Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance
**Clause 228(2) Checklist**

In addition to the requirements of the *Is an EIS required?* guideline as detailed in the REF, the following factors, listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

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<th>Factor</th>
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<tbody>
<tr>
<td>a. Any environmental impact on a community? &lt;br&gt;The proposal would have temporary traffic and access, noise and vibration and visual impacts, as well as a reduction in available public parking in the car park adjacent to the proposal area throughout construction activities. The proposal would also require the removal of the garden area at the corner of Starkey Street and Warringah Road and the removal of up to six mature Eucalyptus trees. Property acquisition would be required from the Forest Animal Hospital property on the northeast corner of the intersection. &lt;br&gt;The proposed bridge would have long term positive impacts by improving traffic flow and delays throughout the local network, as well as improving safety for pedestrians crossing Warringah Road in this location. &lt;br&gt;The proposal would also impact on the existing visual amenity of the area, by erecting a bridge over Warringah Road were currently a signalised pedestrian crossing exists. &lt;br&gt;Safeguards described in section 7 of this REF would be implemented to minimise any potential negative impacts.</td>
<td>Minor short term and long term negative impacts &lt;br&gt;Long term positive impacts</td>
</tr>
<tr>
<td>b. Any transformation of a locality? &lt;br&gt;The proposal would provide a pedestrian bridge over Warringah Road at Forestville. This bridge is replacing an existing signalised pedestrian crossing, which introduces a new piece of road infrastructure along the road corridor. The new bridge is consistent with the existing road use, therefore would not transform the locality. The urban design assessment identified that the bridge would assist in creating a landmark feature in the local area.</td>
<td>Long term positive impacts</td>
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### Review of Environmental Factors

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<tr>
<td>c. Any environmental impact on the ecosystems of the locality?</td>
<td>Minor</td>
</tr>
<tr>
<td>The proposal would remove up to six mature Eucalyptus trees from a local garden area. These species were not identified as threatened species or part of an ecological community. These trees are unlikely to provide important habitat for transient threatened species in the regional area. This is not expected to have an impact on the local ecosystem. A landscaping plan developed during detailed design would reinstate landscaping in the local area to minimise this minor loss of biodiversity.</td>
<td></td>
</tr>
<tr>
<td>d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</td>
<td>Minor long term negative and positive</td>
</tr>
<tr>
<td>The proposed bridge structure would introduce a new landmark and will give identity to the intersection. Landscape character impacts have been identified as moderate to low impacts. Visual impacts are highest for side street road users, and at the north-eastern and south-western corners of the intersection and are moderate impacts. The proposal would not reduce the recreational, scientific or other environmental qualities or values of the locality due to the works being located within the road corridor and management measures identified in the REF.</td>
<td></td>
</tr>
<tr>
<td>e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?</td>
<td>Nil</td>
</tr>
<tr>
<td>The proposal would not have an impact on the locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.</td>
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<tr>
<td>f. Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?</td>
<td>Nil</td>
</tr>
<tr>
<td>The proposal would is unlikely to impact on the habitat of protected fauna. The proposal would remove up to six mature Eucalyptus trees from a local garden area. These trees are unlikely to provide important habitat for transient protected species in the area.</td>
<td></td>
</tr>
<tr>
<td>g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</td>
<td>Nil</td>
</tr>
<tr>
<td>The proposal is unlikely to endanger any species of animal, plant or other form of life.</td>
<td></td>
</tr>
<tr>
<td>h. Any long-term effects on the environment?</td>
<td>Positive long term positive impacts</td>
</tr>
<tr>
<td>The proposal would improve traffic flow and delays through the local road network as well as improve pedestrian safety at the locality. It would include a new permanent pedestrian bridge in this location and the permanent loss of three car parking spaces and modifications to a further two spaces in the adjacent public car park.</td>
<td>Minor long term negative impacts</td>
</tr>
<tr>
<td>The proposed bridge structure would introduce a new landmark and will give identity to the intersection. Landscape character impacts have been identified as moderate to low impacts. Visual impacts are highest for side street road users, and at the north-eastern and south-western corners of the intersection and are moderate impacts</td>
<td></td>
</tr>
<tr>
<td>i. Any degradation of the quality of the environment?</td>
<td>Nil</td>
</tr>
<tr>
<td>The proposal is unlikely to degrade the environment due to the small scale of works in an isolated location and the management measures outlined in the REF.</td>
<td></td>
</tr>
<tr>
<td>j. Any risk to the safety of the environment?</td>
<td>Positive long term impacts</td>
</tr>
<tr>
<td>The proposal would improve pedestrian safety in the locality. The construction management measures identified in the ref would manage and mitigate potential risks to the environment</td>
<td></td>
</tr>
<tr>
<td>Factor</td>
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<tr>
<td><strong>k. Any reduction in the range of beneficial uses of the environment?</strong>&lt;br&gt;The proposal would require impacts to up to five car parking spaces to accommodate the new stairwell and lift structure. This would include the loss of three parking spaces and modifications to two additional parking spaces which would require nosing under the stair structure (between two to five metres high from ground level). Seven new bicycle parking facilities (holding up to 14 bicycles) would be provided as part of the proposal on both sides of Warringah Road. The proposal would improve the safety of pedestrians at the crossing, in particular for school children and less mobile people.</td>
<td>Minor long term negative impacts Long term positive impacts</td>
</tr>
<tr>
<td><strong>l. Any pollution of the environment?</strong>&lt;br&gt;The proposal is unlikely to pollute the environment due to the limited scale of works and the mitigation measures identified in section 7 of the REF.</td>
<td>Minor short term</td>
</tr>
<tr>
<td><strong>m. Any environmental problems associated with the disposal of waste?</strong>&lt;br&gt;The proposal is unlikely to have any problems with the disposal of waste due to the limited scale of works and the mitigation measures identified in section 7.</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</strong>&lt;br&gt;The proposal is not expected to increase demand on resources that are, or are likely to become in short supply.</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>o. Any cumulative environmental effect with other existing or likely future activities?</strong>&lt;br&gt;The proposed works are expected to take about 12 months to complete, it is likely that this construction period is likely to overlap with the construction activities for the Northern Beaches Hospital and the associated road works about two kilometres north of the proposal area. Mitigation measures identified in section 7 would aim to minimise this impact.</td>
<td>Negative short term impacts</td>
</tr>
<tr>
<td><strong>p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?</strong>&lt;br&gt;The proposal is not expected to impact on any coastal processes and coastal hazards.</td>
<td>Nil</td>
</tr>
</tbody>
</table>
Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment.

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<tr>
<td>a. Any impact on a World Heritage property?</td>
<td>Nil</td>
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<tr>
<td>b. Any impact on a National Heritage place?</td>
<td>Nil</td>
</tr>
<tr>
<td>c. Any impact on a wetland of international importance?</td>
<td>Nil</td>
</tr>
<tr>
<td>d. Any impact on a listed threatened species or communities?</td>
<td>Nil</td>
</tr>
<tr>
<td>e. Any impacts on listed migratory species?</td>
<td>Nil</td>
</tr>
<tr>
<td>d. Any impact on a Commonwealth marine area?</td>
<td>Nil</td>
</tr>
<tr>
<td>g. Does the proposal involve a nuclear action (including uranium mining)?</td>
<td>Nil</td>
</tr>
<tr>
<td>Additionally, any impact (direct or indirect) on Commonwealth land?</td>
<td>Nil</td>
</tr>
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Appendix B

Concept Design Drawings
PROVIDE WHEEL STOPS FOR 3 PARKING SPACES

CONSTRUCT CONCRETE FOOTPATH TO SERVICE LIFT AND STAIRS

CONSTRUCT LOW LEVEL KERBS RETURNING WALL FOOTINGS TO AVOID EXISTING SERVICES

NEW FOOTPATH TO CONNECT TO EXISTING FOOTPATH AND MATCH LEVELS

REMOVE 3 PARKING SPACES AND PROVIDE KERBS AND BOLLARDS

CONSTRUCT KERB RAMP TO ACCESSIBILITY STANDARDS

CONSTRUCT LOW LEVEL KERBS RETURNING WALL FOOTINGS TO AVOID EXISTING SERVICES

NEW FOOTPATH TO CONNECT TO EXISTING FOOTPATH AND MATCH LEVELS

PROVIDE BUS STOP FOR RELOCATED BUS STOP LOCATION

CONSTRUCT CONCRETE FOOTPATH TO SERVICE LIFT AND STAIRS

LIFT STRUCTURE 2.2m CLEAR OF VERSAN OPTICAL FIBRE

RELOCATE STREET LIGHT AND OVERHEAD ELECTRICAL OUT OF CLEAR ZONE TO BACK OF PATH AND PROVIDE EXTENDED OUTREACH

VEHICLE SAFE PEDESTRIAN FENCE TO RESTRICT PEDESTRIAN ACCESS ACROSS WARRINGAH ROAD ADJACENT TO THE PEDESTRIAN BRIDGE TO RMS MODEL DRAWING MD014.A.A - MEDIAN

EXISTING BUS STOP LOCATION TO BE RETAINED APPROX 30m

PROVIDE WHEEL STOPS FOR 3 PARKING SPACES

LEGEND

EXISTING

PROPOSED

PROVIDE WHEEL STOPS FOR 3 PARKING SPACES

PROVIDE BUS STOP FOR RELOCATED BUS STOP LOCATION

CONSTRUCT CONCRETE FOOTPATH TO SERVICE LIFT AND STAIRS
RECONSTRUCT KERB RAMP TO COMPLY WITH ACCESSIBILITY STANDARDS

RELOCATE EXISTING BUS STOP AND SHelter TO EASTERN SIDE OF INTERSECTION

PROVIDE RAMP FOR CYCLIST ACCESS TO OVERBIDGE

REDEFINE PEDESTRIAN FENCE TO RESTRICT PEDESTRIAN ACCESS ACROSS WARRINGAH ROAD TO RMS MODEL DRAWING MD.R201.C14.A - VERGE

REMOvE KERB RAMP AND PROVIDE PLANTINg AND TURF

REMOvE SIGNALISED PEDESTRIAN CROSSING AND LINEMARKING

RECONSTRUCT KERB RAMP TO COMPLY WITH ACCESSIBILITY STANDARDS

REMOvE ELECTRICAL POLE AND 130m OF OVERHEAD ELECTRICAL AND RELOCATE UNDERGROUND

REMOvE KERB RAMP AND PROVIDE PLANTING AND TURF

RELINE FOOTPATH TO RESTRICT PEDESTRIAN

REALIGN FOOTPATH TO RESTRICT PEDESTRIAN

RECONSTRUCT KERB RAMP TO COMPLY WITH ACCESSIBILITY STANDARDS

REMOvE KERB RAMP AND PROVIDE PLANTING AND TURF

REMOvE ELECTRICAL POLE AND 130m OF OVERHEAD ELECTRICAL AND RELOCATE UNDERGROUND

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RECONSTRUCT KERB RAMP TO COMPLY WITH ACCESSIBILITY STANDARDS

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Appendix C

Urban Design Report and Landscape Character and Visual Impact Assessment
Starkey Street pedestrian bridge, Forestville

Urban design report and landscape character and visual impact assessment - final report

May 2015
Looking east towards southeastern corner of Starkey Street intersection with Warringah Road
Starkey Street pedestrian bridge, Forestville

Urban design report and landscape character and visual impact assessment - final report

May 2015

Prepared by:

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Looking east towards southeastern corner of Starkey Street intersection with Warringah Road
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1. Introduction, proposal description and requirements

1.1 Proposal identification

Roads and Maritime Services (Roads and Maritime) is proposing to construct a pedestrian bridge over Warringah Road near the Starkey Street and Ferguson Street intersection, Forestville to improve traffic flow along Warringah Road and pedestrian safety at the intersection (the proposal). The existing signalised pedestrian crossing across Warringah Road would be removed as part of the proposal. The proposal site is located within the Warringah Council Local Government Area (LGA).

Warringah Road is a main arterial road providing connections from the Northern Beaches and North Shore suburbs to the M2 and Pacific Highway and into the city. Immediately surrounding the proposal area are residential and commercial areas and community facilities.

The intersection of Warringah Road, Starkey Street and Ferguson Street is serviced by a four-way signalised intersection, which provides for through traffic on Warringah Road and access to and from Starkey Street (on the southern side) and Ferguson Street (on the northern side). Pedestrian movements at the intersection are currently provided for by three signalised pedestrian crossings on Ferguson Street, Starkey Street and the western side of the intersection on Warringah Road.

During peak periods, Warringah Road currently experiences extensive delays in the westbound direction in the morning and in the eastbound direction in the evening. Traffic is further constrained where side street traffic needs to join through traffic, at pedestrian crossings and at bus loading areas. Due to the multiple interactions occurring at this intersection, it has been identified as a stress point on Warringah Road. Removing the need for a road level pedestrian crossing of Warringah Road and improving bus stop locations would improve the operation of the intersection and reduce delays along the Warringah Road corridor through Forestville.
1.2 Purpose of the report

This urban design report and landscape character and visual impact assessment has been undertaken as part of the review of environmental factors (REF) prepared by RPS on behalf of 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 review of environmental factors 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 works and associated environmental impacts have been undertaken in context of clause 228 of the Environmental Planning and Assessment Regulation 2000, 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 review of environmental factors 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 review of environmental factors 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 and Infrastructure 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 potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need 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.
1.3 Location and study area

The proposal is located on the Northern Beaches of Sydney, in the suburb of Forestville about 15.6 kilometres (km) north of the Sydney CBD and about 8.9 km west of Dee Why. The surrounding road network comprises Warringah Road, an important arterial road on Sydney’s Northern Beaches, Starkey Street to the south, which connects the suburbs of Forestville and Killarney Heights; and Ferguson Street, which connects to the north with Forestville and Frenchs Forest. The location of the proposal is shown in Figure 1-1.

The suburbs of Frenchs Forest, Killarney Heights and Forestville, are straddled by Garrigal National Park and Middle Harbour and are dotted with playing fields, parks and remnant bushland, which afford its residents plentiful recreational resources, open space and visual amenity. Colloquially known as the Forest, the suburbs are centrally located between Chatswood and the beaches of Dee Why and Curl Curl.

The bus stop known as Jamieson Square is a well known local landmark as it forms the gateway to Killarney Heights and in addition to being a regular service bus stop, is a bus stop servicing special events. Existing pedestrian bridges are located at the eastern and western ends of the study area crossing Warringah Road. The location of the proposal and key features within the study area are shown in Figure 1-2.

Figure 1-1: Location of the proposal
Figure 1-2: The study area including location of existing pedestrian crossings and bridges
(Source: Background image: Copyright NSW Land & Property)
The proposed pedestrian bridge would be located over Warringah Road, immediately to the east of the Starkey Street intersection at Forestville, and would include the following features (refer to Figure 3-1):

- A set of curved stairs and a lift on the southern side of Warringah Road to the east of Starkey Street. The stairwell/lift structure would be located within the road reserve of Warringah Road. In this location the road reserve includes the adjacent public car park which is owned and managed by Warringah Council.
- A set of curved stairs and a lift on the northern side of Warringah Road to the east of Ferguson Street. The majority of the stairwell/lift structure would be located within the existing Warringah Road corridor, with the remainder requiring partial acquisition of the adjacent premises (Forest Animal Hospital) (refer to section 3.6 for further details).
- A tied arch bridge deck spanning Warringah Road with overhead cover, safety fencing and throw screens.
- Reinstatement and provision of pedestrian paths leading to and around the bridge access points and nearby bus stops.
- Bicycle ramp provisions within the stairs would be considered as part of the detailed design investigations and include a review of public access and safety guidelines and maintenance issues.

The Proposal would also include:

- Removal of the on road signalised pedestrian crossing leg across Warringah Road on the western side of the intersection. (The on road signalised pedestrian crossings for the intersection would remain across Starkey Street and Ferguson Street).
- Relocation of the eastbound bus shelter on the northern side of Warringah Road. Currently located on the western side of the intersection, the bus shelter would be relocated about 55 metres east of the intersection. A new bus shelter would be constructed and the existing bus shelter would be demolished.
- Installation of pedestrian safety fencing at:
  > The corner of Warringah Road and Starkey Street on the western side of the intersection
  > The corner of Warringah Road and Ferguson Street on the western side of the intersection
  > Along the concrete median on Warringah Road on the eastern side of the intersection (underneath the new pedestrian bridge).

- Alterations to the Starkey Street car park, including:
  > Removal of up to five car parking spaces to accommodate the new stairwell and lift structure. (two of these five spaces would be reviewed and potentially modified as small car parking only during detailed design)
  > Installation of a new kerb and guttering around the new stairwell and lift structure.
  > Retention of the existing community notice board within the Starkey Street car park adjacent to Starkey Street.

1.4 The proposal
• Provisions for cyclists, including:
  > Installation of about seven bicycle parking spaces adjacent to the new stairwell/lift structure.
  > Provision of access from Warringah Road to the bridge at Ferguson Street pedestrian crossing
  > Provision of access from Warringah Road to the bridge at Starkey Street pedestrian crossing and the public car park
• Provision of pram ramps at the Starkey Street and Ferguson Street pedestrian crossings
• Installation of required road signage
• Landscaping of:
  > The garden area on the south-eastern corner of the intersection, within the car park
  > The road verge on the northern side of Warringah Road on both sides of Ferguson Street to complement the new property boundary of the Forest Animal Hospital and modified paths and fencing on the western site
  > The road verge on the south western side of Warringah Road including modification of paths.
• Relocation of above ground and below ground utilities
• Temporary compound site within the public car park area immediately adjacent to the proposal, for use during construction
• Partial property acquisition at the Forest Animal Hospital
1.5 Urban design guidance

The following documents, guidelines and policy framework are important references for the design development for the proposal and have been considered in the preparation of this urban design report and associated concept design and mitigation measures (refer Plate 1-1):

- Beyond the Pavement (Roads and Maritime, 2013)
- EIA N04 Practice Note: Guidelines for Landscape Character and Visual Impact Assessment V2.0 (Roads and Maritime, 2013)
- Bridge Aesthetics (Roads and Maritime, 2012)
- Pedestrian Bridge Standard for Built Up Areas (RMS, 2014)
- Landscape Guidelines (Roads and Traffic Authority, 2008)
- Northern Beaches Hospital Precinct Supporting Road Network - Urban Design Framework (KI Studio, September 2013)

For a list of referenced documents refer to the end of this report

Plate 1-1: Cover pages of Roads and Maritime (formally RTA) guidelines and policies referenced
Looking north from the Forestville Senior Citizens Centre towards the intersection of Starkey Street with Warringah Road
2. Existing environment

The following section of the report provides a summary of existing landscape context and cultural influences on the proposal area. The purpose of this background information is to inform the development of mitigation measures that respond to potential impacts that have been identified. Further detail can be obtained by reviewing the relevant specialist consultant’s reports.

2.1 Climatic factors

The Frenchs Forest to Terry Hills area is relatively high in a local context and known locally to be more exposed to heavy rainstorms and colder temperatures than the nearby coastal suburbs. According to Bureau of Meteorology data, Frenchs Forest has a total mean annual rainfall of 1,348.8 millimeters (mm), with the highest mean monthly rainfall falling in the months of January to April (129.5 to 155.5 mm per month). At Collaroy Beach 2.8 km to the north of Dee Why, reduced mean rainfall of 119.7 to 109.4 mm is recorded for the same period.

Frenchs Forest has a mean average annual temperature of 21.6 degrees Celsius (C), with the warmest months being December to February (about 28° C) and the coldest months of June to August (about 15 to 16°C).

Urban design considerations:
• Seasonal impacts on construction activities, specifically landscape implementation
• Planting and revegetation species would need to be adaptable to expected climate.

2.2 Landform and topography

The broader study area comprises a series of ridges, plateaus and gullies, with the major road ie Warringah Road, generally following, either directly over or next to a ridgeline tending east to west/ north to south. Elevations in the immediate study area range from 113 to 120 metres above sea level (a.s.l). The ridge continues in an easterly direction where it intersects with the ridge associated with the Wakehurst Parkway, some two kilometres away. To the west, Warringah Road gradually descends towards the Roseville Bridge over Middle Harbour, steepening on approach to the bridge.

The proposed pedestrian bridge site, which crosses Warringah Road, traverses a side slope, which sees Starkey Street rising to the south and Ferguson Street falling towards the north. At the intersection of Warringah Road and Starkey Street, the topographic height is about 115 metres a.s.l.

Urban design considerations:
• Prominent visual position from all approaches
• Vertical and horizontal alignment design challenges for bridge access.
2.3 Hydrology and drainage

General overland flow across the study area flows in a northerly direction, intercepted by pit and pipe drainage infrastructure associated with roads and developed properties. Cross drainage patterns are more subtle and strongly influenced by drainage infrastructure.

**Urban design considerations:**
- Sensitive broader catchments, comprising bushland creeks and water bodies
- The study area is generally well drained due to the ridge top location, which drain to nearby gullies and creeks.

2.4 Vegetation

Dense stands of indigenous vegetation remain in the broad study area, however residential and commercial land uses and roads have substantially impacted and continue to impact the remaining areas, creating a patchwork in various states of intactness. The more important areas of vegetation are consistent with Duffyys Forest Ecological Community associated with the Wakehurst Parkway corridor in the east and the Sydney Sandstone Ridgetop Woodland and the Sydney Sandstone Gully Forest which surround the proposal site.

Native and exotic cultural planting associated with Warringah Road, local streets, community, commercial and residential properties comprise an eclectic mix of species. Trees immediately to the west and east of the proposed pedestrian bridge consists of native Eucalyptus species. Another notable tree is the Norfolk Island Pine (*Araucaria heterophylla*) located on private property on the northern side of Warringah Road.

**Urban design considerations:**
- Clearing of any species associated with any vegetation community should be avoided
- Indigenous vegetation should not be cleared for ancillary work such as site compounds or temporary water quality infrastructure.

**Vegetation communities**

A number of vegetation communities including endangered ecological communities (EECs) exist around the study area, these are:
- Duffyys Forest Endangered Ecological Community
- Sydney Sandstone Ridgetop Woodland
- Sydney Sandstone Gully Forest.
2.5 Transport and pedestrian network

Warringah Road is the main arterial road in the region and in combination with Boundary Road to the south of the study area, links Chatswood and the Pacific Highway with the Northern Beaches. Wakehurst Parkway, to the east of the proposal site, provides an alternative route from Seaforth, Manly and the Spit Bridge to Narrabeen and the Northern Beaches. Forest Way, also to the east of the proposal site, connects Warringah Road with Mona Vale Road, an important regional arterial road that connects Mona Vale and Terry Hills in the north to St Ives and the Pacific Highway. All of these routes provide important connections for people of the Northern Beaches with either the City or the Pacific Highway and are heavily congested in the peak travel times.

Government and private (Forest Coach Lines) bus services operate in the study area, connecting Manly, Warringah Mall, Dee Why, Forestway Shopping Centre, Roseville, Terry Hills and Chatswood Rail Interchange. Buses also provide access to local schools and other community facilities. Several bus stops are located in the immediate study area around the proposal site on Warringah Road and Starkey Street. There are no rail or light rail services in the area, which places reliance on private vehicle and bus usage. There are no formal bicycle facilities aside from use of roads, bus lanes, verges and footpaths and occasional sections of shared path.

Warringah Road and Starkey Street form critical routes and intersections for the functioning of the local area as well as ongoing connectivity for local residents to essential services. Buses, bicycle and pedestrian routes are also present with important connections along Warringah Road and Starkey Street connecting retail commercial and community facilities to residential areas and major transport routes and connections. Pedestrian footpaths are located on both sides of Warringah Road and Starkey Street, providing various connections, all of which are to be maintained during and post-construction of the proposed pedestrian bridge (refer Figure 2-1).

Existing carpark located next to and near the proposal provide important carparking opportunities for locals using community and retail facilities. The carpark located immediately south of the proposal also serves as a drop off area for the Jamieson Square bus stop, as well an important carparking facility servicing bus access to major events such as those occurring at Sydney Olympic Park. The carpark is close to a church, senior citizens centre and a community hall and provides a safe drop off for less mobile people using these facilities, private vehicles and community minibus services.

Urban design considerations:

- Heavy vehicle congestion in peak hours and weekends, likely to worsen upon completion of the Northern Beaches Hospital
- Bus services and pedestrian connectivity to the local area is important
- High levels of pedestrian activity during school opening and closing times
- Improved bicycle and pedestrian connectivity and safety is needed
- Consideration of local vehicle, bicycle and pedestrian routes between residential areas, institutional and commercial facilities
- Relationship to regional road network in terms of connectivity and visual consistency.
Figure 2-1: Landscape context plan of the proposal area
2.6 Historical context

Historical context of the study area represents Aboriginal heritage, non-Aboriginal heritage and other notable site features that contribute to the history of the site.

Aboriginal heritage

For at least 20,000 years prior to European settlement in 1788, local Aboriginal people, largely of the Guringai and Gai-Marijgal, lived out a subsistence existence utilising the abundant source of food from densely forested areas, grasslands as well as nearby water bodies. The ridgetops and creeklines provided travel routes within the study area and to surrounding areas including the coast.

Exposed rock platforms found in and around the broader study area are considered suitable as surfaces for engraving and sharpening of stone axes/tools, or for shelter. No examples have been found in or around the immediate proposal site, however examples of rock engravings are known to exist in the local area. Many examples of Aboriginal culture that would have previously existed have since been destroyed by previous land uses and in some cases vandalism. No Aboriginal sites or deposits have been identified, nor are they likely to be uncovered during construction due to previous disturbance.

Non-aboriginal heritage

Europeans first discovered the Frenchs Forest and Forestville area shortly after settlement in 1788. Governor Arthur Phillip explored the area for the purpose of finding arable land and water sources for the colony. He noted that the area was not particularly suitable for agricultural uses and that there was dense bushland and areas of native grassland.

Settlement of the coastal villages such as Manly and Narrabeen began prior to the 1830s. Formalised land grants of 100-200 acres commenced in the Frenchs Forest area (to the east of the proposal site) around the 1840s-50s and consisted of small farms divided from the larger grants. Further subdivisions occurred, with smaller eight to ten acre residential lots available from the 1870s, often these were divided from the earlier, larger grants.

Substantial residential settlement of the Forestville area began about 1916 and continued during the years following World War I in the form of five-acre-lot returned soldier settlements, however progress was relatively slow due to the isolation of the area and scattered nature of the community. Access from the more densely populated south was via what is now Allambie Road from Manly, via the bullock track from Bantry Bay (now Bantry Bay Road) and via the Spit and Roseville punts across Middle Harbour.

Access improved with the construction of the first Roseville Bridge in 1924 (providing a connection to Willoughby and Chatswood) and the replacement of the Spit punt with a bridge in the same year. About 500 people lived in the area at the time, with the main occupations being related to rural activities but also brick-makers, labourers and the like. Rural activities consisted of dairy, poultry and pig farming as well as market gardening and orchards. Despite the above, the area remained largely rural until the mid nineteenth century.
After the second world war, the 1950-60s saw substantial low-density suburban development and road and infrastructure construction, as well as the construction of the village shopping centre in Forestville and the nearby suburbs of Killarney Heights, Davidson and Belrose and isolated pockets of commercial development along Warringah Road. Local schools were also established during this time, with Forestville Public School (established 1952) and Killarney Heights High School (established in the early 1960s), being located in close proximity to the proposal.

Roseville Bridge was replaced in 1966 with the larger capacity six-lane configuration that still stands today. Bus services became more frequent, with the “Royale” line linking Terry Hills with the city via Frenchs Forest (a route now serviced by Forest Coach Lines). From the 1960s until the present day, the study area has continued to develop and is a well known stretch of road due to its ridge top position, vegetated character and surrounding land uses.

Construction of the Northern Beaches Hospital and associated road network enhancements, will likely commence the next major phase of development in the surrounding area.

**Historically notable sites**

There are no items of heritage significance within the study area on the world, national, state or Roads and Maritime registers, however there are some items registered as having local significance on the Warringah Council Local Environmental Plan, including:

- Presbyterian Church of St Columbia: 685 Warringah Road., Forestville (about 50 metres east of the proposal).

Other locations exhibiting local character or considered important in an urban design sense to the history and development of the area are:

- The Forest Animal Hospital (located at the northern edge of the proposal on Ferguson Street)
- Forestville Memorial Hall (located about 80 metres south of the proposal on Starkey Street)
- Saint David’s Anglican Church (located about 100 metres west of the proposal on Warringah Road).

**Urban design considerations:**

- Construction activities in the study area should avoid items of heritage significance and be managed in accordance with best practice and management plans.
Figure 2-2: Historical urban design context of the study area (Source: Background image: Copyright NSW Land & Property)
2.7 Land use and key stakeholders

The land uses present in the proposal study area include community facilities (community hall, senior citizens centre and churches), residential (medium density townhouses and low density single-lot dwellings), retail (shopping village), commercial and light industrial (between Starkey Street and Cook Street to the east).

Key stakeholders

The study area consists of several stakeholder sites where strategic urban design measures would be required in order to mitigate the impacts of the proposal. These impacts include functional issues such as maintaining access and parking, as well as visual amenity issues such as screening.

Understanding the location, visual amenity and functional requirements of these stakeholders is a key urban design consideration in order to ensure mitigation measures adequately address the needs of these stakeholders. Refer to Figure 2-1 for locations.

These key stakeholders and stakeholder sites are (refer to Plate 2-1):

- Forest Animal Hospital on Warringah Road (refer Plate 2-1 A)
- Jamieson Square bus stop and carpark (refer Plates 2-1 B and C)
- Saint Columbia’s Presbyterian Church on Warringah Road (refer Plate 2-1 C)
- Hardwicks Motor Repairs and Forest Auto Electrics and other similar businesses (refer Plate 2-1 D)
- Forestville Senior Citizens Centre on Starkey Street (refer Plate 2-1 E)
- Forestville Memorial Hall on Starkey Street (refer Plate 2-1 F)
- The Centre Shopping Village between Starkey Street and Darley Street (refer Plate 2-1 G)
- Saint David’s Anglican Church on Warringah Road
- Northscape apartments and other similar townhouse developments on Warringah Road and Starkey Street (refer Plate 2-1 B)
- Single-lot residences on Warringah Road and local side streets including Walkom Avenue, Ferguson Street and Nicholas Avenue (refer Plate 2-1 F).

Urban design considerations:

- Visual, noise, access and character impacts on nearby land uses, particularly residences
- Regeneration of vegetation in areas previously disturbed by development.
- Contribution of land uses to determination of landscape character.
Plate 2-1: Key stakeholders (a-h)

A. Warringah Road (behind)
B. Jamieson Square bus stop
C. St Columbia’s (behind)
D. Ferguson Street
E. Walkom Avenue

URBAN DESIGN REPORT AND LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT - FINAL
2.8 Existing pedestrian bridges

Existing pedestrian bridges in the local area provide an architectural context for the proposed pedestrian bridge as they are experienced by local pedestrians and cyclists and viewed by motorists in quick succession of each other. Despite this, current standards and bridge guidelines would have more weight in terms of a basis for design due to safety and structural standards.

Warringah Road/Arthur Street intersection

A pedestrian bridge spans Warringah Road providing pedestrian and cyclist access between Arthur Street and Forestville Avenue, about 700 metres west of the proposal (refer Plate 2-2 and Figure 1-2 for location). Installed in the 1990s, the shared path bridge is connected to footpaths on Warringah Road via ramps at either end. The form of the bridge in cross section, is a prefabricated ‘U’ shaped girder with a circular tunnel-form safety screen. In elevation, the bridge presents a level steel girder with steel framing forming a combined parapet and bridge deck. The substructure is limited to the ramps and consists of a rebated concrete headstock and paired concrete rectangular columns. Visual screens have been provided at the southern end due to the proximity of a single residence. The northern end adjoins an existing retail development, locally known as “the crown of the hill” due to its prominent position on a local ridge line as one ascends from Roseville Bridge further south.

Warringah Road/Forest Way intersection

A pedestrian bridge spans Warringah Road immediately south of the Forest Way intersection with Warringah Road, about 1.5 kilometres to the east of the proposal (refer Plate 2-3 and Figure 1-2 for location). The pedestrian bridge provides access between a shared path next to Karingal Crescent residences and Forestway Shopping Centre and associated facilities and Frenchs Forest Public School. Constructed in the 1970s, the pedestrian bridge is an arched concrete structure with integrated haunching and circular columns. The pedestrian bridge does not comply with current accessibility standards, both in terms of slope and railing heights, nor does it satisfy clearance heights over the road or safety standards such as cyclist barrier rails or pedestrian safety screens. As part of the Northern Beaches Hospital road network enhancement proposal, which involves substantial widening of the road, a replacement shared path bridge is proposed.
Plate 2-3: Existing pedestrian bridge over Warringah Road at the intersection with Forest Way
Looking west towards Jamieson Square bus stop at the intersection of Warringah Road and Starkey Street.
3. Urban and landscape design concept

3.1 Urban design and landscape objectives and principles

Objectives

The over-arching aim of the urban design proposal is to ensure that the proposal is physically and visually integrated with its surrounding environment and to ensure clear and safe wayfinding across the intersection and to local facilities.

In order to meet this aim, a set of key urban design objectives and related design principles has been developed. These objectives and principles reference Roads and Maritime’s Beyond the Pavement and other key guidelines. These objectives and principles are also based on an understanding of the landscape and cultural values of the study area and the urban design and landscape issues that affect, or are affected by, the proposal.

These urban design objectives are as follows:

• Retain and reinforce the urbanised parkland character of Warringah Road
• Reinforce the vegetated character of the area and express the bushland character
• Deliver an integrated approach to traffic (including pedestrian and cycle), public transport and land use
• Retain the privacy and amenity for residents and commercial exposure for local businesses and community facilities in the immediate area
• Express the intersection as a gateway to the suburbs of Forestville and Killarney Heights
• Create a clear structural framework for streetscapes that enhances the legibility, wayfinding and functioning of the precinct and provide opportunities for urban restructuring and redevelopment
• Design integrated urban infrastructure/landscape design elements that allow the landscape to dominate built forms to recede.

Principles

A series of urban design principles have been developed to ensure that the urban and landscape design objectives are achieved. The purpose of these principles is to integrate sound urban design practice into all aspects of the concept design development, and also inform the detailed design and construction phases of the proposal.

The urban design principles relate to three broad areas of design influence:

• Alignment design - The design of the location and geometry of the proposal (alignment of the structure is referred to in this instance)
• Elements design - Input into the design of ancillary structures, fences and furniture that are required for the effective operation of the intersection
• Landscape design - The design of planting areas in order to integrate the proposal with the existing local landscape character and natural patterns, and to provide interest to the road users and pedestrians.

Table 1-1 (over page) describes the interrelationship between the urban design objectives, their associated urban design principles and the areas of the proposal that they influence. The mitigation measures that respond to the principles and impacts identified are located in Section 4 of this report.
### Table 3-1: Urban design objectives and principles

<table>
<thead>
<tr>
<th>Urban design objectives &amp; related principles</th>
<th>Areas of design influence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Retain and reinforce the urban parkway character of Warringah Road</strong></td>
<td>![Alignment design] ![Elements design] ![Landscape design]</td>
</tr>
<tr>
<td>1A Ensure that the parkway character of Warringah Road is retained through the retention of existing trees and the planting of trees wherever possible</td>
<td>![Alignment design] ![Elements design] ![Landscape design]</td>
</tr>
<tr>
<td>1B Carefully locate built elements and footpaths in order to avoid the need to remove existing trees or prevent the planting of trees</td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td><strong>2 Reinforce the vegetated character of the area and express the bushland character</strong></td>
<td>![Alignment design]</td>
</tr>
<tr>
<td>2A Retain the informal bush character of nearby garden beds through replanting of any cleared areas or newly created garden beds with locally occurring indigenous tree, shrub, ground cover and grass species</td>
<td>![Alignment design]</td>
</tr>
<tr>
<td>2B Proposed street tree planting should be of a locally occurring indigenous species</td>
<td>![Alignment design]</td>
</tr>
<tr>
<td>2C Reinforce the definition of the intersection through strategic landscape measures such as revegetating impacted areas where applicable</td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td>2D Minimise impacts to existing vegetation and utilise it as green buffers to of built form and urban infrastructure</td>
<td>![Alignment design] ![Landscape design] ![Landscape design]</td>
</tr>
<tr>
<td><strong>3 Deliver an integrated approach to traffic (including pedestrian and cycle), public transport and land use</strong></td>
<td>![Alignment design] ![Elements design] ![Landscape design]</td>
</tr>
<tr>
<td>3A Maintain user friendly pedestrian crossings at Warringah Road and Starkey Street</td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td>3B Ensure easy and safe connectivity to public transport modes, particularly bus stops along Warringah Road and community shuttle pickups in the community centre carpark and to community and commercial facilities on Starkey Street</td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td>3C Provide improved bicycle facilities including connections with regional cycle routes, secure bicycle parking with easy access to the existing bus stop at Jamieson Square and the proposed pedestrian bridge</td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td><strong>4 Retain the privacy and amenity for residents and commercial exposure for local businesses and community facilities in the immediate area</strong></td>
<td>![Alignment design] ![Landscape design]</td>
</tr>
<tr>
<td>4A Screening should take the form of vegetative screening wherever possible as opposed to walls and solid panels</td>
<td>![Landscape design] ![Landscape design]</td>
</tr>
<tr>
<td>4B Provide visual screening of the pedestrian bridge for adjacent properties, particularly to the Forest Animal Hospital and adjacent residents on Ferguson Street and Walkom Avenue</td>
<td>![Alignment design] ![Landscape design]</td>
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### Urban design objectives & related principles

<table>
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<td>Alignment design</td>
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| 4C | Retain clear sightlines from Warringah Road to the Forest Animal Hospital and from Starkey Street to community facilities. Consider means of highlighting the animal hospital to west bound traffic on Warringah Road |  |  | 🔺 |
| 5 | Express the intersection as a gateway to the suburbs of Forestville and Killarney Heights |  |  |  |
| 5A | Retain the Forest Animal Hospital and associated Norfolk Island Pine as a local landmark | 🔺 |  |  |
| 5B | Reinforce the character of the intersection through strategic landscape measures such as revegetating impacted areas where applicable and planting of trees |  |  | 🔺 |
| 6 | Create a clear structural framework for streetscapes that enhances the legibility, way-finding and functioning of the precinct and provide opportunities for urban restructuring and redevelopment |  |  |  |
| 6A | Utilise existing vegetation as visual screening within any new developments within the study area in order to retain vegetative character and minimise visual impacts. |  |  | 🔺 |
| 6B | Retain the informal bush character of nearby garden beds through replanting of any cleared areas or newly created garden beds with locally occurring indigenous shrub, ground cover and grass species |  |  | 🔺 |
| 6C | Rationalise wayfinding signage as part of an overhaul of signage at the intersection aimed at reducing clutter and providing clear messages to the road user |  |  | 🔺 |
| 6D | Integrate the pedestrian bridge structure within the landscape setting and ensure logical pathway connections to existing footpaths and building entries |  |  |  |
| 6E | The pedestrian bridge design should be in accordance with Roads and Maritime guidelines and consist of clean, streamlined forms and not be overly fussy in terms of detailing. Materials and colours should be recessive in order to allow the existing landscape to dominate with selected architectural highlight colours to express dramatic forms or features of the bridge |  |  | 🔺 |
| 7 | Design integrated urban infrastructure/landscape design elements that allow the landscape to dominate built forms to recede |  |  |  |
| 7A | At the bases of bridges and along pedestrian fences and paths, ensure that landscape treatments are well considered and soften hard edges |  |  | 🔺 |
3.2 Urban design and landscape strategy

In Section 1 of this report, a description of the proposal, background and guidelines has been provided followed by an outline of landscape context in Section 2 that defines the landscape setting of the proposal.

The urban design strategy follows on from the development of urban design objectives and principles, which when considered in parallel with the impacts analysis and subsequent mitigation measures outlined in Section 4, culminates in the concept urban design proposal.

A summary of the strategy, which aims to identify specific direction for the proposal, is outlined in Figure 3-1.

The strategy is described in detail in the key areas of bridge design, structures, road side furniture and landscape treatments in the following sub-sections.

Key benefits of the proposal

While there are challenges resulting from the removal of an at-grade pedestrian crossing and mitigation measures required in order to reduce character and visual impacts, the proposal design strategy would provide many improvements to the public domain as follows:

- Upgrading of existing pedestrian footpaths associated with the intersection, including widening and better connectivity to bus stops and responsiveness to pedestrian ‘desire lines’
- Connectivity with a defined regional bicycle route, that may encourage further development of bicycle facilities within the Warringah LGA
- Provision of a safer pedestrian environment, which avoids having to cross the road at grade
- Relocation of a bus stop that would enable safer sight distances and a more generous pedestrian waiting area
- Improvements to traffic flow on Warringah Road, particularly during peak times.

Key impacts of the proposal

The primary impacts of the proposal that the strategy aims to address through the development of mitigation measures are:

- Visual and character impacts associated with the introduction of a pedestrian bridge
- The requirement for some property strip acquisition, which would impact private property at the Forest Animal Hospital (noting that the current design does not directly impact on the building)
- The removal of a small number of car parking spaces in the Jamieson Square car park to the south east of the intersection, which services the bus stop, church, Memorial Hall and Senior Citizens Centre.
Figure 3-1: Urban design strategy plan
3.3 Structures

In terms of this proposal, the design of structures is focused on the proposed pedestrian bridge and associated stairs and lift towers required in order to maintain pedestrian access once on-road pedestrian access is removed. Design of this structure would be in accordance with the urban design objectives and principles as well as the relevant Roads and Maritime guidelines. Ancillary structures in the form of low retaining walls, resulting from modifications associated with providing access to the bridge would also be required.

Pedestrian bridges and shared path bridges

A pedestrian bridges and shared path bridges are required in order to maintain pedestrian and cyclist connectivity between suburban areas and across arterial roads where no on-road crossing is possible.

A proposed pedestrian bridge would be required in order to reduce the number of surface movements through the signalised intersection at Starkey Street and therefore increase the general traffic flow of Warringah Road at peak times. The bridge would maintain pedestrian connectivity following the removal of an at-grade crossing of the signalised intersection (refer Figures 3-3 and 3-4).

Pedestrian bridge design guidelines

The Roads and Maritime guidelines for an acceptable pedestrian bridge design describe a tied arch superstructure supported by lift shafts, which have a glazed front for visibility and security. The tied arch reduces the height of the lifts and the stairs compared to a traditional girder design and comprises a simple, elegant and distinctive form. The absence of long ramps reduces the bridge footprint, its capital cost and its physical and visual impact. In addition to these main elements the design incorporates the following features and characteristics:

- The lift can accommodate passengers including bicycles
- The open ends of the bridge deck allow views and provide a more pleasant user experience or can be screened off where views over existing properties are not desired
- A roof over the bridge span protects users from the elements
- Light weight and visually permeable metal screens would perform the dual function of ensuring safety of pedestrians and to ensure objects do not fall on to the roadway
- The bridge would be customised to help create a unique identity suitable to site context, in terms of materials, finishes and colours of the lift shafts, the arch and roof structure as well as in the landscape design
- Feature lighting can be employed to create a distinctive night time effect, however this is not currently proposed.

Principles specific to pedestrian bridge design

Following a review of guidelines and an understanding of context, the following design objectives are provided in order to guide the detailed design development of the pedestrian bridge:

- Design is to be in accordance with Roads and Maritime Bridge Aesthetics and Pedestrian bridge design standard for built up areas guidelines
Pedestrian bridges are to span the entire roadway without the need for supporting piers. Substructure is to be integrated with the main bridge deck structure and supporting lift towers. The pedestrian bridge is to be designed to a level of finish suitable for a high profile urban setting. Colours and finishes are to complement the surrounding urban bushland setting (refer Figure 3-2). Urban design of the pedestrian bridges is to focus on reducing visibility of the main structural members so that the structures appear lighter.

Retaining walls
The need for retaining due raised footpath levels should be ‘designed out’, or levels retained through edge thickening or kerbs only as to avoid highly visible structures that would be prone to vandalism.

![Indicative materials palette](image)

Note
1. All paint colours from Murobond range or similar principal approved. Manufacturer advice to be sought regarding suitable paint products and techniques.
2. Colour sampling to be undertaken prior to finalising colour schema.
3. Anti-graffiti sealant to be applied to all surfaces.
4. Final architectural design, structural design, configuration, location and finishes of the bridge subject to change during detailed design.

Figure 3-2: Pedestrian bridge - indicative materials palette
Figure 3.3: Urban Design Elevation - pedestrian bridge, lift tower and stairs

- Stainless steel mesh
- Weatherproof canopy
- Glazed lift entry
- New concrete paving at base of stairs and lands
- Concrete piers, concrete piles
- Stainless steel mesh balustrade
- Steel posts with dark recessive color
- Concrete bridge beams
- Vertical sight lines, western side of intersection entry
- Horizontal relief bundling on concrete side panels to assist with scale mitigation
- Mesh screen at end of walkway
- Steel guardrail at base of stairs
- Steel guardrail at base of stairs
- 1500 high pedestrian fence
- New concrete paving at max 1:40 cross fall at base of stairs and lands
- 0.7% down to 0.1% down
- ELEVATION SCALE 1:150 @ A3
Figure 3-4: Urban Design cross-section - pedestrian bridge deck and walkway
3.4 Roadside furniture

Roadside furniture comprises furniture, fittings and fixtures associated with the safe and functional operation of the road upgrade.

Bus shelters
An existing bus shelter on the northern side of Warringah Road, to the west of Ferguson Street would be relocated further along Warringah Road to the east, in order to provide a more direct relationship with the pedestrian bridge access. The proposed location would be consistent with Transport for New South Wales (TfNSW) objectives for the corridor. The design of the replacement bus shelter would be in accordance with Warringah Council requirements.

Fences
Fencing would be provided in the median on the eastern side of the intersection, as although pedestrians do not currently cross on that side, the relocated bus stop may encourage illegal crossing of the road. Fencing on the western side would be located in the verge, which in combination with proposed garden beds and redirecting of the footpaths, aims to discourage pedestrians from crossing where the current signalised crossing is located. These locations and fencing types would be further explored in the detailed design stage following a safety audit.

Suitable fencing designs/ materials would include visually permeable steel balustrades, selected to be as unobtrusive as possible. Fencing such as Roads and Maritime Type 1 pedestrian fencing (verge and median) would be considered for the basic level of acceptance.

Replacement of fencing along property boundaries is not anticipated however would be undertaken under consultation with the land owner if required.

Visual screens
Screening next to the pedestrian bridge access stairs would be required in order to prevent views into private property, primarily from the bridge deck and landings. Suitable materials would consist of light weight, semi-opaque materials in colours that compliment the structure so that they appear as integrated elements.

Barriers
Currently the proposed bridge is outside of the designated clear zone for this road and only fences are proposed for pedestrian safety. A review of safety in terms of collision and sightlines through fencing types and locations would be included in the detailed design stage. Fencing would aim to mitigate pedestrian desire lines across the road and to ensure safe spaces for pedestrians to occupy. Suitable materials would include visually open steel palisade fencing. Concrete should be limited to vehicle collision risk areas only as determined by Roads and Maritime safety assessment.
3.5 Landscape treatments

The general approach to the landscape design is to provide a well-vegetated road corridor that aims to integrate the proposal with the surrounding landscape, minimise visual and physical impacts for local residents and to reinforce a sense of place. In order to achieve this, the landscape revegetation must strike a balance between screening the proposal from sensitive views from surrounding areas and maintaining key views from the proposal to the surrounding landscape.

Landscape implementation methods would be developed to support the urban design mitigation measures and to restore the vegetative qualities of the place. Several treatments would be required to suit the existing conditions and to integrate the proposal with the surrounding landscape, thereby assisting to minimise the potential visual and ecological impact of the proposal.

The planting and revegetation design also aims to minimise the potential ecological impacts of the proposal by stabilising earthworks to prevent erosion, and reinforce existing habitats and ecological corridors through indigenous species selection.

Where planting is not employed, turving in the form of rolls or sods would be undertaken to existing turf areas damaged during the work or ground left exposed by the removal of footpaths or utilities trenches.

Principles specific to landscape treatments

The following landscape design principles would be applied to the proposal:

- Revegetation is to be undertaken to all areas affected by construction work
- The revegetation technique is to consist of planting of advanced indigenous species
- Revegetation in the form of seeding applications would not be used due to the small scale of the proposal and its urban setting
- Limited use of ‘feature’ planting at key intersections and important cultural areas
- Use of provenance plant material (plants grown from locally collected seeds) wherever possible and if not available, use of bioregionally sourced plants from reputable sources
- Planting and turving would be undertaken in accordance with Roads and Maritime Landscape Guidelines and specification RI 79.
3.6 Concept design drawings

Following the preparation of several options for the design of the bridge, the preferred option concept design drawings have been provided in order to describe the proposal and the proposed urban and landscape design and mitigation measures. The design would be further developed in subsequent design stages (refer Figures 3-5 to 3-6).
Figure 3-5: Concept urban design and landscape plans
Figure 3-6: Concept urban design and landscape plans.
4. Impact assessment

4.1 Overview

The following section of the report comprises a landscape character and visual impact assessment. This has been undertaken in accordance with the Roads and Maritime EIA N04 Practice Note: Guidelines for Landscape Character and Visual Impact Assessment V2.0 (Roads and Maritime, 2013) and has been undertaken in parallel with development of the concept design. Outcomes of the impact assessment have been incorporated directly into the final concept design. In both the landscape character and visual impact assessments, the Roads and Maritime impact grading matrix is employed.

Landscape character impacts

Impacts on landscape character have been interpreted through the identification of landscape character zones distributed across the proposal study area. An assessment of change is determined by developing an understanding of a zone’s impact to absorb or respond to changes brought about by the proposal.

Visual impacts

Visual impacts have been interpreted based on a series of viewpoints that are located on key areas surrounding the proposal. An assessment of potential impacts is made for each viewpoint based on an assessment of several viewpoints within the precinct and determining an overall value.
4.2 Landscape character assessment

The landscape contextual studies have demonstrated that the proposal area, has an identifiable sense of place. The combination of urban bushland, cultural tree planting, low-density residential and other land uses combine to create visual amenity that is consistent with the northern beaches of Sydney. The historical development of the area has seen recognisable cultural patterns on the landscape, juxtaposed with road alignments that respond to natural landscape features such as topography. Remnant bushland can be found in nearby corridors and remnant patches within the urban fabric of the study area.

Landscape character assessment methodology

The Roads and Maritime ‘Guidelines for Landscape Character and Visual Impact Assessment’ (RMS, 2009) provides the following definition of landscape character -

‘Landscape character is the aggregate of built, natural and cultural aspects that make up an area and provide its unique sense of place. Landscape in this context is taken to include all aspects of a tract of land - the built, planted and natural topographical and ecological features.’

In applying this definition to the specific conditions within the study area and the features of the proposal, the landscape character assessment also considers how the road upgrade would be used and how it would function as a part of the region. The assessment has considered both existing landscape character and potential landscape character post-completion.

Magnitude

In landscape character assessment, magnitude refers to the type of proposal and its compatibility with the existing landscape character. All anticipated elements of the proposal, including bridge and road infrastructure, shared paths, planting, lighting, etc., are considered. The scale of the element (height, length), as well as its location or setting, all have a bearing on the magnitude of the physical presence of the works.

A high magnitude results if the proposal is a major development or piece of road infrastructure and contrasts highly with the surrounding landscape, or entails heavy modification of the existing landscape, for example, the large-scale removal of existing vegetation. A moderate magnitude rating would result if the proposal is moderately integrated into the landscape. A low magnitude rating would occur if the proposal is of a small scale and integrates well into the landscape. The magnitude impact rating also considers whether the proposal has a positive or negative impact on the landscape character of the zone. For example, a proposal may be of a large scale but may provide beneficial outcomes such as increased open space, enhancement of the areas ‘sense of place’, and better connectivity.
Sensitivity
Sensitivity is assessed on the perceived value of the existing landscape character. A judgment has been made as to the quality of the landscape, its cultural and historical importance to the community, scenic quality, and overall composition of the place and its inhabitants. The following sensitivity judgments have been used as the basis for this assessment:

- Places with high social, recreational, and historical significance to local residents have higher sensitivity.
- Generally, water and natural environments are more highly valued than modified areas.
- Areas of unique scenic quality have higher sensitivity.
- A pristine environment would have greater sensitivity with less ability to absorb proposed elements in the landscape than modified landscapes or those areas with contrast and variety of landscape types.
- The number and frequency of viewers affects sensitivity, with retail, residential and open space.

Impact
Impact is the combination of the magnitude and sensitivity rating in accordance with the Impact Assessment Grading Matrix (refer Table 4-1).

Table 4-1: Roads and Maritime impact grading matrix

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate to Low</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate to Low</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate to Low</td>
</tr>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>High impact</td>
</tr>
<tr>
<td>High</td>
<td>High impact</td>
</tr>
<tr>
<td>High</td>
<td>High impact</td>
</tr>
<tr>
<td>High</td>
<td>High impact</td>
</tr>
<tr>
<td>High</td>
<td>High impact</td>
</tr>
</tbody>
</table>

Table 4-1: Roads and Maritime impact grading matrix
Landscape character zone identification

Landscape character zones (LCZs) are defined for the purpose of gaining an understanding of land use, topography and vegetation in combination with other factors intrinsic to the local landscape. The landscape character zones facilitate detailed assessment of the character of the proposal study area and of the magnitude, sensitivity and impact likely on the landscape character of each zone to be experienced as a result of the proposal.

Three landscape character zones have been identified within the study area based on the criteria identified above (refer Figure 4-1 and Table 4-2).

Table 4-2: Landscape Character Zones

<table>
<thead>
<tr>
<th>Landscape character zone</th>
<th>Description</th>
<th>Key proposal element</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Warringah Road</td>
<td>“Parkway to beaches” character corridor including immediate curtilage</td>
<td>Pedestrian bridge structure</td>
</tr>
<tr>
<td>02 Village</td>
<td>Area south of Warringah Road dominated by ‘The Centre’ shopping village and community facilities</td>
<td>Pedestrian bridge structure access provisions and landscaped curtilage</td>
</tr>
<tr>
<td>03 Residential</td>
<td>Area north of Warringah Road dominated by single lot residential housing and tree-lined streets</td>
<td>Pedestrian bridge structure access provisions and screening elements</td>
</tr>
</tbody>
</table>
Figure 4-1: Landscape character zones of the proposal study area
Landscape character zone 01: Warringah Road

Existing landscape character

The main component of landscape character zone 01 is Warringah Road, which when considered across the study area (refer Figure 1-2) comprises a six lane single carriageway road for much of its length and is lined with predominantly exotic street trees with a backdrop of mixed native and exotic vegetation associated with private property. This ‘parkway’ character reinforces the character of the northern beaches and is viewed by the many people that enter the area via this conduit as well as locals.

On approach to the proposed pedestrian bridge location along Warringah Road from the east, the road falls gradually following a local ridge line enclosed by mature street trees. The western approach along Warringah Road is characterised by a steeply inclining road having crossed Roseville Bridge, initially surrounded by native bushland, then opening out into a semi-enclosed residential parkway. From both directions ‘sense of arrival’ is experienced by the road user on arrival at Starkey Street. The intersection is broad and forms a gateway into Killarney Heights to the south and Forestville to the north and south, several signs reinforce this. The road is heavily used in morning and afternoon peak times causing the intersections along Warringah Road to be heavily congested. The road is also lined and crossed by overhead power cables.

Pedestrian and cyclist access through this character zone is limited to parallel footpaths and crossings at the major intersections via signalised on road crossings and existing pedestrian bridges to the east and west of the proposal. The road is not conducive to cycling as no separated facilities are provided (although is defined as a regional cycling route by Warringah Council), topography is steep in places and the road heavily congested at certain times including substantial bus movements.

Refer to Plates 4-1 and 4-2 for existing character images

The proposal

The proposed pedestrian bridge would be located on the eastern side of the intersection with Starkey Street. Minimal footpath construction and landscaping, as well as the relocation of an existing bus stop would occur.

Landscape character assessment

The impact on landscape character is described in Table 4-3.

Table 4-3: Landscape character zone 01 rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Existing six lane urban road with turning lane</td>
<td>Moderate to low</td>
</tr>
<tr>
<td></td>
<td>Vegetated parkway character</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mix of single-lot and medium density housing with occasional community, retail or light commercial land use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Existing pedestrian bridges either side of the study area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate pedestrian bridge at prominent location</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proposed fencing and signage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tree and shrub removal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minor footpath construction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Landscaping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bus stop relocation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Utility modification</td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-1: View A: East bound approach on Warringah Road looking towards the intersection with Starkey Street

Street trees with vegetative background on approach to proposal site

Plate 4-2: View B: East bound approach to Warringah Road (near Ferguson Street) looking towards the intersection with Starkey Road
Landscape character zone 02: village

Existing landscape character

This landscape character zone comprises a well-vegetated suburban village bordered by Warringah Road along its northern edge. The area contains a mix of land uses, with many providing important community facilities including, churches, halls, a senior citizens centre, library and shopping mall. There are pockets of medium density housing close to Warringah Road, which makes way for more traditional single lot housing further south. There are also light industrial uses. The functional centre of the community comprises the shopping mall and a small precinct of community facilities located next to an existing carpark.

Refer to Plates 4-3 and 4-4 for existing character images

The proposal

The proposal would see tree removal next to the road corridor on the southern side and access provisions for the proposed pedestrian bridge on the southern side of the intersection with Starkey Street. Impacts would include the removal of an existing signalised pedestrian crossing. Minimal footpath construction and landscaping would be required.

Landscape character assessment

The impact on landscape character is described in Table 4-4.

Table 4-4: Landscape character zone 02 rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
<tr>
<td>¬ Existing four lane suburban road, parking areas and service loops</td>
<td>Tree and shrub removal</td>
<td></td>
</tr>
<tr>
<td>¬ Tree lined suburban village</td>
<td>Minor footpath construction</td>
<td></td>
</tr>
<tr>
<td>¬ Mix of medium density housing with community, retail and light commercial land uses. Low density housing further south</td>
<td>Access route modifications</td>
<td></td>
</tr>
<tr>
<td>¬ Important pedestrian and cyclist connections between community facilities and local schools and to transport connections</td>
<td>Utility modification</td>
<td></td>
</tr>
<tr>
<td>¬ Landscaping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-3: View C: The Centre Shopping Village, Forestville near Starkey Street entry, looking west.

Plate 4-4: View D: Service road associated with the carpark servicing the Forestville Memorial Hall, looking north towards the Starkey Street intersection and proposal site.
Landscape character zone 03: residential

Existing landscape character

This landscape character zone comprises a well-vegetated suburban area bordered by Warringah Road along its southern and eastern edges. Dense vegetation associated with the Carol Creek/ Middle Harbour catchment encloses the suburb to the west. The zone can be accessed from Warringah Road in several locations, however these are no major intersections and roads generally provide immediate local access only, which results in a more secluded environment. The combination of tree lined streets and well-vegetated yards, defines the character of this zone. A well-known commercial property, namely the Forest Animal Hospital is also located within this zone next to Warringah Road. The building and grounds are of a residential scale and the building itself a notable local landmark due to its decorative architectural form.

Refer to Plates 4-5 and 4-6 for existing character images

The proposal

The proposal would see minor strip acquisition of an existing property immediately to the east of the intersection with Ferguson Street. Minimal footpath construction and landscaping, as well as the relocation of an existing bus stop would occur within the proposal area.

Landscape character assessment

The impact on landscape character is described in Table 4-5.

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
<tr>
<td>Quiet residential area with access to shops, schools and community facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractive vegetated streets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-5: View E: Looking northeast along Walkom Avenue to the north of the proposal site

Plate 4-6: View F: Looking north along Ferguson Street to the north of the proposal site
Landscape character assessment summary

The study area consists of a suburban village with surrounding residential areas that are in close proximity to bushland and recreational amenities. The character of the study area is reinforced by tree lined local streets, occasional vistas to surrounding natural landscapes and the relatively low vertical scale of the surrounding development and experienced by local residents who inhabit these surrounding suburbs as well as road-users.

Warringah Road, which is the primary road in the study area, is characterised by a combination of medium density townhouses, single lot housing and street trees, as well as occasional retail, community and light industrial land uses. Motorists and other users of Warringah Road experience bushland character immediately after crossing Roseville Bridge to the west of the study area, an experience that continues in an easterly direction, as well as to the north and south via local roads.

The Forestville village centre is focused around an open-air shopping mall and associated community facilities, which are woven together by pedestrian scale development and pedestrian friendly tree-lined streetscapes.

Other notable features are the quiet and well-vegetated suburban streets, which currently enjoy limited exposure to the main arterial roads.

Landscape character impact would be evenly spread across the three character zones identified. A moderate to low impact rating has been identified for zones outside of the road corridor due to the minimal magnitude of work proposed. The precedent of pedestrian bridges at either end of the study area has reduced the potential sensitivity of the potential viewers of the proposed bridge over the road corridor itself and therefore resulted in an acceptable level of impact.

The landscape character impact of the proposal across the study area is summarised in Table 4-6 below.

<table>
<thead>
<tr>
<th>Landscape character zone</th>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Warringah Road</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate to low</td>
</tr>
<tr>
<td>02 Village</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
<tr>
<td>03 Residential</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
</tbody>
</table>
4.3 Visual impact assessment

Overview
The potential visual impact of the proposal has been assessed in relation to a number of key viewpoints. It is based on the existing pattern of land use and development adjoining the works. The method of assessment has involved:

- Defining the scale or size, form and type of the proposal within the context of the study area
- Establishing an estimated visual catchment, through desktop analysis and ground-truthing on site
- Identifying key viewpoints from where the proposal would be visible
- Identifying key road user views of the proposal
- Assessing the level of potential visual impact on viewers at these viewpoints as a result of the proposal.

Visual impact methodology
The magnitude of change to existing views and the sensitivity of the viewers has been assessed for each of the chosen viewpoints in accordance with the Roads and Maritime impact grading matrix (refer Table 4-1).

Magnitude
Magnitude of change to existing views refers to the nature and scale of the proposal, and the extent and proximity of the view to the work. Magnitude represents the contrast in scale, form and type of the proposal works to the location and context to which it is to be placed. A high magnitude results if the proposal is of a major scale and are considered out of scale or uncharacteristic of the existing visual character; or if there is considerable modification to the existing landscape. A moderate magnitude would result if the proposal works are prominent but not considered to be substantially uncharacteristic with the existing visual character. A low magnitude results if there is minimal alteration to the existing view and the works are of a scale and nature that is consistent with the existing visual character.

Sensitivity
Sensitivity is the measure of the visual importance of the view and is dependent on the following:

- Distance between viewer and the works
- The category of viewer such as resident, visitor or worker
- The elements of the proposal that are visible
- Importance of the view.
Visual sensitivity includes the consideration of the perceived cultural and historical values of the visual environment and the elements within it. Generally, viewers with the highest sensitivity include:

- Residents who have existing views that would be affected by the proposal works
- Users of public open space where their attention is focused on the visual landscape, for example, lookouts or other scenic natural areas
- Communities that place high cultural and historical significance on the visual landscape.

Viewers with the lowest sensitivity are most likely to be:

- Employees working within an enclosed workplace and focused on their work – however interesting views should be provided for them within a short walk from their workplace
- Motorists (apart from tourists) whose attention is focused on driving – however it is important to provide a stimulating motorist experience.

Impact

Impact is the combination of the magnitude and sensitivity rating in accordance with the Impact Assessment Grading Matrix (refer to Table 4-1).

Visual catchment zones

A combination of the physical characteristics of the site, the nature of the existing road corridor and the proposal itself define the visible area and the catchment from where the works are visible. This visual catchment has then been defined as visual catchment zones (VCZ).

Refer to Figure 4-2 for visual catchment zone and visual assessment precinct identification. Two Visual Catchment Zones have been identified based on geographic proximity to the proposal, as follows:

- Primary visual catchment zone approximately 0 – 25 m
- Secondary visual catchment approximately 25 – 100 m.

Visual assessment viewpoints

Within the Primary and secondary VCZ, viewpoints have been identified based on key centres of activity associated with the proposal. The chosen viewpoints have been assessed using the following methods:

- Field investigations, site photography and mapping
- Computer generated visualisations based on 3-dimensional design and survey data
- Aerial views and transects using Google Earth Professional software.
In measuring the impact of change within the visual assessment precinct, the following conditions have been taken into account:

- Distance between viewer and road
- Elevation change between viewer and road
- A visual and desktop assessment made of the vertical and horizontal field of view impacted on by physical site features
- An assessment made of the type of intervention made by the proposal into the existing landscape.

The assessments are undertaken against the following primary conditions:

- Public domain impacts
- The impact from private properties or other selected locations
- The impact upon users of the road itself or other connecting roads.

**Primary visual catchment zone**

An assessment of the immediate terrain, built form and vegetation has determined the Primary visual catchment zone as an approximate 25 metre band around the proposal. The zone captures the front facades of residential, community and commercial buildings from where the most impacted views are located.

These properties tend to be located at similar elevations to the road, typically slightly above on the southern side of Warringah Road and slightly below on the northern side, although there are locations where this varies. Medium density residential townhouses would have views over the proposal from higher floors. Many surrounding properties are screened by existing vegetation.

Users of institutions and community facilities would also be impacted, namely Forestville Memorial Hall, Foresville Senior Citizens Centre and Saint Columbia’s Presbyterian Church, as well as users of more distant facilities that include The Centre Shopping Village and schools further afield. Properties in close proximity would be extremely sensitive to vegetation loss, which would potentially open up views of the proposal and associated road related infrastructure.
Figure 4-2: Visual impact analysis plan
**Viewpoint A**

**Location and description**
This viewpoint is located east of the intersection of Warringah Road and Ferguson Street on the northern verge and about 40 metres from the proposed pedestrian bridge (refer Plate 4-7).

**Visible elements of the proposal:**
- Pedestrian bridge, lift towers and stairs
- Relocation of bus shelter
- Vegetation removal on southern verge
- Tree planting and landscaping

**Affected viewers:**
- Workers and visitors en route to the Forest Animal Hospital
- Visitors to community facilities
- Residents on Warringah Road
- Pedestrians and cyclists.

**Description of impacts:**
- Removal of vegetation and blockage of views of vegetation reduces visual amenity
- Enclosure of portal view through road corridor as opposed to current open landmark intersection
- Reduced sight lines of pedestrian footpath on northern verge

The visual impact on these viewpoints is summarised in Table 4-7

**Table 4-7: Viewpoint A impact rating**

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Partly commercialised mixed with suburban residences and community facilities</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Existing six lane road with additional turning lane at intersection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Existing pedestrian bridges at either end of the study area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetated backdrop to intersection and parkway character</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pedestrian bridge, lift towers and stairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetation removal on southern verge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relocation of bus shelter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tree planting and landscaping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Undergrounding of overhead utilities and removal of pole.</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Plate 4-7: Viewpoint A: looking east to south east along Warringah Road towards the intersection with Starkey Street

Legend
- Indicative visible area of proposed pedestrian bridge
Viewpoint B

Location and description
This viewpoint is located on the eastern side of the intersection of Warringah Road and Ferguson Street on the northern verge and about 10 metres from the proposed pedestrian bridge (refer Plate 4-8).

Visible elements of the proposal:
- Pedestrian bridge stairs and lift tower in immediate foreground with bridge deck and southern verge bridge elements in background
- Bridge barriers and furniture eg bicycle racks
- Vegetation removal on northern and southern verge
- Landscaping and concrete footpath construction

Affected viewers:
- Workers and visitors to Forest Animal Hospital
- Workers and shoppers en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities
- Residents on Warringah Road
- Pedestrians and cyclists.

Description of impacts
- Removal of vegetation and blockage of views of vegetation reduces visual amenity
- Close range views to/from bridge access stairs and lift foyer
- Reduced sight lines of pedestrian footpath on northern verge

The visual impact on these viewpoints is summarised in Table 4-8.

Table 4-8: Viewpoint B impact rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
| Very close to commercial premises and residences on Warringah Road
| Existing six lane road with additional turning lane at intersection
| Existing pedestrian bridges at either end of the study area
| Vegetated backdrop to intersection and parkway character
| Pedestrian bridge, lift towers and stairs
| Vegetation removal on southern verge
| Tree planting and landscaping
| Undergrounding of overhead utilities and removal of poles
| Fencing |

Impacts: High to moderate
Plate 4-8: Viewpoint B: looking east to south along Warringah Road towards the intersection with Starkey Street

Legend
- Indicative viable area of proposed pedestrian bridge

- Forest Animal Hospital
- Northscape Apartments
- Warringah Road and Starkey Street intersection
**Viewpoint C**

**Location and description**
This viewpoint is located on the western side of the intersection of Warringah Road and Starkey Street on the southern verge about 40 metres from the proposed pedestrian bridge. It is similar to views experienced by the adjacent residential townhouse development *Northscape* (refer Plate 4-9 and 4-10).

**Visible elements of the proposal:**
- Pedestrian bridge, lift towers and stairs
- Direct view of vegetation removal on southern verge
- Tree planting and landscaping
- Concrete footpath construction

**Affected viewers:**
- Workers and shoppers en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities
- Residents on Warringah Road, particularly the *Northscape* townhouses
- Pedestrians and cyclists.

**Description of impacts**
- Removal of vegetation and blockage of views of vegetation reduces visual amenity
- Enclosure of portal view through road corridor as opposed to current open landmark intersection
- Reduced sight lines of pedestrian footpath on northern verge

The visual impact on these viewpoints is summarised in Table 4-9.

**Table 4-9: Viewpoint C impact rating**

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Moderate</td>
<td>High to moderate</td>
</tr>
<tr>
<td>- Very close to residential townhouses</td>
<td>- Pedestrian bridge, lift towers and stairs</td>
<td></td>
</tr>
<tr>
<td>- Partly commercialised mixed with suburban residences and community facilities</td>
<td>- Direct view of vegetation removal on southern verge</td>
<td></td>
</tr>
<tr>
<td>- Existing six lane road with additional turning lane at intersection</td>
<td>- Tree planting and landscaping</td>
<td></td>
</tr>
<tr>
<td>- Existing pedestrian bridges at either end of the study area</td>
<td>- Undergrounding of overhead utilities and removal of poles</td>
<td></td>
</tr>
<tr>
<td>- Vegetated backdrop to intersection and parkway character</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-9: Viewpoint C: looking north to north east along Warringah Road towards the intersection with Ferguson Street

Legend

- Indicative visible area of proposed pedestrian bridge
Note: This visualisation illustrates the urban design recommendations to be considered further during detailed design development and is subject to change.

Plate 4-10: Perspective view of proposed pedestrian bridge, looking north to north east along Warringah Road towards the intersection with Ferguson Street
Viewpoint D
Location and description
This viewpoint is located east of the intersection of Warringah Road and Starkey Street on the southern verge about 25 metres east of the proposed pedestrian bridge (refer Plate 4-11 and 4-12).

Visible elements of the proposal:
- Pedestrian bridge, lift towers and stairs
- Vegetation removal on southern verge
- Landscaping
- Concrete footpath construction.

Affected viewers:
- Workers and clientele en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities
- Users of Jamieson Square bus stop
- Pedestrians and cyclists.

Description of impacts
- Removal of vegetation and blockage of views of vegetation reduces visual amenity
- Enclosure of portal view through road corridor as opposed to current open landmark intersection
- Reduced sight lines of pedestrian footpath on southern verge

The visual impact on these viewpoints is summarised in Table 4-10

Table 4-10: Viewpoint D impact rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Partly commercialised mixed with community facilities</td>
<td>Pedestrian bridge, lift towers and stairs</td>
<td></td>
</tr>
<tr>
<td>Existing six lane road with additional turning lane at intersection</td>
<td>Vegetation removal on southern verge (vegetation backdrop on south western corner retained)</td>
<td></td>
</tr>
<tr>
<td>Existing pedestrian bridges at either end of the study area</td>
<td>Tree planting and landscaping</td>
<td></td>
</tr>
<tr>
<td>Vegetated backdrop to intersection and parkway character</td>
<td>Undergrounding of overhead utilities and removal of poles</td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-11: Viewpoint D: looking west to south west along Warringah Road towards the intersection with Starkey Street

- Forest Animal Hospital
- Northscape Apartments
- Jamieson Square bus stop
- Warringah Road and Starkey Street intersection

Legend

- Intensive visual area of proposed pedestrian stop
Note: This visualisation illustrates the urban design recommendations to be considered further during detailed design development and is subject to change.

Plate 4-12: Perspective view of proposed pedestrian bridge, looking west to south west along Warringah Road towards the intersection with Starkey Street.
Viewpoint E

Location and description
This viewpoint is located east of the intersection of Warringah Road and Starkey Street on the southern verge (refer Plate 4-13) about 25 metres east of the proposed pedestrian bridge.

Visible elements of the proposal:
- Pedestrian bridge, lift towers and stairs
- Vegetation removal on southern verge.

Affected viewers:
- Workers and clientele en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities, in particular Saint Columbia's Presbyterian Church
- Users of Jamieson Square bus stop
- Pedestrians and cyclists.

Description of impacts
- Removal of vegetation on southern verge mitigated by retention of foreground and background vegetation
- Enclosure of portal view through road corridor as opposed to current open landmark intersection
- Removal of car parking spaces.

The visual impact on these viewpoints is summarised in Table 4-11

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
</tbody>
</table>
- Party commercialised mixed with community facilities
- Existing parking area next to six lane road
- Existing bus stop and associated furniture
- Vegetated backdrop to intersection and parkway character
- Pedestrian bridge, lift towers and stairs partially visible behind parked cars
- Vegetation removal on southern verge (foreground and background vegetation retained)
- Removal of car parking spaces
- Concrete footpath construction.
Plate 4-13: Viewpoint E looking south west to north west along Jamieson Square carpark towards the intersection with Warringah Road and Starkey Street.
Viewpoint F

Location and description
This viewpoint is located south east of the intersection of Warringah Road and Starkey Street about 20 metres south of the proposed pedestrian bridge (refer Plate 4-14).

Visible elements of the proposal:
- Pedestrian bridge, lift tower and stairs
- Fencing and furniture eg bicycle racks
- Vegetation removal on southern verge.

Affected viewers:
- Workers and clientele en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities, in particular the Forestville Senior Citizens Centre
- Pedestrians and cyclists.

Description of impacts
- Removal of vegetation on southern verge mitigated by retention of foreground and background vegetation
- Views of bridge structure, fencing and furniture obscured by vegetation and parked cars

The visual impact on these viewpoints is summarised in Table 4-12.

**Table 4-12: Viewpoint F impact rating**

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>◊ Community facilities with mix of user types and varying intensities of patronage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Existing parking area next to six lane road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Existing bus stop and associated furniture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Well vegetated road reserve area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Pedestrian bridge, lift towers and stairs partially visible behind vegetation and parked cars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Vegetation removal on southern verge (foreground and background vegetation retained)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Removal of car parking spaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>◊ Concrete footpath construction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-14: Viewpoint F: looking north west at the Jamieson Square parking area towards the intersection with Warringah Road and Starkey Street.
Viewpoint G

Location and description
This viewpoint is located south of the intersection of Warringah Road and Starkey Street about 50 metres south of the proposed pedestrian bridge (refer Plate 4-15).

Visible elements of the proposal:
- Pedestrian bridge, lift tower and stairs
- Vegetation removal on southern verge.

Affected viewers:
- Workers and shoppers en route to The Centre Shopping Village and other retail, commercial and light industrial premises
- Visitors to community facilities, in particular the Forestville Memorial Hall
- Pedestrians and cyclists.

Description of impacts
- Removal of vegetation on southern verge mitigated by retention of foreground and background vegetation
- Views of bridge structure and associated barriers and furniture obscured by vegetation and parked cars

The visual impact on these viewpoints is summarised in Table 4-13

Table 4-13: Viewpoint G impact rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Pedestrian bridge, lift towers and stairs partially visible behind vegetation and parked cars</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Vegetation removal on southern verge (foreground and background vegetation retained).</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Community facilities with mix of user types and varying intensities of patronage</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Existing driveway in vegetated carpark area</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Existing bus stop and associated furniture</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Well vegetated road reserve area</td>
<td>Low</td>
</tr>
</tbody>
</table>
Plate 4-15: Viewpoint G: looking north at the Forestville Memorial Hall driveway towards the intersection with Warringah Road and Starkey Street.
Viewpoint H

Location and description
This viewpoint is located south of the intersection of Warringah Road and Starkey Street on the northern verge (refer Plate 4-16).

Visible elements of the proposal:
• Pedestrian bridge, lift tower and stairs
• Furniture eg bicycle racks
• Vegetation removal on southern verge.

Affected viewers:
• Workers and clientele en route to The Centre Shopping Village and other retail, commercial and light industrial premises
• Visitors to community facilities, in particular the Forestville Memorial Hall
• Pedestrians and cyclists.

Description of impacts
• Removal of vegetation on southern verge mitigated by retention of foreground and background vegetation
• Views of bridge structure and associated furniture obscured by vegetation and parked cars

The visual impact on these viewpoints is summarised in Table 4-14

Table 4-14: Viewpoint H impact rating

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>✗ Partly commercialised mixed with community facilities</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>✗ Medium density residential development with limited views of intersection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗ Well vegetated road reserve area</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗ Pedestrian bridge, lift towers and stairs partially visible behind vegetation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗ Vegetation removal on southern verge (foreground and background vegetation retained)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗ Removal of car parking spaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗ Concrete footpath construction.</td>
<td></td>
</tr>
</tbody>
</table>
Plate 4-16: Viewpoint H: looking north along Starkey Street towards the intersection with Warringah Road

Legend
- Indicative visible area of proposed pedestrian crossing
Visual impact assessment summary

The visual impact assessment summary for the proposed pedestrian bridge is described in Table 4-15. Potential impacts in the primary visual catchment zone would not necessarily be governed by proximity alone as these views are often screened by vegetation or reduced through the apparent visible width of the bridge structure. Viewer types also impact the results due to frequency of views.

Vegetation removal would have the most substantial impact from western viewpoints due to the more open nature of these views. Planting of trees would help to mitigate this. Eastern viewpoint impacts would generally be mitigated through retention of foreground and background vegetation. A range of impacts would potentially be experienced in secondary visual catchment zone viewpoints, the highest being on the western side for similar reasons as with the primary zone.

Overall, visual impacts are considered reasonable for the type of work proposed within a semi-urban setting such as this.

Table 4-15: Viewpoint visual impact rating

<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>VCZ</th>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Secondary</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>B</td>
<td>Primary</td>
<td>High</td>
<td>Moderate</td>
<td>High to moderate</td>
</tr>
<tr>
<td>C</td>
<td>Secondary</td>
<td>High</td>
<td>Moderate</td>
<td>High to moderate</td>
</tr>
<tr>
<td>D</td>
<td>Primary</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>E</td>
<td>Primary</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
<tr>
<td>F</td>
<td>Primary</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>G</td>
<td>Secondary</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>H</td>
<td>Long range</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>
4.4 Visual impact assessment - road users

Overview
Road user views of the proposed pedestrian bridge have been assessed in order to better understand the visual changes that would be experienced. The views and visual experience of road users are different from ‘road viewers’ and need to be carefully considered in order to promote a visually attractive, stimulating and safe experience for the motorist. The relationship between road user views and urban design principles can improve this driver experience and contribute to a ‘sense of place’.

The visual impact on road user views is described below and summarised in Table 4-16.

Road user impacts

Warringah Road (eastbound)
Heading east along Warringah Road from Forestville, motorists will follow a curving local ridgeline on approach the intersection with Ferguson Street. The proposed pedestrian bridge and associated lift towers and stair structures would be clearly visible on the southern side of Warringah Road from a distance of about 200 metres. It would be visible on both sides of Warringah Road from a distance of about 90 metres. On passing under the bridge, a portal type driving experience would be experienced and a brief minor narrowing of the motorist’s verge from the eastbound lanes, particularly when rounding the bend at a range of 90 metres (refer Plate 4-15).

Warringah Road (westbound)
Having passed the intersection with Cook Street, motorists would be immediately aware of the proposed pedestrian bridge and associated lift towers on the southern verge of Warringah Road at a distance of about 250 metres. The bridge structure would be visible on both sides of Warringah Road from a range of about 150 metres. Stair structures would be partially visible behind the towers from closer range.

Ferguson Street (southbound)
Having rounded the bend at the intersection with Epacris Avenue, motorists on Ferguson Street would experience first glimpses of the proposed pedestrian bridge from a distance of about 110m through a canopy of enclosing street trees. Views of the entire structure would increase on approach to the intersection with Walkom Avenue, although these views would be on a skew which would conceal the southern components of the bridge. The bridge would be completely visible from the intersection with Warringah Road.

Starkey Street (northbound)
Starkey Street, between The Centre Shopping Village and Warringah Road, is a straight, downhill road, which potentially offers road user views from a considerable distance. This is reduced due to substantial vegetation on the eastern side associated with the community buildings, which partially conceal the proposed pedestrian bridge. The southern lift tower would be visible from about 150 metres, while the northern lift tower would be visible from about 70 metres.
Plate 4-17: Road user eastbound view along Warringah Road of the proposed pedestrian bridge location at a distance of about 200 metres (above) and 90 metres (below) (Source: Background image: Copyright Google, Digital Globe, 2010)
Plate 4.18: Road user westbound view along Warringah Road of the proposed pedestrian bridge location at a distance of about 250 metres (above) and 150 metres (below)
(Source: Background image: Copyright Google, Digital Globe, 2010)
Plate 4-19: Road user southbound view along Ferguson Street of the proposed pedestrian bridge location at a distance of about 110 metres (above) and 70 metres (below)

(Source: Background image: Copyright Google, Digital Globe, 2010)
Plate 4-20: Road user northbound view along Starkey Street of the proposed pedestrian bridge location at a distance of about 150 metres (above) and 70 metres (below)
Table 4-16: Road user visual impact rating

<table>
<thead>
<tr>
<th>Precinct</th>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warringah Road eastbound</strong></td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>✓ Partly commercialised mixed with suburban residences</td>
<td>✓ Visible from up to about 200 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing six to seven lane road</td>
<td>✓ Visible on both sides of road from about 90 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing pedestrian bridge at either end of study area</td>
<td>✓ Portal created over road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Consistent street trees, vegetation and parkway character</td>
<td>✓ Tree removal on southern side (far side verge)</td>
<td></td>
</tr>
<tr>
<td><strong>Warringah Road westbound</strong></td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>✓ Partly commercialised mixed with suburban residences</td>
<td>✓ Visible from up to about 250 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing six to seven lane road</td>
<td>✓ Visible on both sides of road from about 150 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing pedestrian bridge at either end of study area</td>
<td>✓ Portal created over road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Consistent street trees, vegetation and parkway character</td>
<td>✓ Tree removal on southern side (near side verge)</td>
<td></td>
</tr>
<tr>
<td><strong>Ferguson Street southbound</strong></td>
<td>High</td>
<td>Moderate</td>
<td>High to moderate</td>
</tr>
<tr>
<td></td>
<td>✓ Suburban residential character</td>
<td>✓ Visible from up to about 110 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing suburban road</td>
<td>✓ Visible on both sides of Warringah Road from about 70 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Well vegetated character with funnelled streetscape view towards Warringah Road</td>
<td>✓ Bridge structure on skew visible at termination of view</td>
<td></td>
</tr>
<tr>
<td><strong>Starkey Street northbound</strong></td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate to low</td>
</tr>
<tr>
<td></td>
<td>✓ Partly commercialised mixed with suburban residences and community facilities</td>
<td>✓ Visible from up to about 150 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Existing four lane road</td>
<td>✓ Visible on both sides of Warringah Road from about 70 metres</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Well vegetated eastern side, developed western side</td>
<td>✓ Portal visible on skew</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Road descends towards intersection which increases viewing potential</td>
<td>✓ Tree removal on eastern side (far side verge)</td>
<td></td>
</tr>
</tbody>
</table>
4.5 Impacts during construction

Impacts during construction

Road Construction and staging
Construction of the proposed pedestrian bridge would be undertaken in stages to minimise disruption of road users and maintain safety of pedestrians. Staging details would be determined during the detailed design stage. It is likely there would be occasional periodic disruptions to traffic flows on Warringah Road. Night time construction activities should be considered.

Safety
Safety of students en route to local schools eg Forestville Public School and Killarney Heights High School, would be a major priority during construction. Footpaths are to be clearly delineated, with barriers wherever possible in order to provide safe passage next to construction areas.

Access
Pedestrian bridges provide access between residential areas and commercial and community facilities, it is therefore critical that access is maintained at all times. The existing signalised pedestrian crossing is to remain until commissioning of the bridge in order to ensure safe access is maintained across Warringah Road.

Site Compound
A site compound would likely be located within the carpark at the corner of Warringah Road and Starkey Street. The immediate area consists of a combination of light industrial businesses and community facilities.

The compound and stockpile areas would be screened by vegetation from most viewpoints. In order to mitigate visual impacts temporary mesh screening would be required. Other environmental controls such as noise and dust would also be required.

Visual impacts relating to the site compound are considered to be low.
4.6 Mitigation measures

This section describes the mitigation measures that have been included as part of the proposed pedestrian bridge concept design and strategy, described in Section 3 of this report and a summary of further mitigation measures to be considered during the detailed design and construction phases of the proposal. They have been developed in accordance with the urban design and landscape principles and objectives outlined in Table 1-1.

Mitigation incorporated in the concept design

The integration of the engineering and performance objectives with urban and landscape design objectives for the proposed pedestrian bridge, aims to produce an urban design outcome that fits sensitively with the existing qualities and characteristics of the area. In order to achieve this, a range of mitigation measures have been incorporated into the proposal as the concept has developed.

These measures combine to develop a solution that seeks to protect and maintain the existing visual character of the area and visual amenity of surrounding viewers (refer Table 4-17).

Table 4-17: Summary of urban design and landscape mitigation measures to be incorporated into the detailed design

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Location for use</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention of existing trees</td>
<td>Warringah Road southern and northern verge</td>
<td>Retention of landmark tree Araucaria heterophylla (Norfolk Island Pine)</td>
</tr>
<tr>
<td>Replacement of street tree planting</td>
<td>Corner of Warringah Road and Starkey Street</td>
<td>Assists with visual and character impact mitigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer species selection and procurement guidelines</td>
</tr>
<tr>
<td>Planting</td>
<td>Warringah Road southern and northern verge</td>
<td>Landscape buffer screening for sensitive residential ‘receivers’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Planting to rear of proposed fences and structures</td>
</tr>
<tr>
<td>Pedestrian bridge design</td>
<td>Lift towers, Bridge deck, Stairs and landings</td>
<td>Design in accordance with Roads and Maritime guidelines (refer Section 1 of this report)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lightening the visual appearance of structural members and reducing scale of the lift towers</td>
</tr>
<tr>
<td>Screen panel design</td>
<td>Warringah Road southern verge next to Forest Animal Hospital</td>
<td>Stair landings where a change in direction would align views from the bridge towards the building</td>
</tr>
<tr>
<td>Pedestrian and bicycle connections</td>
<td>Warringah Road and footpaths</td>
<td>Reinforcement of pedestrian and cyclist network, including design of widened shared footpaths, connections with shared paths or Warringah Council’s regional bicycle network</td>
</tr>
</tbody>
</table>
Mitigation to be incorporated into the detailed design

Further design stages would be required in order to develop the final urban design and landscape plan. Whilst development of the concept design has aimed at mitigating the overall impact of the proposed pedestrian bridge, the design and integration within the study area’s landscape and cultural setting, opportunities will arise during detail design to further refine the design of the proposal to produce enhanced urban design outcomes.

The urban design objectives and principles outlined in Section 1, together with the urban design and landscape concept included in Section 3, would be used to further guide the detailed design of key proposal elements of the road network and public domain areas. A summary of the key mitigation and management strategies that would be considered during the detail design phase of the proposal is provided below:

- Assessment of additional replacement street trees on approach to the proposed pedestrian bridge on Warringah Road, Starkey Street and Ferguson Street
- Removal of existing secondary footpath next to the existing bus stop west of Ferguson Street that is proposed be relocated further east and widening of the main footpath
- Incorporation of a bicycle ramp within stair profile so that bicycles can be ‘walked’ up the stairs in case of lift malfunction and to encourage active community members such as school children to use the bridge without having to wait for a lift. Note this would need to be carefully managed in relation to other user groups and accessibility standards
- Fence locations are to be carefully considered for function and safety, however minimisation of these furniture items would assist with mitigating landscape character and visual impacts. In addition, transparent barriers should be used as opposed to concrete barriers wherever possible
- Design levels (RLs) for lift tower and stair entries are to consider minimising cross falls and ensuring compliance with access standards and ease of connections
- Screen panel design to utilise opaque or semi-opaque panels employing textured surface and colours appropriate to the bridge structure as well as the urban bushland setting and local context. Translucent material to include patterning or colouring to mitigate bird impacts
- Wayfinding signage directing cyclists to other crossing locations of Warringah Road that do not require dismount eg signalised crossings to the west and east and existing pedestrian bridge at Arthur Street to the west
- Any further exploration of colour combinations and finishes is to ensure a contemporary urban design/architectural quality that is complimentary to this urban bushland setting and that lightens structural members and considers long term impacts such as water staining, bird droppings and fading caused by ultra violet rays
- Structural assessment of lift towers to determine whether glazed facade panels can be employed on both the front and rear panels of the lift towers
- Consider improved pedestrian safety measures on Starkey Street associated with existing community facilities.
5. Conclusion

Following an analysis of landscape context, the development of objectives, principles, strategies and mitigation measures, an assessment of landscape character and visual impact has been undertaken in accordance with Roads and Maritime guidelines. The results of this assessment has been incorporated into the concept design and has been recommended for further consideration in subsequent detailed design stages.

The landscape character and visual impact assessment of the proposal represents a qualitative assessment based on the landscape character zones, which have been determined based on an investigation of landscape and cultural context and an analysis of land use, vegetation, topography and scenic values. Impacts have been determined and measures proposed in order to address these impacts.

While the proposal would have the potential to provide a more efficient transport system along the Warringah Road corridor, through improvements to traffic flow, as well as maintain access for pedestrians and to a lesser degree, cyclists, overall, the proposal would result in a generally moderate degree of impact on both landscape character and visually, as experienced by road users and sensitive receptors. These impacts would be most felt in the immediate vicinity of the proposed pedestrian bridge.

Landscape character impact would be evenly spread across the three character zones identified. A moderate to low impact rating has been identified for zones outside of the road corridor due to the minimal magnitude of work proposed. The precedent of pedestrian bridges at either end of the study area has reduced the potential sensitivity of the potential viewers of the proposed bridge over the road corridor itself and therefore resulted in an acceptable level of impact for the road corridor also.

Visual impact is highest in three key locations, namely:
- Road user views on approach from Ferguson Street due the bridge forming a termination to the ‘funnelled’ view along this street
- The north eastern corner of the intersection of Warringah Road and Ferguson Avenue due to the proximity of the structure to existing commercial premises and the potential for overlooking by bridge users
- The south western corner of the intersection of Warringah Road and Starkey Street due to the prominence of the structure in the view from existing residences and the removal of existing trees that would otherwise screen the southern lift towers and stairs.

Lesser impacts would be experienced by viewers along the Warringah Road corridor, namely pedestrians approaching from the east and road users in both directions as the views are more resilient to change due to precedent or views being screened by existing vegetation. Impacts would potentially be the least for viewpoints east of the proposal near existing community facilities due to the well vegetated carpark area and building frontages. Views on approach from Starkey Street have low impacts due to the alignment of the bridge, existing vegetation on the eastern side and the more developed character of the western side associated with Forestville village, making the view more receptive to change.

In order to mitigate landscape character and visual impacts within this urban bushland/parkway setting, special consideration would be required to the retention of existing vegetation, replanting of trees and utilisation of materials and colours that are appropriate to the setting and which satisfy the urban design objectives and principles.
References

Roads and Maritime Services (formerly RTA) references and guidelines
Roads and Maritime Services, Appendix D Pedestrian bridge standard for built up areas, Not dated.
Roads and Maritime Services, Beyond the Pavement, Urban design policy, procedure and design principles, 2013.

Proposal reports
RPS, Starkey Street pedestrian bridge, Forestville, Review of Environmental Factors (draft), May 2015.
SMEC, Starkey Street pedestrian bridge, Forestville, evaluation of potential options assessment report, October 2014.

Background reports
SMM, Northern Beaches Hospital Connectivity and Network Enhancements Urban design and landscape character and visual impact assessment report: Concept Proposal and Stage 1, October 2014.
SMM, Northern Beaches Hospital Connectivity and Network Enhancements Urban design and landscape character and visual impact assessment report: Stage 2, April 2015.
SMEC, Northern Beaches Hospital Connectivity and Network Enhancements Environmental Impact Assessment Report, 2014.
KI Studio, Northern Beaches Hospital Precinct Supporting Road Network - Urban Design Framework, September 2013.
SMEC, Northern Beaches Hospital Connectivity and Network Enhancements Preliminary Environmental Investigation, 2014.
Appendix D

Construction Noise Assessment
Report

Starkey Street, Forestville – Pedestrian Bridge Construction Noise and Vibration Assessment

SMEC

Job ID. 09277

13 May 2015
PROJECT NAME: Starkey Street, Forestville – Pedestrian Bridge Construction Noise and Vibration Assessment

JOB ID: 09277

DOCUMENT CONTROL NUMBER ACO-NW-001-09277

PREPARED FOR: SMEC

APPROVED FOR RELEASE BY: A. McKenzie

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<th>DATE</th>
<th>COMMENT</th>
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<th>REVIEWED BY</th>
</tr>
</thead>
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<td>27/03/2015</td>
<td>Draft</td>
<td>A. Rouggos</td>
<td>A. McKenzie</td>
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1 INTRODUCTION

Pacific Environment was engaged by SMEC to complete a construction noise and vibration assessment on behalf of Roads and Maritime Services for the proposed construction of a pedestrian bridge over Warringah Road located on the east side of the Starkey Street intersection in Forestville.

Roads and Maritime Service (Roads and Maritime) are proposing to replace the existing pedestrian crossing of Warringah Road at the Starkey Street intersection with a pedestrian bridge to reduce traffic congestion on Warringah Road during peak periods caused by delays from operation of the pedestrian crossing.

As the project is not changing the road geometry or pavement type, operational road noise is not anticipated to change as result of the project.

This study provides a quantitative assessment of noise and vibration associated with construction of the pedestrian bridge.

This assessment has been conducted with consideration to the following documents:

- Road Noise Policy (RNP) DECCW 2011
- Noise Criteria Guideline (NCG), ROADS AND MARITIME 2014
- Noise Mitigation Guideline (NMG), ROADS AND MARITIME 2014
- Environmental Noise Management Manual (ENMM) RTA 2001
- Interim Construction Noise Guidelines (ICNG) DECC 2009
- Assessing Vibration, A Technical Guideline (Vibration Guideline) DEC 2004
- DIN 4150-3-1999 Structural Vibration – Part 3 Effects of vibration on structures
2 PROJECT DESCRIPTION

Roads and Maritime Services (Roads and Maritime) is proposing to construct a pedestrian bridge over Warringah Road near the Starkey Street and Ferguson Street intersection, Forestville to improve traffic flow along Warringah Road and pedestrian safety (the Proposal). The existing on road signalised pedestrian crossing across Warringah Road would be removed as part of the proposal. The Proposal site is located within the Warringah Council Local Government Area.

The proposed Starkey Street Pedestrian Bridge would include:

- A set of curved stairs and a lift on the southern side of Warringah Road to the east of Starkey Street. The stairwell and lift structure would be located within the road reserve of Warringah Road. In this location the road reserve includes the adjacent public car park which is owned and managed by Warringah Council.
- A set of curved stairs and a lift on the northern side of Warringah Road to the east of Ferguson Street. The majority of the stairwell and lift structure would be located within the existing Warringah Road corridor, with the remainder requiring partial acquisition of the adjacent premises (Forest Animal Hospital).
- A tied arch bridge deck spanning Warringah Road with overhead cover, safety fencing and throw screens.
- Reinstating and providing pedestrian paths leading to and around the bridge access points and nearby bus stops.
- Providing bicycle ramps within the stairs would be considered as part of the detailed design investigations and include a review of public access and safety guidelines and maintenance issues.

The Proposal would also include:

- Removing the on road signalised pedestrian crossing leg across Warringah Road on the western side of the intersection. (The on road signalised pedestrian crossing leg would remain across Starkey Street and Ferguson Street).
- Relocating the eastbound bus stop and shelter on the northern side of Warringah Road. The bus stop and shelter is currently located on the western side of the intersection and would be relocated about 55 metres east of the intersection. A new bus stop and shelter would be built and the existing bus stop and shelter would be demolished. A new leaning rail would also be installed next to the new shelter.
- Installing pedestrian safety fencing at:
  - The corner of Warringah Road and Starkey Street on the eastern and western side of the intersection.
  - The corner of Warringah Road and Ferguson Street on the western side of the intersection.
  - Along the concrete median on Warringah Road on the eastern side of the intersection (underneath the new pedestrian bridge).
- Altering the Starkey Street car park, including:
  - Removing three car parking spaces to accommodate the new stairwell and lift structure.
  - Two additional parking spaces would be modified to allow cars to be parked under the stair structure (between two to five metres high from ground level). The two modified parking spaces would include wheel-stops and height restrictions.
    - Installing new kerb and guttering around the new stairwell and lift structure.
  - Retaining the existing community notice board within the Starkey Street car park adjacent to Starkey Street.
• Provisions for cyclists would include:
  • Installing about seven bicycle parking facilities (up to 14 parking spaces) next to the new
    stairwell and lift structures
  • Providing access from Warringah Road to the bridge from the Ferguson Street pedestrian
    crossing
  • Providing access from Warringah Road to the bridge from the Starkey Street pedestrian
    crossing and the public car park
  • Providing pram ramps at the Starkey Street and Ferguson Street pedestrian crossings with
    realignment of crossing markings
  • Installing road signage
  • Providing landscaping on the:
    • Garden area on the south-eastern corner of the intersection, within the car park
    • Road verge on the northern side of Warringah Road on both sides of Ferguson Street to
      compliment the new property boundary of the Forest Animal Hospital and modified paths
      and fencing on the western side
    • Road verge on the south-western side of Warringah Road including the modified paths.
  • Relocating above ground and below ground utilities
  • Installing a temporary compound site within the public car park area next to the Proposal during
    construction

The location of the proposed pedestrian bridge in relation to the nearest noise sensitive receivers with
potential line of sight to the bridge construction works are shown in Figure 2.1 and listed in Table 2.1. A
plan of the pedestrian bridge is includes as Figure 2.2.

<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>Location</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR001</td>
<td>608 Warringah Rd</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR002</td>
<td>610 Warringah Rd</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR003</td>
<td>612 Warringah Rd</td>
<td>Commercial (Veterinary)</td>
</tr>
<tr>
<td>SR004</td>
<td>4 Ferguson St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR005</td>
<td>2 Ferguson St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR006</td>
<td>614A Warringah Rd</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR007</td>
<td>3 Ferguson St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR008</td>
<td>5 Ferguson St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR009</td>
<td>618 Warringah Rd</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR010</td>
<td>2 Starkey St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR011</td>
<td>2 Starkey St (level 2)</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR012</td>
<td>697 Warringah Rd</td>
<td>Church</td>
</tr>
<tr>
<td>SR013</td>
<td>2 Darley St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR014</td>
<td>2 Darley St (level 2)</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR015</td>
<td>6 Darley St</td>
<td>Library</td>
</tr>
<tr>
<td>SR016</td>
<td>2 Starkey St</td>
<td>Church</td>
</tr>
<tr>
<td>SR017</td>
<td>1 Starkey St</td>
<td>Municipal Public Building</td>
</tr>
<tr>
<td>SR018</td>
<td>3 Starkey St</td>
<td>Municipal Public Building</td>
</tr>
<tr>
<td>No.</td>
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<td>Type</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>SR019</td>
<td>3A Wyngate Cr</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR020</td>
<td>673 Warringah Rd</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR021</td>
<td>713 Warringah Rd</td>
<td>Dwelling</td>
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<tr>
<td>SR022</td>
<td>Darling St and Warringah Rd</td>
<td>Commercial</td>
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<tr>
<td>SR023</td>
<td>4 Darley St</td>
<td>Dwelling</td>
</tr>
<tr>
<td>SR024</td>
<td>4 Darley St (level 2)</td>
<td>Dwelling</td>
</tr>
</tbody>
</table>
Figure 2.1: Proposed Location of Pedestrian Bridge
Figure 2.2: Pedestrian Bridge plan
3 EXISTING AMBIENT NOISE ENVIRONMENT

The existing acoustic environment was characterised by a combination of long term and short term noise measurements.

Unattended background monitoring was completed at 612 Warringah Road, Forestville, from the 10 March to 17 March 2015. The logger location was set back approximately seven metres from the northern abutment of the bridge within the Forest Animal Hospital and is considered representative of the noise levels for the nearest noise sensitive receivers in the proposal area.

Noise monitoring was conducted using an ARL Type 316 noise logger. All equipment carries current calibration certificates and the calibration was checked in the field before and after the measurements with no significant drift (±0.5 dB) observed.

Meteorological conditions were recorded at the Terry Hills Bureau of Meteorology automatic weather station. Weather conditions including rainfall events and wind speeds greater than 5 metres per second during the monitoring period were excluded. Data was excluded on the 11 and 15 March. The resulting dataset was considered suitable for establishment of background noise goals.

The noise levels obtained are expressed in terms of $L_{A10, 15\text{min}}$, $L_{90, 15\text{min}}$ and $L_{Aeq, 15\text{min}}$.

- $L_{A10, 15\text{min}}$ is the A-weighted noise level that is exceeded for 10% of the monitoring time period (15 minutes).
- $L_{90, 15\text{min}}$ is the A-weighted noise level that is exceeded for 90% of the monitoring time period (15 minutes).
- $L_{Aeq, 15\text{min}}$ is the 15 minute equivalent continuous noise level containing the same acoustic energy as the actual fluctuating noise level.

The $L_{90, 15\text{min}}$ is commonly referred to as the background noise level and the lowest 10th percentile $L_{90, 15\text{min}}$ over a period (day, evening, night) is referred to as the period assessment background level (ABL). The Rating Background Level (RBL) for each day, evening and night period of the monitoring occurrence is then calculated by taking the median of the ABLS.

Table 3.1 presents a summary of the measured noise levels.

<table>
<thead>
<tr>
<th>Location</th>
<th>Day</th>
<th>Measured Noise Level, dB(A)</th>
<th>Evening</th>
<th>Night</th>
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<tr>
<td></td>
<td>$L_{10}$</td>
<td>$L_{RBL}$</td>
<td>$L_{Aeq}$</td>
<td>$L_{10}$</td>
</tr>
<tr>
<td>612 Warringah Road</td>
<td>69</td>
<td>55</td>
<td>68</td>
<td>68</td>
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</tbody>
</table>

Daily graphs and results of the noise monitoring results are included in Appendix A. Analysis of the noise logging data resulted in a RBL of 55 dB(A) during the day time, 51 dB(A) during the evening and 34 dB(A) during the night time.

Daily noise logger graphs and processed noise levels indicated an environment with high levels of traffic noise during the day time, evening and night time periods. Background $L_{90}$ noise levels were also high during the day time and evening, but reduced significantly during the night time period.
Short term (attended) noise measurements were also carried out at 4 Ferguson Street on the 10 March 2015 and 2 Ferguson Street on the 17 March 2015. Measurements were undertaken over 15 minute intervals using an NTi Audio XL2 Type 1 Sound Level Meter. Field calibration was checked before and after each measurement occasion with no significant drift (±0.5 dB) observed.

The weather conditions on both the 10 and 17 March included slightly overcast conditions with a slight north-easterly breeze.

A summary of the attended noise measurements is shown in Table 3.2.

**Table 3.2: Attended Noise Measurement Results**

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Location</th>
<th>Measured Noise Level dB(A)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/03/2015</td>
<td>4 Ferguson Street</td>
<td>73, 66, 54, 64</td>
<td>Background noise environment consisted of waiting traffic (idling vehicles), trees rustling, birds chirping. Cars accelerating from traffic lights 60 - 65. Trucks and busses passing by 65 – 70. Motorbikes 70 -75.</td>
</tr>
<tr>
<td>17/03/2015</td>
<td>2 Ferguson Street</td>
<td>73, 68, 56, 65</td>
<td>Similar results obtained to previous attended measurement at 4 Ferguson Street.</td>
</tr>
</tbody>
</table>

Attended monitoring indicated the noise environment was influenced primarily by vehicle pass-bys on Warringah Road, general road traffic noise and sporadically by local fauna (such as birds and dogs). Vehicles idling while waiting at lights were observed influencing the background noise level.
4 NOISE CRITERIA

4.1 Construction Noise

Appropriate noise targets are given in the Office of Environment and Heritage Interim Construction Noise Guideline (ICNG). In general these criteria are that construction noise should not exceed the background noise level by more than 10dB(A) during standard hours, and by more than 5dB(A) outside of standard hours. The criteria relevant to residential receivers for this project are given in Table 4.1.

Table 4.1: Construction Noise Management Levels at Private Residences

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Management Level</th>
<th>How to Apply</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Noise affected</td>
<td>The noise affected level represents the point above which there may be some community reaction to noise.</td>
</tr>
</tbody>
</table>
|            | RBL + 10dB(A)    | ➢ Where the predicted or measured $L_{eq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.  
  ➢ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays | Highly noise affected 75dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.  
➢ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:  
  1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences  
  2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
|            | Noise affected   | A strong justification would typically be required for works outside the recommended standard hours.  
➢ The proponent should apply all feasible and reasonable work practices to meet the noise affected level.  
➢ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. |
| Outside recommended standard hours | RBL + 5dBA | |


For non-residential receivers, the construction noise management levels are summarised in Table 4.2.

Table 4.2: Non-residential land use construction noise management levels

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Noise Management Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Places of worship (when in use)²</td>
<td>$L_{A_{eq},15min}$ 40 dB(A) (internal)</td>
</tr>
<tr>
<td>Commercial premises (when in use)</td>
<td>$L_{A_{eq},15min}$ 70 dB(A)</td>
</tr>
<tr>
<td>Library buildings²</td>
<td>$L_{A_{eq},1hr}$ 40 dB(A) (internal)</td>
</tr>
<tr>
<td>Municipal public buildings²</td>
<td>$L_{A_{eq},1hr}$ 50 dB(A) (internal)</td>
</tr>
</tbody>
</table>

Note: 1. When occupants are within the building
2. AS/NZS 2107:2000 provides recommended internal sound levels, maximum recommended adopted where receiver is exposed to high levels of traffic noise

Based on the logged background noise levels and the ICNG management levels, Table 4.3 presents the construction noise criteria for residential receivers during standard daytime, and out of hours periods.

Table 4.3: Residence Construction Noise Criteria

<table>
<thead>
<tr>
<th>Location</th>
<th>$L_{A_{eq}, 15 min}$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>612 Warringah Road</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>39</td>
</tr>
</tbody>
</table>

4.2 Sleep Disturbance

The Road Noise Policy (RNP, EPA 2013) and Environmental Noise Management Manual (ENMM, Roads and Maritime 2001) provide guidance as to the likelihood of sleep disturbance. As acknowledged by the RNP, there are no universally accepted criteria governing the likelihood of sleep disturbance. In other words, at the current level of understanding, it is not possible to establish absolute noise level goals that would correlate to levels of sleep disturbance for all, or even a majority of people.

Based on a review of research to date, the RNP suggests that:

- Maximum internal noise levels below 50 dB(A) to 55 dB(A) are unlikely to cause awakening reactions.
- One or two events per night, with maximum internal noise levels of 65 dB(A) to 70 dB(A), are not likely to affect health and wellbeing significantly.

In addition, the RNP references previous research contained within the Environmental Criteria for Road Traffic Noise (ECRTN, EPA 1999) which provided a guideline limit for sleep disturbance effects where maximum noise events do not exceed 15 dB above the background noise level.

In consideration of the above, the adopted screening criterion for sleep disturbance effects is $L_{A_{1,1min}} = RBL + 15$ dB.

Table 4.4 presents the criteria used in sleep disturbance assessment.

Table 4.4: Sleep Disturbance Criteria

<table>
<thead>
<tr>
<th>Location</th>
<th>$L_{A_{max}, 15 min}$ dB(A) Sleep Disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>612 Warringah Road</td>
<td>49</td>
</tr>
</tbody>
</table>
4.3 Construction Vibration

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage).

Human Comfort

The EPA administered guideline entitled Assessing Vibration: A Technical Guideline provides acceptable values for continuous and impulsive vibration in the range 1-80Hz.

Where vibration is intermittent, such as for construction sources, a vibration dose is calculated and acceptable values are shown in Table 4.5 below.

**Table 4.5: Acceptable Vibration Dose Values for Intermittent Vibration (m/s^1.75)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Daytime</th>
<th>Night Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preferred Value</td>
<td>Maximum Values</td>
</tr>
<tr>
<td>Critical areas^2</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>Residences</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Offices, schools, educational institutions and places of worship</td>
<td>0.40</td>
<td>0.80</td>
</tr>
<tr>
<td>Workshops</td>
<td>0.80</td>
<td>1.60</td>
</tr>
</tbody>
</table>

Notes:
1. Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472:1992.

Building Damage

German Standard DIN 4150-3:1999 “Structural Vibration – Part 3 Effects of vibration on structures” provides methods for evaluating the effects of vibration on structures.

The recommended limits (guide values) from DIN 4150 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.6.

**Table 4.6: Guideline Vibration Values for Short Term Vibration on Structures (mm/s)**

<table>
<thead>
<tr>
<th>Type of Building</th>
<th>Guideline values for velocity (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 to 10 Hz</td>
</tr>
<tr>
<td>Commercial and Industrial Building</td>
<td>20</td>
</tr>
<tr>
<td>Dwellings and buildings of similar occupancy or design</td>
<td>5</td>
</tr>
<tr>
<td>Structures that, because of their particular sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value</td>
<td>3</td>
</tr>
</tbody>
</table>
5 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

5.1 Introduction

The proposed construction works are estimated to take 12 months to complete and the primary phases will include earthworks, bridge construction, and post construction landscaping and reinstatement of road signage.

The majority of construction works are anticipated to be completed during recommended standard hours:

- Monday to Friday, 7.00am to 6.00pm
- Saturday, 7.00 to 1.00pm
- No works on Sundays or public holidays.

Information provided by Roads and Maritime suggest that some night works may be required outside of these standard hours to minimise traffic impacts. This may include the delivery and installation of the prefabricated bridge structure, utility adjustments and median/kerbside adjustments.

Works outside of standard hours (if required) would be in accordance with the procedure contained in the ENMM Practice Note vii – Roadworks Outside of Normal Working Hours, the ICNG and the measures outlined in this report. This would include notifying the local community of any works planned to be undertaken outside standard construction hours.

5.2 Methodology

Noise modelling has been undertaken using the ISO 9613 Acoustics – Attenuation of sound during propagation outdoors (ISO, 1996) algorithms, as implemented within the CadnaA 4.4 acoustic modelling package. The noise modelling takes into consideration the sound power level of the proposed site operations, activities and equipment, and applies adjustments for attenuation from geometric spreading, acoustic shielding from intervening ground topography, ground effect, meteorological effects and atmospheric absorption.
5.3 **Construction Activity**

Construction of the pedestrian bridge is expected to occur across a number of stages as shown in **Table 5.1**.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Name</th>
<th>Description</th>
<th>Predicted Period</th>
<th>Predicted Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Site Establishment (clearing)</td>
<td>Tree removal</td>
<td>Day</td>
<td>Cherry picker, Chainsaw, Mulcher, Trucks</td>
</tr>
<tr>
<td>1b</td>
<td>Site Establishment</td>
<td>Site Compound, Traffic controls, Establishment of temporary controls, Utilities</td>
<td>Day/night</td>
<td>Hand tools, Truck</td>
</tr>
<tr>
<td>2</td>
<td>Earthworks and Foundations</td>
<td>Piling and excavation, Foundation of lift shafts and stairs for both sides of Warringah Road</td>
<td>Day</td>
<td>Excavator, Piling rig, Hand tools, Generator, Concrete mixer, Trucks</td>
</tr>
<tr>
<td>3a</td>
<td>Structures (lifts and stairs)</td>
<td>Construction and installation of lift shafts, Construction of columns for supporting structures and stairs, Construction of stairs</td>
<td>Day</td>
<td>Crane, Generator, Concrete pump, Compressor, Hand tools, Trucks</td>
</tr>
<tr>
<td>3b</td>
<td>Structures (bridge lift)</td>
<td>Placement of prefabricated bridge structure</td>
<td>Night</td>
<td>Crane, Generator, Hand tools, Trucks</td>
</tr>
<tr>
<td>4</td>
<td>Final works and construction site decommissioning</td>
<td>Relocation of eastbound bus stop, Realignment of parking area spaces, Landscaping, Construction of concrete paths and fencing</td>
<td>Day</td>
<td>Hand tools, Trucks</td>
</tr>
</tbody>
</table>

Sound power levels for plant used in construction are taken from the Pacific Environments database of noise levels, UK HSE and DEFRA construction noise database. The sound power levels adopted for construction equipment are presented in **Table 5.2**.
### Table 5.2: Construction Equipment Sound Power Levels, dB(A)

<table>
<thead>
<tr>
<th>Construction Fleet</th>
<th>SWL, Leq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavator (20 tonne)</td>
<td>97</td>
</tr>
<tr>
<td>Cherry Picker</td>
<td>95</td>
</tr>
<tr>
<td>Chainsaw</td>
<td>106</td>
</tr>
<tr>
<td>Mulcher</td>
<td>119</td>
</tr>
<tr>
<td>Piling Rig (auger)</td>
<td>104</td>
</tr>
<tr>
<td>Crane (Small)</td>
<td>95</td>
</tr>
<tr>
<td>Crane (Large)</td>
<td>103</td>
</tr>
<tr>
<td>Hand Tools</td>
<td>87</td>
</tr>
<tr>
<td>Generator</td>
<td>94</td>
</tr>
<tr>
<td>Compressor</td>
<td>103</td>
</tr>
<tr>
<td>Concrete Pump</td>
<td>103</td>
</tr>
<tr>
<td>Concrete Mixer</td>
<td>105</td>
</tr>
<tr>
<td>Truck</td>
<td>107</td>
</tr>
</tbody>
</table>

#### 5.4 Construction Noise Assessment

A total of 24 receivers were considered when assessing construction noise impacts from the proposed pedestrian overpass, including 1 place of worship, 2 commercial properties a municipal public building and a library. There were no residential receivers identified within 10 metres of the proposed construction activity, either side of Warringah road.

Modelling was undertaken at both the south and north side of Warringah road. Results have been presented as a range of noise levels to encapsulate when activities are closest and further away from receivers.

These results are shown in Table 5.3. Where noise exceedances are expected to be above the construction criteria, cells have been shaded grey. Results above the highly impact 75 dB(A) noise criteria are shown as bold.

The predicted construction noise levels are considered to be conservative and are representative of the worst case noise levels given that:

- Not all sources will be operating at once.
- All noise sources are assumed to be located at the nearest point to the receptor.
- Noise levels will be reduced at any given location as construction activities progressively move.

#### 5.4.1 Discussion of Results

The results of noise modelling indicate a number of potential noise exceedances associated with each of the construction stage

- Stage 1

A review of the assessment results indicated that day time tree removal works (on the southern side of Warringah Road) would be expected to exceed noise criteria at residential receivers in the project area. The nearest three receivers on the northern side of the site were predicted to exceed the highly affected construction noise management level of 75 dB(A). This is due to the high noise emission from
chainsaws and wood chipping equipment. Although elevated, these works would be completed in a relatively short period.

The compound site would be established within the public car park off Starkey Street, and would be established within standard working hours.

Site establishment activities, excluding tree removal were not predicted to result in exceedances of the day time standard hours criteria. However, where night time works are required, exceedances of out of hour’s noise criteria during the night time period were predicted. Night time works were predicted to result in noise levels of 50 – 60 dB at nearby receivers with the highest results of 64 dB(A) predicted for receiver SR004 to the north on Walkom avenue. The predicted noise levels although elevated above the night time noise criteria of 39 dB(A) are of a similar order of magnitude to peak night time traffic noise levels.

- **Stage 2**

Noise levels exceeding the highly affected construction noise management level of 75 dB(A) were predicted for construction activity adjacent SR003. Exceedances of the day time construction criteria by up to 4 dB(A) were predicted at SR004, SR016 and SR017. These noise levels were of a similar order of magnitude to average day time traffic noise levels.

- **Stage 3**

Similar results were predicted for stage 2 and are not anticipated to result in significant annoyance during day time construction activities for this stage.

The night time bridge lift component of this stage resulted in noise levels ranging between 45 – 65 dB(A) at residential receivers, exceeding the night time out of hours noise criteria. The predicted noise levels although elevated above the night time noise criteria of 39 dB(A) are of a similar order of magnitude to peak night time traffic noise levels recorded. The duration of these night time works is expected to be short term.

- **Stage 4**

Final works were not predicted to result in significant exceedance of the noise criteria and were expected to result in satisfactory noise levels except at receivers SR003 and SR016 these being the Veterinary Clinic and Church respectively.

Noise mitigation measures are discussed further in Section 6.
<table>
<thead>
<tr>
<th>Receiver</th>
<th>Criteria</th>
<th>Stage 1(a)</th>
<th>Criteria</th>
<th>Stage 1(b)</th>
<th>Criteria</th>
<th>Stage 2</th>
<th>Criteria</th>
<th>Stage 3(a)</th>
<th>Criteria</th>
<th>Stage 3(b)</th>
<th>Criteria</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR001</td>
<td>65</td>
<td>70</td>
<td>39</td>
<td>43 - 53</td>
<td>65</td>
<td>59</td>
<td>65</td>
<td>56 - 57</td>
<td>39</td>
<td>54 - 56</td>
<td>65</td>
<td>43 - 53</td>
</tr>
<tr>
<td>SR002</td>
<td>65</td>
<td>71 - 76</td>
<td>39</td>
<td>49 - 57</td>
<td>65</td>
<td>62 - 65</td>
<td>65</td>
<td>61 - 62</td>
<td>39</td>
<td>60</td>
<td>65</td>
<td>49 - 57</td>
</tr>
<tr>
<td>SR003</td>
<td>70</td>
<td>70 – 86</td>
<td>-</td>
<td>-</td>
<td>70</td>
<td>62 – 78</td>
<td>70</td>
<td>61 – 77</td>
<td>-</td>
<td>-</td>
<td>70</td>
<td>57 – 75</td>
</tr>
<tr>
<td>SR012</td>
<td>50</td>
<td>51</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>34</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>SR013</td>
<td>65</td>
<td>57</td>
<td>39</td>
<td>38 – 45</td>
<td>65</td>
<td>45 – 51</td>
<td>65</td>
<td>43 – 48</td>
<td>39</td>
<td>44 – 49</td>
<td>65</td>
<td>38 – 45</td>
</tr>
<tr>
<td>SR015</td>
<td>50</td>
<td>52 – 57</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>35 – 41</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>30 – 39</td>
</tr>
<tr>
<td>SR016</td>
<td>50</td>
<td>64 – 72</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>60 – 69</td>
<td>50</td>
<td>57 – 68</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>53 – 64</td>
</tr>
<tr>
<td>SR017</td>
<td>60</td>
<td>63 – 69</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>58 – 66</td>
<td>60</td>
<td>55 – 65</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>51 – 61</td>
</tr>
<tr>
<td>SR018</td>
<td>60</td>
<td>61 – 66</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>55 – 62</td>
<td>60</td>
<td>52 – 60</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>48 – 57</td>
</tr>
<tr>
<td>SR019</td>
<td>65</td>
<td>64 – 69</td>
<td>39</td>
<td>47</td>
<td>65</td>
<td>53 – 54</td>
<td>65</td>
<td>51</td>
<td>39</td>
<td>49 – 50</td>
<td>65</td>
<td>47 – 48</td>
</tr>
<tr>
<td>SR021</td>
<td>65</td>
<td>55 – 60</td>
<td>39</td>
<td>36 – 42</td>
<td>65</td>
<td>43 – 47</td>
<td>65</td>
<td>40 – 45</td>
<td>39</td>
<td>40 – 45</td>
<td>65</td>
<td>36 – 42</td>
</tr>
</tbody>
</table>

Table 5.3: Predicted Construction Leq Noise Level, dB(A)
<table>
<thead>
<tr>
<th>Receiver</th>
<th>Criteria</th>
<th>Stage 1(a)</th>
<th>Criteria</th>
<th>Stage 1(b)</th>
<th>Criteria</th>
<th>Stage 2</th>
<th>Criteria</th>
<th>Stage 3(a)</th>
<th>Criteria</th>
<th>Stage 3(b)</th>
<th>Criteria</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Hours</td>
<td></td>
<td>Standard /Night time</td>
<td></td>
<td>Standard Hours</td>
<td></td>
<td>Standard Hours</td>
<td></td>
<td>Night time</td>
<td>Standard Hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR022</td>
<td>70</td>
<td>58 – 60</td>
<td>70</td>
<td>44 – 50</td>
<td>70</td>
<td>50 – 56</td>
<td>70</td>
<td>48 – 53</td>
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<td>47 – 53</td>
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<tr>
<td>SR023</td>
<td>65</td>
<td>60 – 63</td>
<td>39</td>
<td>40 – 46</td>
<td>65</td>
<td>49 – 51</td>
<td>65</td>
<td>47 – 49</td>
<td>39</td>
<td>47 – 49</td>
<td>65</td>
<td>40 – 46</td>
</tr>
<tr>
<td>SR024</td>
<td>65</td>
<td>63 – 64</td>
<td>39</td>
<td>45 – 47</td>
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<td>52 – 53</td>
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<td>50 – 51</td>
<td>39</td>
<td>50</td>
<td>65</td>
<td>44 – 47</td>
</tr>
</tbody>
</table>

Note: results exceeding the criteria are shaded, results above the highly affected noise goal are shown in bold.
1. Commercial premises.
2. Place of worship. Correction of 10 dB(A) applied for noise intrusion into building (when in use).
3. Library. Correction of 10 dB(A) applied for noise intrusion into the building (when in use).
4. Municipal public building. Correction of 10 dB(A) applied for noise intrusion into building.
5. Criteria presented for night time out of hours activities.
5.5 Sleep Disturbance Assessment

Construction stages 1(b) and 3(b) are primarily expected to be completed outside of standard hours, however some night time works may be required at any stage due to safety requirements for workers. The $L_{\text{max}}$ values are projected to be between 110 – 118 dB(A) for some noise sources during these stages. These may include: crane revving, engines starting/stopping, dropping of materials and material striking structures or other hard objects.

It is anticipated that these high noise events would be intermittent and could occur during the night when works are being carried out.

Table 5.4 presents $L_{\text{max}}$ noise levels representative of sleep disturbance predicted to exceed the sleep disturbance screening criteria during the night time period. The receivers that are predicted to be affected are shaded in grey.

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Noise Goal</th>
<th>Stage 1(b)</th>
<th>Stage 3(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR001</td>
<td>49</td>
<td>46 – 56</td>
<td>56 – 65</td>
</tr>
<tr>
<td>SR002</td>
<td>49</td>
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<td>62 – 68</td>
</tr>
<tr>
<td>SR003</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SR004</td>
<td>49</td>
<td>57 – 67</td>
<td>65 – 75</td>
</tr>
<tr>
<td>SR005</td>
<td>49</td>
<td>57 – 65</td>
<td>65 – 73</td>
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<tr>
<td>SR006</td>
<td>49</td>
<td>46 – 48</td>
<td>53 – 56</td>
</tr>
<tr>
<td>SR007</td>
<td>49</td>
<td>55 – 61</td>
<td>63 – 69</td>
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<tr>
<td>SR008</td>
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<td>52 – 56</td>
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<td>47 – 56</td>
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<td>SR010</td>
<td>49</td>
<td>58 – 59</td>
<td>66 – 67</td>
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<tr>
<td>SR011</td>
<td>49</td>
<td>59 – 61</td>
<td>67 – 69</td>
</tr>
<tr>
<td>SR012</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SR013</td>
<td>49</td>
<td>41 – 48</td>
<td>50 – 56</td>
</tr>
<tr>
<td>SR014</td>
<td>49</td>
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<td>52 – 55</td>
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<tr>
<td>SR015</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SR016</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>SR017</td>
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<td>SR018</td>
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<tr>
<td>SR020</td>
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<td>62 – 64</td>
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<td>SR021</td>
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<td>39 – 45</td>
<td>47 – 53</td>
</tr>
<tr>
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<tr>
<td>SR024</td>
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<td>48 – 52</td>
<td>56 – 58</td>
</tr>
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</table>
5.5.1 Discussion of Results

$L_{A_{max}}$ events were predicted to exceed noise goals at all receivers, however the predicted noise levels did not exceed the highly affected noise goal of 75 dB(A). Predicted noise levels were within similar ranges to existing traffic noise levels. The highest noise levels were predicted for residential receivers SR004 and SR005 adjacent the northern works area.

Night time construction works are not anticipated to occur for more than a two consecutive nights and would be done in accordance with Roads and Maritime Practice Note VII. Noise mitigation measures are discussed further in Section 6.
## 5.6 Vibration Assessment

The methodology contained in the USA’s Federal Transit Administration *Noise and Vibration Impact Assessment Manual*, (FTA Manual) as recommended in *Assessing Vibration a Technical Guideline*, was used to predict vibration levels of plant at a range of distances. Vibration source levels were taken from the ENMM and the FTA Manual. **Table 5.5** presents a summary of the predicted levels.

**Table 5.5: Predicted Vibration Levels**

<table>
<thead>
<tr>
<th>Item¹,²</th>
<th>Guideline Levels (mm/s)³</th>
<th>Predicted Vibration Level PPV mm/s at Distance (m)</th>
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<tr>
<td></td>
<td>Commercial</td>
<td>Residential</td>
</tr>
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<td>5</td>
</tr>
<tr>
<td>Excavator</td>
<td>2.8</td>
<td>1</td>
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</table>

Note: 1. Vibration source levels taken from Section 9 of ENMM. Predictions are indicative only and will vary depending on specific type of plant and geotechnical conditions.
2. Pile boring source level sourced from the FTA Manual
3. Criteria presented are the most stringent criteria from DIN 4150-3

The guideline levels represent a vibration level below which damage to buildings is not expected to occur. Exceedance of the guideline levels does not necessarily lead to damage, however further investigation would be required.

**Table 5.5** indicates a piling rig and excavator could operate at 5m or greater from residential structures without exceeding the guideline limit.

Where work occurs within 5m of a residence similar sensitive structure trial vibration measurements should be considered to establish safe working distances.

In order to reduce the potential impact of any vibration, it is recommended that construction vibration is considered as part of the construction noise and vibration management plan.
6 MITIGATION

6.1 Noise Mitigation

Construction noise should be managed by a detailed Construction Noise and Vibration Management Plan (CNVMP) and should be prepared by the successful construction contractor prior to commencement of works on site. This would utilise more detailed information in relation to the proposed construction methodology, activities, durations and equipment type and numbers. It is envisaged that the management plan would consider the following as a minimum:

- Identify nearby residences and other sensitive land uses.
- Develop noise management levels consistent with the ICNG.
- Assess the potential impact from the proposed construction methods.
- Where management levels are exceeded examine feasible and reasonable noise mitigation.
- Develop reactive and proactive strategies for dealing with any noise complaints.
- Identify a site contact person to follow up complaints.
- Noise monitoring.

Source controls:

- Mitigation of specific noise sources using portable temporary screens on site structures or other items, where this is possible.
- Maximising the offset distance between noisy plant items and sensitive receivers.
- Orienting equipment away from sensitive receivers.
- Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including cranes, excavators and trucks.
- Using lower powered or reduced size equipment where noise benefits are available, where practical.
- Using spotters, “smart” reversing alarms, or broadband reversing alarms in place of traditional beeper reversing alarms.
- Operating machinery in a manner which reduces maximum noise level event including excavators.
- Turning off machinery when not in use.

Administration controls:

- Respite and/or restricted construction hours for extended periods of noise intensive works would be required, especially where they occur outside of standard hours.
- Selecting plant and equipment based on noise emission levels.
- Using alternative construction methods to minimise noise levels.
- Avoiding the use of horns and alarms, especially at night.
- Education and training of site staff is necessary for satisfactory implementation of noise mitigation measures.
- Site awareness training / environmental inductions that include a section on noise mitigation techniques / measures to be implemented throughout the project.
- Ensuring work occurs within approved hours.
- Ensuring plant and equipment is well maintained and not generating excessive noise.
- Avoid dropping materials and tools or dragging materials across hard surfaces.
Community management:

- Notifying receivers potentially affected by the works.
- Keeping the community informed in relation to noise intensive activities in the immediate area.
- Consultation where prolonged or consecutive periods of out of hours work are planned.

Site controls:

- Limiting the number of plant and equipment on site.
- Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.
- Arrange site accesses to minimise impacts on sensitive receivers.
- Carrying out loading and unloading away from sensitive receivers.
- Selecting site access points and roads as far as possible away from sensitive receivers.

Where noise levels are above the highly noise affected level, restricting the hours that the very noisy activities can occur would be considered, taking into account the times identified by the community when they are less sensitive to noise (such as mid-morning or mid-afternoon for works near residences). Through community consultation, it can be determined if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Furthermore, the contractor would examine alternative and quieter work procedures, respite periods including restrictions on timing and/or close communication with affected residents in relation to the works and their duration. For example, where feasible and reasonable, noise intensive activities should be completed as early as possible in the evening (if evening work is necessary) and preferably not be carried out after midnight.

For out of hours work, the programming and consultation procedures outlined in ENMM practice note vii would be followed. This includes avoiding impacting residential receivers on two consecutive nights or six days in a month. Noise intensive work would be programmed to accommodate this and periods of major student examination periods. Where it is not practical to implement this program, additional noise and vibration management measures should be considered.
6.2 Vibration Mitigation

Where activities using sources of vibration occur within close proximity to structures and identified receivers, potential impacts are likely to be increased. In this case, the following mitigation measures are recommended for consideration:

- Undertake Building Condition Surveys prior to construction works as required.
- Increase separation distance between vibration source and sensitive receiver where feasible and reasonable.
- Substitution of methods of high vibration emission to lower vibration methods.
- Consideration of vibration impacts in the CNVMP.
- Where excavation or piling is expected to occur within 5m of a sensitive structure, vibration trial measurements should be conducted to establish safe working distances.
- Undertaking trial measurements to establish the site specific vibration propagation from high risk activities to establish site specific offset distances required for compliance with the cosmetic building damage criteria.
- Vibration monitoring as required, as part of vibration impact management.
- Where vibration monitoring is undertaken and criteria exceedances are identified, management measures should be implemented immediately to ensure vibration compliance is achieved.
7 CONCLUSION

An assessment of traffic noise and construction noise and vibration levels from the proposed development of a pedestrian bridge located over Warringah Road, east of the Starkey Street intersection at Forestville has been conducted.

Existing ambient noise levels were determined, at a representative receiver using a combination or short term attended and long term unattended noise monitoring.

Construction of the project is expected to occur during and outside of standard hours. Construction outside of standard hours is required as the development involves work that is potentially disruptive to traffic and is occurring on the existing Warringah Road.

Overall noise impacts from the proposed development were determined at noise sensitive receivers potentially affected. The assessment of construction noise impacts indicated that a number of residential receivers would be expected to experience noise levels in excess of the construction noise management levels and in some cases would be highly noise affected for receivers closest to the works. In addition maximum noise levels would also be expected to exceed the sleep disturbance screening criteria when works are undertaken during the night time period.

The assessment of construction vibration indicated an offset distance of at least 5m for impacts to be minimised.

In-principal construction noise and vibration mitigation measures have been recommended which includes the development of a CNVMP. It is recommended that source, administrative and site controls, in parallel will community management mitigation measures be implemented as means to manage noise impact from the construction of the pedestrian bridge.
8 REFERENCES

AS/NZS 2107-2000 (2000), Acoustics – Recommended design levels and reverberation times for building interiors


DECCW (2009) Interim Construction Noise Guideline

DEFRA, UK (2008), Construction Noise Database (Phase 3), Database of noise emissions from equipment used on construction and open sites

DIN4150 (1999), Structural vibration – Effects of vibration on structures

HSE, UK (2008), Noise emissions and exposure from mobile woodchippers


NSW Department of Environment Climate Change and Water (2011) Road Noise Policy (RNP).


NSW Environmental Protection Authority (1999), Environmental Criteria for Road Traffic Noise (ECRTN).

Appendix A  UNATTENDED NOISE MONITORING
A.1 NOISE MONITORING GRAPHS

612 Warringah Road - 10.03.15

612 Warringah Road - 11.03.15
Table A-8.1 Summary of Noise Logging Results, 612 Warringah Road, Forestville

<table>
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<tr>
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<th>Evening LA10</th>
<th>Night LA10</th>
<th>Day L_Aeq</th>
<th>Evening L_Aeq</th>
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</tbody>
</table>

Notes: * period not logged
A.2  LOGGER LOCATION

Figure 8.1: Noise Logger Location (a)
Appendix E

Roads and Maritime PACHCI Stage 1 Letter
25/09/2014

Joanne Moore  
Project Development Officer  
Level 8, 27-31 Argyle Street  
Parramatta NSW 2150

Dear Joanne

Re: Preliminary assessment results for the Warringah Road and Starkey St intersection improvements proposal based on Stage 1 of the Procedure for Aboriginal cultural heritage consultation and investigation (the procedure).

The project, as described in the Stage 1 assessment checklist, was assessed as being unlikely to have an impact on Aboriginal cultural heritage. The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate any known Aboriginal objects or places in the immediate study area.
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage’s Due diligence Code of Practice for the Protection of Aboriginal objects in NSW and the Roads and Maritime Services’ procedure.
- No mature aged trees with Aboriginal cultural modification are present.
- Note: No site compound assessment is included in this clearance letter. When the location of a compound site is identified, it will need to be assessed for possible impacts to Aboriginal Heritage.

Your project may proceed in accordance with the environmental impact assessment process, as relevant, and all other relevant approvals.

If the scope of your project changes, you must contact me and your regional environmental staff to reassess any potential impacts on Aboriginal cultural heritage.

If any potential Aboriginal objects (including skeletal remains) are discovered during the course of the project, all works in the vicinity of the find must cease. Follow the steps outlined in the Roads and Maritime Services’ Unexpected Archaeological Finds Procedure.

For further assistance in this matter do not hesitate to contact me.

Yours sincerely,

Mark Lester  
Aboriginal Cultural Heritage Officer (ACHO) – Sydney Region

Roads and Maritime Services
Appendix F

ISEPP Consultation Correspondence
15/04/2015

Our reference: D/00516
Contact person: Joanne Moore

Boris Bolgoff
Warringah Council
Civic Drive
725 Pittwater Road
Dee Why NSW 2099

Dear Boris Bolgoff

RE: Consultation regarding proposed Starkey Street, Forestville Pedestrian Bridge.

Roads and Maritime Services (Roads and Maritime) is proposing to undertake works for the provision of a pedestrian bridge over Warringah Road at the Starkey Street intersection. The works would include removing the existing signalised pedestrian crossing on the western side of the intersection.

Under the State Environmental Planning Policy (Infrastructure) 2007, Roads and Maritime Services is required to consult with Warringah Council under clause 13 due to the potential impacts on council infrastructure.

I appreciate your attendance and participation at a recent Constructability, Risk and Safety workshop for the proposal. An outline of the proposal as presented during the workshop is attached to this letter.

It would be appreciated if you could provide any comments regarding this proposal within 21 days of the date of this letter.

Roads and Maritime would be pleased to provide further information if required. In this regard Joanne Moore may be contacted on 02 8849 2345 or by email joanne.moore@rms.nsw.gov.au.

Yours sincerely

Joanne Moore
Project Development Manager

Roads & Maritime Services
Starkey Street pedestrian bridge, Forestville

The proposal

Roads and Maritime is proposing to remove the signalised pedestrian crossing of Warringah Road at Starkey Street and install a new pedestrian bridge over Warringah Road east of Starkey Street. The proposed Starkey Street Pedestrian Bridge would increase the transport efficiency on Warringah Road through Forestville, minimise delays, allow for more effective road-based public transport and improve road safety.

The proposed pedestrian bridge would include:

- A set of curved stairs and a lift on the southern side of Warringah Road to the east of Starkey Street. The stairwell/lift structure would be located within the existing Warringah Road corridor
- A set of curved stairs and a lift on the northern side of Warringah Road to the east of Ferguson Street. The majority of the stairwell/lift structure would be located within the existing Warringah Road corridor, with the remainder requiring partial acquisition of the adjacent premises (Forest Animal Hospital)
- A tied arch bridge deck spanning Warringah Road with overhead cover, safety fencing and throw screens
- Reinstatement of pedestrian paths leading to and around the bridge access points and nearby bus stops
- Bicycle access facilities built into the stairwells on both sides.

The proposal would also include:

- Removal of the signalised pedestrian crossing leg across Warringah Road on the western side of the intersection. (The signalised pedestrian crossings for the intersection would remain across Starkey Street and Ferguson Street)
- Relocation of the eastbound bus shelter on the northern side of Warringah Road (currently located on the western side of the intersection). A new bus shelter would be constructed and the existing bus shelter would be demolished
- Installation of pedestrian safety fencing at
  - The corners of Warringah Road and Starkey Street on the eastern side of the intersection
  - The corner of Warringah Road and Ferguson Street on the eastern side of the intersection
  - Along the median on Warringah Road on the eastern side of the intersection
- Alterations to the Starkey Street car park, including:
  - Removal of a number of car parking spaces to accommodate the new stairwell and lift structure
  - Installation of a new kerb and guttering around the new stairwell and lift structure
  - Potential installation of motor cycle/bicycle parking spaces adjacent to the new stairwell/lift structure to maximise the available space
- Installation of required road signage
- Landscaping of the road verges along the northern side of Warringah Road and the garden area adjacent to the car park on the southern side of Warringah Road
- Relocation of above ground and below ground utilities.
Construction Methodology

The construction methodology would be refined during detailed design, but it is anticipated that the proposed works would be staged to complete the construction of the stairs and lift shafts on both sides of Warringah Road before installing the tied arch bridge deck, which would be pre-constructed offsite and assembled on site.

Construction is expected to involve the following activities:

- Site establishment including temporary construction compound, traffic controls, environmental controls and establishment of temporary bus stops where required
- Relocation of utilities
- Removal of vegetation from both sides of Warringah Road
- Piling and excavation for the foundation of lift shafts and stair supports. Piles would be bored
- Construction of lift shafts and installation of lifts
- Construction of columns for supporting structures and stairs
- Construction of stairs
- Erection of bridge girder
- Placement of the pre-cast tied arch bridge deck and prefabricated bridge structure
- Installation of lighting and safety screens
- Relocation of eastbound bus stop and shelter
- Realignment of parking area spaces, including the installation of new kerb and guttering around southern stairwell and lift structure
- Construction of concrete paths to and around the new bridge and installation of pedestrian fencing
- Installation of signage
- Landscaping and reinstatement of garden areas
- Site clean-up and demobilisation of the temporary construction compound.

The proposed works is expected to take about 12 months to complete and construction would be undertaken during standard working hours, including:

- Monday to Friday, 7:00am to 6:00pm
- Saturday, 7:00am to 1:00pm
- No works on Sundays or Public Holidays.

The majority of the works would be undertaken outside of the AM and PM traffic peak hours. Some night works may be required for certain construction activities, including but not limited to:

- The delivery and installation of the pre-cast tied arch bridge deck pre-fabricated bridge structure. It is anticipated this would be delivered and installed on site over the course of a few nights
- Utility adjustments
- Adjustments to the median or kerbside lanes (eg signage and fencing)

A construction work area and compound site would be required for the proposed works. The area would be used for storage of material, parking of vehicles, access to the site and site amenities. The proposed construction work area and compound site location is within the adjacent public car park on the southern corner of Starkey Street and Warringah Road. The compound site is expected to occupy a number of car parking spaces.
Roads and Maritime is currently investigating a number of options in the area for use as a compound site. This would endeavour to minimise any construction impacts to the public car park.

Further Information

For further information about the proposal please visit the proposal web site. Further information such as preliminary plans and an options assessment document can be found via the following link:


The REF for the proposal is expected to be exhibited for community comment in June 2015 where submissions for the REF would be accepted and considered for the project followed by the release of a submissions report.
5 May 2015

Ms Joanne Moore
Project Development Manager
Development Sydney Infrastructure Development
Roads and Maritime Services
Level 8 27 Argyle Street
PARRAMATTA NSW 2150

Dear Ms Moore

Starkey Street Pedestrian Bridge ISEPP (Infrastructure) response

Thank you for your letter dated 15 April 2015 regarding consultation on the proposed Starkey Street Pedestrian Bridge. Please note the following comments in relation to the proposal and construction methodology:

- Please note that a DA will be required if advertising on the bridge is to be installed at a later date.

- We support the installation of bicycle wheeling ramps on stairways

- What additional lighting will be provided? Council requests that lighting for pedestrian safety is included in the design of the new bridge. It should ideally highly efficient using LED technology where possible. Costs for pedestrian lighting and operation of the lift should be borne by RMS.

- Removal of bus shelter – there is a process that must be gone through to dispose of this asset. Consideration of residual value and remaining useful life of the asset must be discussed with Council.

- Council needs to know how the construction of the bridge will impact on parking space numbers. It is requested that RMS provide additional parking to offset any loss of parking from Council’s carpark. A detailed carpark design plan is requested from RMS. This design should include existing and proposed linemarking and sign posting.

- Street furniture such as fencing to prevent pedestrians crossing Warringah Road to remain as RMS asset for maintenance and renewal.

- Landscaping – submit to Council for comment.

- What is proposed to deal with bus movements in Starkey Street?
• Construction methodology, including details of detours and road closures will need to be detailed and supplied to Council in advance of the work. Council will need to know about heavy vehicles will bypass the site whilst Warringah Road is closed for bridge construction (placement of the deck). How will RMS inform the public and local residents about this stage of the construction?

• Ideally, the compound for construction of the bridge should be located off Council land. Disruption to the carpark must be kept to an absolute minimum.

• RMS must consider the provision of way finding and directional signage as part of the bridge construction. This location holds community information banners, location signage and other information that will be necessary to keep once the bridge is installed.

• Council has contractual arrangements with Adshel. Any impact on the visibility of the advertising panels on the bus shelters (including during construction) will have implications for revenue for Council and will need to be addressed.

• RMS should provide information about where the bicycle parking will be located in the final design.

• Details of how RMS will manage access for pedestrians during construction must be submitted to Council. Pedestrian management in and around the carpark is critical and details are to be provided as to how this will be managed pre and post construction.

Should you require any further information about matters raised in this letter please contact me on 9942 2673.

Yours faithfully

Boris Bolgoff
Group Manager Roads Traffic and Waste
Appendix G
Community Updates
Blank Page
The NSW Government is planning improvements at the Starkey Street and Warringah Road intersection at Forestville to improve traffic flow.

Roads and Maritime Services is proposing to remove the signalised pedestrian crossing of Warringah Road at Starkey Street and install a new pedestrian bridge over Warringah Road east of Starkey Street.

The proposed pedestrian bridge would increase the transport efficiency on Warringah Road through Forestville, minimise delays, allow for road-based public transport and improve road safety.

What improvements are proposed?
There is currently a very high demand for the signalised pedestrian crossing of Warringah Road at Starkey Street due to the local buses, shops, community facilities and schools. Over 100 pedestrians per hour use the crossing in the morning peak period. The minimum crossing time for this pedestrian crossing is 25 seconds. The frequency and length of time the pedestrian crossing is used causes congestion on Warringah Road during peak times.

Roads and Maritime developed and evaluated four options to improve this intersection. Options that were developed and evaluated included:

- **Option 1 – (do nothing)** – Maintaining the existing road configuration along Warringah Road within Forestville and retaining the existing pedestrian crossing across Warringah Road
- **Option 2** – Installing a pedestrian bridge over Warringah Road at Starkey Street and widening Starkey Street
- **Option 3** – Installing pedestrian bridges over Warringah Road at Starkey Street and Brown Street
- **Option 4** – Installing a pedestrian bridge over Warringah Road at Starkey Street and not widen Starkey Street.

Evaluation of the options included traffic modelling to assess network and intersection performance, an economic analysis and a value/risk management workshop.
Roads and Maritime has prepared an options report for the Starkey Street pedestrian bridge proposal, which outlines the four options that were developed and evaluated, and provides information on how the preferred option was chosen. You can view the options report on the project website at [www.rms.nsw.gov.au/projects/sydney-north/index.html](http://www.rms.nsw.gov.au/projects/sydney-north/index.html)

Following assessment of the four options, Roads and Maritime selected a preferred option (Option 4). The key features of the preferred option include:

- Installing a new pedestrian bridge over Warringah Road east of Starkey Street
- Removing the existing pedestrian crossing of Warringah Road at Starkey Street
- Relocating the existing eastbound bus stop from west of Starkey Street to east of Starkey Street near the proposed pedestrian bridge entry.
- Providing new pedestrian connections, including a defined pathway through the existing car park to the pedestrian bridge entry and bus stop.

**Proposal benefits**

The proposed pedestrian bridge over Warringah Road would:

- Improve the efficiency of traffic flow along Warringah Road at Forestville, particularly westbound traffic in the morning peak and eastbound traffic in the evening peak
- Reduce delays on Warringah Road in both the morning and evening peak
- Support improvements to road-based public transport on Warringah Road by improving traffic capacity
- Improve safety by separating pedestrians from a busy main road
- Improve transport access by aligning bus stops with the proposed pedestrian bridge
- Provide urban design improvements in the adjacent car park.

The main impacts of the proposal would be:

- Changes in visual amenity
- Some property acquisition to accommodate the bridge
- A reduction in the number of car parking spaces in the car park, which services the Forestville Memorial Hall and Senior Citizens Centre.
Other road upgrades in Sydney’s northern suburbs

- **Wakehurst Parkway flood mitigation** – Roads and Maritime is investigating options to reduce the impact of flooding on Wakehurst Parkway in parallel with the planning for the Northern Beaches Hospital road upgrades.

- **Wakehurst Parkway left-turn slip lane extension** – Roads and Maritime is extending the southbound left-turn lane for Wakehurst Parkway into Frenchs Forest Road East to improve traffic flow and safety for all road users. This work is currently being carried out and is due to be completed in early 2015.

- **Mona Vale Road East and West upgrade** – Roads and Maritime is proposing to upgrade Mona Vale Road between Terrey Hills and Mona Vale to improve safety and traffic efficiency. The upgrade includes:
  - **Stage 1** – Improvement of Mona Vale Road intersection with Ponderosa Parade and Samuel Street, Mona Vale
  - **Stage 2** – Mona Vale Road East upgrade: Upgrade of 3.2 kilometres of Mona Vale Road from two lanes to four lanes between Manor Road, Ingleside and Foley Street, Mona Vale
  - **Stage 3** – Mona Vale Road West upgrade: Upgrade of 3.2 kilometres of Mona Vale Road from two lanes to four lanes between McCarrs Creek Road, Terrey Hills and Powder Works Road, Ingleside.

  Roads and Maritime recently consulted on the proposed road upgrades for Mona Vale Road East and West. Community feedback on the proposals is currently being reviewed and will inform further development of the projects.

  For further information please contact the project team on 1800 633 332 or monavaleroad@rms.nsw.gov.au or visit www.rms.nsw.gov.au/projects/sydney-north/mona-vale-road/index.html

- **Northern Beaches Hospital road upgrades** – The NSW Government is planning road upgrades around the new Northern Beaches Hospital with works scheduled to be completed in time for the hospital opening. These upgrades would provide customers with a better travelling experience by car or bus, increase the capacity of the road network and improve access through the precinct.

  Roads and Maritime is planning and delivering the road upgrades in two stages. Stage 1 would provide essential access to the Northern Beaches Hospital. Stage 2 would help increase capacity of the road network and reduce congestion.

  Roads and Maritime recently exhibited the Environmental Impact Statement (EIS) for Stage 1 of the road upgrade project and the broader concept for the whole project.

  Roads and Maritime is preparing a separate EIS for the proposed Stage 2 road upgrades and expects to exhibit the EIS for community and stakeholder comment by mid-2015.

  For further information please contact the project team on 1300 367 459 or nbroadwork@rms.nsw.gov.au or visit www.rms.nsw.gov.au/projects/sydney-north/northern-beaches-hospital/index.html
Next steps
Roads and Maritime will prepare a Review of Environmental Factors (REF) to examine the likely and potential impacts of the Starkey Street pedestrian bridge proposal. The REF will also outline measures to reduce and manage the impacts of the proposal. The REF will be displayed in mid 2015 for community and stakeholder comment.

We will engage an urban design specialist to ensure consideration is given to urban design issues while facilitating the most appropriate, practicable and cost effective urban design outcome.

Further information
Roads and Maritime welcomes community and stakeholder feedback on this proposal and will consider all feedback as development progresses.

Comments should be sent to Joanne Moore:

Email: joanne.moore@rms.nsw.gov.au
Mail: Joanne Moore
Roads and Maritime Services
PO Box 973
Parramatta NSW 2124

For further information please contact Joanne Moore during business hours on 8849 2345 or joanne.moore@rms.nsw.gov.au

Translating and Interpreting Service
If you need an interpreter, please call the Translating and Interpreting Service (TIS National) on 131 450 and ask them to telephone Roads and Maritime Services on 02 8849 2345.

Arabic
إذا كنت بحاجة إلى مترجم، الرجاء الاتصال بخدمة الترجمة الخاصة بالبحث (TIS National) على الرقم 131 450. أطلب منهم الاتصال بوكالتكم على الرقم 02 8849 2345.

Cantonese
若你需要口譯及翻譯服務請致電 131 450 聯絡 Roads and Maritime Services．

Mandarin
如果你需要口譯及翻譯服務請致電 131 450 聯絡 Roads and Maritime Services．

Greek
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Appendix H

Arborist Report
Arboricultural Assessment

Address: 612 Warringah Road, Forestville

Prepared by: Michael Sullings – Consulting Arborist (AQF Level 5)
February 25th, 2015
(Revised May 19th, 2015)
1 SUMMARY

This report has been commissioned by Joanne Moore from Roads & Maritime Services, to discuss the health and structural condition of 1x Norfolk Island Pine (*Araucaria heterophylla*) located at 612 Warringah Road, Forestville, and to provide recommendations on its long-term viability within the site, particularly in relation to the proposed construction of a pedestrian footbridge spanning Warringah Road.

The tree was assessed using elements of the VTA, SULE, and STARS methods of tree assessment (see Section 3), with observations, results and photographs provided in Section 5.

The tree was determined to be of high significance to the local area, due to its good condition and good vigour, its species-typical form, and its visual prominence. Due to its high significance, the tree is recommended for retention.

5 separate recommendations are provided, each depending on where exactly the construction footprint is ultimately located.
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INTRODUCTION & AIM

This report has been commissioned by Joanne Moore from Roads & Maritime Services. The report is to discuss the health and structural condition of 1x Norfolk Island Pine (*Araucaria heterophylla*) located at 612 Warringah Road, Forestville (on the corner with Ferguson Street). It is to provide recommendations on its long-term viability within the site in regards to health and structure, particularly in relation to the proposed construction of a pedestrian footbridge spanning Warringah Road.

3 METHOD

The tree was assessed using elements of the ‘Visual Tree Assessment’ (VTA – see Section 3.1) procedure, and then given a rating for its ‘Safe Useful Life Expectancy’ (SULE – see Section 3.2). Tree Protection Zones (TPZ) and Structural Root Zones (SRZ) were allocated in accordance with the Australian Standard for tree protection (see Section 3.3), and a Retention Value was determined using the ‘STARS’ method (see Section 3.4). The tree was assessed from ground level only on Thursday January 22nd, 2015. This report will discuss the current structural condition and health of the tree, and will provide recommendations regarding its viability relative to the proposed works.

- No internal diagnostic testing has been completed.
- No sub surface root testing or soil testing has been completed other than inspection of the severed roots which were visible.
- All observations were made from the ground only.
- Tree heights have been estimated and stem diameters have been measured with a diameter tape.
3.1 VISUAL TREE ASSESSMENT (VTA)

The VTA system is based on the theory of tree biology, physiology and tree architecture and structure. This method is used by arborists to identify visible signs on trees that indicate good health or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure. This system is based around methods discussed in *The Body Language of Trees*¹. For the purpose of this report, parts of the VTA system will be used along with other industry standard literature and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees; however it is important to realize that for a tree to be hazardous there must be a target. In this case the target potential is high with the probability that, if there were to be a significant failure, it would likely land on the buildings at 612 Warringah Road, or onto Warringah Road itself.

![Visual Tree Assessment Diagram](image)

Figure 1 – An interpretation of the VTA procedure outlined in *The Body Language of Trees*¹.

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The remaining Safe Useful Life Expectancy (SULE) of a tree is an estimation of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of a particular species, less its estimated current age. The life expectancy of the tree is then further modified (where necessary) in consideration of its natural range of occurrence, climatic preferences, rainfall, micro-climate, soil types, current health and vigour, condition and suitability to the site. This system is the accepted industry standard and was developed by Jeremy Barrell, a highly respected British arborist. It is important to understand that a SULE rating is based upon the trees at the time of inspection and from what could be seen or established at the time of inspection through a reasonable level of examination. Also it should be noted that trees can fail at any time without warning and there is always an inherent risk associated with trees. Table 1 shows the categories of SULE and the associated descriptions are how trees are allocated a rating.

Table 1 - SULE categories².

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Long SULE</td>
<td>a. Structurally sound trees located in positions that can accommodate future growth.</td>
</tr>
<tr>
<td></td>
<td>b. Trees which could be made suitable for long term retention by remedial care.</td>
</tr>
<tr>
<td></td>
<td>c. Trees of special significance which would warrant extraordinary efforts to secure their long term retention.</td>
</tr>
<tr>
<td>2. Medium SULE</td>
<td>a. Trees which may only live from 15-40 years.</td>
</tr>
<tr>
<td></td>
<td>b. Trees that may live for more than 40 years but may be removed for safety or nuisance reasons.</td>
</tr>
<tr>
<td></td>
<td>c. Trees which may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings.</td>
</tr>
<tr>
<td></td>
<td>d. Trees which could be made suitable for retention in the medium term with remedial care.</td>
</tr>
<tr>
<td>3. Short SULE</td>
<td>a. Trees which may only live from 5 to 15 years.</td>
</tr>
<tr>
<td></td>
<td>b. Trees that may live for more than 15 years but may be removed for safety or nuisance reasons.</td>
</tr>
<tr>
<td></td>
<td>c. Trees which may live for more than 15 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings.</td>
</tr>
<tr>
<td></td>
<td>d. Trees which require substantial remediation and are only suitable for retention in the short term.</td>
</tr>
<tr>
<td>4. Removal</td>
<td>a. Dead, dying suppressed or declining trees</td>
</tr>
<tr>
<td></td>
<td>b. Dangerous trees through instability or recent loss of adjacent trees. Dangerous trees because of structural defects including cavities decay included bark, wounds or poor form.</td>
</tr>
<tr>
<td></td>
<td>c. Damaged trees that are clearly not safe to retain.</td>
</tr>
<tr>
<td></td>
<td>d. Trees which may live for more than 5 years but would be removed to prevent interference with more suitable individuals or to provide space for new plantings.</td>
</tr>
<tr>
<td></td>
<td>e. Trees which are damaging or may cause damage to existing structures within the next 5 years.</td>
</tr>
<tr>
<td></td>
<td>f. Trees that will become dangerous after the removal of other trees for the reasons given in (A) to (F).</td>
</tr>
<tr>
<td></td>
<td>g. Trees in categories (A) to (G) that have a high wild life habitat value and with appropriate treatment could be retained subject to regular review.</td>
</tr>
<tr>
<td>5. Small, young or regularly pruned</td>
<td>a. Small trees less than 5m in height.</td>
</tr>
<tr>
<td></td>
<td>b. Young trees less than 15 years old but over 5m in height.</td>
</tr>
<tr>
<td></td>
<td>c. Formal hedges and trees intended for regular pruning to artificially control growth.</td>
</tr>
</tbody>
</table>

3.3 TREE PROTECTION ZONE (TPZ) & STRUCTURAL ROOT ZONE (TPZ) CALCULATIONS

In accordance with Australian Standard AS4970-2009, Tree Protection Zone (TPZ) radius is calculated using the following procedure. Diameter of the trunk is measured at approximately 1.4m above ground level; this measurement is referred to as DBH (Diameter at Breast Height). \( R_{TPZ} = DBH \times 12 \). For multi-stemmed trees the formula used is \( R_{TPZ} = \sqrt{(DBH1)^2 + (DBH2)^2 + (DBH3)^2} \). The TPZ is measured radially from the centre of the stem and must be protected on all sides.

The Structural Root Zone (SRZ) radius is calculated by measuring the diameter of the stem close to ground level, just above the basal flare. This measurement is taken as \( D \) and then used in the following formula: \( R_{SRZ} = (D \times 50)^{0.42} \times 0.64 \). The result gives the SRZ, measured radially from the centre of the stem.

It is important to realize that these calculations provide a notional figure only and tree dynamics, form and site conditions will greatly affect these zones. It is the job of the arborist to interpret the information correctly.

Figure 2 - TPZ & SRZ calculations.

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3 Standards Australia. 2009. AS4970-2009 Protection of trees on development sites.
3.4 SIGNIFICANCE OF A TREE, ASSESSMENT RATING SYSTEM (STARS)

The STARS system was developed by IACA, and is useful for determining the retention values of trees, by assessing the trees’ significance within the landscape, and expected lifespan. Landscape significance is determined by criteria from Table 2. (Note: a tree must have a minimum of 3 criteria in a category to be classified in that group.) The assessment criteria are for individual specimens, but can also be applied to tree stands of like species i.e. hedges. A tree that is an environmental pest or noxious weed, or that is hazardous or in irreversible decline, is automatically placed in the Low Significance category.

Table 2 outlines the criteria for Tree Significance.

**Table 2 – Assessment criteria for Tree Significance using the STARS method.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| **1. High Significance**  | a. The tree is in good condition and good vigour  
b. The tree has a form typical for the species  
c. The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age  
d. The tree is listed as a Heritage Item, Threatened Species or part of an Endangered Ecological Community or listed on Council’s Significant Tree Register.  
e. The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity  
f. The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values  
g. The tree’s growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* – tree is appropriate to the site conditions |
| **2. Medium Significance**| a. The tree is in fair-good condition and good or low vigour  
b. The tree has form typical or atypical of the species  
c. The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area  
d. The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street  
e. The tree provides a fair contribution to the visual character and amenity of the local area  
f. The tree’s growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ* |
| **3. Low Significance**   | a. The tree is in fair-poor condition and good or low vigour  
b. The tree has form atypical of the species  
c. The tree is not visible or is partly visible from surrounding properties as is obstructed by other vegetation or buildings  
d. The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area  
e. The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation Orders or similar protection mechanisms and can easily be replaced with a suitable specimen  
f. The tree’s growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa *in situ* – tree is inappropriate to the site conditions  
g. The tree is listed as exempt under the provisions of the local Council’s Tree Preservation Order or similar protection mechanisms  
h. The tree has a wound or defect that has potential to become structurally unsound |
| **3. Environmental Pest/ Noxious Weed Species** | i. The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties  
j. The tree is a declared noxious weed by legislation |
| **3. Hazardous/ Irreversible Decline** | k. The tree is structurally unsound and/or unstable and is considered potentially dangerous  
l. The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in the immediate or short term |

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4 IACA. 2010. *IACA Significance of a Tree, Assessment Rating System (STARS).*
Once the tree is placed into a Significance category, an assessment is also made of its Estimated Life Expectancy (ELE). This is an estimate of the sustainability of the tree in the landscape. This calculation is based on an estimate of the average lifespan of the species, less its estimated current age. The life expectancy of the tree is then further modified where necessary in consideration of its natural range of occurrence, climatic preferences, rainfall, microclimate, soil types, current health and vigour, condition and suitability to the site. It is worth noting that determinations for ELE are essentially interchangeable with SULE.

When both Significance and ELE have been determined, the matrix in Table 3 is used to determine Retention Value. Retention Values are ‘Priority for Retention’, ‘Consider for Retention’, ‘Consider for Removal’ and ‘Priority for Removal’ (see Table 4).

Table 3 - Tree Retention Values priority matrix.

<table>
<thead>
<tr>
<th>Significance in Landscape</th>
<th>Significance in Landscape</th>
<th>Significance in Landscape</th>
<th>Environmental Pest/Noxious Weed Species</th>
<th>Hazardous/Irreversible Decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Long &gt;40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Medium 15-40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Short &lt;1-15 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 - Legend for priority matrix.

Priority for Retention (High) – These trees are considered important for retention and should be retained and protected. Design modification or re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard AS4970-2009 Protection of trees on development sites. Tree sensitive construction measures must be implemented e.g. pier and beam etc if works are to proceed within the Tree Protection Zone.

Consider for Retention (Medium) – These trees may be retained and protected. These trees are considered less critical; however their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.

Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.

Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.
SITE DETAILS

The tree is located within 612 Warringah Road, Forestville, which is on the corner with Ferguson Street (see Figures 3 & 4). Access to the tree is best achieved from Ferguson Street.

Figure 3 – The site, with frontages on Warringah Road and Ferguson Street. The location of the tree is marked in yellow. Trees marked in red have previously been removed. Taken from Google Maps.

Figure 4 - The site in relation to the surrounding area. Taken from Google Maps.

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5 Google Maps. 2015. The location of Starkey Street and Warringah Road, Forestville.
Table 5 shows a range of criteria the tree was assessed on during a site visit. The details of the nearest adjacent tree were also captured.

Table 5 - Tree details.

<table>
<thead>
<tr>
<th>Tree #</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td><em>Araucaria heterophylla</em></td>
<td><em>Magnolia grandiflora</em></td>
</tr>
<tr>
<td>Common Name</td>
<td>Norfolk Island Pine</td>
<td>Bull Bay Magnolia</td>
</tr>
<tr>
<td>Height (m)</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>DBH/D (mm)</td>
<td>770/950</td>
<td>350/430</td>
</tr>
<tr>
<td>TPZ/SRZ (m)</td>
<td>9.2/3.2</td>
<td>4.2/2.3</td>
</tr>
<tr>
<td>Health &amp; Vigour Structure</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Defects</td>
<td>None observed from ground level</td>
<td>Suppressed</td>
</tr>
<tr>
<td>Pests</td>
<td>None observed from ground level</td>
<td>None observed from ground level</td>
</tr>
<tr>
<td>Age Class</td>
<td>Mature</td>
<td>Mature</td>
</tr>
<tr>
<td>SULE</td>
<td>Long (1 a. &amp; c. – see Table 1)</td>
<td>Medium (2 a. – see Table 1)</td>
</tr>
<tr>
<td>Significance</td>
<td>High (1 a, b. &amp; e. – see Table 2)</td>
<td>Medium (2 a, d. &amp; f. – see Table 2)</td>
</tr>
<tr>
<td>Retention Value</td>
<td>Priority for Retention (High – see Table 3)</td>
<td>Consider for Retention (Medium – see Table 3)</td>
</tr>
<tr>
<td>Comments</td>
<td>Tree is of high significance to surrounding area – highly prominent, in great condition.</td>
<td></td>
</tr>
</tbody>
</table>
5.1 THE TREE

During a site visit, observations were made regarding the health and structural condition of the tree, and how it stands to be affected by the proposed development of a pedestrian footbridge, and associated construction activities.

Figure 5 - The Norfolk Island Pine (*Araucaria heterophylla*) as viewed from Ferguson Street, looking east.

Figure 6 – The tree is neighboured by a mature Bull Bay Magnolia (*Magnolia grandiflora*) specimen of much lower significance.

Figure 7 – The tree as viewed from the opposite side of the intersection, looking northeast.

Figure 8 – The tree as viewed from the Starkey Street Car Park, looking north.
6 DISCUSSION

6.1 THE TREE

Tree 1 is a mature specimen of Norfolk Island Pine (*Araucaria heterophylla*), of approximately 25 metres height. The tree is located within 612 Warringah Road, and has high significance to the local area. It is exhibiting good health and vigour, as well as good structure, and is visually prominent from basically all directions (as can be seen in Figures 5, 7 & 8). No defects or pests were observed from a ground level inspection.

Tree 1 was estimated to have a long remaining lifespan (40+ years), fitting the SULE criteria of "structurally sound trees located in positions that can accommodate future growth" and "trees of special significance which would warrant extraordinary efforts to secure their long term retention".

Tree 1 was determined to have high significance, fitting the STARS criteria of "the tree is in good condition and good vigour", "the tree has a form typical for the species" and "the tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity".

Using the STARS method, a long remaining lifespan in combination with high significance gives a high Retention Value (Priority for Retention – see Table 3). The tree's contribution to the amenity of the landscape is likely to continue for many decades, and where possible, Tree 1 should be protected from any impacts associated with the proposed construction, whether through tree protection measures, appropriate construction methods, or modification of plans.

Tree 1 is neighboured by a mature specimen of Bull Bay Magnolia (*Magnolia grandiflora*), of approximately 8 metres height, and of medium significance (see Figure 6). Tree 2 is exhibiting fair-good health and vigour, and good structure – despite being slightly suppressed by the much larger Tree 1. Tree 2 was estimated to have a medium remaining lifespan (15–40 years) which, in combination with its medium significance, gives a medium Retention Value (Consider for Retention – see Table 3), using the STARS method. As with Tree 1, Tree 2 should also be protected from any impacts associated with the proposed construction, where possible. Considering its location relative to the works, it is likely that the protection measures for Tree 1 would also encompass Tree 2.

6.2 THE PROPOSED CONSTRUCTION

The construction proposed for the site involves the installation of a pedestrian footbridge that would span Warringah Road, from the Starkey Street Car Park on the southern side to #612 Warringah Road on the northern side (see Figure 9). While the exact extent of the construction footprint has not been determined (as plans have not been finalised), it appears likely that it will encroach into the Tree Protection Zone (TPZ) of Tree 1, but not its Structural Root Zone (SRZ). This means that the construction footprint may come within 9.2m of the stem, but not closer than 3.2m.

According to AS4970-2009 Protection of trees on development sites, minor encroachment into the TPZ is permissible if it is “less than 10% of the area of the TPZ and is outside the SRZ” as long as “the area lost to this encroachment [can] be compensated for elsewhere and contiguous with the TPZ”. A TPZ with radius 9.2m gives a total area of 268.1m², which means any incursion less than 26.8m² should be acceptable (as long as the SRZ remains intact), as the area lost can easily be compensated for in the grassed area to the northeast of the tree.
To ensure any incursion remains less than 10% of the TPZ area, the footprint would need to remain further than 6.3m from the trunk of Tree 1.

If, however, the plans are modified and the construction footprint comes within the SRZ (closer than 3.2m to the stem) or incurs more than 10% of the TPZ (greater than 26.8m²), AS4970-2009 states that “the project arborist must demonstrate that the tree(s) would remain viable”. This may involve modifying the TPZ, non-destructive root investigation, and consideration of other relevant factors.

The SRZ encompasses the area of structural roots where "the trunk enters the ground, [and] subdivides into six or eight large buttress roots. These roots spread the loading of the tree over a much larger area. They taper rapidly once they are underground... This area is called the zone of rapid taper or the root... Cutting or damaging roots in this area can seriously weaken the tree6." Aside from potentially destabilising the tree, the cutting or damaging of structural roots also leaves large wounds which allow for the introduction of fungal decay. As described by Lonsdale, “Root severance is thought to provide a possible avenue for infection by decay fungi which can lead to a further impairment of water absorption and eventually to instability... [and] the general debilitation of trees due to root severance can make them more susceptible to invasion by some decay fungi, such as Armillaria species.”

It is not only the root zone that would suffer from building too close, as any construction within ~4m of the trunk would also require the pruning, or at least shortening, of some major branches. Any pruning work would affect the significance of the tree, as it would render the canopy asymmetrical, and diminish the species-typical form that this tree has.

Ideally the construction footprint would be kept further than 9.2m from the trunk (outside the TPZ), but this seems unlikely, given the limited space at the site. It is recommended that the encroachment of the construction footprint be kept to an absolute minimum. If encroachment is unavoidable, it is recommended that the footprint comes no closer than 5m from the trunk, to allow for maximum undisturbed root space below ground, and future branch growth and wind movement above ground.

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Based on ground-based visual inspections alone, the following conclusions have been reached regarding the 2 trees at 612 Warringah Road, Forestville:

- **Tree 1** is a mature specimen of Norfolk Island Pine (*Araucaria heterophylla*), approximately 25 metres tall, exhibiting good health and vigour, and good structure.
- **Tree 2** is a mature specimen of Bull Bay Magnolia (*Magnolia grandiflora*), approximately 8 metres tall, exhibiting fair-good health and vigour, and good structure.
- Tree 1 is estimated to have a long SULE (40+ years).
- Tree 2 is estimated to have a medium SULE (15-40 years).
- Tree 1 was determined to have high significance, due to its good condition and good vigour, its species-typical form, and visual prominence.
- Tree 2 was determined to have only have medium significance, due to its good condition and fair-good vigour, its visibility from neighbouring properties, and its moderate above ground restrictions.
- Using the STARS method, Tree 1 was determined to have a high Retention Value (Priority for Retention).
- Using the STARS method, Tree 2 was determined to have a medium Retention Value (Consider for Retention).
- Where possible, Tree 1 should be protected from any impacts associated with the proposed construction, whether through tree protection measures, appropriate construction methods, or modification of plans.
- The construction proposed for the site involves the installation of a pedestrian footbridge spanning Warringah Road, from the Starkey Street Car Park on the southern side to #612 Warringah Road on the northern side.
- It appears likely that the construction footprint will encroach into the Tree Protection Zone (TPZ) of Tree 1, but not the Structural Root Zone (SRZ), i.e. closer than 9.2m, but further than 3.2m.
- A TPZ incursion of less than 10% (<26.8m²) should be acceptable (as long as the SRZ remains intact), as the area lost can easily be compensated for in the grassed area to the northeast of the tree.
- To ensure any incursion remains less than 10% of the TPZ area (<26.8m²), the construction footprint would need to remain further than 6.3m from the trunk of Tree 1.
- A TPZ incursion of more than 10% (>26.8m²), or that encroaches on the SRZ, will require demonstration from the project arborist that the tree will remain viable, through TPZ modification, non-destructive root investigation, and consideration of other relevant factors.
- Cutting or damaging roots within the SRZ has the potential to cause destabilisation, and also allows for the introduction of fungal decay into the root system and stem base.
- If the construction footprint comes within ~4m of the trunk, it is likely that some major branches will require pruning, or shortening. This will have the effect of diminishing the tree's significance, by impacting its symmetry and species-typical form.
- It seems that some TPZ encroachment is likely, given the limited space at the site, however, the footprint should be kept at least 5m from the trunk, to minimise the loss of root space, and remove the need for pruning of branches.
Table 6 contains the recommendations for the 2 trees at 612 Warringah Road, Forestville, given 5 differing locations for the construction footprint.

Table 6 – Recommendations.

<table>
<thead>
<tr>
<th>Circumstance – in order of preference (measurements taken from the centre of the trunk of Tree 1)</th>
<th>Recommendations for trees</th>
</tr>
</thead>
</table>
| 1. Locate construction footprint further than 9.2m (outside TPZ) from Tree 1 | • Install Tree Protection Zone fencing  
• Exclude construction activities from TPZ |
| 2. Locate construction footprint closer than 9.2m, but further than 6.3m, from Tree 1 | • Compensate for area lost by modifying TPZ, extending it into the grassed area to the northeast of Tree 1  
• Install TPZ fencing  
• Exclude construction activities from TPZ |
| 3. Locate construction footprint closer than 6.3m, but further than 5m, from Tree 1 | • Have project arborist demonstrate that the tree will remain viable, through TPZ modification, non-destructive root investigation, or consideration of other relevant factors  
• Install TPZ fencing  
• Exclude construction activities from TPZ |
| 4. Locate construction footprint closer than 5m, but further than 3.2m (outside SRZ), from Tree 1 | • Have project arborist demonstrate that the tree will remain viable, through TPZ modification, non-destructive root investigation, or consideration of other relevant factors  
• Install TPZ fencing  
• Exclude construction activities from TPZ  
• Prune or shorten branches to achieve clearance above construction footprint |
| 5. Locate construction footprint closer than 3.2m (inside SRZ) from Tree 1 | • Have project arborist demonstrate that the tree will remain viable, through TPZ modification, non-destructive root investigation, or consideration of other relevant factors (unlikely)  
  ○ Install TPZ fencing  
  ○ Exclude construction activities from TPZ  
  ○ Prune or shorten branches to achieve clearance above construction footprint  
-or-  
• Remove Tree 1 (likely) |

Any pruning work should be carried out by appropriately trained professionals (minimum AQF Level 3) to the standard prescribed in *AS4373-2007 Pruning of amenity trees*\(^8\).

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The Stationery Office. London.

Barrell Tree Consultancy. Hampshire, UK.

Standards Australia. Sydney.

IACA. 2010. *IACA Significance of a Tree, Assessment Rating System (STARS).*

Google Maps. 2015. *The location of Starkey Street and Warringah Road, Forestville.*


Arboricultural Association. Stonehouse (UK).

Standards Australia. Sydney.
DISCLAIMER

The information contained within this report is to be used solely for the purposes that were specified at the time of engagement.

All attempts have been made to ensure the legitimacy of any information which has been gathered in the process of compiling this report, however Sydney Arbor Trees Pty. Ltd. cannot be held liable for inaccurate or misguiding information which has been provided by others.

Any tree inspections or assessments which have been carried out for the purposes of this report are valid only at the time of inspection and are based on what could reasonably be seen or diagnosed from a visual inspection carried out from ground level.

All inspections unless otherwise stated are based upon Visual Tree Assessment (VTA) techniques, industry best practice and applied knowledge. No internal diagnostic testing or below ground investigation has been carried out unless otherwise stated.

Trees are a dynamic living organism and as such they have a finite lifespan the end of which cannot always be predicted or understood, even apparently healthy trees can die suddenly or fall without warning. As such there is no warranty or guarantee provided, or implied, regarding the future risks associated with any tree.

Please feel free to contact me either via telephone or email if you have any questions regarding this report.

Kind regards,

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