Appendix G
Preliminary Environmental Assessment Report

February 2018

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1 Introduction

1.1 Background

North East Link is a proposed new freeway-standard road connection that would complete the missing link in Melbourne's metropolitan ring road, giving the city a fully completed orbital connection for the first time. The proposed North East Link will begin on the Eastern Freeway at Springvale Road before connecting via a new 11-kilometre roadway to the M80 Ring Road at Greensborough.. It provides a freeway solution that connects growth areas, activity centres and employment innovation clusters in the north and north east to communities and businesses in the east and south-east.

Since 1969, successive Victorian Governments have identified the need for a freeway standard road link through Melbourne's north east to complete the city's orbital connection. Potential routes have been identified in:

- Victorian Government (1969), Melbourne Transportation Plan
- Victorian Government (1974), F35 Study: Eastern Freeway – Ringwood to Greensborough
- Victorian Government (1979), Outer Ring Study, Diamond Creek to Ringwood: Technical Report: Transport and Economic Evaluation
- Victorian Government (2008), Investing in Transport (the Eddington Study)
- Victorian Government (2008), Victorian Transport Plan.

More recently, in 2016, North East Link was identified as Victoria's next priority road project in Infrastructure Victoria's 30-year strategy, which sets out a pipeline of initiatives to be delivered over the next three decades to help create the best possible future for the State of Victoria. The strategy undertook a high-level analysis and nominated North East Link as a short- to-medium-term project that would enhance access to major employment centres and improve the capacity of the freight network.

Plan Melbourne 2017-2050, Melbourne's Metropolitan Planning Strategy, sets out a vision for Melbourne through to 2050. In the context of a more connected Melbourne, Plan Melbourne sets out strategies to meet the objective of providing an integrated transport system connecting people to jobs and services and goods to market. Plan Melbourne identifies North East Link as a key transport infrastructure strategy to improve the efficiency of the freeway network and to link the north east to the western, southern and central parts of the city.

1.2 Purpose of this report

As part of developing the business case for the project, the North East Link Authority (NELA) undertook a number of preliminary technical and environmental investigations.

This report presents the findings of the preliminary environmental investigations and outlines the potential benefits and impacts of the project's scope as presented in the business case and outlined in Section 2.

2 Project description

The project description presented in this section was developed to inform the business case and assessment of the corridor against the project objectives and guiding principles.

Should the project proceed past the business case stage, State will undertake a more exhaustive consideration of all aspects in refining the project scope and developing the Reference Design. This will involve consideration of more design options and construction methods within the project corridor to inform the project approvals.

For the purpose of the business case, North East Link can be separated into four precincts as described below:

- M80 Ring Road to Lower Plenty Road
- Tunnels
- Bridge Street to Eastern Freeway
- Eastern Freeway upgrade.

M80 Ring Road to Lower Plenty Road	Works within the M80 to Lower Plenty Road section of the project would include widening of the M80 Ring Road from Plenty Road to the Greensborough Bypass, and provision of a new interchange at the existing Greensborough Bypass, providing connectivity to and from North East Link in all directions. Minor works may occur on the existing Greensborough Bypass through to Diamond Creek Road and may include bridge strengthening at the Plenty River bridge. South of the M80 and extending to Watsonia Station, the existing Greensborough Bypass would likely be upgraded to become North East Link. Separate local roads would be provided to the east (generally southbound) and west (generally northbound) of North East Link, providing local connectivity to and from the M80, Greensborough Bypass, North East Link, Grimshaw Street, Watsonia Station and selected local roads. South of Watsonia Station, North East Link would diverge to the east of the existing Greensborough Bypass, and would likely dive down into a cutting structure. To maintain connectivity of the local road network, bridges would be provided across the cutting at various locations.
Tunnels	The northern tunnel portal would likely be in the vicinity of Erskine Road and Coleen Street, and the driven tunnels would likely start just north of Lower Plenty Road. An interchange at or near Lower Plenty Road would provide connectivity to and from North East Link in all directions. Between Lower Plenty Road and Bridge Street / Manningham Road, North East Link would include twin three lane bored tunnels running in a generally north-south orientation. The tunnels would travel under the residential area to the south of Lower Plenty Road, Banyule Flats, the Yarra River, Yarra Valley Country Club, the grounds of Heide Museum of Modern Art and Banksia Park. At each tunnel portal, supporting tunnel infrastructure would be required, including ventilation structures, water treatment plants, deluge tanks, substations, and associated infrastructure.
Bridge Street to Eastern Freeway	Within the Bridge Street to Eastern Freeway section of the project, North East Link would be constructed as a cutting structure and bored or mined tunnel. The southern tunnel portal would likely be located south of the Veneto Club. Further south, North East Link would comprise a new road at surface level and viaduct structure to connect into the Eastern Freeway via a new interchange. An interchange at Manningham Road would provide connectivity to and from North East Link in all directions.

Eastern Freeway Upgrade	North East Link would provide new dedicated bus lanes along the Eastern Freeway, from the Victoria Park precinct (near Hoddle Street) to Doncaster Road, creating an uninterrupted path for bus services travelling between the eastern suburbs and the central city. Currently there are two options being considered for connection of the new bus lanes into the existing network near the Victoria Park precinct. This includes an option starting near Victoria Park Station, where dedicated bus lanes would travel on a new viaduct structure over the Eastern Freeway and on to the existing freeway median, travelling towards Burke Road. To accommodate the new bus lanes, a new bridge structure would also be required over Merri Creek. The second option is for the bus lanes to travel along the freeway shoulders from Hoddle Street before passing over the Eastern Freeway on new viaduct structures east of Merri Creek and on to the existing median and travelling towards Burke Road. In both options, the bus lanes east of Burke Road would cross over the freeway on a new viaduct structure to the northern side of the freeway adjacent to the new Bulleen Road / Eastern Freeway interchange. The bus lanes would cross Bulleen Road and North East Link interchange via a new underpass. East of Bulleen Road, the bus lanes would be at surface level on the northern side of the Eastern Freeway through to Doncaster Road. Eastern Freeway works would also include widening from around Chandler Highway in the west, to around Springvale Road in the east. The widening would consist of an additional one to four lanes in various locations. Widening would likely take place on both sides of the freeway and in the median. Widening is likely to occur at-grade for the most part although reconstruction of some bridge structures would likely be required. The widening works may also involve covering parts of Koonung Creek with new structures and/or converting sections of the existing open creek to culverts.

In addition to the works described above, other works that would occur throughout the project corridor include, provision of new shared use paths, replacement and adjustments to noise walls, and reconstruction of traffic signs and gantries.

3 Preliminary identification and assessment of benefits and impacts

3.1 Approach

During development of the business case, preliminary environmental specialist assessments were undertaken. These assessments considered the project objectives and guiding principles including the relevant criteria and measures that were developed and used as part of the options assessment process (refer to **Appendix D** of the business case).

The assessments provide an initial basis for:

- Understanding the existing conditions in the area where the North East Link would be located
- Predicting the potential impacts that may arise
- Identifying potential strategies to assess and manage these impacts.

The assessments were informed by:

- Desktop assessments of Aboriginal heritage, air quality, contaminated land and spoil, ecology, groundwater, historical heritage, land use planning, landscape and visual, surface noise and vibration, surface water and hydrology, and vibration and regenerated noise
- High-level preliminary field surveys to contextualise desktop findings and gather additional information relating to Aboriginal heritage, ecology, historic heritage, landscape and visual, and surface water
- A targeted geotechnical drilling program which yielded information on soil and groundwater.

Together, these assessments provide an initial basis for predicting the potential environmental impacts that may arise from North East Link and identifying potential strategies to identify the potential to manage impacts.

3.2 Overview of potential environmental impacts

Table 1 summarises the key potential environmental impacts that would need to be managed during construction and operation of North East Link. These potential impacts are further described in Sections 3.3 to 3.15.

Table 1 Overview of potential environmental impacts

Theme	Key issues	
1. Aboriginal cultural heritage assets	1.1	Disturbance or destruction of registered Aboriginal cultural heritage places
	1.2	Disturbance or destruction of unknown Aboriginal cultural heritage
	1.3	Changes to intangible Aboriginal values
2. Air quality	2.1	Changes in air quality associated with the redistribution of traffic during construction
	2.2	Changes in air quality due to construction works
	2.3	Odour arising from the excavation of soil
	2.4	Changes in air quality associated the redistribution of traffic on surface roads during operation
	2.5	Changes in air quality associated with emissions from tunnel ventilation structures
	2.6	In-tunnel NOx and CO_2 concentration and impact on road users

Theme	Key issues	
3. Contaminated land and spoil management	3.1	Disturbance of contaminated soil due to construction
	3.2	Treatment, storage, reuse, transport and/or disposal of contaminated soil
	3.3	Management, transport and disposal of asbestos-containing materials or other waste
	3.4	Management, disposal and transport of Potential Acid Sulphate Soils (PASS)
	3.5	Spills or leaks potentially affecting soil quality
	3.6	Release of vapours and/or ground gases from contaminated soil
4. Ecology	4.1	Threats to populations of EPBC Act listed and state listed (FFG Act) aquatic species due to the disturbance or modification of fish passage
	4.2	Threats to populations of EPBC Act listed and state listed (FFG Act) flora or fauna due to changes to surface water quality
	4.3	Shading of waterways and vegetation by viaduct structures causing changes to habitat and/or vegetation
	4.4	Death or injury to fauna due to construction
	4.5	Disturbance of native fauna by increased artificial light, noise or vibration
	4.6	Disturbance and/or removal of remnant vegetation and/or scattered trees
	4.7	Removal of habitat for EPBC Act listed and state listed (FFG Act) aquatic flora and fauna
	4.8	Removal of habitat for EPBC Act listed and state listed (FFG Act) terrestrial flora and fauna
	4.9	Spread of weeds and / or pathogens due to construction.
	4.10	Groundwater drawdown causing changes to groundwater availability for ecosystems
	4.11	Removal of amenity plantings
5. Greenhouse gas	5.1	Greenhouse gas emissions from use of construction plant and equipment
	5.2	Changes to greenhouse gas emissions across the transport network due to the project
	5.3	Greenhouse gas emissions from operation of tunnel pumps, lighting and ventilation
6. Ground movement	6.1	Local subsidence due to dewatering associated with construction activity
	6.2	Local subsidence due to deep excavations associated with tunnel works and long-term operation
	6.3	Construction activities in locations where there are folds, faults, dykes and fractures in the Silurian bedrock, which may give rise to instability around the tunnel headings and at portals
7. Groundwater	7.1	Handling and management of saline groundwater during construction and operation
	7.2	Changes to groundwater quality due to spills or leaks during construction and operation
	7.3	Mobilisation of existing contaminated groundwater due to construction and operation of the project
	7.4	Changes to hydraulic connectivity associated with construction of structures
	7.5	Changes to groundwater availability or quality impacting users
	7.6	Release of vapours from contaminated groundwater

Theme	Key issues	
8. Historic heritage	8.1	Temporary changes to historical heritage places associated with construction infrastructure
	8.2	Permanent changes to historical heritage places associated with new built form (viaduct structures, tunnel ventilation structures, portals, etc.)
	8.3	Vibration and subsidence impacts on heritage structures
	8.4	Full or partial disturbance or removal of historical heritage places
9. Land use	9.1	Temporary occupation of commercial and industrial land during construction
	9.2	Temporary changes to development potential in the vicinity of the project corridor during construction
	9.3	Permanent changes to existing commercial and industrial land uses
	9.4	Permanent changes to existing residential and community land uses
	9.5	Permanent changes to development potential in the vicinity of the project corridor
10. Landscape and visual	10.1	Temporary visual changes associated with construction activities and compounds
	10.2	Visual changes to high quality landscapes within residential areas, community facilities, parks and reserves, shared use paths and roads due to viaduct structures, tunnel ventilation structures, noise walls, cuttings and other infrastructure
	10.3	Alteration, removal or severance of public open space, landscape buffers and vegetation
	10.4	Overshadowing of residential areas, vegetation and public spaces
	10.5	Overlooking from viaduct structures to residential areas, community facilities and public spaces
	10.6	Lighting impacts on residential areas, community facilities and public spaces
11. Noise and vibration (surface and tunnel)	11.1	Noise and vibration from surface works during construction
	11.2	Changes to noise levels for communities associated with the redistribution of traffic in due to construction
	11.3	Changes to noise levels for communities associated with the redistribution of traffic due to operation
	11.4	Noise associated with the operation of the tunnel ventilation system and structures
12. Surface water	12.1	Changes to flood frequency due to built infrastructure
	12.2	Diversion or obstruction of stormwater flow paths during construction causing inundation of properties
	12.3	Flooding of the tunnel portals or cuttings
	12.4	Changes to surface water quality due to construction and operation
	12.5	Bed and/or bank erosion of waterways due to construction works
13. Vibration and regenerated noise	13.1	Noise and vibration from tunnelling works

3.3 Aboriginal heritage

3.3.1 Existing conditions

North East Link is proposed to be located within an urban area that has been significantly disturbed by previous land uses and development. Nevertheless, considerable Aboriginal cultural heritage values remain, particularly in the vicinity of waterways. The project corridor runs through a number of defined areas of Aboriginal cultural heritage sensitivity. These include land within 200 metres of named waterways or wetlands and land within 50 metres of registered Aboriginal cultural heritage places, as well as some registered Aboriginal cultural heritage places.

North of Lower Plenty Road, the known Aboriginal heritage items present are two registered Aboriginal places close to the intersection between the M80 and the Greensborough Bypass. These places have been impacted by works associated with the M80. Land within 50 metres of these places are defined as areas of cultural heritage sensitivity.

Banyule Creek, situated in the western section of Simpson Barracks, has an associated area of cultural heritage sensitivity, extending from roughly the point where Reid Walk meets Greensborough Road, south to its confluence with the Yarra River.

The Yarra River and associated wetlands, including the Banyule Flats, is an area of cultural heritage sensitivity. This area includes HO72 Bulleen Drive-In (fmr), where the values are unknown at this stage. It also includes the Bolin Bolin Billabong, HO30, which is one of small group of billabong wetlands formed from the movement of the Yarra River, and is understood to represent an important ceremonial site for the Wurundjeri people. It was assessed as of state significance in the Manningham Heritage Study Review (Context 2006) and contains a registered Aboriginal place.

The corridor also intersects with areas of sensitivity adjacent to the Eastern Freeway, including Koonung Creek, Merri Creek, and the Yarra River. Some of these areas, particularly Koonung Creek, are highly disturbed due to the previous construction of the freeway in this location.

3.3.2 Potential impacts

Construction impacts associated with the project have been considered across three key areas: from the M80 to the northern portal; from the southern portal to the surrounding Bulleen Road; further south to the intersection with the Eastern Freeway and along the Eastern Freeway. The proposed bored tunnel construction method avoids impacts to substantial areas of cultural heritage sensitivity associated with the Yarra River and associated registered Aboriginal heritage places.

Construction

The key construction impacts on Aboriginal heritage values are described below:

- Works at the M80-Greensborough Bypass intersection may impact the two registered places in the vicinity, however, it is likely that this area has previously been disturbed.
- Works along the western boundary of Simpson Barracks are substantially within an area of cultural heritage sensitivity, which may not have been previously substantially disturbed. Similarly, the surface works in areas north of Lower Plenty Road could have impacts.
- Surface construction south of the tunnel would potentially have impacts on the identified Aboriginal heritage values however, much of this impact would occur along Bulleen Road within an area that has previously been disturbed.

Operation

The key impacts of the project on Aboriginal heritage are associated with the construction of the project and are discussed above. No key impacts for the operational phase have been identified.

3.3.3 Further investigations and management measures

As the project works would involve high impact activities within areas of cultural heritage sensitivity, a Cultural Heritage Management Plan (CHMP) would be prepared in accordance with the Aboriginal Heritage Act 2006. The CHMP would provide a means to assess and manage the risk to identified Aboriginal cultural heritage values. It would manage harm to known Aboriginal cultural heritage and any potential harm to Aboriginal cultural heritage identified during construction activities, through detailed management conditions and contingency plans.

3.4 Air quality

3.4.1 Existing conditions

The meteorological conditions for the project area from the M80 to the Simpson Army Barracks were determined from automatic weather station data recorded by Bureau of Meteorology (BoM) at Viewbank and Coldstream. For the southern section of the project area, the meteorological conditions were determined from the automatic weather station data from the Environment Protection Authority (EPA) Victoria air quality monitoring station at Alphington. The Viewbank region, with an annual wind speed average of 3.4 m/s, is exposed to higher winds more frequently, compared with Alphington, the latter with an annual wind speed average of 2.9 m/s. Both areas experience the strongest winds from the north and southwest quadrants. Viewbank rarely experiences winds from out of the south-east quadrant while Alphington experiences light winds drifting down the Yarra Valley with an easterly component.

Existing air quality for the region around the project has been determined from data collected at air quality monitoring stations managed by EPA Victoria at Alphington and Mooroolbark. The latest published data from EPA Victoria is for 2015.

Of particular interest in the context of North East Link are levels of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) because of their relationship with vehicle emissions. Existing PM_{10} background levels at both monitoring stations had no instances of higher than the intervention level specified in the SEPP (Air Quality Monitoring) (AQM) during 2015 (60 µg/m³ intervention level). Existing NO_2 background levels are below the intervention level at both stations.

In terms of background levels for $PM_{2.5}$, no appropriate on-site background data exists. This would be investigated further.

3.4.2 Potential impacts

Construction

During construction, dust emissions associated with spoil excavation, handling and removal and other construction activities may impact surrounding residents, businesses and communities. Road works and tunnel construction would involve substantial civil construction work. Standard mitigation would be applied to manage these impacts and dust management and monitoring in accordance with EPA guidelines would be required.

Operation

The potential key air quality impacts that would need to be managed during operation of the project are described below:

- Changes to air quality arising from the project would be assessed and may need to be mitigated. However, the predicted traffic volumes along the new and upgraded roads are expected to be no greater than volumes for other existing roads in Melbourne.
- The placement of road sections within a cutting has the potential to inhibit the dispersion of vehicle emissions. However, the consequential impacts are low as the structure is unlikely to result in pollutant levels exceeding air quality standards.
- In-tunnel air quality would be required to meet relevant standards through the design of a tunnel ventilation system to capture and disperse vehicle emissions including during any potential congested traffic events.
- Potential impacts on air quality due to emissions from the ventilation structures located at each of the tunnel portals, would be addressed by designing a tunnel ventilation system to meet best practice and design requirements of the SEPP (AQM) and to achieve zero portal emissions during operation. An air quality monitoring program would also be developed to monitor ambient and in-tunnel air quality during project operations.

3.4.3 Further investigations and management measures

A detailed assessment of the changes in air quality in the vicinity of surface roads and due to the ventilation system would be undertaken using an assessment methodology developed in consultation with EPA Victoria.

The project would manage impacts through design and implementation of a tunnel ventilation system which meets the requirements of the SEPP (AQM) and the EPA Victoria Works Approval.

The project would also develop and undertake an ambient air quality monitoring program in consultation with the EPA.

3.5 Contaminated land and spoil management

3.5.1 Existing conditions

Contaminated sites

The project corridor does not coincide with major industrial land areas that are identified as having an increased potential for contamination.

A review of Melbourne aerial photographs from 1945 indicates that past land uses in the project corridor included livestock grazing, rural residential, fruit production (orchards) and defence housing. The preliminary conclusions regarding the potential for contamination by area are as follows:

- Watsonia North – low potential for soil and groundwater contamination
- Greensborough – low potential for soil and groundwater contamination, except in the M80 and Greensborough Bypass area where a former quarry backfilled with waste material is likely to be present

- Watsonia – some potential for soil and groundwater contamination due to a range of potentially contaminating uses such as drycleaners, timber and hardware stores, service stations, vehicle service and repair centre, and substation
- Macleod/Yallambie – some potential for soil and groundwater contamination from service stations and the potential presence of historic landfills
- Rosanna/Viewbank – low potential for soil and groundwater contamination
- Heidelberg – some potential for soil and groundwater contamination due to historic agricultural use
- Bulleen – potential for soil and groundwater contamination given historical and current land uses which include service stations, vehicle service / repair centres, brick quarry and manufacturing, industrial tubes and cores manufacturing and drycleaners.

A number of landfills or potential uncontrolled fill sites have also been identified close to the project corridor.

In addition to the possible contaminated areas listed above, there may also be sites which have been issued with a formal Clean Up Notice (CUN) or Pollution Abatement Notice (PAN) by the EPA Victoria. In addition, there may be sites where a statutory environmental audit has been undertaken.

Soil and rock contamination

Information regarding the potential for ASS to be present in the project area was obtained from the Atlas of Australian Acid Sulfate Soils, and indicated that the project area is provisionally classified as "low probability/very low confidence", which is described as an area with low probability of ASS occurrence (6-70% chance) generally within the upper one metre in wet or riparian areas with sodosols, chromosols and dermosols.

Generation of acidic conditions is also associated with sulphide enrichment of rock. Previous mining activities north of the project area indicate that there is an increased potential for sulphide enrichment of the underlying Silurian / Devonian aged bedrock.

3.5.2 Potential impacts

Construction

The potential key contaminated land impacts that would need to be managed according to standard procedures during the construction of the project include:

- The generation, handling, storage, re-use and disposal of potentially contaminated material, particularly in the areas between Watsonia and Bulleen, where tunnel, cut and cover and cutting construction types are proposed. Spoil generated within areas of potentially contaminated land (e.g. service station and historic landfill and uncontrolled fill sites) would require characterisation to determine waste classification, which in turn would dictate the approach to management.
- Depending on the nature and extent of identified contamination along the project corridor, specific remediation may be required; especially if excavation or piling is required through former landfill or uncontrolled fill sites.
- Acid sulfate soils (ASS) have the potential to generate sulfuric acid when exposed to oxygen and water and if not carefully managed, this is a potential source of pollution. Controls may be required to manage ASS during excavation and tunnelling activities.

- Excavation or other construction activities have the potential to cause volatile contaminants (such as petroleum fuels and solvents) or ground gases (such as methane, carbon dioxide and hydrogen sulphide) to be released. However, this would be managed through standard mitigation measures depending on the nature of the gases released, the quantity and the location with respect to sensitive receptors.
- The potential for groundwater plumes to originate on the site or migrate into the project boundary from off-site, may result in contaminant migration and mobilisation.

Operation

The potential key environmental impacts relevant to contaminated land would likely be associated with inflows of contaminated groundwater and residual volatile contaminants within the tunnels. However, this would be mitigated through the provision of watertight structures.

3.5.3 Further investigations and management measures

Potential impacts would be managed through the preparation and implementation of a Spoil Management Plan (SMP). This would include the requirements and methods for the management of waste acid sulphate soil material and odour management in accordance with relevant regulations and guidelines in consultation with EPA Victoria.

Further investigations would focus on assessing the risk associated with individual sites. This would include a more detailed review of historical data and records including aerial photographs, certificates of title, council records, EPA Victoria information and site inspections of areas identified to have an increased potential for contamination. Based on the detailed review of data and records, targeted soil sampling and testing would be undertaken at key sites to characterise existing contamination. This information would then be used to carry out an assessment of risks associated with the disturbance of contaminated land and groundwater.

3.6 Ecology

3.6.1 Existing conditions

The project area is predominantly urbanised, but areas of high ecological value remain in some sections, mainly near the Yarra River and its associated floodplain. As this land is a floodplain within a large metropolitan area, it is characterised by expansive, well-treed, multi-use recreational parks (including golf courses), which retain important patches of high ecological value.

Vegetation communities and flora species

Vegetation within the project area is predominantly located within the Gippsland Plain bioregion and to a lesser extent the Highland Southern Fall bioregion in the northern parts of the corridor. Key areas include:

- Riparian and floodplain vegetation associated with the Yarra River and its tributaries, including Koonung Creek, Merri Creek and Banyule Creek. Vegetation in these areas is Floodplain Riparian Forest (EVC 56), and includes River Red gums (*Eucalyptus camaldulensis*) which occur in remnant patches or as isolated scattered trees. Areas adjoining the Bolin Bolin Billabong contain a diverse understorey of sedges, rushes and herbs including several *Cyperus, Juncus, Isolepis* and *Persecaria* species. Additionally, this area contains a species-rich shrub layer that has been enhanced by recent revegetation efforts and contains many large River Red gum trees.

- Remnant vegetation occurs throughout the corridor including at the Simpson Army Barracks and M80 bike path area, and is characterised by a canopy layer made up of several eucalypts and a grassy understorey (Plains Grassy Woodland (EVC 55) and Valley Grassy Forest (EVC 47)). In several of these locations, the presence of the EPBC Act and FFG Act listed Matted-Flax Lily (Dianella amoena) was recorded.

Five ecological communities listed under the EPBC Act have been identified as having a potential to occur within the project area. These are:

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Natural Damp Grassland of the Victorian Coastal Plains
- Natural Temperate Grassland of the Victorian Volcanic Plain
- Seasonal Herbaceous Wetlands (Freshwater of the Temperate Lowland Plains)
- White Box Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

A review of ecological communities listed under the FFG Act has identified that there is a potential for one ecological community to occur within the project area as follows:

- Herb-rich Plains Grassy Wetland (West Gippsland) Community.

Eighty-four EPBC Act and FFG Act listed flora species have been historically recorded within five kilometres of the project corridor. The following species are considered to have a high likelihood of occurring, or are known to be present within the project area:

- Clover Glycine (*Glycine latrobeana*)
- Matted Flax-lily (*Dianella amoena*)
- River Swamp Wallaby-grass (*Amphibromus fluitans*).

Terrestrial fauna

The areas of high ecological value along the corridor also retain important patches of high value habitat for terrestrial fauna.

The woodland and forest areas that remain or that have regenerated or been re-planted offer low to moderate value habitat for threatened fauna species. While some threatened species may use these habitats occasionally they are more likely to be used and visited by common and adaptable fauna that occur across much of Melbourne.

Further south, in the suburbs of Macleod and Viewbank, the corridor runs along a relatively large area of remnant woodland/forest, particularly for this part of otherwise urbanised Melbourne. This habitat is of high value and is likely to support threatened fauna species.

The corridor then passes alongside Banyule Creek, which is relatively degraded (weedy, and with non-native trees and shrubs) and generally of low to moderate value to fauna for most of its length. However, Banyule Creek flows into or alongside Banyule Wetland within a large area of recreational parks associated with the Yarra River floodplain in Heidelberg and Bulleen, where there are numerous records of threatened species. The corridor then continues along the eastern side of more high value Yarra River floodplain, including the Bolin Bolin Billabong.

Eighty-two threatened fauna species have been recorded within five kilometres of the corridor. Records include 39 species listed as threatened or migratory under the EPBC Act, 47 species listed under the FFG Act and 66 species listed under the Victorian Advisory List of Threatened Vertebrate or Invertebrate Fauna respectively (DELWP 2013, 2009). Of the species recorded in the past, the following are considered to have a high likelihood of occurring:

- Swift Parrot (*Lathamus discolor*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Growling Grass Frong (*Litoria raniformis*)
- Latham's Snipe (*Gallinago hardwickii*)
- Broad-shelled Turtle (*Chelodina expansa*)
- Barking Owl (*Ninox connivens connivens*)
- Brown Toadlet (*Pseudophyrne bibronii*)
- Powerful Owl (*Ninox strenua*)
- Glossy Grass Skink (*Pseudemoia rawlinsoni*)
- Southern Toadlet (*Pseudophryne semimarmorata*)

Aquatic fauna

Yarra River – a key natural feature that has significant aquatic ecology values along the alignment including known populations of Australian Grayling, an EBPC listed native migratory fish. The river also provides habitat to a range of other native fish and is a major aquatic corridor connecting the aquatic habitats in the wider stream network. Although the river at this location has moderately good instream habitat and good riparian vegetation condition, it is impacted by urban stormwater and other threats to water quality.

Banyule wetland – a non-permanent wetland and, with the associated lake, provides a regionally significant and relatively well protected floodplain wetland. Due to the presence of barriers to fish passage, the aquatic ecology values of this site are likely to be limited to opportunistic species that are able to colonise during rare overbank flows and high flow events. Notably, this may include EBPC listed Dwarf Galaxias, as the habitat may be suitable for this species.

Bolin Bolin Billabong – a regionally significant floodplain wetland, with a largely intact riparian vegetation, but considerable weed infestation and lack of hydrological connectivity with the Yarra River, because of increasingly rare overbank flows. The billabong historically has been mostly dry, but has high amounts of potential aquatic habitat structural diversity (i.e. woody debris and leaf litter), and little bed or bank disturbance suggesting it has good potential to contain high ecological values during periods of inundation.

Listed aquatic fauna species that are considered to have a high likelihood of occurring, or are known to be present within the project area include:

- Dwarf Galaxias (*Galaxiella pusilla*)
- Murray Cod (*Maccullochella peelii*)
- Macquarie Perch (*Macquaria australasica*)
- Australian Mudfish (*Neochanna cleaveri*)
- Australian Grayling (*Prototroctes maraena*)
- Broad-shelled Turtle (*Chelodina expansa*).

Merri Creek –given its proximity to the Yarra River, Merri Creek is likely to have similar aquatic values area as the Yarra River environment. This may include the presence of EPBC listed Australian Grayling populations and other listed native migratory fish.

3.6.2 Potential impacts

Construction

Key impacts during construction could potentially include the following:

- Ground disturbing construction activity resulting in the removal of native vegetation, scattered trees, amenity trees or habitat for EPBC Act or State listed flora and fauna
- Ground disturbing construction activity resulting in the spread or introduction of weeds and pathogens into native vegetation
- Inputs of surface sediments, chemicals and rubbish into waterways or waterbodies leading to degradation of waterways or waterbodies or the degradation of fauna habitat
- Changes to groundwater/surface water levels, resulting in changed ecohydrology
- Changes to water quality from ground disturbance and runoff
- Temporary structures and building impacts to waterways, blocking fauna passage (including Koonung Creek and Banyule Creek).

Operation

Key impacts during operation could potentially include the following:

- Overhead structures resulting in the reduction of light and rain penetration to vegetation and habitat, with the potential to result in loss of cover, habitat and water quality and resulting in potential for behavioural impedance to fauna passage
- Changes to stormwater inputs to waterways, affecting ecohydrology, water quality and aquatic habitat quality
- Changes to groundwater or surface water levels, resulting in changed ecohydrology
- Shading of waterways inhibiting natural behaviours of aquatic fauna.

3.6.3 Further investigations and management measures

Further investigations to support project planning approvals would include a detailed flora and fauna assessment, targeted surveys or habitat assessments, and detailed field assessments. This would include determining offset requirements in accordance with relevant guidelines.

Potential impacts would be managed through additional pre-clearing surveys and inspections undertaken under the guidance of a suitably qualified ecologist, to confirm flora and fauna locations, and enable relocation or offset measures, if necessary. During construction 'no-go' zones around retained native flora and fauna species would be identified to avoid and mitigate impacts to these species.

Measures would also be developed and implemented to avoid the spread or introduction of weeds and pathogens during construction.

3.7 Greenhouse gas

3.7.1 Overview

In 2014, Australia's total greenhouse gas emissions were 523,310 kilotonnes of CO_2-e. The transportation sector, which includes cars, light and heavy commercial vehicles and motorcycles, accounted for 15 per cent of Australia's overall greenhouse gas emissions. At the state-level, Victoria's total greenhouse gas emissions were 118,973 kilotonnes of CO_2-e. The transportation sector accounted for 16 per cent of Victoria's overall greenhouse gas emissions.

Greenhouse gases are emitted from the combustion of fossil fuels in plant, equipment and vehicles as well as from the production of electricity which is purchased from the grid. Other activities that release greenhouse gas emissions include clearing vegetation as well as the transportation and manufacture of construction materials.

3.7.2 Potential impacts

To estimate potential greenhouse gas emissions at this early stage of the project, a high-level analysis was performed using the results of the Environment Effects Statement for the West Gate Tunnel Project, where the Carbon Gauge tool was used to calculate greenhouse gas emissions during construction and operation. These results were apportioned for North East Link based on the length of surface road, cutting, viaducts and tunnels.

Construction

Greenhouse gas emissions would result from the manufacture of the materials used to build the project. The embodied carbon in materials used during construction represents the largest emissions source. However, the consequence of greenhouse gas emissions is considered minor and can be further managed by implementing leading practices in infrastructure sustainability such as the Infrastructure Sustainability Rating Tool (IS Tool,) that evaluates sustainability initiatives and potential environmental, social and economic impacts of infrastructure projects. The Materials category in IS tool aims to minimise the consumption of precious resources, optimise resource efficiency and reduce the environmental impacts of infrastructure through life cycle - cradle to cradle thinking.

Materials Credit 1 uses a materials calculator to assess the lifecycle impact of materials use on a project/asset and the results of this calculator can be used to inform design of the project particularly around use of resources more efficiently and select lower impact materials and product options.

The release of greenhouse gas emissions from construction activities is considered to be almost certain. The use of fossil fuels such as diesel or grid-powered electricity is necessary to operate plant, equipment and the tunnel boring machines used to construct the project, causing greenhouse gas emissions.

The impacts of greenhouse gas emissions from construction plant and equipment can be managed with initiatives relating to the IS Tool credit Ene-1, which provides energy and carbon modelling and monitoring throughout the project lifecycle.

Operation

During operation, greenhouse gas emissions would result from the use of electricity for the tunnel pumps, lighting, and ventilation. While greenhouse gas emissions would also be generated from the use of fossil fuels to operate plant and equipment, site vehicles, and from the delivery of materials for maintenance, these sources would be relatively minor.

3.7.3 Further investigations and management measures

Further investigation of greenhouse gas emissions from the project's construction and operation would be undertaken. This would include:

- Assessing greenhouse gas emissions and potential impacts associated with the project
- Demonstrating compliance with the *Environment Protection Act 1970* (Vic) including the State Environment Protection Policy (SEPP) (Air Quality Management)
- Developing performance requirements for greenhouse gas emissions management that specify the limits and processes that must be followed to achieve an acceptable outcome
- Integrating sustainable design practices into the design process to minimise, to the extent practicable, greenhouse gas emissions arising from construction, operation and maintenance of North East Link
- During detailed design, considering the selection of materials and during construction monitor energy and carbon, to target reductions for greenhouse gas emission impacts of materials and energy consumption in accordance with the IS rating tool.

3.8 Ground movement

3.8.1 Existing conditions

The geology underlying the corridor is relatively complex in that it encompasses a sequence of marine, alluvial, sedimentary and volcanic soils and rock laid down over a time interval of more than 400 million years.

The oldest of the rock units (dating to the Silurian Period) have been subjected to folding, faulting, weathering, uplift, and erosion, with subsequent burial by more recent volcanic rocks and alluvial soils. The geological history of deposition has been interspersed with prolonged periods of erosion ("planation") that have resulted in weathering and modification of the rocks and soils beneath.

Based on a review of the topography, geomorphology, geological structure and geology of the project area, the following geo-hazards have been identified:

- Potentially poor ground conditions (e.g. unstable excavations and high groundwater inflow associated with discrete faults and fault zones within the underlying rock)
- Abrasivity, slow progress and cutter wear in sandstone and conglomerate beds within the rock
- The presence of acid sulfate conditions within unweathered basement rock units
- Potential for high groundwater inflows, soft ground conditions and de-watering drawdown effects within thick Yarra Valley floodplain sediments
- The hydraulic properties, (e.g. hydraulic conductivity), of fractured rock aquifers is highly variable, anisotropic and inhomogeneous. These properties are key to assessing potential de-watering drawdown effects.
- Known flooding potential within the Yarra Valley and Banyule flats and potential for "flash flooding" in tributaries to the Yarra River.

3.8.2 Potential impacts

The potential for ground movement to occur during construction activities is influenced by local geotechnical and hydro-geological conditions.

Construction activities that modify existing landforms at the surface or remove soil, rock and groundwater at depth have the potential to affect buildings and structures due to ground movement. Ground movement may occur as a result of settlement due to excavated soil or groundwater inflow, settlement from constructing on weaker compressible soil, or from land slip when constructing on, or creating, a slope that is too steep.

Experience from tunnelling projects around the world shows that typically, tunnels represent a significantly higher level of risk and cost when compared to surface road construction. This is due to the variable nature of the ground in which the tunnel is constructed and the complex interaction between the tunnelling process and the ground response.

Construction

Potential key construction impacts are discussed below:

- When tunnelling beneath roads, structures, residential areas former landfill sites and utilities, there is the potential for ground settlement and subsidence. Where the proposed alignment seeks to follow existing highways and easements, the impacts on residential areas would be reduced.
- In the lower reaches of the Yarra Valley towards Heidelberg, significant thicknesses of alluvial soils are expected, which would mean that any tunnelling in that area may traverse sections of soft ground. Within this area there is potential for significant consolidation settlement in addition to "volume loss" settlement.
- Portals and dive structures in flood prone areas, including the lower reaches of the Yarra Valley would require specific flood protection measures. Depending on the design flood levels, tunnel structures would need to be designed for significant additional temporary water loads.
- Folds, faults, dykes and fractures in the Silurian bedrock may give rise to instability around the tunnel portals and potential instability around the tunnel heading. This would depend on the local intensity and condition of the fractures, groundwater conditions, depth of weathering and the residual stress in the rock mass.

Operation

The key ground movement impacts of the project are associated with the construction phase and are discussed above. No key impacts for the operational phase have been identified.

3.8.3 Further investigations and management measures

The potential impacts identified above are routinely managed on major infrastructure projects. To investigate and address these potential impacts, the following studies would be undertaken:

- An assessment of volume loss and drawdown settlement would be undertaken using empirical, analytical and numerical methods as appropriate. An assessment of the risk to any existing utilities or buildings within the "zone of influence" of movements due to construction would be undertaken. Those structures that are assessed as "moderate" risk of damage or greater would be subject to more detailed assessments based on detailed review of construction details and conditions surveys.

- For those structures that fall within the moderate risk category after detailed assessment, appropriate mitigation measures would be developed. These may comprise: modifications to the tunnelling process or methods; pre-support of the ground adjacent to the structures; isolation of the structures from the ground movement; re-location of the affected structures; or, structural support of the structures.
- In conjunction with these measures a detailed three dimensional geological/geotechnical model would be prepared of the ground conditions along the project alignment.

3.9 Groundwater

3.9.1 Existing conditions

Hydrogeology – identified aquifers

Fractured Rock Aquifers – comprise Silurian – Devonian age indurated sediments, (Anderson Creek, Melbourne and Humevale Formations). Several kilometres in thickness, forming the geological basement, these indurated sediments are likely to have similar hydrogeological behaviour (hydraulic connection). Grouping the geologies into a single 'basement' aquifer system is therefore considered reasonable. These rocks are widespread throughout the corridor, occurring as outcrops, or buried beneath younger floodplain sediments or volcanics. Basalt of the Newer Volcanics (Quaternary / Upper Tertiary) and Older Volcanics (lower Tertiary) also constitute fractured rock aquifers. The Newer Volcanics are mapped west of the corridor, and the Older Volcanics may occur as dykes within the Palaeozoic basement rocks but have also been mapped at the northern end of the corridor in Watsonia North. Within these aquifers, groundwater is (mostly) transmitted by secondary porosity flow mechanisms in these rocks, e.g. fractures, joints and other discontinuities within the rock mass.

Porous Media Aquifers – The porous media geologies include the Tertiary Brighton Group, and the Quaternary age (alluvial and colluvial) sediments. Both units comprise variable mixtures of sands, silts, clays and gravels. The Quaternary sediments constitute a key aquifer in the corridor and are laterally restricted to the present day drainage lines and waterways, (floodplain of the Yarra River). In some cases these aquifers can have a high degree of interaction with waterways. The sediments are potentially more permeable than the fractured rock aquifers, and therefore groundwater flows are potentially higher when they are intersected.

Aquifer connection – From a regional perspective, there is a strong likelihood of a high degree of interaction between the various aquifers within the lithological profile, i.e. there is no regional aquitard within the project study area. All aquifers potentially represent the water table aquifer and under hydrostatic pressure. Artesian flow conditions are not expected. There may be localised areas where groundwater is perched, or confined or hydraulically separated from adjoining beds.

Groundwater levels and flow directions

The groundwater depth is quite variable along the corridor with depths varying between less than five metres to over 20 metres. In the higher topographies, groundwater levels are deeper, with groundwater flow driven by topographic gradients towards the lower lying areas and valleys. Water levels in the higher topographies can be considerably deeper than 20 metres below the surface.

Groundwater is expected to discharge towards valleys and floodplains as seeps and spring flow. Under these circumstances, the shallowest water levels are expected to occur associated with the creeks and waterways could be less than five metres below the natural surface within floodplain areas of the Yarra River.

Groundwater quality and use

Groundwater is classified into segments based on the State Environment Protection Policy (SEPP) (Groundwaters of Victoria). Regional mapping of groundwater quality indicates that groundwater salinities typically fall within Segment B, i.e. 1,000 mg/L to 3,500 mg/L Total Dissolved Solids. Groundwater quality potentially freshens nearer to waterways, such as within the floodplain of the Yarra River.

At salinities at the upper end, or above the Segment B range, the groundwater becomes increasingly complex to manage, particularly in terms of its disposal if encountered during construction, (e.g. greater salt loads to sewers).

Groundwater use occurs along the project corridor, however, use is limited by the urbanised setting (small land parcels, and availability of reticulated water) and the low bore yields. Groundwater bores have been installed for investigation purposes, (environmental or contaminated land investigations), but also for stock and domestic use, (garden watering, swimming pool top up).

The corridor does not fall within a groundwater management area as defined by the Department of Environment, Land, Water and Planning.

3.9.2 Potential impacts

Construction

Potential impacts that could arise from the project's interaction with groundwater during construction of the project include:

- Potential impacts associated with the interaction of above ground works with groundwater resulting in:
  - Groundwater contamination caused by chemical or fuel spills or discharges of wastewater.
  - Migration of groundwater contamination arising from dense pile clusters creating a conduit for it to move.
- Potential impacts associated with the interaction of below ground works with groundwater resulting in:
  - Local subsidence associated with aquifer dewatering.
  - Diminished availability of groundwater for users as a result of groundwater drawdown.
  - Diminished availability of groundwater for groundwater dependent ecosystems or waterways due to groundwater drawdown.

Operation

The operation of the project has the potential to indirectly interact with groundwater during operation through chemical or fuel spills or discharges of wastewater.

There is also potential for impacts on groundwater quality through mobilisation of existing contamination or the migration of existing contaminated groundwater plumes.

3.9.3 Further investigations and management measures

Further investigation into the potential for interaction between the project and the groundwater environment will be required, including further geotechnical drilling to develop a geological and hydrogeological model and establishment of a groundwater monitoring network.

Once the groundwater system in the vicinity of the project is understood, modelling would be undertaken to predict changes in the groundwater environment due to the project. The implications for groundwater users, buildings and other infrastructure assets and groundwater dependent ecosystems would then be assessed.

Potential impacts to groundwater quality and groundwater users would be mitigated through project design and management plans for monitoring, reuse and disposal of groundwater inflows that comply with the relevant legislation and guidelines. These include the *State Environment Protection Policy Prevention and Management of Groundwaters of Victoria 1997* (Vic), *State Environment Protection Policy Waters of Victoria 2003* (Vic), *State Environment Protection Policy Prevention and Management of Contaminated Land 2002* (Vic), *Water Industry Regulations 2006* (Vic), and in accordance with relevant EPA Publications.

3.10 Historic heritage

3.10.1 Existing conditions

A range of historical heritage places were identified as being within or close to the project corridor. Many of these places relate to early residential and other activities and developments near the Yarra River.

North of Lower Plenty Road, the project intersects or is close to a series of heritage places relating to historical residences, the Simpson Barracks, significant trees and areas of environmental significance.

The Yarra River parklands, which extend along the Yarra River, as a whole are associated with a broad heritage value comprising numerous State and local significant heritage places and associated riparian edge, wetland features and River Red Gums (*Eucalyptus camaldulensis*).

South of Banyule Road, the project intersects or is close to a series of heritage places including parkland areas such as Banyule Flats, significant trees, historical residences and associated streetscapes. This area also includes two sites on the Victorian Heritage Register being Heide I and Heide II (5-7 Templestowe Road, Bulleen, VHR H0687 (HO160) and VHR H1494 (HO161)): These two co-located and related VHR places comprise the Heide Museum of Modern Art.

South of Manningham Road the project intersects or is near to a series of heritage places including archaeologically valuable sites, a number of significant trees and historic residences, community facilities with some historic value, as well as the Bolin Bolin Billabong, which is subject to a large Heritage Overlay (HO30).

Along the Eastern Freeway, the project interests or is near to heritage places associated with the Yarra River, including Yarra Bend Park (V7922-0142), which is also subject to a heritage overlay (HO307), and Victoria Park Precinct (HO337).

The corridor also includes a small number of listed archaeological sites. It is likely that there are other unlisted archaeological sites associated with the corridor but future archaeological predictive modelling would be required to confirm this.

3.10.2 Potential impacts

Construction

The construction of the project has the potential to result in the following impacts:

- Damage to heritage buildings and structures may occur due to ground movement and vibration (from tunnelling and surface works). Following further assessment and depending on the level of risk, measures would be developed to eliminate or minimise potential impacts.
- Indirect impacts on the Victorian Heritage Register sites that make up the Heide Museum of Modern Art would be avoided where possible, or mitigated.
- Disturbance of historical archaeological sites of significance (including Victorian Heritage Inventory listed sites, HO sites described as having archaeological values and unidentified sites). Where sites are known, there is an ability to manage the works to allow for investigation of the archaeological values of these sites and the realisation of their research potential. In this way, the adverse impact (damage or loss of the site) could be partly mitigated and there are also some benefits from these archaeological investigations.
- Disturbance to locally listed HO places including trees and residences may result in adverse visual impact, and some potential physical impact. Where sites are known, there is an ability to manage the works to avoid direct impacts and maintain the core values of the heritage places.

In addition, there is potential for the discovery of unidentified sites during construction.

Operation

The key impacts of the project on historic heritage are associated with the construction phase of the project.

3.10.3 Further investigations and management measures

The project would be designed to avoid adverse effects to significant historic heritage values. Where this is not possible, the impacts would need to meet the requirements of the *Heritage Act 1995*, and obtain the appropriate authorisations from Heritage Victoria.

Further work to support an EES would include additional detailed existing conditions work based on more detailed design information. This includes the preparation of a land use history for the corridor and surrounding area. The history would provide context for existing conditions and impact assessment work and support high-level predictive modelling for historical archaeology. Particularly where surface impacts are proposed, further investigation should focus on sourcing and reviewing any relevant Conservation Management Plans, historical research, place-specific reports, studies and plans for identified heritage places and specific overlay areas as required.

This may also involve additional fieldwork including inspection of specific heritage places and places with potential heritage value along the corridor. A high-level predictive study would also be developed for historical archaeology for the corridor focusing on areas of subsurface disturbance where archaeology could be impacted.

Consultation would also be required with Heritage Victoria and local councils within the corridor to seek access to information about current and potential heritage places, current and proposed future heritage studies or assessments, current VHR nominations or assessments, archaeological investigations within or in proximity to the corridor.

A protocol for the discovery of archaeological sites would be developed in accordance with the requirements of the *Heritage Act 2017* (to be implemented from 1 November 2017, which includes some changes to procedures for historical archaeology) and in consultation with Heritage Victoria.

3.11 Land use planning

3.11.1 Existing conditions

The project area contains numerous land use attributes which have been identified as elements which would influence design. These include:

- **Activity centres and employment clusters** – The La Trobe National Employment and Innovation Cluster (NEIC) has been identified in State planning policy for targeted growth and investment in employment and business. Ensuring connectivity and access to the precinct is a key objective of NEIC policy. Similarly, targeted investment and growth has been identified in structure plans for Greensborough, Heidelberg and Ivanhoe activity centres within Banyule and Doncaster Hill activity centre within Manningham.
- **Density of development and associated controls** – The project does not encroach or place direct pressure on the Urban Growth Boundary, which is in place to contain urban sprawl and protect non-urban areas. The majority of the project area follows existing arterial routes (Road Zone), as well as areas zoned for Public Conservation and Recreation surrounded by General Residential zoned land. Further south, the alignment passes through a number of passive and active open space areas, land reserved for education purposes and pockets of Industrial zoned land.
- **Waterways** – A number of areas along the alignment are located within an Urban Flood Zone (UFZ), Land Subject to Inundation Overlay (LSIO) and Special Building Overlay (SBO). These areas are susceptible to flooding, including areas to the west of the alignment (the Yarra River) and waterways that feed into the Yarra River such as the Plenty River and Diamond Creek.
- **Areas of public open space and national parks** – The alignment contains significant parkland and smaller areas of public open space generally found in land subject to the Public Conservation and Recreation Zone (PCRZ) and Public Parks and Recreation Zones (PPRZ) where the purpose of these planning controls is to protect and conserve areas of recreational open space and environmental value from inappropriate development. Designated National Parks are located along the upper to mid reaches of the Yarra River forming a green spine across the Wester corridor. These areas are generally larger parcels of land in the centre and east of the proposed Western corridor, are zoned PCRZ and are generally Crown land.
- **The natural landscape, environmental and biodiversity values** – Overlays for the alignment centre on protection of environmental and landscape values located through the City of Banyule and the Yarra River corridor. Native vegetation and key landscape areas are subject to planning scheme controls including the Environmental Significance Overlay (ESO), Significant Landscapes Overlay (SLO) and the Vegetation Protection Overlay (VPO), which are in place to protect and conserve areas of environmental, vegetation and landscape significance. Generally, the ESO and SLO extend along the Yarra River environs across the proposed Western corridor. Review of the VPO indicates the protection of vegetation of significant value is largely centred around the Greensborough and Heidelberg areas.
- **Bushfire risk** – The Bushfire Management Overlay (BMO or WMO) generally applies to land with lower density to the north and east of the project area reflecting the lower density, higher vegetated nature of the area increasing the potential for bushfire.

3.11.2 Potential impacts

Construction

During construction of the project, it is expected that key impacts would be associated with adverse land use impacts to general residential zones, public park and recreation zones, public conservation and resource zones, industrial zones, community and education facilities, and activity centres. This is due to the range of construction methodologies that impact ground-level land uses, including cutting, cut and cover tunnel, mined tunnel, surface road and viaduct structures. In some locations, these may require land acquisition, removal or relocation of existing local vehicle access routes, and severance of existing pedestrian and cycling linkages, to facilitate the works.

Operation

The potential key impacts of the project on land use during operation are likely to be associated with the following:

- New and expanded road connections throughout the proposed alignment may have a positive impact by improving local connectivity to activity centres, public transportation and gateways identified in local policy. These may include, but are not limited to, Watsonia Neighbourhood Activity Centre and Station, Bulleen Road Gateway and Manningham major gateways. Where the proposed alignment is located within or alongside land already zoned for road use, this may also minimise direct land use impacts.
- Potential expansion of the road corridor may reduce the distance between the existing road zone and adjacent residential land. This reduction may adversely impact the residential land use due to increased noise, traffic and other amenity considerations from the operation of the road.
- Whilst land acquisition would be avoided where possible, a number of sections of the proposed alignment may require permanent residential acquisition, which may impact the long-term use, connectivity, amenity and – in some cases – development potential of the surrounding areas. Some of these areas are also subject to a Design and Development Overlay which seeks to increase residential densities around activity centres and along main roads. Key locations along the alignment where this impact may be evident include the Lower Plenty Road interchange, the alignment south of Manningham Road and the works associated with connecting to and modifications to the Eastern Freeway.
- Some of the proposed surface road works, and associated infrastructure, run through a number of areas zoned for Public Park and Recreation. This may require permanent partial acquisition and permanently limit local access, amenity and use of the associated public open space and community facilities.
- Land zoned for industrial use may also be impacted by the proposed Manningham Road interchange. This would require permanent land acquisition and have long-term implications for connectivity, commercial viability and development opportunity within this industrial activity area.
- Sections of the alignment include viaduct structures near land zoned for Public Conservation and Resource and subject to Design and Development Overlays, which are in place to protect and enhance the natural landscape character of the Yarra River corridor of vegetation and canopy trees are the dominant features. In some locations, including south of Manningham Road, the alignment encroaches these land uses, which may have permanent implications for the long-term use and protection of these locations, such as the Yarra River parkland and surrounding environment.

3.11.3 Further investigations and management measures

Further investigations would be focused on additional consultation with relevant authorities and strategic justification for the approval mechanism to be applied. This may include additional consultation with relevant councils in relation to impacts associated with activity centres, industrial precincts, and any other risks to land use.

This may also include further investigation into the land use issues and approvals required according to the relevant permit triggers to provide recommendations for mitigation and potential design modifications. Protection of the project infrastructure for operation would also be investigated.

3.12 Landscape and visual impact

3.12.1 Existing conditions

The project area consists of the following landscape character types:

- Residential areas on vegetated hilly landscapes
- Parkland areas concentrated around the Yarra River corridor and the Eastern Freeway corridor
- An industrial area along Greenaway Street
- A woodland around Simpson Barracks.

The residential areas south of the M80 are defined by low scale built form with dwellings in garden settings.

An industrial area is located along Greenaway Street, as well as a commercial precinct along Manningham Road.

Parkland areas are generally along the Yarra River corridor and the Eastern Freeway corridor. They are mostly naturalistic in character however, a number of sporting ovals and golf clubs are also located along these waterways, including the Yarra Valley Country Club and Freeway Golf Course as well as the Heide Museum of Modern Art.

The Eastern Freeway is a broad six to eight lane freeway with limited views from the road of surrounding built form. The roadside is characterised by naturalistic features such as mature native planting, rock escarpments and earth mounding. Views towards the Eastern Freeway from surrounding residential areas are filtered by the existing open spaces and vegetated buffers adjacent to the freeway.

3.12.2 Potential impacts

Construction

During construction of North East link, it is expected that there would be adverse landscape and visual impacts to open space, shared paths, residential areas, community facilities and commercial areas. This is due to compounds, temporary buildings, laydown areas, hoardings, large equipment, vegetation removal, and changes to pedestrian and cyclist access and linkages associated with the works.

Operation

The key potential permanent impacts of the project on the visual and landscape character are likely to be associated with the following:

- Widening of the road corridor, which may bring it closer to residential properties and involve the removal of vegetation and installation of noise walls.
- Due to the width of the corridor in some places, existing vegetation and landscape buffers that are removed may not be able to be replaced, for example the existing vegetation at the Simpsons Barracks and the vegetated embankments to the north of the alignment at the M80.
- The siting of ventilation structures and tunnel portals within proximity to residential, community or open spaces, or near the Yarra River and its floodplain.
- The proposed viaduct section connecting to the Eastern Freeway may have visual impact on key receptors such as the Yarra River corridor, and other community, recreation and education facilities.
- Viaducts and overpasses may attract undesirable behaviour (such as graffiti and vandalism) which may impact on visual amenity.
- Ramps and structures over elevated roads may result in a highly visually prominent addition to the landscape, for example the interchanges at the Eastern Freeway, the M80, and Lower Plenty Road.
- The driver experience may be impacted by upgrades to the Eastern Freeway including widening works, additional structures over watercourses, replacement of pedestrian bridges, any reconstruction of road bridges, replacement and new noise walls, removal of roadside vegetation and modifications to the existing rock escarpments.
- Upgrades to the Eastern Freeway that modify the shared paths, pedestrian crossings and the existing adjacent landscaped buffers and open spaces (that currently filter views towards the freeway) may have an impact on visual amenity and connectivity. Additional paths and pedestrian links provided as part of the upgrades to the Eastern Freeway may provide a positive impact.
- The removal of any mature street trees from urban environments to accommodate the freeway may have an impact on visual amenity. However, additional street trees would be planted in urban environments to mitigate this impact.
- The creation of a barrier to movement between areas of public open space may disrupt the way the community uses and interacts with public spaces. Dissecting a park may also affect a person's experience of an open space.

3.12.3 Further investigations and management measures

A landscape concept design would be prepared as part of the Reference Design using an integrated design approach. The landscape concept design would be in accordance with the principles and objectives of the Urban Design Strategy. The landscape concept design would seek to enhance landscape and visual outcomes as well as minimise and mitigating visual impacts.

Detailed landscape and visual performance measures would be included as part of the project's Urban Design Strategy which would form part of the basis upon which urban design project proposals would be developed and evaluated.

3.13 Noise and vibration

3.13.1 Existing conditions

A summary of the assumed existing noise and vibration conditions has been based on similar assessments undertaken within the Melbourne Metropolitan area:

- The ambient noise environment is expected to be dominated by noise from the Eastern Freeway, Greensborough Bypass and M80 at receptors adjoining the freeway. Locations further from the freeway but without acoustic screening from the freeway noise are also exposed to high levels of traffic noise.
- Noise barriers are located along most of the M80, Greensborough Bypass (east of the M80) and the Eastern Freeway to control traffic noise levels at sensitive receptors.
- Based on previous monitoring and modelling undertaken, existing noise levels are predicted to exceed the VicRoads Traffic Noise Reduction Policy levels at a number of locations.
- A number of public spaces are located in an areas currently exposed to high levels of traffic noise.
- Noise from traffic on local roads is likely to be a significant noise source at sensitive receptors within the study area. Properties further from the project alignment would also be exposed to high traffic noise levels from nearby major roads.
- Discrete maximum noise events are likely to be a feature of the areas closest to the freeway and busy local roads. Maximum noise events are typically caused by heavy vehicle movements, the use of heavy vehicle engine brakes and motorbikes.
- Non-traffic noise sources in the area are expected to include industry, aircraft movements and railway movements on the Hurstbridge metropolitan railway line.

There has not been any background vibration monitoring undertaken at this stage, as vibration from transport corridors is typically imperceptible unless there are irregularities in the road surface. This assumption is consistent with measurements undertaken for the West Gate Tunnel Project. This is evident in the NSW Road Noise Policy (DECCW 2011).

3.13.2 Potential impacts

Construction

North East Link construction entails a wide range of activities. The potential for noise and vibration impacts varies considerably between activities based on the nature of the work, the plant and equipment which is used, time of day and the sensitivity of the receptor. Key impacts during construction include:

- A significant number of sensitive receptors are expected to be located within 50 metres of noisy construction works. Consequently, construction noise levels at residential buildings are likely to be above 80 dB(A) in areas immediately adjacent to noisy works for various durations without noise mitigation. Additionally, community buildings and recreational areas may also be exposed to high impacts, particularly in locations that adjoin the freeway.
- Vibration intensive works associated with the project may occur within the nominated safe working distances for cosmetic damage and human amenity.
- Blasting may be required in some areas to improve the efficiency of excavation activities and shorten the overall excavation program. Areas that would be most likely to require blasting would be the cutting leading to and from the tunnel portals however these activities would be confirmed during detailed design and refined where necessary in response to geological conditions experienced during construction. Impacts created by blasting are largely dependent on the blast methodology. The size of the charge, spaces between charge and timing between charges results in a large variability in the vibration generated by a blast.

Operation

The potential key noise and vibration impacts that would need to be managed during operation include:

- Traffic noise impacts to residential and community buildings may increase due to the project roads.
- Traffic noise impacts may also apply to areas surrounding local roads outside of the corridor where a change in traffic volumes as a result of the project has the potential to increase the noise level.
- Traffic noise impacts to outdoor recreation and public open spaces immediately adjacent to the corridor.

3.13.3 Further investigations and management measures

Further investigation and modelling is required to determine the potential changes in traffic noise due to the construction of new roads and viaduct structures, new and altered interchangers and road widening. Noise modelling would consider the various heights of heavy vehicle-related noise sources, including exhausts, engines, braking, wheel and tyre interface.

Detailed noise modelling would also be required to establish traffic noise mitigation requirements and acoustic controls. Upgrades to existing noise barriers on the Eastern Freeway may be required to mitigate increased traffic noise, and this could include replacement and relocation of existing noise walls, application of absorptive treatments and increasing the height of noise walls to achieve better noise attenuation. Noise from tunnel ventilation structures has the potential to impact upon sensitive receivers (such as residential areas). Therefore, surrounding land uses would be considered when locating the ventilation structures and appropriate engineering standards in tunnel ventilation system design would be adopted in order to support meeting noise limits.

Property owners and communities may be impacted by noise and vibration impacts during construction. A Construction Noise and Vibration Management Plan (CNVMP) would be prepared and implemented to meet the noise and vibration guideline targets recommended by EPA Publication 1254.

3.14 Surface water and hydrology

3.14.1 Existing conditions

There is one major waterway, two main creeks, and one main drain that interact with the project alignment footprint. These include the Yarra River, Koonung Creek, Banyule Creek, and Yando Main Drain respectively. The existing flooding and water quality conditions are assessed below.

Banyule Creek

Banyule Creek originates at Simpson Barracks and flows south into the Yarra River. The creek is approximately four kilometres in length. The catchment consists of urban development and includes part of the Simpson Barracks and also some open space areas. North of Lower Plenty Road, Banyule Creek runs parallel to Greensborough Road through Simpsons Barracks and an open reserve. South of Lower Plenty Road the creek flows through an open reserve near residential properties until it meets the Yarra River. At Drysdale Road the creek passes under the road in a single 0.61 metre diameter culvert. At Lower Plenty Road the creek passes under the road in two 1.58 metre diameter culverts. The creek is also associated with an LSIO (Land Subject to Inundation Overlay), which represents the approximate 1% Annual Exceedance Probability (AEP) flood extent.

Koonung Creek

Koonung Creek is a small tributary of the Yarra, approximately 12 kilometres long and runs from Blackburn North, west towards the Yarra River. The creek meanders back and forth either side of the freeway for much of its length. Its catchment is almost entirely urban, however the creek contains major parklands in some of its reaches that have high recreational value. The creek has been heavily modified by realignment and erosion control works, particularly those associated with the Eastern Freeway, however it has retained native fish species, listed water birds, the growling grass frog and the floodplain contains sites of significant Aboriginal heritage.

Hydrologic and hydraulic models of Koonung Creek existing flood conditions have been developed for the investigation of flood risk and potential impacts to surface water. The creek is also associated with an LSIO (Land Subject to Inundation Overlay), which represents the approximate 1% Annual Exceedance Probability (AEP) flood extent.

Yando Main Drain

Yando Main Drain is a combined underground and above ground stormwater drainage system running west to east near the M80 and Greensborough Bypass interchange, flowing through Kalparrin Gardens before joining Plenty River. Downstream of the study area, the catchment of the Yando Main Drain is heavily urbanised and includes a series of wetlands before the confluence with Plenty River.

Where Yando Main Drain crosses Greensborough Bypass the drain consist of a single underground 1.8 metre diameter circular pipe and a pedestrian underpass-culvert that conveys overland flows from west to the east of Greensborough Bypass.

Hydrologic and hydraulic models of Yando Main Drain existing flood conditions have been developed for the investigation of flood risk and potential impacts to surface water.

Yarra River

Melbourne Water describes the Yarra River catchment as follows (Melbourne Water and Port Phillip Westernport Catchment Management Authority, 2007):

> *"The Yarra catchment lies north and east of Melbourne, beginning on the southern slopes of the Great Dividing Range in the forested Yarra Ranges National Park. Around two million people, over one-third of Victoria's population, live in the catchment, which has an area approximately 4000 square kilometres."*

The Yarra River floodplain between Birrarrung Park and the Chandler Highway provides a significant amount of flood storage, before the river is confined downstream at Chandler Highway. Hydrologic and hydraulic models of the Yarra River existing flood conditions have been developed for the investigation of flood risk and potential impacts to surface water. The river is also associated with an LSIO (Land Subject to Inundation Overlay), which represents the approximate 1% Annual Exceedance Probability (AEP) flood extent, which, in the area of interest, is in the order of 1200 m^3/s.

Merri Creek

Melbourne Water describes Merri Creek as follows (Melbourne Water and Port Phillip Westernport Catchment Management Authority, 2007):

"Merri Creek flows from the foothills of the Great Dividing Range north of Wallan on the Hume Highway. It is a major tributary of the Yarra River flow over basalt plains to meet the Yarra at Fairfield. Tributaries include Edgars and Central creeks. Merri Creek has high Aboriginal heritage value, as the creek and surrounding lands were important for food, shelter and travel."

Merri Creek in the vicinity of the project area is surrounded by urban suburbs. This naturalised system is considered very poor according to the IRC rating of waterways.

3.14.2 Potential impacts

Construction

Construction works along and within waterways have the potential to affect the water quality and frequency and depth of flooding in the project area. Key impacts include:

- Flooding and inundation of property and infrastructure due to the diversion or obstruction of stormwater flow paths causing increased inundation of surrounding properties.
- Water quality impacts due to pollutants in soil and in waterways becoming mobilised in stormwater causing adverse impacts on waterway health. Stockpiled spoil sites might also become mobilised in stormwater during earthworks, causing adverse impacts on waterway health. Flood events causing inundation of machinery may release of fuels into the environment.
- Structural damage of assets due to construction activities causing adverse impacts to the structural condition of existing drainage assets.
- Environmental impacts associated with the potential realignment of sections of Koonung Creek and Banyule Creek to facilitate the construction of the project.

Operation

Operation of the project has the potential to affect the water quality and frequency and depth of flooding in the project area. Impacts include:

- Increased flooding impacts where the diversion or obstruction of stormwater flow paths may cause increased inundation of surrounding properties. Where a flood event occurs during the operation of tunnels, the inundation of vehicles and the general public may be further impacted.
- Waterway health impacts where a change in the concentration of pollutants in stormwater runoff as a result of the construction of additional impervious surfaces may cause adverse impacts on waterway health. Project operation would also involve the discharge of fuels, oils and other contaminants as a result of spills causing adverse impacts on water quality and waterway health.
- Long-term environmental impacts associated with the potential realignment of Koonung Creek and Banyule Creek due to the project works.

3.14.3 Further investigations and management measures

The project would be designed and constructed so that all permanent works and associated temporary construction works do not increase flood risk (considering flood levels, flows and velocities) associated with overland flow paths to the requirements and satisfaction of Melbourne Water and in consultation with other relevant drainage authority and local council. To assess the flood risk, further investigation and modelling would be undertaken of the design of permanent and temporary works to demonstrate the resultant flood levels and risk profile. This includes modelling for the four main areas of investigation including the Yarra River, Koonung Creek, Banyule Creek and Yando Main Drain.

Water sensitive urban and road design assessment would be undertaken to quantify the impact of the project in receiving waters from additional runoff volume, timing, and contamination from increased pollutants. Any road works that create additional pavement area would be required to meet water sensitive road design criteria and provide additional water treatment and flow retention as it is necessary. This would include modelling to quantify the impacts using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC).

For construction works, a Surface Water Management Plan would be prepared and implemented and set out the requirements and methods for best practice sediment and erosion control and monitoring, in accordance with EPA Victoria publications 275 (1991), 480 (1996), and 960 (2004) including maintenance of existing flow paths, drainage lines and floodplain storage.

3.15 Vibration and regenerated noise

3.15.1 Existing conditions

Background vibration in the vicinity of the tunnel is expected to be intermittent rather than constant, quite different from background noise. No vibration information has been collected as yet, however it would be necessary to collect this data at several representative locations within the project corridor, to establish if normally applied criteria for vibration can be adequately administered.

3.15.2 Potential impacts

Construction

Tunnelling and the associated development of the portal dive structures would induce vibration and regenerated noise. Construction methodology is an important component in determining the impact of this vibration and regenerated noise. In the absence of a construction schedule dictating what equipment would be used, a generic tunnelling method of using a tunnel boring machine (TBM) for the mainline tunnels, and hydraulic hammers for the portal dive structures is initially considered.

The cutting performance of a TBM determines the level of induced ground vibration. Machine variables which affect this include torque, speed and thrust, and physical characteristics of the machine including diameter and type and number of cutters. As the TBM diameter increases, the power supplied to the cutting head increases accordingly to maintain similar rates of penetration.

Operation

The key vibration and regenerated noise impacts associated with the project would occur within the construction phase and are discussed above.

3.15.3 Further investigations and management measures

Vibration and regenerated noise from the construction of the project would be required to comply with guideline values that are specified in relevant standards (Australian or International) or are consistent with those guidelines imposed on other large scale tunnel construction projects within Australia, such as the Metro Tunnel Project and West Gate Tunnel Project. The portal dive structures involve longer term works and consideration should be given to maximising the separation from densely populated areas.

Further detailed modelling of vibration and regenerated noise levels would be undertaken once a tunnel and dive structure arrangement has been designed and indicative construction technique confirmed.

Collection of background vibration measurements to define the existing environment would be necessary to ensure that the criteria for the project can be adequately administered.

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared and implemented to meet the noise and vibration guideline targets recommended by EPA Publication 1254.

4 Environmental management framework

The mitigation of actual or potential adverse impacts associated with the project would take place within an overarching Environmental Management Framework (EMF). This framework would provide a transparent and accountable framework for managing environmental aspects of the project's delivery in accordance with applicable legislation and approval conditions.

A set of Environmental Performance Requirements (EPRs) would be developed for the project during detailed assessment to define the minimum environmental outcomes that must be achieved for design, construction and operation.

The EPRs would be performance-based and expressed in terms of outcomes to be achieved for net community benefits, while allowing flexibility in the detailed design response or specific measures to be put in place to achieve the requisite outcome.

The EPRs will be developed during preparation of the Environment Effects Statement (EES), assessed by an independent panel appointed by the Minister for Planning, and considered by the Minister during assessment of the EES.