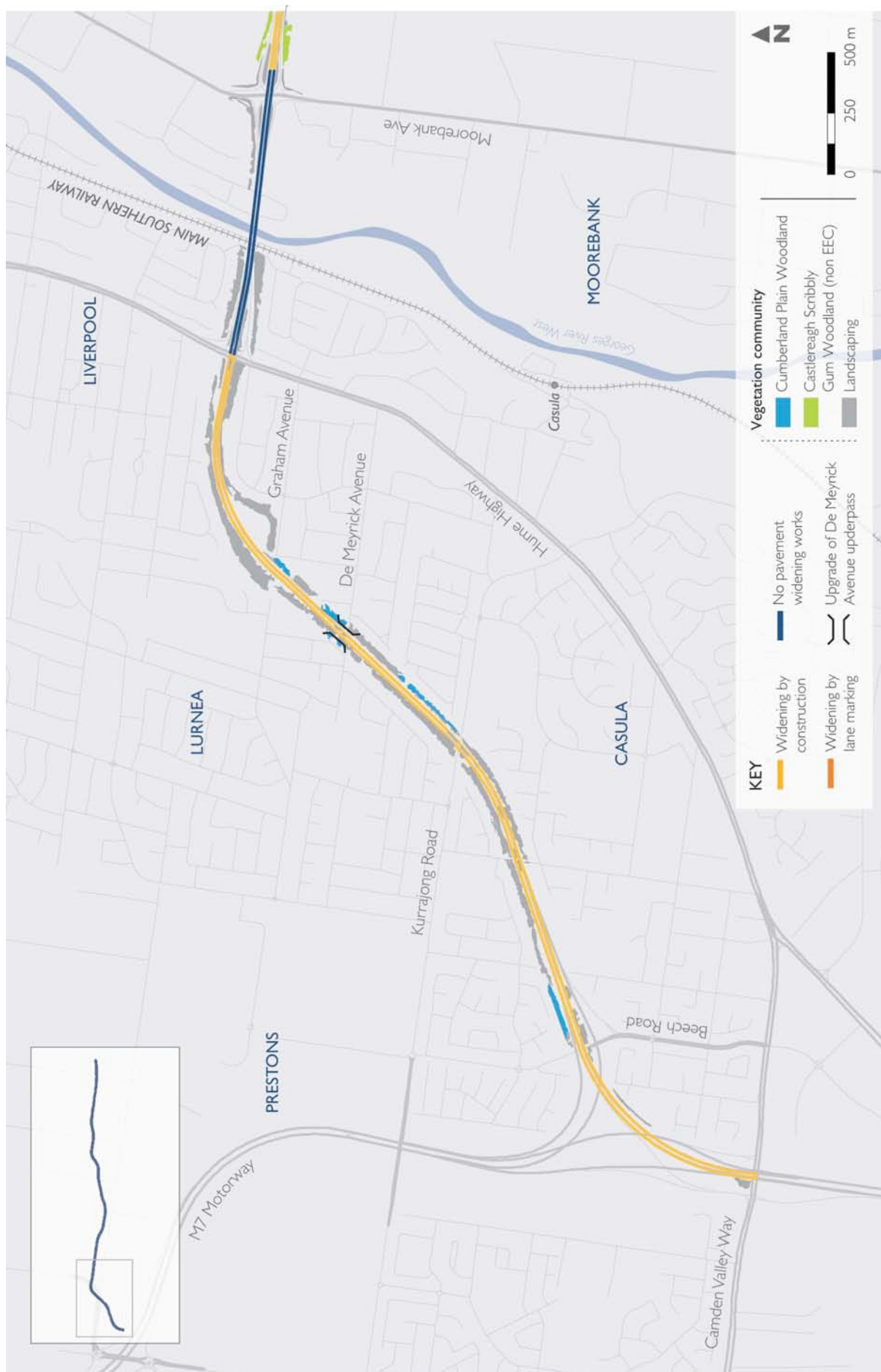
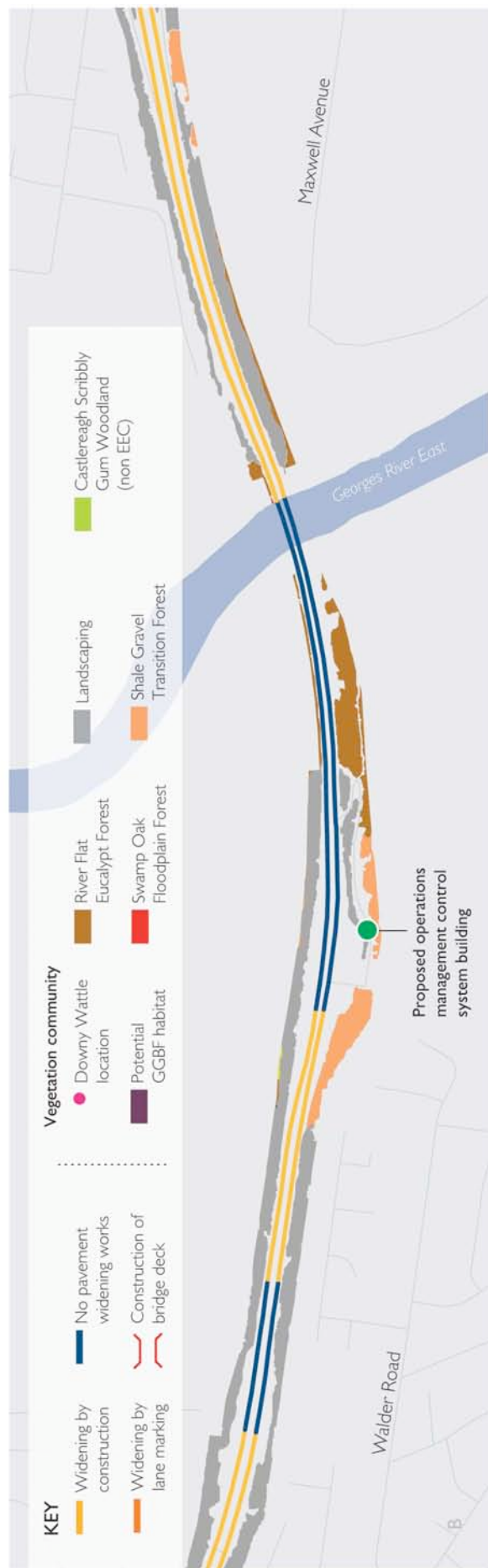
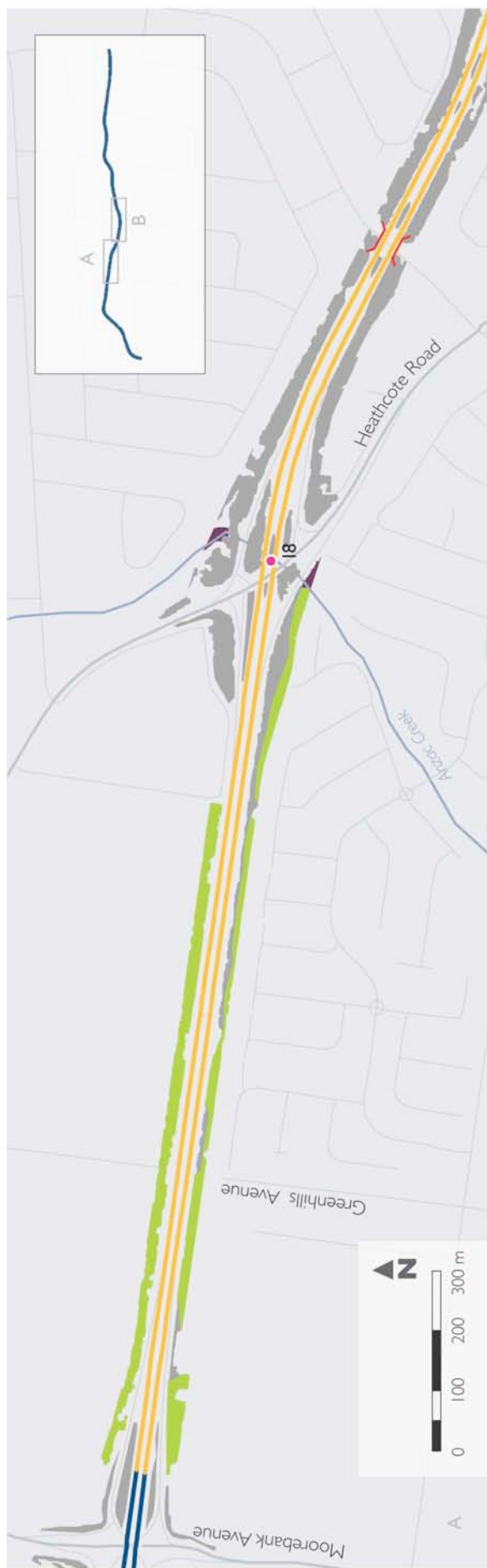






Note: Project detail shown is indicative only, subject to detailed design

Figure 8.8(b) Key biodiversity features of the M5 South West Motorway Corridor

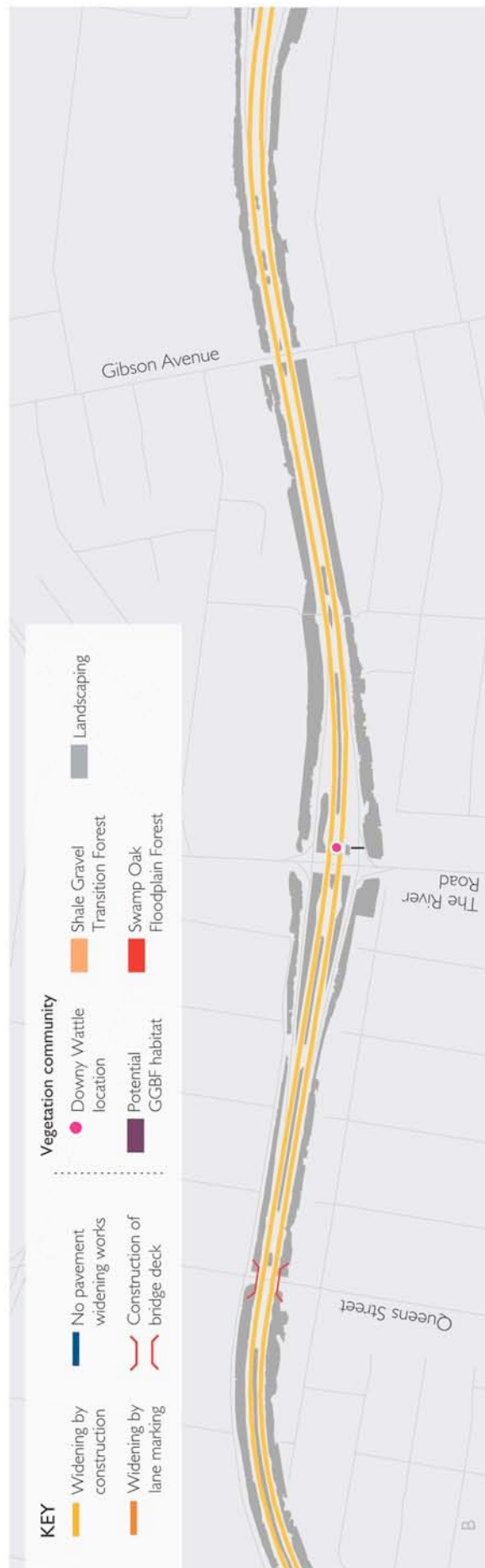
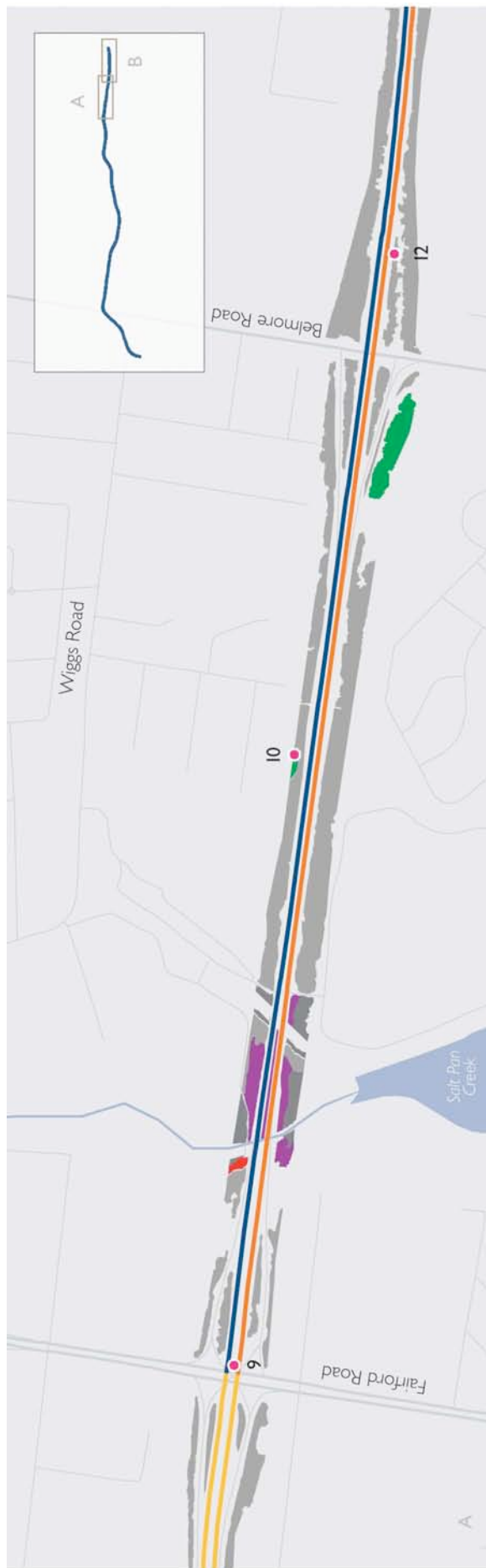


Figure 8.8(c) Key biodiversity features of the M5 South West Motorway Corridor

Note: Project detail shown is indicative only, subject to detailed design



Note: Project detail shown is indicative only, subject to detailed design

Figure 8.8(d) Key biodiversity features of the M5 South West Motorway Corridor

Endangered ecological communities

Large and highly connected vegetation patches – including endangered ecological communities – occur adjacent to the subject site, particularly in the vicinity of the Georges River. Based on a desktop assessment, six endangered ecological communities were identified within the study area. These are:

- Coastal Saltmarsh (listed under the TSC Act).
- Cooks River/Castlereagh Ironbark Forest (listed under the TSC Act).
- Cumberland Plain Woodland (listed under the EPBC and TSC acts).
- River-flat Eucalypt Forest (listed under the TSC Act).
- Shale Gravel Transition Forest (listed under the TSC Act).
- Swamp Oak Floodplain Forest (listed under the TSC Act).

While the species planted as part of the original landscaping of the motorway are generally indicative of Cumberland Plain Woodland endangered ecological community, they do not represent this community (refer to section 4.4 of Appendix G).

Large remnant and restored areas of Coastal Saltmarsh endangered ecological community were identified adjoining the subject site at Salt Pan Creek. This community includes the species *Wilsonia backhousei* (Narrow-leaved *Wilsonia*), which is listed as vulnerable under the TSC Act.

The majority of areas identified as endangered ecological communities in the desktop assessment were surveyed during site visits. The biodiversity working paper (Appendix G) indicates that where these areas could be identified as an endangered ecological community to a reasonable degree of certainty, they were mapped as being 'high certainty' endangered ecological communities. However the working paper also indicates that a number of areas consist of both remnant vegetation and landscaped areas that were coded 'moderate certainty' endangered ecological communities. Taking a precautionary approach, the high and moderate certainty endangered ecological communities have been combined for the purposes of this environmental assessment and are considered as representative of the endangered ecological community for assessment purposes (refer to Figure 8.8(a)–(d)).

Vegetation within the motorway corridor has been subject to a history of disturbance since the construction of the original motorway and most areas have been subject to moderate to high levels of weed invasion or structural modification. Areas of vegetation identified as being landscaped and/or highly disturbed are identified in Figure 8.8(a)–(d).

Central median vegetation

The median of the M5 South West Motorway between King Georges Road and Fairford Road is currently paved, as is the median between the Hume Highway and Moorebank Road. The remaining median sections within the study area consist predominantly of mown exotic grasses with occasional plantings and concentrated landscape plantings around bridge abutments (refer to section 3.2.4 of Appendix G for typical photos).

The species recorded along the central median have been planted (or hydro-mulched) as part of landscaping of the M5 South West Motorway, and no remnant vegetation is present within the median. While the species planted are native, they do not entirely represent species that would have naturally occurred in the area. The groundcover in all areas of the median consists predominately of introduced grasses.

About 33 *Acacia pubescens* (Downy Wattle) individuals were observed within landscaped areas in the central median of the M5 South West Motorway, close to the overpasses for River Road, Fairford Road and Heathcote Road (refer to Figure 8.8(a)–(d)). These individuals exist due to hydro-mulching and landscaping activities associated with the original construction of the motorway, with seed stock sourced from plants that are thought to have naturally occurred within the M5 corridor area (NPWS, 2003a).

A number of *Doryanthes palmeri* (Giant Spear Lily) individuals were also observed in the concentrated landscape planting around the bridge abutments between the Hume Highway and Camden Valley Way. This species is native to northern NSW and is a relatively commonly planted landscape species.

Verge and batter vegetation

The landscaping along the verge and batters of the M5 South West Motorway varies with the width of setback from the carriageway, ranging from areas with no landscaping, to narrowly landscaped areas in front of noise walls and large landscaped areas with setbacks of up to 50 metres from the carriageway.

The majority of vegetation within batters and setback areas has been planted, with a consistent suite of species used throughout the subject site. No threatened ecological communities were recorded within the subject site area and it is unlikely that any of the vegetation present is remnant vegetation.

A number of threatened ecological communities listed under State and federal legislation have been mapped adjacent to the subject site (NPWS, 2002). While some small areas of these communities have been mapped within the boundaries of the subject site, field survey found that no natural vegetation remains. However, this vegetation may potentially provide habitat for threatened species.

In addition to the 33 *Acacia pubescens* (Downy Wattle) individuals identified within the central median, Downy Wattle individuals were also observed:

- On the verges and batters of the motorway mostly between Beaconsfield Street and Horsley Road, Revesby (an additional 43 individuals).
- Within the motorway corridor behind noise walls (an additional 113 individuals). These individuals were concentrated towards the eastern end of the motorway between Penshurst Road and Salt Pan Creek.

In all, 189 Downy wattle were observed within the motorway corridor (refer to Figure 8.8(a)–(d)).

Terrestrial habitat values

The native vegetation communities and areas of landscaping within the M5 South West motorway corridor includes flowering native plants that potentially offer foraging resources for various native fauna, including threatened species. Given the high level of disturbance and the amount of noise along the motorway, it is unlikely that the motorway would be utilised by most species.

A range of common and disturbance-tolerant native species such as *Cacatua galerita* (Sulfur-crested Cockatoo), *Corvus coronoides* (Australian Raven), *Gymnorhina tibicen* (Australian Magpie), *Pseudocheirus peregrinus* (Common Ringtail Possum), *Rhipidura leucophrys* (Willie Wagtail) and *Trichosurus vulpecula* (Common Brushtail Possum) are likely to utilise the limited foraging resources available at the subject site (including Endangered Ecological Communities) from time to time.

A majority of the works would be undertaken within the central median and previously landscaped areas and therefore the potential impact on these common native fauna species is expected to be low. Potential edge effects as a result of vegetation removal (including increased weed invasion and habitat alteration) are not expected to result in any adverse impacts on native fauna.

The vegetation within the motorway corridor is already weedy, disturbed and fragmented to the extent that it does not form any significant buffer to surrounding vegetation and it is unlikely that the proposed works would further increase edge effects. No other habitat features were observed that may have conservation significance or ecological value (such as tree hollows, aquatic areas, roost sites and rock piles).

Riparian and aquatic habitats

The subject site supports numerous aquatic ecological habitat values ranging from drainage infrastructure such as table drains and drainage basins to riparian habitat associated with the Georges River East (Milperra), Georges River West (Moorebank) and Salt Pan Creek. Within the subject site, Georges River East and Salt Pan Creek are subject to tidal flow and support ecology indicative of a saline environment.

Salt Pan Creek is fringed by mangroves and saltmarsh, which provide important ecosystem functions and are valuable habitat for some aquatic species. These areas also provide foraging resources for migratory birds.

Areas of Coastal Saltmarsh (an endangered ecological community listed on the TSC Act) and Estuarine Mangrove Forest (protected under the *Fisheries Management Act 1994* (FM Act)) are present along Georges River East and Salt Pan Creek. Liverpool weir is located about 1.8 kilometres upstream of the study area along Georges River West. The weir represents the tidal limit of the Georges River. As such the vegetation surrounding the subject site at its intersection with Georges River West is likely to be more representative of a freshwater than a saline environment.

The motorway's drainage infrastructure consists of a network of drainage lines and drainage basins that capture and treat stormwater runoff before it enters surrounding piped or natural stormwater systems. The drainage infrastructure typically consists of three main forms: natural (earthen), re-enforced and concrete-lined.

The reinforced and concrete-lined drainage infrastructure support little in the way of aquatic ecology due to a lack of substrate and the rapid flow that the structures are designed to carry. The natural (earthen) drainage basins and drainage lines support limited macrophytes, such as the invasive native species *Typha orientalis* (Broad-leaf Cumbungi), and would provide limited habitat for disturbance-tolerant species.

The invasive exotic fish *Gambusia holbrooki* (Plague minnow) was observed in a number of drainage lines and drainage basins and is likely to reduce the suitability of these areas for breeding of native fauna species (such as fish and amphibians).

No clearing of riparian habitat would be required and no works would be required within waterways.

Vegetation at proposed construction site compounds

A desktop assessment of the potential construction site compounds was undertaken to determine if any ecological survey would be required. It identified four potential construction site compounds for further ecological survey:

- Moorebank Avenue – corner of Moorebank Avenue and the M5 South West Motorway.
- M5 South West Motorway/Graham Avenue – two sites located adjacent to Graham Avenue within the motorway corridor.
- Heathcote Road (north) – corner of Heathcote Road and Junction Road.

Table 8.26 and Figure 8.9 provide an overview of the results of further detailed investigations undertaken at these four potential construction site compounds. Further detail is also provided in section 3.2.9 of Appendix G.

Table 8.26 Results of further detailed investigation at potential construction site compounds

Site	Investigation detail	Ecological constraint
Moorebank Avenue	• Ex-Defence land – largely cleared with an exotic grass understorey. • Mix of remnant native, planted native and exotic tree species scattered across the site. • Some Narrow-leaved Black Peppermint individuals (listed as vulnerable under the TSC Act and EBPC Act) are located on the site. It is a commonly planted street and garden tree (DECCW, 2010b) and has no conservation significance at this site. • A small wetland in the west of the site was observed to be in very poor condition, but the vegetation around the wetland is considered consistent with River-flat Eucalypt Forest, an endangered ecological community under the TSC Act. • The majority of this site is considered to be a low ecological constraint with the wetland in the west of the site determined as a high ecological constraint. The construction site compound would be situated to avoid the wetland area to the west, thereby avoiding the area of high ecological constraint.	Low and moderate
M5 South West Motorway/ Graham Avenue (two sites)	• Both potential construction site compounds have planted vegetation (locally native species) on a large fill batter. • Many of these species are indicative of Cumberland Plain Woodland. This vegetation has been planted and does not constitute the critically endangered ecological community. • Both sites have low ecological constraints.	Low
Heathcote Road (north)	• Characterised by two cleared areas on either side of a drainage line (Anzac Creek), which is a tributary of the Georges River. The drainage line is substantially modified, and flows in a channel for much of its length. • Landscape planting exists within the site along the boundary of Heathcote Road and the M5 South West Motorway. • The drainage line is considered a moderate ecological constraint while the remaining (majority) of the site is considered to be a low ecological constraint.	Low and moderate

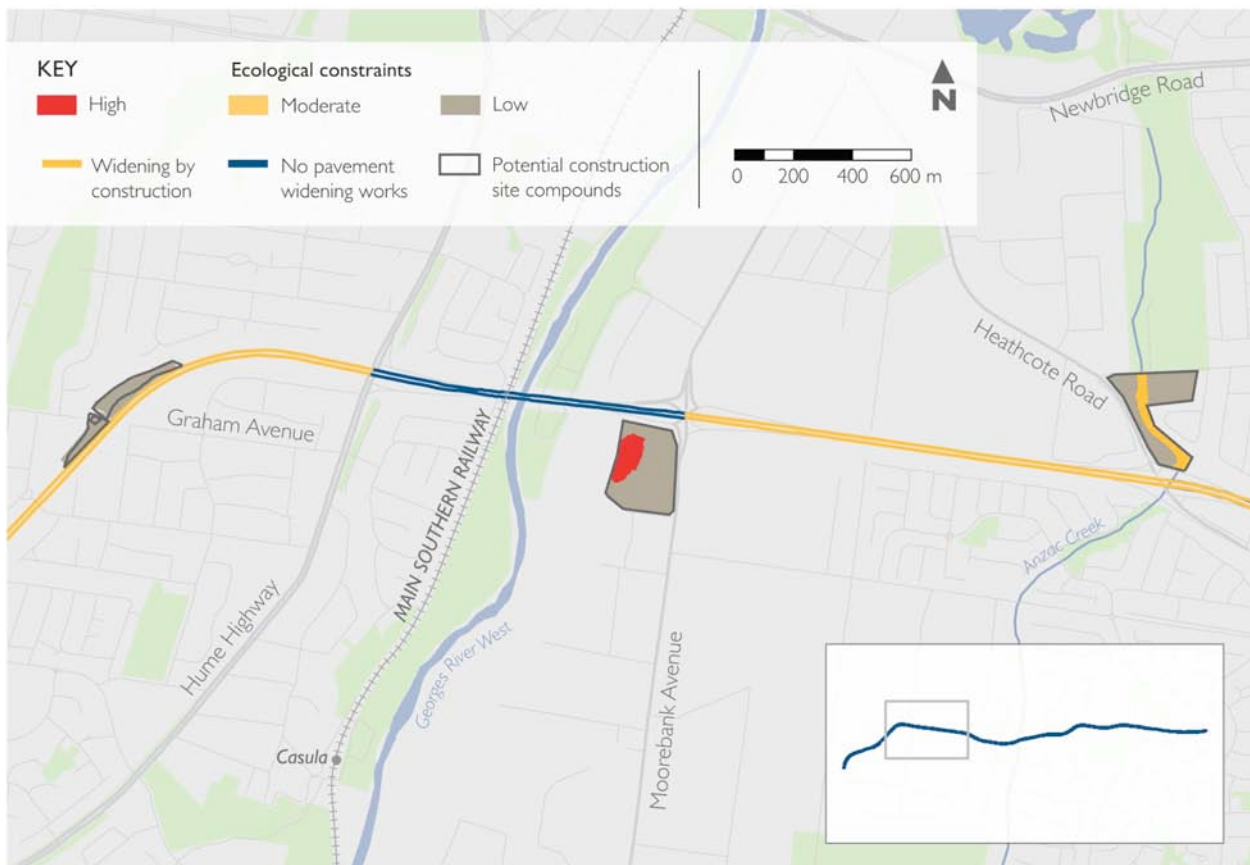


Figure 8.9 Ecological constraints at potential construction site compounds

Noxious weeds

Fourteen of the 110 exotic species recorded at the subject site and construction site compounds are declared noxious weeds within the Canterbury, Bankstown and Liverpool local government areas (DPI, 2010). Refer to section 3.2.10 of Appendix G for further detail.

Vegetation at proposed drainage basin locations and spoil re-use sites

A number of new or augmented drainage basins are required for the project. Detail relating to drainage basins is provided in section 5.3.4 and indicative drainage basin locations are illustrated in Figure 5.1(a)–(d). Spoil re-use sites would also be required as part of the project. Figure 6.3 identifies the location of spoil reuse sites within the motorway corridor. Detail regarding proposed spoil re-use sites is provided in section 6.4.2.

The vegetation communities potentially affected by the proposed augmentation of existing drainage basins – or by the introduction of new basins – and by the introduction of proposed spoil re-use sites are identified in Table 8.27.

Table 8.27 Vegetation communities affected by drainage basins and spoil reuse sites

Vegetation community	Conservation significance	Drainage basins	Spoil re-use sites
Castlereagh Scribbly Gum Woodland	Not listed under legislation	✓	✓
Cumberland Plain Woodland	Critically endangered under the EPBC Act and TSC Act	✓	✓
Cooks River/Castlereagh Ironbark Forest	Endangered under the TSC Act	✗	✓
River Flat Eucalypt Forest	Endangered under the TSC Act	✓	✗
Swamp Oak Floodplain Forest	Endangered under the TSC Act	✓	✗
Landscaping	Not listed under legislation	✓	✓

8.3.2 Assessment of impacts

Key threatening processes

A number of key threatening processes that are listed on the schedules of the TSC Act and the FM Act are considered relevant to the project. These key threatening processes include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act).
- Clearing of native vegetation (TSC Act).
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (TSC Act).
- Invasion of native plant communities by exotic perennial grasses (TSC Act).
- Invasion and establishment of exotic vines and scramblers (TSC Act).
- Predation by *Gambusia holbrooki* (Plague Minnow) (TSC Act).
- Degradation of native riparian vegetation along New South Wales watercourses (FM Act).

A majority of vegetation clearing proposed as part of the project would affect previously landscaped vegetation and therefore the project is unlikely to exacerbate any of the above-listed key threatening processes. In addition, the removal of vegetation from the motorway median may assist in reducing the spread of exotic perennial grasses into adjoining native vegetation communities.

Impacts on threatened flora

Comprehensive impact assessments for species likely to be impacted by the project pursuant to the requirements of the EP&A Act and the EPBC Act have been included in Appendix E of the Biodiversity working paper (refer to Appendix G). The findings are summarised below.

Giant Spear Lily

Some Giant Spear Lily individuals would be removed as part of the project. Although this species is classified as threatened under the TSC Act, it is native to northern NSW and has clearly been planted as part of the original landscaping for the motorway. No significant impacts are expected from its removal.

Downy Wattle

The Downy Wattle is listed as vulnerable under the EPBC Act and TSC Act. About 76 Downy Wattle stems would be removed as part of the project. This equates to a loss of about 40 per cent of the planted population of Downy Wattle within the motorway corridor. An additional 113 Downy Wattle individuals located within the motorway corridor are unlikely to be impacted by the project.

A review of the presence of this species within the region (five kilometre radius) based on National Parks and Wildlife Atlas data indicated that there are about 1,300 Downy Wattle records in the region. Many of the records in the National Parks and Wildlife Atlas records do not contain information on the number of individuals at each site, nor were any of the locations visited to confirm whether the populations still existed. Where no information was available regarding the number of individuals at each site, it was assumed that only one plant was recorded. This may have resulted in an underestimate of the size of the regional population, however this estimate is considered to be a reasonable assumption.

From this data it can be determined that the removal of 76 Downy Wattle stems as a result of the M5 West widening project equates to the removal of about six per cent of the regional population. During the assessment of impact for this species a number of uncertainties arose with regard to the species. These uncertainties are discussed in section 4.2 of Appendix G and summarised as follows:

- There is uncertainty surrounding the significance of the individuals present within the study area. It was listed as an endangered species on the rare or threatened plants (ROTAP) list in the original M5 South West Motorway EIS. The individuals present are not naturally occurring and were included as part of the original M5 South West Motorway landscaping in order to increase the size of the local population (there was no legislative requirement for this at the time).
- There is uncertainty surrounding the source material of the planted population. No records could be located to determine whether seeds or cuttings were actually collected from the impacted populations or from adjoining populations. This species is a clonal species (vegetative self replication) and therefore it is not possible to quantify the importance of the original populations. There is also potential for all the planted specimens to have come from one individual (with genetic material of the planted individuals either of very high or low conservation significance depending on origin). A precautionary approach has been adopted to the assessment of this species. It has been assumed that the Downy Wattle within the M5 South West Motorway corridor have been planted as compensatory habitat and constitute genetic material from populations which no longer exist within the locality.

The following assessment findings are summarised with respect to this species:

- The occurrence of Downy Wattle at the subject site does not constitute the potential limit of its known distribution.
- Based on extensive past development, the subject site no longer constitutes natural habitat for Downy Wattle.
- It is unlikely that genetic material would be successfully transferred from existing planted individuals to adjoining populations by natural pollinators.

Downy Wattle individuals within the motorway corridor have apparently been planted as part of landscaping undertaken after construction of the original motorway. This population is mentioned (albeit as an *in situ* planted population) in the *National Recovery Plan for the Downy Wattle (Acacia pubescens)* (NPWS, 2003a), and could include genetic material from populations that no longer exist in the locality. The removal of 76 Downy Wattle individuals has the potential to constitute a significant impact given that their removal could lead to 'a long-term decrease in the size of an important population of a species' and 'interfere substantially with the recovery of the species' (refer to Appendix E of the Biodiversity working paper (Appendix G)).

A propagation and translocation program for the Downy Wattle is proposed to manage potential impacts of the project on this species (refer to section 8.3.3 below). This measure is considered to have a high likelihood of success given that:

- The Downy Wattle individuals currently present within the M5 South West Motorway corridor have become established from a previous translocation process (hydroseeding).

- The proposed translocation process would involve a considered strategy in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia – Second Edition* (Australian Network for Plant Conservation, 2004) under the supervision of appropriately experienced ecologists and with ongoing management to ensure establishment.
- Samples of propagative material (either cuttings or seeds) from the plants would be collected prior to translocation and be available for re-planting should the transplanted individuals not successfully take the first time.

Four Downy Wattle translocation sites have been identified within the M5 South West Motorway corridor (refer to section 8.3.3 below). Criteria for identifying these sites included:

- Size – preference for parcels of land greater than 250 square metres to make on going management easier
- Condition – weed-free and not adjoining weed-infested areas.
- Location – at least 300 metres from other known populations of Downy Wattle to minimise risk of genetic interbreeding.
- Physical characteristics – ground not waterlogged and preference for gravelly soils.
- Number – preference for a number of different sites to safeguard against unforeseen events such as fires.

Narrow-leafed Wilsonia

Narrow-leafed Wilsonia was recorded in Coastal Saltmarsh in Salt Pan Creek adjoining the subject site and adjacent to a bridge pylon. This species is unlikely to be directly affected by the project as no works are required in this location. Management of bridge drainage infrastructure to redirect water draining from bridges to drainage basins prior to discharge to Salt Pan Creek is proposed as part of the project. This redirection of water would reduce indirect impacts on Coastal Saltmarsh associated with stormwater, sediment and erosion.

Impacts on threatened fauna

Bat species

The Large-eared Pied Bat, Eastern Freetail Bat and Eastern Bent-wing Bat (all listed as vulnerable species under the TSC Act with the Large-eared Pied Bat also listed as vulnerable under the EPBC Act) were assessed as having the potential to occur within the subject site. The potential habitat for these species within the subject site was assessed as being opportunistic foraging habitat that is well represented within the study area. The assessment concluded that the project would have negligible impacts on these species.

Green and Golden Bell Frog

The green and golden bell frog was not recorded in the study area during the most recent surveys, but a key population of this species is known to occur in the vicinity of the subject site (DECC, 2008b).

Potential habitat for the green and golden bell frog was identified at two locations within the subject site (refer to Figure 8.8(a)–(d)), but it is considered that this species is most likely to utilise significant wetland habitat on adjoining lands such as Hammondville Golf Course.

The green and golden bell frog could be present in low numbers, or otherwise transiently or periodically occupy habitat within the subject site during migrations from other downstream areas within the catchment. The potential habitat for the green and golden bell frog within the subject site is considered minor in terms of the long-term conservation of the species.

About 0.18 hectares of potential green and golden bell frog habitat within the subject site would be modified by the project. This includes areas where upgrades to drainage infrastructure are proposed in the vicinity of potential green and golden bell frog habitat, which has the potential to indirectly affect the quality of that habitat during construction.

The potential green and golden bell frog habitat at the subject site is unlikely to constitute significant breeding habitat for this species and mitigation measures have been developed to manage potential impacts of the project on the identified potential green and golden bell frog habitat (refer section 8.3.3). Based on the extent of available green and golden bell frog habitat on adjoining lands and the management measures proposed, the project would not have a significant impact on this species.

If the green and golden bell frog is identified on site during the targeted or pre-works surveys, biodiversity offset measures in the form of compensatory habitat would be provided as part of any proposed drainage works (including drainage basins) occurring in the green and golden bell frog habitat areas. Compensatory habitat measures would consider the preferred habitat needs of the green and golden bell frog and be developed in consultation with a herpetologist with experience in designing green and golden bell frog habitat.

Impacts on vegetation communities

State and federally listed endangered ecological communities identified within the study area are listed in section 8.3.1 and illustrated in Figure 8.8(a)–(d). Areas of vegetation identified as being landscaped and/or highly disturbed are not identified in Figure 8.8(a)–(d), but are identified in Figures 7(a)–(g) of Appendix G. The extent of vegetation impacts as a result of the project is summarised in Table 8.28.

Table 8.28 Vegetation communities affected by the project

Vegetation community	Conservation significance	Area in M5 corridor (ha)	Area to be removed (ha)	% cleared	% cleared (of regional distribution ¹)
Castlereagh Scribbly Gum Woodland	Not listed under legislation	3.70	0.66	18%	0.2%
Cooks River/Castlereagh Ironbark Forest	Endangered under the TSC Act	3.38	0.25	7%	0.2%
Cumberland Plain Woodland	Critically endangered under the EPBC Act and TSC Act	1.35	0.34	24%	0.03%
River Flat Eucalypt Forest	Endangered under the TSC Act	1.43	0.14	10%	0.02%
Swamp Oak Floodplain Forest	Endangered under the TSC Act	0.3	0.18	61%	0.03%
Landscaping	Not listed under legislation	60.10	6.8	12%	N/A
Total		70.26	8.37	12%	

1. Regional distribution data based on vegetation types present within a five-kilometre radius of the subject site (based on 2002 National Parks and Wildlife vegetation mapping data).

Central median works and side works

Section 4.4 of the Biodiversity working paper (Appendix G) indicates that flora species planted as part of the original landscaping of the motorway do not represent the Cumberland Plain Woodland endangered ecological community. Removal of all the vegetation within the median to enable works on the central median of the motorway would therefore not constitute removal of native vegetation or removal of any areas of endangered ecological community. These central median works would require the removal of 1.3 hectares of landscaping (about two per cent of the total area of landscaping within the corridor).

Vegetation removed from the side of the motorway to enable side works would be limited to landscaped vegetation and 0.01 hectares of Cumberland Plan Woodland.

Construction site compounds, noise walls, drainage basins and spoil re-use sites

Indicative drainage basin and noise wall locations are identified in Figure 5.1 (a)–(d). Proposed construction site compounds and spoil re-use sites are identified in Figure 6.3. The extent of vegetation impacted by these structures and facilities has been assessed based on the identified surface area of each, with an additional five-metre buffer to cover construction impacts associated with the proposed drainage basins.

Vegetation clearance required for specific project elements are identified in Table 8.29.

Table 8.29 Vegetation clearance required for specific project elements (in hectares)

Vegetation community	Central median works	Drainage basins	Side works	Spoil reuse sites	Noise walls
Castlereagh Scribbly Gum Woodland	0	0.32		0.35	0
Cooks River/Castlereagh Ironbark Forest	0	0		0.25	0
Cumberland Plain Woodland	0	0.03	0.01	0.3	0
River Flat Eucalypt Forest	0	0.14		0	0
Swamp Oak Floodplain Forest	0	0.18		0	0
Landscaping	1.3	1.26	0.6	4.62	1
Total	1.3	1.93	0.61	5.52	1

The potential impacts of the project on vegetation communities have been considered against relevant State and federal assessment guidelines (refer to Appendix E of the Biodiversity working paper (Appendix G)). The vegetation communities within the subject site are assessed as being of poor condition based on past and current disturbances, fragmentation and isolation.

The assessment concluded that the project would not significantly impact on any of the endangered ecological communities within the study area. This conclusion assumes that only areas identified as a 'low' ecological constraint would be utilised for construction site compounds. If any additional works associated with construction site compounds are proposed in areas identified as either a 'moderate' or 'high' ecological constraint, then impacts are likely to occur and further assessment would be required prior to commencement of those additional works.

In consideration of the scale, condition, connectedness and viability of the vegetation communities impacted by the project and the value of this habitat for native fauna species it is not proposed to include biodiversity offset measures as part of the project.

Impacts on riparian and aquatic ecology

The bridges over Georges River East, Georges River West and Salt Pan Creek do not require structural modification as part of the project. Some minor works (such as the addition of drainage infrastructure) may be required in some areas but these works can be provided with no physical work conducted in proximity to watercourses or riparian areas. There would be no loss of mangrove, saltmarsh or aquatic habitat as a result of the project, nor any impact on fish passage.

During construction

There would be potential for indirect impacts on aquatic ecology during the construction phase of the project, if not managed properly. Potential impacts on aquatic ecology would be from the decline in water quality and absence of available oxygen that occurs as a result of pollution. As noted in section 9.1.3, the Georges River and Salt Pan Creek catchments are significantly degraded due to long-term development.

The likelihood of further degradation during the construction of the project would be minimised by the application of mitigation measures consistent with industry best practice as outlined in section 8.3.3. As such, impacts to aquatic ecology as a result of construction of the project would be negligible.

During operation

Potential indirect impacts on the aquatic environment would be limited to a potential increase in surface runoff from the motorway which may result in pollutants such as sediments, suspended soils, litter, oil and grease, hydrocarbons and heavy metals entering the system. The Georges River and its tributaries have been assessed as being highly degraded, but management measures to control the potential for further degradation would be introduced as part of the project. Information regarding potential water quality impacts and proposed water quality management measures is provided in section 9.1.

Section 9.1.3 concludes that there would likely be an overall improvement in receiving water quality. This would be due to the construction of additional water quality devices and drainage basins, which would be sufficient to capture a 'first flush' of stormwater in rainfall events up to 20 millimetres. The capture and treatment of this volume of water would result in a lower pollutant load from runoff than would otherwise be entering catchments. This would have beneficial effects on aquatic ecology.

Section 4.5 of Appendix G concludes that there are not expected to be any significant impacts on the aquatic ecology of the subject site and study area as a result of the project.

Impacts on ecological corridors

There are substantial areas of vegetation surrounding the study area (including endangered ecological communities and riparian vegetation) that form part of ecological corridors in the region (refer to Table 3 of Appendix G). These corridors are associated with remnant vegetation along Georges River and Salt Pan Creek.

The motorway crosses each of these significant ecological corridors via a series of bridges, which allow for vegetation connectivity and for the north–south movement of fauna across the study area. The project does not require any major alterations to the bridge structures and the project would not result in any adverse impacts on the connectivity of these ecological corridors.

Impacts on street trees

In order to establish and maintain lines of sight, the installation of some variable message signs (ID numbers 2, 5, 7, 8, 9, 12 and 15) may require removal of surrounding street trees and shrubs. Tree removal rather than lopping of branches is proposed as trenching works may damage tree roots and lopping requires ongoing maintenance, results in additional visual impacts and can work to destabilise trees.

8.3.3 Management measures

The site-specific management measures and ecological management procedures identified in Table 8.30 have been developed for implementation during the pre-construction, construction and operational phases of the project.

Table 8.30 Proposed site-specific mitigation measures and ecological management procedures

Item	Mitigation measure/ecological management procedure	Timing
Downy Wattle (<i>Acacia pubescens</i>)	In order to minimise potential impacts on Downy Wattle, the following has been developed in consultation with the Department of Environment Climate Change and Water. Develop a propagation and translocation program in accordance with the <i>Guidelines for the Translocation of Threatened Plants in Australia – Second Edition</i> (Australian Network for Plant Conservation, 2004). As a minimum, the propagation and translocation program will include details on: • Objectives and performance targets. • Appropriate propagation/translocation methods. • Genetic research. • Identification of appropriate recipient sites for long-term conservation. • Logistical requirements. • Licensing requirements (State and federal). • Post-translocation management, monitoring and evaluation. This propagation and translocation program will be undertaken at the following four distinct recipient sites within the motorway corridor: • Northern road verge between King Georges Road and Penshurst Road. • Interchange between the motorway, M7 on-ramp and Beech Road. • Landscaped area in the motorway corridor near the corner of Graham Avenue and Grove Street. • Northern road verge between the motorway on-ramp and Henry Lawson Drive.	Pre and post construction
Green and golden bell frog (<i>Litoria aurea</i>)	The following recommendations and mitigation measures have been developed in accordance with the various DECCW recovery plan initiatives (NPWS 2003b, DEC 2005; DECC 2008b,c) and aim to increase the green and golden bell frog habitat values over the longer term. Around the November and/or December period, a targeted survey for the green and golden bell frog will be conducted within the M5 South West corridor. This survey will target areas identified as potential green and golden bell frog habitat. A construction phase green and golden bell frog management plan will be developed (based on information generated from the targeted survey) to manage the risk to this species. If the targeted survey confirms that green and golden bell frogs are present within the subject site, any drainage works in these habitat areas should be undertaken during the late autumn/early winter months to minimise the potential impacts on the breeding cycle of the green and golden bell frog. Prior to any works to potential green and golden bell frog habitat occurring outside of this time, a pre-works survey would be undertaken and any green and golden bell frog observed would be managed in accordance with a green and golden bell frog management plan (see above). If any green and golden bell frog is observed during construction, work will cease immediately and DECCW should be consulted. If the green and golden bell frog is located on site during the targeted or pre-works surveys, then compensatory habitat is to be provided as part of any sedimentation and drainage works within those areas identified as potential green and golden bell frog habitat.	Pre and post construction

Item	Mitigation measure/ecological management procedure	Timing
Location of drainage infrastructure	Wherever practicable, road drainage and other associated infrastructure (such as noise walls or electrical conduits) will be located outside areas identified as potential green and golden bell frog habitat, outside areas identified as endangered ecological community and outside areas identified as Coastal Mangrove Swamp. Drainage works will, where practicable, aim to avoid all impacts on potential green and golden bell frog habitat near Georges River West. Where practicable, drainage infrastructure will not require clearing of endangered ecological communities beyond the subject site. Should this be unavoidable, an additional survey may be required to determine the precise impacts on State and federally listed endangered ecological communities. Preference will be given to areas mapped as having 'moderate' mapping confidence rather than 'high' mapping confidence (refer to Figure 7(a)–(g) of Appendix G). Any impacts on State or federally listed endangered ecological communities will be appropriately offset.	Detailed design, pre-construction
Location of spoil re-use sites	Removal or reduction of impacts on endangered ecological communities will be a key consideration when locating and developing a detailed design for spoil re-use sites. Wherever practicable, spoil re-use sites will be located outside areas of vegetation identified as an endangered ecological community.	Detailed design
Environmental induction	All staff working on the project will undertake a site-specific environmental induction. As a minimum, the induction will include information on: • The sensitivity of surrounding vegetation (particularly endangered ecological communities). • Site environmental procedures (vegetation management, sediment and erosion control, protective fencing, noxious weeds, management of injured fauna). • What to do in case of an emergency. • Key contacts in case of environmental emergency.	Pre-construction
Vegetation clearance	Where trees require felling, the timber will be retained (where practicable) as coarse woody debris to enhance degraded habitats. Work will cease immediately if any previously unknown threatened flora or fauna species are encountered, and DECCW will be consulted. WIRES will be consulted if any injured fauna are encountered.	Construction
Erosion and sedimentation controls	Controls to manage exposed soil surfaces and to prevent sediment discharge into waterways, wetlands and fauna habitat will be developed for the project with specific focus on crossings of the Georges River and Salt Pan Creek, which support numerous endangered ecological communities and threatened species.	Pre and during construction
Riparian areas	All land within 40 metres of the top of bank of a clearly defined drainage line (permanent or intermittent) will be clearly delineated and appropriate sediment and erosion controls introduced.	Pre and during construction
Weed management	A noxious weed management protocol will be established for the project. This protocol will outline appropriate inspection and maintenance procedures. Noxious weeds will be controlled in accordance with the requirements of the <i>Noxious Weeds Act 1993</i>. All noxious weeds cleared as part of the project will be disposed of appropriately.	Pre and during construction

Item	Mitigation measure/ecological management procedure	Timing
Site rehabilitation	Areas disturbed during construction will be reinstated to their previous condition or in accordance with the landscape design as soon as practicable through a progressive landscaping regime to ensure stabilisation of areas of exposed soil and, where possible, to take advantage of optimal growing conditions.	During and post-construction

8.4 Visual impacts, urban design and landscaping

Director General's requirements	Where addressed
The Environmental Assessment must include consideration of the urban design and landscape implications of the project, including supporting infrastructure at Hammondville.	Section 8.4.4
The assessment must:	Section 8.4.1
- identify urban design and landscaping objectives to enhance the current road corridor, and - demonstrate how the proposed urban design elements of the road project would be consistent with the existing (and desired) character of the area.	Section 8.4.2 Section 8.4.4

8.4.1 Assessment methodology, urban design principles and objectives

Assessment methodology

A thorough assessment of the visual impact of the project and the proposed urban design and landscaping strategies has been undertaken and is presented in this section. This assessment is supported by the landscape character and visual impact assessment working paper (Spackman, Mossop and Michaels, 2010) attached as Appendix H.

The assessment has been undertaken to identify the potential visual impacts of the project and assess the adequacy of the various elements of the design in minimising the visual impacts and addressing the urban design and landscape objectives for the project. In the following sections:

- The visual impact of the project has been undertaken with reference to both the visual effect of the proposed works and the visual sensitivity of the surrounding areas. An assessment matrix has been used to determine the level of impact, with impact levels ranging from negligible to high impact (refer to Figure 8.10). The various elements of the project were assessed individually based on the types of visual impact each would have. The findings were then summarised for visual precincts along the corridor to put each element in a geographical context.
- Visual effect is the expression of the visual interaction between a proposed development and the existing visual environment surrounding it. The visual effect can also be expressed as the level of visual contrast between the road upgrade and the visual setting within which it would be placed.
- Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from various areas and users. The visual sensitivity of a proposed development therefore depends on the type of viewers and surrounding land uses likely to see the proposed development, as well as on the visual characteristics of the existing environment. For example, viewers are likely to be highly sensitive to development in previously undeveloped areas and less sensitive to developments in areas that are already highly developed.

The following sections provide an assessment of the existing visual character of the corridor, the proposed changes as a result of the project, and the likely visual impact of these changes.

Urban design principles

The following urban design principles were developed to maintain and protect the visual experience of the M5 South West Motorway and to achieve the urban design and landscape objectives for the project:

- Corridor character – Maintain the existing character of the motorway as a vegetated green corridor.
- Revegetation and landscaping – Maintain and improve the planting/revegetation strategy that takes into account the long-term visual quality of the motorway corridor.
- Views – Retain potential view corridors at elevated points.

		VISUAL EFFECT LEVEL					
		HIGH	HIGH TO MODERATE	MODERATE	MODERATE TO LOW	LOW	NEGLIGIBLE
VISUAL SENSITIVITY LEVEL	HIGH						
	HIGH TO MODERATE						
	MODERATE						
	MODERATE TO LOW						
	LOW						
	NEGLIGIBLE						

Figure 8.10 Visual impact assessment matrix

Urban design objectives

The urban design and landscape objectives for the project are:

- Develop an integrated engineering and urban design outcome for the addition of two traffic lanes, and the associated works to the M5 South West Motorway that is both cost effective and consistent with the RTA's *Beyond the Pavement* principles.
- Maintain the essential qualities of the corridor and the sense of place imparted by the motorway experience, particularly the well established Cumberland Plain Woodland plantings.
- Maintain and enhance key landmarks along the route, including notable views and vistas.
- Enhance the sense of a distinct beginning and an end to the motorway but ensure consistency with the Sydney Orbital desired character.
- Maintain the provision of safe, convenient and enjoyable pedestrian and local traffic connections across the motorway.
- Maintain and protect the hydrological system through improved stormwater detention devices.

The desired character of the Sydney Orbital is a motorway corridor that:

- Respects the landscape types through which it passes.
- Allows views of the greater Sydney area and surrounds.

- Provides a visually distinctive, high quality durable architectural and landscape outcome.
- Ensures safe and adequate pedestrian and cyclist connections along and across the corridor.

8.4.2 Existing environment

A variety of land uses adjoin the M5 South West Motorway including suburban residential areas, industrial areas, and educational facilities. Vegetation cover is prevalent along most of the corridor. In particular, a linear park system adjoins the motorway corridor to the north and south, from King Georges Road to Salt Pan Creek. It provides a visual buffer between the motorway and the adjoining residential areas.

Major visual elements of the motorway include the motorway, interchanges, toll plaza and the two existing variable message signs.

Nine interchanges are located along the motorway. There are no footpaths, but pedestrians are able to cross over and under the motorway at a number of points, generally at the vehicular overpasses and underpasses and at the two dedicated pedestrian overpasses. Cyclists use the outside shoulder and marked cyclist crossings are provided at some ramps.

The toll plaza at Hammondville is a major visual element. Here, the motorway expands to 10 lanes, and an awning with associated toll booths spans the area. Four signage gantries span the motorway either side of the toll plaza. The Interlink Roads offices and the M5 South West Motorway control centre are located to the south. Toll booths are also located at the Fairford Road, River Road and Henry Lawson Drive interchanges.

For the purposes of this assessment the motorway was divided into 12 precincts. The location of these precincts and a more detailed description of their key landscape and visual features are shown in Figure 8.11 and in Table 8.31.

Existing character of the area

The study area adjoins a highly modified landscape of suburban, commercial and industrial land uses, with little tree cover. Residential development occurs at predominantly lower densities with interceding industrial areas at Riverwood, Padstow, and Moorebank. Two major green corridors traverse the study area at Salt Pan Creek and the eastern Georges River crossing.

The character of the motorway is relatively constant with two generally flat two-lane carriageways, a grass median, well-vegetated verges and no at-grade access. Bridge structures, signage, crash barriers and outdoor advertising are expected elements in a motorway environment and occur at numerous locations along the corridor. As a result of the extensive landscape planting and the presence of noise walls, the corridor is for the most part visually enclosed and it is difficult to discern the surrounding land uses from the motorway for the majority of its length. Exceptions to this are the elevated sections over Salt Pan Creek and Georges River where views into the surrounding landscape are possible.

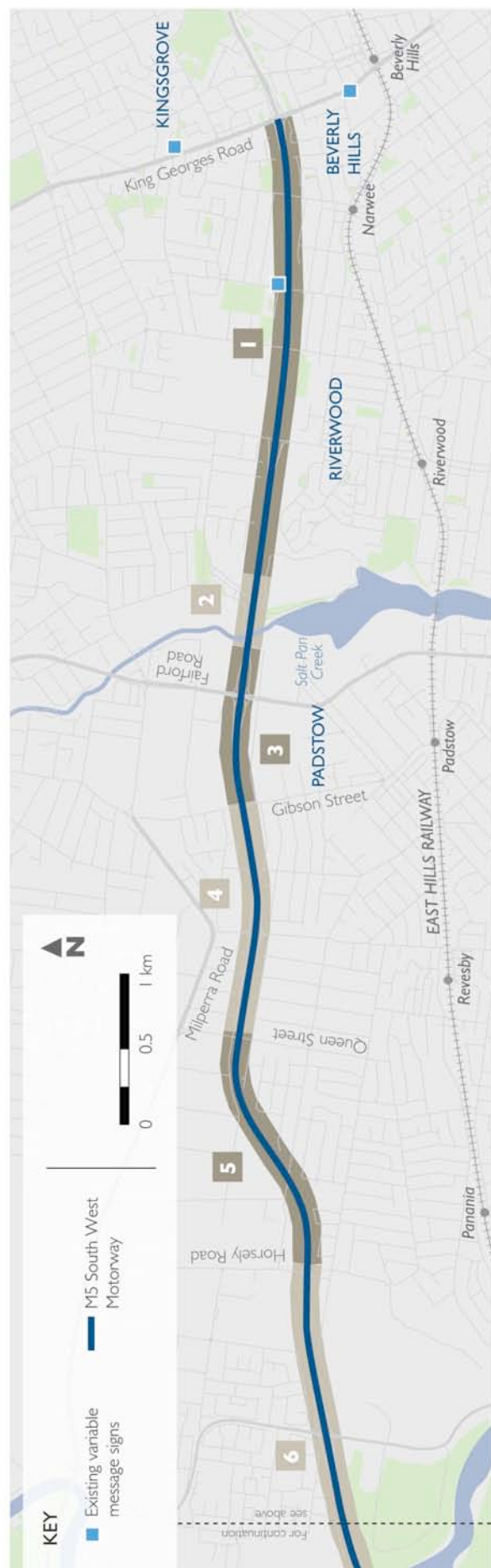
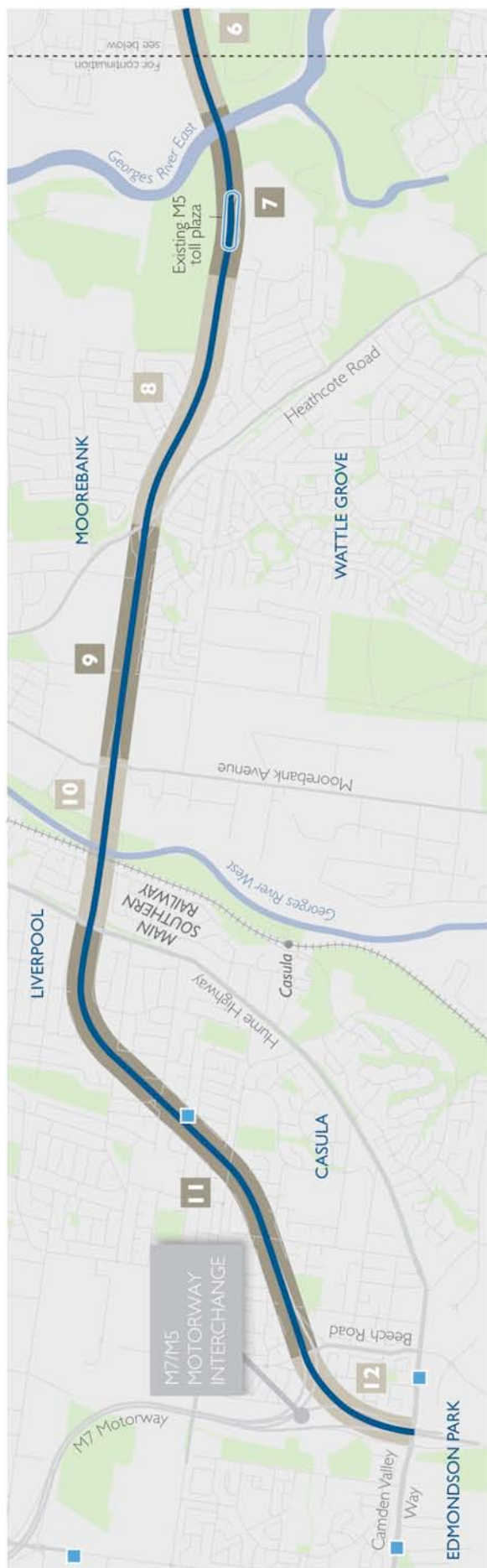


Figure 8.11 Existing landscape and visual precincts of the M5 South West Motorway Corridor

Note: Project detail shown is indicative only subject to detailed design

Table 8.3I M5 corridor – visual precincts

Precinct	Landscape and visual features
Precinct 1: King Georges Road to Salt Pan Creek	• Hard surfacing across the entire roadway, a wide paved verge on both sides, and a wire rope barrier in the centre. • Noise walls on vegetated batters at locations on both sides of the motorway. • Adjacent open space areas buffering the corridor. These areas are generally heavily vegetated (native plant species) next to the corridor and further away they consist of scattered trees planted in grass, bicycle tracks, playgrounds and playing fields.
Precinct 2: Salt Pan Creek floodplain	• Twin bridges traversing the Salt Pan Creek floodplain. • Expansive views are afforded over the floodplain and adjacent parkland and industrial areas to the north and south.
Precinct 3: Salt Pan Creek to Gibson Avenue	• Two lanes in both directions with a paved verge and a grassed median edged by a wire rope barrier. • The Fairford Road interchange consists of on- and off-ramps (including toll booths) for both east and west bound traffic. • This section of the motorway sits below the adjacent landscape. The embankments are planted with Cumberland Plain Woodland vegetation, which allow filtered views to the adjoining Padstow industrial area. • A section of noise wall sits atop the embankment to coincide with the block of residential housing east of Gibson Avenue.
Precinct 4: Gibson Avenue to Queen Street	• Two lanes in both directions with a central grass median with groupings of shrub planting. • The River Road interchange has on- and off-ramps (including toll booths) for both eastbound and westbound traffic. • From Gibson Avenue to River Road the motorway is lower than the surrounding landscape. The embankments are planted with Cumberland Plain Woodland vegetation, with a noise wall to the top. • From River Road to Queen Street, the motorway sits slightly above the surrounding landscape. Noise walls are adjacent to the carriageway (excluding Queen Street) and Cumberland Plain Woodland vegetation is planted along the other side of these walls.
Precinct 5: Queen Street to Horsley Road	• Two lanes in both directions with a grassed median. There are groups of planted shrubs at certain locations within the median. • Trees have been planted adjacent to the Beaconsfield Street and Horsley Road bridges. • A noise wall is adjacent to the southern side of the carriageway. Planted Cumberland Plain Woodland provides screening for residents.
Precinct 6: Horsley Road to Georges River	• Two lanes in both directions with a grassed median. Groups of planted shrubs are located in the median and tree planting is on both sides of the Henry Lawson Drive interchange. • Noise walls are located along sections of the corridor. In some locations they are screened by dense vegetation, or mounted on embankments. • Henry Lawson Drive is a major intersection with on- and off-ramps and toll booths.

Precinct	Landscape and visual features
Precinct 7: Georges River floodplain and toll plaza	• A six-lane bridge traverses the Georges River. The bridge has a lightweight steel anti-missile screen attached to the southern side. The bridge affords mid-distance views to the north and south along the Georges River and adjacent open space and golf courses. • The motorway continues as six lanes, and then expands to 10 lanes at the toll plaza. • Interlink Roads offices and the operations management control system building (single storey) are located to the south of the toll plaza. A small works depot building is located to the east. • West of the bridge, the motorway reverts to two lanes and the road remains elevated, with barriers to each side. • West of the toll plaza, a noise wall adjoins the carriageway on the southern side, screening the suburb of Hammondville.
Precinct 8: West of the toll plaza to Heathcote Road	• Two lanes in both directions with a grassed median. Groups of planted shrubs are located in the median. • West of the toll plaza the motorway is edged with wide embankments vegetated with Cumberland Plain Woodland and with a noise wall at the top. • Along some sections of the corridor the noise wall directly adjoins the motorway on both sides. Cumberland Plain Woodland vegetation is located between the noise walls and property boundaries.
Precinct 9: Heathcote Road to Moorebank Avenue	• Three lanes in both directions with a thin grassed median and barriers. • There is a narrow verge of Cumberland Plain Woodland vegetation on both sides of the motorway. • A noise wall is located for some distance along the southern side of the corridor. • There are no noise walls screening the industrial areas and glimpses of these areas are available through the trees.
Precinct 10: Moorebank Avenue to Hume Highway	• Four lanes in both directions, including twin bridges over the Georges River. • Noise walls are located along some sections. • Expansive views of the river, residential suburbs and industrial area are afforded from the bridge and its approaches.
Precinct 11: Hume Highway to Beech Road	• Two lanes in both directions with a grassed median. Groups of planted shrubs are located in the median. • Wide verges with Cumberland Plain Woodland are located west of the Hume Highway. • At some locations the noise wall abuts the carriageways. • On the eastern side is a large area of land currently used for stockpiling (a service centre is proposed – not part of the project). • Near Beech Road the area is quite open with wide, sparsely vegetated embankments to the approaches to the M7 interchange.
Precinct 12: Beech Road to Camden Valley Way	• The corridor is generally open with grassed verges and minimal tree planting. • The character of this precinct is dominated by infrastructure associated with the M7, including a westbound overpass off-ramp and an overpass linking the M7 with the westbound lanes.

Desired future character

Local plans and strategies often articulate the desired future character of neighbourhoods and include controls on development to achieve their stated aims. In this case, the relevant local plans generally recognise the role of the M5 South West Motorway as a regional transport corridor and include objectives, zoning and other

controls consistent with that purpose. In general terms this means designating land for infrastructure and ensuring that any development that occurs does not adversely affect its operation.

Another aspect of the desired future character for the motorway corridor should be retention and enhancement of the existing vegetated 'green' corridor created by the extensive landscape plantings. An assessment of the project elements against the desired future character of the corridor is provided in section 8.4.4.

Project elements proposed are consistent with the existing character of the corridor and its surrounds given their similarity to those already found in these locations. The urban design principles and objectives outlined in section 8.4.1 more specifically articulate the desired future character of the corridor. An assessment of how the project would meet these objectives is also included in section 8.4.4.

8.4.3 Assessment of construction impacts

Motorway widening works

The proposed motorway widening works are divided into two distinct types, being central median works and side of motorway works (side works):

- The central median works would involve any construction adjacent to the inside ('fast') lane of the motorway and would include excavation, pavement construction, drainage works, bridge works and service utilities works.
- The side works would involve any construction adjacent to the outside ('slow') lane and shoulder of the motorway, including drainage and excavation works, pavement widening in some locations, drainage basin works, service utilities and operations management control system works, installation of signage (both fixed static signage and variable message signs), noise mound and wall construction and landscaping.

Central median works and/or side works would be required along the majority of the corridor. Work would typically be undertaken in one section at any one time, such that when central median works are being performed in one section, no side works would be performed in that section, and vice versa (refer to section 6.3.4 for further details).

Median and side work site establishment would involve the placement of temporary concrete safety barriers and fencing to create a safe work zone. Screening fencing would be installed along the barriers where required.

The existing motorway sits generally within cut areas with well-vegetated embankments and noise walls screening the corridor from surrounding land uses. Therefore the construction works would not be visible from outside the motorway corridor for a majority of the project length. Some works, however, have the potential to result in short-term visual impacts for people adjacent to the corridor. These impacts would typically result from activities such as vegetation clearance, drainage and sedimentation works and the construction of soil mounds and noise walls. There may also be some minor impacts on road users and those residences located adjacent to the motorway associated with light spill from night-time construction works. However, these impacts would be temporary given the transitional nature of the on-motorway construction works required.

Vegetation clearance would be limited to that required to construct the project; where practicable, landscaping would be progressively introduced to limit this impact. Where an existing noise wall requires removal (wholly or partly) prior to the introduction of a new noise wall, the new walls would be introduced as soon as practicable following removal of existing noise walls to ensure minimal impact on residents.

While construction of the entire project is estimated to take about two years, construction works at any one location along the corridor would occur over a much shorter period.

Although noticeable to road users and some surrounding residents, the visual impacts of construction works within the corridor would be short term and generally rated as low to moderate in nature. The provision of some screening fencing between the motorway and the construction sites would reduce the visual impact of construction and limit distractions for road users.

Construction site compounds

Given that the project would be constructed under traffic there would be no opportunity to locate construction site compounds between the two motorway carriageways, and limited opportunity to locate them within the motorway corridor. The project includes the establishment of construction site compounds at locations outside the motorway corridor but as close as possible to the motorway (refer section 6.7).

Construction site compounds would comprise offices and material laydown areas and be fenced and generally covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose-built temporary structures as required. The potential visual impact associated with each of the construction site compounds is considered in Table 8.32 below.

Construction site compounds would be visible from surrounding land uses and from within the motorway corridor. Some construction site compounds are identified for 24-hour use (refer section 6.7). At these locations the potential for light spill would be carefully managed to minimise impacts on adjacent residents.

The potential visual impacts associated with the introduction of construction site compounds ranges from low to moderate and measures to further minimise these potential impacts would be implemented.

Table 8.32 Potential visual impacts of construction site compounds

Location	Context	Visual sensitivity	Magnitude of visual effect	Overall visual impact	Potential treatments
Moorebank Avenue	This site is flat and grassed with some trees. An artificial pond is located directly to the south-west of the site and surrounded by vegetation. It is zoned for industrial and transport uses and surrounded by industrial land uses. There are no surrounding residential uses and motorway embankments mean that the site is lower than the motorway with limited visibility from the corridor.	L	L	L	No specific mitigation is required. Use of this site as a construction site compound would not be inconsistent with surrounding land uses.
M5/Graham Avenue – 1	This site is grassed and contains some hardstand areas and stockpile sites from previous works. It would be accessed directly from the M5 South West motorway. Residential development to the south-east is screened by vegetated embankments.	L	L	L	No specific mitigation is required. This site would be visible from the motorway corridor only.
M5/Graham Avenue – 2	This site is flat and grassed with some mature trees. It would be accessed directly from the motorway. Vegetated embankments screen residential development to the north.	L	L	L	No specific mitigation is required. This site would be visible from the motorway corridor only.

Location	Context	Visual sensitivity	Magnitude of visual effect	Overall visual impact	Potential treatments
M5/Graham Avenue – 3	This site is sloping and grassed with mature trees, wattles and casuarinas. It would be accessed directly from the motorway. Offices and materials laydown would be visible from some adjacent residences.	ML	L	ML	- Maximise retention of mature trees adjacent to residences. - Locate the temporary offices with regard to impact on adjacent residences.
Bransgrove Road	This site has previously been used as a landfill location. This site would not be visible from residential areas and vegetation screens the site from the motorway.	L	Ne	Ne	No specific mitigation is required. The site would not be visible from the motorway or residential areas.
Henry Lawson Drive	This site is flat and cleared and screened from the motorway and all surrounding uses by vegetation.	L	Ne	Ne	No specific mitigation is required. The site would not be visible from the motorway or residential areas.
Beaconsfield Road	This site is located within an industrial area and contains a building that could be used for offices.	L	L	L	No specific mitigation is required. Use of this site as a construction site compound would not be inconsistent with surrounding land uses.
Heathcote Road (north)	This site slopes away from the motorway and contains mature trees and shrubs. The site would need to be cleared and would therefore be visible to residences.	M	M	M	Maximise retention of mature trees that screen the site from residences.

Ne = Negligible; VL = Very Low; L = Low; ML = Medium Low; M = Medium; MH = Medium High; H = High; VH = Very High.

Variable message signs

Each variable message sign would need to be connected to the local power supply and to the operations management control system building via 'either direction connection' or the existing local telecommunications network. This would involve the construction of a trench to provide these connections. The extent of trenching would be minimised to the greatest extent possible. Other installation work would involve constructing the footing, concreting, delivering and installing the sign.

As much of the work as possible would be completed during daytime construction hours. However, depending on the location and whether traffic lane closures are required, some work (including lifting the sign into place) may be undertaken at night to minimise disruption to traffic. Where practicable, these works would be undertaken in the evening to minimise night-time noise impacts.

The installation of a variable message sign usually takes up to five weeks, but could take longer in locations where substantial trenching works are required. The extent of the area required to construct the variable message sign would be limited to approximately 50 square metres. Trenching works would be transitional and require a three-metre-wide area for trenching activities.

Should variable message sign construction be required during night-time periods there may also be the potential for minor light spill impacts in the immediate area surrounding the construction site. Given the short-term construction periods associated with the introduction of variable message signs and that a majority

of the variable message signs would be introduced on arterial roads or the motorway, light spill impacts associated with the construction of variable message signs are anticipated to be negligible.

Further detailed assessment of potential construction impacts associated with the installation of variable message signs is included at Appendix H.

Spoil re-use sites

The visual impact of identified spoil re-use sites are assessed in section 5.2 (illustration 68) of Appendix H. The locations for the proposed spoil re-use sites are within the existing M5 South West Motorway corridor and are generally located in groups along the length of the motorway. As identified in illustration 68 of Appendix H, the overall visual impact ratings determined as a result of the introduction of the spoil re-use sites ranged from 'medium low' to 'medium high'.

The removal of existing established vegetation increases the potential visual impact of the spoil re-use sites during the construction period. However, following construction, these sites would be returned to at least their pre-construction state, or incorporated into landscape design that would be developed during the detailed design stage (refer section 7.1.8 of Appendix H).

8.4.4 Assessment of operational impacts

Table 8.33 provides a summary of the elements of the project and their potential visual impact. The precincts described are shown in Figure 8.12. Categories of the types of visual impact are shown for each precinct to provide context to the assessment. Table 8.34 provides a summary of the visual impact for each precinct along the corridor, taking into account the visual sensitivity of each precinct.

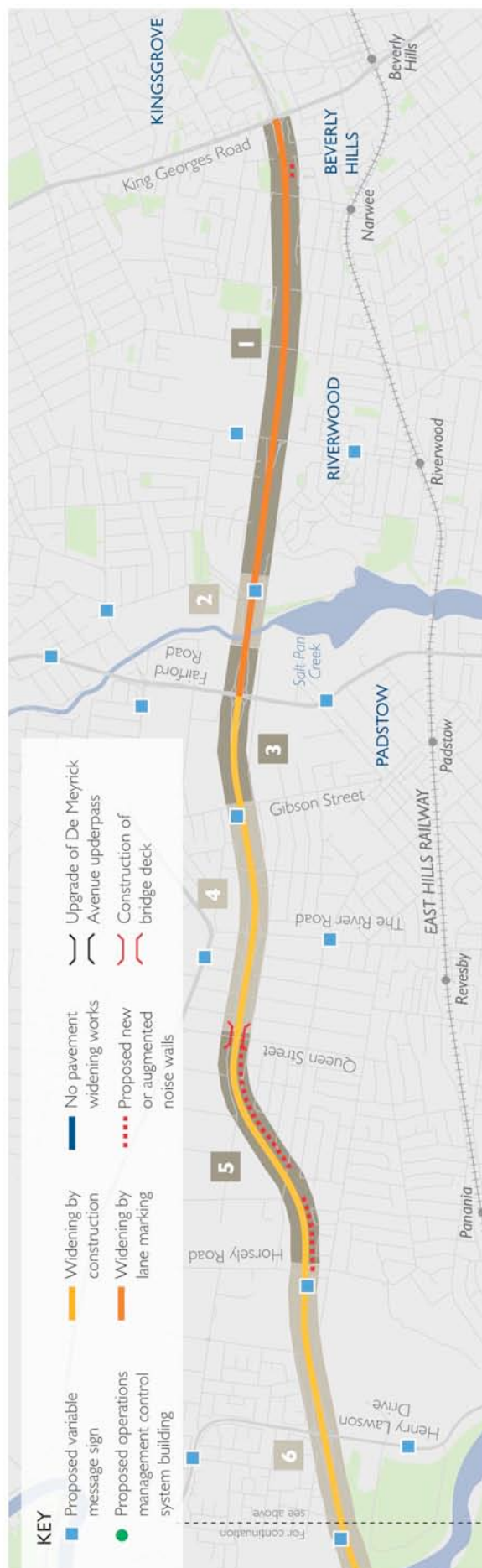
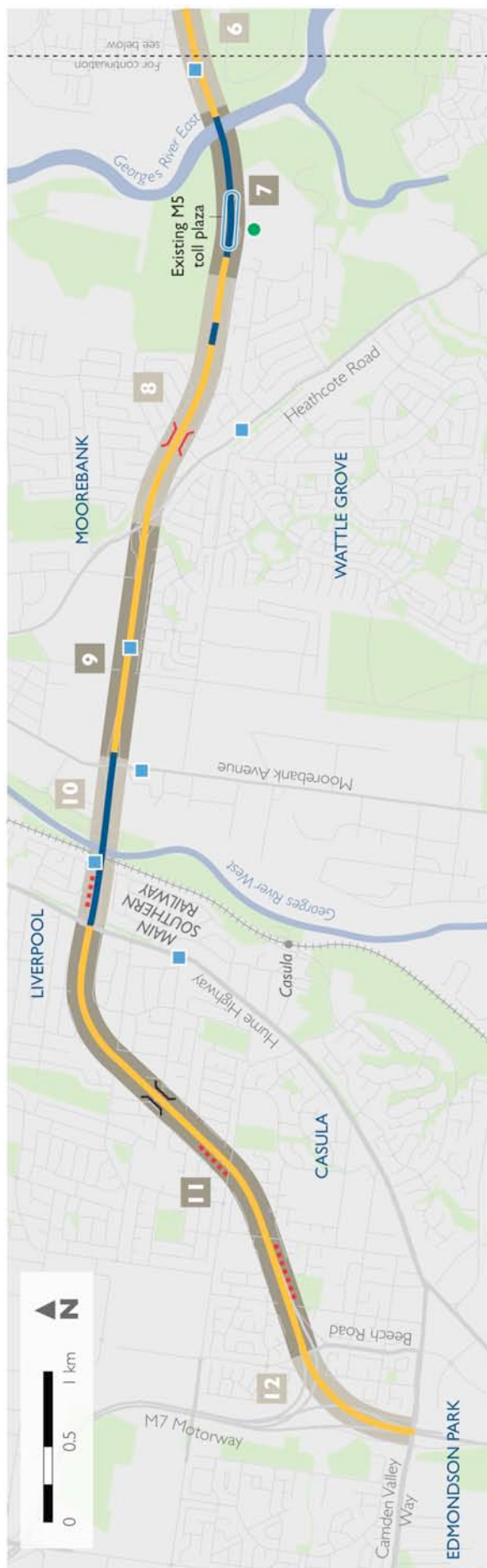


Figure 8.12 New visual elements of the M5 South West Motorway Corridor

Note: Project detail shown is indicative only, subject to detailed design

Table 8.33 Potential visual impact from project elements

Project elements	Locations	Description of impact	Visual impact
Operations management control system building	Precinct 7: Georges River floodplain and toll plaza.	- Additional building and horizon interruptions on the southern side of motorway for motorists. - Blocking of views of the motorway for receivers south of the toll plaza area.	Moderate.
Noise management measures	- Precinct 1, 2: King Georges Road to Salt Pan Creek floodplain. - Precinct 5: Queen Street to Horsley Road. - Precinct 7: Georges River floodplain and toll plaza. - Precinct 8: West of toll plaza to Heathcote Road. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 11: Hume Highway to Beech Road.	- Additional screening of the motorway for receivers outside the corridor. - Narrowing of vistas for motorists, limited to the road reserve.	Moderate.
Drainage basins	- Precinct 7: Georges River floodplain and toll plaza. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 11: Hume Highway to Beech Road.	- Effects on tree canopy lines for vegetation outside the road reserve. - Impacts on character of Cumberland Plain Woodland.	Low
Bridges and underpass	- Precinct 3: Salt Pan Creek to Gibson Avenue. - Precinct 4, 5, 6: Gibson Avenue to Georges River. - Precincts 8, 9: West of the toll plaza to Moorebank Avenue. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 11: Hume Highway to Beech Road.	- Installation of four galvanised steel conduits fixed to the outside face of the existing southern parapet of the westbound motorway underpass bridge. The bridges where cable crossing is required include Penshurst Road, Bonds Road, Salt Pan Creek Bridge, Queen Street and Nuwarra Road. - Widening of Queen Street and Nuwarra Road bridges with infill decking. - Upgrading of DeMeyrick Avenue underpass.	Low to Moderate.
Embankments, retaining walls and barriers	All precincts	- Installation of concrete safety barriers in the median and removal of existing vegetation. - Additional proximity to oncoming traffic for motorists.	Moderate.
Gateway treatments	- Precinct 1, 2: King Georges Road to Salt Pan Creek floodplain. - Precinct 12: Beech Road to Camden Valley way.	- Additional tree plantings and softening of skyline. - Focusing of vistas to the road reserve. - Distinguishing the area from the surrounding character of the corridor to accentuate the motorway start and finish.	Low.

Project elements	Locations	Description of impact	Visual impact
Interchanges	- Precinct 1, 2: King Georges Road to Salt Pan Creek floodplain. - Precinct 3: Salt Pan Creek to Gibson Avenue. - Precincts 8, 9: West of the toll plaza to Moorebank Avenue. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 12: Beech Road to Camden Valley way.	- Additional planting to screen motorway from nearby receivers. - Widening of vistas for motorists to accentuate interchange facilities.	Low.
Other landscaping and removal of vegetation	- Precinct 1, 2: King Georges Road to Salt Pan Creek floodplain. - Precinct 4, 5, 6: Gibson Avenue to Georges River. - Precincts 8, 9: West of the toll plaza to Moorebank Avenue. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 11: Hume Highway to Beech Road. - Precinct 12: Beech Road to Camden Valley Way.	- Removal of screening for motorists travelling in opposite directions. - Hardening of visual landscape within the road reserve.	Moderate.
Lane marking	- Precinct 1, 2: King Georges Road to Salt Pan Creek floodplain. - Precinct 3: Salt Pan Creek to Gibson Avenue. - Precinct 7: Georges River floodplain and toll plaza. - Precinct 10: Moorebank Avenue to Hume Highway. - Precinct 12: Beech Road to Camden Valley Way.	Minor visual impact from increased density of traffic.	Negligible.

Table 8.34 Summary of visual impact for each precinct

Project component	Assessment	Visual impact
Precincts 1 and 2: King Georges Road to Salt Pan Creek floodplain		
- An additional westbound lane would be accommodated in the paved verge by lane marking. There would be no increase in pavement width. - The wire rope barrier within the median would be replaced with concrete safety barriers, similar to the barrier already across Salt Pan Creek. - Enhanced planting would be provided at the King Georges Road interchange to provide a 'gateway' to the M5 South West corridor. - Some shrub and tree planting may be removed at the location of the new variable message sign westbound approaching Salt Pan Creek to provide clear sight lines.	Visual effect – Negligible - The changes are deemed minimal. Visual sensitivity – Negligible - Motorists are likely to have negligible visual sensitivity to the changes. - The modified lane marking would not be visible to those outside of the corridor due to shielding from existing vegetation, batters and noise walls, and the elevation of the bridge.	Negligible
Precinct 3: Salt Pan Creek to Gibson Avenue		
- Up to the Fairford Road interchange, the additional westbound lane would continue to be accommodated within the paved verge, with lane marking modifications. - The existing grassed median would be replaced with two new lanes, a concrete safety barrier (instead of the existing wire rope) and a median on both sides. - Under Fairford Road and Gibson Avenue, the existing guardrails would be removed and replaced with concrete safety barriers abutting the existing central bridge piers. - Planting at the Fairford Road interchange would be enhanced to a 'parkland' style.	Visual effect – Moderate to low - The loss of the grassed median and associated tree and shrub planting is not considered significant in a motorway environment. Visual sensitivity – Low - Motorists are likely to have negligible visual sensitivity to the changes. - The works at Fairford Road and Gibson Avenue would be visible to pedestrians and motorists, but their visual sensitivity is likely to be low due to the transient nature of the road travel and pedestrian movement.	Moderate to low.

Project component	Assessment	Visual impact
Precincts 4, 5 and 6: Gibson Avenue to Georges River		
- The existing grassed median would be replaced with two new lanes, a concrete safety barrier (instead of the existing wire rope) and a paved median on both sides. - A number of native shrubs and small trees would be removed from the existing median. - The bridge over Queen Street would be widened by infilling between the two carriageways. - Guardrails under River Road, Beaconsfield Street, Horsley Road and Henry Lawson Drive would be replaced with concrete safety barriers abutting the central piers. - The planting at the River Road and Henry Lawson Drive interchanges would be enhanced to a 'parkland' style. - Three new variable message signs would be installed (eastbound) west of Gibson Avenue, (westbound) west of Horsley Road bridge and (eastbound) east of the Georges River. This may require the removal of some shrub and tree planting to provide clear sight lines. - Additional noise walls would be installed.	Visual effect – Moderate - The loss of the grassed median and associated tree and shrub planting is not considered significant in a motorway environment. Visual sensitivity – Moderate - Motorists are likely to have negligible visual sensitivity to the changes. - The works would be visible to pedestrians and motorists at River Road, Beaconsfield Street and Henry Lawson Drive, but their visual sensitivity is likely to be low due to the transient nature of road travel and pedestrian movement.	Moderate.
Precinct 7: Georges River and toll plaza		
- No additional lanes are proposed in this location but some minor lane marking may be required. - The proposed operations management control system building would be located to the east of the existing building adjacent to the toll plaza. - An existing sedimentation pond may require modification, including retaining walls.	Visual effect – Moderate to low - Only the upper section of the new control centre would be visible and it would be built with consideration to the design of the existing building. Visual sensitivity – Moderate to low - Motorists are likely to have negligible visual sensitivity to the changes due to the transient nature of road travel, and the scale of the building and its visibility.	Moderate to low.

Project component	Assessment	Visual impact
Precincts 8 and 9: West of the toll plaza to Moorebank Road		
- The existing grassed median would be replaced with two new lanes, a concrete safety barrier (instead of the existing wire rope) and a lane-marked median on both sides. - A number of native shrubs and small trees would be removed from the existing median. - The bridge over Nuwarra Road would be widened by infilling between the two carriageways. - Guardrails under Heathcote Road would be replaced with concrete safety barriers abutting the central piers. - The planting at the Heathcote Road and Moorebank Avenue interchanges would be enhanced to a 'parkland' style. - A new variable message sign would be installed (westbound) between Heathcote Road and Moorebank Avenue. This may require the removal of some shrub and tree planting to provide clear sight lines.	Visual effect – Moderate - The loss of the grassed median and associated tree and shrub planting is not considered significant in a motorway environment. Visual sensitivity – Low - Motorists are likely to have negligible visual sensitivity to the changes. - The works would be visible to pedestrians and motorists at Heathcote Road and Nuwarra Road, but their visual sensitivity is likely to be low due to the transient nature of road travel and pedestrian movement. - The works between Heathcote Road and Moorebank Avenue would be visible to workers in adjacent industrial areas. Their visual sensitivity is considered low due to the working environment and the place from which they would view the motorway (ie from the car park).	Moderate to low
Precinct 10: Moorebank Road to Hume Highway		
- No additional lanes are proposed in this location but some minor lane marking may be required. - Guardrails under the Hume Highway would be replaced with concrete safety barriers abutting the central piers. - The planting at the Hume Highway interchange would be enhanced to a 'parkland' style. - A new variable message sign would be installed (eastbound) between the Hume Highway and Moorebank Avenue. This may require the removal of some shrub and tree planting to provide clear sight lines. - A new drainage basin would be installed on the western side of the river, between the motorway and the existing noise wall. - Additional noise walls would be installed.	Visual effect – Low - The new drainage basin would not be visible to motorists or outside viewers. - The other changes are deemed minimal. Visual sensitivity – Low - Motorists are likely to have negligible visual sensitivity to the changes. - The changes would not be visible to those outside the corridor due to shielding from existing vegetation, batters and noise walls.	Low

Project component	Assessment	Visual impact
Precinct 11: Hume Highway to Beech Road		
- The existing grassed median would be replaced with two new lanes, a concrete safety barrier (instead of the existing wire rope) and a line-marked median on both sides. - A number of native shrubs and small trees would be removed from the existing median. - The De Meyrick Avenue underpass would be upgraded. - Two new sedimentation basins would be installed. - Additional noise walls would be installed.	Visual effect – Moderate - The upgrade of the De Meyrick Avenue underpass would have minor overshadowing effects. - The drainage basins are unlikely to be visible. - The loss of the grassed median and associated tree and shrub planting is not considered significant in a motorway environment. Visual sensitivity – Moderate - Motorists are likely to have negligible visual sensitivity to the changes. - The works would be visible to pedestrians and motorists on the Hume Highway, De Meyrick Avenue, Kurrajong Road and the pedestrian overpass, but their visual sensitivity is likely to be low due to the transient nature of road travel and pedestrian movement.	Moderate
Precinct 12: Beech Road to Camden Valley Way		
- No additional lanes are proposed in this location but some minor lane marking may be required. - Enhanced planting would be provided near the Camden Valley Way interchange to provide a 'gateway' to the M5 corridor.	Visual effect – Negligible - The changes are deemed minimal. Visual sensitivity – Low - Motorists are likely to have negligible visual sensitivity to the changes. - The changes would not be visible to those outside the corridor due to shielding from existing vegetation, batters and noise walls.	Negligible

Consideration of the project against the desired future character of the area

An assessment of the project was made against the desired future character of the area, taking into account the broader urban design principles (refer Appendix H).

The urban design principles take into account urban design and visual character not only for the corridor, but also reflect its relationship with surrounding areas. The integration of project elements and urban design and landscaping treatments within the corridor helps achieve the desired future character. The urban design and landscaping treatments are set out in section 8.4.5. These treatments would:

- Include extensive landscaping measures to maintain and enhance the vegetated character of the corridor.
- Provide diversity in landscape treatments at interchanges that reinforces the relationship between the motorway and its various entry and exit points (which would enhance the motorway driving experience).
- Provide for a consistent and distinguishable M5 South West Motorway within the Sydney orbital network by using consistent treatments for new motorway elements such as noise walls.
- Incorporate materials and finishes for new motorway elements that align with those elements already within the corridor.
- Seek to limit the visual intensity of motorway elements relative to the wider vegetated corridor through a consistent and limited colour palette.

Variable message signs

The variable message sign network proposed for the M5 West widening project comprises 22 variable message signs on and around the motorway.

The variable message signs would assist with the safe flow of traffic on the motorway and wider road network and have been located to provide road users with advanced information about potential traffic impacts as a result of major events or road incidents.

The variable message signs are a standard design with clean lines and a grey finish, which would help to blend the structures into the background. The variable message signs would contain flashing amber lights to alert motorists and be as conspicuous as possible when in operation.

The signs would be mounted on cantilevered galvanised steel gantries and would have a platform on the back to enable maintenance.

The installation of each VMS would require connection to a local power supply and connection to the motorway control centre via either:

- Connection to the local telecommunications network.
- Direct connection to the M5 South West Motorway control centre.

The extent of trenching works required to provide these connections would be minimised to the greatest extent practicable.

Variable message sign installation involves construction of a trench and the footing, concreting, installation of services and delivery and installation of the sign. Protective barriers may also need to be installed at the each variable message sign site to prevent injuries to persons in vehicles that would occur in the event of a vehicle colliding with the variable message sign structure. Vehicle maintenance bays would be constructed at each of the six on-motorway variable message signs. Personnel access to a variable message sign requires an access ladder on the support structure. The service walkway would have kick plates and steel sheeting around the bottom of the platform to prevent slipping or items falling onto the roadway when the sign is being maintained with live traffic below.

The variable message signs operate in conjunction with static directional signage, the variable message signs need to be located so that road users have sufficient time to comprehend and absorb the traffic information and react accordingly. It is therefore important that variable message signs are located prior to key route decision points, have sufficient sight distances and are not too close to existing static directional signage. These considerations have been key drivers in determining the preferred variable message sign locations described in section 5.4.1.

Visual impact of proposed variable message signs

The visual impacts of the proposed variable message signs have been considered from both the road user perspective and for surrounding residents and businesses. The variable message signs need to be visually prominent so they can be readily seen by road users, but the visual impacts on surrounding land uses (including potential for light spill) should be minimised to the greatest extent practicable.

An assessment of potential visual impacts at each variable message sign locality is included in Appendix H. This assessment considers each identified variable message sign locality and has been completed using the same methodology as described in section 8.4.1. The extent of impacts resultant from the introduction of the variable message sign was found to be between low–medium and medium–high. In general, locating the variable message signs within an area of higher density urban/commercial development would have a reduced visual impact compared with those in lower density land use areas. This is due to the variable message signs being more in keeping with an urban context.

The preferred localities for the introduction of four variable message signs (numbers 1, 3, 4 and 16) are in the vicinity of listed heritage items. An assessment of the potential impacts of these variable message signs on the setting of these heritage items is included in section 9.6 of this environmental assessment.

Cumulative visual impact of variable message signs

The cumulative impact of installing 22 variable message signs in the preferred locations on and around the M5 South West Motorway has been considered. While a number of variable message signs would be installed in close proximity to one another, it would not be possible to view more than one variable message sign at a time. Therefore, no cumulative visual impacts would result from the installation of the variable message signs in the identified localities.

8.4.5 Mitigation measures

Construction impacts

To minimise the potential visual impacts of the project during construction the following measures would be considered:

- The visual impact of construction site compounds on adjacent residential areas will be minimised through the careful planning and positioning of temporary offices, other plant and material laydown areas, and specific management of lighting and potential for light spill within the identified construction site compounds.
- Vegetation, mature or otherwise, currently located between construction site compounds and adjacent residential areas will be retained where practicable to screen views to the proposed construction site compounds.
- Vegetation clearance will be limited to that required to construct the project. Where practicable landscaping would be progressively introduced to provide screening between adjacent residences and the motorway corridor.
- Where an existing noise wall requires removal (wholly or partly) prior to the introduction of a new noise wall, the new walls will be introduced as soon as practicable following removal of existing noise walls to ensure minimal impact on residents.

- Some screening fencing will be introduced between the motorway carriageways and the work sites in the median and to the sides of the motorway to reduce the visual impact of construction and limit distractions for road users.

Operational impacts

The visual impacts of the project would be managed by implementing appropriate urban design and landscaping treatments, based on the urban design and landscaping objectives outlined in section 8.4.1. These objectives were set to ensure that the project elements enhance the current road corridor and are consistent with the existing (and desired) character of the area.

Table 8.35 provides a description of elements of the motorway corridor and how they would be designed to ensure compliance with the urban design and landscaping objectives and principles.

Table 8.35 Compliance with urban design and landscaping objectives

Project elements	Urban design and landscaping treatments
New operations management control system building	The proposed operations management control system building would be integrated into the existing landscape setting. The building would be sited to complement the landform to reduce its prominence and the impact on the existing landscape planting as much as possible. The building would be a conventional single-storey building of concrete, steel and lightweight steel frames and cladding. The proposed building would also be designed to integrate with the architectural style, form and scale of the existing building; and the materials and colour of the building would match those of the existing building, thereby minimising visual contrast.
Noise mitigation	Noise walls are proposed at a number of locations, as shown in Figure 5.1 (a)–(d). The design of noise walls would establish a linear identity along the M5 for the road user and respond to the bushland context of the corridor. The noise wall panel design would consider both the road users' and road neighbours' views. Use of transparent panels would be considered on bridges and where overshadowing of residences may be an issue. It is recommended that any new noise wall panels be designed with minimal texture or patterning – similar to the existing walls – to ensure ease of maintenance. The colour palette proposed would respond to the changing site context and provide a backdrop to the planted corridor edges. The design of new noise walls immediately adjacent to the carriageway (and therefore highly visible to passing traffic) would consider alternative strategies to reduce the visual impact, such as: • Mounding to reduce the wall heights. • Landscape screening such as tree and shrub planting or the use of climbers on the wall. • Varying the colour, overlapping panels or varying the panel shape (for example not just rectangular) where there is limited space for landscape screening.
Drainage basins	Design of the new and modified drainage basins would consider re-vegetation opportunities as well as re-shaping the landform to reduce visibility and maintain the Cumberland Plain Woodland character of the motorway. Canopy tree planting around some basins behind noise walls would enhance the visible canopy above the noise walls. This would help to retain a green corridor experience for motorists and screen the road from surrounding residences.
Embankments, retaining walls and barriers	Any changes to cut-and-fill batters would seek to minimise impacts on the adjoining vegetation in the areas above the proposed earthworks. Low retaining walls would be considered in preference to the re-shaping of the embankment. Safety considerations would also be factored into the design of the retaining walls. Where new retaining walls are required to be visible, they would be sensitive in design to both any existing adjacent abutment and/or new noise wall design. Shotcrete would be avoided and hydromulching/seeding would be considered where the embankment is self-supporting.

Project elements	Urban design and landscaping treatments
Gateway treatments	The beginning and end of the M5 South West Motorway (ie King Georges Road and the vicinity of Campbelltown Road) would be highlighted with 'gateway' landscape treatments. The location of these treatments would have good sight distance in order to signal the start of the M5 South West Motorway at each end, but would not impact on the sight lines to any directional or advertising signage. The selection of plant species would consider microclimatic conditions caused by aspect, elevation, slope and adjoining surfaces and land uses as well as soil conditions and maintenance requirements over time. Creating the gateways may require the removal of some existing vegetation in order to achieve the intended design effect – namely, to distinguish the gateways from the rest of the corridor.
Interchanges	Parkland style landscaping utilising Cumberland Plain Woodland species would be enhanced at a number of interchanges to differentiate these areas from the rest of the corridor. This treatment is proposed for the interchanges at: • Belmore Road. • Fairford Road. • The River Road. • Henry Lawson Drive. • Heathcote Road. • Moorebank Avenue. • Hume Highway. • Camden Valley Way.
Other landscaping	The project would necessitate the clearing of a number of trees contained in the motorway corridor. To lessen this impact, ameliorative measures would include: • Revegetation with Cumberland Plain Woodland vegetation in roadside areas to reduce perceived corridor width. Vegetation would include grasses, groundcovers, and shrubs, depending on sight line requirements. • Revegetation with Cumberland Plain Woodland vegetation in areas unaffected by utilities and infrastructure, maintaining sight lines to these elements and considering clearance requirements. • Screen planting against new retaining and noise walls to reduce their visual dominance and soften the edge effect of straight lines adjacent to the motorway corridor.
Lane marking	Lane marking would have negligible impacts, but would result in increased density of traffic due to closer proximities.

