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Project review of environmental factors (REF) - roads



M2 Macquarie Park Motorscapes Project Review of environmental factors

July 2016



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Roads and Maritime Services

M2 Macquarie Park Motorscapes Project Review of environmental factors July 2016

Prepared by Jacobs and The Hills Motorway Limited

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Approval and authorisation

Title	M2 Macquarie Park Motorscapes Project review of environmental factors
Accepted on behalf of NSW Roads and Maritime Services by:	
Signed:	
Dated:	

The proposal

The Hills Motorway Limited (THML) propose to install an artwork and carry out site rehabilitation to a vacant area of land that was previously used in part as a site construction compound for both the construction and upgrade of the Hills M2 Motorway. The proposal is an initiative of THML's 'Think Long Term' sustainability strategy.

The overall site rehabilitation work, collectively known as the M2 Macquarie Park Motorscapes Project would include removal of noxious weeds, revegetation, as well as improvements to drainage, water quality and visual amenity. The site is situated on the northern side of the Hills M2 Motorway at Macquarie Park, between the eastbound carriageway, Lane Cove National Park, Khartoum Road and Christie Road (the site).

The proposal aims to restore ecological communities which complement the Lane Cove National Park adjacent to the site, and to install an artwork to enhance the driving experience for passing motorists and the surrounding community.

Need for the proposal

The site of the proposal lies within the M2 Motorway boundary adjacent to the Lane Cove National Park at Macquarie Park. As a result of previous land use the site has been significantly disturbed and exhibits very poor ecological and aesthetic characteristics.

The majority of the site is dominated by exotic weed species, including Weeds of National Significance and species listed under the Noxious Weeds Act 1993 (the NW Act). The site is a major source of noxious weed infestation for the adjacent Lane Cove National Park.

Two watercourses, namely Shrimptons Creek and Industrial Creek drain the site and carry gross pollutants and contaminants from upstream of the site into the Lane Cove National Park and the Lane Cove River. Additionally, internal site drainage is currently underperforming and surface water run-off from the M2 Motorway has the potential to adversely affect water quality of the Lane Cove River.

The location of the site adjacent to the Lane Cove National Park provides an opportunity for the site to act as a buffer between the M2 Motorway and the national park. The rehabilitation of the proposed site would create a stronger visual connection to the national park while assisting in the control of weeds and improving water quality.

Proposal objectives and development criteria

The key objectives of the proposal are as follows:

- Revegetate the site with appropriate ecological communities and eliminate the weed infestation to complement the ecosystem of the Lane Cove National Park
- Provide a public artwork that is well received by key stakeholders and the community
- Enhance water quality leaving the site and draining north to the Lane Cove River.

Options considered

Two options were considered for the development of the site between 2013 and 2016. Both options focused on improving the environmental condition and visual amenity of the site as part of THML's commitment to sustainability and positively contributing to local communities or 'being a good neighbour'. While one option included introducing public access and connectivity of the site, the preferred option was oriented to regeneration and revegetation to rehabilitate the environment.

A regeneration plan for the site proposed by Jacobs in 2014 included:

- A linear system of open space park areas for passive and active recreation that facilitated public access through the site via pathways, as well as connecting to other neighbourhood tracks and paths
- A stormwater runoff capture and filtration system through a series of open wetland ponds and vegetated drainage channels
- Landscaping of creeks
- Vegetation of different types and densities.

A discussion with Landcare subsequent to the Jacobs concept explored an alternative, less costly, regeneration approach. This would involve:

- A vegetation management plan, including removal of weeds
- Establishing appropriate ecological communities, including an an endangered tree species that is native to the area
- Stabilisation of slopes and creek banks
- Maintenance for two years
- Potential to recruit volunteers through the federal government Green Army program.

While certain positive benefits for the community were recognised by including paths for connecting the site to Khartoum Road and Christies Road, and improving movement through the site, these options were not pursued. Landcare's cost-effective regeneration was nominated as the preferred option, with the addition to include a design element on site by way of an artwork. THML ran a competition for design ideas that would promote sustainable energy, be visually appealing and use leading edge technology.

Statutory and planning framework

The State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across New South Wales. Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. The proposal can therefore be assessed under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) by Roads and Maritime as both the proponent and determining authority.

This REF fulfils the requirements of section 111 of the EP&A Act and has been prepared in accordance with clause 228 of the *Environmental Planning and Assessment Regulation 2000* and in consideration of matters of national environmental significance protected by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Community and stakeholder consultation

THML's overarching intention for the proposal is to 'give something back' to the community in recognition of its corporate commitment to 'strengthen communities through transport'. As a part of this, THML have included the community in the public art competition to determine the most appropriate artwork.

The community surrounding the proposal who may be impacted during the construction period would be notified of the proposal in accordance with Roads and Maritime community consultation procedures. Stakeholder consultation has been carried out with NSW National Parks and Wildlife Service and the City of Ryde Council as part of ISEPP requirements and THML's good neighbour policy.

Environmental impacts

The main environmental impacts are the benefits to the ecological value of the site and surrounding area. The proposal would result in the transformation of a weed-infested site to an area of native bush and an improved drainage network in the waterways and creeks within the site. The proposal would also involve an artwork which would add to the visual amenity of the area for local residents and motorists.

There is the potential for erosion and sedimentation, traffic, noise and visual impacts during construction however these can be mitigated through standard safeguards outlined in this REF.

There would be no impacts to matters of national environmental significance and Commonwealth land.

Justification and conclusion

This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

The long-term benefits of the proposal outweigh the potential construction environmental impacts and the proposal is considered justified.

This REF has concluded the proposal would not have a significant impact on the environment and therefore an environmental impact statement and assessment under Part 5.1 of the EP&A Act is not required. This REF has also found there would be no significant impact to matters of national environmental significance or to the environment of Commonwealth land.

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1 Introduction

This section introduces the proposal and provides the context of the environmental assessment. In introducing the proposal, the objectives and project development history are detailed and the purpose of the report provided.

1.1 **Proposal identification**

Roads and Maritime, proposes to restore a vacant area of about five hectares of land within the M2 Motorway corridor (the site). Part of the site was previously used as the site compound and processing area for the M2 Widening Project. One of the management measures for the M2 Widening Project was to restore the construction site at the completion of those works. The restoration works were undertaken in early 2013, however performance monitoring of the plant regrowth has identified the condition of the site is weed infested and could be improved by undertaking site rehabilitation.

Key features of the proposal would include:

- Installing a culvert to allow on-going access to the site
- Implementing dissipation controls in the existing drainage systems that support the surrounding motorway infrastructure
- Improvements to watercourses within the site through bank stabilisation and riparian rehabilitation
- Rehabilitation of the site to provide an urban bushland landscape sympathetic with the adjacent Lane Cove National Park
- Installation of an artwork to improve the visual amenity for passing motorists and the community.

The proposed features are collectively known as the M2 Macquarie Park Motorscapes Project (the proposal) which is situated on the northern side of the Hills M2 Motorway (the motorway) at Macquarie Park, between the motorway eastbound carriageway to the south, and Lane Cove National Park to the north. To the east of the site is Khartoum Road and to the west of the site is Christie Road. The eastern end of the northern boundary adjoins two unit blocks and a small parcel of council owned land known as Dunholm Reserve which is disconnected from the main parcel of Dunholm Reserve by Leisure Close (refer to **Figure 1-1**).

Between 200 and 400 metres south of the site beyond the motorway is the Macquarie Centre, Macquarie University and Macquarie University train station, residential and commercial areas. To the north-east of the site the area around Khartoum Road consists of a mix of medium to high density residential uses.

There are two waterways within the site namely Industrial Creek at the eastern end of the site and Shrimptons Creek towards the western end of the site. Industrial Creek flows in a northerly direction into Lane Cove River which is located around 270 metres from the northern boundary of the site. Shrimptons Creek flows from the western boundary towards Blaxland waterfall in Lane Cove National Park. Both creeks drain water from an area south of the motorway through existing culverts beneath the motorway.

The proposal is located about 12 kilometres north of Sydney's Central Business District (CBD) in the suburb of Macquarie Park within the City of Ryde Local Government Area (LGA).

THML currently lease the site from Roads and Maritime and is responsible for the management of the site until 2048. The proposal fits with Roads and Maritime's strategic plan for asset management and addressing local environmental problems caused by existing conditions.

It is anticipated that the construction phase of the proposal would be delivered over a period of nine months with the proposal anticipated to be complete by May 2017. The maintenance and regeneration component of the proposal would continue for around 27 months and be managed by Landcare Australia. The maintenance phase is discussed in this REF as part of the 'operational' phase of the proposal.

The site would not be accessible to the public during construction or operation.

The associated costs of the artwork, site restoration and regeneration works would be funded by THML and are expected to have a capital investment value of \$4.5 million.

The location of the proposal is shown in **Figure 1-1** and an overview of the proposal activities are provided in **Figure 3-1**. Section 3 describes the proposal in more detail.

Figure 1-1: Location of the proposal (Remove from pdf version)

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Jacobs on behalf of THML and Roads and Maritime. For the purposes of these works, Roads and Maritime is the proponent and the determining authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed work and associated environmental impacts have been undertaken in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of section 111 of the EP&A Act that Roads and Maritime examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act
- The significance of any impact on threatened species as defined by the TSC Act and/or FM Act, in section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of the Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2.1 Strategic need for the proposal

The proposal is consistent with the objectives of the *NSW State Plan 2021* to strengthen our local environment. The proposal also fulfils Roads and Maritime's strategic plan for asset management and addressing local environmental problems caused by existing conditions. It supports *A Plan for Growing Sydn*ey, specifically the Epping and Macquarie Park urban renewal. The regeneration of the site will augment the health and improve the visual continuity of Lane Cove National Park beside the motorway and in proximity to the Macquarie urban, commercial and shopping precinct. The proposal would also provide an artwork for the enjoyment of motorists and local residents as well as ensure the obligations to restore the site of the M2 Upgrade Project are met or exceeded.

The site is located within the motorway lease boundary adjacent to the Lane Cove National Park. Local environmental problems have been identified within the site including heavy concentration of both noxious weeds and weeds of national significance as well as poorly performing motorway drainage infrastructure.

The site was initially incorporated into the motorway lease boundary in 1997 for the purposes of maintenance and operation of the motorway. The site has more recently been used as a construction site compound for storage of materials and processing as a part of the Hills M2 Upgrade Project.

As a result of previous land use the site has been significantly disturbed and exhibits very poor ecological and aesthetic characteristics. The site is currently vacant.

Small remnants of native vegetation communities are badly degraded. The majority of the site is dominated by exotic weed species, including Weeds of National Significance and species listed under the *Noxious Weeds Act 1993* (the NW Act).

The site is a major source of noxious weed infestation for the nearby Lane Cove National Park. As the northern part of the site abuts the Lane Cove National Park it poses ongoing pressure on the ecological integrity of the park via weed infestation.

Two watercourses, namely Shrimptons Creek and Industrial Creek (refer to Figure 1-1) drain the site and carry gross pollutants and contaminants from upstream of the site into the Lane Cove National Park and the Lane Cove River. Riparian vegetation along stretches of Shrimptons Creek and Industrial Creek within the site is in very poor condition.

Additionally, internal site drainage is currently underperforming and surface water run-off from the site has the potential to adversely affect water quality of the Lane Cove River. Poor water quality, gross pollutants and the degraded condition of the riparian vegetation communities reflect the highly urbanised catchment areas of the creeks, comprising mainly residential and commercial properties with some light industrial development.

Within this context, the proposal is required in order to:

- Rehabilitate the riparian habitats along Shrimptons Creek and Industrial Creek
- Reduce water velocity, reduce sediment run-off and reduce waterborne contaminants from motorway stormwater run-off
- Improve the visual amenity of the site
- Rehabilitate the existing remnant vegetation and reintroduce species and botanical composition consistent with Hornsby Enriched Sandstone Exposed Woodland and selected species of the Sydney Turpentine Ironbark Forest (Margin Forest)
- Remove exotic weed species from the site and manage exotic weed species and vertebrate pests.

2.2 Existing infrastructure

The site consists primarily of vegetated bushland, with Shrimptons Creek crossing the site from south to north in the western portion of the site and Industrial Creek crossing the site from south to north at the eastern end of the site. An open drainage channel runs from east to west along the southern extent taking surface runoff from the motorway carriageway to a water quality basin. The remaining portion of the site is made up of a relatively flat one hectare area adjacent to the motorway referred to as the 'deck', and several steep slopes and embankments between the deck and the riparian areas. The site has few existing infrastructure items. The site includes a water quality basin and concrete channels leading to the water quality basin, and several internal and informal pedestrian tracks. There are no established roads within the site or other infrastructure.

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The key objectives of the proposal are as follows:

- Enhance water quality leaving the site and draining north to the Lane Cove River
- Revegetate the site with appropriate ecological communities and eliminate the weed infestation to complement the ecosystem of the Lane Cove National Park
- Provide a public artwork that is well received by key stakeholders and the community.

2.3.2 Development criteria

The development criteria for the proposal included:

- Improvement to water quality in both Shrimpton's Creek and Industrial Creek
- Improvement to the drainage network at the site
- Removal of weeds and re-establishing appropriate ecological communities, including native species to the area
- Design an artwork to promote sustainable energy, be visually appealing and use leading edge technology.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

In selecting the preferred option the following factors were taken into consideration:

- The ability of the design to meet the objectives of the proposal
- The environmental sensitivities associated with the nearby Lane Cove National Park
- The suitability of the soil conditions on site to support the regeneration and rehabilitation of native ecological communities
- Site topography
- The durability of the proposal and its ability to achieve sufficient life-cycle longevity
- Constructability issues due to the uneven terrain comprising imported fill material, some of which is known to be contaminated and unsuitable for re-use
- The inability of the existing site drainage to function appropriately
- The availability of funding for the proposal
- Compliance with M2 Hills Motorway operational and maintenance obligations
- Safety of the local community including pedestrians and motorists.

The suitability of various options and solutions and the ability to implement them quickly are key factors that have been considered to date for the site. The rate of noxious weed growth has increased in recent times and the site continues to cause adverse environmental impacts to the nearby Lane Cove National Park and downstream receiving water bodies.

2.4.2 Identified options

Two options were considered for the development of the site between 2014 and 2016. Both options focused on improving the environmental condition and visual amenity of the site as part of THML's commitment to sustainability and positively contributing to local communities or 'being a good neighbour'.

While one option included improving public access and connectivity of the site, both involved the revegetation of the site (to varying degrees) and general environmental improvements to the site (such as water quality).

The two options that were identified, other than a 'do nothing' option, include:

- The M2 Park option
- The Artwork option (the proposal).

The M2 Park option involved the creation of a park that would be open to the general public and would include landscaping of the site using native species, pedestrian and shared path connections through the site linking Khartoum Road and the Macquarie Park precinct via Alma Road, and a stormwater runoff capture and filtration system through a series of open wetland ponds and vegetated drainage channels improving visual and environmental amenity.

The Artwork option focused on the rehabilitation of the site using native species and communities, and improvements to waterways and drainage to improve the environmental performance and sustainability of the site. It also included the installation of an artwork.

2.4.3 Analysis of options

The methodology used for the selection of the preferred option was to analyse the environmental, community and sustainability outcomes of both the 'do nothing' and the proposal in order to confirm whether the options achieve the objectives of the proposal.

'Do nothing' option

Under the 'no nothing' option, the site would not be restored and it would continue to deteriorate due to the effects of weed invasion, erosion and sedimentation. This has the potential to result in adverse environmental impacts to the nearby Lane Cove National Park and downstream receiving water bodies.

Advantages:

- No impact on vegetation, soils and surrounding environment and community
- No temporary road traffic impacts or noise impacts during construction
- No construction costs.

Disadvantages:

- Deteriorating site attributes would remain and potentially accelerate resulting in continued site and downstream impacts
- THML's sustainability objectives would not be met
- No improvement to the biodiversity values of the site, as remnant vegetation would not be rehabilitated
- Water quality and drainage would not be improved
- Site aesthetics would not improve.

The 'do nothing' option is not considered appropriate as it would present an unacceptable risk to the ongoing operation of the site. This would not be consistent with THML's sustainability strategy and objective to create a positive and enduring ecological legacy at the site.

The M2 Park option

This option would involve the creation of a park that would be open to the general public, which would include a linear system of open space park areas for passive and active recreation, as well as pedestrian and shared path connections linking to the surrounding suburban network. an artwork.

Advantages:

This option would enhance pedestrian and cycle connections in the local area and would create a new public place that would enhance the functionality of the site and would cater for the local community in the surrounding residential and commercial areas via:

- Creating a new area of accessible, high quality public open space for passive and active recreation
- Providing better connections to Lane Cove National Park, Macquarie Shopping Centre and the adjacent Macquarie Park commercial precinct
- Developing connected walking and cycling paths that encourage more active and safe transport through the site linking Alma road to the south to Khartoum road to the east
- Creation of wetland plantings, an open water catchment and vegetated earth mounds.

Disadvantages

The M2 Park option was not advanced further as the preferred option as there were:

- Concerns around potential benefit and whether or not the community would actually utilise the open space
- Concerns over safety of cycling connections, given the heavily trafficked road connections on nearby Christie and Talavera Roads
- Concern over potential access to live motorway environment
- Increased cost compared to preferred option.

The Artwork option

This option would involve the rehabilitation of the site to improve the environmental performance and sustainability of the site, and would include an artwork.

This option would involve bush rehabilitation works to remove exotic weeds and would involve the planting of locally endemic species with particular focus on riparian areas. The works would also involve creek stabilisation works along the banks of Shrimptons Creek and Industrial Creek, and the construction of a drainage swale and water quality basin to improve water quality discharges.

Advantages:

- Improved ground stabilisation, weed removal and regeneration of native flora species, improved habitat for fauna species and water quality improvements
- Improved visual amenity
- Reduced maintenance costs
- Consistent with THML's sustainability objectives.

Disadvantages:

- Use of natural resources and increase in energy demand to deliver the proposal •
- Greater potential for soil erosion and sedimentation during the construction stage .
- Construction impacts including traffic delays, noise and visual impacts •
- No public access to open space.

2.5 Preferred option

While the M2 Park option would have some benefits for the local community, such as improved connectivity and improved functionality of the site compared to a do nothing option, this option was not pursued as there were concerns regarding the attractiveness of this space for passive and active recreation due to its location and amenity.

The Artwork option was considered the preferred option as it involved a cost-effective solution that provided for the rehabilitation of the site, thereby improving the environmental performance and sustainability of the site. In particular, it would improve the biodiversity values of the site in the long term. It would also allow for the improved visual amenity as well as the installation of an artwork.

While there would be short term impacts associated with construction activities, as well as a cost implication, when compared to the alternative options, the preferred option is considered to best meet the objectives of the proposal.

2.6 Design refinements

Artwork design

To select the artwork installation at the site, THML ran a design competition for ideas that would promote sustainable energy, be visually appealing and use leading edge technology.

Over a dozen designs were submitted which were assessed by a judging panel to determine which designs should be carried forward for a feasibility assessment. The panel comprised of Transurban's CEO and Roads and Maritimes' Head of Centre for Urban Design along with local officials. Details of the artworks can be found in the Appendix D (Visual Impact Assessment Report).

The competition entries were judged in line with the competition objectives, being to 'engage the community to collect creative ideas' and be consistent with the transformation of the site. Refer to **Figure 2-1** for the matrix of selection criteria that was used to determine the preferred option.

As a result, the designs Kinetica, Interleaves and Solar Weave were carried forward for a feasibility assessment which considered numerous factors including sustainability, material selection and overall cost of construction. Upon review of the feasibility study outcomes, Kinetica was determined as the proposed artwork for the project, in concurrence with judging panel representatives.

Kinetica was selected was based on the material type and quantity required along with the impact of the artwork and its' connection with the proposed rehabilitation of the site. The impact the Kinetica artwork would have on the road side is one of potential significance, communicating a harmonizing message to the local and wider community.

Idea	Criteria	Sustainability Performance (0-15)	Road Safety Audit	Ongoing Maintenance effort	Engineering Risk	Fabrication & installation timeframe	UAP Recommendatio n	Project team Recommendation
Kinetica		11	Medium Risk	Moderate	Low	32 Weeks	Proceed to Design Development	Preferred
Interleaves		14	Medium Risk	Low	Moderate	32 Weeks	Proceed to Design Development	Second choice
Solar Weave		6	Medium Risk	High	High	32+ Weeks	Idea requires significant design development and modification to minimise structural risk	Last choice
Comments		Interleaves best overall due to lower power demand and environmental impact (higher impact per tonne/material but lower material quantity overall). Kinetica next best mainly due to higher power need	All Ideas have comparable safety risk – mitigation measures have been proposed and are being considered	All Ideas require annual cleaning, Interleaves and Kinetica need annual inspection. Kinetica needs moving part refurb > 10 years. Concerns about access to LEDs in event of failure for Solar Weave	Interleaves may require further 'grounding' of elements while there are wind harmonic and other structural concerns for Solar Weave	Comparable timeframes for Kinetica and Interleaves. Additional time assumed for Solar Weave given need for further design development	UAP recommend undertaking design development work for Kinetica and Interleaves before selecting idea for implementation	Kinetica is the most preferred of the three Ideas (highest/equal highest score in 4 of the 6 criteria) Kinetica also Ideas Competition winner and lowest cost

Key:

Highest score Middle score Lowest score

Figure 2-1 Matrix of criteria for selection of preferred artwork

3 Description of the proposal

This section describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

The proposal seeks to rehabilitate and improve the general environmental and visual amenity of a disused site that was previously used as a construction compound during the construction and upgrade of the Hills M2 Motorway.

The site boundary is shown in **Figure 1-1**, and an 'additional proposal area' is identified in **Figure 3-1** to encompass the proposal activities to access the site temporarily through Dunholm Reserve and to remove the motorway signage which is located adjacent to the south of the site.

The main elements of the proposal are the improved drainage system and waterways (including the installation of a culvert to access the site), removal of weed species and revegetation of the whole site using native plants, and installation of an artwork.

The proposal would comprise a construction phase which is anticipated to start in mid-2016 and continue for about a nine month period, followed by a 27 month maintenance and monitoring period which is referred to in this REF as part of the 'operational' phase of the proposal.

The key activities to be carried out as part of the proposal are shown in **Figure 3-1**. Further detail on the individual aspects of the activities is provided hereunder.

Figure 3-1: The proposal (Remove from pdf version)

Figure 3-1 illustrates the key features of the proposal which include:

- Rehabilitation of the site, including removal of noxious weeds and revegetation of the site using locally indigenous species
- Installation of an artwork on the southern side of the site
- Water quality improvement works, including installation of gross pollutant traps and creek bank protection works at Shrimptons Creek and Industrial Creek
- Repairs to parts of the drainage swale adjacent to the motorway
- Improvements to the channel and drainage of water from the swale drain into the water quality basin drainage
- A temporary widening of the existing pedestrian access point at Leisure Close (via Dunholm Reserve) to enable construction equipment to access Industrial Creek
- Restoration of pedestrian access gate at Leisure Close following construction works to enable on-going maintenance purposes (pedestrian only)
- A new access point from the motorway for construction and maintenance purposes, which would require a section of a guardrail and non-essential road signage to be removed.
- A 750 millimetre pipe culvert within the existing drainage swale to allow construction and maintenance access from the motorway
- Importation of 5,000 cubic metres of topsoil and VENM to provide a base layer for revegetation and to create internal access tracks
- Ongoing management and monitoring of the site, in accordance with a Monitoring Plan.

Further information on the proposal design is described below.

3.1.1 Vegetation Management Plan

The proposal area has been mapped by the Office of Environment and Heritage (OEH 2013) as 'cleared', with high density of weeds and exotics found across the proposal area. As part of the proposal, initially weed control would be carried out over the five hectares of the site in a staged manner. Priority would be given to the high density areas identified as the riparian areas and slopes and embankments. The weed control would use mechanical, manual or chemical treatment. Chemical treatment includes herbicides spray application, or targeted cut and paint and injection to grasses and other weeds. Primarily weeds would be removed at the base of the plant (rather than the root) in order to maintain a stable soil profile and reduce the potential for run-off.

The weeds would be mulched on-site. Within the riparian areas weed mulch that may have a propensity to spread would be relocated to an elevated level to decompose. Seed bearing debris, would be bagged and removed to a landfill site, unless they are buried at depth under weed free soil.

Follow-up weeding would be carried out at intervals of six to eight weeks after primary weeding to ensure that re-growth is controlled. Following this, monitoring and on-going weed control would occur at an interval of two months.

Revegetation of the weeded areas would progressively commence within about three months after the initial weed control. The local indigenous species used will be suited to the different management zones identified as the deck, slopes/embankments and riparian zones shown in **Figure 3-1**. The density of planting would aim to resemble the original vegetation community where practicable. The revegetation would include niche planting of species in suitable sites for their requirements (e.g; soil depth, aspect, plant available water capacity, drainage). In particular, the revegetation would reintroduce local indigenous species, including the Hornsby Enriched Sandstone Exposed Woodland community and selected species of Sydney Turpentine Ironbark Forest Margin (STIF MF).

The majority of the site would be subject to plantings, with the exception of the area where the artwork would be installed, with species selected in proximity of the installation to maintain view lines from the motorway.

The initial weed control and revegetation would be carried out over the construction period of the proposal which is anticipated to take about nine months. The monitoring and maintenance of the weed control and revegetation works would continue over a period up to 27 months..

Further detail on the revegetation proposed is provided in Section 3.3.1 and Section 6.2, and the proposal would be guided by the Vegetation Management Plan (refer to Appendix C).

3.1.2 Artwork installation

An artwork is proposed to make a positive contribution to the motorway landscape and local community of Macquarie Park.

The artwork would be constructed within the southern area of the site to maximise visibility from the motorway for eastbound and westbound motorists (refer to **Figure 3-2**). The surrounding rehabilitation work would enhance the visual impact of the installation. Sightlines to the artwork by passing traffic would be maintained through selection and planting of appropriate small shrub and groundcover species.

The artwork would include nine individual sculptures ranging from about two metres to 10.5 metres tall and be constructed primarily from painted mild steel. Reinforced concrete footings would be constructed in-situ to support the artwork. The artwork would be illuminated for night time effect and visual interest by in-ground LED lighting and solar panels. The overall footprint is about 50 metres long and 15 metres wide and is set back about five metres from the top of the existing drainage swale embankment running along the northern edge of the motorway. An element of the artwork (the waratah) would be chain driven with a motor based at ground level for ease of access. The artwork would require re-painting about every 15 years and would require cleaning on an annual basis as a minimum.

The artwork would require the removal of two existing (non-advisory) motorway signs in order to maximise views of the artwork for motorists and provide access for maintenance crews.

The design of the artwork is subject to further detailed design, including consideration of site planning considerations in relation to sight lines from the motorway and other road safety factors.



Figure 3-2 View east of the artwork (not including proposed bush rehabilitation)

Figure 3-3 View east to proposed location of artwork



M2 Eastbound

M2 Westbound

Herring Road on-ramp

3.1.3 Water quality improvement work

The water quality improvement work comprises a number of distinct components which relate to stretches of Shrimptons Creek and Industrial Creek in addition to improvements and modification of the existing drainage and water quality infrastructure on the site (refer to **Figure 3-1** for an overview of proposal activities).

The work on the creek banks is required to stabilise sections of the creeks that have been identified as being susceptible to erosion and the transport of sediment downstream. This work would include creek bank protection works that are designed to appropriately suit the geomorphic properties of each creek and the modelled water flows. The proposed works associated with each creek is described separately in more detail in the following section.

Shrimptons Creek

Creek bank toe scouring has been observed along parts of Shrimptons Creek downstream from the culvert that runs under the motorway. There is the potential for this scouring, which is considered to be within the natural functioning of the creek system, to increase in the future if unmitigated.

Bank protection works along the creek banks would occur where toe erosion is evident. This would include the placement of larger rock boulders (300-400 millimetres in diameter) and a mix of aggregate (40 millimetres and 100 millimetres in diameter) against the lower part of the bank to armour and stabilise the bank toe. The upper bank profile would be regraded to a slope of 1 (V) to 3 (H) and jute mesh would be installed with the lower end secured behind the rock. The regraded and meshed upper bank would be planted with suitable native species as shown in **Figure 3-4**.



Figure 3-4 Proposed bank protection works illustrating cross section of rock revetment

As part of the bank protection works, rock revetment would commence on both banks at the culvert and extend downstream for around 21 metres on the western side of the creek, and 75 metres on the eastern side of the creek.

In addition to the creek bank protection works, a small gross pollutant trap (otherwise referred to as a trash rack) would be installed at Shrimptons Creek, located about 10 metres downstream of the culvert. A plan of the works to be carried out at Shrimptons Creek is shown in **Figure 3-5**.



Figure 3-5 Shrimptons Creek plan

The gross pollutant trap would be constructed across the low flow channel of Shrimptons Creek and would comprise two of 2500 millimetre panels bolted to 100 millimetre by 100 millimetre posts which would be fastened to a constructed concrete base about 20 square metres in area and 150mm thick. A drawing of the gross pollutant trap for Shrimptons Creek is presented in **Figure 3-6**. In order to minimise the potential for upstream hydraulic impacts at high flows resulting from the installation of the gross pollutant trap, the gross pollutant trap would be located within the low flow channel and would have a maximum height of one metre. This would capture gross pollutants during low to moderate flow events up to the capacity of the main flow channel.



Figure 3-6 Proposed gross pollutant trap at Shrimptons Creek

Industrial Creek

The section of Industrial Creek within the site has been observed to be relatively stable with well vegetated banks (comprising weed species) and a gravel and cobble bed forming a natural poolriffle sequence. There are some sections of the eastern bank where toe scouring was evident which is considered to be within the natural functioning of the creek system. However, there is the potential for this to increase.

Bank protection works would occur where toe erosion is evident (refer to **Figure 3-4**). The rock revetment toe protection would commence on both banks from the existing 2.4 metre diameter reinforced concrete pipe located near the southern boundary of the site, and extend downstream for around 15 metres on the western bank and 53 metres on the eastern bank. A plan of the construction work at Industrial Creek is provided in **Figure 3-7**.



In addition to the bank protection works, a small gross pollutant trap would be installed. The gross pollutant trap would be constructed between two and three metres upstream of the box culvert located near the northern boundary fence line of the site. A drawing of the gross pollutant trap for Industrial Creek is provided in **Figure 3-8**. In the event of a complete blockage of the gross pollutant trap, stormwater could continue to enter the culvert and thereby minimise the potential for any flooding to occur.



Figure 3-8 Gross pollutant trap proposed for Industrial Creek

Swale drain next to the Hills M2 Motorway

The existing drainage swale runs parallel to the motorway pavement inside the site boundary and consists of a poorly vegetated drain that is lined with crushed shale rock. Three small drainage lines carrying pavement run-off from the motorway discharge into this drain, which grades towards the west.

Due to its poor condition, the swale drain represents a potential source of fine sediment contamination to downstream environments. Surface water run-off from the motorway travels westwards along the swale prior to flowing into a shotcrete channel connected to a water quality basin located further to the north west of the site. At the bottom end of the shotcrete channel, there is potential for the water to enter an overflow pipe to Shrimptons Creek, rather than draining to the water quality basin due to the inlet of the overflow pipe being lower than required.

To reduce the potential for sediment transportation from the swale and to improve its function, the swale batters would be regraded. This would involve removal of the upper layer of soil (about 200 millimetres) and replacement with a clean and suitable topsoil layer, secured with jute mesh and native vegetation. The regrading, topsoiling and revegetation would maintain the required drainage capacity of the swale and reduce sediment transport in drainage water.

Low berms constructed from rock and coir logs would be incorporated into the swale drain, running perpendicular across the invert at 10 to 20 metre intervals. The rock will be a maximum of 300 millimetres high in the bottom of the channel and will provide a stable base for the 300 millimetre diameter coir logs, which will be staked in place, and partially buried to a depth of approximately 200 millimetres in and behind the rock. The top of the coir logs will be around 100 millimetres higher than the imported topsoil. The berms would provide some litter capture capacity as well as the potential to retard spills from the motorway. As topsoil would raise the channel invert level, a drop structure consisting of coir logs and riparian protection would be constructed at the downstream end of the swale to transition the invert to the existing shotcrete lined channel.

A plan layout of the swale drain and details of berm and drop structure construction are shown in **Figure 3-9** and **Figure 3-10** and further details are presented in the Water Quality Improvement Plan in Appendix F.



M2 Motorscapes Project Review of Environmental Factors



Water quality basin drainage channel

To re-direct water flows away from Shrimptons Creek and into the water quality basin, modifications to the concrete channel would be constructed. The concrete channel would also be modified to improve the aeration of the flows (refer to Plate 1).

The modification would include installation of a low rise weir, about 150 to 300 millimetres in height, which would be constructed below the end of the concrete channel near the inlet of the overflow pipe. The optimum location of the low rise weir would be 500 millimetres from the inlet as shown in Figure 3 6. The weir would act to direct stormwater preferentially into the basin whenever the water level in the basin was below the weir level. **Figure 3-11** depicts the proposed low rise weir and the modifications to the lower section of the concrete channel on approach to the water quality basin. The weir would be constructed from cored blocks and lean mix concrete and would serve to better direct flows into the water quality basin to restrict the frequency of discharge into the overflow pipe.

As shown in **Figure 3-11**, the main components of the work include the placement of a series of blocks, typically spaced between 500 to 1000 millimetres along the full length of the channel. The blocks would be installed by drilling a hole into the shotcrete and using an epoxy grouted dowel for placement. The placement of the irregularly spaced blocks in the channel would help create turbulence to aerate the water. The blocks would be located to ensure water is not diverted out of the channel.

Works would also include the removal of the edge shotcrete on the creek side of the channel and replacement with new shotcrete edge to direct channel flows to the water basin inlet side of the new weir. The new shotcrete would be a minimum of 300 millimetres above the base of the channel.





Plate 1 Inlet to water quality basin that requires modification (photo left) Plate 2 Discharge pipe and transition (photo right)



Figure 3-11 Illustration of water quality basin channel modification

3.1.4 Site access points and tracks

Motorway access

A new permanent maintenance access point would be provided from the eastbound carriageway around 320 metres west of the Khartoum Road underpass. To provide this access point, a section of the existing guardrail would be removed as well as non-essential signage.

The access point would be designed to ensure adequate widths and turning movements are achieved for the largest construction vehicles and equipment accessing the site. The access track would be around five metres wide and comprise 250 millimetre minimum heavily bound base to Roads and Maritime specification R73.

To enable access across the drainage swale that runs alongside the eastbound carriageway, a new crossing would be constructed by way of a pipe culvert. The culvert would provide adequate width for vehicles entering and exiting the site while maintaining the existing drainage catchment and flow conditions of the site. The following activities would be required:

- Removal of existing vegetation and topsoil from existing drainage swale
- Construction of a 750 millimetre pipe culvert and headwalls within the existing drainage swale to allow vehicle access from the motorway
- Backfill pipe culvert to form the crossing in accordance with Roads and Maritime specifications.

The access point would be demarcated with bollards and would not be accessible to the public. The access point would also serve during construction and is discussed in Section 6.7.

Leisure Close access

An existing pedestrian gated access would be used to access the site from Leisure Close via Dunholm Reserve. For around two months at the commencement of the proposal the access would be widened to allow for construction equipment to carry out work at Industrial Creek. To
protect Dunholm Reserve, 'Tracmats' would be placed on the Reserve between Leisure Close and the access gate. 'Tracmats' are typically polyurethane mats which are placed on the ground to protect the ground surface from damage or disturbance by machinery.

Following the two month period of construction work at Industrial Creek, the access would be restored and the existing pedestrian gate reinstated. This access would be used for maintenance staff only, and is required to provide access to the gross pollutant trap at Industrial Creek.. The access point would not be accessible to the public.

Any removal of waste from the gross pollutant trap would be carried by hand to a maintenance vehicle at Leisure Close.

Internal access tracks

A permanent access track (as shown in **Figure 3-1**) would provide pedestrian access to the Shrimptons Creek gross pollutant trap for construction and on-going maintenance purposes and would connect to the existing water quality basin access track. The permanent pedestrian access track would be around 1200 millimetres in width and would be constructed using VENM aggregate material compacted to 100 millimetre depth.

In providing access for the periodic retrieval of rubbish, the track would have low maintenance staff activity only. On steeper sections, steps would be installed for safety and slowing surface water velocity. The track would be constructed to minimise the potential for erosion consistent with *Managing urban stormwater: soils and construction* – Volume 1, 4th Edition (Landcom, 2004). Where required, the track edges would be stabilised with rock armouring.

The access point would also serve during construction and is discussed in Section 6.7

3.2 Design

The following sections provide a description of the design criteria, design features and engineering constraints of the proposal.

3.2.1 Design criteria

The key design guides and policies considered during the development of the proposal included:

- Austroads Guide to Road Design (Austroads, 2009) and Roads and Maritime supplements to the Austroads Guide
- Austroads Road Safety Audit Manual (Austroads, 2009)
- Roads and Maritime's Road Design Guide (Roads and Maritime, undated)
- Roads and Maritime's Delineation Guidelines (Roads and Maritime, undated)
- Soils and Construction Managing Urban Stormwater, Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008b).

3.2.2 Engineering constraints

The design and construction of the proposal would consider a number of issues and constraints including:

- Access directly from the motorway and the use of limited existing access points from local roads
- Ensuring all design work remains within the site boundary to avoid impacts to Lane Cove National Park
- Known flooding patterns would constrain the design of the rehabilitation of the drainage swale would be designed to convey the same volumes of water as the existing swale and be suitably stable to prevent scour and erosion within the channel
- The design of the improvements to the creeks and the drainage components network would be carried out in accordance with known flooding constraints

• The loading of the selected artwork and existing ground conditions, which would limit the design of the associated support structure.

3.3 **Construction activities**

This section provides a summary of the likely construction methodology, work hours, plant and equipment and associated activities that would be used to construct the proposal. For the purpose of this REF, an indicative construction plan and methodology is provided. The detailed construction staging plans and methods would be identified during the design and construction planning process.

The actual construction method may vary from the description in this sectionas a result of factors such as identification of on-site conditions during pre-construction activities, ongoing refinement of the design and consultation with nearby property owners and stakeholders. The final Construction Environment Management Plan (CEMP) and methods used for construction would be consistent with statutory requirements (including any work, health and safety (WH&S) regulations and all conditions of approval issued following approval of the proposal).

A construction environmental management framework to manage and mitigate impacts is presented in Section 7 of the REF. The final construction plan and methods would be consistent with this framework.

3.3.1 Work methodology

Construction activities would be carried out in accordance with the CEMP that would be developed consistent with the requirements of the Roads and Maritime QA Specification G36 Environmental Protection (Management System). Construction would be located within the work area specified within the CEMP and completed to incorporate all safeguards as described in this REF and any other relevant Roads and Maritime environmental specifications.

The description of the construction process/methodology is provided in the expected chronological order of construction however some activities are carried out simultaneously.

Construction phase	Activities
Environmental management system (EMS)	Develop environmental management plans.
Early work	Survey construction site
	Notify residents of start of work
	 Widen existing site access point from Leisure Close via Dunholm Reserve for construction vehicles
	 Adjust roadside motorway infrastructure and construct the site access point off the motorway.
	Carry out site establishment
	• Develop site compound including sheds and an area for six car parking spaces
	 A temporary fence to be erected on the site boundary to the east on Khartoum Road and shade cloth to be installed on the northern boundary with Lane Cove National Park
	• Fence the sensitive environmental areas (native vegetation to be maintained)
	Install erosion and sediment controls.
Site preparation	Establish access tracks
	 Install a wheel wash and rumble grid at the motorway access
	Erect traffic barriers.
Vegetation Manag	ement Plan

Construction phase	Activities
Weed removal	• Wherever possible, all indigenous and well-established non-indigenous native vegetation (dbh >75mm) will be marked, protected and retained across the site. Some previously sown immature non-indigenous native vegetation (eg. <i>Acacia spp.)</i> will be removed
	• Incremental removal / treatment of weeds through mechanical, manual or chemical treatment. Chemical treatment would include herbicides spray application, or targeted cut and paint and injection to grasses and other weeds. Manual and mechanical removal would involve removing the weed at the base of the plant leaving roots intact to minimise soil disturbance
	• Target slopes and embankments on the northern boundary of the site and riparian zones of both creeks due to the high weed density
	 Mulching of weeds in-situ on slopes and embankments
	• Weed mulch in riparian areas would be re-located to higher elevated land to reduce the risk of offsite movement during high flows, particularly for species that regenerate vegetatively such as <i>Lantana camara</i>
	 Mulch on the deck area would be buried by the topsoil
	• Follow-up weeding would be carried out at intervals of six to eight weeks after primary weeding to ensure that re-growth is controlled during nine month construction period.
Earthwork	 Laying of 4,000 cubic metres of topsoil onto the deck area.
Revegetation	 Progressive planting of native species in accordance with Vegetation Management Plan Appendix C
	 Revegetation on the deck area would involve planting via tube stock with overlying hydro-seeding to stabilise exposed soils
	Revegetation on the slopes/embankments and riparian areas would involve planting tube stock into the ground.
Water quality imp	rovement works
General method	• Type and size of machinery and attachment will be appropriate for the creek site and type of works to prevent over excavation and the need to add materials for levelling of the waterway bed
	• Sand bags will be filled with clean sand with no fines, waste or contaminants
	 Refuelling and servicing of plant and equipment will be carried out away from creeks and other sensitive areas
	Where possible, non-toxic hydraulic fluids, such as vegetable based fluids will be used for machinery working in waterways
	Restore pedestrian access gate following construction work at Industrial Creek.
Installation of	Establish site access and temporary erosion and sediment controls
trash racks in the	Establish suitable locations for material stockpiles
CIEEKS	All materials would be delivered to site to minimise time required for flow diversions
	• Works would be carried out over the shortest possible timeframe and in current and projected dry conditions. Creek flows and weather conditions to be monitored at all times when working in the creek
	Nominated weed vegetation would be removed
	• Install site specific controls for the establishment of flow diversions. This may involve establishment of temporary sand bag coffer dams upstream and downstream of the construction site and installation of a pipe and/or pumping arrangement to convey low flows around the site
	• Dewater construction area to the nearby basin, or via a watercart. Alternatively, dewater into densely vegetated areas at least 20 metres distance from the creeks once sediments have settled
	Re-profile creek bed and banks as necessary to permit installation of concrete

Construction	Activities	
phase		
	slab	
	Prepare concrete formwork	
	• Install in situ concrete and allow to cure. Use quick setting mixes where appropriate to minimise the risk of water pollution. Do not undertake concrete pours when rainfall is forecast. Isolate from waterway any cast-in-place concrete for at least 48 hours to allow pH to neutralise	
	Install pre-fabricated stainless steel racks	
	Remove temporary flow diversion pipe and coffer dams	
	 Restore levels around final works and disturbed areas to pre-existing. Revegetate and stabilise areas disturbed during construction 	
	 Removal of debris, rubbish and surplus materials including rock, vegetation, spoil, metal and cement 	
	 Remove temporary erosion and sediment controls following satisfactory establishment of stabilisation measures. 	
Installation of rock	Establish site access and temporary erosion and sediment controls	
revetment at	Establish suitable locations for material stockpiles	
Creeks	All materials would be delivered to site to minimise time required for flow diversions	
	• Works would be carried out over the shortest possible timeframe and in current and projected dry conditions. Creek flows and weather conditions to be monitored at all times when working in the creek	
	Nominated weed vegetation will be cleared	
	• Works would be progressively staged to limit the length of bank disturbance to a maximum of 10 metres at any time	
	 site specific controls would be installed for the establishment of flow diversions. This may involve placing sand bags parallel to the bank to temporarily direct low flows to the opposite half of the channel invert 	
	Re-profile creek bed and banks as necessary to permit rock placement	
	Batter upper banks and place jute matting	
	Place backing aggregate and large rock	
	Remove any temporary flow diversion measures	
	Restore levels around final works, site access and disturbed areas to pre- existing. Revegetate and stabilise areas disturbed during construction	
	 Removal of debris, rubbish and surplus materials including rock, vegetation, spoil, metal and cement 	
	 Removal of temporary erosion and sediment controls following satisfactory establishment of stabilisation measures. 	
Drainage swale works and pipe	• Regrade swale batters by removing upper layer of soil (about 200 millimetres) and replace with a clean and suitable topsoil layer	
culvert	• Install low berms constructed from rock and coir logs into the swale drain, running perpendicular across the invert at 10 to 20 metre intervals. The rock would be a maximum of 300 millimetres high in the bottom of the channel and provide a stable base for the 300 millimetre diameter coir logs, which would be staked in place, and partially buried to a depth of about 200 millimetres in and behind the rock. The top of the coir logs will be around 100 millimetres higher than the imported topsoil	
	• Construction of a 750 millimetre pipe culvert and headwalls within the existing drainage swale to allow vehicle access from the motorway	
	Backfill pipe culvert to form the crossing in accordance with Roads and Maritime specifications.	
	A drop structure consisting of coir logs and riparian protection would be constructed at the downstream end of the swale to transition the invert to the existing shotcrete lined drain	

Construction phase	Activities	
	• The drainage swale would be secured with jute mesh and native vegetation.	
Improvement to water quality basin drainage channel	 Place erosion protection at the channel and water quality basin Install a low rise weir, about 150 to 300 millimetres in height, below the end of the concrete channel near the inlet of the overflow pipe. The optimum location of the low rise weir would be 500 millimetres from the inlet as shown in Figure 3 6 Install a series of blocks at irregular intervals, typically spaced between 500 to 1000 millimetres along the full length of the channel by drilling a hole into the shotcrete and using an epoxy grouted dowel for placement Removal of the edge shotcrete and replacement with new shotcrete to direct channel flows to the water basin inlet side of the new weir. The new shotcrete would be a minimum of 200 millimetres above the base of the placement 	
Artwork		
Artwork	 Remove signage blocking views of artwork Construct concrete footings for artwork Install artwork 	
De-commission		
Finishing work	 Carry out landscape and re-vegetation work to disturbed areas Revegetation of, temporary access tracks Decommission temporary facilities (eg site compounds and temporary access points), and finalise re-vegetation works Clean up the site and dispose of all surplus waste materials 	
Maintenance and	monitoring	
	 Remove weed regrowth and monitor planted species growth Monitoring of weed control would occur at an interval of two months over the 27 month monitoring and maintenance period. Backfill planting where required Check and empty gross pollutant traps Continue to implement pest control program Monitor efficiency of drainage network 	

3.3.2 Construction hours and duration

The construction of the proposal is anticipated to start in mid-2016 and continue for about a nine month period followed by a 27 month maintenance and monitoring phase.

The majority of construction work would generally be carried out during standard working hours, as follows:

- Monday to Friday 7am to 6pm
- Saturday 8am to 1pm
- Sunday and public holidays, no work.

Out of hours work may be required to facilitate site establishment, mobilisation and de-mobilisation, heavy haulage material deliveries, motorway signage removal and the artwork delivery and installation.

Deliveries to the site

The proposal requires the importation of about 5,000 cubic metres of material in total. This would comprise 4,000 cubic metres of topsoil to provide a suitable material for revegetation, and a further 1000 cubic metres of material (ie. VENM) is included as a conservative estimate to establish access tracks. The source of the material is not yet confirmed and would potentially be sought from

excessive spoil excavated from nearby road construction projects or other suppliers. Delivery of construction materials such as culvert pipes and headwalls to the site is proposed to be undertaken outside of peak traffic hours.

Where there is a requirement for night work or additional out of hours work, sensitive receivers that are located near the proposal would be notified in advance. Any work proposed outside standard construction hours would be carried out in accordance with the requirements of Practice Note vii *Roadworks outside normal working hours in the Environmental Noise Management Manual* (Roads and Traffic Authority of New South Wales, 2001) (the ENMM).

Work with the potential to generate noise levels more than 5dB above the relevant night-time rating background levels at the most affected sensitive receivers would be scheduled no more than two nights per week. Request to work more than two nights per week would be determined by Roads and Maritime. In accordance with the requirements of the ENMM:

- Any very noisy activities required outside standard construction hours would be completed by 10pm
- The relevant Roads and Maritime Environmental Advisor shall be notified before the start of the work.

3.3.3 Plant and equipment

An indicative list of plant and equipment that would typically be required has been provided below:

- Excavators
- Loaders
- Bull dozers (ie. positrack)
- Jack hammers
- Mulchers
- Mobile cranes and frannas
- Soil nail drilling rigs and other ground stabilisation plant and equipment
- Articulated (and other) dump trucks
- Pile augers (eg if deeper foundation required for artwork)
- Elevated work platforms
- Compressors
- Generators
- Chainsaws
- Welding equipment
- Vibrator rollers
- Water carts
- Seeding equipment
- Lighting towers
- Road sweepers
- Concrete/shotcrete equipment (epoxy/grouting for gross pollutant traps)
- Site sheds
- Toilet facilities (portaloos)
- Hand tools (powered and unpowered)
- Grouting pumps
- Traffic barriers.

3.3.4 Earthworks

Earthworks would be undertaken for the following activities as part of the proposal:

- Construction of the culvert to provide access from the motorway
- Construction of internal access tracks
- Laying of topsoil over the deck area
- Water quality improvement work at the creeks, swale drain and water quality basin.

Due to the potential presence of asbestos fibres on the deck area and slopes and embankments, any earthworks in these areas would be limited and undertaken following management measures identified in the CEMP.

Around 4,000 cubic metres of topsoil would be used to cover the deck area (by around 300 mm depth). The topsoil would provide both a layer of suitable soil material for revegetation and minimise the disturbance of the current soil profile where the presence of asbestos has been identified. Imported material (VENM) would be used as required, such as the formation of access tracks.

All imported material would be stockpiled on the deck area.

3.3.5 Source and quantity of materials

An indicative list of the materials required for the proposal includes:

- Mulch material for the deck area
- Tube stock and other seedlings for revegetation (refer to the VMP for specific vegetation proposed)
- 4,000 cubic metres of topsoil for the deck area
- Up to 1,000 cubic metres of VENM or other road based material to establish access tracks (ie. heavily bound base to RMS QA specification R73 (minimum four per cent cement)
- Leasing of Tracmats for access via Dunholm Reserve. Tracmats are typically polyurethane mats which are placed on the ground to protect the ground surface from damage or disturbance by machinery
- Water for irrigation of revegetation and construction
- Materials for the artwork:
 - Laser cut corten steel, laser cut aluminium plate
 - Automotive/powedercoat exterior grade paint finish
 - Mechanical fixings, motor for Waratah element
 - Solar panels and LED lighting fixtures
 - Reinforced concrete footings.

The supply of the materials has not yet been confirmed however topsoil and other VENM material would be sourced from commercial suppliers or other nearby projects. However, the preference would be to import soil that constitutes landscape grade topsoil material inclusive of up to 10 per cent compost to improve the rootzone growing medium for revegetation. All material would be analysed or confirmed for physico-chemical and contaminant concentrations prior to transportation to the site.

The demand for water during construction would vary across the program. Peak water demand would be during earthworks, as well as for dust control, staff site facilities and revegetation purposes. While the overall water requirement is unknown at this stage, it is unlikely to be a significant volume. Water would be sourced from authorised off-site sources, recycled water and potentially water from the water quality basin.

3.3.6 Traffic management and access

The site is bounded by a 1.8 metre high chain mesh fence along its northern boundary, with access gates behind the apartment blocks on Leisure Close and about 200 metres along the Lane Cove National Park fire trail. For the proposal, access to the site would be created from two locations:

- Access from Leisure Close through Dunholm Reserve at the northern boundary of the site
- Access from the motorway at the southern boundary of the site using either a rolling lane closure or a static lane closure.

Access via Leisure Close

During construction, access to the site from Leisure Close through Dunholm Reserve would also be constructed temporarily for machinery (excavator and positrack) prior to the completion of the motorway access. The temporary construction access would be required for a period of around two months. Following construction, the reserve would be restored to its pre-construction condition in consultation with Council. As detailed in Section 3.1.4, this access point would be used for pedestrian access for maintenance staff only.

Around two to three construction staff vehicles would require street parking in Leisure Close for the two month period. The machinery would be kept on site during this period of work to avoid disruption to the local residences and road traffic. As discussed in Section 3.1.4, the access track would be converted to a permanent pedestrian access for maintenance purposes only.

Access from the motorway

As detailed in Section 3.1.4, a permanent access to the site from the motorway would be constructed. Sections of the existing guardrail barriers would be removed to facilitate access to the site. For safety reasons this work would not be carried out under live traffic conditions. Static lane closure traffic management arrangements on the motorway would be required while the guardrails are removed and access established. To avoid the potential for traffic disruption on the motorway this work would occur outside of peak traffic periods when motorway traffic volumes are low.

Construction vehicles entering and leaving the site would utilise the rolling closure where practical and use the innermost motorway lane for deceleration and acceleration. As noted above, during rolling closures the nearside lane will have some temporary reductions in speed as the Truck Mounted Attenuator would slow the nearside lane while the construction vehicles exit the construction site and accelerates to the highway speed. The traffic routes to and from the site are shown in Figure 3-1.

Static closure and rolling closure are described as follows:

- Rolling Closure: The delivery vehicles approach the site along the eastbound carriageway with a truck mounted attenuator (TMA) in tow. The TMA would deploy it's attenuator and use it's arrow board to signal traffic behind to slow down and merge right as they approach the site in the nearside lane. As the delivery vehicle slows down and pulls into the site and off the motorway, the TMA would continue eastbound, accelerating to the sign posted speed. Typically the rolling closure would impact the nearside lane by stopping momentarily for as little as 30 seconds. The maximum time anticipated for rolling closures is 10 minutes however this is subject to low traffic volumes, off-peak times and approval from the M2 Motorway traffic control room.
- Static Closure: This would consist of typical traffic management in accordance with a traffic control plan and Roads and Maritime Services' Traffic Control at worksites manual. This would involve the temporary closure of a maximum of two lanes and speed reduction to 40 kilometres per hour. This would be undertaken in accordance with THML's permit system and be governed by THML's operations management from the Hills M2 Motorway traffic control room. These lane closures would only be required occasionally during the early and late phases of the construction program. They would be implemented during daytime hours generally 10am to 6pm, and night time hours generally 8pm to 5am subject to low traffic volumes and approval from the M2 Motorway traffic control room.

The largest component of vehicle movements to the site would be associated with the delivery of imported material to the site. Based on the conservative estimation that about 5,000 cubic metres of imported fill material, this would equate to about 330 truck and dog vehicular loads, or 330 two way heavy vehicle movements.

During the peak earthworks activity, it is anticipated that about six to eight movements per hour would occur with a round trip of about an hour (including loading and unloading based on the fill coming from local construction projects) depending on the size of the fleet and the construction program. This stage of construction would be likely to occur for a maximum of about three to four weeks. Construction vehicle delivery movements are planned to be outside peak times.

On site the delivery trucks would use the deck area for turning in and out of the site as shown in **Figure 3-1**.

Parking for staff at the site would be provided for up to six vehicles in the site compound. This would be supplemented as necessary by using the Hills M2 Motorway control room parking area, about 900 metres west of the site and staff would be driven to the site from this parking area.

No local road closures are proposed. Traffic management would be carried out in accordance with the *Traffic Control at Work sites Manual* (RTA, 2006). Before the start of construction the contractor would need to obtain a Work Permit from the motorway operator.

Internal access tracks

Within the site, construction vehicles and construction workers would utilise existing access tracks, but would require additional access tracks to be constructed, as discussed below.

From the permanent motorway access point, a temporary vehicular access track would be constructed to allow delivery of materials and turning circle on the deck area for safe entry and exit of the site via the motorway (refer to **Figure 3-1**). The access track would be around five metres wide and comprise 250 millimetre minimum heavily bound base to Roads and Maritime specification R73. A temporary vehicular access track would be constructed to Industrial Creek via Leisure Close and Dunholm Reserve. The access track would be revegetated following completion of the construction work. An access track from the water quality basin to Shrimptons Creek would be constructed to provide light vehicle and machinery access during construction, and pedestrian access for ongoing maintenance.

The routes of access tracks are shown in **Figure 3-1**. The construction of the access tracks would require the removal of existing woody weed vegetation. The pedestrian access tracks would be around 1200 millimetres in width and would be constructed using VENM aggregate material compacted to 100 millimetre depth. On steeper sections, steps would be installed for safety and slowing surface water velocity. Where required, the track edges would be stabilised with rock armouring.

3.4 Ancillary facilities

A construction compound would be required for the proposal and the *Roads and Maritime's Stockpile site Management Procedures* (RTA, 2011) has been taken into consideration in choosing a location.

The proposed location of the site compound is behind the noise wall to limit noise and visual impacts from the proposal as shown in **Figure 3-1**. The construction compound would typically include a combination of demountable offices, meal rooms, toilets/showers and parking facilities. The sheds would be transported onto site by hiab type crane-truck. The site compound would be accessed via an internal access track through the deck area. The compound site would be secured.

For this proposal, stockpiles would be located on the deck area and not within the site compound. This is proposed to avoid double handling and minimise environmental impact. The *Stockpile site Management Procedure* (RTA 2001) and the QA Specification R44 – Earthworks, have been taken into consideration in locating the stockpiles and site compound.

Upon completion of the proposal, the temporary site compound and access tracks would be removed, cleared of any rubbish and materials, and revegetated consistent with the site.

The location of the compound, stockpile sites and the vehicle turning areas would be confirmed during pre-construction planning and included in the CEMP.

3.5 Public utility adjustment

An underground sewer main is located on the eastern bank of Shrimptons Creek and crosses the creek about 60 metres from the existing culvert under the motorway. It is not envisaged that activities associated with the proposal would impact the sewer. Should adjustments to the sewer be required, this would be determined in consultation with Sydney Water Corporation. Any necessary approvals would be obtained prior to works commencing.

There are no other known public utilities that would be affected by the proposal. 'Dial before you dig' and subsurface investigations would be carried out prior to the commencement of work to confirm the location and depth of any utility assets present including the Sydney Water sewer main. Consultation would occur with the utility owner as required.

3.6 **Property acquisition**

No property acquisition or property adjustments are required as part of the proposal.

This section provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road related activity and is to be carried out on behalf of Roads and Maritime, it can be assessed under Part 5 of the EP&A Act. Development consent from City of Ryde Council (the Council) is not required.

The proposal is not located on land reserved under the National Parks and Wildlife Act 1974 and does not affect land or development regulated by State Environmental Planning Policy No. 14 – Coastal Wetlands, State Environmental Planning Policy No. 26 – Littoral Rainforests, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Projects) 2005.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

Clause 13 of ISEPP requires consultation with council if a proposal is permissible without development consent and is likely to have an impact that is not minor or inconsequential on certain council infrastructure or services. This includes the installation of a temporary structure, or enclosing of, a public space under the control or management of a council that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.

Clause 15 of the ISEPP states that a public authority must not carry out a development on floodliable land that would change flood patterns other than to a minor extent, unless the authority has given written notice of the intention to carry out the development to the relevant council. The creek areas are liable to 1 in 100 year flooding. However, the proposal would not change flood patterns other than to a minor extent and therefore consultation with Council is not required under this clause.

Clause 16 of the ISEPP states that a consent authority must not carry out development adjacent to land reserved under the *National Parks and Wildlife Act 1974* without giving written notice to the specified authority and taking their response into consideration.

The proposal site lies immediately adjacent to the Lane Cove National Park. As such, consultation with the NSW Office of Environment and Heritage (OEH) is required under clause 16 of ISEPP.

Consultation, including consultation as required by ISEPP (where applicable) is discussed in Section 5 of this REF.

State Environmental Planning Policy 55 – Remediation of land

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) was enacted to provide a state-wide approach for the remediation of contaminated land for the purpose of minimising harm to the health of humans and the environment. In accordance with clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of any development on lands unless it has considered whether the land is contaminated.

Due to the historic land use of the site a contamination investigation was carried out in early 2016. Results from the soil sampling and analysis indicated the presence of asbestos (fibrous) contamination at one sampling location on the deck area.

The contamination assessment stated that the potential for additional areas of contamination to be found was considered to be a negligible to low constraint to the design and construction of the proposal. It is considered unlikely that the proposal would trigger any requirements to remediate the site.

Nonetheless, construction management measures to manage contamination risks have been recommended in the REF. Further, any unexpected finds would be managed in accordance with the unexpected finds procedure to be contained in the CEMP.

4.1.2 Local Environmental Plans

Ryde Local Environmental Plan 2014

The *Ryde Local Environmental Plan 2014* (the Ryde LEP) outlines zoning in the Ryde local government area and describes development types in each zone that are permissible with and without consent or are prohibited.

Under the Ryde LEP, the site is zoned as SP2 Classified Road. Any development that is ordinarily incidental or ancillary to road construction, operation and maintenance is permitted without consent within this zone.

The proposal is consistent with the objectives of the SP2 Classified Road zoning, which provides for road infrastructure and related uses. It is also compatible with, and does not detract from, the provision of road infrastructure.

4.2 Other relevant NSW legislation

4.2.1 Environmental Planning and Assessment Act 1979

Development in NSW is assessed in accordance with the provisions of the EP&A Act and the EP&A Regulation. The EP&A Act provides a framework for environmental assessment, including approvals and environmental impact assessment for proposed developments.

The EP&A Act contains three parts that impose requirements for planning approval. These are generally as follows:

- Part 4 provides for assessment and approvals of 'local development' that require development consent (this includes State Significant Development)
- Part 5 provides for the assessment and approvals of 'activities' that do not require approval or development consent under Part 4
- Part 5.1 provides for assessment and approvals for State Significant Infrastructure.

The need or otherwise for development consent is set out in environmental planning instruments – State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs) (now deemed SEPPs) or Local Environmental Plans (LEPs).

As outlined in Section 4.1.1, the proposal is permissible without consent and therefore would be assessed under Part 5 of the EP&A Act.

A SIS is not required as the proposal would not be carried out on land that is critical habitat and would not significantly affect a threatened species, population or ecological community or its habitat.

Factors that need to be taken into account when considering the likely impact of an activity on the environment are outlined in clause 228 of the EP&A Regulation and are discussed in Appendix A.

4.2.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The TSC Act aims to, amongst other things, 'conserve biological diversity and promote ecologically sustainable development'. It contains schedules that list endangered, critically endangered and vulnerable species, populations, ecological communities, and key threatening processes in NSW.

Section 5A of the EP&A Act lists a number of factors to be taken into account in deciding whether there is likely to be a significant impact on threatened species, populations or ecological communities or their habitats. If a threatened species or community would be impacted, an Assessment of Significance must be completed to determine the significance of the impact. A SIS is required if there is likely to be a significant impact on a threatened species, population, or ecological community or its habitat.

As discussed in Section 6.5 of the REF, there is the potential for the proposal to impact on threatened species and communities that are listed under the TSC Act. Assessments of significance under Section 5A of the EP&A Act were prepared and concluded that the proposal is unlikely to have a significant impact on threatened species, communities or populations listed under the TSC Act, and therefore a SIS is not required.

4.2.3 The Noxious Weeds Act 1993

The Noxious Weeds Act 1993 (NW Act) provides for the declaration of noxious weeds by the Minister for Primary Industries. Weeds may be considered noxious on a national, state, regional or local scale. All private landowners, occupiers, public authorities and councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act.

Noxious weeds have been identified on the site (refer to Section 6 of this REF and Appendix E (Flora and Fauna Survey)).

One of the key objectives and drivers of the proposal is minimise the spread of the existing weed infestation on the site, and risks to the Lane Cove National Park. The proposal seeks to remove exotic weeds at the site, including the identified 21 species of noxious weed species which require control in accordance with the NW Act. This is discussed further in Section 6.5 of the REF.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and Section 6 of the REF.

A referral is not required for proposed road activities that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic

assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Findings – matters of national environmental significance (other than biodiversity matters)

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of the Environment under the EPBC Act.

Findings – nationally listed biodiversity matters

The assessment of the proposal's impact on nationally listed threatened species, populations, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Section 6 of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of road infrastructure facilities and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Part 5 of the EP&A Act.

Roads and Maritime is the determining authority for the proposal. This REF fulfils Roads and Maritime's obligation under clause 111 of the EP&A Act to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Referral of the proposal under the EPBC Act is not required.

5 Consultation

This section discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Community involvement

Due to the location of the proposal within the existing motorway corridor and the nature of the proposal, community engagement would occur upon approval of the REF. This would commence with the distribution of a community update to residents, local businesses and key stakeholders surrounding the project site. Particular attention will be given to visually impacted residents to ensure they are made aware of the project including the final artwork design before work commences. Artist's impressions of the artwork will be included, along with the project's contact details on print and electronic communication with the resident. This will ensure there are open and clear lines of communication with visually impacted residents should they need to speak to THML regarding the project.

Ongoing engagement with residents (including visually impacted residents), local businesses and key stakeholders would occur throughout the project with the distribution of regular construction updates, the establishment of a project website and an enquiries email account. Print advertisements would be published in local newspapers and a community information session would be held prior to the artwork installation.

The Communications and Stakeholder Engagement Plan (CSE Plan) prepared by THML and reviewed by Roads and Maritime (Appendix K) contains additional information regarding the community engagement activities. The CSE Plan includes notification to stakeholders of the construction to commence within two weeks and a community update outlining the proposal. Landcare Australia and THML have met with NPWS to discuss the proposal. This has been shared with local bushcare groups including Friends of Lane Cove National Park.

5.2 Aboriginal community involvement

A desktop assessment of the site and surrounding area indicated two listed Aboriginal sites in proximity to the site, about 30 metres and 90 metres north of the site boundary respectively. The site cards identify both as a rock shelter. No art or stone artefacts were listed on the site cards. Both sites are located within the boundary of the Lane Cove National Park along the banks of Shrimptons Creek. It is not anticipated that the proposal would impact the Aboriginal sites, as the proposal site (including site access points) is outside of the Lane Cove National Park and the nature of the aboriginal sites recorded.

The proposal site has been previously disturbed by past construction activities, the most recent being for the purposes of the M2 Motorway widening project. The findings of the REF for that project support the conclusion that there would not be any impacts to Aboriginal heritage caused by the current proposal at the same site.

As such, consultation with Aboriginal stakeholders is not required for this proposal.

5.3 **ISEPP** consultation

Clause 13 of ISEPP requires consultation with council if a proposal is permissible without development consent and is likely to have an impact that is not minor or inconsequential on certain council infrastructure or services. This includes the installation of a temporary structure, or enclosing of, a public space under the control or management of a council that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.

Access to Industrial Creek via Leisure Close through Dunholm Reserve is proposed for construction vehicles over a temporary period of around two months and would constitute the installation of a temporary structure over a public space that is likely to cause disruption. As such ISEPP consultation with Council is required under this clause. Consultation with Council has commenced and a letter was sent to Council on 10th June 2016 to meet the obligations of clause 13 of ISEPP. No response from Council has been received.

Clause 14(1) of the ISEPP requires consultation with Council for a development that would have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item). Lane Cove National Park and the Macquarie University Ruins are the two nearest heritage items of local significance. The proposal would not have any impacted on these heritage items listed on the Ryde LEP. Therefore, formal consultation with Council is not required under this clause.

Clause 15 of the ISEPP states that a public authority must not carry out a development on floodliable land that would change flood patterns other than to a minor extent, unless the authority has given written notice of the intention to carry out the development to the relevant council. The Ryde LEP flood planning map does not indicate that the site is flood liable land however modelling shows some sections of the site around Industrial Creek and Shrimptons Creek are flood liable (refer to Section 6.4.1). The proposal would not change the flood patterns by more than a minor extent and therefore consultation with Council is not required under this clause.

Clause 16 of the ISEPP states that a consent authority must not carry out development adjacent to land reserved under the *National Parks and Wildlife Act 1974* without giving written notice to the specified authority and taking their response into consideration.

The proposal site lies immediately adjacent to the Lane Cove National Park. As such, consultation with the NSW Office of Environment and Heritage (OEH) is required under clause 16 of ISEPP.

A letter of consultation was sent to OEH (National Parks and Wildlife Service (NPWS)), regarding the proposal on 29 April 2016. A copy of the letter and reply from OEH is included in Appendix G. OEH comments are summarised in **Table 5.1**

Issues that have been raised as a result of ISEPP consultation are outlined below in Table 5.1.

Agency	ssue raised Response / where addressed in REF	
OEH (NPWS)	Continued consultation throughout the project be made with OEH (National Parks and Wildlife Service (NPWS)) Valleys Area.	 Section 5.5 includes ongoing consultation with OEH (NPWS) has, and would be undertaken.
OEH (NPWS)	 Transurban and THML apply the guidelines for development adjacent to OEH Estate. 	 Included as a general management measure in Section 7.2, Safeguards and management measures.

Table 5.1: Issues raised through ISEPP consultation

Agency	Issue raised	Response / where addressed in REF
OEH (NPWS)	• Upon completion of environmental assessments, as well as any technical drawings or designs for the proposed works, be forwarded through to OEH (NPWS) for comment prior to the commencement of works.	 Acknowledged and a copy of the REF would be provided to OEH (NPWS) Technical drawings or designs for the proposed works would be provided to OEH (NPWS).

5.4 Government agency and stakeholder involvement

Consultation with the Department of Primary Industries (Fisheries) would be undertaken for works proposed in the creeks. This consultation would be carried out prior to construction and any requirements by the Department of Primary Industries (Fisheries) would be included in the Construction Environmental Management Plan (CEMP).

Consultation has not been considered required with other government agencies beyond the government agencies in Section 5.3.

5.5 Ongoing or future consultation

Prior to the start of construction the Contractor would prepare a Community and Stakeholder Engagement Plan that would detail the relevant notification and communication protocols and requirements for the works. The residents and commercial premises potentially affected by the proposal would be notified prior to the start of construction and provided with the contact details for relevant personnel associated with the proposal. This would include notification before the start of any work outside of standard construction hours in accordance with the requirements of Practice Note VII in the ENMM.

Notification and consultation activities for the proposal may include:

- Proposal information provided through the Roads and Maritime website and/or THML website
- On-going consultation with OEH (NPWS) in relation to the proposal
- Notification/consultation with Council if relevant, in relation to traffic management
- Notification to the community and motorway users with a minimum of four weeks' notice regarding closures of the eastbound carriageways to install the access from the motorway to the site and the removal and relocation of motorway barriers and signage
- Notification to the community and surrounding businesses with a minimum of five days notice of construction work commencing
- Notifications would be placed in local print media before the start of works detailing the likely timing of the proposal, potential changes to traffic conditions and project management contact details to open communication channels to provide further details or address complaints
- Electronic variable message signs (VMS) may be used along the Hills Motorway network to inform local community of the upcoming construction of the proposal.

6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines Is an EIS required? (DUAP 1995/1996) as required under clause 228(1) of the *Environmental Planning and Assessment Regulation 2000* and the *Roads and Related Facilities EIS Guideline (DUAP 1996)*. The factors specified in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000* are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Land use

6.1.1 Existing environment

The site has been heavily modified for construction support for projects associated with the motorway and is currently disused. Historically modified fill has been imported into the site and the presence of asbestos has been identified at the site.

There are a number of existing land uses surrounding the proposal including:

- Hills M2 Motorway. The motorway is a 21 kilometre motorway that links the lower north shore and the northwest regions of Sydney. It is a key public transport corridor and used by an estimated 75,000 motorists per day
- Residential. The dominant residential precinct is located to the north east of the site (about 10 to 15 metres from the site boundary at the nearest residence) and is characterised by small scale apartments and townhouses, typically two to four stories. In addition, a new residential tower has been constructed at the intersection of Alma Road and Talavera Road south of the site
- Macquarie University. Macquarie University is one of the Sydney's major tertiary educational centres and services a large area of Sydney's northern and western suburbs. Macquarie University is located about 200 metres to the southwest of the site
- Open Space. There is a high level of open space within a distance of about one kilometre from the proposal and many of these consist of sports ovals or training facilities. A number of open spaces exist primarily on the northern side of the motorway including:
 - Tuckwell Park adjoining Lane Cove Road
 - Fontenoy Park and playground off Fontenoy Road
 - Macquarie University sports fields off Culloden Road
 - Christie Park.
- Commercial. Commercial land uses dominate the area to the south of the proposal next to the motorway. These typically include low and high rise buildings with car parks and a small number of commercially designed landscaped areas. The Macquarie Shopping Centre precinct is located between 200 and 400 metres to the south of the site
- Lane Cove National Park. Lane Cove National Park is highly valued for its natural and cultural values. The park is subject to programs to manage fire, vertebrate pests and weeds including community involvement through local Bushcare groups. Lane Cove National Park is a public park (covering 670 hectares) and serves as a primary vegetation corridor linking many smaller urban bushland remnants. The park protects important Sydney bushland, estuarine communities and provides habitat for threatened species
- Small reserves such as Dunholm Reserve, at Leisure Close. Dunholm Reserve is a small reserve adjacent to the site and used by the local community as an entry point to the fire trail within the Lane Cove National Park and for recreational purposes.

6.1.2 Potential impacts

Construction

The proposal would occur within the site boundary (shown on **Figure 3-1**) which is predominantly land within the existing motorway corridor. However access to the site through Dunholm Reserve would be required for a period of about two months and approval from Council would be sought for this purpose. No property acquisitions or alterations are proposed to accommodate the proposal and the motorway lease area would remain unchanged. Impacts to private property as a result of construction of the proposal are not anticipated.

The site is currently disused, and there is no public access to the site. The proposal would not alter the land use of the site in terms of public access.

During construction, there would be a reduction in the local amenity for residences located near the site from temporary noise, construction traffic and visual impacts. Dunholm Reserve would be impacted for around two months during construction to provide access for construction vehicles to Industrial Creek. Leisure Close is a quiet residential street which provides road access to Dunholm Reserve. The proposed use of this reserve would result in a temporary change in land use, and loss of recreational amenity for the local residents. The access track through Dunholm Reserve would demarcate the road access for construction vehicles and no go zones for local residents. The use as an access track has the potential to disturb ground cover and/or soils, in the absence of mitigation. However, the potential impacts are considered to be temporary, minor and manageable, subject to the implementation of measures such as 'tracmats' to protect the ground as detailed in Section 6.1.3. Further, following the completion of construction, Dunholm Reserve would be restored to its pre-construction condition in consultation with Council.

Heavy vehicles associated with the construction of the proposal would use the motorway and connected regional roads to access the site. The motorway would continue to operate with a truck mounted attenuator to direct and slow traffic in the nearside lane and through moving vehicles to change lanes while construction traffic would decelerate predominately in the egress to the construction site. Construction vehicles would access the site out of peak hours and it is therefore anticipated that there would be no increase in travel times or discernible impact on motorists.

Changes or impacts to the land use of surrounding commercial buildings, the Macquarie Shopping Centre and Macquarie University are not anticipated during construction or operation of the proposal due to the distance and nature of the proposal activities.

Operation

There would be no change to adjacent land uses of the site during operation.

The site itself, would remain inaccessible to the public, however it would be transformed in terms of the biodiversity land use of the site by removing the weed infestation and establishing native bushland sympathetic to the Lane Cove National Park. The artwork would provide a new visual element though would not alter the use of the site.

Permanent access points to the site, via the motorway and Dunholm Reserve would be infrequently used by maintenance staff only and would generate a positive impact by facilitating better access to infrastructure for maintenance purposes.

6.1.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Loss of amenity at Dunholm Reserve	 Demarcation of road access through Dunholm Reserve for construction vehicles and no go zones for local residents The reserve will be protected using tracmats for construction of the access track Dunholm Reserve will be restored to its original condition following completion of the proposal at Industrial Creek which is anticipated to take around two months. 	Construction contractor	Pre- construction, construction,	Additional safeguard LU1

6.2 Biodiversity

6.2.1 Existing environment

The biodiversity assessment has considered the *Environmental impact assessment practice note: biodiversity assessment* (EIA-N06) for guidance on the biodiversity assessment.

Flora and ecological communities

A Flora and Fauna Survey, carried out by UBM Ecological Consultants for Landcare (Appendix E) found the majority of the site is comprised of weed thickets and exotic grassland with an overall lack of structural complexity.

There is a medium to high weed density uniformly across the site with 21 noxious weeds species identified in the Noxious Weeds (Weed Control) Order 2014 specific to the Ryde LGA. Of the 21 noxious weeds, six are weeds of national significance. The greatest concentration of weeds occurs in the riparian zones of Industrial and Shrimptons Creeks. The deck area consists of a dense groundcover of exotic grasses and forbs with a number of woody weeds. A summary of the 21 noxious weeds recorded on the site are summarised in **Table 6.1**.

Table 6.1 Noxious Weeds recorded on the site

Family	Botanical Name	Common Name	Noxious Weed Class
Apocynaceae	Araujia sericifera	Moth Vine	Class 4
Asparagaceae	Asparagus aethiopicus	Ground Asparagus	Class 4; WoNS
	Asparagus asparagoides	Bridal Creeper	Class 4; WoNS
	Asapargus densiflorus	Fern Aspargus	Class 4; WoNS
Asteraceae	Senecio madagascariensis	Fireweed	Class 4; WoNS
Basellaceae	Anredera cordifolia	Madeira Vine	Class 4

Family	Botanical Name	Common Name	Noxious Weed Class
Caprifoliaceae	Lonicera japonica	Japanese Honeysuckle	Class 4
Convovulaceae	Ipomoea indica	Morning Glory – purple	Class 4
Fabaceae	Erythrina crista-galli	Cockspur Coral Tree	Class 4
	Genista linifolia	Flax-leaf Broom	Class 4, WoNS
	Senna pendula var. glabrata	Cassia	Class 4
Ochnaceae	Ochna serrulata	Mickey Mouse Plant	Class 4
	Ligustrum lucidum	Broad leaf Privet	Class 4
	Ligustrum sinese	Narrow leaf Privet	Class 4
Poaceae	Arundo donax	Giant Reed	Class 4
Poacea	Cortaderia selloona	Pampas Grass	Class 3
Polygonaeceae	Acetosa sagittata	Turkey Rhubarb	Class 4
Roaceae	Rubus fruticosus spp. aggregate	Blackberry	Class 4; WoNS
Sapindaceae	Cardiospermum grandiflorum	Balloon Vine	Class 4
Solanaceae	Cestrum parqui	Green Cestrum	Class 3
Verbenaceae	Lantana camara	Lantana	Class 4;WoNS

Much of the vegetation community comprises low closed forest and shrubland dominated by privet (*Ligustrum spp.*), lantana (*Lantana camara*), broom (*Genista linifolia*) and box elder (*Acer negundo*). The deck is a combination of couchgrass (*Cynodon dactylon*), broom, wattle (*Acacia spp.*) grassland and shrubland.

In summary there were 175 plant species recorded in, or directly adjacent to the site. This number includes:

- 87 species of exotic introductions or weeds (of these 21 are noxious weeds)
- 80 species which are considered to be naturally occurring and characteristic of the Hornsby Enriched Sandstone Exposed Woodland ecological community
- Three non-indigenous species that have been planted
- Five locally indigenous species that have been planted.

No endangered, vulnerable, near-threatened and/or threatened (EVNT) flora species listed under the NSW TSC Act or Commonwealth EPBC Act were recorded on the site. A search of the Atlas of NSW Wildlife database (based on a 10 kilometre radius) indicates the potential occurrence of nine ENVT species. These included:

- *Tetratheca glandulosa* (Black-eyed Susan) (vulnerable)
- Epacris purpurascens var. Purpurascens (vulnerable)
- Darwinia biflora (vulnerable)
- Eucalyptus nicholii Narrow-leaved Black Peppermint (vulnerable)

- Melaleuca deanei Deane's Paperbark (vulnerable)
- Syzygium paniculatum Magenta Lilly Pilly (endangered)
- Pimelea curviflora var. curviflora (vulnerable)
- Hibbertia sp. Turramurra (endangered)
- Grevillea parviflora subsp. parviflora (Small-flower Grevillea) (vulnerable).

Although it is likely that no appropriate habitat for these species remains within the site, targeted searches were carried out for individuals or populations of the listed species during the flora survey. One endangered plant species (TSC Act) was recorded; one individual of *Melaleuca deanei*. This occurred in Lane Cove National Park, about 10 metres north of the fire trail and site boundary.

No plant community was recorded in or directly adjacent to the site is listed under the TSC Act or Commonwealth EPBC Act as a threatened ecological community. The nearest occurrence of a threatened community is Sydney Turpentine Ironbark Forest, that occurs sporadically in the area bounded by Macquarie Shopping Centre, Epping Road and Epping Boys High School (OEH, 2013).

A summary of the flora and ecological communities in each management zone is provided in **Table 6.2** and shown in **Figure 6-1**



Figure 6-1 Management zones for revegetation

Table 6.2 Flora surveyed in management zones

Management zone	Description of flora
Steep slopes, embankments and batters	The condition of this management zone is described as poor to very poor by Landcare's VMP. Woody weeds have invaded the area and potentially unstable slopes, have been stabilised by the weeds. A small number of native trees/shrubs remain in situ however the management zone mainly comprises exotic species. <i>Ligustrum lucidum</i> (Large-leaved Privet) was the most common

Management zone	Description of flora
	species throughout this unit. Other common species were: Lantana camara (Lantana), Ligustrum sinense (Small-leaf Privet), Ipomoea indica (Morning Glory), Genista linifolia (Flax- leaf Broom) and Acacia parramattensis (Parramatta Wattle). The latter was probably planted as a landscape rehabilitation element following construction of the motorway.
	Canopy trees were sparse, with introduced <i>Casuarina glauca</i> (Swamp Oak), <i>Eucalyptus tereticornis, Eucalyptus robusta</i> (Swamp Mahogany), <i>Eucalyptus microcorys</i> and remnant <i>Eucalyptus piperita</i> being recorded. Small trees included Acacia spp., <i>Allocasuarina littoralis</i> and <i>Ulmus parvifolius</i> (Small-leaved Elm).
	The ground cover was generally either sparse, owing to the dense cover of <i>Ligustrum spp.</i> (Privets) or localised carpets of seedling <i>Ligustrum sinense</i> (Small-leaved Privet).
	This section of vegetation is mapped as exotic vegetation by OEH.
The deck	The highest part of the site is referred to as the flat-topped "deck", adjacent to the motorway. This area comprises consolidated fill material and was used as a works compound during the motorway construction. Whilst the main flat section contains a low cover of shrubs and grasses the perimeter is fringed with taller species from the slopes and batters. Previous rehabilitation work has created a vegetation community dominated by exotic and non- indigenous species, with a few indigenous species and a moderate to high density of invasive weeds.
	Previous rehabilitation work appears to have involved the seeding of grasses (mainly <i>Cynodon dactylon</i> – Couch Grass and smaller amounts of <i>Eragrostis curvula</i> (African Love-grass) and <i>Chloris</i> <i>gayana</i> (Rhodes Grass)) with various wattles also present, including <i>Acacia saligna</i> (Golden Wreath Wattle), <i>Acacia longifolia</i> (Sydney Golden Wattle), <i>Acacia parramattensis</i> and <i>Acacia</i> <i>fimbriata</i> (Fringed Wattle). However, weedy species such as <i>Genista linifolia</i> , Verbena spp (Purpletop) and various Asteraceae and Poaceae have colonised.
	Subsequent small plantings of native species were observed including <i>Angophora costata, Eucalyptus piperita, Dodonaea triquetra</i> (Common Hop Bush), <i>Acacia myrtifolia</i> (Myrtle-leaved wattle) and <i>Themeda triandra</i> (Kangaroo Grass).
Riparian zone: Shrimptons Creek	Owing to severe disturbance previously, there was little of the original natural vegetation remaining at the time of the survey. The dominant vegetation comprised <i>Ligustrum lucidum</i> closed and low closed forest. Variants to this included occasional <i>Cinnamomum camphora</i> (Camphor Laurel), <i>Ipomoea indica, Erythrina crista-galli</i> (Indian Coral Tree) and numerous <i>Acer negundo</i> (Box Elder). The shrub stratum was dominated by <i>Ligustrum sinense</i> . Individuals of <i>Casuarina glauca, Salix babylonica</i> (Weeping Willow) and <i>Eucalyptus grandis</i> (Flooded

Management zone	Description of flora
	Gum) were noted.
	Owing to the deep shade created by the canopy the ground cover was either absent or limited to a very dense cover of <i>Tradescantia albiflora/fluminensis</i> (Wandering Jew) or <i>Ligustrum sinense</i> .
	The vegetation mainly comprised <i>Ligustrum lucidum</i> with a small tree stratum of <i>Ligustrum sinense</i> and juvenile <i>Ligustrum lucidum</i> , and a ground cover of <i>Tradescantia fluminensis</i> . One large <i>Salix babylonica</i> (Weeping Willow) was growing on the top of the concrete culvert. Other species near the creek included Hedera helix (English Ivy), <i>Cardiospermum grandiflorum</i> (Balloon Vine), two introduced <i>Callistemon spp. Cyathea cooperi</i> (Straw Tree Fern), <i>Ehrharta erecta</i> (Veldt Grass) and <i>Nephrolepis cordifolia</i> (Fishbone Fern). The only locally indigenous species present were a few <i>Pteris tremula</i> (Tender Brake), <i>Christella dentata</i> (Binung), <i>Persicaria decipiens</i> (Spotted Knot Weed), and <i>Rumex brownii</i> (Swamp Dock).
Riparian zone: Industrial Creek	Most of the natural vegetation of the riparian zone and adjacent area had been cleared many decades previously and replaced by exotic species. Most of these were probably introduced incidentally by birds and other vectors. However the Acer negundo may have been planted.
	The vegetation mainly comprised <i>Ligustrum lucidum</i> with a small tree stratum of <i>Ligustrum sinense</i> and juvenile <i>Ligustrum lucidum</i> , and a ground cover of <i>Tradescantia fluminensis</i> . One large <i>Salix babylonica</i> (Weeping Willow) was growing on the top of the concrete culvert. Other species near the creek included Hedera helix (English Ivy), <i>Cardiospermum grandiflorum</i> (Balloon Vine), two introduced <i>Callistemon spp. Cyathea cooperi</i> (Straw Tree Fern), <i>Ehrharta erecta</i> (Veldt Grass) and <i>Nephrolepis cordifolia</i> (Fishbone Fern). The only locally indigenous species present were a few <i>Pteris tremula</i> (Tender Brake), <i>Christella dentata</i> (Binung), <i>Persicaria decipiens</i> (Spotted Knot Weed), and <i>Rumex brownii</i> (Swamp Dock).

Figure 6-2 shows the existing vegetation communities in the area and the presence of the Hornsby Enriched Sandstone Exposed Woodland as mapped in The Native Vegetation of the Sydney Metropolitan Area (NSW OEH, 2013). The majority of the site is mapped by OEH without a recognised vegetation classification, indicative of its history of significant disturbance and the dominance of exotic and introduced native species.

Figure 6-2 Existing vegetation communities (delete this page in pdf)

Fauna and habitat values

The three major habitats types present within the site are low closed-forest and shrubland, open grassland and aquatic habitats which afford suitable foraging, sheltering, nesting and breeding habitat for a suite of resident fauna genera as well as for vagrant or migratory species. The two creeks and water quality basin offer a constant water source throughout the year. The site is highly connected with Lane Cove valley and Lane Cove National Park.

The majority of fauna species recorded during the site survey were typically urban-tolerant species, however a high diversity of herpetofauna was observed.

Previous fauna surveys and compilation lists from the Atlas of NSW Wildlife (BioNet OEH, 2015) database have identified 14 native frogs, 39 native reptiles, 208 native birds, 17 native mammals (excluding bat species) and 21 native bat species within a 10 kilometre radius of the site. Of those native species recorded in the area in the past 10 years, 19 are listed as EVNT species under the Schedules to the EPBC and/or TSC Acts. These species are listed in Table 6.3.

Common name	Botanical Name	TSC Act status	EPBC Act status
Green and Golden Bell Frog	(Litoria aurea)	E1	V
Red-crowned Toadlet	(Pseudophryne australis)	V	-
Australasian Bittern	(Botaurus poiciloptilus)	E	E
Black Bittern (Ixobrychus flavicollis)	(Ixobrychus flavicollis)	V	-
Little Eagle	(Hieraaetus morphnoides)	V	-
Square-tailed Kite	(Lophoictinia isura)	V	-
Eastern Osprey	(Pandion cristatus)	V	-
Gang-gang Cockatoo	(Callocephalon fimbriatum)	E	-
Gang-gang Cockatoo	Gang-gang Cockatoo (Callocephalon fimbriatum)	V	-
Little Lorikeet	(Glossopsitta pusilla)	V	-
Swift Parrot	(Lathamus discolour)	E	E
Barking Owl	(Ninox connivens)	V	-
Powerful Owl	(Ninox strenua)	V	-

Common name	Botanical Name	TSC Act status	EPBC Act status
Grey-headed Flying-fox	(Pteropus poliocephalus)	V	V
Yellow-bellied Sheathtail-bat	(Saccolaimus flaviventris)	V	-
Eastern Freetail-bat	(Mormopterus norfolkensis)	V	-
Eastern False Pipistrelle	(Falsistrellus tasmaniensis)	V	-
Eastern Bentwing-bat	(Miniopterus schreibersii oceanensis)	V	-
Greater Broad-nosed Bat	(Scoteanax rueppellii)	V	-

Ten introduced bird species and six (6) domesticated or pest mammals have also been recorded in the area. For database search results refer to Table 4-3 of the Flora and Fauna Survey (Appendix E).

A field survey was carried out in February 2016, and recorded two native mammals (excluding microbats), 17 native birds, seven native reptiles, two native amphibians and five native invertebrates within or in close proximity to the site. These are listed in the **Table 6.4**

Common name	Botanical Name	TSC Act status	EPBC Act status
Peron's Tree Frog	Litoria peronii	-	-
Leaf-green Tree Frog	Litoria phyllochroa	-	-
Eastern Water Skink	Eulamprus quoyii	-	-
Eastern Water Dragon	Intellagama lesueurii	-	-
Eastern Brown Snake	Pseudonaja textilis	-	-
Dark-flecked Garden Sunskink	Lampropholis delicata	-	-
Lace Monitor	Varanus varius	-	-
Red-bellied Black Snake	Pseudechis porphyriacus	-	-
Eastern Snake-neck Turtle	Chelodina longicollis	-	-
Australian Raven	Corvus coronoides	-	-
Australian Magpie	Cracticus tibicen	-	-

Table 6.4 Fauna species recorded within or in close proximity to the site (February 2016)

Common name	Botanical Name	TSC Act status	EPBC Act status
Common Myna	Sturnus tristis	-	-
Eastern Yellow Robin	Eopsaltria australis	-	-
Eastern Whipbird	Psophodes olivaceus	-	-
Fairy-wren	Malarus sp.	-	-
Grey Goshawk	Accipiter novaehollandiae	-	-
Laughing Kookaburra	Dacelo novaeguineae	-	-
Little Pied Cormorant	Microcarbo melanoleucos	-	-
Masked Lapwing	Vanellus miles	-	-
Noisy Miner	Manorina melanocephala	-	-
Rainbow Lorikeet	Trichoglossus haematodus	-	-
Red-whiskered Bulbul	Pycnonotus jocosus	-	-
Silvereye	Zosterops lateralis	-	-
Sulphur-crested Cockatoo	Cacatua galerita	-	-
White Browed Scrub-wren	Sericornis frontalis	-	-
Swamp Wallaby	Wallabia bicolor	-	-
Common Brushtail Possum	Trichosurus vulpecula	-	-
Gould's Wattled Bat	Chalinolobus gouldii	-	-
Eastern Bentwing-bat	Miniopterus orianae (schreibersii) oceanensis	V	-
White-striped Freetail-bat	Austronomus australis	-	-
Southern Freetail-bat	Mormopterus planiceps	-	-
Eastern Free-tailed Bat	Mormopterus ridei	-	-
Eastern Broad-nosed Bat	Scotorepens orion	-	-
	Scoteanax rueppellii#/ Scotorepens orion/ Falsistrellus tasmaniensis#	V - V	- - -
	Falsistrellus tasmaniensis#/ Vespadelus darlingtoni	V -	-
Southern Forest Bat	Vespadelus regulus	-	-

Common name	Botanical Name	TSC Act status	EPBC Act status
a Forest Bat	Vespadelus vulturnus/ Vespadelus pumilus	-	-
	Myotis macropus#/ Nyctophilus sp.	V -	
Black Rat	Rattus rattus	-	-
European Fox	Vulpes vulpes	-	-
Garden Snail	Helix aspera	-	-
Funnel-web Spider	Atrax robustus	-	-
Common Yabby	Cherax destructor	-	-
Native Cockroach	Order: Blattodea	-	-
Wandering Percher	Diplacodes bipunctata	-	-
Common Bluetail	Ischnura heterosticta	-	-

A diversity of fauna, including birds, amphibians, reptiles and mammals, was detected within or adjacent to the large detention basin, which provides a valuable permanent water source for local fauna species. A number of Black Rats (*Rattus rattus*) were captured at night-time on the camera trap, with an Eastern Brown Snake (*Pseudonaja textilis*) captured the following day. Rats are likely to make up a large proportion of the diet of Eastern Brown Snakes in the locality, and this individual was likely attracted by the scent left behind. A Red-bellied Black Snake was also observed during the field survey. This species specialises in eating frogs, and its presence within the site suggests there is an adequate amount of prey species available.

A high level of microbat activity was observed, with at least 11 microbat species detected through Anabat recordings with varying levels of confidence. This included four threatened microbat species, being the Eastern Bentwing-bat (*Miniopterus orianae* (*schreibersii*) *oceanensis*), The Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), and the Greater Broad-nosed Bat (*Scoteanax rueppellii*) were detected with a probable level of confidence, and unable to be distinguished from other species with similar calls.

No other EVNT species, listed under the EPBC Act or TSC Act, were detected on the site.

Two introduced birds, two pest mammal species – the Black Rat (*Rattus rattus*) and the European Red Fox (*Vulpes vulpes*) – and one (1) introduced invertebrate were also detected. The control of vertebrate pests is important for the survival of medium-sized ground-dwelling and semi-arboreal mammals. The adjacent bushland is at present subject to a fox control program, with 1080 poison baits laid within the national park boundaries from March 2015 – March 2016. Implementation of an on-going vertebrate pest control and monitoring program within the site is recommended before the commencement of the proposal.

Fauna habitat assessment

A summary of the three types of habitat present within the site and their habitat significance is provided in **Table 6.5**.

Table 6.5 Summary of fauna habitats

Management zone	Description of flora
Low closed-forest and shrubland <i>Moderate conservation</i> <i>significance</i>	The low closed-forest is found primarily on the slopes and embankments, between the deck and riparian areas. Much of the vegetation within the site is comprised of dense thickets of Lantana and Privet forming a low closed-forest where little light can penetrate. Structural habitat is very limited in all stratums, with little woody debris observed on the ground stratum and the sparse native canopy being too young to contain hollows that may be utilised by native fauna for shelter and nesting. Occasional arboreal termite mounds were observed within mature native trees, which provide valuable habitat and food source for a number of species known to occur in the area, including the Lace Monitor observed during field investigations.
	At the time of survey, not all of the site was traversed on foot due the often impenetrable nature of the dense weed thickets and safety hazard of steep terrain. Whole scale removal of Lantana has been identified as detrimental to reptile biodiversity, especially skinks (Virkki et al. 2012). Although Superb Fairy-wrens prefer native shrubs, Lantana has been identified as a substitute (shelter and nesting) habitat in urbanised weedy areas (Parsons et al. 2008).
	Fairy-wrens were detected within the weed thicket habitat, as well as Eastern Whipbirds (<i>Psophodes olivaceus</i>), White-browed Scrubwrens (<i>Sericornis frontalis</i>) and Silvereyes (<i>Zosterops lateralis</i>) which are also known to utilise Lantana as habitat. A number of Eastern Water Skinks (<i>Eulamprus quoyii</i>) were also observed along the creek line where dense low-lying vegetation was present.
Cleared (exotic) grassland Low conservation significance	This habitat is found on the deck and throughout the site. Such habitat is of 'low' conservation significance for local fauna, having been cleared entirely with little shrub stratum persisting. No structural habitat is available in the form of hollow-bearing trees or fallen logs, and accumulations of leaf litter are absent that would otherwise be present if scattered canopy trees were present. Only limited sheltering habitat is available in the form of overgrown grasses and cracking soils. Such habitat is likely to be utilised by small ground-dwelling herpetofauna and mammals only, and a number of Dark-flecked Garden Sunskinks were observed within such areas, as well as a mature Red-bellied Black Snake basking at the edge of the forested habitat.
	The cleared open exotic grassland provides low-quality foraging habitat for local fauna, including granivorous (seed- eating) birds such as the Crimson and Eastern Rosella, however no birds were observed utilising such habitat during the field survey. A large number of flying insects were flushed from such habitat during the field survey, which indicates potential foraging habitat for insectivorous birds and bats. The internal fence lines, access tracks and clearings within the site are likely to be

Management zone	Description of flora
	utilised by the European Red Fox for hunting, of which fresh scats were detected during the field survey.
Aquatic habitat <i>Moderate to high</i> <i>conservation significance</i>	The aquatic habitat within the site is found in Shrimptons and Industrial Creeks and the existing detention basin. Such aquatic habitat has been adversely affected by development within the catchment, with foamy surface scum visible in Shrimptons Creek, and scattered urban debris visible along Industrial Creek, as well as encroaching weed infestations.
	A high occurrence of impervious surfaces within Macquarie University, Macquarie Shopping Centre and local business parks would create high rates of discharge during rain events leading to issues of erosion, sedimentation and pollution of aquatic habitat within the site.
	Much fauna activity (including reptiles, amphibians, birds, mammals and invertebrates) was concentrated around the large retention basin in the northern corner of the study area, which provides a permanent water source for resident and vagrant fauna species. A high level of microbat activity was also detected by the Anabat, and two native tree frogs were detected in Song Meter recordings, which were both deployed adjacent to the basin. However, there is a general lack of aquatic vegetation, which would otherwise provide nesting and breeding opportunities for amphibians and aquatic birds. The combination of limited aquatic vegetation, weed infestation and polluted water, deems available aquatic habitat unsuitable for the threatened Red-crowned Toadlet (<i>Pseudophyrne australis</i>) and Green and Golden Bell Frog (<i>Litoria aurea</i>) recorded in the region.
	Drainage lines and other depressions create ephemeral water features after periods of significant rain, which may also offer potential breeding habitat for amphibians.

6.2.2 Potential impacts

Construction

The proposal has the potential to impact fauna species as a result of the disturbance to existing vegetation and structures within the site, or as a result of indirect impacts (such as soil erosion). An Assessment of Significance has been completed for each native fauna species which occurs or has the potential to occur at the site. These assessments found that the proposal would not significantly impact any threatened species, and would be beneficial to their survival in the locality in the long-term.

During the weed removal stage of construction there is the potential for loss of fauna habitat, and areas of harbourage having a detrimental impact on fauna. The amount of above ground weed biomass removed would vary substantially across the site, with the largest quantity being in the riparian zones. To minimise this impact, native vegetation would be retained at the site. To protect existing fauna weed thickets (lantana and privet) would be removed incrementally, and replaced with dense plantings of native shrubs, grasses and ground covers to provide supplementary refuge, nesting and foraging habitat. In particular it is important remnant indigenous vegetation

species on the site adjoining the Lane Cove National Park would be protected as fauna habitat and to maintain stable embankments.

Although the culverts were not surveyed, they were identified as being potential habitat for microbats. There would be no direct disturbance of the culvert habitat by the construction works. All existing native canopy trees to support fauna and as potential microbat habitat would be retained.

The weed removal would result in woody and semi-woody mulch from above-ground biomass being retained on site and below ground root biomass retained in situ. This is inconsistent with the Roads and Maritime's *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011) specifying that weeds to be removed from site however it is appropriate in the context and scale of the proposal to revegetate the site.

There is the potential for erosion and sedimentation to occur during construction to impact aquatic habitat, however the existing environment in the creeks is highly degraded and the risk of impact is therefore low. As a precautionary measure, consultation with Department of Primary Industries (Fisheries) would be carried out for the proposed works in the creeks. There is the potential to impact Lane Cove River aquatic habitat if the importation of fill is not stabilized effectively and substantial run-off occurs from the proposal. These impacts would be mitigated by implementing the safeguards in the Erosion and Sedimentation Control Plan (Section 7.2).

During the clearing of weeds and importation of fill, there is the potential for weed species to spread further if not managed appropriately. The weeds would be mulched and weeds on the deck area buried on site which would minimise the potential for the weeds to spread into other areas. Weeds removed in the riparian zones which have the potential for weed propagation would be removed and relocated to areas of higher elevation on the site. The VMP includes measures to remove the weeds at the base of the plant (rather than root removal) in order to maintain a stable soil profile and reduce the potential for run-off.

If weeds and pests are not controlled after the revegetation works, there is the potential for the planting density to be strongly reduced or fail, with the potential impact for continued weed problems on the site and adjacent Lane Cove National Park. Post-planting, there would be significant effort on monitoring and controlling weed emergence and pest impact. There would also be on-going monitoring of planted species survival, with appropriate backfilling (re-planting) of native species to maintain targeted density of the reintroduced vegetation community.

The VMP provides recommendations and safeguards to manage the potential impacts including weed control strategies, prioritisation of actions (in consideration of other water quality improvement works being undertaken the site), species and botanical composition, revegetation methods, a maintenance programme, a works schedule, performance indicators and a monitoring and reporting framework (Appendix C). The VMP would be included in the CEMP.

Operation

There is the potential for re-growth of weeds, however an intensive follow-up maintenance and monitoring program would be implemented to continually eradicate the regrowth and weed species.

During operation, the proposal would increase the size and functionality of the existing biodiversity corridor and provide a protection buffer between the Lane Cove National Park and surrounding urban environment. There would be a beneficial impact to native fauna and flora which would be promoted within the site, and a positive impact to the ecological value of the area through the reduction of weeds.

Aquatic habitat would be improved by installing the rock revetment to reduce erosion and sediment transport downstream and the gross pollutant traps would minimize pollution in the creeks and Lane Cove River.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required.

The proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Biodiversity	The CEMP will include, but not be limited to plans and details of areas to be cleared, protected, and revegetated. The Roads and Maritime's <i>Biodiversity</i> <i>Guidelines: Protecting and</i> <i>Managing Biodiversity on RTA</i> <i>Projects</i> (RTA, 2011) would be implemented where practical.	Contractor	Pre- construction	Core standard safeguard B1 Section 4.8 of QA G36 Environme nt Protection
Minimising loss of biodiversity	 Construction site boundaries will be clearly marked at all times Indigenous flora species will be marked, protected and retained wherever possible across the site. Removal of flora will strongly focus on exotic species, particularly WoNs and noxious species. Introduced native species that are well established (dbh>75mm will be retained) Prior to commencing staged weed control work, patches of weed vegetation will be surveyed to prevent injury and entrapment impacts on fauna species. 	Contactor	Detailed design / pre- construction	Core standard safeguard B2
Removal and management of noxious weeds	Noxious, Weeds of National Significance and environmental weeds will be controlled across the site through a targeted weed control program undertaken prior to commencement of any	Construction contractor	Construction	Additional safeguard B3

6.2.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	earthworks or drainage works (as specified in the VMP). Weeds removed in the riparian zones which have the potential for weed propagation would be removed and relocated to areas of higher elevation on the site.			
Loss of fauna	 Safeguards as detailed in the CEMP will be implemented to protect fauna at the site including: Removal of weed thickets (Lantana and Privet) will be undertaken incrementally and replaced with dense plantings of native shrubs, grasses and ground covers to provide supplementary refuge, nesting and foraging habitat Retention and protection of existing rock habitat scattered through the site and lining the creeks Retention of hollow- bearing logs and natural debris (such as fallen timber) for refuge habitat Retention of native canopy trees Installation of nesting boxes and a nest-box strategy outlining installation guides, monitoring and maintenance schedules be prepared Retention of structural habitat (logs, rocks) within and adjacent to existing aquatic habitat Avoid using herbicides within riparian zones Limit the use of pesticides Supplementary planting of locally occurring native plants that produce nectar, pollen and fruits, thereby attracting a range of invertebrate prey species. 	Contractor	Construction	Additional safeguard B4

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Eradication of pests	A pest control program will be implemented prior to construction and on an on-going basis (in conjunction with (OEH) NPWS and potentially the Urban Feral Animal Action Group).	Contractor	Pre- construction, construction, post construction	Additional safeguard B5
Biodiversity protection	If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Roads and Maritime Services Unexpected Threatened Species Find Procedure in the Roads and Maritime Services Biodiversity Guidelines 2011 – Guide 1 (Pre-clearing process). Fauna handling must be carried out in accordance with the requirements the Roads and Maritime Services Biodiversity Guidelines - Guide 9 (Fauna Handling).	Contractor	Pre- construction	Additional safeguard B6
Management of noxious weed species and plant pathogens	All machinery needs to be inspected and clean of all soil and plant material prior to being permitted on site. A rumble grid and wheel wash would be installed on the site to assist manage the spread of weeds and soil.	Contractor	Construction	Additional safeguard B7
Management of noxious weed species and plant pathogens	Management of declared noxious weeds will take into consideration the requirements under the NW Act and Guide 6 (Weed Management) of the <i>Biodiversity Guidelines.</i> <i>Protecting and managing</i> <i>biodiversity on RTA projects</i> (2011).	Contractor	Construction	Additional safeguard B8
Protection of aquatic habitat	Consultation with the Department of Primary Industries (Fisheries) will be undertaken for works proposed in the creeks.	THML/ Contractor	Pre- construction	Additional safeguard B9
Protection of aquatic habitat	Retention of structural habitat (logs, rocks) within and adjacent to existing aquatic habitat.	Contractor	Construction	Additional safeguard B10

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Management of site compound	No clearing would be undertaken for the establishment of the site compound. Native vegetation within the site compound area would be clearly demarcated to avoid any impact to the vegetation or critical root zones.	Contractor	Construction	Additional safeguard B11

Other safeguards and management measures that would address impacts to biodiversity habitat (implementing an Erosion and Sedimentation Control Plan) are identified in Section 7.2
6.3 Water quality, drainage and flooding

6.3.1 Existing environment

Waterways and drainage network

There are two natural watercourses draining the site in a northerly direction, Industrial Creek and Shrimptons Creek. A short section of Industrial Creek runs through the eastern end of the site. Shrimptons Creek runs through the site at the western end of the site. Lane Cove River is about 220 metres from the northern boundary of the site (refer to **Figure 3-1**).

The riparian zones of Shrimptons and Industrial Creeks (the creeks) are severely degraded by woody weeds, with an understorey of exotic ground covers such as *Tradescantia fluminensis* (Wandering Jew). In some sections, the banks of both creeks are being undercut and eroding. The Shrimptons Creek catchment area upstream of the motorway is 560 hectares in size and the Industrial Creek catchment is 49 hectares. The catchment areas of both creeks have been highly modified and primarily comprise of residential development with some areas of commercial and industrial developments. The water quality in the creeks is generally poor due to the extensive urban development and because there are no known stormwater quality treatment devices within the catchments upstream of the motorway corridor.

Industrial Creek flows underneath the motorway corridor via a 2.4 metre diameter pipe at the Khartoum Road underpass. At the pipe outlet, the creek bed and banks have been stabilised with shotcrete and a gabion structure for a distance of about 10 metres from the pipe outlet. The creek is then vegetated with a cobblestone bed until the downstream boundary of the site where the creek enters a single box culvert to exit the proposal site.

Shrimptons Creek flows under the motorway via a large culvert about 250 metres from the western boundary towards Blaxland waterfall in Lane Cove National Park. This creek area is characterised by having some relatively large trees, relatively thick understorey, a small dry weather flow channel and an area which appears as if resulting from deposition of granular materials around and within vegetated area. The creek channel is considered to be fairly stable with well-vegetated banks (dominantly weed species) and a bed comprising gravel, cobbles and bedrock. There are some sections of bank where there is evidence of bank toe scour, particularly along the eastern bank.

Rainfall runoff generated over the motorway road pavement is collected by the existing pavement drainage system which consists of a stormwater pit and pipe network collecting the westbound carriageway runoff and a vegetated table drain collecting the eastbound carriageway runoff. The stormwater from both drainage channels flows down the concrete channel and passes directly into an overflow pipe, instead of draining into the water quality basin as designed.

The existing water quality basin is meant to provide the first flush treatment of the runoff from the motorway before it is discharged into Shrimptons Creek. During wet weather events, the water quality basin overflows into Shrimptons Creek located about 50 metres to the west of the water quality basin. The existing basin has a surface area of about 740 square metres and captures an area of about 3.3 hectares. Other landscaped areas of the motorway corridor that exclude pavement surfaces discharge directly into Shrimptons Creek.

An underground sewer main owned and managed by Sydney Water is located on the eastern bank of Shrimptons Creek and crosses the creek about 60 metres from the proposed culvert.

Flooding

Information on existing flood behaviour in Shrimptons Creek and Industrial Creek has been detailed in previous studies (M2 Motorway Upgrade Environmental Assessment, Macquarie Park Floodplain Risk Management Study and Plan (City of Ryde, 2011), M2 Park Site Assessment and

Constraints Study, (Jacobs, March 2015) and the Water Quality Improvement Plan (Landcare Australia, March 2016).

Sections of the site are flood liable. These areas are shown in **Figure 6-3** and largely follow natural drainage lines.

The *Macquarie Park Floodplain Risk Management Study and Plan* indicated design flow rates through Industrial Creek at the site as being about 11 cubic metres per second for the five year ARI event and about 18 cubic metres per second for the 100 year two hour design event.

The *Macquarie Park Floodplain Risk Management Study and Plan* indicated design flow rates through the Shrimptons Creek at this location as being about 66 cubic metres per second for the five year ARI event and about 128 cubic metres per second for the 100 year two hour design event.



Figure 6-3 100 year ARI flood extends and levels at Shrimptons Creek and Industrial Creek within and in the vicinity of the site (Bewsher). Note the site boundary is shown as a red line.

6.3.2 Potential impacts

Construction

The impacts of the proposal on water quality are predominately from exposed soil if allowed to runoff. The impact would be erosion and sedimentation transport from the surrounding area and degraded water quality in the creeks. Other impacts to water quality may occur through increased nutrient concentrations in run-off from rapidly decomposing mulch left on-site, the transport of organic material into the water, construction material spilling or leaching into soils and water, drainage systems not functioning effectively and blocked gross pollutant traps causing flooding. The transport of viable weed seed may also contribute to the spread of weed species downstream.

The proposal would be undertaken in a number of stages to minimise the general soil disturbance and allow the areas to be restored progressively. Wherever possible, all weed species root material will be retained in situ, to minimise soil profile disturbance. Due to the size and topography of the site, proximity of waterways, proposed excavation works and importation of fill, any significant wet weather event during construction could result in deterioration in the quality of downstream receiving waters. Applying a crushed sandstone surface to sections of the access tracks would provide a stable trafficable surface and minimise the potential for erosion and sedimentation to occur. Sediment controls would be implemented in accordance with the Blue Book to minimise erosion and sedimentation potential, and all chemicals would be stored in bunded areas within designated bunded areas.

Where required, crushed sandstone would be placed as fill and as a stable material to create access tracks to the creek work sites. This may result in material placed close to or on the banks of both creeks and or in areas that are subject to flooding during periods of high rainfall. As this material would be at or slightly above the ground surface, it is likely to have negligible impact on the hydrology of waterways.

A minor increase in nutrient concentration in run-off is a potential impact from mulching the removed weeds when the biomass is left in-situ. Mulched vegetative biomass with likelihood of a higher decomposition rate (lower C:N ratio) would be removed from the adjoining riparian area which would minimise nutrient run-off impacting water quality. In other areas of the site the biomass would be left to decompose naturally.

Construction materials and fuel spills have the potential to diminish water quality. Grout and concrete would be used to construct the weir and other elements of the drainage channel at the inlet to the water quality basin. It would also be used for the construction of the support base for the gross pollutant traps at Shrimptons Creek and Industrial Creek. There is the potential for spills to occur that may impact on water quality while the material is been used on site. Mitigation measures would be implemented to monitor the use of cement and grout where it is being used close to a watercourse and procedures would be developed to clean up any grout spills.

Operation

The proposal aims to improve the overall long term water quality and drainage at the site through specified treatment of the existing site drainage and water quality infrastructure. These proposed improvements to the creeks, drainage swale and water quality basin would have a net beneficial impact on downstream receiving waters.

The Water Quality Improvement Plan has taken the *Macquarie Park Floodplain Risk Management Study and Plan* flood modelling into account in the proposal for the Shrimptons and Industrial Creek bank protection works and gross pollutant trap. Survey and LIDAR information were used to determine catchment boundaries and existing topographical information.

Bank protection works would not change carrying capacity of or water velocities within each creek. As such, these works are not considered to have any noticeable impact on flood behaviour at the site, or geomorphology downstream of the works.

Without appropriate design and location consideration, the gross pollutant traps have the potential to result in flooding issues in the event that they become blocked. The optimum location selected for the installation of the gross pollutant trap on Industrial Creek was determined to be about two to three metres upstream of the box culvert (refer to **Figure 3-7**). This location and height of the gross pollutant trap was chosen so that, should complete blockage of the gross pollutant trap occur, stormwater could still flow over the gross pollutant trap and through the box culvert to minimise the potential for flooding. The cobbled creek bed will be retained downstream of the gross pollutant trap to minimise potential for bed disturbance.

On Shrimptons Creek, the expected flows rates during the design year events would overflow through any gross pollutant trap constructed across the full width of the watercourse. Therefore the optimum location is within the low flow channel, with a maximum height of one metre. The upstream hydraulic impact of the gross pollutant trap is expected to be minimal due to the slope of the invert through the arch culvert beneath the motorway.

The drainage swale that runs parallel with the motorway has a total pervious area of about 1.6 hectares and a total paved area of about 0.7 hectares. A pipe culvert would be constructed in order to permit construction and operational traffic to cross the existing drainage swale while maintaining the existing catchments and conditions during the works. The pipe culvert would not impact on current drainage conditions or flooding. Repair works to the drainage swale would also improve the performance of the swale.

6.3.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Soil and water	A site specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented and included in the CEMP. The ESCP will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including, but not necessarily limited to: • Catchments and runoff • Diversion and drainage points • Sediment basins and sumps (including standard drawings for how they should be set up) • Scour protection • Check dams, fencing and swales (including standard drawings for how they should be set up) • Staged implementation arrangements. The Plan will also include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up meaures to be applied in the event of wet weather and when. The ESCP will be prepared in accordance with the <i>NSW Soils and Construction – Managing Urban Stormwater</i> "the Blue Book" (Landcom, 2004).	Contractor	Detailed design / pre- constructio n	Core standard safeguard SW1 Section 2.1 of QA G38 Soil and Water Management

6.4 Soils

6.4.1 Existing environment

Topography

The site and land around the proposal generally declines from south to north. The site is partly within the land categorized as Lucas Heights (lh) Soil Landscape Unit (SLU)(to the south), and partly within the Gymea (gy) SLU (to the north). The Lucas Height landscape is characterised by gentle undulating crest and ridge with moderately deep hard-setting duplex sand gradational soils. The Gymea landscape is typically characterised by gently rolling low hills on Hawksebury Sandstone with a wide range of soil properties. The topography of the site is shown in **Figure 6-4**.

Soil testing was undertaken within three separate areas of the site based on the topography and landscape. The three areas are shown in Figure 6-5. Areas 1 and 3 include the embankments which grade towards the northern boundary of the site adjoining Lane Cove National Park and the two creeks as shown in Figure 6-3. On the western side of Shrimptons Creek there is a relatively steep rise to a smaller plateau adjoining the motorway. The deck (Area 2) is about one hectare in size, is flat and flanked by relatively steep slopes on the northern, western sides and eastern sides. Overall site relief is about 25 metres, and the higher areas, inclusive of the deck, are flanked by relatively steep slopes on the northern (around 1:3 metres), western sides (around 1:2.5 metres) and eastern sides (around 1:5 metres). The soil between Area 2 and Area 1 was is likely to be of a similar nature to Area 2. As such, for the purposes of this assessment, it is considered to be the same as Area 2.

The riparian zone along the Shrimptons Creek is generally flat and low-lying, topped by a bench approximately 200 to 400 millimetres above the creekbed. There are shallow soils in the riparian zone and high water table during moist seasons.

The area along Industrial Creek features exposed sandstone outcropping occurred across the southern end and the creek banks contained clay soil in some sections, with fill material from the creek bank upslope adjacent to the apartment block in Leisure Close. Large pebbles had been deposited in the creek, possibly in order to stabilise the creek bed.

Figure 6-4 Topography of site (delete in pdf version)

Figure 6-5 Soil test pit locations and areas (delete in pdf version)

Geology and soils

The geology of the area is characterised by the plateau surfaces of the Mittagong Formation. The Mittagong Formation is comprised of Hawkesbury Sandstone and Wianamatta Shale. The original soil type at the site and surrounding area is a combination of Lucas Heights soil landscape in the south and Gymea soil landscape in the north. Soils in the area tend to have low fertility, stony steep slopes and high soil erosion.

A search of the Australian Soil Resource Information System database in March 2016 shows that there is a low to extremely low probability of acid sulfate soils occurring at the site. A search of the NSW Government Planning viewer in March 2016 was undertaken. No salinity information was available for the site.

A soil survey and assessment of the site (Jacobs, 2016) has been completed and found the topsoil profile around Area 1 was of a higher quality than Areas 2 and 3. The fill material observed across Area 1 and Area 3 compromised mainly of soil materials (ie sandy clays, silty clays). The soil in Area 1 has a reasonable capacity to retain nutrients and is considered stable. The fill material observed across Area 2 comprises mainly sandstone, shale and concrete with minor inclusions of other waste materials such as wood and plastic. Asbestos fibres have also been identified in Area 2 and this is discussed in Section 6.5 (Contamination). The soil in Area 2 has a low capability to retain nutrients and is considered stable. In Area 3 the soil has a reasonable capacity to retain nutrients and is considered stable. Nutrient levels were not analysed in the sample, but are likely to be similar to results from the Area 2 soil material.

6.4.2 Potential impacts

Construction

During construction the proposal would have the potential to create large areas of exposed soil. Given the topography of the site, the drainage features, the nature of the proposal and the proximity to Lane Cove National Park, the primary environmental risk due to this proposal in relation to soil is the potential for sedimentation impacts to surrounding land and in sensitive aquatic environments down gradient from the proposed work areas.

The proposal activities have the potential to cause the following impacts:

- Soil erosion/scouring and increased sediment loads entering the creeks, swale drain and water quality basin and resulting in adverse impact to benthic ecosystems
- Sediment deposition on adjoining lands due to run-off from the proposal
- Soil contamination from chemical spills
- Improvement of drainage and a reduction in erosion through modification of the landform and revegetation
- Soil tracking onto local roads and the motorway.

Soil erosion and sedimentation

The proposal involves excavation, and vegetation clearing in many locations which would potentially result in exposure of underlying soils and this may lead to erosion and sedimentation in downstream water bodies. These activities pose the greatest risk where they occur near waterways, on steep slopes or land subject to flooding. The potential for sediment transport and erosion and sedimentation issues is influenced by factors such as severity of storm events, the slope of disturbed area, the construction methodology and management controls in place.

Vegetation clearing or weed removal across each management zone within the site would be carried out by leaving the root of the vegetation in situ in order not to destabilise the ground surface and cause increased erosion and sediment movement. The revegetation of the site would be

carried out immediately after the importation of fill and topsoil to limit any potential for erosion and sedimentation from the proposal.

Excavation of soils would be largely limited to the bank protection works at the creeks and installation of the gross pollutant traps, modification of the swale drain, drainage channel and inlet to the water quality basin and creation of access tracks. Sedimentation in these areas has the potential to degrade the aquatic habitat of the creeks and potentially Lane Cove River.

The importation of about 5,000 cubic metres of clean fill material and topsoil for the site would be a high risk source of erodible material. This activity has the potential to result in substantial erosion, sedimentation and degradation of downstream environments (terrestrial and aquatic).

The creation of access tracks and ground disturbance on steep gradients and the embankments could result in erosion and sedimentation. This would be managed through the use of crushed sandstone (VENM) or heavily bound base to RMS QA specification R73 to stabilise the tracks. Once the site has been fully stabilised and revegetated and all temporary access tracks would be removed and revegetated to manage and minimise risk of erosion.

Chemical spills causing soil contamination

Chemical and fuel spills from equipment and chemical treatment of weeds during construction has the potential to result in localised soil contamination. Large quantities of fuels would not be stored on or around the site because vehicles and equipment would be refuelled offsite, where practicable.If re-fuelling in the field is necessary, it would be undertaken with appropriate bunding, and spill response kits would be provided by the contractor. A small quantity of fuel (to be used in a generator and small tools) and Roads and Maritime approved herbicides (predominately glyphosate) chemicals would be secured in a storage container and bunded within the construction compound.

Operation

During operation of the proposal there would be the potential for chemical spills where weeds are treated by herbicides, however the impact would be localised and minor. Overall a positive impact and improvement on the drainage network and soil profile of the site is anticipated.

6.4.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Erosion and sedimentation	As identified in Section 6.3.3 a site specific Erosion and Sediment Control Plan will be prepared and implemented as part of the CEMP.	Contractor	Pre- construction, construction	Core standard safeguard SG1
Accidental spill	A site specific emergency spill procedure will be developed, and include spill management measures in accordance with the Roads and Maritime <i>Code of</i> <i>Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. The procedure will address measures to be implemented in the event of a	Contractor	Detailed design / Pre- construction	Core standard safeguard SG2 Section 4.3 of QA G36 Environme nt

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers). An emergency spill kit will be kept on site at all times and all staff are to be made aware of the location of the spill kit and trained in its use. The spill kit will be regularly inspected and restocked.			Protection

Other safeguards and management measures that would address soil impacts are identified in Sections 6.3 and 6.5.

6.5 Contamination

6.5.1 Existing environment

Contamination at the proposal site has been assessed in several previous reports including a Preliminary Contamination Assessment (M2 Park Site Assessment and Constraints Study, March 2015, Jacobs) and a recent Preliminary Contamination Investigation (March 2016, Jacobs) which concluded the following:

- The sub-surface material encountered across the site generally comprises either fill material or fill material overlying natural soils. The fill material observed across Area 1 and Area 3 compromised mainly of soil materials (ie sandy clays, silty clays). The fill material observed across Area 2 comprised mainly of sandstone, shale and concrete with minor inclusions of other waste materials such as wood and plastic
- Asbestos fibres were identified within the fill material excavated from Area 2. The presence of
 asbestos within the fill mass is further supported by the identification of bonded asbestos at the
 surface of Area 2 during an site walkover. There is the potential for asbestos to be present in
 other locations within the fill mass
- Zinc concentrations were detected in one soil sample exceeding the Ecological Investigation Level (EIL) however it is unlikely that zinc at these concentrations would impact upon construction works, site users and environmental receptors.

Refer to Figure 6-5 for location of boreholes, test pits and areas of investigation.

6.5.2 Potential impacts

Construction

The presence and potential presence of asbestos at the site is a potential health and safety risk. Asbestos fibres were identified within the deck (Area 2) and the nature of the fill in this area (including the fill areas between Area 2 and Industrial Creek) suggests that the risk of further asbestos being in-situ is high. There was no notable contamination identified in other areas of the site (Area 1 and 3), however due to the presence of fill, there is a risk that contamination maybe present in areas of fill not subject to testing and analysis.

Contamination (in particular asbestos) could be liberated as fibres during construction activities such as minor excavation or planting of tubestock. Asbestos fibres could impact upon site workers and surrounding site users.

Operation

During operation of the proposal, there would be risks to exposure of contaminants during maintenance activities or other future activities proposed at the site. The risk would managed by implementing a Site Management Plan in accordance with the Work Health and Safety Regulation 2011.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Contaminate d land	A Contaminated Land Management Plan will be prepared in accordance with the <i>Guideline for the Management of</i> <i>Contamination</i> (Roads and Maritime, 2013) and implemented as part of the CEMP. The plan will	Contractor	Detailed design / Pre- construction	Core standard safeguard C1 Section 4.2 of QA G36

6.5.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	 include, and not be limited to the following safeguards: Capture and management of any surface runoff contaminated by exposure to the contaminated land Management of the remediation and subsequent validation of the contaminated land, including any certification required Measures to ensure the safety of site personnel and local communities during construction. 			Environment Protection
Asbestos	 To reduce the risk associated with the disturbance of contaminated soils, the disturbance of the ground surface within Area 2, and the area between Area 2 and Industrial Creek, would be minimised and carried out under the Contaminated Land Management Plan that would be prepared in accordance with the following: Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC:2002 (2005)) Code of Practice for the Management and Control Asbestos in the Workplace (NOHSC:2018 (2005)) Work Health and Safety Regulation 2011. 	Construction contractor	Pre- construction, construction	Core standard safeguard C2
Unexpected contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented in accordance with the Contaminated Land Management Plan to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls (environmental and health and safety) or further actions identified	Contractor	Detailed design / Pre- construction, construction	Core standard safeguard C3 Section 4.2 of QA G36 Environment Protection

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	in consultation with the Roads and Maritime Environment Manager and/or EPA.			
Minimise exposure of contaminants during operation	In the event exposure to contaminants is identified, a Site Management Plan will be implemented to manage long- term exposure risk from contamination for site use/maintenance. The Site Management Plan will be prepared in accordance with the requirements of the <i>Work Health</i> <i>and Safety Regulation 2011</i> .	site manager	Post- construction	Additional safeguard C4

Other safeguards and management measures that would address soil impacts are identified in Sections 6.4.

6.6 Traffic and transport

6.6.1 Existing environment

The Hills M2 Motorway plays a key role in Sydney's Orbital network, providing capacity for about 75,000 vehicles per day comprising commuter, commercial, freight and road-based public transport over 21 kilometres within Sydney. The motorway adjacent to the site has three lanes and a shoulder, referred to herein as the nearside lane.

The proposal is located within the motorway corridor and adjacent to the eastbound carriageway at Macquarie Park. The site is bounded by Khartoum Road to the east which is a two lane road with street parking. Access to the site at the northern boundary is via Khartoum Road and Leisure Close, which is a small residential cul-de-sac that has unmetered street parking and two-way traffic. There are two existing gates providing pedestrian access. One is located at the site boundary with Dunholm Reserve (which is accessed via Leisure Close) and the second gate is located halfway along the fire trail and the sites northern boundary.

There is no public access to the site.

6.6.2 Potential impacts

Construction

During construction, potential impacts would include:

- Temporary loss of street parking at Leisure Close
- Temporary loss of amenity of Dunholm Reserve for construction access
- Temporary and minor impact to motorists passing the site on the motorway whilst equipment or deliveries are entering and exiting the site, and removal of signage and the guardrail.

Access to the site would be required for construction vehicles through Leisure Close and Dunholm Reserve for about two months as part of the construction work at Industrial Creek. This would result in a loss of the Dunholm Reserve amenity for local residents. About two to three car parking spaces would also be required in Leisure Close for the duration of construction work at Industrial

Creek. Most residents on Leisure Close have off street parking and the requirement of up to three spaces would be have a minor impact, particularly as it would be required during daytime hours.

The Leisure Close access would be temporarily used to bring plant and equipment to the site and from the site for the vegetation clearance phase of construction. Once the plant and equipment has been received at the site, the access point would only be used by workers moving to and from the site. Less than ten vehicle movements would pass along this track per day during the two month period that it would be in-use. As such impacts associated with the use of this track are expected to be negligible on the surrounding road network.

Access to the site from the motorway would be sought under controlled motorway conditions via the nearside lane, using about 200 metres of this lane throughout construction. A section of about 10 metres of the guard rail barrier protection for the swale drain would be removed to provide this access point. Construction traffic could then enter the site directly from the eastbound carriageway through the gap in the barriers and cross the swale drain on the culvert and proceed to the turning area on the deck, or the site compound.

Construction vehicles exiting the site would exit left into the nearside lane and accelerate up to speed. The access into and out of the site has been designed to accommodate truck and dog trailer configurations to minimise the number of truck movements into and out of the site. However, lane widths along the section of the eastbound carriageway in the vicinity of the proposal would remain unaffected by the proposal.

For construction egress the nearside lane may have some temporary reductions in speed as the truck mounted attenuator would slow the nearside lane while the construction vehicles enter/exit the construction site and accelerates to the highway speed. There would be no noticeable increase in travel times anticipated for passing motorists. By using the truck mounted attenuator the construction vehicles would be able to slow down in the nearside lane while through moving vehicles would be advised to change lanes by the truck mounted attenuator. In addition the size and angle of the opening would allow most of the deceleration and acceleration of the trucks to occur in the motorway shoulder and verge area.

Lane closures would also be required on the motorway to enable heavy haulage items to be delivered to site including building materials, plant, equipment, site compound sheds and the artwork. The lane closure traffic control plan would be developed in accordance with Roads and Maritime Services' Traffic Control at Worksites Manual and be approved by the M2 Motorway work authority permit system. Implementation of the lane closures is anticipated during the early establishment of the project as well as at the end of the construction period when the site is decommissioned. The lane closures would be implemented with the approval of the M2 Motorway traffic control room during off-peak times.

During the peak construction period, about six to eight trips per hour by heavy construction vehicles would be generated. These would access the site via the motorway and would occur outside of peak traffic hours. As such, there would not be any noticeable impact on the existing high volume of traffic or flow. This stage of construction would be likely to occur for a maximum of about three to four weeks.

Construction vehicles entering and leaving the site may increase the risk of vehicle collisions. All access and egress points at the site would be designed to allow heavy vehicles to enter and leave safely. Truck mounted attenuators would be used as required to assist heavy vehicles entering and leaving the site to ensure the safety of all motorway users. No local road closures are proposed as part of the proposal. Therefore impact to traffic using the motorway would be minor and temporary and would not be a consistent impact throughout the construction period.

A parking area for the construction workforce of about six vehicle spaces would be established within the site compound and would be removed following the construction period. It is anticipated that this would be sufficient for the construction personnel and if further parking is required the

motorway control room would be used, which is located 900 metres to the west of the proposal and staff driven to the site.

Operation

Access to the site would be maintained from the motorway to the site during operation. This would not impact traffic as it is anticipated only a minor number of vehicles at any one time would access the site for maintenance and monitoring purposes. There would be space available for maintenance vehicles to park on the site for this purpose. A gate would prevent the public from driving into the site during operation.

Pedestrian access would occur from Leisure Close, but this would not be open to the public. This would have no discernible impact and maintenance staff would require only one or two car parking spaces in Leisure Close while they access the site.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Traffic and transport	 The traffic and transport safeguards will be implemented as part of the CEMP and will include: Confirmation of haulage routes Measures to maintain access to local roads and properties Site specific traffic control measures (including signage) to manage and regulate traffic movement Requirements and methods to consult and inform the local community of impacts on the local road network Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads A response plan for any construction traffic incident Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic Monitoring, review and amendment mechanisms Awareness of safety issues with construction plant movements and separation 	Contractor	Detailed design / Pre- construction	Core standard safeguard TT1 Section 4.8 of QA G36 Environment Protection

6.6.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	distances would be refreshed via Tool Box Talks as required.			
Traffic and Transport	 A Traffic Control Plan (TCP) will be prepared and implemented as part of the CEMP. The TCP will be prepared in accordance with the Roads and Maritime <i>Traffic Control at Work sites Manual</i> (RTA, 2010) and QA <i>Specification G10 Control of Traffic</i> (Roads and Maritime, 2008). The TCP will include: Lane closure plans including details for advance warning of motorists Details of number of signs required and number of arrow boards and truck mounted attenuators. 	Contractor	Detailed design / Pre- construction	Core standard safeguard TT2
Increased risk of collision risk	 Site access and egress would be designed to allow construction vehicles to enter and exit the motorway lanes at appropriate speeds to limit the potential for collisions. TMAs would be used as required to assist heavy vehicles safely existing and entering the traffic lanes. 	Construction contractor	Pre- Construction / Construction	Additional safeguard TT3
Traffic disruption and safety	 Flashing lights would be used on all construction vehicles Traffic safety awareness training would be developed and delivered to all site personnel. 	Construction contractor	Construction	Additional safeguard TT4

6.7 Noise and vibration

Noise and vibration issues can arise when noise emissions from a proposal exceed criteria established from relevant policies and guidelines. An assessment was completed to determine potential noise and vibration impacts associated with the construction and operation of the proposal. Details of this assessment are summarised below, with the complete assessment provided in Appendix H.

6.7.1 Existing environment

Noise sensitive receivers

The nearest residential receivers are located north-east of the proposal along Leisure Close, Durham Close, Carlisle Close and Gloucester Avenue, and at the Meriton Apartments located to the south-west of the proposal off Talavera Road. A number of other non-residential receivers were also identified, including commercial/industrial, health and recreational. These receivers are all displayed in **Figure 6-6**.



Figure 6-6 Proposal location and surrounding receivers (Imagery: Google Earth)

Background noise levels

The quantitative noise assessment method in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) requires an understanding of existing ambient and background noise levels around the proposal site.

Unattended background noise measurements were collected as part of the assessment, M2 Park Development Acoustic constraints and options study, (Jacobs, December 2014) in December 2014. Results from this monitoring are summarised in **Table 6.6**.

Table 6.6 Background noise levels, (Jacobs, December 2014)

Monitoring	Monitoring Day (7am to 6 pm) Evening (6 pm to 10 pm		om to 10 pm)	0 pm) Night (10 pm to		
location ID	L _{Aeq} dB	L _{A90} dB	L _{Aeq} dB	L _{A90} dB	L _{Aeq} dB	L _{A90} dB
M1	61	55	56	49	57	40

The term 'LA90' is a statistical descriptor which refers to the noise level exceeded 90 per cent of the time during the monitoring period. It is commonly used to define the background noise level. 'LAeq' which is the equivalent continuous sound level or energy-time average for the period of monitoring.

This monitoring was considered to be indicative of ambient noise conditions at the nearest surrounding receivers, although it was noted that levels at residential receivers R15 to R20 may be lower, owing to the increase in setback distance from the motorway.

Vibration sensitive receivers

All nearby residential premises and buildings used for other purposes are considered to be vibration-sensitive receivers. A review of the Aboriginal and non-Aboriginal heritage section of the REF identified the following heritage structures within the vicinity of the proposal which may be highly sensitive to vibration generated by construction activities:

- Shrimptons Creek indigenous rock shelter about 30 metres to the north of the site.
- Macquarie University ruins about 200 metres to the south west of the site.

6.7.2 Potential noise and vibration impacts

Construction impacts

Construction assessment criteria

In NSW, noise impacts arising from construction activities are managed in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC,2009). The ICNG has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities. Owing to the expected duration of the proposal and the need for the proposal to be completed outside the standard hours of construction, a quantitative noise assessment approach was applied for this proposal.

Using the ICNG guidance (Table 2, ICNG) and the measured background noise levels described above, the following noise management levels (NMLs) have been established to assess and manage noise impacts during construction.

Table 6.7 Construction NMLs for residential receivers

Day (7an	n to 6 pm)	Evening (6 pm to 10 pm)		Night (10 p	om to 7am)
L _{A90} dB	NML dB(A)	L _{A90} dB	NML dB(A)	L _{A90} dB	NML dB(A)
55	65	49	54	40	45

The ICNG also provides guidance for other types of receivers. Recommended management levels for relevant receiver types within the vicinity of the proposal and construction compound areas have been reproduced in **Table 6.8**.

Table 6.8 Noise management levels for non-residential land uses (ICNG, DECC 2009)

Land use	Management level L _{Aeq 15 minute} dB(A) (when in use)
Hospital wards and operating theatres	45 dB(A) internal noise level
Commercial premises	70 dB(A) external noise level
Industrial premises	75 dB(A) external noise level
Recreational area (active)	65 dB(A) external noise level

Noting that the ICNG criterion for hospitals is an internal level, a conservatively estimated transmission loss of 20 dB(A) has been applied (equivalent to a closed, single-glazed window as detailed in Australia Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites (AS2436-2010)), which would result in an external criterion of 65 dB(A) at Macquarie University Hospital (receiver H01 as displayed in Figure 6-7), when considering impacts associated with the proposal activities.

Sleep disturbance criteria

The sleep disturbance awakening criterion is the threshold at which an awakening reaction is likely to occur. Research discussed in the NSW Road Noise Policy (RNP), (DECCW, 2011) identified this threshold to be an internal bedroom noise level of about 50 to 55 dB(A).

Windows often allow the greatest amount of sound transmission from outside to inside across a building façade. Noting guidance presented in AS2436-2010, where bedrooms are ventilated by an opened window, a sleep disturbance awakening criterion measured outside the bedroom window of 60 to 65 dB(A) less the conversion from an LAEq 15 minute to an LA 1 minute (conservatively assumed to be 10 dB(A) was considered (i.e. 55 dB(A)).

Construction vibration criteria

Section 7 of the *Draft Construction Noise and Vibration Guideline* (DCNVG), (Roads and Maritime, December 2015 (Draft)) recommends safe working distances for achieving human comfort (Assessing Vibration: a technical guideline, (DECC, February 2006)) 2006) and cosmetic building damage (BS7385-2:1993) criteria for a range of different plant and equipment. These have been reproduced in **Table 6.9**.

Plant	Rating / description	Safe working distance (meters)		
		Cosmetic damage response (BS7385-2: 199 2006)	Human 93) (DECC,	
Vibratory Roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 metres 6 metres 12 metres 15 metres 20 metres 25 metres	15 m to 20 metres 20 metres 40 metres 100 metres 100 metres 100 metres	
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 metres	7 metres	
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 metres	23 metres	
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 metres	73 metres	
Vibratory pile driver	Sheet piles	2 to 20 metres	20 metres	

Table 6.9 Recommended safe working distances for vibration-intensive plant and equipment (DCNVG, Roads and Maritime 2015 (Draft))

Plant	Rating / description	Safe working distance (meters)	
		Cosmetic damage Human response (BS7385-2: 1993) (DECC, 2006)	
Pile boring	:5800 mm	2 metres	4 metres
Jackhammer	Hand held	1 metres	2 metres

Guidance for more sensitive structures is presented in the German Guideline, *DIN 4150-3 Structural vibration Part 3: Effects of vibration on structures* [DIN 4150-3:1999-02]. Vibration velocities not exceeding 3 mm/s at 1 to 10 Hz are recommended to avoid potential structural impacts for these types of structures. This criterion would apply at previously recorded Aboriginal site with the Lane Cove National Park (rock shelter) and the Macquarie University ruins.

Construction traffic noise criteria

Considering guidance from the Application notes of the Road Noise Policy, a relative increase criterion of 2 dB(A) was adopted for the assessment of construction traffic impacts. Guidance from relevant standards was used for the determination of individual plant and equipment sound power levels (SWLs).

Quantitative assessment methodology – construction noise impacts

Temporary construction noise impact from vehicle access via Leisure Close

Prior to the development of the permanent access off the motorway, an existing access track off Leisure Close would temporarily be used to bring plant and equipment onto the site for the vegetation clearance phase of construction. Once the plant and equipment has been received at the site the track would only be used by workers moving to and from the site. It is estimated less than ten vehicle movements would pass along this track per day during the six to nine week period that it would be in-use. As such impacts associated with the use of this track are expected to be negligible and it is not assessed further in this noise impact assessment.

Construction noise impact

Overall sound power levels (SWLs) were predicted for each activity and phase of construction associated with the proposal as described in **Table 6.10**.

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
01	Establishment of site access and temporary	Franna	1	104
fencing, installation of erosion and sediment controls	Materia	1		
	ls truck	2		
02	Establishment and demobilisation of	Franna	1	102
construction compound	Flatbed truck	1		
		Light vehicle	2	
03	Site compound operations	Franna	1	104
		Delivery truck	1	
		Light vehicle	2	
		Lighting tower	2	
		Generator	1	
		Compressor	1	

Table 6.10 Plant and equipment associated with each construction activity and estimated overall SWLs

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
04	Compound stockpiling activities	Excavator	1	112
		Dump truck	1	
		Front end loader	1	
05A	Vegetation clearing and grubbing - clearing	Bulldozer	1	112
		Excavator	1	
05B	Vegetation clearing and grubbing - grubbing	Chainsaw	1	109
		Mulcher	1	
06	Stripping, stockpiling and management of topsoil and unsuitable material	Bulldozer Excavator	1 1	113
	Forthwork proporation			
07	Earthwork preparation	Vibratory roller	1	110
08A	Water quality improvement work – Shrimptons Creek scour protection	Hand tools	2	109
			1	
		Excavator	1	
		Materials truck	1	
08B	Water quality improvement work – Shrimptons Creek gross pollutant trap	Concrete pump / Concrete	1	106
	installation	Agitator	1	
		nd		
		tool		
000	Water quality improvement work Industrial		0	400
080	Creek scour protection	Hand tools	2	109
			1	
		Excavalor Materials truck	1	
000	Water quality improvement work – Industrial		1	100
080	Creek gross pollutant trap installation	Agitator	1	106
	5 1 1	Hand tools	1	
08E	Water quality improvement work –	Excavator	1	105
	swale drain repairs			
08F	Water quality improvement work – Water	Concrete equipment	1	109
	quality basin channel modification	Grout pump	1	
		Hand tools	1	
09	Landscaping and revegetation	Water cart	1	107
		Seeding machine	1	
10A	Demobilisation works - installation of safety	Hand tools	1	103
	barriers and rending	Franna	1	
		Materials truck	1	
		Light vehicle	2	
10B	Demobilisation works - removal of motorway	Elevated work platform	1	109
	signage	Hand tools	1	
		Franna	1	
		Materials truck	1	
		Jackhammer (less than 50 cent of the time)	1	

ID	Activity	Plant / equipment	No.	Typical overall sound power level dB(A)
		Light vehicle	2	
11	Road sweeping of access routes	Road sweeper	1	106
12	Artwork	Piling equipment Mobile Crane Flatbed truck Concrete pump	1 1 1 1	116
13	Ongoing vegetation management and monitoring and maintenance work.	Water cart Light vehicle	1 1	107
14A	Development of paved access point off the motorway for operational maintenance vehicles – Sub-base compaction and placement of road base	Excavator Grader/roller Dump truck	1 1 1 1	112
14B	Development of paved access point off the motorway for operational maintenance vehicles – Pavement formation	Hand tools Concrete agitator inc. pump Concrete	1 1 1	108

The locations for the activities identified in **Table 6.10** would be positioned at the site to carry out the activities shown in **Figure 3-1**.

It is noted that activity 02, 12, 14A, 14B and activity 10B (motorway signage relocation) are the only activities proposed to be completed potentially during night time hours.

To evaluate potential impacts associated with each construction activity, computer-based modelling was completed using SoundPlan. Predictions were compared against the proposal NMLs to determine potential impacts.

Predicted construction noise impacts

Indicative noise levels were predicted for each stage of the construction work described above in **Table 6.10** at each of the receivers displayed in **Figure 6-6**. These predictions are listed and colour-coded relative to proposal NMLs in Appendix H.

For construction activities proposed during day time hours, predictions indicated that NMLs were generally expected to be within the daytime NMLs, however there would be some exceptions at R1 to R5 during activities 01, 5A, 5B, 6, 7, 9 and 13 in Table 6-5. There would be occasional exceedances also predicted at receivers R14 and R21 for activities 5A, 6, 12. Overall, levels exceeding the ICNG 'highly affected' criterion of 75 dB(A) were not predicted to occur during the proposal.

For potential activities at night (ID 02, 12, 14A, 14B and 10B in Table 6-5), night time NMLs were predicted to be exceeded at around two-thirds of surrounding residential receivers, with sleep disturbance impacts possible at residential receivers R01 to R04 and R21 (refer to Appendix H for further details regarding potential sleep disturbance impacts).

Predicted construction vibration impacts

Vibration-intensive equipment including vibratory rolling, pile boring and jackhammering equipment are proposed to be used during construction.

The safe setback distance of 40 metres for activities involving the use of a vibratory roller (activity 07 in Table 6-5) should be implemented in relation to receivers R01, R02, R03, R04 and R05. Alternative ground preparation methods or monitoring and surveys may be required to limit or manage impacts during such works in these areas if it is within 40 metres. Vibratory rolling activities are not expected to result in exceedances at receivers during works at any other areas of the proposal site.

With reference to the recommended safe setback distances presented in the DCNVG, activities involving jackhammer and pile boring or soil nailing equipment would be set at a sufficient distance from receivers so that vibration impacts arising from these plant and equipment are not expected.

Using prediction methods from the FTA Guidance Manual for Transit Noise and Vibration Impact Assessment, (US Federal Transit Administration, 2006) and BS 5228-1:2009, velocities from vibration-intensive equipment were calculated to be well below the three millimetres per second criterion at the two non-Aboriginal heritage items and the Aboriginal heritage site identified within the vicinity of the proposal.

Predicted results – construction traffic noise

Traffic volume data from the reports M2 Park Development Acoustic constraints and options study, (Jacobs, December 2014) and M2 Motorway Remedial Work near Vimiera Road, Marsfield Review of Environmental Factors, (EnviroPlan Pty Ltd, July 2013) indicates typical AM and PM traffic flows along the motorway of about 2000 vehicles in each direction (ie eastbound and westbound) with a heavy vehicle proportion of about five per cent. Considering the comparatively small volume of additional construction traffic expected to be generated by the proposal (about six to eight trips per hour), the change in resulting traffic noise levels are not expected to exceed the 2 dB(A) relative increase criterion.

Operational

Where a proposal has the potential to generate a new source of noise for residential receivers due to changes in road alignment or where a proposal would result in a change to the volume or mix of vehicles, an operational traffic noise assessment is undertaken in accordance with the Road Noise Policy. Where the changes of an existing road alignment are only minor, a less detailed assessment of traffic noise impacts is required.

In accordance with the *Roads and Maritime Noise Criteria Guideline* (NCG), (Roads and Maritime, 2014), the minor works criteria of noise levels not increasing by 2 dB(A) relative to existing noise levels at the worst affected receiver apply. As such, the primary operational noise criteria considered for this assessment has been whether the proposal would result in a traffic noise increase of 2 dB(A) or more at any nearby receiver as a result of the permanent access point off the motorway.

The permanent access point which would be established off the motorway would only be used for maintenance vehicles during the operational phase of the proposal. The frequency of vehicles expected to use this access point is expected to be of the order of about two movements per month and as such are not expected to impact upon operational traffic noise conditions.

6.7.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Noise and vibration	 Noise and vibration safeguards will be implemented as part of the CEMP. These safeguards will generally follow relevant guidance in the <i>Road Noise Policy</i> (2011) and <i>Interim Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify: All potential significant noise and vibration generating activities associated with the activity Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. 	Contactor	Detailed design / pre- construction	Core standard safeguard NV1 Section 4.6 of QA G36 Environme nt Protection
Noise and vibration	 All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: The project Night time works and indication of level of potential noise impact The construction period and construction hours Contact information for project management staff Complaint and incident reporting How to obtain further information. 	Contactor	Detailed design / pre- construction	Core standard safeguard NV2
Noise impacts during day time construction activities	 Select low-noise plant and equipment Ensure equipment mufflers operate in a proper and efficient manner Where possible, use quieter and less vibration emitting construction methods Only have necessary equipment on-site and turn off 	Contractor	Construction	Additional safeguards NV3

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	 when not in use Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices Implement training to induct staff on noise sensitivities associated with the proposal. 			
Noise impacts during night time construction activities	 Wherever possible, carry out works during standard working hours. If this is not possible, try to complete any noisy work before 10pm Limit on-site speed limits to 20 kilometres per hour or less Arrange internal haulage routes in a manner which eliminates the need for reversing (ie limit reverse alarm noise) Take care to avoid banging of truck tail gates during unloading activities Contact the potentially affected sensitive receivers by letter and inform them of the proposed works, location, type of work, days and dates of works and hours involved. The contact should be made at least 5 days prior to commencement of any works Consult with receivers R01 to R04 and R21 which may experience sleep disturbance impacts Avoid cumulative impacts associated with night time activities 04 and 10B by scheduling them for separate dates. 	Contractor	Construction	Additional safeguards NV4
Noise impacts during night time construction activities	There will be respite from noise impacts in accordance with Practice Note 7 in the Roads and Maritime Services <i>Environmental</i> <i>Noise Management Manual</i> and Roads. This will include restricting the number of noisy nights to no more than two per	Contractor	Construction	Additional safeguard NV5

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	week or six per month.			
Cosmetic building and human health vibration impacts at receivers R01 to R05	Use alternative, non-vibratory equipment when conducting earthwork preparation activities within 40 metres of receiver R01 to R05.	Contractor	Construction	Additional safeguard NV6

6.8 Aboriginal heritage

6.8.1 Existing environment

A search of the AHIMS register was carried out in March 2016. The AHIMS basic search returned no Aboriginal sites within a zero buffer of the site, one Aboriginal site within a 50 metre buffer of the site and two Aboriginal sites within a 200 metre buffer of the site. An extensive search indicated the two Aboriginal sites are located with the Lane Cove National Park, about 30 metres and 90 metres north of the proposal site boundary (refer to **Figure 6-7**). The site cards identify both Aboriginal sites as rock shelters located along Shrimptons Creek in the vicinity of the base of Shrimpton Falls. No art or stone artefacts were listed on the site card, however an estuarine shell was found on the surface, suggesting the site may contain more archaeological material.

This information was cross-checked with a previous Aboriginal heritage study of the area conducted for the Review of Environmental Factors for the M2 Remedial Work near Vimiera Road, Marsfield, and was found to be consistent.



Site boundary
 Site boundary
 AHIMS site
 National Park

Figure 6-7 Aboriginal recorded sites within 200 metres of the site

6.8.2 Potential impacts

It is considered unlikely that the proposal would directly impact the Aboriginal sites identified in Section 6.8.1. The sites are located within the boundary of the Lane Cove National Park and are

not within the vicinity of any access or fire trails. Access to sites would not be via the national park to avoid direct impacts to the Aboriginal sites. Indirect impacts would be limited to the degradation of the water quality within Shrimptons Creek, or by construction vibration. However, due to the distance between the sites and the construction equipment to be used with potential vibration impacts, the impacts would be avoided or mitigated through safeguards outlined in Section 7.2.

As the site has been heavily modified for previous land use, it is unlikely that any unknown or unrecorded items of Aboriginal heritage significance would be uncovered as a result of the proposal. Nevertheless if any unexpected finds are discovered during construction, the procedures outlined in *Standard Management Procedure: Unexpected Heritage Items* would be implemented. This would include the immediate cessation of activities and consultation with THML Environmental Project Manager and Roads and Maritime's Aboriginal Cultural Heritage Advisor.

A Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) clearance letter has been provided by Roads and Maritime Aboriginal Heritage Officer and assessed the proposal as being unlikely to have an impact on Aboriginal cultural heritage (refer to Appendix L for the PACHCI letter).

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Aboriginal heritage	If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Roads and Maritime Services Aboriginal cultural heritage officer and regional environment manager contacted immediately. Steps in the Roads and Maritime Services <i>Standard Management</i> <i>Procedure: Unexpected Heritage</i> <i>Items</i> must be followed.	Contactor	Detailed design / pre- construction	Core standard safeguard AH1 Section 4.9 of QA G36 Environment Protection
Impact to Lane Cove National Park and listed Aboriginal sites	Staff would be briefed on the need to stay within the construction site boundaries due to the proximity of the Lane Cove National Park and listed Aboriginal sites.	Construction contractor	Construction	Additional Safeguard AH2

6.8.3 Safeguards and management measures

6.9 Non-Aboriginal heritage

6.9.1 Existing environment

The following databases have been searched for heritage properties that may be within or near the proposal site:

- Roads and Maritime's Section 170 Register
- NSW Heritage database
- Commonwealth EPBC heritage list
- Australian Heritage Places Inventory
- Ryde LEP.

The NSW Heritage database and the Ryde LEP identified the closest heritage item to the proposal being Lane Cove National Park (Item No. 59) adjacent to the site. The heritage values of Lane Cove National Park primarily relate to landscape and biodiversity.

Macquarie University Ruins (Item No. 10), which is a locally listed heritage item, is more than 200 metres to the south west of the site. No other items of non-Aboriginal heritage significance were identified in the immediate vicinity of the proposal.

6.9.2 Potential impacts

Construction

It is not anticipated that there would be any direct construction impacts to the landscape of the Lane Cove National Park heritage item. The construction site does not encroach onto national park land and the construction site boundaries would be clearly marked at all time. In the event that access to or through the national park was required, existing access and fire trails would be used to avoid impact.

Potential construction impacts and safeguards relevant to biodiversity within Lane Cove National Park are addressed in Section 6.2.

Potential indirect construction impacts would be limited to the degradation of water quality within Shrimptons Creek and spread of weeds into the national park. These impacts would be mitigated through safeguards outlined in Section 6.2.3 and Section 6.5.3.

Construction works are at sufficient distance to the Macquarie University Ruins to not generate any direct or indirect construction related impacts on the item.

Operation

The operation of the proposal would have positive impacts on the Lane Cove National Park through the proposed weed control measures and revegetation works. These measures would improve the quality and long-term sustainability of the bushland in the park and surrounding areas.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Non- Aboriginal heritage	If unexpected archaeological remains are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Roads and Maritime	Contactor	Detailed design / pre- construction	Core standard safeguard H1

6.9.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	Services Standard Management Procedure: Unexpected Heritage Items must be followed. Roads and Maritime Services Senior Environment Specialist - Heritage must be contacted immediately.			Section 4.10 of QA G36 Environment Protection

6.10 Landscape character and visual impacts

6.10.1 Existing environment

The landscape character on the site has been highly modified from its natural state due to the construction of the motorway. Part of the overall site (about one hectare) was used as a construction compound as part of the construction of the motorway.

The margins of the past compound footprint comprise relatively steep embankments with heavy weed infestation. The high level of weed infestation detracts from the visual character of the site and is inconsistent with the natural bushland vegetation to the north of the site in Lane Cove National Park.

The site is primarily visible to passing motorists using both carriageways on the motorway. In excess of 75,000 vehicles use this section of the motorway each day. The site is partially visible from the upper floors for a number of commercial properties and serviced apartment buildings to the south of the motorway as well as a medium density residential precinct to the north-east (serviced by Khatoum Road, Leisure Close, Durham Close and Carlisle Close).

The Visual Impact Assessment (MBG Landscape Architecture, 2015) (the VIA, Appendix D), provides a map of the visual envelope of the site in **Figure 6-8**.



Figure 6-8 Visual envelope map and key viewpoint locations

6.10.2 Potential impacts

Construction

The VIA primarily considered two key viewpoints, both of which are from the motorway. Visibility of the site from the medium density residential precinct was also considered. Views from the upper

floors buildings in the commercial and residential precinct south of the motorway were considered generally as access to these properties was not possible.

The VIA considered the proposed site rehabilitation works (including revegetation, weed control, site drainage, creek riparian zone stability and water quality work) and the proposed artwork. Potential impacts would be associated with:

- Changes to landform
- Changes to vegetation patterns
- The nature, density and scale of existing attributes and proposed works.

The proposed scale of the preferred artwork (refer to Figure 6-7 and Figure 6-8) has been assumed to be within an envelope of 50 metres in length by 15 metres width and 20 metres in height.

It was noted in the VIA that the artwork element of the proposed work is somewhat different from most proposals that undergo visual assessment, as the intention of the proposal is to provide a landmark artwork installation.

Motorway viewpoints

The VIA identified a high volume of road users would have short duration views of the proposal site and concluded that these viewpoints has a low sensitivity to change.

During construction, there would be adverse visual impacts from construction activity due to the removal of vegetation, earthworks and general construction activity (such as vehicles accessing/departing the site), which would be visible from the motorway.

Medium density residential precinct viewpoints

The north-eastern areas of the proposal site, including Industrial Creek, would be visible from the perimeter driveway of the apartment complex accessed from Leisure Close as well as the apartments facing the proposal site. These areas of the site would be subject to site rehabilitation work, primarily including creek bank stabilisation, weed removal and revegetation work. The artwork site is not visible from these properties due to extensive vegetation cover.

During construction, there would be some visual impacts experienced at these properties due to the presence of construction equipment and activity, earthworks and the removal of some vegetation. The visual impact is likely to be low as the majority of vegetation removal would occur in the ground storey layer, while existing native trees and understorey plants would be retained and protected. Yhe construction site would be screened with shade cloth fencing on the northern boundary of the site to minimise temporary visual impacts for these receivers.

Commercial and residential precinct south of the motorway

The proposal site is not visible from the street level of the commercial properties south of the motorway. However it is likely that the proposal site would be visible from the upper floors of the properties. As such, there may be some minor visual impacts during construction and operational stages of the proposal.

During construction, there would be some visual impacts experienced at these properties due to the presence of construction equipment and activity, earthworks and the removal of some vegetation. As the properties are separated from the site by the motorway, the impact is considered to be low and would not require mitigation.

Operation

Operationally, the VIA assessed the proposal as being generally consistent with the overall motorway landscape, which includes extensive vegetation, various roadside structures and signage. The visual impact of the proposal would likely be low as the views of vegetation would remain constant and be further bolstered over time as the reinstated vegetation matures.

During operation, the visual impact for the medium density residential precinct is likely to be positive and improve with time as the revegetation of the site develops. Water quality in Industrial Creek is likely to be improved with the proposal, with positive visual impacts where the waterway is visible to residential receivers.

From the commercial and residential precinct south of the motorway, the VIA assessed the proposal as being generally consistent with the overall motorway landscape. As such, the visual impact from these properties would likely be low, with minor positive impacts caused by the regeneration of the site and the artwork.

The proposed regeneration works would substantially improve the visual amenity of the site by restoring vegetation cover that once existed. The scale and magnitude of the preferred artwork is considered to be consistent with the scale and frequency of various roadside infrastructure elements and not have any road safety implications.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Landscape character and visual impact	 Urban design will be implemented as part of the CEMP and guided by the VMP including design treatments for: Location and identification of existing vegetation and proposed landscaped areas, including species to be used Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage Procedures for monitoring and maintaining landscaped or rehabilitated areas. 	Contactor	Detailed design / pre- construction	Core standard safeguard UD1
Loss of visual amenity due to poor revegetation success	Ongoing monitoring and management of revegetated areas and weed control to ensure revegetation success at the site for 27 months by Landcare and subsequent monitoring by THML.	site manager	Post- construction	Standard safeguard UD2
Visual impact from construction equipment and activity	The construction site will be screened with shade cloth fencing on the northern boundary of the site to minimise distraction and visual impact.	Contractor	Pre- construction and construction	Standard safeguard UD3
Distraction to motorists entering the motorway from Christie	The final position of the artwork will be carefully considered using three dimensional models to minimise distraction to motorists traveling eastbound on the	Contractor	Detailed design / pre- construction	Standard safeguard UD4

6.10.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
road on ramp	Christie road on ramp without significantly compromising sight lines from mainline traffic travelling in both the eastbound and westbound directions.			

6.11 Socio-economic

6.11.1 Existing environment

The proximity of residential and commercial premises and the motorway is described in detail in previous sections of this REF.

6.11.2 Potential impacts

Construction

The potential social impacts from the proposal are short-term noise, traffic and visual impacts during construction. These are described in Section 6.6, Section 6.7 and Section 6.10.

Operation

There would be no social impact from noise or traffic during operation of the site. The visual impact is anticipated to be a positive impact.

6.11.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Socio- economic	 A Community and Stakeholder Engagement Plan (CSEP) will be prepared and implemented to provide timely and accurate information to the community during construction. The CSEP will include (as a minimum): Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints. The CSEP will be prepared in accordance with the <i>Community</i> <i>Involvement and Communications</i> <i>Resource Manual</i> (RTA, 2008). 	Contactor	Detailed design / pre- construction	Core standard safeguard SE1

Other safeguards and management measures that would address socio-economic impacts are identified in sections 6.6, 6.7 and 6.10.

6.12 Air quality

6.12.1 Existing environment

The background air quality at the site is dominated by the traffic on the motorway.

The closest sensitive receivers include residences located about 10 metres on the north-eastern boundary of the proposal and commercial and residential apartment blocks about 70 metres to

south of the proposal. Other sensitive receivers and environments include the road users and the Lane Cove National Park.

Regional air quality can be highly variable in nature and is subject to factors such as seasonal variations, wind and temperature effects, varying potential pollutant sources such as vehicular emissions and industry and event type pollutant loads such as bushfires.

6.12.2 Potential impacts

The potential air quality impacts from the proposal may include:

- · Aesthetic effects which arise from visible airborne dust plumes
- Potential adverse health effects including eye, nose and throat irritation from exposure to and inhalation of fine particles, gases and exposure to asbestos
- General loss of amenity for residences, road users and other people in the vicinity of the proposal
- Potential impact to household activities, for instance, air-drying of clothes on washing lines
- Traffic hazards for motorway users if visibility is affected.

The ability of dust to cause impacts would be affected by factors such as:

- Wind direction and speed (affects suspension and deposition of particles)
- Soil types (less cohesive soils have greater dust generation potential)
- Soil moisture (wetter soils are less likely to generate dust)
- The size of the disturbed area
- The height of stockpiles of loose material
- Topography
- The effectiveness of the management and mitigation measures implemented.

The volume of potential emissions from construction equipment is expected to be minor given the exiting air quality within the proposal area.

The construction involves ground disturbance that may have dust emission impacts on nearby residential receivers. Due to the potential presence of asbestos fibres, comprehensive safeguards are required to appropriately manage the potential impacts to nearby receivers.

6.12.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Dust generation	 Dust management safeguards will be implemented as part of the CEMP. Examples of appropriate safeguards to be included in the Plan (but not limited to) are: Dust suppression techniques ie. water spraying will be used for any excavation activities in high risk areas such as the deck Exposed soils/surfaces and/or stockpiles would be covered where practicable Weather will be monitored and excavation will not take place in 	Construction contractor	Pre- construction	Additional safeguard AQ1

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	 conditions of high wind Vehicle speeds would be reduced on unsealed access tracks to limit dust generation Access points to the road network would be inspected to determine whether material is being transferred to roads. Roads would be swept as required to control dust generatio Minimising the time between ground disturbance and rehabilitation as far as practicable to minimise airborne dust and particulates Registering, investigating and responding to complaints in accordance with THML procedures. 			

Other safeguards and management measures that would address socio-economic impacts are identified in Section 7.2.

6.13 Waste

6.13.1 Existing environment

The site was predominantly used as the site compound for the construction of the motorway. The deck area consists of engineered and uncontrolled fill comprising bitumen, concrete, bricks, bottles (plastic and glass), cans, plastic bags, plastic conduits, cloth, metal wire and fence posts. Asbestos fibres were also found on the site during investigations (as discussed in Section 6.4). It is understood that there are no current waste management infrastructure in place at the site.

6.13.2 Potential impacts

Waste materials, such as general litter, refuse and construction waste, would be generated by the proposal. These would include binding for stakes plant for guards, plant guard wrapping, and chemical containers, which would be disposed through the approved channels. Seedling containers (forestry tubes and hiko trays), would be recycled. Provided these materials are managed as per the safeguards in Section 6.13.3, the environmental impacts of this waste would be minimal.

The site remediation work has the potential to spread weeds across the site and beyond, including some noxious weed species. It is proposed that the weeds removed would be mulched and buried on site to minimize this potential.

As detailed in Section 6.5 of the REF, asbestos fibres have been found within the deck area of the site. It is highly unlikely that this material would be disturbed, as the proposal involves placing topsoil and mulch over the deck area of the site for revegetation.
Due to the historical use of the site, there is the potential for hazardous substances to be encountered during construction. Without appropriate management, hazardous substances may impact the local environment, waterways, and human health of contractors on site. If hazardous materials are found on-site, it would be appropriately stored and disposed of by appropriately certified construction contractors in accordance with the Waste Classification Guidelines (EPA 2014).

The proposal would have a water requirement for the duration of the proposal. The water requirement would vary across the program and it is anticipated that the peak requirements would be for the earthworks, dust control, staff site facilities and revegetation activities. While the overall water requirement is unknown at this stage it is unlikely to be a significant volume. Water would be sourced from authorised off-site sources or potentially from the local water quality basin.

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Waste management	 Waste management procedures will be prepared and implemented as part of the CEMP. The procedures will include but not be limited to: Measures to avoid and minimise waste associated with the project Classification of wastes and management options (re- use, recycle, stockpile, disposal) Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions Procedures for storage, transport and disposal Monitoring, record keeping and reporting. 	Contractor	Detailed design / pre- construction	Core standard safeguard W1 Section 4.2 of QA G36 Environment Protection

6.13.3 Safeguards and management measures

6.14 Cumulative impacts

6.14.1 Study area

The area considered for the cumulative impact is the suburb of Macquarie Park and Lane Cove National Park. Other suburbs serviced by the motorway were not included due to the minimal impact which the proposal would have on motorway traffic.

6.14.2 Potential impacts from other projects and developments

A search of the Major Project Assessments (NSW Department of Planning and Environment website) indicates a number of projects which may be carried out on Herring Road and within Macquarie University at the same time as the proposal.

The proposal is not anticipated to result in cumulative effects during its construction with these projects. There would be a slight increase in traffic on the motorway to import fill, though it would not be of any magnitude that would affect other nearby projects.

6.14.3 Safeguards and management measures

No additional safeguards or management measures are proposed as there are no adverse cumulative impacts associated with the proposal.

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and provided to the Roads and Maritime Environment Officer for review and comment. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the: *QA Specification G36 – Environmental Protection (Management System).*

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in **Error! Reference source not found.**

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
GEN1	General - minimise environmental impacts during construction	 A CEMP will be prepared and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity. As a minimum, the CEMP will address the following: Any requirements associated with statutory approvals Details of how the project will implement the identified safeguards outlined in the REF Issue-specific environmental management plans Roles and responsibilities Communication requirements Induction and training requirements Procedures for monitoring and evaluating environmental performance, and for corrective action Reporting requirements and record-keeping Procedures for emergency and incident management Procedures for audit and review. 	Contractor / Roads and Maritime project manager	Pre- construction / detailed design	Core standard safeguard GEN1

Table 7.1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor / Roads and Maritime project manager	Pre- construction	Core Standard safeguard GEN2
GEN3	General – environmental awareness	 All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: Areas of Aboriginal heritage sensitivity Contaminated land Threatened species habitat Adjoining residential areas requiring particular noise management measures. 	Contractor / Roads and Maritime project manager	Pre- construction / detailed design	Core standard safeguard GEN3
GEN4	General	The Contractor's Environmental Management Plan will include management measures from the <i>Guidelines for development adjoining land managed by Office of Environment and Heritage</i> , OEH	Contractor	Pre- construction and constructio	Additional safeguard GEN4
GEN5	General	Dial before you dig searches and subsurface investigations (as required) would be carried out prior to commencement of the proposal to confirm the location and depths of any other utility assets present such as the Sydney Water Corporation sewer main. Consultation would occur with the relevant utilities as required.	Contractor	Pre- construction	Additional safeguard GEN5
LU1	Loss of amenity at Dunholm Reserve	 Demarcation of road access through Dunholm Reserve for construction vehicles and no go zones for local residents The reserve will be protected using tracmats for construction of the 	Contractor	Pre- construction construction	Additional safeguard LU1

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 access track Dunholm Reserve will be restored to its original condition following completion of the proposal at Industrial Creek which is anticipated to take around two months. 			
B1	Biodiversity management	The CEMP will include, but not be limited to plans and details of areas to be cleared, protected, and revegetated. The Roads and Maritime's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) would be implemented where practical.	Contractor	Pre- construction	Core standard safeguard B1 Section 4.8 of QA G36 Environment Protection
B2	Minimising loss of biodiversity	 Construction site boundaries will be clearly marked at all times Indigenous flora species will be marked, protected and retained wherever possible across the site. Removal of flora will strongly focus on exotic species, particularly WoNs and noxious species. Introduced native species that are well established (dbh>75mm will be retained) Prior to commencing staged weed control work, patches of weed vegetation will be surveyed to prevent injury and entrapment impacts on fauna species. 	Contractor	Detailed design / pre- construction	Core standard safeguard B2
В3	Removal and management of noxious weeds	 Noxious, Weeds of National Significance and environmental weeds will be controlled across the site through a targeted weed control program undertaken prior to commencement of any earthworks or drainage works (as specified in the VMP) Weeds removed in the riparian zones which have the potential for weed propagation would be removed and relocated to areas of higher 	Contractor	Construction	Additional safeguard B3

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		elevation on the site.			
В4	Loss of fauna	 Safeguards as detailed in the CEMP will be implemented to protect fauna at the site including: Removal of weed thickets (Lantana and Privet) will be undertaken incrementally and replaced with dense plantings of native shrubs, grasses and ground covers to provide supplementary refuge, nesting and foraging habitat Retention and protection of existing rock habitat scattered through the site and lining the creeks Retention of hollow- bearing logs and natural debris (such as fallen timber) for refuge habitat Retention of native canopy trees Installation of nesting boxes and a nest-box strategy outlining installation guides, monitoring and maintenance schedules be prepared Retention of structural habitat (logs, rocks) within and adjacent to existing aquatic habitat Avoid using herbicides within riparian zones Limit the use of pesticides Supplementary planting of locally occurring native plants that produce nectar, pollen and fruits, thereby attracting a range of invertebrate prey species. 	Contractor	Construction	Additional safeguard B4
B5	Eradication of pests	A pest control program will be implemented prior to construction and on an on-going basis (in conjunction with (OEH) NPWS and potentially the Urban Feral Animal Action Group).	Construction contractor	Pre- construction, construction, post construction	Additional safeguard B5
B6	Biodiversity protection	If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Roads and Maritime Services	Construction contractor	Pre- construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 Unexpected Threatened Species Find Procedure in the Roads and Maritime Services Biodiversity Guidelines 2011 – Guide 1 (Pre-clearing process) Fauna handling must be carried out in accordance with the requirements the Roads and Maritime Services Biodiversity Guidelines - Guide 9 (Fauna Handling). 			В6
В7	Management of noxious weed species and plant pathogens	All machinery needs to be inspected and clean of all soil and plant material prior to being permitted on site. A rumble grid and wheel wash would be installed on the site to assist manage the spread of weeds and soil.	Construction contractor	Construction	Additional safeguard B7
B8	Management of noxious weed species and plant pathogens	Management of declared noxious weeds will take into consideration the requirements under the NW Act and <i>Guide 6 (Weed Management)</i> of the <i>Biodiversity Guidelines. Protecting and managing biodiversity on RTA projects</i> (2011).	Contractor	Construction	Additional safeguard B8
B9	Protection of aquatic habitat	Consultation with the Department of Primary Industries (Fisheries) will be undertaken for works proposed in the creeks.	THML/ Contractor	Pre- construction	Additional safeguard B9
B10	Protection of aquatic habitat	Retention of structural habitat (logs, rocks) within and adjacent to existing aquatic habitat.	Contractor	Construction	Additional safeguard B10
B11	Management of site compound	No clearing would be undertaken for the establishment of the site compound. Native vegetation within the site compound area would be clearly	Contractor	Construction	Additional safeguard B11

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		demarcated to avoid any impact to the vegetation or critical root zones.			
SW1	Soil and water	 A site specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented and included in the CEMP. The ESCP will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including, but not necessarily limited to: Catchments and runoff Diversion and drainage points Sediment basins and sumps (including standard drawings for how they should be set up) Scour protection Check dams, fencing and swales (including standard drawings for how they should be set up) Staged implementation arrangements. The Plan will also include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up meaures to be applied in the event of wet weather and when. The ESCP will be prepared in accordance with the NSW Soils and Construction – Managing Urban Stormwater "the Blue Book" (Landcom, 2004).	Contractor	Detailed design / pre- construction Detailed design / pre- construction	Core standard safeguard SW1 Section 2.1 of QA G38 Soil and Water Managemen t
SG1	Erosion and sedimentation	As identified in SW1, a site specific Erosion and Sediment Control Plan will be prepared and implemented as part of the CEMP	Contractor	Pre- construction, construction	Core standard safeguard SG1
SG2	Accidental spill	A site specific emergency spill procedure will be developed, and include spill management measures in accordance with the Roads and Maritime <i>Code of</i>	Contractor	Detailed design / Pre-	Core standard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 Practice for Water Management (RTA, 1999) and relevant EPA guidelines. The procedure will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers). An emergency spill kit will be kept on site at all times and all staff are to be made aware of the location of the spill kit and trained in its use. The spill kit will be regularly inspected and restocked. 		construction	safeguard SG2 Section 4.3 of QA G36 Environment Protection
C1	Contaminated land	 A Contaminated Land Management Plan will be prepared in accordance with the <i>Guideline for the Management of Contamination</i> (Roads and Maritime, 2013) and implemented as part of the CEMP. The plan will include, and not be limited to the following safeguards: Capture and management of any surface runoff contaminated by exposure to the contaminated land Management of the remediation and subsequent validation of the contaminated land, including any certification required Measures to ensure the safety of site personnel and local communities during construction. 	Contractor	Detailed design / Pre- construction	Core standard safeguard C1 Section 4.2 of QA G36 Environment Protection
C2	Asbestos	 To reduce the risk associated with the disturbance of contaminated soils, the disturbance of the ground surface within Area 2, and the area between Area 2 and Industrial Creek, would be minimised and carried out under an appropriate Contaminated Land Management Plan that would be prepared in accordance with the following: Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC:2002 (2005)) Code of Practice for the Management and Control Asbestos in the Workplace (NOHSC:2018 (2005)) 	Construction contractor	Pre- construction, construction	Core standard safeguard C2

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		Work Health and Safety Regulation 2011.			
C3	Unexpected contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented in accordance with the Contaminated Land Management Plan to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls (environmental and health and safety) or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.	Contractor	Detailed design / Pre- construction, construction	Core standard safeguard C3 Section 4.2 of QA G36 Environment Protection
C4	Minimise exposure of contaminants during operation	In the event exposure to contaminants is identified a Site Management Plan will be implemented to manage long-term exposure risk from contamination for site use/maintenance. The site Management Plan will be prepared in accordance with the requirements of the <i>Work Health and Safety Regulation 2011</i> .	Site manager	Post- construction	Additional safeguard C4
TT1	Traffic and transport	 The traffic and transport safeguards will be implemented as part of the CEMP and will include: Confirmation of haulage routes Measures to maintain access to local roads and properties Site specific traffic control measures (including signage) to manage and regulate traffic movement Requirements and methods to consult and inform the local community of impacts on the local road network Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads A response plan for any construction traffic incident Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the 	Contractor	Detailed design / Pre- construction	Core standard safeguard TT1 Section 4.8 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 cumulative increase in construction vehicle traffic Monitoring, review and amendment mechanisms Awareness of safety issues with construction plant movements and separation distances would be refreshed via Tool Box Talks as required. 			
TT2	Traffic and Transport	 A Traffic Control Plan (TCP) will be prepared and implemented as part of the CEMP. The TCP will be prepared in accordance with the Roads and Maritime <i>Traffic Control at Work sites Manual</i> (RTA, 2010) and QA <i>Specification G10 Control of Traffic</i> (Roads and Maritime, 2008). The TCP will include: Lane closure plans including details for advance warning of motorists Details of number of signs required and number of arrow boards and truck mounted attenuators. 	Contractor	Detailed design / Pre- construction	Core standard safeguard TT2
TT3	Increased risk of collision risk	 Site access and egress would be designed to allow construction vehicles to enter and exit the motorway lanes at appropriate speeds to limit the potential for collisions TMAs would be used as required to assist heavy vehicles safely existing and entering the traffic lanes. 	Construction contractor	Pre- Construction/ Construction	Additional safeguard TT3
TT4	Traffic disruption and safety	 Flashing lights would be used on all construction vehicles Traffic safety awareness training would be developed and delivered to all site personnel. 	Construction contractor	Construction	Additional safeguard TT4
NV1	Noise and vibration	 Noise and vibration safeguards will be implemented as part of the CEMP. These safeguards will generally follow the relevant guidance in the <i>Interim</i> <i>Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify: All potential significant noise and vibration generating activities associated with the activity Contingency measures to be implemented in the event of non- compliance with noise and vibration criteria. 	Contactor	Detailed design / pre- construction	Core standard safeguard NV1 Section 4.6 of QA G36

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
					Environment Protection
NV2	Noise and vibration	 All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: The project Night time works and indication of level of potential noise impact The construction period and construction hours Contact information for project management staff Complaint and incident reporting How to obtain further information. 	Contactor	Detailed design / pre- construction	Core standard safeguard NV2
NV3	Noise impacts during day time construction activities	 Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner Where possible, use quieter and less vibration emitting construction methods Only have necessary equipment on-site and turn off when not in use Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices Implement training to induct staff on noise sensitivities associated with the proposal. 	Contractor	Construction	Additional safeguards NV3
NV4	Noise impacts during night time construction activities	 Wherever possible, carry out works during standard working hours. If this is not possible, try to complete any noisy work before 10 pm Limit on-site speed limits to 20 kilometres per hour or less Arrange internal haulage routes in a manner which eliminates the need for reversing (ie limit reverse alarm noise) Take care to avoid banging of truck tail gates during unloading activities 	Contractor	Construction	Additional safeguards NV4

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 Contact the potentially affected sensitive receivers by letter and inform them of the proposed works, location, type of work, days and dates of works and hours involved. The contact should be made at least 5 days prior to commencement of any works Consult with receivers R01 to R04 and R21 which may experience sleep disturbance impacts Avoid cumulative impacts associated with night time activities 04 and 10B by scheduling them for separate dates. 			
NV5	Noise impacts during night time construction activities	There will be respite from noise impacts in accordance with Practice Note 7 in the Roads and Maritime Services <i>Environmental Noise Management Manual</i> and Roads. This will include restricting the number of noisy nights to no more than two per week or six per month.	Contractor	Construction	Additional safeguard NV5
NV6	Cosmetic building and human health vibration impacts at receivers R01 to R05	Use alternative, non-vibratory equipment when conducting earthwork preparation activities within 40 metres of receiver R01 to R05.	Contractor	Construction	Additional safeguard NV5
AH1	Aboriginal heritage	If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Roads and Maritime Services Aboriginal cultural heritage officer and regional environment manager contacted immediately. Steps in the Roads and Maritime Services <i>Standard Management Procedure: Unexpected Heritage Items</i> must be followed.	Contactor	Detailed design / pre- construction	Core standard safeguard AH1 Section 4.9 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
AH2	Impact to Lane Cove National Park and listed Aboriginal sites	Staff would be briefed on the need to stay within the construction site boundaries due to the proximity of the Lane Cove National Park and listed Aboriginal sites.	Construction contractor	Construction	Additional Safeguard AH2
H1	Non-Aboriginal heritage	If unexpected archaeological remains are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Roads and Maritime Services <i>Standard Management Procedure:</i> <i>Unexpected Heritage Items</i> must be followed. Roads and Maritime Services Senior Environment Specialist - Heritage must be contacted immediately.	Contactor	Detailed design / pre- construction	Core standard safeguard H1 Section 4.10 of QA G36 Environment Protection
UD	Landscape character and visual impact	 Urban design will be implemented as part of the CEMP and guided by the VMP including design treatments for: Location and identification of existing vegetation and proposed landscaped areas, including species to be used Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage Procedures for monitoring and maintaining landscaped or rehabilitated areas. 	Contactor	Detailed design / pre- construction	Core standard safeguard UD1
UD2	Loss of visual amenity due to poor revegetation success	Ongoing monitoring and management of revegetated areas and weed control to ensure revegetation success at the site for 27 months by Landcare and subsequent monitoring by THML.	Site manager	Post- construction	Standard safeguard UD2

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
UD3	Visual impact from construction equipment and activity	The construction site will be screened with shade cloth fencing on the northern boundary of the site to minimise distraction and visual impact.	Contractor	Pre- construction and construction	Standard safeguard UD3
UD4	Distraction to motorists entering the motorway from Christie road on ramp	The final position of the artwork will be carefully considered using three dimensional models to minimise distraction to motorists traveling eastbound on the Christie road on ramp without significantly compromising sight lines from mainline traffic travelling in both the eastbound and westbound directions.	Contractor	Detailed design / pre- construction	Standard safeguard UD4
SE1	Socio-economic	 A Communication and Stakeholder Engagement Plan (CSEP) will be prepared and implemented to provide timely and accurate information to the community during construction. The CSEP will include (as a minimum): Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions Contact name and number for complaints 	Contactor	Detailed design / pre- construction	Core standard safeguard SE1
AQ1	Dust generation	 Dust management safeguards will be prepared as part of the CEMP. Examples of appropriate safeguards include (but not limited to) are: Dust suppression techniques ie. water spraying will be used for any excavation activities in high risk areas such as the deck Exposed soils/surfaces and/or stockpiles would be covered where practicable Weather will be monitored and excavation will not take place in conditions of high wind 	Construction contractor	Pre- construction	Additional safeguard AQ1

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		 Vehicle speeds would be reduced on unsealed access tracks to limit dust generation Access points to the road network would be inspected to determine whether material is being transferred to roads. Roads would be swept as required to control dust generation Minimising the time between ground disturbance and rehabilitation as far as practicable to minimise airborne dust and particulates Registering, investigating and responding to complaints in accordance with THML procedures. 			
W1	Waste management	 Waste management procedures will be prepared and implemented as part of the CEMP. These procedures will include but not be limited to: Measures to avoid and minimise waste associated with the project Classification of wastes and management options (re-use, recycle, stockpile, disposal) Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions Procedures for storage, transport and disposal Monitoring, record keeping and reporting. 	Contractor	Detailed design / pre- construction	Core standard safeguard W1 Section 4.2 of QA G36 Environment Protection

7.3 Licensing and approvals

The licences and approvals required for the proposal have been listed in **Table 7.2**.

Table 7.2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Roads Act 1993	A Work Permit would be required to be obtained from the Hills M2 Motorway operator where a lane closure is required.	Prior to commencement of work.

Agreement would also be required from Council (as the landowner) to access and use Dunholm Reserve prior to commencement of work.

8.1 Justification

The REF assessment concludes that the minor short-term adverse impacts during construction are outweighed by the beneficial longer term ecological impacts. The proposal would result in:

- Transformation of a weed infested area to native bushland to complement the ecosystem of the Lane Cove National Park
- Efficient functioning of waterways and drainage networks
- Installation of an art work that is well received by key stakeholders and the community.

Under the 'no nothing' option, the site would not be restored and it would continue to deteriorate due to the effects of weed invasion, erosion and sedimentation. This has the potential to result in adverse environmental impacts to the nearby Lane Cove National Park and downstream receiving water bodies.

Some potential for environmental and community impacts have been identified as a result of implementing the proposal. The impacts and risks, however, can be reduced to acceptable levels through the implemented of the proposed environmental safeguards and management measures. With effective implementation, the overall environmental and community impacts associated with the proposal are not anticipated to be significant. In the long term, the proposal would have a significant environmental benefit for the local environment and the community/road users.

The proposal is consistent with Roads and Maritime's strategic plan for asset management and addressing local environmental problems caused by existing conditions. This fulfils the objectives of the *NSW State Plan 2021* to strengthen our local environment. It supports *A Plan for Growing Sydney*, specifically the Epping and Macquarie Park urban renewal, part of which is to create vibrant public spaces close to transport links and jobs. The regeneration of the site will augment the health and improve the visual continuity of Lane Cove National Park beside the motorway and in proximity to the Macquarie urban, commercial and shopping precinct. The proposal would also provide an artwork for the enjoyment of motorists and local residents, supporting the development of vibrant public spaces near transport routes and links.

8.2 Objects of the EP&A Act

Table 8.1 identifies the objects of the EP&A Act and their relevance to the proposal.

Table 8.1 Summary of Objects of the	EP&A Act	
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Object	Comment
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposal design, impact, and safeguards and management measures detailed in this REF allow for the proper management, development and conservation of natural and artificial resources. The proposal would also improve the social and economic welfare of the community by improving the environmental characteristics of the site and the nearby Lane Cove National Park. The visual amenity of the area would be improved.

Object	Comment
5(a)(ii) To encourage the promotion and co- ordination of the orderly economic use and development of land.	The ongoing operational integrity of the motorway is necessary to ensure the orderly and economic use of land both around the motorway and along the wider development corridor formed by the Sydney orbital motorway and road network. The proposal would also promote sustainability values within the site by rehabilitating an unused area of land for environmental benefit.
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	Not relevant to the proposal.
5(a)(iv) To encourage the provision of land for public purposes.	The proposal would not result in adverse impacts to any land used for public purposes. It is anticipated that the long-term beneficial effects of the proposal would have a net benefit for the adjacent Lane Cove National Park.
5(a)(v) To encourage the provision and co- ordination of community services and facilities.	Not relevant to the proposal.
5(a)(vi) 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.	Impacts to native animals and plants, including threatened species, populations and ecological communities and their habitats were considered in Section 6. The majority of the construction footprint is within the motorway corridor and has been highly disturbed. The proposal is required to stabilise existing sources of erosion, improve water quality and visual amenity and to restore ecological values of the site. It would also have beneficial impacts to the Lane Cove National Park. Assessments of significance undertaken as part of the Flora and Fauna Assessment (UBM, Ecological Consultants, 2016) (refer to Appendix E) found that the proposal is unlikely to have a significant impact to any threatened species, population or ecological communities. Safeguards and mitigation measures would be implemented to manage impacts to biodiversity and cleared areas would be appropriately revegetated at the completion of works. The safeguards recommended in this REF would be sufficient to ensure that the environment is adequately protected during the proposal.

Object	Comment
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 8.2.1 to 8.2.4 below.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the project.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the project.
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	The proposal development process has involved consultation with relevant stakeholders. Consultation undertaken and proposed is outlined in Section 5.

8.2.1 The precautionary principle

The assessment of the potential impacts of the proposal is considered to be consistent with the precautionary principle. The detailed environmental investigations carried out for this REF have been consistent with accepted scientific and assessment methodologies (refer to Section 6). The investigations have identified a range of potential impacts associated with the construction and operation of the proposal.

The evaluation and assessment of alternative options within the proposal have also aimed to reduce the risk of serious and irreversible impacts on the environment as a result of the proposal.

The proposal has sought to take a precautionary approach to minimising environmental impacts. This has been applied through the development of a range of safeguards and management measures, as summarised in Section 7. These safeguards and management measures would be implemented during construction and operation of the proposal.

No safeguards and management measures have been postponed as a result of lack of scientific certainty. The selected construction contractor would be required to prepare a CEMP before starting construction. No safeguards and mitigation measures or management mechanisms would be postponed as a result of a lack of information.

8.2.2 Intergenerational equity

The proposal would benefit future generations by removing the sources of environmental degradation and by re-establishing and sustaining native ecological conditions and values. Implementation of the safeguards and management measures contained in this REF (refer to Section 7.2) would ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Should the proposal not proceed, the site of the proposal would remain in its current degraded and disturbed condition with low environmental value and performance continuing. The proposal would mitigate this risk.

It is acknowledged that the proposal may have some adverse impacts on the current generation, generally through, noise impacts and traffic impacts during construction. However, these are not considered to be of a nature or extent that would disadvantage future generations.

8.2.3 Conservation of biological diversity and ecological integrity

A key objective of the project is to minimise adverse impacts on the environmental values of the area. Conservation of biological diversity and ecological integrity has been considered during all stages of the proposal's development. Potential impacts have been avoided where possible and safeguards and management measures have been included where necessary.

The biodiversity assessment (refer to Section 6.2 and the Flora and Fauna Assessment in Appendix E) concluded that the proposal would not have a significant effect on any existing flora or fauna species, biodiversity communities or the overall biological integrity of the proposal and nearby areas. The findings of the biodiversity assessment indicate that the potential impacts would be acceptable and minimised through the proposed safeguards (refer to Section 6.5). The reestablishment of vegetation and an ecological endangered community would be a positive outcome for biodiversity in general.

8.2.4 Improved valuation, pricing and incentive mechanisms

Environmental and social issues were considered in the strategic planning and establishment of the need for the proposal, and in consideration of various proposal options. The value placed on environmental resources is evident in the extent of the planning and environmental investigations, and in the design of the proposed mitigation measures and safeguards.

It is anticipated that the fill material required as part of the proposal would come from a nearby construction project where there would be a surplus of material. Appropriate recycling and reuse options would be used for all waste materials generated by the proposal. The burial of mulched vegetation waste (ie green waste) on the site and the capping of poor quality and contaminated fill/rubble in the deck area with a suitable clean imported fill material and left on site would have a substantial reduction in the costs associated with haulage and off site disposal of these waste streams.

8.3 Conclusion

The proposed M2 Macquarie Park Motorscapes project within the motorway corridor at Macquarie Park is subject is subject to assessment under Part 5 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on noise, traffic and the visual amenity. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also result in positive environmental impacts by improving the environmental characteristics of the site and the nearby Lane Cove National Park. The visual amenity of the area would also be improved. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act. A Species Impact Statement is not required. The proposal is subject to assessment under Part 5 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999.* A referral to the Australian Department of the Environment is not required.

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

EMmachel

Emily Manchee Senior Environmental Consultant Jacobs Date: 08/07/2016

I have examined this review of environmental factors and accept it on behalf of Roads and Maritime Services.

Majed Odeh Project Manager Motorway Operations Roads and Maritime Services Motorway Management Date: /07/2016

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Term / Acronym	Description
CEMP	Construction Environment Management Plan
EIA	Environmental impact assessment
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	Fisheries Management Act 1994 (NSW)
Heritage Act	Heritage Act 1977 (NSW)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
NES	Matters of national environmental significance under the Commonwealth
Noxious Weeds	Noxious Weeds Act 1993 (NSW)
NPW Act	National Parks and Wildlife Act 1974 (NSW)
Proposal	Refers to the activities associated with the M2 Macquarie Park Motorscapes Project
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP 14	State Environmental Planning Policy No.14 – Coastal Wetlands
site	Refers to the five hectare area that would be directly impacted by the proposal. It includes the total construction footprint, access points, site compound locations, and stockpile sites.

Term / Acronym	Description
THML	The Hills Motorway Limited
TSC Act	Threatened Species Conservation Act 1995 (NSW)
QA Specifications	Specifications developed by Roads and Maritime Services for use with roadworks and bridgeworks contracts let by Roads and Maritime