visit | Working group | Council cycle way meeting | Display | Affected landowner meeting | Other meeting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alex Hawke MP, Member for Mitchell | | x | x | | | | | | | | | |
| | Hopwood, Judy MP, Member for Hornsby | | x | x | | | | | | | | | |
| | Maxine McKew MP, Member for Bennelong | | x | x | | | | | | | | | |
| | Wayne Merton MP, Member for Baulkham Hills | | x | x | | | | | | | | | |
| | Michael Richardson MP Member for Castle Hill | | x | x | | | x | | | | | | |
| | Greg Smith MP, Member for Epping | | x | x | | | x | | | | | | |
| | Phillip Ruddock MP Member for Berowra | | x | x | | | x | | | | | | |
| | Local Government | | | | | | | | | | | | |
| | Blacktown City Council | | x | | | | x | | | | | | |
| | City of Ryde Council | | x | | | | x | | | x | | x | |
| | Hornsby Shire Council | | x | | | | x | | | x | | | x |
| | Lane Cove Council | | x | | | | x | | | | | | |
| | Parramatta City Council | | x | | | | x | | | x | | | |
| | The Hills Shire Council | | x | | | | x | | | x | | | x |
| | Northern Sydney Regional of Councils (NSROC) | | x | | | | | | | | | | |
| | Western Sydney Regional of Councils (WSROC) | | x | | | | | | | | | | |
| Interest group | | | | | | | | | | | | | |
| | Motorway Network | | | | | | | | | | | | |
| | M7 West Link | | x | | | | | | | | | | |
| | Connector Motorways | | x | | | | x | | | | | | |
| | Transport and emergency services | | | | | | | | | | | | |
| | NRMA | | x | x | | | | | | | | | |
| | NSW Taxi Council | | x | | | | x | | | | | | |
| | Australian Trucking Association | | x | | | | | | | | | | x |

| Category | Stakeholder | Consultation activity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning focus meeting | Letter | Telephone | Advertising | M2 corridor community letterbox drop | Briefing | Site visit | Working group | Council cycle way meeting | Display | Affected landowner meeting | Other meeting |
| | Hillsbus | | x | | | | x | | x | | | | |
| | Bus and Coach Association | | x | | | | | | | | | | |
| | Ambulance Service NSW | | x | | | | x | | | | | | |
| | NSW Fire Brigades | | x | | | | x | | | | | | |
| | NSW Police Force | | x | | | | x | | | | | | |
| | Busways Group | | | | | | | | x | | | | |
| | Cyclists | | | | | | | | | | | | |
| | Bicycle NSW | | x | | | | x | | x | | | | |
| | Bike North | | x | | | | x | | x | | | | |
| | CAMWEST | | x | | | | x | | x | | | | |
| | Social/environment groups – West | | | | | | | | | | | | |
| | The Willows Retirement Village | | x | | | | | | | | | | |
| | Royal Institute for Deaf and Blind Children | | x | | | | | | | | | | |
| | Pennant Hills Civic Trust | | x | | | | x | | | | | | |
| | Excelsior Park Bushland Society | | x | | | | x | | | | | | |
| | Winston Hills Neighbourhood Watch | | x | | | | | | | | | | |
| | West Pennant Hills Valley Progress Association | | x | | | | x | | | | | | |
| | The Hills Shire Council Bushland Conservation Committee | | x | | | | x | | | | | | |
| | Bidjigal Reserve Trust | | x | | | | | | | | | | |
| | Social/environment groups – East | | | | | | | | | | | | |
| | Poplars Private Hospital | | x | | | | | | | | | | |
| | Chesalon Care Beecroft Nursing Home | | x | | | | | | | | | | |
| | Ray Park Heritage Group | | x | | | | x | | | | | | x |
| | Beecroft Cheltenham Scouts Group | | x | | | | | | | | | | |
| | Beecroft Cheltenham Civic | | x | | | | x | | | | | | x |

| Category | Stakeholder | Consultation activity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning focus meeting | Letter | Telephone | Advertising | M2 corridor community letterbox drop | Briefing | Site visit | Working group | Council cycle way meeting | Display | Affected landowner meeting | Other meeting |
| | Trust | | | | | | | | | | | | |
| | Beecroft Chilworth Bushcare | | x | | | | x | | | | | | x |
| | Epping Civic Trust | | x | | | | x | | | | | | x |
| | Economic and business groups – West | | | | | | | | | | | | |
| | Sydney Hills Business Chamber | | x | | | | x | | | | | | |
| | ResMed | | x | | | | | | | | | | |
| | Woolworths Ltd | | x | | | | | | | | | | |
| | Parramatta City Chamber of Commerce | | x | | | | | | | | | | |
| | Economic and business groups – East | | | | | | | | | | | | |
| | Ryde Business Forum | | x | | | | x | | | | | | |
| | Optus Singtel | | x | | | | | | | | | | |
| | AMP Capital | | x | | | | | | | | | | |
| | Macquarie Centre | | x | | | | | | | | | | |
| | Macquarie University | | x | | | | x | | | | | | |
| | Microsoft | | x | | | | | | | | | | |
| | Johnson and Johnson | | x | | | | | | | | | | |
| | SanofiAventis | | x | | | | | | | | | | |
| | Foxtel | | x | | | | x | | | | | | |
| | Eden Gardens and Garden Centre | | x | | | | | | | | | | |
| | Colliers International | | x | | | | | | | | | | |
| | Contract Pharmaceutical Services of Australia Pty Ltd (CPSA) | | x | | | | | | | | | | |
| | Canon Australia Pty. Ltd. | | x | | | | | | | | | | |
| | Beiersdorf Australia Ltd. | | x | | | | | | | | | | |
| | Eli Lilly Australia Pty. Ltd. | | x | | | | | | | | | | |
| | Knight Frank Australia | | x | | | | | | | | | | |
| | Macquarie Park Chamber | | | | | | x | | | | | | |
| | M2 corridor Schools | | | | | | | | | | | | |
| | Our Lady of Lourdes Primary School, Baulkham Hills | | x | | | | x | | | | | | x |

| Category | Stakeholder | Consultation activity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning focus meeting | Letter | Telephone | Advertising | M2 corridor community letterbox drop | Briefing | Site visit | Working group | Council cycle way meeting | Display | Affected landowner meeting | Other meeting |
| | Epping Heights Public School, Epping | | x | | | | x | | | | | | |
| | Muirfield High School | | x | | | | | | | | | | |
| | Epping Boys High School | | x | | | | | | | | | | |
| | Model Farms School | | x | | | | | | | | | | |
| | Winston Hills Public School | | x | | | | | | | | | | |
| Affected landowners | | | | | | | | | | | | | |
| | Properties impacted by surface partial-property acquisition | | x | x | | x | | | | | | x | |
| | Properties impacted by sub-surface property acquisition | | x | x | | x | | | | | | | |
| | Properties impacted by noise wall changes (Tier 1 and Tier 2) | | x | x | | x | | | | | | | |
| | Properties impacted by services and geotechnical investigations | | x | x | | x | | | | | | | |
| Indigenous community | | | | | | | | | | | | | |
| | Yarrawalk | | | x | x | | | x | | | | | x |
| | Darug Aboriginal Cultural Heritage Assessment | | | x | x | | | x | | | | | x |
| | Darug Land Observations | | | x | x | | | x | | | | | x |
| | Darug Custodian Aboriginal Corporation | | | x | x | | | x | | | | | x |
| Local M2 corridor community | | | | | | | | | | | | | |
| | Householders and businesses located in the M2 corridor | | | | | x | | | | | x | | |
| General public | | | | | | | | | | | | | |
| | General community and M2 Motorway users | | | | | | | | | | x | | |

Table 2.3 Phase one key consultation activity qualitative outcomes

| Activity | Description | Outcome |
|---|---|---|
| Project Media Releases | Issued by RTA and Transurban on 13 October 2009 advising of the project announcement, overview of the project scope, benefits, approvals process and funding model. | Awareness – Media releases generated TV, radio and newspaper coverage. |
| Project Web Site | Established 13 November 2009. Key items currently on the website include: fact sheet, media release links, project documentation including Project announcement and Director General Requirements, fact sheets, media archive, question and answer document, scope map and drive through animation. The project website will be updated at key milestones with the latest project information. | Awareness – Website has attracted 1043 unique website visits since its launch. |
| Community Fact sheet / Update | A project fact sheet was posted to the website and distributed at all briefings and meetings. The fact sheet provided an overview of the project's background, scope, benefits and assessment process. A further fact sheet/ update will be distributed in the first quarter 2010. This update will provide an overview of project progress, future public exhibition and details of how community members can make a submission. | Awareness – Provides a summary of the project scope and the environmental assessment. |
| Project Telephone line and Email address | The project's community relations team facilitates responses to community and stakeholders' enquiries via email and telephone. | Engagement – Provides timely responses to community enquiries with all community contact recorded in the project's contact data base. |
| Correspondence Response | A range of community members and stakeholders have sent correspondence to the project, the RTA, their local Member of Parliament or the Minister for Transport. | Engagement - Correspondence has received a formal tailored response providing information available to date. |
| Community Subscriber Register | Community members have been invited to register their interest in receiving project updates by registering their contact details on line over the telephone when speaking with a project team member. | Engagement – Over 339 subscribers have registered. |
| M2 corridor Community Correspondence | The unaddressed letter was issued 16 November 2009 to both householders and businesses located in the M2 corridor and advised readers of project announcement, project scope, approvals process, project contact details, shopping centre display details and website location for further information. | Awareness - The letter was distributed to over 7,000 properties. |
| Shopping Centre Displays | Staffed displays were held on 26 and 28 November 2009 at the Macquarie and Winston Hills shopping centres. Communication tools at each display included the project fact sheet, project scope maps, the environmental approvals process map, feedback sheets and registration forms. M2 corridor community members received an invitation to attend via correspondence issued on 16 November 2009. | Awareness and engagement – Approximately 140 community members attended the Macquarie Centre display and 180 attended the Winston Hills display. Attendees contributed comments on feedback sheets. Attendees interested in receiving future project information and updates recorded contact details on registration forms. |

| Activity | Description | Outcome |
|---|---|---|
| Planning Focus Meeting | The Planning Focus Meeting was held in March 2009 with NSW Dept of Planning, Department of Environment and Climate Change, Department of Primary Industries, NSW Dept of Transport and Infrastructure, NSW Dept of Education and Training and the Roads and Traffic Authority. | Engagement – The meeting provided participants with project information and commenced discussions on key project issues and the environmental assessment. |
| MP Briefings | Briefings to State and Federal Members of Parliament in November to December 2009 provided an overview of the proposed project, approvals process and construction approach. | Engagement – Discussion included participants' views on potential issues, impact mitigation strategies and opportunities to improve project outcomes. |
| Council Briefings | Briefings in November 2009 to January 2010 were provided to councils as required under the Director General's Requirements. These included City of Ryde Council, Hornsby Shire Council, and The Hills Shire Council.<br>Additionally briefings were provided to Parramatta City Council, Blacktown City Council and Lane Cove Council due to their close proximity to the project.<br>Briefings provided an overview of the proposed project, approvals process and construction approach. | Engagement – Discussion included participants' views on potential issues, impact mitigation strategies and opportunities to improve project outcomes. |
| Interest Group Briefings | Briefings in November to December 2009 were provided to social, economic, environmental, transport and cyclist interest groups. Attendance at the briefings was by invitation issued to all identified stakeholder groups.<br>Briefings provided an overview of the proposed project, approvals process and construction approach. | Engagement – Discussion included participants' views on potential issues, impact mitigation strategies and opportunities to improve project outcomes.<br>Participants contributed further detailed comments on Feedback sheets. |
| Transport Working Group | Following the Transport Interest Group briefing, a working group was established to allow transport stakeholders and project team members to work together at a greater level of detail, examining design issues.<br>The Transport Working Group included participants from NSW Transport and Infrastructure, Hillsbus and Busways.<br>This group met on a regular basis from November 2009 and has focused on areas including: T2 lane, removal of the Beecroft Road bus ramps, broader M2 corridor issues and construction impacts. | Engagement - Key outcomes of the transport working group have included agreement on:<br>• The tidal bus lane arrangement during construction.<br>• Timing of closure of the Beecroft Road bus ramp. |
| Cyclist Working Group | Following the Cyclist Interest Group briefing, a working group was established to allow cyclist stakeholders and project team members to work together at a greater level of detail, examining design issues.<br>The Cyclist Working Group included participants from Bicycle NSW, Bike North and Camwest.<br>This group met from November 2009 and has focused on the design of the alternate route for cyclists during construction. | Engagement – Key outcomes of the cyclist working group have included consideration of cyclist requirements regarding:<br>• The alternate route.<br>• Safety.<br>• Gradients.<br>• Connectivity. |

| Activity | Description | Outcome |
|---|---|---|
| Council Cycle Way Meetings | Following the Council briefings, meetings were held in December 2009 to February 2010 with council officers responsible for cycle and pedestrian ways. | Engagement – Council input on cyclist and pedestrian issues was considered in conjunction with input from the Cyclist Working Group described above. |
| Affected Landowner Consultation | Properties impacted by surface partial-property acquisition:<br>Consultation with those potentially affected by surface partial-property acquisition was undertaken from November 2009 to February 2010. This has included correspondence, telephone contact, email enquiries and multiple site meetings to address each individual site's specific impacts, property adjustment design and access requirements, property acquisition and valuation processes. | Engagement - Property owners are engaged in the RTA's formal property acquisition process and are liaising with the project team regarding property adjustments and access arrangements. This process is ongoing |
| | Properties impacted by sub-surface property acquisition:<br>Consultation with those potentially affected by sub-surface property acquisition was undertaken from November 2009 to February 2010. This has included correspondence, email enquiries and telephone interviews to explain rock bolt installation for tunnel works and the relevant property acquisition process. | Engagement - Property owners are engaged in the RTA's formal property acquisition process. This process is ongoing. |
| | Properties impacted by noise wall changes:<br>The consultation program has applied a principle of providing early advice to potentially indirectly affected properties.<br>All noise wall changes will occur inside the Motorway lease boundary and will not require property acquisition or directly impact private property.<br>Consultation with nearby land owners has initially included correspondence.<br>Future consultation will include correspondence, face to face meetings, visual materials to show noise wall locations and changes, information regarding the construction process. | Engagement – Neighbouring property owners are aware of noise wall changes. The project team has responded to property owners initially questions. This process is ongoing. |
| | Properties impacted by services and geotechnical investigations:<br>Consultation with this group has included correspondence and response to telephone and email enquiries. | Awareness – Property owners in the vicinity of investigations have been provided information on the nature of investigations, timing and likely impact of the work. |

Table 2.4 Phase one consultation activity quantitative data

| Communication method | Incoming as at 31 January 2010 |
|---|---|
| Telephone calls in from stakeholders | 30 |
| Telephone calls out to stakeholders | 13 |
| Letters in | 3 |
| Letters out (addressed) | 166 |
| Letterbox drop – M2 corridor community letter (unaddressed) | 7000 |
| Letterbox drop – geotechnical investigations (unaddressed) | 209 |
| Emails in | 216 |
| Emails out | 78 |
| Faxes out | 1 |
| Website visits to www.hillsm2upgrade.com.au | 1043 |
| Petitions | 1 |
| Displays held | 2 |
| Attendance at staffed displays | 320 |
| Affected landowner meetings | 9 |
| Briefings and meetings | 36 |
| Community information subscriptions for Project updates | 339 |

# 3 Feedback data management

## 3.1 Community consultation data management

All questions and issues arising from consultation activities have been recorded in the project's feedback data base. Feedback was gathered from briefings and meetings, feedback sheets and correspondence sent to the project team, RTA, local members of parliament and the Minister for Transport. These inputs have been analysed and considered in the preparation of the environmental assessment.

Documentation and analysis of community feedback to identify issues is a key element of the engagement process. Rigorous data management enables transparent and comprehensive consideration of feedback in conjunction with the technical inputs, specialist studies and value management design studies.

Consolidation and analysis of issues is provided in Chapter 4 with references identifying where issues are addressed in the environmental assessment. To consolidate the inputs, issues were categorised by topic, to allow similar issues to be grouped together.

Each issue was allocated to one of the six following categories:

- Functional (e.g. design, engineering, traffic management).
- Construction.
- Environment.
- Social.
- Economic.
- Process (e.g. planning, approval, consultation processes).

Some wording of issues documented in Chapter 4 have been modified or abbreviated where appropriate to allow consolidation of issues raised by multiple contributors. Every attempt has been made to maintain the integrity of issues raised. Wording has also been adjusted to represent all elements of the issues as raised by different contributors.

All issues were provided to the environmental assessment's specialists and have been considered in a coordinated review process.

All information recorded is used and managed in accordance with the Privacy Act 1988.

# 4 Phase one consultation activities

This section outlines further detail of activities undertaken during the preparation of the environmental assessment, and includes:

- Media releases.
- Letterbox drop.
- Project telephone and email address.
- Website.
- Information subscription register.
- Project fact sheet.
- Briefings, meetings and working groups.
- Affected landowner consultation.
- Feedback forms.
- Displays.
- Correspondence.
- Stakeholder database.

## 4.1 Media releases

A media release was issued by the RTA on behalf of the Minister for Transport, David Campbell MP on 13 October 2009. The release announced the project, provided an overview of the project scope, project benefits, approvals process and a funding model. On the same day Transurban issued a release to the Australian Stock Exchange.

Table 4.1.1 Media release issued by the RTA

**MEDIA RELEASE**

**David Campbell MP**
**Minister for Transport**
**Minister for the Illawarra**

NSW GOVERNMENT

**IN-PRINCIPLE AGREEMENT REACHED FOR M2 UPGRADE**

**Tuesday 13 October 2009**

Minister for Transport David Campbell today said the NSW Government and Transurban, the owner of the Hills M2, had signed an in-principle agreement to develop a major upgrade of the motorway.

Mr Campbell welcomed the in-principle agreement, which provided a green light for further design work, and an environmental assessment to proceed, in consultation with the community.

"This is great news for the thousands of bus commuters and motorists who use the M2 every day," Mr Campbell said.

"The upgrade will reduce peak hour congestion and provide new access points to Sydney's fastest growing business and residential centres. It has a current cost estimate of $550 million.

"The project will also provide a significant jobs boost with an estimated 800 new direct jobs and 2,400 indirect jobs created through the life of the project.

"The M2, from Old Windsor Road, Baulkham Hills to Epping Road, North Ryde, is one of Sydney's busiest transport corridors, with 17,000 bus commuters and more than 100,000 motorists using it each work day."

Mr Campbell said the upgrade would be funded by Transurban, with the NSW Government contributing by extending the M2 concession by four years, and allowing for a one-off increase in the toll of around 8 per cent on completion of the work.

"The upgrade will include widening the tunnel in both directions and reinstating the emergency breakdown lane westbound between Lane Cove Road and Beecroft Road, used by cyclists," Mr Campbell said.

"The speed limit will also be lifted to 100kmh and access from the Sydney orbital to Windsor Road and Macquarie Park will be greatly improved."

The in-principle agreement was reached following negotiations over the technical and commercial details of the project.

The upgrade will also include:

- New west facing Windsor Road on and off ramps
- An additional eastbound lane from Windsor Road to Pennant Hills Road
- An additional eastbound lane from Pennant Hills Rd through M2 Tunnel to Lane Cove Road
- New Christie Road eastbound on ramp
- New Herring Road westbound off ramp
- Widening between Lane Cove Road and Beecroft Road to reinstate the 3.5 metre traffic lanes and 2.5 metre breakdown shoulder
- Additional lane westbound from Beecroft Road to Pennant Hills Road.

M2 toll points will be based at new ramps on Windsor Road, Christie Road and Herring Road. The toll will be introduced once the new ramps and lanes are open to traffic.

Transurban CEO Chris Lynch said the in-principle agreement was a great step forward for a project that would demonstrate the benefits of Government partnering with the private sector to meet Sydney's infrastructure needs.

"We are pleased to have reached an in-principle agreement with the NSW Government and will continue to work closely with them over the next year to finalise the agreement and deliver much needed congestion relief to this busy corridor," Mr Lynch said.

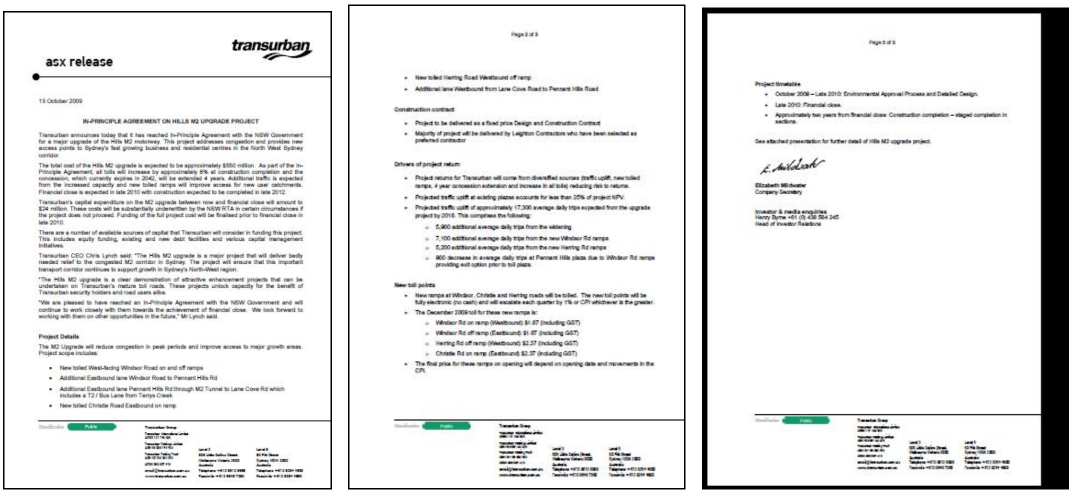
"Projects like the M2 Upgrade show that by working together it is possible to deliver outcomes that work for the community, government and private sector partners."

The next stage of the process is to prepare a thorough environmental assessment for the project. This assessment will be put on public display and the community will be given an opportunity to provide feedback.

Work is expected to begin in 2010 and be completed within two years. Work will proceed once appropriate planning approvals are achieved and after a contract is agreed for the delivery phase of the work.

**Media Contact: Suzie Brady – 0411 104 339**

Table 4.1.2 Australian stock exchange release issued by Transurban




## 4.2 Letterbox drop – M2 corridor community

On 16 November 2009 the project team conducted a letterbox drop to both householders and businesses located in the M2 corridor and advised readers of project announcement, project scope, approvals process, project contact details, shopping centre display details and website location for further information.

Approximately 7,000 unaddressed letters were distributed.

## 4.3 Project telephone and email address

The project team established a 1800 number and email address to provide the community and stakeholders with a central reference point for contact on all project matters. Feedback from the community is important consideration, along with various studies and technical reports, in the assessment of potential impacts and identifying impact mitigation strategies.

The project's community relations team facilitates responses to community and stakeholders' enquiries via email and telephone.

The number: 1800 196 266 and email address: enquires@m2upgrade.com.au is published on all printed M2 Upgrade communications materials, the website and on email signatures.

Table 4.3.1 Telephone line statistics

| Activity | Total since Project launch (Jun 2008) |
|---|---|
| Telephone calls received from stakeholders | 31 |
| Telephone calls out to stakeholders | 15 |
| Emails received | 216 |
| Emails sent to stakeholders | 78 |

## 4.4 Website

The website www.hillsm2upgrade.com.au was launched on 13 November 2009 and provides up to date information about the project for a range of stakeholders. It includes a central home page, an overview of the project, a registration form, a timeline, fact sheets, media releases, frequently asked questions (FAQs) and contact details.

The table below provides a snapshot of website statistics since project inception.

Table 4.4.1 Web statistics table

| Activity for www.hillsm2upgrade.com.au | Total since website inception (13 Nov 2009) |
|---|---|
| Website total visits | 1,252 |
| Unique visitors | 1,043 |
| Page views | 3,820 |
| Top three pages visited: | Home – 41.31%<br>Project – 16.07%<br>Document links – 9.69% |
| Average time spent on web site | 2.37 minutes |

## 4.5 Information subscription register

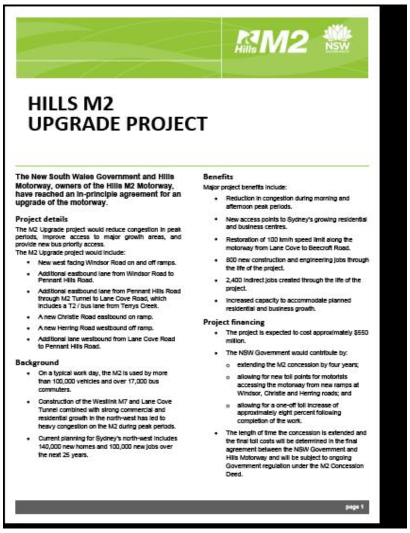
Community members have been invited to register their interest in receiving project updates. Contact details can be provided at the project website or via email (enquiries@hillsm2upgrade.com.au). Alternatively, community members can register their contact details over the telephone (1800 196 266) when speaking with a project team member.

Currently, a total of 339 stakeholders have subscribed to receive information updates.

## 4.6 Project fact sheet

The M2 Upgrade has provided the community with a fact sheet on project background, benefits and key attributes. The fact sheet has been distributed on the website, at briefings and meetings, and mailed to stakeholders as required or upon request. Fact sheets will be updated throughout the life of the project to provide information on project progress and address key areas of interest.

Table 4.6.1 Fact sheet



# HILLS M2 UPGRADE PROJECT

**The New South Wales Government and Hills Motorway, owners of the Hills M2 Motorway, have reached an in-principle agreement for an upgrade of the motorway.**

**Project details**

The M2 Upgrade project would reduce congestion in peak periods, improve access to major growth areas, and provide new bus priority access.

The M2 Upgrade project would include:

- New west facing Windsor Road on and off ramps.
- Additional eastbound lane from Windsor Road to Pennant Hills Road.
- Additional eastbound lane from Pennant Hills Road through M2 Tunnel to Lane Cove Road, which includes a T2 / bus lane from Terrys Creek.
- A new Christie Road eastbound on ramp.
- A new Herring Road westbound off ramp.
- Additional lane westbound from Lane Cove Road to Pennant Hills Road.

**Background**

- On a typical work day, the M2 is used by more than 100,000 vehicles and over 17,000 bus commuters.
- Construction of the Westlink M7 and Lane Cove Tunnel combined with strong commercial and residential growth in the north-west has led to heavy congestion on the M2 during peak periods.
- Current planning for Sydney's north-west includes 140,000 new homes and 100,000 new jobs over the next 25 years.

**Benefits**

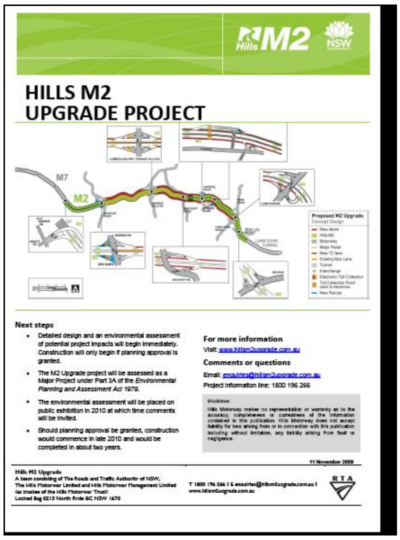
Major project benefits include:

- Reduction in congestion during morning and afternoon peak periods.
- New access points to Sydney's growing residential and business centres.
- Restoration of 100 km/h speed limit along the motorway from Lane Cove to Beecroft Road.
- 800 new construction and engineering jobs through the life of the project.
- 2,400 indirect jobs created through the life of the project.
- Increased capacity to accommodate planned residential and business growth.

**Project financing**

- The project is expected to cost approximately $550 million.
- The NSW Government would contribute by:
  - extending the M2 concession by four years;
  - allowing for new toll points for motorists accessing the motorway from new ramps at Windsor, Christie and Herring roads; and
  - allowing for a one-off toll increase of approximately eight percent following completion of the work.
- The length of time the concession is extended and the final toll costs will be determined in the final agreement between the NSW Government and Hills Motorway and will be subject to ongoing Government regulation under the M2 Concession Deed.

page 1



# HILLS M2 UPGRADE PROJECT

**Next steps**

- Detailed design and an environmental assessment of potential project impacts will begin immediately. Construction will only begin if planning approval is granted.
- The M2 Upgrade project will be assessed as a Major Project under Part 3A of the *Environmental Planning and Assessment Act 1979*.
- The environmental assessment will be placed on public exhibition in 2010 at which time comments will be invited.
- Should planning approval be granted, construction would commence in late 2010 and would be completed in about two years.

**For more information**

Visit: www.hillsm2upgrade.com.au

**Comments or questions**

Email: enquiries@hillsm2upgrade.com.au

Project information line: 1800 196 266

Disclaimer

Hills Motorway makes no representation or warranty as to the accuracy, completeness or correctness of the information contained in this publication. Hills Motorway does not accept liability for loss arising from or in connection with this publication including without limitation, any liability arising from fault or negligence.

11 November 2009

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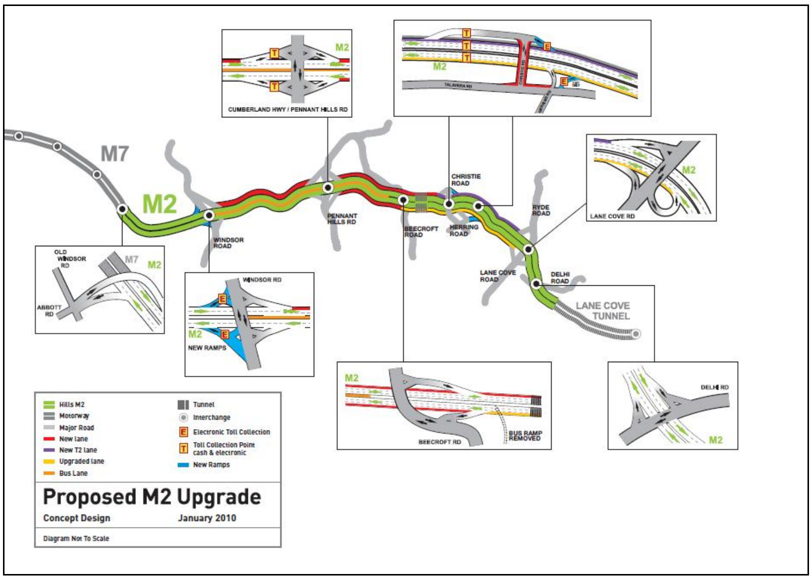
RTA

Table 4.6.2 Scope map



## 4.7 Briefings, meetings and working groups

Targeted stakeholder briefings and meetings were held on a number of dates to various stakeholders.

Table 4.7.1 Targeted briefings, meetings and working groups

| Date | Stakeholders |
|---|---|
| | Planning focus meeting |
| 19 March 09 | The Planning Focus Meeting was held with key government agencies including, the NSW Department of Planning, the Department of Environment and Climate Change; the Department of Primary Industries; NSW Dept of Transport and Infrastructure; NSW Dept of Education and Training; Roads and Traffic Authority |
| | MP briefings |
| 18 Nov 09 | Michael Richardson MP Member for Castle Hill |
| 3 Dec 09 | Phillip Ruddock MP Member for Berowra |
| 17 Dec 09 | Greg Smith MP Member for Epping |
| | Council briefings |
| 12 Nov 09 | Hornsby Shire Council |
| 13 Nov 09 | Parramatta City Council |
| 16 Nov 09 | Lane Cove Council |
| 16 Nov 09 | City of Ryde Council |
| 18 Nov 09 | Hills Shire Council |
| 19 Nov 09 | Blacktown City Council |
| | Council meetings |
| 15 Dec 09 | Hills Shire Council |
| 27 Jan 10 | Hornsby Shire Council |
| | Council cycle way meetings |
| 10 Dec, 14 Dec, 16 Dec 09,<br>21 Jan, 22 Jan, 25 Jan, 29 Jan 10 | The Hills Shire Council<br>Hornsby Shire Council<br>Parramatta City Council<br>City of Ryde |
| | Interest group briefings |
| 10 Nov 09 | Transport and Emergency Services |
| 10 Nov 09 | Cyclists |
| 12 Nov 09 | Motorway network |
| 16 Nov 09 | Social and Environmental (east) |
| 17 Nov 09 | Business (east) |
| 19 Nov 09 | Business (west) |
| 23 Nov 09 | Social and Environmental (west) |
| 24 Nov 09 | Our Lady of Lourdes Primary School |
| 30 Nov 09 | Epping Heights Public School |

| Date | Stakeholders |
|---|---|
| | Interest group meetings |
| 30 Nov 09 | Australian Trucking Association |
| 1 Dec 09 | Epping Civic trust |
| 7 Dec 09 | Our Lady of Lourdes Primary School (Parents and Friends) |
| 30 Nov 09 | Social Environmental (east) |
| 11 –16 Dec 09 | Indigenous heritage meeting and site visit |
| | Working group meetings |
| 17 Nov 09 | Transport working group |
| 25 Nov 09 | Cyclist working group |
| 9 Dec 09 | Transport working group |
| 13 Jan 10 | Transport working group |
| | Landowner meetings |
| 2 Dec – 4 Jan 10 | Affected landowner meetings |

Table 4.7.2 Targeted briefings, meetings and working groups by type

| Activity | Total since Project launch (Jun 2008) |
|---|---|
| Planning focus meeting | 1 |
| MP briefings | 3 |
| Council briefings | 6 |
| Interest group briefings | 9 |
| Council meetings | 2 |
| Council cycle way meetings | 8 |
| Interest group meetings | 4 |
| M2 corridor community meetings | 2 |
| Affected landowner meetings | 9 |
| Working groups | 4 |
| Total | 48 |

## 4.8 Affected landowner consultation

The M2 Upgrade team met with affected landowners on a number of dates. These landowners are identified as those with properties impacted by surface partial-property acquisition, properties impacted by sub-surface property acquisition, properties impacted by noise wall changes and properties impacted by services and geotechnical investigations.

Table 4.8.1 Affected landowner consultation

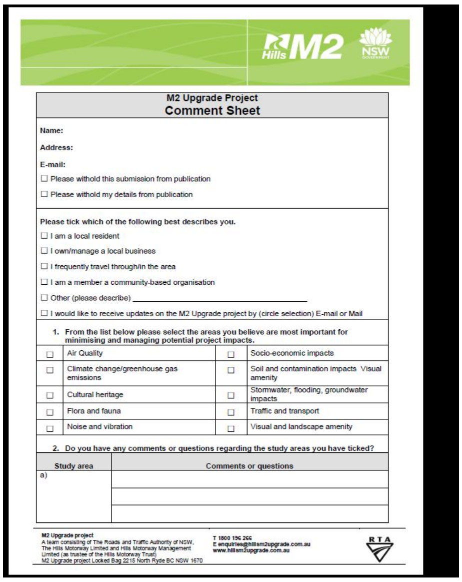
| When | Activity | Total since Project launch (Jun 2008) |
|---|---|---|
| Nov 2009 - Feb 2010 | Correspondence and some site meetings with properties impacted by surface partial-property acquisition. | 6 |
| Nov 2009 - Feb 2010 | Correspondence and some phone calls with properties impacted by sub-surface property acquisition. | 14 |
| Nov 2009 – Feb 2010 | Correspondence to properties impacted by noise wall changes:<br>• 33 properties (Tier 1) – land owners closest to noise wall changes, potentially indirectly affected or have a perception of indirect impact.<br>• 42 properties (Tier 2) – landowners in general vicinity but not directly or indirectly affected by noise wall changes. | 75 |
| Nov 2009 - Feb 2010 | Correspondence to properties impacted by services and geotechnical investigations. | 209 |

## 4.9 Feedback forms

Feedback forms have been made available at each briefing. These forms were provided to offer stakeholders an opportunity to register key issues, questions and general comments on the M2 Upgrade.

A total of 33 feedback forms have been collected from stakeholders.

Table 4.9.1 Feedback forms



M2 Upgrade Project
**Comment Sheet**

Name:

Address:

E-mail:

☐ Please withold this submission from publication

☐ Please withold my details from publication

Please tick which of the following best describes you.

☐ I am a local resident

☐ I own/manage a local business

☐ I frequently travel through/in the area

☐ I am a member a community-based organisation

☐ Other (please describe) ____________

☐ I would like to receive updates on the M2 Upgrade project by (circle selection) E-mail or Mail

1. From the list below please select the areas you believe are most important for minimising and managing potential project impacts.

| | | | |
|---|---|---|---|
| ☐ | Air Quality | ☐ | Socio-economic impacts |
| ☐ | Climate change/greenhouse gas emissions | ☐ | Soil and contamination impacts Visual amenity |
| ☐ | Cultural heritage | ☐ | Stormwater, flooding, groundwater impacts |
| ☐ | Flora and fauna | ☐ | Traffic and transport |
| ☐ | Noise and vibration | ☐ | Visual and landscape amenity |

2. Do you have any comments or questions regarding the study areas you have ticked?

| Study area | Comments or questions |
|---|---|
| a) | |

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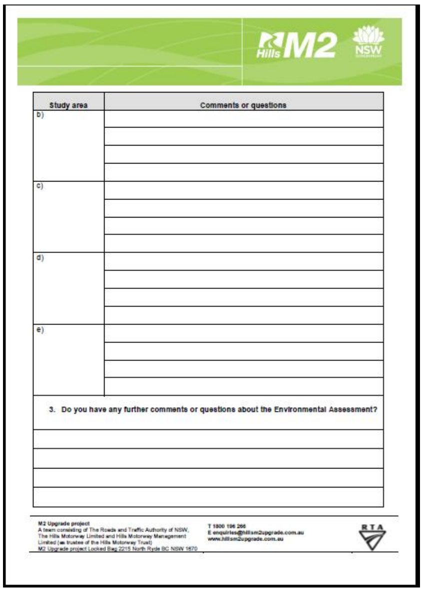

| Study area | Comments or questions |
|---|---|
| b) | |
| c) | |
| d) | |
| e) | |

3. Do you have any further comments or questions about the Environmental Assessment?

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### 4.10 Displays

M2 Upgrade displays were stationed at two shopping centres in close proximity to the M2 Motorway and encouraged people to review the project and register to receive project updates and information about the upcoming public exhibition period.

Communication tools at each display included the project fact sheet, project scope maps, the environmental approvals process map and information subscriptions register. The M2 corridor community received an invitation to attend via the letterbox drop that was issued on 16 November 2009.

Over the two days, 320 people attended the shopping centre displays.

Table 4.10.1 Shopping centre displays

| Date | Location |
|---|---|
| 26 Nov 2009 | Macquarie Shopping Centre, Marsfield - opposite Franklins |
| 28 Nov 2009 | Winston Hills Shopping Centre, Winston Hills - opposite Big W |

### 4.11 Correspondence

The M2 Upgrade team has corresponded with a number of stakeholders since project inception.

Table 4.11.1 Correspondence statistics

| Activity | Total since Project launch (Jun 2008) |
|---|---|
| Letter/emails in | 219 |
| Letters/emails out (addressed) | 234 |
| Letterbox drop – M2 corridor community letter (unaddressed) | approx 7,000 |
| Letterbox drop – geotechnical investigations (unaddressed) | 209 |
| Email out to RTA for Ministerial Co-ordination Unit responses | 2 |

### 4.12 Stakeholder database

The M2 Upgrade team manages all stakeholder content and activity via a secure database.

By tracking and recording incoming feedback and project team responses, the project team is able to effectively distribute communication updates to all stakeholders. All enquiries, comments and complains received by telephone, email or letter are entered into this database along with details of events such as information session, meetings, displays and issues raised at each of these events.

## 5 Future consultation activities

The project will continue to identify and manage issues of interest or concern during the approval process and, should the project be approved, during construction and commissioning.

The next phase of formal community consultation is expected to commence in the second quarter of 2010 as part of public exhibition of the environmental assessment.

## 5.1 Communication and consultation activity – phase two environmental assessment public exhibition

Consultation during this phase will continue to focus on building community awareness of the project and encourage participation in the public exhibition.

The Department of Planning is responsible for the public exhibition of the environmental assessment. The public exhibition period for the assessment extends for at least 30 days.

During the exhibition period, the public is able to review the environmental assessment, obtain information from display materials, and send submissions to the Department of Planning for consideration in its assessment of the project. All written comments received by the Department of

Planning during the exhibition period will be provided to the RTA and M2 Upgrade team for consideration. The comments and any RTA response will be considered by the Department of Planning in its assessment report to the Minister for Planning.

Communication and consultation activities planned for the exhibition period include:

- Newspaper advertisements – public exhibition notification.
- Community update brochure.
- Display materials.
- Fact sheets.
- Community information sessions.
- Stakeholder meetings.
- Email updates to registered list.
- Project telephone and email facilities.

## 5.2 Communication and consultation activity – phase three construction

Community engagement during the construction phase will focus on providing information about the works program, minimising potential impacts and providing timely response to any concerns raised by community and stakeholders.

Communication and consultation activities planned for the construction phase include:

- Works notifications to residents and businesses.
- Traffic management notifications.
- Regular community newsletters.
- Regular website updates.
- Regular advertising in local and metropolitan newspapers.
- Compound site signage.
- Project telephone and email facilities.

## 5.3 Communication and consultation activity – phase four commissioning

Ongoing communications including a range of communication tools will be used to support transition of each element of the M2 Upgrade from commissioning to operation.

# Appendix E Road User Cost Benefit Analysis

# Road User Cost Benefit Analysis

Author
**Mark Alexander**

Created

Updated
25 November 2009

Controller
Mark Alexander

Owner
Development



Classification Commercial in Confidence

transurban

# Revision History

| Date | Version | Author | Comments (including Review History) |
|---|---|---|---|
| Nov. 23, 09 | 0.1 | Mark Alexander | Original draft |
| Oct. 26, 09 | 0.2 | Mark Alexander | Revised for IPA scope and current RTA methodology including the December 2007 Economic Parameters |
| Nov. 20, 09 | 0.3 | Mark Alexander | Updated with AECOM comments (received 13/11/09) |
| Nov. 23, 09 | 0.4 | Mark Alexander | Updated with AECOM comments (received 23/11/09) |

# Contents

## 1 Introduction

The purpose of the Road User Cost Benefit Analysis (RUCBA) is to provide an estimate of the various costs and benefits of the M2 Upgrade.

Procedures and parameters used in the RUCBA were based on current RTA evaluation methodology as supported by "National Guidelines for Transport System Management in Australia" (Australian Transport Council - 2006), the RTA Economic Analysis Manual (Version 2 with December 2007 Economic Parameters).

The RUCBA is based on a thirty year evaluation period from the proposed time of commencing construction. The evaluation involves estimation of costs and benefits over the evaluation period and using discounted cash flow methods to determine the Present Value (PV) of the costs and benefits.

The key indicator of the "value to the community", the Benefit-Cost Ratio (BCR) is then determined by dividing the present value of benefits by the present value of costs. A project with a BCR greater than 1 is considered "economically worthwhile".

To ensure that that Privately Financed Projects (PFPs) meet the public interest it is necessary to carry out a "Public Benefits Evaluation" in accordance with the NSW Government's (December 2006) "*Working with Government Guidelines for Privately Financed Projects".* Part of this evaluation includes assessment against "Value for money" criteria. Demonstration that the project meets these criteria is included in *Section 5*.

## 2 Traffic Inputs

A key input to the RUCBA were outputs from Transurban's strategic traffic model (TUSTM), utilising the Cube Voyager software platform.

The TUSTM is calibrated / validated to a 2006 base year and applied in forecasting mode at 5 year intervals until 2021.

The model outputs used for the RUCBA were network wide Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT) in the Sydney Metropolitan Area. The TUSTM model outputs statistics in terms of average workday traffic volumes (AWDT). It is necessary to convert these model results to annualised figures to reflect lower usage (and benefits) on non workdays. Hence rather than multiply the results by 365, the model outputs are multiplied by 325 to be consistent with the observed ratio of daily to workday traffic volumes on the motorway.

Model results for the base and project cases were extracted for the years 2011 and 2021 and used as the basis for developing annual VKT and VHT profiles with intermediate years interpolated.

Beyond the model end date (2021) VKT and VHT figures for 2021 have been used. That is, there is no further growth in time or distance savings assumed beyond this point. Additional sensitivity testing around this assumption has been included in Section 4.

The 2011 and 2021 modelled VKT and VHT figures used for the RUCBA are included in Table 1below.

**Table 1 Forecast VKT and VHT (Sydney Road Network)**

| Model Output (Annual) | 2011 Base | 2011 M2 Upgrade | 2011 Impact | 2021 Base | 2021 M2 Upgrade | Impact |
|---|---|---|---|---|---|---|
| VKT (Millions) | 30,379 | 30,376 | -0.01% | 34,936 | 34,920 | -0.04% |
| VHT (Millions) | 673.80 | 670.10 | -0.6% | 853.58 | 846.07 | -0.9% |

Items to note in the above figures are as follows:

- An overall reduction in VKT is forecast, though only small in network wide percentage terms, these benefits are significant for new users of the motorway.
- New users will be able to take more direct routes and travel shorter distances to access their destinations. This is particularly the case for the new ramps at Windsor Road and Christie/ Herring Road.
- There would be a significant reduction in vehicle hours travelled. Whilst the majority of benefits for time savings will be M2 users, there will be secondary benefits to

users of the M4 and alternative arterial routes. This is due to traffic vacating these routes to take advantage of the improved service levels on the M2.

Given the project is only scheduled to be completed in the latter part of 2012, the valuation of all benefits and costs are based on their commencement at this time and extending to the latter part of 2042 (the end of the thirty year evaluation period).

# 3 Valuation of Costs and Benefits

## 3.1 Project Costs

The project costs include the initial project capital expenditure incurred during the approvals / design process and the construction period and forecast ongoing capital expenditure and operational expenses incurred over the evaluation period.

The total cost estimated for the project has been assumed to be incurred over a two year period (2010 to 2012) for the RUCBA. The assumptions regarding timing of the capital expenditure used in the RUCBA are set out in Table 2 below.

**Table 2 Assumed Capital Cost Expenditure**

| Year | Capital Expenditure ($M) |
|---|---|
| 2010 | 110 |
| 2011 | 275 |
| 2012 | 165 |

In addition to the initial capital expenditure other ongoing expenses have been included in the RUCBA to cover the incremental capital expenditure and operating expenses associated with the project over the evaluation period. An annual figure of approximately $1M covers additional routine operational and maintenance costs associated with the project. There are also additional capital costs incurred at 5-10 year intervals. These costs are due to the additional expenditure to resurface increased areas and replacement of systems being installed as part of the project (eg/ tolling systems at the new ramps).

## 3.2 Vehicle Operating Costs

A weighted vehicle operating costs (VOC) used in the RUCBA was 30.52 cents per vehicle km (in 2007 dollars). This value was taken from *Table 3 of Appendix B "Economic Parameters for 2007"* and escalated to 2009 prices in line with the Consumer Price Index (CPI) for Sydney. This network wide rate for the urban road network was derived on the basis of an average speed of 40km/h (stop-start conditions).

## 3.3 Travel Time Savings

A weighted travel time value of $23.08 per hour (in December 2007 prices) was used for valuation of travel time savings in the RUCBA. This value was escalated to a 2009 value in line with the Average Weekly Earnings (AWE). It is derived in *Tables 7 to 10 of Appendix B "Economic Parameters for 2007"* and is based on various studies on traffic composition by time of day and vehicle class, trip purpose, vehicle class, vehicle occupancy and value of time.

## 3.4 Accidents

Accident costs used in the RUCBA are based on the values contained in *Table 13 of Appendix B "Economic Parameters for 2007"* as reproduced below. These costs have been escalated to 2009 prices based on the Sydney CPI. The VKT statistics from the model were aggregated to each of the three road classes in Table 3 and the relevant crash cost rate applied for the base and project cases.

**Table 3 Accident Costs**

| Local/Sub-arterial | Average Crash Cost ($/MVKT) – 2007 Prices |
|---|---|
| Local/Sub-arterial | 62,800 |
| Arterial | 45,800 |
| Freeway | 14,300 |

## 3.5 Environmental Costs

Environmental externality values for urban travel conditions are contained in *Table 18 of Appendix B "Economic Parameters for 2007".* These have been reproduced below and have been used to value the environmental cost for the base and project cases. All values were escalated to 2009 prices in line with CPI.

Table 4 Environmental Externalities

| Item | Urban (c/km) – 2007 A$ |
|---|---|
| Noise | 0.83 |
| Air | 2.58 |
| Water | 0.39 |
| Greenhouse | 2.03 |
| Nature and Landscape | 0.05 |
| Urban Separation | 0.60 |
| Upstream and Downstream | 3.48 |
| **Total** | **9.96** |

# 4 Results

Based on the TUSTM outputs and derivation of costs as discussed above the present values (PVs) were calculated using a discount rate of 7% over a 30 year evaluation period for base and project cases. The net value (project case minus base case) for each item is presented in Table 5 below.

Table 5 RUCBA Summary

| Item | Net Present Value (NPV) ($M at 7% discount rate) |
|---|---|
| Capex and Opex | -496 |
| Vehicle Operating Costs | 41 |
| Travel Time Savings | 1609 |
| Accidents | 33 |
| Environmental Costs | 14 |
| **Net Present Value - NPV ($M)** | **1202** |
| **BCR** | **3.4** |

It is therefore concluded that on the basis of the RUCBA the project is economically worthwhile with the benefits to the community being estimated to be 3.4 times greater than the costs.

To test the impact on the BCR in the event of the actual costs and benefits varying to those calculated from traffic model outputs and project cost estimates, the following sensitivity tests were run.

- Variation in RUCBA discount rate.
- Variation in project costs (+/- 20%).
- Variation in project benefits (+/- 20%).
- Diminishing travel time savings.

Given the model outputs only extend to 2021, there is more uncertainty around travel time savings beyond this time. Hence as a test to understand the impact on the BCR if travel time savings were to gradually diminish beyond this date. The last sensitivity test includes reducing the travel time savings to zero over a ten year period from 2021.

The results of these sensitivity tests are included in Table 6 below.

Table 6 Sensitivity Test Results

| Sensitivity Test | BCR | NPV ($M) |
|---|---|---|
| 10% Discount Rate | 2.5 | 697 |
| 4% Discount Rate | 4.9 | 2,103 |
| 20% higher costs | 2.9 | 1,103 |
| 20% lower costs | 4.3 | 1,301 |
| 20% lower benefits | 2.7 | 863 |
| 20% higher benefits | 4.1 | 1,542 |
| Diminishing Travel Time Savings | 2.3 | 629 |

## 5 Public Interest Evaluation – Value for Money

In December 2006 the NSW Government introduced new "*Working with Government Guidelines for Privately Financed Projects".* All asset enhancement and Greenfield projects need to address the Government's requirements in this regard.

As part of the public interest evaluation, projects need to meet "Value for Money" criteria as demonstrated for the M2 Upgrade below.

| Value for Money Criteria |
|---|
| • *Does the project offer better value for money than the best practicable public sector delivery model? This would include consideration of any proposed upfront fees?*<br>• *Where the project involves a user charge to be paid by the public, is the level of user charge appropriate and related to the benefits to be received by the user under the project?*<br>• *Where the project involves a contribution by taxpayers, is the level of contribution reasonable?* |
| • It is proposed all the benefits of the M2 Upgrade including new access ramps, reduced congestion for cars and buses, and improved safety will be funded and delivered by the Hills Motorway Limited with no upfront funding contribution required from Government. M2 Enhancements would be funded through a combination of sources including net cash flow from new toll points, toll increases at existing toll points and extension of Hills Motorway's concession period for the M2.<br>• Motorists who use Hills M2 pay a user charge in the form of a toll. This would remain consistent under the enhancement works, that is, every motorist who uses new ramps at either Windsor Road (west facing) or Herring Road (east facing) would pay a toll. The toll level would be set under a contract with the Government.<br>• The proposed tolls for the new Herring Road (east facing) ramps are determined based on toll rates for the section east of Beecroft Road which reflect the level of congestion on the alternative route for this segment of the corridor. The section between Lane Cove Tunnel and Herring Road is approximately half the distance from Lane Cove Tunnel to Beecroft Road hence the toll is set to be half the main plaza. The toll rate per kilometre is on par with the Beecroft Rd ramps.<br>• The proposed tolls for the new Windsor Road (west facing) ramps are approximately 30% lower than the Pennant Hills Road tolls. This toll rate was determined based on rates that minimise adverse traffic impacts on longer motorway trips and alternative routes including Old Northern Road and Castle Hill Road. |

# Appendix F Construction Environmental Management Framework

# M2 Upgrade Project

## Construction Environmental Management Framework

# 1. Introduction

## 1.1 Purpose and scope

This Construction Environmental Management Framework (CEMF) describes the NSW Roads and Traffic Authority (RTA) and the construction contractor's approach to environmental management on the M2 Upgrade.

The CEMF is designed to be a high-level overview document that outlines the statutory provisions, relevant standards and guidelines applicable to the M2 Upgrade during the construction stage. This CEMF sets out the framework for the completion of a Construction Environmental Management Plan (CEMP). A CEMP would be developed prior to commencement of construction, with the purpose of capturing all environmental management aspects, to a level of detail that would enable effective implementation on-site.

Additionally, the CEMP would be amended to incorporate relevant requirements in the Statement of Commitments (SoC), Submissions Report, Minister's Conditions of Approval (MCoA) and any other approvals or licenses, as they are approved.

## 1.2 Overview of M2 Upgrade environmental assessment and approval

The M2 Upgrade is subject to the process defined under Part 3A of the Environmental Planning and Assessment Act 1979. An Environmental Assessment (EA), developed as part of this process, identifies environmental impacts and mitigation measures for the M2 Upgrade.

## 1.3 Project description

The M2 Upgrade would extend for 14.5 km along the M2 Motorway from Windsor Road, Baulkham Hills to Lane Cove Road, North Ryde. The M2 Upgrade would be undertaken within a broader study area which extends from Abbott Road, Baulkham Hills, to the western portal of the Lane Cove Tunnel in North Ryde.

The proposed upgrade would include the following key components:

- Widening and/or provision of a third lane along sections of the eastbound and westbound carriageways between Windsor Road and Lane Cove Road.
- Provision of new on/off ramps at Windsor Road, Christie Road and Herring Road.
- Widening and provision of a third lane eastbound and westbound in the Norfolk Tunnel.
- Restoration of the westbound breakdown lane and provision of wider lanes between Beecroft Road and Lane Cove Road.
- Removal of the Beecroft Road bus on/off ramp.
- Intersection capacity improvement at Windsor Road.
- Upgrade to M2 Motorway/Windsor Road intersection, Christie Road and Talavera Road.
- Upgrade to the M2 Motorway Intelligent Transport System.

## 1.4 Environmental management framework

### 1.4.1 Environmental management system

The environmental management system (EMS) for the M2 Upgrade would be developed within the framework of the construction contractor's integrated management system.

The construction contractor's integrated management system incorporates the requirements for an EMS and is ISO14001:2004 certified.

### 1.4.2 Construction Environmental Management Plan

The CEMP would describe the EMS by which the environmental aspects of the M2 Upgrade would be delivered. The environmental management framework is presented in Figure 1-1. The purpose of the CEMP is to create a robust EMS for the M2 Upgrade that is also an effective tool for onsite implementation.

The CEMP would address all environmental management aspects relating to the M2 Upgrade. The CEMP would apply to all areas where physical works are to occur and areas that have potential to be impacted by works. The CEMP would be applicable to all personnel of the construction contractor and its sub-contractors. The CEMP would apply to the M2 Upgrade before, during and after construction.

The environmental aspects of the M2 Upgrade that the CEMP would address include:

- Environment policy.
- Environmental objectives.
- Legislative and other requirements.
- Roles and responsibilities.
- Sub-contractor management.
- Document and records management.
- Communication.
- Risk management.
- Implementation of controls.
- Review and monitoring.
- Incident management.

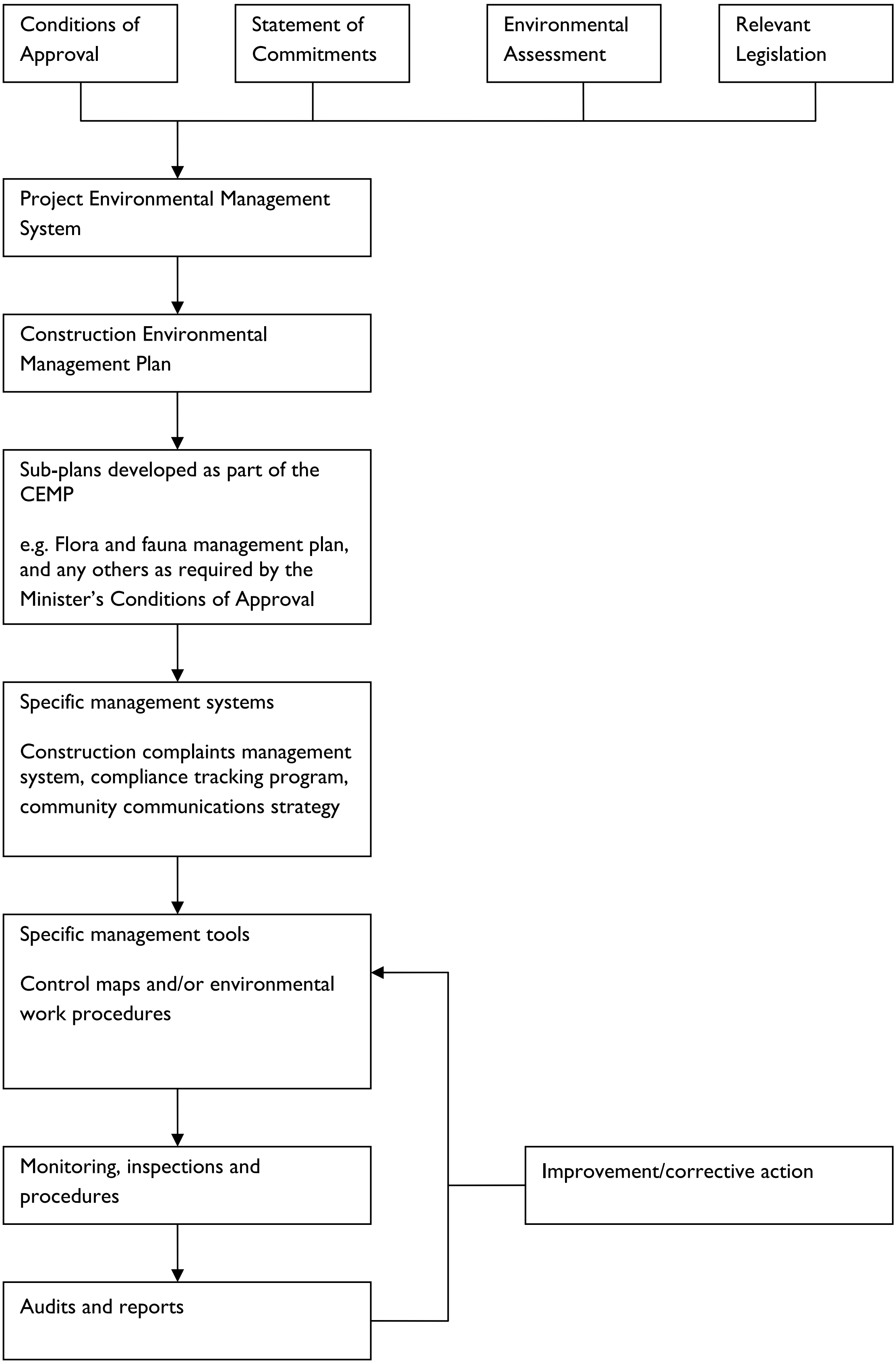
### 1.4.3 Environmental management sub-plans and tools

The CEMP would be supported by a suite of environmental management sub-plans that document the detailed management of specific environmental risks/aspects of the M2 Upgrade. The sub-plans are either required (by the SoC and/or MCoA) to be developed as part of the CEMP or represent a key risk for the M2 Upgrade.

In conjunction with the sub-plans, specific management tools would be developed to assist in implementation. Such tools would capture environmental risks peculiar to specific work locations or work activities, and would include the following:

- Inspection checklists.
- Report and register templates.
- Control maps and plans.
- Environmental procedures.

Figure 1-1 Environmental management framework



### 1.4.4 Environmental management of key issues

As part of the Environmental Assessment, a number of key issue areas have been identified where specific management strategies are required to ensure that potential impacts are adequately managed and reduced to acceptable levels. These key issue areas include:

- Construction noise and vibration management (**Attachment C**).
- Construction traffic and transport management (**Attachment D**).
- Construction soil and water management (**Attachment E**).

As part of this framework, management strategies have been prepared or each of these key issue areas. These strategies are presented in Appendix C of this framework. The CEMP and associated sub-plans and tools to be developed will be consistent with these management strategies.

Table 1-1 describes the approach to the management of key environmental issues on the M2 Upgrade.

Table 1-1 Management of key environmental issues

| Environmental issue | Objective | Management approach | Location | Timing |
|---|---|---|---|---|
| Construction Noise and Vibration | Minimise noise and vibration impacts during construction. | • A management plan would be developed to ensure noise and vibration impacts are mitigated. Further impact assessment would be conducted for major noise-intensive construction activities. | Full length | Prior to construction |
| | | • Community liaison would aim to ensure that the local community is kept informed. Communication methods would be developed such as internet-based information, community meetings, local newsletters and community notice boards. | Full length | Prior to, during and after construction |
| | | • Noise impact mitigation would be considered during scheduling of works. Particular consideration would be given to identified noise-intensive equipment. | Full length | Prior to construction |
| | | • Controls would be developed to mitigate noise from plant, considering aspects such as warming up locations, reversing alarms, noise compliance checks and work practices. | Full length | Prior to construction |
| | | • Controls would be developed to mitigate noise from construction equipment, considering such aspects as fit-for-purpose equipment, noise attenuation devices and maintenance. | Full length | Prior to construction |
| | | • Assessment of noise impacts from compound sites would be carried out to understand specific issues. | Compound sites | Design |
| | | • Strategies would be developed to minimise noise generated from compound sites, such as temporary hoardings or other noise barriers. | Compound sites | Prior to construction |
| | | • Mitigation measures would be developed to address noise generated along local roads, such as timing of movements, driving methods and noise attenuation devices. | Local roads | Prior to construction |
| | | • Baseline mitigation strategies would be developed for sections where noise goals are exceeded, such as temporary hoardings, location of noisy plant and equipment, timing of works, site access points, location of maintenance work and source noise mitigation. | Sections where noise goals are exceeded | Prior to construction |

| Environmental issue | Objective | Management approach | Location | Timing |
|---|---|---|---|---|
| | | • Noise and vibration monitoring would be undertaken prior to construction. | Full length | Prior to construction |
| | | • Noise and vibration monitoring would be undertaken during key phases of construction. | Full length | During construction |
| | | • Work methods for demolition and construction of noise walls would be planned to mitigate noise impacts where reasonable and feasible. | Noise walls | Prior to construction |
| | | • Noise management strategies would be developed to mitigate ground-borne noise. | Full length | Prior to construction |
| | | • Strategies would be developed to mitigate vibration impacts, such as location of plant and equipment, scheduling of works, selection of plant and equipment, provision of respite periods. | Full length | Prior to construction |
| | | • Plans, strategies and processes would be communicated and implemented by construction personnel. Communication tools include inductions, tool-box talks and work method statements would be utilised. | Full length | During construction |
| Flora and Fauna | • Manage impacts on flora and fauna.<br>• Water crossings designed to incorporate best practice principles.<br>• Enhance existing habitat.<br>• Manage the spread of weeds and plant pathogens | • Planning and route selection process would aim to avoid impacts on flora and fauna habitats. | Full length | Design |
| | | • A management plan would be developed to control and mitigate potential impacts to flora and fauna. | Full length | Prior to construction |
| | | • The extent of clearing would be minimised wherever possible. | Full length | During construction |
| | | • Pre-clearing surveys will be undertaken to identify issues such as:<br>o Hollow bearing trees.<br>o Threatened flora (including *Epacris purpurascens var .purpurascens*).<br>o Threatened fauna (including Green and Golden Bell Frog and Red-crowned Toadlet). | Full length | Prior to and during construction |
| | | • Works around waterways would be managed using suitable erosion and sediment controls. | Works near waterways | During construction |
| | | • A strategy for revegetation would be developed. | Full length | During construction |
| | | • Weed management would be undertaken in areas affected by construction. | Full length | During construction |

| Environmental issue | Objective | Management approach | Location | Timing |
|---|---|---|---|---|
| Aboriginal Heritage | Minimise potential for impacts on Aboriginal heritage in accordance with the strategies described in the EA. | • If Aboriginal objects are identified during the course of construction, work should cease in that part of the study area and DECCW and relevant Local Aboriginal Land Council (LALC) would be notified immediately. | Full length | As required |
| | | • If Aboriginal skeletal materials are identified during construction, work would cease immediately and Police, DECCW and the relevant LALC are to be notified immediately. | Full length | As required |
| | | • If previously unknown items a of Aboriginal archaeological heritage significance are uncovered as part of construction works, no further works would occur at that locations until relevant clearance has been granted regarding the heritage issues. | Specific find locations | Prior to recommencement of work |
| | | • A Heritage Management Plan (HMP) would be prepared which would provide detailed guidance regarding known Aboriginal sites in the vicinity of the M2 corridor (e.g. detailed location mapping, fencing specifications, etc). The plan would include, but not be limited to, the following protective measures: | Works in vicinity of known Aboriginal sites | Prior to construction |
| | | • Erecting temporary protective fencing at identified Aboriginal sites where required. | Relevant identified Aboriginal sites | During construction |
| | | • Erecting temporary sedimentation barriers and fencing along the banks of creeks to minimise potential for indirect impacts to site M2A1 through sedimentation and/or personnel access during construction. | Works in vicinity of known Aboriginal sites | During construction |
| | | • Toolbox talks conducted prior to works in the vicinity of known sites and areas of Aboriginal cultural heritage. | Full length | Prior to and during construction |
| | | • Specific access controls and exclusions in the vicinity of the identified sensitive Aboriginal sites where required and appropriate. | Works in vicinity of known sensitive Aboriginal sites | During construction |
| Water Management and Soils | • Minimise erosion and sedimentation. | • A management plan would be developed to control and mitigate potential surface water quality impacts. | Full length | Prior to construction |

| Environmental issue | Objective | Management approach | Location | Timing |
|---|---|---|---|---|
| | • Minimise contamination risk for receiving waters.<br>• Minimise impacts on waterways.<br>• Minimise scour impacts. | • Management measures would be developed in accordance with the requirements of:<br>o Water Policy and Code of Practice for Water Management (RTA 1999).<br>o Managing Urban Stormwater - Soils and Construction Volumes 1 and 2 (often referred to as The Blue Book - Landcom 2004 and 2006). | Full length | Prior to construction |
| | | • A qualified soil conservationist would be used to provide technical advice on soil and water management. | Full length | Prior to and during construction |
| | | • Plans would be developed to manage works in sensitive areas, such as works in or around waterways. | Full length | Prior to construction |
| | | • Soil and water risks would be considered during programming and staging of works to minimise the duration of works undertaken in the vicinity of watercourses. | Full length | Prior to and during construction |
| | | • Physical controls would be utilised, such as silt fencing, straw bales, check dams, sediment basins (new & existing), diversion berms, levees, bunds, scour protection, water diversions. | Full length | During construction |
| | | • Strategies would be developed to facilitate soil stabilisation, such as minimising areas of disturbance. | Full length | Prior to construction |
| | | • Plans, strategies and processes would be communicated and implemented by construction personnel. Communication tools include inductions, tool-box talks and work method statements would be utilised. | Full length | During construction |
| Construction Traffic and Transport | • Minimise road user delays.<br>• Maintain access for road users. | • A Traffic management plan would be developed with the aim of minimising traffic impact on the M2 carriageway and local traffic. Measures that would be considered include timing of works outside peak traffic times, off-site parking areas, development of traffic control plans, vehicle management plans, and pedestrian control plans. | Full length and surrounding areas | Prior to construction |

| Environmental issue | Objective | Management approach | Location | Timing |
|---|---|---|---|---|
| | • Minimise impacts to local residential areas. | • Undertake planning and consultation to consider the appropriate strategies. Strategies would be developed to minimise the impact of construction vehicles on the local road environment, such as preference for the motorway network, arterial roads and other higher order roads, size restrictions, consideration and consultation with sensitive communities. | Full length and surrounding areas | Prior to and during construction |

# 2. Objectives and targets

The RTA's Environment Policy (Attachment A) and the construction contractor's environment policy would be aligned and adopted in the EMS.

The RTA's Environment Policy includes a commitment to undertake its activities in an environmentally responsible manner and effectively manage any risks that could adversely affect the environment. Key elements of the Policy include effective environmental management of all activities, on-going communication and awareness raising, active reporting of environmental incidents, continuous learning from experience, assigning accountabilities and responsibilities, and continuous improvement in environmental performance.

Consistent with the RTA's Environment Policy, preliminary environmental objectives and targets have been established for the M2 Upgrade and are detailed in Table 2-1. These objectives and targets, and the strategies for achieving the targets, would be reviewed following project approval and incorporated into the CEMP and sub-plans, with detailed specifications provided in environmental work plans as required. Additionally, so that the objectives and targets remain realistic and relevant for maintaining or improving environmental performance, a systematic review of objectives and targets, in the CEMP and sub-plans, would be performed when one of the following occurs:

- Changes in environment policy.
- Changes in relevant legislation that impact on environmental control limits.
- Action by a regulatory authority.
- Changes in environmental risk.
- Relevant environmental objectives have been met or repeatedly not achieved, as identified by audits and site inspections.
- Following project environmental management reviews.

Table 2-1 Preliminary project environmental objectives and targets

| Environmental issue | Objective | Target |
|---|---|---|
| Environmental Management | Compliance and continuous improvement in environmental management. | • The construction contractor has an EMS which is implemented for the M2 Upgrade.<br>• Environmental management plans are developed and implemented by suitably qualified and experienced personnel and incorporate the mitigation and management measures adopted in the Environmental Assessment (EA). |
| | Provide a consistent method for managing environmental issues. | • Environmentally sensitive areas relevant to the construction site boundary are marked on sensitive area maps as well as being demarcated and signposted where required.<br>• Maps be made available during on-site briefings to applicable construction personnel. |
| Community Engagement | Informed community | • The community is informed via a range of measures such as letter box drops, media releases, community updates, project website, road signs, and targeted consultation with affected individuals or groups.<br>• Information provided includes changes to access and traffic conditions, details of future works programs, and general construction progress.<br>• An enquiries and complaints management system is implemented and maintained throughout construction. |
| Construction Traffic and Transport | Minimise traffic disruption on M2 Motorway | • Impact on traffic flow during construction minimised by restricting lane occupancies to off peak periods.<br>• Maintain a minimum of two traffic lanes available every weekday during peak periods. |
| | Minimise traffic disruption on non Motorway roads | • Access worksites by using the M2 Motorway where possible. |
| | Minimise disruption to bus services on M2 Motorway | • Minimise disruption of bus services by use of appropriate traffic management arrangements.<br>• Access to M2 Motorway bus stops is maintained during the construction phase. |
| | Minimise impact to cyclists | • Prior to commencement of construction, provide a sign posted off-motorway alternative route for cyclists. |
| Operational Traffic and Transport | Minimise impacts on access to the local road network | • Maintain efficient and safe access routes to/from the local road network and properties. |

| Environmental issue | Objective | Target |
| --- | --- | --- |
| Construction Noise and Vibration | Minimise noise and vibration impacts during construction. | • Implement feasible and reasonable mitigation and management measures to minimise construction noise and vibration at sensitive receivers.<br>• Noise and vibration monitoring to be undertaken at key locations along the M2 Motorway to assess noise levels and the effectiveness of adopted noise mitigation measures.<br>• Prior to undertaking out of hours work at nearby sensitive receivers, appropriate noise mitigation and management measures would be implemented, including notification to affected communities. |
| Operational Noise | Operational noise and vibration managed. | • Feasible and reasonable mitigation measures are developed and implemented to meet the applicable noise criteria.<br>• Operational noise would be monitored within one year of project opening. If monitoring indicates traffic noise levels exceed those predicted, further measures would be implemented in consultation with affected sensitive receivers. |
| Flora and Fauna | Manage impacts on flora and fauna. | • Native vegetation retained where possible.<br>• Minimise clearing for construction compounds and retain mature trees where feasible within compound sites.<br>• Minimise impacts to native fauna, including the engagement of an ecologist during clearing if required.<br>• Minimise impacts on threatened frogs, particularly in detention basins.<br>• Prior to the commencement of construction in the area containing *Epacris purpurascens ssp. purpurascens* would be marked by an ecologist. Clearing would aim to avoid this species.<br>• Manage and minimise impacts to other threatened species and endangered ecological communities. |
| | Water crossings designed to incorporate best practice principles. | • Works adjacent to waterways are designed and developed in accordance with the fish habitat classifications of each waterway. |
| | Enhance existing habitat. | • Revegetation of areas disturbed as a result of construction activities is conducted by suitably qualified and experienced persons.<br>• Suitable felled native trees are reused for habitat. Seeds are collected in the corridor prior to and during clearing and used as part of the landscape plan. |
| | Manage the spread of weeds and plant pathogens | • Weed management occurring throughout the extent and duration of the M2 Upgrade. |

| Environmental issue | Objective | Target |
|---|---|---|
| Urban Design, Visual and Landscape | Minimise the visual impact and enhance the character of the road corridor. | • Detailed design, implementation of built elements undertaken with consideration of the visual and urban design objectives and principles for the M2 Upgrade. |
| Aboriginal Heritage | Minimise potential for impacts on Aboriginal heritage in accordance with the strategies described in the EA. | • Protect items of Aboriginal heritage significance. This would be done by:<br>o General project induction would include appropriate responsibilities, and site-specific briefings would be given to relevant personnel when working in the vicinity of identified heritage items.<br>o If any skeletal remains are encountered, all works that would potentially impact the find would stop immediately. Works would not re-commence until appropriate clearance has been received.<br>o Aboriginal heritage items and sites are managed as environmentally sensitive areas.<br>o Should any previously unidentified Aboriginal objects or items be located during the works, all work would cease in the vicinity of the find until specialist Aboriginal heritage advice is received. |
| Non-Aboriginal Heritage | Minimise impacts on non-Aboriginal heritage. | • Protection items of non-Aboriginal heritage significance. This would be done by:<br>o If previously unidentified non-Aboriginal heritage items are encountered during construction, all works that would potentially impact the find would stop immediately. Works would not recommence until appropriate clearance has been received.<br>o Physical and procedural measures to mitigate potential impacts upon the heritage significance of the Farmhouse are developed and implemented prior to and during construction at that location.<br>o Reasonable physical and procedural construction management measures would be developed and implemented to minimise adverse heritage impacts on the heritage causeway beneath Beecroft Road bus ramp. |
| Water Management and Soils | Minimise erosion and sedimentation. | • All discharges of water off-site complies with the EPL (if required).<br>• Maximise the diversion of stormwater runoff onto the construction site.<br>• Effective soil and water management during construction. |
| | Minimise contamination risk for receiving waters. | • No spills of chemical or fuels into waterways. |
| | Minimise impacts on waterways. | • No significant impacts on waterways. |

| Environmental issue | Objective | Target |
|---|---|---|
| | Minimise scour impacts. | • Provide permanent stream protection and/or energy dissipation measures at affected culverts downstream of transverse culvert outlets if required and where sufficient space is available. |
| Contamination | Protection of the environment, workers and public. | • Potential contamination in the site corridor during construction is addressed with risk management measures.<br>• Collection, testing and classification of sediments in sediment basins would be undertaken. Appropriate management strategies would be implemented prior to works in sediment basins.<br>• Develop and implement an 'Unexpected Finds' protocol. |
| Socio-Economic | Avoid, minimise and manage adverse amenity impacts on residents during construction. | • Manage movement of vehicles (especially outside of standard working hours), construction noise, visual intrusion, dust and light spill. |
| | Minimise amenity impacts on residents during operation. | • Provide vegetative planting at key locations to screen M2 Motorway, if appropriate. |
| Air Quality | Minimise air quality impacts. | • Minimise the generation of emissions.<br>• Minimise the generation of dust and its movement off site.<br>• Undertake dust monitoring at a number of locations along the M2 Motorway for comparison to pre-construction levels. |
| Waste Management | Waste production minimised. | • Maximised 'waste hierarchy' during construction and incorporated into work programs, purchase strategies and site inductions. This would be assessed periodically to identify opportunities for improvement. |
| Hazards and Risks | Minimise risks and hazards to the environment and community. | • Prevent contamination of watercourses by locating storage areas for hazardous materials an adequate distance away from watercourses and entry points to the stormwater system. Spillages to be contained and collected for disposal.<br>• Site specific safety issues and personnel responsibilities included as part of the project induction. Safety issues and responsibilities would be included in activity specific briefings as required. |
| Sustainability | Minimise greenhouse gas (GHG) emissions and energy consumption. | • Energy efficient equipment and management measures would be used where feasible and reasonable. |

| Environmental issue | Objective | Target |
|---|---|---|
| Property and Land Use | Minimise impacts on property and land use. | • Minimise property and land use impacts by conducting property inspections where required, maintaining a register of properties inspected, and where appropriate rectifying any property damage caused directly or indirectly by construction or operation.<br>• Maintain property access for the duration of construction. Temporary access requirements would be assessed, designed, managed and rehabilitation prepared in consultation with affected landholders. |
| Ancillary Facilities | Minimise adverse impacts associated with ancillary facilities. | • Ensure the sites for ancillary facilities satisfy the criteria provided in the EA, unless otherwise approved though the CEMP. |
| Environmental Training | All work personnel to be informed of the M2 Upgrade environmental requirements, including the requirements and responsibilities for implementing impact mitigation and management measures and reporting environmental incidents. | • Site-specific environmental inductions provided to all work personnel before starting work on-site.<br>• Specialised training in environmental management procedures (such as erosion and sediment control) provided to all relevant personnel prior to starting work on-site. |
| Environmental Approvals | M2 Upgrade to be constructed in accordance with planning, environmental and other approvals. | • No identified non-conformances with approvals. |

# 3. Legislative and other requirements

## 3.1 Key legislative requirements

Table 3-1 below identifies NSW legislative requirements and their application to the M2 Upgrade.

**Table 3-1 NSW legislative requirements**

| Legislation and administering authority | Requirement | Project application |
|---|---|---|
| *Contaminated Land Management Act 1997*<br><br>NSW Department of Environment, Climate Change and Water (DECCW) | Process for investigation and remediation of land to be followed where contamination presents a significant risk of harm to human health or some other aspect of the environment. | M2 Upgrade must follow process where contaminated land identified. |
| *Crown Lands Act 1989*<br><br>NSW Land and Property Management Authority | Ministerial approval required to grant a 'relevant interest' over a Crown Reserve. | M2 Upgrade must obtain approval prior to granting a relevant interest over Crown Reserve. |
| *Dangerous Goods Act 1985*<br><br>DECCW<br><br>WorkCover | License required for storage and/or transport of prescribed quantities of dangerous goods. | M2 Upgrade must obtain a licence where storage of dangerous goods for construction is in licensable quantities. |
| *Environmental Planning and Assessment Act 1979*<br><br>NSW Department of Planning (DoP) | Part 3A process to be followed for 'critical infrastructure projects'. | M2 Upgrade declared to be a 'critical infrastructure project' (Ministerial Order published in NSW Government Gazette No.44 on 27 February 2009).<br><br>M2 Upgrade must comply with SoC and MCoA. |
| | Section 75W process to be followed for future modifications to Minister's Approval. | M2 Upgrade must undertake any modifications through the completion and approval of appropriate EA/REF, prior to construction of the modified/varied M2 Upgrade component. |
| *Fisheries Management Act 1994*<br><br>Industry & Investment NSW (I&I) | Permits required under section 201, 205 or 219. | M2 Upgrade exempt from permit requirements. |
| *Heritage Act 1977*<br><br>Department of Planning – Heritage Branch | Approval required under Part 4.<br><br>Excavation permit required under section 139. | M2 Upgrade exempt from approval/permit requirements. |

| Legislation and administering authority | Requirement | Project application |
|---|---|---|
| | Heritage Council to be notified if a relic is uncovered during construction and it is reasonable to believe that the Heritage Council is unaware of the location of the relic. | M2 Upgrade must notify Heritage Council in the event of a notifiable discovery. |
| *National Parks and Wildlife Act 1974*<br><br>DECCW | Permit required under section 87.<br><br>Consent required under section 90. | M2 Upgrade exempt from permit/consent requirements. |
| *Native Vegetation Act 2003*<br><br>DECCW | Section 12 authorisation required to clear native vegetation or State protected land. | M2 Upgrade exempt from authorisation requirements. |
| *Noxious Weeds Act 1993*<br><br>I&I | Control noxious weeds on controlled lands in accordance with relevant control categories. | M2 Upgrade must control weeds as required on lands under the control of the M2 Upgrade. |
| *Protection of the Environment Operations Act 1997*<br><br>DECCW | Environment Protection Licence (EPL) required for scheduled activities. | M2 Upgrade, being 'road construction' is a scheduled activity and requires an EPL. |
| | Notification to DECCW in the event of a pollution incident causing or threatening material harm to the environment | M2 Upgrade must notify DECCW in the event of a notifiable incident. |
| *Roads Act 1993*<br><br>RTA | Section 138 consent required for erection of a structure, or carrying out of work in, on or over a public road or digging up or disturbance of the surface of the road. | M2 Upgrade must obtain consent. |
| *Waste Avoidance and Resource Recovery Act 2001*<br><br>DECCW | Reduce environmental harm and provide for reduction in waste generation in line with ecologically sustainable development principles. | M2 Upgrade must reduce and report waste monthly. |
| *Water Management Act 2000*<br><br>DECCW | Water use approval required under section 89.<br><br>Water management work approval required under section 90.<br><br>Activity approval required under section 91. | M2 Upgrade exempt from approval requirements. |

Table 3-2 below identifies Commonwealth legislative requirements and their application to the M2 Upgrade

**Table 3-2 Commonwealth legislative requirements**

| Legislation and administering authority | Requirement | Project application |
|---|---|---|
| *Environment Protection and Biodiversity Conservation Act 1999*<br><br>Department of Environment, Water, Heritage and the Arts | Approval required for a 'controlled action'. | M2 Upgrade must submit EPBC referral where controlled action required. |
| *National Greenhouse and Energy Reporting Act 2007*<br><br>Department of Climate Change | Requirements for reporting of greenhouse emissions, abatement actions, energy consumption and production data. | M2 Upgrade must report greenhouse and energy use monthly. |

## 3.2 M2 Upgrade environmental obligations

The M2 Upgrade environmental obligations would be sourced from a collection of documents and approvals, including the following:

- Environmental Assessment, including the draft Statement of Commitments.
- Submissions Report.
- Minister's Conditions of Approval.
- Environmental Protection Licence.

## 3.3 Standards and guidelines

Various environmental publications, standards, codes of practice and guidelines that are relevant to the M2 Upgrade would be incorporated into the CEMP, including the following:

- ISO 14001:2004 Environmental Management Systems.
- Guideline for the Preparation of Environmental Management Plans (Department of Infrastructure, Planning and Natural Resources, 2004).
- RTA QA Specification G36 – Environmental Protection (Management System) (October 2009).
- RTA QA Specification G38 – Soil and Water Management (Soil and Water Management Plan) (September 2004).

# 4. Environmental risk assessment

## 4.1 Environmental risk assessment for CEMP preparation

The identification of the environmental aspects and impacts associated with construction is a key step in the development of an EMS for a construction project. Environmental procedures and systems can then be developed to address the significant risks faced by the M2 Upgrade. The risk assessment process involves first identifying the aspects of the proposed activities that could interact with the environment and the potential environmental impacts that could result.

Aspects and impacts must be identified for all proposed construction activities that have the potential to:

- Impact flora and fauna.
- Cause ground instability leading to erosion, sedimentation and water quality impacts.
- Generate noise in the vicinity of sensitive receivers.
- Generate vibration levels experienced by adjacent structures and sensitive receivers.
- Impact on items of heritage significance, both Aboriginal and non-Aboriginal.
- Result in release of potentially contaminating substances to air, soil and water.
- Detract from the general amenity of sensitive receivers in the vicinity of the proposed works locations.
- Create environmental hazards and/or risks.
- Generate wastes.

Once the environmental aspects and impacts have been identified, each impact is evaluated based on:

- The environmental aspect.
- The potential impact.
- The likelihood or probability of the impact occurring.
- The severity or consequence of the impact.

The relative risk of the impact is then determined using the likelihood, consequence and risk descriptions presented in Figure 4-1.

A two stage risk assessment process would be adopted. This process would involve first evaluating the ‘untreated’ risk (i.e. with no management measures or other controls adopted or implemented to control and reduce the risk levels). Then the management measures are outlined that would be implemented to control the risk. The final step would then involve re-evaluating the risk to determine the effectiveness of the proposed management measures and to determine the ‘residual’ risk.

For this an aspects and impacts register would be developed and appended to the CEMP. This register would be used to develop the impact mitigation and management strategies for the CEMP and sub-plans.

**Figure 4-1 Risk Assessment Process**

Consequence Descriptions

| Consequence | Environmental Impact |
|---|---|
| Substantial | Permanent widespread ecological damage |
| Major | Heavy Ecological damage, costly restoration |
| Medium | Major but recoverable ecological damage |
| Minor | Limited but medium term negative effects |
| Negligible | Short-term damage |

Likelihood Descriptions

| Likelihood | Description | Probability |
|---|---|---|
| Almost Certain | This threat can be expected to occur | >75% |
| Likely | This threat will quite commonly occur | 51% - 75% |
| Possible | This threat may occur occasionally | 26% -50% |
| Unlikely | This threat could infrequently occur | 10% - 25% |
| Rare | This threat may occur in exceptional circumstances | <10% |

Risk Matrix

| | | | | | |
|---|---|---|---|---|---|
| Almost Certain | 5 | 10 | 18 | 23 | 25 |
| Likely | 4 | 9 | 17 | 20 | 24 |
| Possible | 3 | 8 | 13 | 19 | 22 |
| Unlikely | 2 | 7 | 12 | 15 | 21 |
| Rare | 1 | 6 | 11 | 14 | 16 |
| | Negligible | Minor | Medium | Major | Substantial |

Risk Description

| |
|---|
| Extreme Threat |
| Very High Threat |
| High Threat |
| Moderate Threat |
| Low Threat |

## 4.2 Preliminary risk analysis

A preliminary environmental risk assessment has been undertaken as part of the environmental assessment process. This risk analysis was used to confirm whether the risk identified in the key issues in the Director-General's Requirements have been adequately covered and whether or not there are additional issues that needed to be addressed. The results of the preliminary environmental risk assessment would be used and considered when undertaking the more detailed environmental risk for the M2 Upgrade.

## 4.3 Ongoing risk assessment

The environmental risk assessment for the M2 Upgrade would be reviewed throughout the constructions period. The risk assessment would be reviewed:

- If a significant incident or impact occurs.
- If activities or the M2 Upgrade changes.
- Following CEMP audits if significant or ongoing non-conformances with the CEMP and Project approval conditions are noted.

Following the completion of the environmental risk assessment reviews, the CEMP, sub-plans would be amended accordingly.

## 4.4 Activity specific environmental risk assessment

Additional risk assessments would be undertaken during the development of site or activity specific environmental work procedures.

# 5. Roles and responsibilities

## 5.1 Project team

To ensure implementation of the requirements of the CEMP, environmental responsibilities must be assigned to key project personnel. The responsibilities of key project personnel with respect to the CEMP and implementation of an EMS is outlined in Table 5-1 below.

These responsibilities outlined would be reviewed:

- When the final Statement of Commitments is issued.
- On receipt and review of the MCoA following Project approval.
- On development of the CEMP.

It is likely the appointment of an Environmental Representative would be a condition of project approval. The Environmental Representative would be independent of the construction contractor and have the responsibility of reviewing construction management documentation, implementation of the EMS and providing advice and feedback. Other responsibilities of the Environmental Representative could include:

- Review and endorsement of the CEMP prior to the commencement of work on-site.
- Review of early works assessments.
- Regular environmental site inspections.
- Auditing of compliance and/or implementation of construction management plans.
- Approval of minor modifications to the CEMP and sub-plans and other environmental management documents.
- Compliance reporting in accordance with requirements of the CEMP and MCoA.
- Liaison with other government agencies as required.

**Table 5-1 Key project roles and environmental responsibilities**

| Role | Responsibility |
|---|---|
| Project Manager | • Overall responsibility for obtaining and compliance with MCoA, Environmental Protection Licence(s) and other licences, permits, approval and consents required for the Project, prior to the commencement of construction.<br>• Overall responsibility for ensuring that CEMP and sub-plans are developed and approved in conjunction with the Construction Manager, Environment Manager and relevant government agencies.<br>• Ensuring appropriate consultation and liaison with government agencies including DoP, DECCW, and I&I.<br>• Ensure that a program of auditing is implemented and reviewed the outcomes and findings of all environmental audits. |

| Role | Responsibility |
|---|---|
| Construction Manager | • Understand, provide input into and be responsible for on-site implementation of the CEMP and sub-plans.<br>• Ensure that appropriate resources are made available to ensure compliance with the MCoA, all other approvals and the CEMP.<br>• Ensure that all project personnel are inducted and are of their individual responsibilities regarding environment management and compliance.<br>• Ensure compliance of sub-contractors with requirements of the CEMP and sub-plans.<br>• Ensure that non-conformance processes are implemented.<br>• Ensure that all environmental incidents are identified, reported and investigated.<br>• Participate in the CEMP audit process and ensure that audit findings are adequately addressed. |
| Environment Manager | • Responsible for the development all environmental management plans including sub-plans to meet the commitments and requirements of all project environmental documentation and approval conditions.<br>• Provide advice to the construction teams regarding implementation of the CEMP, compliance with approval condition and licences and general environmental issues.<br>• Implementation of the CEMP audit program.<br>• Continuous improvement of the CEMP and sub-plans.<br>• Ensure that corrective actions plans (or similar) are developed following each audit and that corrective actions are implemented.<br>• Receive and respond to complaints.<br>• Ensure that appropriate environmental content is included within the General Project Induction.<br>• Ensure that task-specific environmental training (Toolbox talks) are developed and delivered prior to environmental sensitive works.<br>• Investigate environmental incidents as required and assist in developing appropriate corrective actions. |
| Project Engineer | • To provide specific direction to the construction personnel on CEMP requirements and general environmental issues, in consultation with the Environment Manager and Construction Manager.<br>• Ensure that regular site inspections are carried out to check adequate implementation of CEMP and sub-plan requirements and general environmental controls.<br>• Ensuring that the outcomes of audits and incident investigations and any corrective actions are communicated to the construction personnel and that corrective actions are implemented.<br>• Ensuring that environmental (and other) incidents are reported by all construction personnel.<br>• Notifying the Construction Manager and Environment Manager if situations arise that are outside the scope of the CEMP and sub-plans. |

| Role | Responsibility |
|---|---|
| Foreman/Superintendent | • On-site implementation of CEMP and sub-plans.<br>• Ensure that all environmental (and other) incidents are reported immediately.<br>• On-site implementation of corrective actions arising from audits, incidents and other identified non-conformances.<br>• Routinely checking and maintaining all environmental controls<br>• Ensure that all project personnel under their direction have received the General Project Induction.<br>• Ensure that personnel attend appropriate task-specific environmental training (Toolbox talks) prior to commencement of that activity.<br>• Stopping work and reporting to the Project Engineer immediately if situations arise that are outside the scope or not covered by the CEMP and sub-plans. |
| Construction personnel and other staff | • Attend all relevant project inductions and environmental training required.<br>• Understand and comply with environmental responsibilities.<br>• Implement all directions given by Foreman/Superintendent regarding environmental issues and compliance.<br>• Undertake all activities in accordance with agreed procedures and work methods.<br>• Not starts any environmentally sensitive work until appropriate has been granted by a direct supervisor.<br>• Report any environment (and other) incidents, near misses and hazards to their direct supervisor (or higher) immediately. |

## 5.2 Sub-contractors

Sub-contractors present the greatest environmental risks to a project due to:

- Their absence of direct involvement in the environmental assessment and approval process.
- Their lack of direct knowledge of and direct responsibility regarding the SoC and the MCoA.
- The potential for miscommunication between the construction team and on-site sub-contractor personnel.
- The numbers of sub-contractors spread across the project works areas.
- Lack of familiarity with the specific EMS that would be developed for the project.

### 5.2.1 Sub-contractor assessment and selection

The construction contractor has an ongoing sub-contractor assessment program that assesses the sub-contractor on the basis of past performance on similar projects. Environmental compliance and performance is a key component of this assessment and evaluation process. Sub-contractors that perform poorly in the past are excluded from the selection process for future projects. This ensures that only sub-contractors with a proven track record would be chosen for the M2 Upgrade. Sub-contractors are aware of the construction contractor's assessment and evaluations process, which add further incentive to perform well in all areas, including environmental compliance.

### 5.2.2 Environmental compliance for sub-contractors

Sub-contractors would be obliged contractually to comply with the requirements of the CEMP and sub-plans. In addition, sub-contractors would be required to follow any direction given by the construction contractor regarding environmental management and compliance.

All sub-contractor personnel would attend the general project induction and any task-specific environmental training (toolbox talks) relevant to the activities they are involved in.

Routine and documented environmental site inspections by the construction contractor would be undertaken for all sub-contracts. Sub-contractors would be subject to environmental compliance audits as part of the project audit program.

Where the sub-contractors are responsible for large components of the construction works or works that are environmentally sensitive, consideration would be given for a key person to be nominated by the sub-contractor to be responsible for ensuring compliance with the CEMP and sub-plans. The nominated person would be responsible for:

- Undertaking site documented site inspections.
- Reporting to the construction contractor on environmental matters.
- Participating in audits and incident investigations.
- Implementing corrective actions arising from audits and inspections.

# 6. Training awareness and competence

## 6.1 Project induction

A Project induction would be delivered to provide personnel with a general understanding of the local conditions, site constraints, rules, procedures, risks and responsibilities, relating to the M2 Upgrade and the environment.

All personnel, including sub-contractors would be inducted prior to commencing work on the M2 Upgrade.

The induction would include the following topics:

- Soil and water management requirements.
- Water quality protection.
- Vegetation clearing protocols and requirements.
- Fauna protection requirements.
- Heritage issues and management.
- Site access controls.
- Traffic management.
- Waste management.
- Storage and handling of chemicals, fuels and oils.
- Spill prevention and response.
- Complaints handling procedures.
- Environmental incident reporting requirements.

## 6.2 Line management training

Prior to the commencement of site works, line management training would be delivered to relevant management personnel regarding environmental issues, protocols and requirements for the M2 Upgrade. The training would focus on:

- Vegetation clearing protocol requirements.
- Soil and water management requirements.
- Weed management/equipment wash down requirements.
- Environmental inspection, reporting and documentation protocols and requirements.
- Environmental incident reporting requirements.

## 6.3 Toolbox talks

Toolbox talks would be delivered to communicate site-specific or task-specific environmental procedures, protocols, risks and requirements to relevant personnel.

Toolbox talks may also be developed to provide additional environmental training to personnel. Training topics would include:

- Heritage sensitivities.
- Night-works and associated risks.
- Riparian works and associated risks and mitigation measures.
- Changes to the CEMP.

- Reinforcement of CEMP requirements to address improvement opportunities in environmental performance.

# 7. Incident and emergency preparedness and response

## 7.1 Emergency preparedness

Emergency preparedness would be managed with monitoring, surveillance and training. Preventative actions would include the following:

- Daily inspections of active work sites.
- Completion of routine environmental site inspection checklists (see example in Attachment B).
- Issue and quick close-out of non-conformance notices.
- Maintenance of constant supervision on site.
- On-going environmental training.
- Environmental audits of work sites, sub-contractors and conformance issues.

Environmental and safety information on hazardous substances (e.g. Material Safety Data Sheets) would be available at the main site office and where such substances are to be stored.

Spill kits and other emergency response equipment would be strategically located throughout the M2 Upgrade site.

Testing of environmental response procedures would be conducted in areas where a pollution risk is present. Personnel with potential to be involved in emergency response activities would be provided with specific training.

## 7.2 Incident management

The CEMP would describe an incident management process that ensures the interfacing ability between the RTA incident management process and the construction contractor's incident management process. Key aspects of the process would be described and include the following:

- Immediate response actions.
- Notification triggers.
- Incident reporting (internal and external).
- Incident investigation.
- Corrective, remedial and preventative action generation and tracking (e.g. review of CEMP and risk registers).
- Communication of incident outcomes (e.g. lessons learnt).

# 8. Environmental monitoring, inspections and auditing

## 8.1 Inspections

There would be a number of different types of inspection programs. These may include:

- Construction diaries.
- Audits.
- Non-conformance investigations.
- Incident investigations.
- Erosion and sediment inspections.
- Regular, routine reporting against environmental site inspection checklists (refer to Attachment B).

## 8.2 Environmental monitoring

Environmental monitoring, involving the collection and analysis of data, may be undertaken for key environmental issues to:

- Assess the effectiveness of environmental protection measures being implemented through the CEMP and sub-plans.
- Identify the need for addition environmental management measures or modifications to existing strategies.

The scope, timing, methodology and responsibilities for environmental monitoring programs would be specified in the respective sub-plans for each key issue. Monitoring may range from formal sample collection, analysis and measurement, through to more qualitative assessments based on observations.

## 8.3 Audits

### 8.3.1 Internal audits

A program of internal audits would be undertaken. Elements that may be audited include:

- Compliance with the MCoA and SoC.
- Compliance with the CEMP.
- Compliance with other approval, permit and licence obligations.
- Compliance with environmental work procedures.
- Complaint response.
- Sub-contractor activities.
- Training records.
- Non-conformances.
- Monitoring results.
- System documentation such as checklist completion.

These internal audits would be performed within three months of commencement of construction and at least once every six months thereafter.

### 8.3.2 External audits

External audits may be required as part of the MCoA and/or by the RTA. It would cover the same elements as those covered by the internal audit. A program of external audits would be developed by the construction contractor.

## 8.4 Reporting

Typical reporting requirements that are likely to be applicable to the M2 Upgrade are summarised in Table 8-1.

Table 8-1

| Report | Details | Timing |
|---|---|---|
| Internal audit results | Audit for compliance against the MCoA, relevant licenses and approvals. | First internal audit within 3 months of start of construction, and then at least 6 monthly thereafter |
| External audit results | Audit for compliance against the MCoA, relevant licences, permits and approvals. | As required |
| Monitoring results/data | Potential exceedances against criteria reported by environment officers, filed electronically and in hard copy. | As required |
| Project team meeting | Project team meeting to include environmental component, and minutes of meetings to be recorded and distributed to project team. | 1-2 weekly |
| Corrective action, environmental inspection report, environmental improvement notice, stop work notice | Non-conformances/corrective action/notices/inspection reports registered by environment team. | As required |
| Environmental site inspection checklists | Completed weekly and kept on site. Major repeated non-conformances reported to Environment Manager. | Weekly |
| Complaints report | Monthly summary report, filed electronically. | Monthly |

# 9. Environmental non-conformances

A system for identifying environmental non-conformances and implementing corrective actions to address the non-conformances would be developed as part of the EMS and documented in the CEMP.

The system would include:

- A program of documented environmental site inspections.
- An environmental compliance auditing program.
- Environmental incident reporting and investigation procedures.
- An environmental compliance tracking program.
- Corrective action processes.

The non-conformances and corrective actions system and procedures would be communicated to all relevant project personnel.

# 10. Review and improvement of the CEMP

## 10.1 Environmental management review

Implementation of the CEMP and sub-plans would be reviewed throughout the duration of construction. The review would generally occur:

- Following environmental compliance audits.
- Following significant environmental incidents.
- Following regulatory action due to environmental non-conformances.
- As a result of repeated non-conformance identified during the environmental site inspection program.

The environmental management review would be undertaken by the construction contractor's management team with input from the RTA, regulatory agencies and sub-contractors as required. The review would comprise:

- A review of audit results.
- A review of environment incidents investigations and coactive actions.
- A review of project environmental non-conformances and related procedures/system tools.

The CEMP and sub-plans would be updated as required based on the outcomes of the environmental management review to ensure continual improvement.

# Attachment A – RTA Environment Policy


## Commitment

The Roads and Traffic Authority of NSW is committed to undertaking its activities in an environmentally responsible manner and effectively managing any risks that may lead to an impact on the environment. The RTA will do all that is reasonably practical to ensure that there is continuous improvement in environmental performance, including ongoing communication and awareness raising, active reporting of environmental incidents and continuous learning from experience.

The RTA is committed to environmental management being an essential element of effective road and traffic related infrastructure planning, construction, maintenance and operation that must be properly considered and integrated into all phases of RTA projects.

## Accountability

Senior executive management is accountable for the RTA's overall environmental performance. This includes providing leadership, direction, and resources and support, to ensure the RTA's activities are undertaken in a manner that at all times considers and effectively manages potential environmental risks and always strives for environmental performance improvement.

## Responsibility

Line managers and supervisors are responsible, within their work areas, for implementing the RTA's environmental policies and guidelines. They must proactively address issues that may adversely affect environmental performance at project worksites and workplaces for which the RTA is responsible.

## Cooperation

The RTA requires its employees to cooperate in the management of environmental matters, including responding to the reasonable directions of external environmental regulators. Employees must monitor the continued effective installation and operation of environmental controls within the scope of their day to day work.

## Consultation

The RTA will consult with management, employees, relevant regulatory agencies and where appropriate, the community, on the development, implementation and refinement of its environmental function.

## Compliance

The RTA will conduct all its operations, whether carried out by or on behalf of the RTA, in accordance with relevant legislation and government policy and agreements.

## Management

The RTA will demonstrate due diligence in the provision of its services, manage its work activities in a manner that is consistent with the principles of ecologically sustainable development, and will deliver continuous improvement in environmental performance through:

- Setting and reviewing environmental objectives and targets for the RTA.
- Implementing the RTA's environmental management system.
- Assessing likely environmental outcomes before deciding to proceed with activities.
- Considering environmental outcomes when making decisions, in the same way that consideration is given to safety, cost, quality and time.
- Minimising pollution and managing potential environmental impacts resulting from the RTA's activities and promoting the efficient use, reuse and recycling of resources.
- Monitoring, reviewing and reporting publicly on the environmental performance of the organisation.
- Building constructive and collaborative working relationships with external stakeholders.

## Employees

All RTA staff have a responsibility to actively contribute towards avoiding or minimising environmental impacts in their day to day work.

To do this staff must:

- Work carefully at all times to protect the environment.
- Report any environmental impacts, hazards or potential environmental management issues of which they become aware to the responsible officer, including poorly installed or poorly operating equipment they encounter in their working day.
- Work in a manner consistent with the RTA's legal environmental obligations.
- Work in accordance with all RTA environmental management programs and follow specified systems of work.
- Participate in relevant environmental management consultation and training initiatives, and use effective environmental management measures in their work.

This environmental policy will be reviewed in 2012.

Michael Bushby

Chief Executive

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# Attachment B – Example environmental site inspection checklist

# Environmental Checklist

| | | | |
|---|---|---|---|
| **Project:** | | **Project No:** | |
| **Date:** | | **Time:** | ☐ AM ☐ PM |
| **Weather:** | | **Rain:** | |

**Site Activity:**
e.g. working east wall

## 1. Water Quality

- ☐ Assess general protection with reference to the sediment / erosion control plan / ESWMS (detail below)
- ☐ Monitor pH, turbidity, temp., dissolved oxygen, electro conductivity, and oil and petrochemicals (visual inspection or films or odours) at water courses as required
- ☐ Monitor TSS at discharge of basins or dammed water if required

**Comments:**

| Control | Action | New / Maintain |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

## 2. Air Quality

- ☐ Constant visual observation for excessive dust production
- ☐ Random monitoring of regularly trafficked access roads, exit to site and residences within 300m of site
- ☐ Weather station monitoring for wind speed and direction
- ☐ Monthly dust monitoring equipment in place
- ☐ Rumble grids/rock rumbles/wheel washes being used to minimise dirt tracked onto roads
- ☐ Are streets near exit to site clean / swept?

**Comments:**

## 3. Noise

- ☐ Check site for significant noise sources (noisy equipment rock dumping)
- ☐ Monitor sensitive receptors monthly or as required
- ☐ Spot checks at random locations with hand held meter

**Comments:**

## 4. Vibration

- ☐ Monitor during heavy vibrating rolling within 60m of a dwelling

- [ ] Monitor during piling operations
- [ ] Spot checks of sensitive locations within 300m

**Comments:**

## 5. Waste Management

- [ ] Recycling bins available and being used
- [ ] Oil and petrochemical leaks, spills or uncontrolled discharges cleaned up and/or managed properly
- [ ] Are spill kits at each designated location?
- [ ] Are spill kits fully stocked / scaled?
- [ ] Servicing and refuelling practices meet environmental plan requirements
- [ ] Assess plant wash down pit and daily visual inspection of outlet drain and silt trap devices
- [ ] Is the site tidy and waste collection areas being used appropriately

**Comments:**

## 6. Hazardous Waste

- [ ] Identify and record any leaks, spills or uncontrolled discharges

**Comments:**

## 7. Flora and Fauna

- [ ] No disturbance of flora outside work areas
- [ ] Inspect mulching/chipping operations to ensure the invasive weed species are not being chipped: e.g. Privet, Camphor Laurel, Coral Tree, Poplar, Chinese Elm, Willow
- [ ] Presence of noxious weeds
- [ ] Cleared organic material is stockpiled as per mulch plan and at least 50m from watercourses with appropriate bunds on upstream side and sediment control downstream (if required)
- [ ] Stockpiles to be no greater than 2m high
- [ ] Control of declared pest e.g. Fire Ants, dieback / weeds.

**Comments:**

| Location | Fauna Noted |
|---|---|
| | |
| | |
| | |
| | |

## 8. Cultural Heritage

- [ ] Daily inspection of works area for cultural heritage 'finds'

**Comments:**

## 9. Contaminated Land and Acid Sulphate Soils

- ☐ Sampling and testing performed as per management plan
- ☐ Certificate from suppliers that materials are free from contamination

**Comments:**

## 10. Summary of Actions

| No. | Action |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |

## 11. Inspection Details

**Inspected By:** **Signature:**

Name

**Other Comments:**

# Attachment C – Construction Noise and Vibration Management Strategy

# Construction Noise and Vibration Management Strategy

## Management objectives

Construction of the M2 Upgrade project has the potential to generate elevated noise and vibrations with the potential to adversely affect the amenity of adjacent receivers. Construction noise and vibration will need to be actively managed to ensure the levels experienced by adjacent receivers are reduced where reasonable and feasible to acceptable levels. The construction noise and vibration objectives for the project are:

- To reduce noise and vibration levels experienced by receivers adjacent to the motorway and project areas due to construction activities.
- To reduce the durations of elevated noise and vibration levels experienced by receivers adjacent to the motorway and project areas due to construction activities.
- To limit wherever practicable noise and vibration impacts due to construction activities to less sensitive times of the day.
- To provide timely and accurate information to receivers in the vicinity of the motorway regarding construction works and potential noise and vibration impacts.

## Management principles – construction noise

In general the management of construction noise impacts can focus on reducing noise at the source or addressing and/or reducing potential impacts at the receiver. The project has more direct control and influence over noise generation at the source. As such noise source control is the favoured strategy. The following hierarchy of control strategies is proposed for the M2 Upgrade project:

- Reduce noise levels generated due to construction (source measures.)
- Reduce the propagation noise from the works locations wherever practicable (propagation measures).
- Treat or otherwise address residual noise impacts at the receiver (receiver measures).

Due to the location of the Motorway in a predominantly urban environment and the nature of the proposed works, managing and reducing construction noise will be a key challenge for the project. Also, the Motorway must remain operational at all times. As such, due to space restrictions, potential safety risks to road users and construction personnel, potential traffic implications and other technical reasons, certain activities would be required when traffic volumes are low, i.e. during the late evening and night time periods.

The specific management principles that would be adopted to reduce and manage potential construction noise impacts throughout the construction phase of the project (with reference o the hierarchy to control strategies identified above) are outlined below:

- Consider changes to construction methodologies to reduce the level of noise generation.
- Consider potential noise impacts when selecting plant.
- Avoid the operation of multiple items of noise intensive equipment simultaneously in close proximity, wherever practicable.
- Consider sensitive noise receivers when determining trucks routes to and from works sites and compounds.
- Schedule noise intensive works to less sensitive time of the day wherever practicable.

- Set-up work sites and traffic management arrangements to facilitate as much construction activity as possible during the day.
- Consider the location of sensitive noise receivers when setting up works sites and compounds, with particular reference to the placement noisy plant and activities.
- Investigate options for temporary noise barriers and other measures to prevent propagation of noise from construction locations.
- Undertake noise monitoring for noise intensive activities to confirm that predicted noise levels are not exceeded.
- Implement suitable respite periods for noise intensive and high impact noise activities.
- Investigate options for reducing noise levels at receivers adjacent to the works locations.
- Consult with the potentially affected receivers regarding noise intensive activities, timing and durations.

## Strategic approach

### *Noise management strategy for general construction*

Each works location would be reviewed with the intention of identifying potential opportunities to minimise noise generation. The following approach would be adopted:

- Review each works location and identify potential noise sources and potential noise receivers.
- Review the proposed construction methodology to determine potential impacts, with particular reference to noise intensive activities and equipment and identify any opportunities to modify construction methodologies to reduce potential noise impacts.
- Review works staging to minimise the need to operate multiple items of noise intensive equipment simultaneously in close proximity.
- Set up work sites and traffic management arrangements wherever practicable to maximise day time construction activities.
- Review the required plant and investigate the options for elimination or substitution of noisy plant and options for reducing noise using silencers and mufflers.
- Identify noise intensive equipment and high impact noise activities for which respite periods will be required.
- Identify procedural and behavioural changes that could be implemented to reduce noise emissions (for example, switching off equipment when not in use).

Identify options for the use of temporary and portable noise controls such as hoarding.

When a strategy has been developed for each work location, the outcomes would be communicated to all relevant personnel. The responsibility for implementing appropriate noise control strategies at each work location would be assigned to key project personnel.

### *Noise management strategy for strategy for compounds*

Given the urban environment in which the Motorway is situated, many of the proposed compound locations would be in close proximity to sensitive noise receivers. The following strategies would be adopted at each compound to reduce potential noise impacts:

- Plant selection with consideration of potential noise generation and impacts with substitution and/or elimination of potentially noisy plant wherever practicable.
- Position noisy plant as far as practicable from adjacent residences.

- Position locations for unloading and loading of equipment and materials as far away from adjacent residences.
- Schedule potentially noisy activities during less noise sensitive times of the days if practicable.
- Position crib huts and site offices etc between general compound area and adjacent residents to provide noise attenuation.
- Install noise hoarding along compound perimeters to protect adjacent residences.
- Assign a key person responsibility for the management of noise at each compound location.

Some works would be required to be undertaken outside of standard construction hours. As such, the use of some compounds outside of standard construction hours would be required to support these activities. The following strategies would be adopted to address potential noise impacts from use of those compounds:

- Favour the use of compounds that are not is close proximity to residents (i.e. within 200m) to support night works wherever practicable.
- Review proposed activities that occur at the compound with the potential to cause elevated noise levels and prohibit certain activities during certain times.
- Investigate additional options to those described above to provide further attenuation of noise at the compound perimeter if required.

The key personnel responsible for the respective compound would be responsible for ensuring that appropriate strategies are implemented.

### *Noise management strategy for works outside of standard construction hours*

As the Motorway must remain operational and space within the Motorway in which to set up work zones is limited certain activities need to be undertaken at night, particularly to reduce potential safety risks to road users and construction personnel and to limit potential traffic disruptions. The following strategy would be adopted in for these activities:

- Each work location would be investigated on a case by case basis and the potential noise impacts assessed, with reference to the proposed construction methodology, site specific equipment lists and scheduling and local conditions that would affected the propagation of noise for the work site.
- For each location, noise level predictions would be made potential impacts to adjacent residences assessed against appropriate noise management levels.
- Site specific noise management strategies and controls would be developed for each location, guided by the general noise management principles identified above.
- A Construction Noise Impact Statement (CNIS) would be prepared for each location.

Prior to the commencement of the works at each location, the content and specific requirements of each CNIS would be communicated to all relevant project personnel.

The potentially affected residents in the vicinity of the works location would be consulted with about the work and potential noise impacts. The focus of the consultation would be on the nature, timing and duration of the works. The consultation would continue for the duration of the issue at each location.

Noise monitoring would be undertaken during the start up of works outside standard construction hours at each location to confirm noise performance against predicted noise levels and licence conditions if applicable. If non-compliances are detected, construction methodologies and adopted noise management strategies and controls would be reviewed to address the non-compliance.

### *Vibration management strategy*

Potential vibration impacts were assessed as part of the Environmental Assessment. The major potential sources of construction vibration related to the M2 Upgrade project include the use of excavators, rock breakers, vibratory rollers, rock grinders and rock bolting.

In general the environmental assessment concluded that vibration produced by earthworks and road forming operations is expected to lie below structural damage criteria at the nearest sensitive receptors. Vibration may be perceptible for relatively short periods of time when construction activities are immediately adjacent to specific dwellings.

Where vibration-intensive operations are being conducted in close proximity to buildings nearest to the road works (e.g. construction of the Windsor Road ramps), judicious selection of plant and equipment will be necessary to minimise the potential for perceptible vibrations at the adjacent buildings.

### *Noise and vibration management strategy for tunnelling*

Managing the potential air-borne and ground-borne noise impacts associated with tunnelling and modification of the tunnel portals represents a key challenge for the project, due to the noise intensive nature of the works and the need to tunnel continuously a certain times to maintain structural integrity of the tunnel and address potential safety risk to road users and construction personnel.

The strategy outlined for works outside of standard construction hours would also be adopted for tunnelling works. In addition, key works scheduling strategies are proposed to reduce potential noise impacts to acceptable levels.

Information from the environmental assessment regarding predicted noise levels compare to appropriate noise management levels for tunnelling works is summarised below:

- Maximum predicted noise levels associated with works at the tunnel portals are predicted to be 62 dB(A), slightly above the day time noise management level.
- Maximum predicted noise levels associated with works at the tunnel entrances with an acoustic shed in place but without a acoustic curtain to control noise leaving the shed are predicted to be 51 dB(A), slightly above the evening noise management level.
- Maximum predicted noise levels associated for work that would occur entirely within the tunnel tubes with acoustic sheds and acoustic curtains in place are predicted to be 39 dB(A) slightly higher than the night time noise management level.
- The exceedances of relevant noise management are predicted at the few houses around each portal with a direct line of sight to the tunnel entrances and proposed work locations. As the works would occur within the deep existing excavations of the tunnel portals, construction noise levels are predicted to fall away sharply with increasing distance from the edge of the portals.
- For grinding works, the nearest affected receivers, with a slant distance of around 15m from the cutting face, would potentially experience maximum exceedances of night time noise management levels due to ground-borne noise of around 5 dBA.
- For residences with slant distance of less than 29m from the cutting face, exceedances of night time noise management levels (by less than 5 dBA) might be experienced for a period of 10-12 days.

Based on the above assessment, the following strategy is proposed to manage potential noise impacts associated with the tunnelling and widening of the tunnel portals:

- Work associated with widening of the tunnel portals would occur during the day time period until such time as the works can occur within an acoustic shed.
- Works that could occur within the acoustic shed at the tunnel entrances would occur during day time and evening time periods until such time as works could occur with the acoustic curtain in place.
- Works that could occur immediately inside the tunnel with the shed and curtain in place would be undertaken during the day, evening and night time periods.
- A detailed CNIS would be prepared to support the above staging arrangements and to re-evaluate predicted maximum noise levels, noise management levels and potential noise impacts based on a more detailed understanding of the proposed construction methodology as it becomes available.
- Noise modelling would be undertaken to confirm compliance of actual noise levels against predicted maximum noise levels identified in the CNIS. Where non-compliance is identified, a review of staging and noise management strategies would occur and work practices would be modified accordingly.
- Targeted consultation would occur prior to the commencement of works outlining the nature of the works, the proposed timings, durations and the expected noise impacts.

## Documentation

The documentation described below would be prepared regarding noise and vibration impacts and management.

### *Construction Noise and Vibration Management Plan*

A detailed Construction Noise and Vibration Management Plan (CNVMP) would be developed for the project based on the strategy outlined above. The Plan would contain as a minimum the noise and vibration management strategies and controls outlined in this strategy. The following would be included in this plan:

- Site specific investigation and assessment processes
- Pre-construction compliance requirements and hold points
- The responsibilities of key project personnel with respect to the implementation of noise and vibration management strategies and controls
- Noise compliance monitoring requirement
- Compliance record generation and management
- Relevant noise and vibration related procedures

### *Construction Noise and Vibration Impact Statements (CNISs)*

To ensure the adequacy of the noise and vibration mitigation measures for the actual design and construction method, detailed Construction Noise and Vibration Impact Statements (CNISs) would be prepared for major noise-intensive construction activities. In particular, CNISs would be prepared for areas where construction of new noise walls prior to the removal of existing noise walls is not possible, noise intensive activities during standard construction hours with the potential to exceed appropriate noise management levels and for works proposed outside of standard construction hours.

CNISs would review the proposed construction methodology, scheduling, equipment lists, activities and the surrounding environment. Detailed noise and vibration level predictions would be undertaken and a suite of management strategies to deal with specific impacts on a location by location basis would be developed. The CNIS would also outline appropriate noise monitoring requirements. CNISs would be revised as required.

### *Compliance records*

Noise and vibration monitoring would be undertaken as part of the Project. Detailed records of measured noise levels reported against appropriate noise management or predicted maximum noise levels as outlined in the Environmental Assessment, CNISs or licence conditions would be generated as required. Records would be retained as evidence of compliance for the duration of construction as a minimum.

## Strategy Implementation

### *General project induction*

As all project personnel would have the potential to influence construction noise and vibration associated with the project, relevant information regarding this strategy and the contents of the CNVMP would be included in the general project induction delivered to all construction personnel prior to their involvement in the project. The induction would cover (as a minimum) the potential impacts, behavioural and other options reduce construction noise and vibration, general do's and don'ts and personal responsibilities with respect to construction and vibration.

### *Construction planning*

Prior to the commencement of construction, the final detailed design and construction methodology would be reviewed. All locations where noise intensive activities are proposed would be identified to ensure that appropriate planning of those activities occurs with consideration of the content of this strategy and the CNVMP. The identified locations and activities would be cross-checked against the environmental assessment to ensure that no locations or activities had been missed and to confirm the likely maximum noise levels, noise management levels and predicted potential exceedances. This would be used to determine the requirements for the preparation of CNISs.

The list of locations and activities would be communicated to the relevant Construction Manager and project engineers as required to ensure that potential noise and vibration impacts, CNISs and the principles and strategies outlined in the document are considered in the detailed construction planning.

### *CNISs*

CNISs would be prepared as described in this strategy for noise intensive activities with detailed input from the construction team and assistance from specialist consultants. This would occur prior to the commencement of construction at the specific location or in response to changing site conditions and activities.

### *Pre-start talks prior to noise intensive activities*

Immediately prior to the commencement of noise intensive activities for which CNISs have been developed, a pre-start talk would be delivered to all relevant construction personnel. The talk would cover relevant details from the CNIS, including the required noise and vibrations control strategies which must be implemented. Noise and vibration issues would also addressed in additional pre-start talks where non-compliances have been measured against maximum noise levels predictions/compliance goals or changes in the construction methodology or noise and vibration management strategies are warranted.

### *Noise and vibration compliance monitoring*

As described in relevant CNISs for noise intensive activities, noise and vibration compliance monitoring would be implemented as required. Monitoring would generally occur at the start up of activities to confirm noise and vibration levels against pre-work predictions. Processes would be developed during development of the CVMP to address and report non-compliances and to amend work practices and noise and vibration management strategies as appropriate.

### *Community Consultation*

From the environmental assessment and the construction planning process, the residents and other sensitive noise receivers in the vicinity of the construction zones would be identified. A general noise catchment around each activities or locations would be identified. Targeted and specific community consultation would be undertaken prior to and for the full duration of any noise and vibration issues associated with the activity the works location. Details of the work activity, the proposed equipment, the likely extent, magnitude and duration of the likely noise and vibration impacts and the proposed management options and strategies to be implemented would be included in this consultation as required.

# Attachment D – Construction Traffic Management Strategy

# Construction Traffic Management Strategy

## Management objectives

It is recognised that effective management of construction impacts on the road network is critical to the success of the M2 Upgrade project. The traffic and access management objectives for the project are:

- To provide a safe environment for road users and construction personnel.
- To minimise traffic disruption to road users, particularly in peak traffic conditions.
- To maintain access for the local community, transport operators and commercial developments.
- Provide timely and accurate information to road users and local communities regarding changed traffic conditions.

## Management Principles

The management principles that would be adopted to manage traffic and access impacts throughout the construction phase of the project are outlined below.

- Separate work and active traffic areas to promote safety for road users and construction personnel.
- Stage the works and the implementation of traffic management controls to minimise potential disruption to road users.
- Set-up work sites and develop construction methodologies to minimise potential road occupancy requirements and other potential impacts on the trafficable portions of the motorway and local road network.
- Maintain current road conditions and lane alignments as far as reasonably practicable.
- Modify existing road conditions, traffic controls (such as lane markings) and public transport arrangements where original traffic conditions cannot be maintained.
- Develop appropriate road speed limits in the vicinity of work zones to maximise safety and minimise potential traffic disruption and delays.
- Communicate proposed changed traffic conditions to motorists and other road users and provide appropriate signage immediately before work zones with details of modified traffic conditions.

## Strategic approach

The general strategic approach to effective traffic and access management that would be adopted for the project is outlined below:

- Assess the existing environment to understand how the Motorway is used and the traffic characteristics of both the Motorway and the adjacent local and arterial roads. This has been undertaken as part of the environmental assessment for the project.
- Identify the potential impacts associated with proposed works. Whilst a general assessment of potential impacts is provided in the environmental assessment for the project, further investigations of potential impacts is warranted on a work site by work site basis. This will require an in-depth review and understanding of the final detailed design and proposed construction methodology to determine the specific impacts at each location.

- Develop appropriate traffic and access management measures to address site-specific impacts, which may include overall staging strategies to manage traffic and access across the entire project area for the duration of the project through to the introduction of site-specific procedural and physical controls that would be implemented at individual work sites. The detailed design and proposed construction methodologies may also be reviewed and amended as part of the process.
- Liaise with key stakeholders including the RTA, Motorway operators, NSW Police, Local Council(s), emergency service agencies and transport operators regarding the proposed traffic and access management strategies to maximise effectiveness, minimise potential disruption and ensure these groups are informed about proposed changes to the road network.
- Document the proposed control and management strategies and measures in a clear and concise manner to allow effective implementation. The responsibilities of key project personnel with respect to traffic and access management would be outlined and the timing of implementation would be documented.
- Communicate proposed strategies and control measures both to external stakeholders and within the project team including:
  - the timely dissemination of information regarding project staging and proposed modifications to traffic conditions and controls to the general public and other users of the Motorway.
  - Signage and other such devices would be installed along the Motorway on the approach to work sites to alert road users to altered traffic conditions ahead.
  - All project personnel would be provided with relevant information about their personal responsibilities with respect to traffic and access management. More specific training would be provided to personnel with key responsibilities regarding traffic management and prior to the implementation of specific traffic management measures on site.
- Obtain real time information for the Motorway operator regarding traffic volumes and other relevant data to assist with timely staged implementation of control strategies and management measures to minimise the potential for traffic disruption.
- Implement the proposed control strategies in accordance with the overall Traffic Management Plans and site-specific Traffic Control Plans, using experienced personnel to direct the implementation process and to ensure compliance with these plans.
- Monitor the performance of implemented traffic management strategies and controls to determine their effectiveness and adequacy in achieving the project objectives.
- Refine traffic management strategies and controls in a timely manner to address any issues that are identified during the monitoring process.

## Documentation

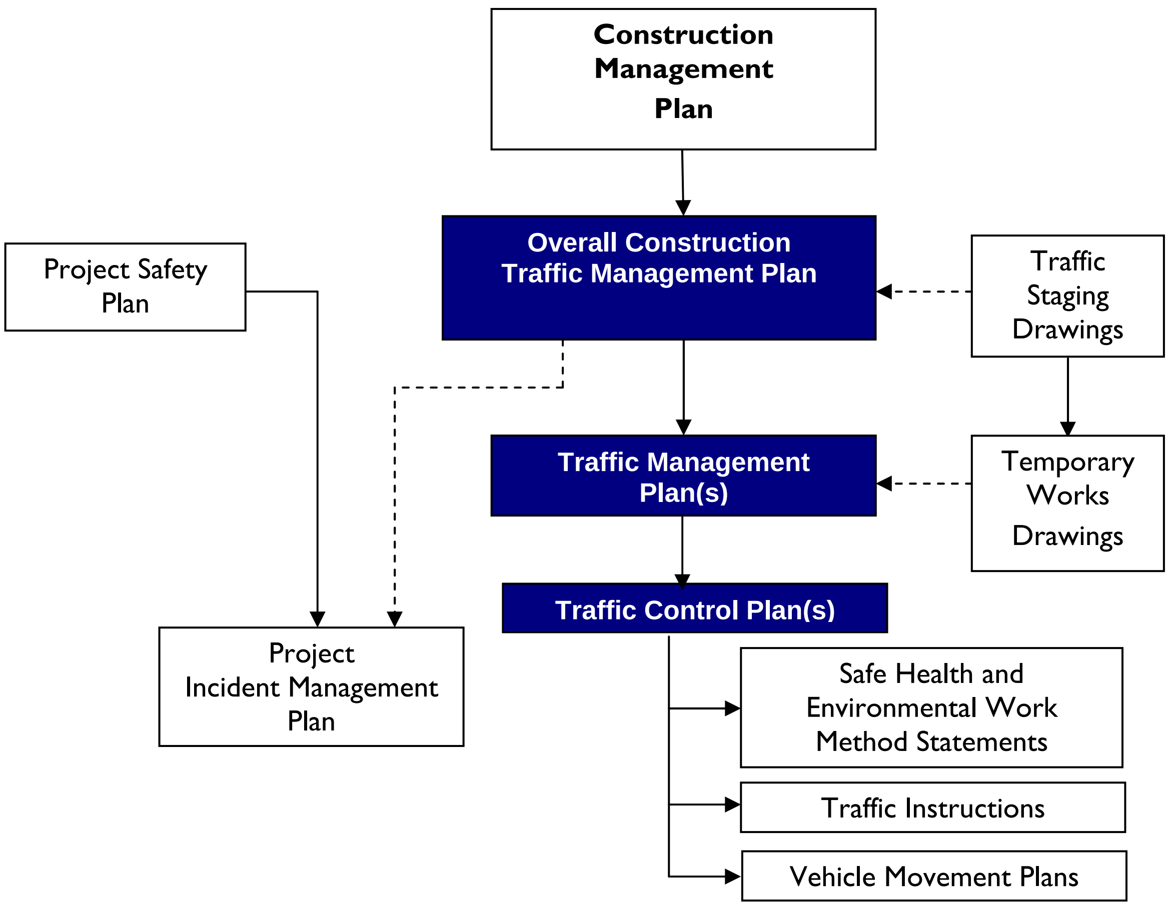
A Construction Traffic Management Plan (CTMP) would be developed for the project based on the strategy outlined above. This plan will operate as the master document in a set of plans, drawings and topic instructions dealing with the safe and effective management of traffic and access during the design and construction phase of the project. The Plan would interface with other associated plans developed and implemented as part of the overall Project Management System.

The following documents and associated operational procedures would be integrated with, and referenced in the CTMP:

- Traffic management plans.
- Traffic staging drawings.

- Temporary works drawings.
- Traffic control plans.
- Process instructions.
- Traffic instructions.
- Safe health and environmental work method statements.

The relationship of these documents and procedures to the overall CTMP is outlined in the flowchart below.




## Strategy Implementation

### *Traffic staging concept development*

Staging of construction works and traffic management implementation are the most critical measures in minimising the overall impact of the project with respect to traffic and access. The development of an overall Traffic Staging Concept is therefore an integral component of the construction planning phase of the project. The overall Staging Strategy must be developed concurrently with the detailed design process, the development of the proposed construction methodologies and the formulation of the overall construction program.

This strategy would be developed by the Project Traffic Manager in consultation with the Design Manager and the Construction Managers prior to the commencement of construction. The traffic staging concept, detailed design, overall construction program and proposed construction methodologies at each work location would be amended accordingly in an iterative process.

### *Identifying location specific information*

The construction of this project will impact on the existing traffic flows along the M2 Motorway and the various local roads in close proximity to the M2 corridor.  These potential impacts will be minimised by adopting the strategy outlined above.

Specific work locations and proposed construction activities will be assessed on a case by case basis to provide the detailed information required to develop site and activity specific management and control plans. The information that would be collected (where available and applicable) would include but not be limited to information in respect of:

- Existing on-street parking (including type and associated time limits).
- Existing traffic controls.
- Traffic control signals (TCS) at intersections.
- Existing junction configurations.
- Restrictions on existing traffic movements (right turn bans).
- Local area traffic management schemes (LATMS).
- Existing road occupancies.
- Public transport (buses (including stops), taxis, rail, trams).
- Traffic generating developments, (e.g. schools, shopping centres, churches, industrial areas, hospitals, airports, sporting complexes, clubs).
- Temporary access arrangements or restrictions for local residents, businesses, traffic generating developments, major and special events.
- Emergency vehicle access point.
- Heavy vehicle movement restrictions, including over dimension vehicle loads.
- Pedestrians, including disabled persons.
- Cyclists (general road, cycle and share way facilities).

### *Preparation of traffic staging drawing from temporary works drawings*

On the basis of the information collected and from a review of the proposed construction methodology at each work locations, temporary works drawings and traffic staging drawings would be prepared by the Traffic Manager. These drawings would then be used to develop site-specific traffic management and control plans in accordance with the strategy outlined above. The traffic management and control plans would be developed in consultation with the Motorway operator and would require approval by the RTA prior to implementation.

### *Consultation*

A Traffic and Transport Liaison Group (TTLG) would be formed and would provide a forum for discussion of all traffic, transport and road safety matters associated with the M2 Upgrade project. It would include representation from Motorway operators, transport service operators, emergency services and local councils.

The contents of traffic management plans and control plans would be developed and amended with consideration of matters discussed by the Traffic and Transport Liaison Group.

### *Implementation of site-specific controls*

Immediately prior to the implementation of site-specific traffic management controls, the appropriate project personnel would be assembled. The content of the relevant plans for implementation would be outlined, including identification of personal responsibilities, staging of works, and key issues and risks. The plans would then be implemented in a co-ordinated manner with appropriate input and approval for the Motorway operator and other key stakeholders as required.

The construction works for which the traffic management would be required would not commence until the appropriate plans have been implemented and the required traffic conditions instated.

# Attachment E – Construction Erosion and Sediment Control Management Strategy

# Erosion and Sediment Control Strategy

## Management objectives

The following Erosion and Sediment Control Strategy has been developed with reference to Chapter 3 of Managing Urban Stormwater, Soils and Construction Volume 2 (DECC 2008).

The overall objectives of erosion and sediment control are to:

- Prevent the pollution of surface and ground waters through erosion control.
- Prevent erosion.
- Retain sediment within the work site.

## Management principles

In general, it is noted that pollution prevention is a more effective strategy than pollution control, as techniques for retaining eroded sediment are limited in their effectiveness. Therefore the following hierarchy of control strategies is proposed:

- Limit potential erosion and sediment transport within the work sites to prevent pollution.
- Intercept run-off from site and capture sediment to control pollution.

The following principles adopted from Volume 1 of the Blue Book would be applied to the Project:

- Implement the relevant statement of commitments and management measures identified in the environmental assessment for the project.
- Plan for erosion and sediment control during the design phase.
- Minimise the area of soil disturbance.
- Conserve topsoil for site rehabilitation.
- Intercept and divert water from upslope areas around or through work sites.
- Stabilise all discharge locations.
- Rehabilitate or otherwise stabilise disturbed areas as soon as practicable following the disturbance.
- Capture or intercept and filter/treat sediment laden water from site prior to discharge.
- Maintain erosion and sediment control measures.
- Continually monitor the condition and effectiveness of controls and improve control strategies where required.

## Planning and design strategy considerations

Effective erosion and sediment control requires activities to be carried out during the life of the project including:

- Planning and design.
- Construction.
- Operation.

The commitments and measures in the environmental assessment and the requirements of EPL conditions would be adopted.

The effectiveness of construction stage control measures can be enhanced during the detailed design stage of the project. The following would be considered in the development surface water control during the detailed design for the project:

- Capture of 'clean' water from upslope areas.
- Inclusion of catch drains and berm drains to divert 'clean' water through or away from the motorway areas.
- Design and augmentation of the existing surface water capture and reticulation systems to capture and treat potentially polluted water from the motorway areas.

The motorway already has an extensive surface water drainage capture, reticulation and treatment system which could potentially be affected as part of the works. The surface water drainage system would also require modification as part of the works. The following is proposed to address these issues:

- Identify potential impacts to the existing surface water control systems due to the concept design and construction methodologies.
- Review the predicted changes to the hydrologic characteristics of the motorway as outlined in the Environmental Assessment.
- Identify and assess the performance of existing water quality basins due to changed hydrologic conditions and specify changes to the basins to address any changes in run-off characteristics (volume and quality).
- Specify changes to the drainage system to address any changes in hydrologic conditions.
- Identify options for early construction of operational controls during the construction phase to assist with the management of construction related erosion and sedimentation issues.

The outcomes of the detailed design process with respect to surface water control, erosion and sedimentation would be documented in design drawings and be included in specifications for the works and site-specific erosion and sediment control plans, to ensure that they are implemented during construction.

### Construction phase strategy considerations

Erosion and sedimentation risk is directly related to the area of soil exposed to potential erosion and the duration of that exposure.  In accordance with the hierarchy of control strategies outlined above, the prevention of pollution would be favoured over the control of pollution.  As such, the staging and scheduling of land disturbance and subsequent stabilisation works is essential in order to minimise the potential for erosion to occur.  In order to achieve this, the strategies relating to works staging and scheduling that would be employed on a location by location basis at work sites include:

- Minimise forward clearing, especially immediately adjacent to watercourses, until just prior to works in the location.
- Staging of construction activities where practicable to confine land disturbance to the minimum area possible.
- Define clearing limits and delineate to reduce the risk of disturbance additional area.
- Progress rehabilitation planning prior to the commencement of disturbance at each location wherever practicable.
- Stabilise disturbed areas as soon as practicable following the disturbance with temporary or permanent measures as required.
- Rehabilitate progressively and as soon as practicable after works are complete.

To limit the amount of run-off from site and the potential for sediment transport, the following surface water control strategies would be developed and implemented on a location by location basis at each work site to limit the volume of run-off water from site and the potential for sediment transport from site and water pollution:

- Intercept and divert 'clean' water from upslope areas around or through disturbed areas and works locations to minimise potential run-off and sediment transport from the work site.
- Provide suitable stabilised discharge points for any collected run-on water to prevent scour and sedimentation.
- Break up slope lengths within the work sites to reduce surface water run-off velocities and erosive potential within the work sites.
- Minimise catchment areas within work sites to reduce run-off volumes.
- Capture and reuse stormwater run-off wherever practicable.

Wherever practicable, permanent operational control measures identified and specified during detailed design would be integrated with temporary construction measures. For example, catch drains located at the top of cut batters would be installed prior to earthworks at the cut commencing wherever practicable.

It is inevitable that even with the above pollution prevention strategies implemented that some sediment laden run-off from the site would need to be managed. The pollution control strategies that would be implemented on location by location basis at each work site would include:

- Capture surface water run-off from the work site wherever practicable.
- Filter sediment from the run-off wherever practicable.
- Treat any captured run-off to remove sediment (through the use of flocculants etc) prior to discharge (when water is of a reasonable quality in accordance with discharge limits specified in any licence conditions).

A monitoring and maintenance program would be essential to ensure effective pollution prevention and control for the duration of the proposed works at each location. Daily inspections of all works sites would occur to assess the condition and effectiveness of implemented erosion and sedimentation control strategies. These would be undertaken by the project construction personnel responsible for the specific work sites. Maintenance would occur on an as needed basis to address any issues identified during these inspections. More intensive inspection and maintenance regimes would be implemented during periods of wet weather, at assess how the controls are performing and to address any damage that has occurred.

Weekly inspections of all works sites would be undertaken by project environmental personnel. The condition and effectiveness of implemented erosion and sedimentation control strategies would be a key focus during these inspections.

Site inspections of key works sites in sensitive areas (as a minimum) would also be undertaken a soil conservationist or similarly qualified external specialist to assess the condition and effectiveness of implemented erosion and sedimentation control strategies and identify any potential options for improvement.

As potential erosion and sedimentation issues would continue at rehabilitated areas until such time as persistent soil stability is achieved, an ongoing monitoring program would be developed for the post-construction period. This program would assess the condition and effectiveness of installed erosion, define maintenance requirements and responsibilities and provide a mechanism staged removed of continual improvement of the installed controls as required.

## Documentation

A thorough and detailed Primary Erosion and Sediment Control Plan (ESCP) would be developed as part of the project's Construction Environmental Management Plan prior to works commencing. The Primary ESCP would outline the general approach to surface water management and erosion/sedimentation prevention and control across the entire project area. This Plan would outline the overall strategies to develop and manage site specific erosion and sedimentation controls at each works location. The responsibilities of key project personnel with respect to erosion and sedimentation control planning, design and implementation would be outlined. Training requirements and personal responsibilities for all project personnel with respect to erosion and sedimentation control would also be outlined.

A soil conservationist or similarly qualified and experience specialist would be engaged to assist in the development of this Primary ESCP.

Using the Primary ESCP as the basis, site specific ESCPs would be developed. In the preparation of these plans the final detailed design and proposed construction methodology and staging at each work location would be reviewed and assessed. Each ESCP would specify the strategies and measures that would be implemented at each work sites to prevent and control potential erosion and sedimentation issues. Relevant controls outlined in the environmental assessment, the Construction Environmental Management Plan and the Blue Book to prevent and control pollution would be included in each ESCP as necessary.

Site specific ESCPs would be modified as the proposed work progresses to capture and address changing site conditions and suitable control strategies. Changes to each site specific ESCP would be prepared by project environmental personnel in consultation with the project soil conservationist as required. Any changes would be communicated to all relevant site personnel. A copy of the current site-specific ESCP for kept onsite at all times.

## Implementation strategy

Under contractual obligations all contractors involved in the project would be obliged to undertake their activities in compliance with the Construction Environmental Management Plan and all subordinate plans, including this strategy. All project personnel would be made aware of their personal responsibilities with respect to erosion, sedimentation and pollution prevention and control as part of the general project induction that would be provided to all project personnel prior to their involvement in the project.

Site specific Erosion and Sediment Control Plans (ESCPs) would be developed by the Project Team prior to any works commencing in the particular area. The project Soil Conservationist would liaise with the Project Team during the development of the ESCPs to ensure appropriate and effective controls are proposed.

The site specific ESCPs would be provided to the Site Foreman prior to works commencing. The site specific controls and personal responsibilities would be communicated to all relevant construction personnel prior to the commencement of construction at each location.

The Site Foreman would be responsible for ensuring that all proposed erosion and sediment controls are implemented as per the ESCP. The Environmental Co-ordinator would be available during this stage provide guidance to the Site Foreman where required.

The Site Foreman would inspect their specific work area daily and undertaken repair work as required. The Environmental Co-ordinator would undertake weekly inspections, with additional inspections after a rainfall event that causes run-off from the construction site. The Soil Conservationist would undertake periodic inspections of the construction site to ensure effective erosion and sediment controls are implemented.  The current site specific ESCP would be reviewed as part of these site inspections programs.

An actions list would be developed from each of these inspections and provided to the Site Foreman to undertake the remedial work. This actions list would prioritise the remedial actions in relation to the level of risk. The implementation of actions arising out of site inspections would added to a register of issues and the close out of each action monitored and tracked until it is adequately closed out or no longer required.

# Appendix G EPBC Act referral decision

Mr Greg Butler
Project Services Manager
Roads and Traffic Authority, NSW
Locked Bag 928
NORTH SYDNEY NSW 2059

Date: 19 February 2010
EPBC Ref: 2010/5329
EPBC contact: Ms Kerrie Hankinson
(02) 6274 1242
kerrie.hankinson@environment.gov.au

Dear Mr Butler

**Decision on referral**
**M2 Motorway Upgrade, Sydney, NSW (EPBC 2010/5329)**

This is to advise you of my decision, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), about the proposed action to upgrade the section of the M2 Motorway between Lane Cove Road and Windsor Road in Sydney, NSW.

**I have decided that the proposed action is not a controlled action. This means that the proposed action does not require further assessment and approval under the EPBC Act before it can proceed.** A copy of the document recording this decision is enclosed. This document will be notified publicly on the Department's website.

Please note that this decision relates only to the specific matters protected under Chapter 4 of the EPBC Act.

This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

The Department has an active audit program for proposals that have been referred under the EPBC Act. The audit program aims to ensure that proposals are implemented as planned. You should be aware that your project may be selected for audit by the Department at any time and all related records and documents may be subject to scrutiny. Information about the Department's audit strategy is enclosed.

If you have any questions about the referral process or this decision, please contact the EPBC project manager and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Ms Michelle Wicks
Acting Assistant Secretary
Environment Assessment Branch

cc Ms Louisa Rebec, AECOM Australia Pty Ltd

Australian Government

Department of the Environment, Water, Heritage and the Arts

# Notification of REFERRAL DECISION – not controlled action

## M2 Motorway Upgrade, Sydney, NSW (EPBC 2010/5329)

### Proposed action

| | |
|---|---|
| person named in the referral | Roads and Traffic Authority of NSW |
| proposed action | Upgrade of the M2 Motorway in north west Sydney. This includes widening sections of the motorway between Windsor Road and Lane Cove Road; construction of new exit and entry ramps; and the widening of local and arterial roads near the motorway, as described in the referral documentation received by the department on 21 January 2010. |

### Referral decision: Not a controlled action

| | |
|---|---|
| status of proposed action | The proposed action is not a controlled action. |

### Person authorised to make decision

| | |
|---|---|
| Name and position | Ms Michelle Wicks<br>Acting Assistant Secretary<br>Environment Assessment Branch |
| signature | mwicks |
| date of decision | 19/2/2010 |