Appendix C - Part A

PRINCES HIGHWAY UPGRADE
DIGNAMS CREEK REALIGNMENT

URBAN DESIGN REPORT AND
LANDSCAPE CHARACTER AND
VISUAL IMPACT ASSESSMENT
FINAL REPORT

MAY 2013

Prepared for

Transport Roads & Maritime Services

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EXECUTIVE SUMMARY

Introduction

This Urban Design Report and Landscape Character and Visual Impact Assessment has been prepared for Roads and Maritime Services (RMS) of New South Wales (NSW), by Spackman Mossop Michaels (SMM) as part of the Review of Environmental Factors (REF) for the proposed realignment of the Princes Highway, Dignams Creek. This proposed highway realignment (the proposal) has been developed in response to an identified need for a realignment upgrade in order to improve road user safety and travel times.

Existing Context

The study area for the proposal covers a 3.7 km section of the Princes Highway in the Dignams Creek valley, approximately 375 km south of Sydney, and 244 km southeast of Canberra on the New South Wales South Coast. In local context, the site is 20 km south of Narooma, 9 km west of the coast at Bermagui, and 10 km northeast of Cobargo.

The Princes Highway is the main coastal road connection between Sydney and Melbourne and known as Highway 1 on the National Highway Network. As the Princes Highway is not as direct a route as the Hume Highway, it experiences lower traffic volumes. The highway is classified as a tourist route due to its many scenic qualities.

From the north, the existing highway passes through forested areas before descending into the scenic rural valley associated with Dignams Creek. The valley comprises a number of private farms and rural residences and the creek is crossed via an existing heritage-listed bridge. The southern section of the proposal climbs over forested ridges adjacent to the Kooraban and Gulaga National Parks, and crosses via an existing heritage-listed bridge. The existing highway would be used in part to retain property access in the Dignams Creek valley, and the remainder would be decommissioned and revegetated or potentially converted to walking trails where within Gulaga National Park.

Refer Section 2 for a detailed study of existing context and Section 6 for a detailed assessment of landscape character impacts.

The Proposal

Roads and Maritime Services (RMS) propose to realign approximately 3.7 km of the existing Princes Highway at Dignams Creek on the South Coast of NSW. The proposal is located between Narooma and Cobargo in the Eurobodalla Shire and Bega Valley Shire Local Government areas (LGA). The proposal includes the section of the Princes Highway about 1.5 km north of the intersection of Dignams Creek Road to around 2.2 km south of the intersection. The proposal is split into two stages in order to find a better value for money proposal that improves road safety and also provides a plan for future works.

The proposal comprises the construction of a new 3.7 km stretch of single carriageway crossing Dignams Creek approximately 250 m southeast of the existing bridge. The existing highway would be used in part to retain property access in the Dignams Creek valley, the remainder would be decommissioned and revegetated or potentially converted to walking trails where within Gulaga National Park.

Refer Section 3 for a summary of the proposal from an urban design standpoint.

Urban Design Strategy

The over-arching aim of the urban design strategy is to ensure that the proposal is physically and visually integrated with its surrounding environment, reduces visual impact and where possible, maximises engagement of the road user in a local context to provide a more enjoyable and interesting driving experience. The proposal would demonstrate consistency with other nearby Princes Highway upgrade projects and minimise impacts on the natural and cultural environment.

The urban design strategy also considers local resident requirements such as maintaining the semi-rural character of the place and mitigating visual impacts. Bridges, retaining walls, cut and fill, drainage and water quality structures, fauna crossings and fencing are all considered as part of the strategy.

Refer Section 4 for key urban design strategies and Section 7 for a detailed assessment of visual impacts.

Landscape Design Strategy

The landscape design strategy outlines landscape methodologies for establishing vegetation into the proposal. These methodologies comprise planting, seeding and bushland reconstruction methodologies aimed at producing a cost-effective and rapidly establishing revegetation outcome. A combination of methods is required to accommodate the various construction zones and to work with endemic vegetation zones.

The general approach to the landscape design is to provide a well-vegetated road corridor that aims to integrate the highway with the surrounding landscape and provide motorists with a sense of place along the highway journey. In order to achieve this, the landscape revegetation must strike a balance between screening the highway from the sensitive views from surrounding areas and maintaining key views from the highway to the surrounding landscape.

The planting and revegetation design also aims to minimise the potential ecological impacts of the proposal by stabilising earthworks to prevent erosion, and reinforce existing habitats and ecological corridors through endemic species selection. Offsite sections of highway passing through forest offer an opportunity to undertake bushland reconstruction, a cost-effective method ensuring endemic seed is harvested from site topsoil and trees cleared for the proposal.

Refer Section 5 for key landscape design strategies.
The overall character impacts in each LCZ are summarised below.

### Landscape Character Assessment

Following field and desktop studies, the proposal study area has been divided into four Landscape Character Zones (LCZ). Each zone has been defined through gaining an understanding of land use, topography, and vegetation in combination with other factors intrinsic to the local landscape. The four landscape character zones are:

- **LCZ 1** - Northern Forested Ridges (towards Tilba Tilba within Eurobodalla Shire).
- **LCZ 2** - Dignams Creek valley (the intersection of Dignams Creek Road and the Princes Highway).
- **LCZ 3** - Southern Forested Ridges (Gulaga and Kooraian National Parks).
- **LCZ 4** - Narira Creek valley (towards Cobargo within Bega Valley Shire).

From the perspective of local property owners, tourists, cyclists and pedestrians, landscape character would be impacted, particularly in LCZ 2: Dignams Creek valley, due to the magnitude of the proposal and openness of the valley.

Overall, the proposal would have an impact on landscape character. While the works, for the most part, are to take place in an established road corridor, they would impact on all LCZs to some degree.

### Visual Impact Assessment

The potential visual impact of the proposal has been assessed in relation to a number of key and potential viewpoints within defined visual catchment areas. The study area has then been defined into three Visual Catchment Zones (VCZ) based on geographic proximity to the proposal which are:

- **Primary VCZ**: approximately 0 - 500 m.
- **Secondary VCZ**: approximately 500 m - 1.5 km.
- **Tertiary VCZ & Long Range Views**: approximately 1.5 - 3+ km.

Overall, the proposal would have an impact on views in and around the study area. While the works, for the most part, are to take place in an established road corridor, they would impact on all VCZs to some degree, with the greatest impact being on the road user and local residents within the Primary VCZ, particularly within Dignams Creek valley.

The overall visual impacts in each VCZ are summarised below.

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<td>High</td>
<td>High to Moderate</td>
<td>High</td>
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<tr>
<td>Secondary Zone: 500 m - 1.5 km</td>
<td>Moderate</td>
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<td>Moderate</td>
</tr>
<tr>
<td>Tertiary Zone: 1.5 km - 3+ km</td>
<td>Moderate to Low</td>
<td>Low</td>
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<td>Road User</td>
<td>High to Moderate</td>
<td>High to Moderate</td>
<td>High to Moderate</td>
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Refer Section 7 for Visual Impact Assessment detailed analysis and results.

### Conclusion

The visual qualities of the Dignams Creek valley are considered unique in a local context, which distinguishes it from other valleys and townships in the local area. These intrinsic values are highly regarded by the local residents who live there, as well as a potentially substantial proportion of the general population, tourists, etc. who value the scenic qualities of these rural landscapes.

The proposal for the realignment of the Princes Highway at Dignams Creek would involve the construction of a new elevated road and bridge within this rural valley, along with substantial earthworks and vegetation removal in forested sections to the north and south of the bridge.

The urban design and landscape principals and objectives that have been developed, for the proposal take into consideration the existing landscape character and scenic qualities of the area. Mitigation measures and landscape treatments have been derived from these objectives in order to develop a strategy for reducing visual impacts. This strategy would form the basis of future design stages.

Overall, the proposal would have moderate to high visual impacts when viewed from local residences within 500 m within Dignams Creek valley. In particular, views of the elevated road and bridge structure require careful design consideration. Long-range views would be far less impacted; however, some of these long-range views may also require impact mitigation. Specifically, views of the ridge line in the southern section from the lookout on Mount Dromaderry and also from the Cobargo-Bermagui Road would be impacted by landform cutting and vegetation removal. Localised treatments, including revegetation, would assist with mitigation of short and long range viewpoint impacts.

Whilst the road user experience would be improved in terms of safety and views, there would be a potential reduction in road user awareness of local character due to higher speeds, which result in reduced time to appreciate detailed vistas.

The proposal fulfils the identified urban design objectives and principles, when assessed in combination with the proposal mitigation measures.

Refer Section 8 for a detailed summary of conclusions.
1 INTRODUCTION

1.1 Proposal Overview
1.1 PROPOSAL OVERVIEW

1.1.1 BACKGROUND

This Urban Design Report and Landscape Character and Visual Impact Assessment has been prepared for Roads and Maritime Services (RMS) of New South Wales (NSW) as part of the Review of Environmental Factors (REF) for the proposed realignment of the Princes Highway, Dignams Creek. This proposed highway realignment (the proposal) has been developed in response to an identified need for a realignment upgrade in order to improve road user safety and travel times.

The proposal has been designed in two (2) stages in order to deliver the required safety measures within an acceptable time frame and to utilise available budgets, allowing planning and design of the second stage to continue. This assessment has been prepared in the context of the combined stages with a greater emphasis on the interim Stage 1 works. A more detailed description of the proposal is in Section 3 of this report.

The report has been prepared in accordance with the RMS document Guidelines for Landscape Character and Visual Impact Assessment and describes:

• The landscape character of the existing site and its surrounds.
• A landscape contextual analysis.
• The sensitivity of the landscape character to the proposal.
• The potential impacts on landscape character.
• The potential visual impacts caused by the proposal.
• Preliminary urban design recommendations, which are to be addressed as the design is developed to improve the design outcome for motorists and local residents, as well as avoiding and mitigating visual impacts.
• Recommendations, which in conjunction with the REF document, aim to minimise impacts on the natural environment and how to vegetate the works.

1.1.2 STUDY METHOD

The undertaking of the landscape character and visual impact assessment along with the finalisation of the concept design has been an iterative process. This has enabled the concept design to be refined throughout the development process, thereby reducing and mitigating the potential landscape character and visual impact wherever possible to preserve the aesthetic quality of the Dignams Creek valley (refer Plate 1.1).

The method used to undertake this study is summarised as follows:

• Undertaking an initial site visit and field investigation, reviewing relevant literature, analysing aerial photographs, topographic maps to understand the study area.
• Reviewing the initial engineering concept design and supporting material to gain an appreciation of the proposal.
• Defining landscape character through a contextual analysis.
• Identifying and describing LCZs and evaluating the impact of the proposal on these zones.
• Identifying the visual catchment of the proposal.
• Selecting viewpoints within the visual catchment representing the range of different land uses in the proposal area.
• Re-visiting the site to ground truth initial analysis and concept designs.
• Evaluating visual impact of the proposal by comparing the sensitivity of viewpoints and the magnitude of the impact of the proposal upon them.
• Identifying urban design and landscape opportunities, as well as methods for mitigating adverse visual impacts, to be considered during the detail design phase.

Works associated with the proposal have been assessed, including:

• Construction of a new road alignment and removal of vegetation.
• Construction of a new bridge.
• Construction of new fill batters and access tracks.
• Excavation of cut batters and access tracks.
• Construction of sediment basins, drainage channels, and other drainage devices.
• Revegetation, feature planting, and creek embellishment planting.

Plate 1.1: Looking west over Dignams Creek valley to the ranges beyond.

Source: RMS
2 THE EXISTING CONTEXT

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2.1 OVERVIEW

The study area for the proposal covers a 3.7 km section of the Princes Highway in the Dignams Creek valley, approximately 373 km south of Sydney and 244 km southeast of Canberra (refer Figure 2.1). In local context, the site is 20 km south of Narooma, 9 km west of the coast at Bermagui, and 10 km northeast of Cobargo.

The Princes Highway is the main coastal road connection between Sydney and Melbourne, and known as Highway 1 on the National Highway Network. However, it is not the most direct route between Sydney and Melbourne and as a result experiences relatively lower traffic volumes than the Hume Highway between Sydney and Melbourne.

Figure 2.1: Regional context with the proposal study area
Source: Base map Google Maps, artwork: SMM.

Figure 2.2: Local context with the proposal
Source: Base map Department of Lands, additional base data provided by RMS, artwork: SMM.
2.2 PROPOSAL STUDY AREA

The urban design, landscape character and views for proposal study area encompasses the immediate route corridor and includes the wider landscape and views that surrounds the corridor. The proposal study area crosses two local government areas of the Eurobodalla Shire Council to the north and Bega Valley Shire Council to the south (refer Figure 2.2).

In order to identify the potential landscape character and visual impact of the proposal, it is necessary to understand the current visual and landscape character of the study area, which includes existing features such as the bridge (refer Place 2.1), as well as the sensitivity of the local population and visitors to changes of this character. This chapter of the report provides a summary of the area’s key environmental factors.

The study area assessed in this report also includes a visual catchment area, both in terms of where the proposal would be viewed from and what would be seen from the proposal. Whilst much of this area is limited to the Dignams Creek valley and immediate forest edges, it also extends to local high points to the north and west as well as lower elevations to the south from which the proposal would potentially be visible.

2.3 LAND USE

Conservation management areas (National Parks, State Parks etc) and timber production (refer Figure 2.3) comprise the main land use in the region. These areas form an elevated background to the Dignams Creek and Bega valleys, where more intensive activities occur. Land use in the valleys consists mainly of rural lands and rural residential properties. The main agricultural practices undertaken on these lands consist of grazing, which has a 140+ year history in the area. Dairy farming, whilst a historically important land use, is a relatively small local industry (NSW Archaeology, 2009).

Design Considerations
- With tourism being a substantial growth industry in both shires and agriculture increasingly under pressure from residential development, the rural and agricultural character of Dignams Creek would be preserved both as a tourism resource and for agricultural uses.
- Increased pressures on farming activities from climate change, urban development and other factors would be considered when undertaking greenfield development as it is important to preserve viable farming land.

The proposal is located within 10 km of the coast, which results in milder temperatures than locations further inland. At Narooma, 20 km to the north, the mean winter temperature is approximately 16.5 °C, while in summer the mean temperature is around 23.0 °C. Mean rainfall is approximately 910 millimetres (mm) per year with the higher rainfall occurring between January and March. Based on Narooma’s proximity to the proposal study area, similar conditions are likely along the majority of the proposal.

Design Considerations
- The climatic conditions expected to occur within the proposal study area, particularly the annual rainfall can be expected to provide ideal growing conditions for vegetation. This is relevant as the proposal would stipulate the use of endemic vegetation and species that are accustomed to these conditions.
- Species use may change along the proposal to target specific climatic (and cultural) conditions. Care would be taken, with regards to the aspect of cut and fill batters, to ensure that adequate solar access is provided.
- Shaded areas would occur along the edges of the proposal that are in close proximity to dense forest and at the base of embankments and cuttings.

Refer Section 2.7 of this report for more detailed information regarding existing vegetation.
2.5 LANDFORM & GEOLOGY

The proposal study area is located in south eastern NSW, within a coastal lowlands system consisting of rolling to undulating terrain (Gunn et al. 1978 cited in NGH 2010), which is illustrated in Figure 2.4. There is a range of elevations within the proposal study area, the lowest being Dignams Creek at 16 m above sea level (asl) and the highest being the nearby ridgelines to the west, which range from 100-300 m asl. The nearest regional high point is Gulaga (Mount Dromadery) approximately 6 km to the north, which rises steeply to 806 m asl.

Heading south through forest-lined roads south of Narooma, the Princes Highway descends into Dignams Creek valley. The highway then traverses an east-west ridge line before descending into a broad open coastal valley to the south. To the east lies Wallaga Lake, a tidal estuary of the Pacific Ocean. To the west lies forested slopes which separate the proposal study area from the plains of the Monaro grazing districts.

Geotechnical surveys have indicated that the typical subsurface profile comprises clay based topsoil to a maximum depth of 1.1 m, overlying sandstone and siltstone bedrock at depths of 0.5-6.8 m. Bedrock of varying quality would be expected (refer Plate 2.2).

Design Considerations
• In cuttings, batter slopes would need to consider the highly weathered sandstones/siltstones.
• Landform modifications would integrate where possible with natural terrain, particularly where highly visible from nearby properties and from important long-range viewpoints. (refer Section 07).

Plate 2.2: Existing roadside cutting approaching Dignams Creek revealing underlying geology.

Source: SMM

Figure 2.4: Topography in the proposal study area

Source: Base map Department of Lands; additional base data provided by RMS; artwork: SMM.
2.6 HYDROLOGY & DRAINAGE

The proposal is located within two drainage catchments comprising the Dignams Creek and Narira Creek river systems. Dignams Creek drains the northern section of the proposal in an easterly direction into Wallaga Lake. The downstream reach of Dignams Creek is classified as the ‘Dignams Creek Sanctuary Zone’ and flows through a series of wetlands listed under the State Environmental Planning Policy No 14 - Coastal Wetlands. Narira Creek drains the southern section of the proposal, where water also flows in an easterly direction through the Bega Valley floodplain into Wallaga Lake (refer Figure 2.5).

Estuaries and creeks provide a broad range of habitat for a wide diversity of aquatic plant and animal species, as well as supporting a range of ecological processes. Many of the freshwater rivers and creeks in the region, specifically Dignams Creek and Narira Creek, are influenced by tidal flows that support freshwater and estuarine flora and fauna.

Localised flooding can occur during localised high rainfall events, (refer Plate 2.3) and whilst rarely closing the highway, the flood waters are known to force the closure of local roads, cause erosion to embankments and cause damage to bridge and road infrastructure.

Design Considerations
• Proposal bridge span would provide required level of flood immunity.
• New drainage facilities would work with natural drainage patterns across the landscape and provide protection to natural systems.

Plate 2.3: Dignams Creek during a flood event in 2010.

Source: RMS, April 2010

Figure 2.5: Creek flows in the proposal study area
Nine oblique aerial view looking south
2.7 VEGETATION

The proposal study area is surrounded by a series of National and State Parks, namely Wallaga Lakes National Park and the Kooraban and Gulaga National Parks (refer Figure 2.6). Further afield lies Bermagui State Forest, Bermagui Nature Reserve, Goora Nature Reserve, Bodalla State Forest, Murrab State Forest, and the Wadbilliga National Park. As a result there are substantial, well-established stands of forest surrounding the proposal study area, particularly on the steeper and upper slopes. These create substantial vegetative corridors across and adjacent to the proposal study area (refer Plate 2.4).

Kooraban National Park adjacent to the existing highway was previously a State Forest and has been extensively logged. This has had an impact on flora maturity and diversity as well as habitat values (NGH 2010). Other forested areas adjacent to the proposal study area are often located on private lands.

Steeper and upper slopes tend to be forested with native species, while valleys and pockets of ridge lines are defined by more gentler slopes are typically cleared for agriculture and settlements. Forested areas in some cases within both the Eurobodalla and Bega Valley Shires, comprise plantations of timber for harvesting purposes. The remainder of the vegetation within the proposal study area consists of occasional exotic tree planting and introduced weeds and grasses located mainly in the cleared valleys.

Source: SMM

Plate 2.4: Dense roadside vegetation near Dignams Creek

Figure 2.6: National Park lands in the proposal study area

Source: Base map Department of Lands; additional base data provided by RMS; artwork: SMM.
Vegetation assessment and mapping (SKM, 2012) determined there are a total of six (6) vegetation communities in the proposal study area (refer Figure 2.7).

For a detailed discussion on exiting vegetation communities refer to the Upgrade of the Princes Highway, Dignams Creek Review of Environmental Factors, SKM (2013).

**Design Considerations**
- Existing vegetation communities would inform revegetation for the proposal during detail design stage.
- Bushland reconstruction techniques utilising seed infused site topsoil would be considered for use in off-line and densely vegetated sections of the proposal.

![Figure 2.7: Vegetation communities in the proposal study area (SKM).](image-url)
2.8 CULTURAL HERITAGE

The proposal is situated within the boundaries of the Merrimans Local Aboriginal Land Council. Prior to European occupation, the Aboriginal people of the region practiced a hunting, gathering and fishing economy and survived on a diet of Zamia, Cabbage Tree Palm, native fauna, fish, shellfish and eel (NSW Archaeology, 2009).

Forestry and timber getting has had a major influence on the landscape from c1820-1830, creating cleared valleys that were subsequently used for agriculture and dairy farming. Remnants of old tracks and stock routes, bridge abutments and culverts associated with these activities can be found in the proposal study area (NSW Archaeology, 2009).

Dairy farming in the area was prominent from 1870 to the 1950’s however, few farms continued dairy farming into the later half of the twentieth century. “Pretty Valley” farm, immediately to the east of the existing highway is a notable exception that continued dairy farming until being purchased by the RMS in 2012. Many derelict dairy farm buildings and other remnant structures exist across the region and exist within the proposal study area (refer Figure 2.8). These contribute to the layering of history evident in the landscape of Dignams Creek.

Additional details regarding non-Aboriginal heritage of the area can be found in the Princes Highway Upgrade Dignams Creek near Cobargo NSW - Historical Heritage Report (2009).

Additional details regarding Aboriginal heritage of the area can be found in the Princes Highway Upgrade at Dignams Creek via Cobargo, NSW - Preliminary Aboriginal Archaeological Assessment (July 2008)

Design Considerations
- Aboriginal and non-Aboriginal cultural sites would be left undisturbed wherever possible.
- Remnant rural structures and vistas to and between these structures and visual connections would be maintained wherever possible.

Figure 2.8: Cultural heritage in the proposal study area

Map Key
2.9 CULTURAL & SCENIC VALUES

Stages 1 and 2 of the proposal are situated within two distinct areas that have been formed by the combination of landscape types (refer Plate 2.5), vegetation formations present and how these have evolved over time. The impacts caused by human activities i.e. dairy farming, agriculture, timber harvesting and urban settlement have been reflected in the visible landscape of the present-day. Views of the surrounding landscape experienced by the road-user would consist of these landscape types, with cultural views likely to be the most valued by the general public (refer Plates 2.6-2.8).

Dense roadside vegetation restricts sweeping landscape views on approach to the Dignams Creek valley which in turn emphasises the broad views within the valley. Views from within the forested areas would be possible when the proposal is elevated on fill. Potential views of the proposal major cuttings from homesteads would be possible from various locations. Views of the proposal from local roads and rural homesteads have been assessed for potential visual impacts as part of this report (refer Section 7).

Design Considerations

- The combination of the natural and cultural scenic qualities with local heritage values establishes a unique identity to the area. These values have a special meaning and provide a sense of place for the local inhabitants, as well as visitors and through traffic.
- The proposal would minimise impacts on the cultural and scenic areas within the proposal study area to the greatest extent possible.

Plate 2.5: Aerial view towards the northwest over Wallaga Lakes and the proposal area towards Gulaga (Mount Dromedary).

Plate 2.6: Views of Dignams Creek from the Pretty Valley farm to the east.

Plate 2.7: View of Dignams Creek valley from the southern approach to the bridge on the existing highway.

Plate 2.8: View of Dignams Creek Road in the upper catchment of Dignams Creek valley.
2.11 INFRASTRUCTURE

2.11.1 TRANSPORT NETWORK

During the early 1900s, the Main South Road was constructed along the east coast of NSW and provided an important road link with Sydney. Prior to this goods and materials were primarily transported to the area by boat. Following a visit of the Prince of Wales in 1920, the Main South Road was renamed the Princes Highway and a series of road improvements were undertaken.

Following many minor road upgrades and realignments, the Princes Highway continues to provide access to coastal townships and is still provides an important coastal link between Sydney and Melbourne (refer Figure 2.1 and 2.2). Today it is considered more of a tourist route with varying speed limits, scenic areas and longer journey times than the shorter and more direct route along the Hume Highway.

These factors have the effect of reducing traffic and heavy vehicle usage of the road (evidenced by the low 1,500 vehicle movements a day at Dignams Creek), and increasing enjoyment of road users through providing a more relaxed driving experience. Additionally, there is a higher than expected accident rate on the highway, and a higher than expected percentage of fatalities (RTA Realignment Options Report, 2010).

2.11.2 PUBLIC TRANSPORT, PEDESTRIAN AND CYCLE FACILITIES

Dignams Creek is poorly serviced by public transport and is not linked directly to train services. NSW Country Link provides coach services between Canberra and Eden stopping at the nearest station of Bega.

A local bus network links Dignams Creek with Bega, Thar, Cobargo and Bermagui via the Princes Highway (http://www.countrytransport.131500.com.au).

There are no specific pedestrian or cycling facilities, in or adjacent to the proposal. Bike touring occurs due to the scenic qualities of the coastal landscape and prevalence of National Parks. Substantial pedestrian activity is unlikely due to the lack of nearby urban infrastructure and prevalence of car transport. Some local hiking trails exist in the adjacent National Parks, however, access to these trails would be via local roads rather than the Princes Highway.

2.10 UTILITY INFRASTRUCTURE

2.10.1 UTILITY INFRASTRUCTURE

The main utility infrastructure in the proposal study area is the 33 kilovolts (kV) high voltage power line which runs approximately parallel to the highway (refer Plate 2.9). The power line crosses Dignams Creek around 500 m to the southeast of the existing bridge and would remain untouched by construction works associated with the proposal. Smaller power lines and other services are present near the proposal to service nearby properties. One of these local overhead power lines crosses the proposal north of the creek.

2.10.2 ROAD INFRASTRUCTURE

The major piece of existing road infrastructure is the heritage listed bridge over Dignams Creek (refer Plate 2.10). Road infrastructure associated with this section of the Princes Highway include standard RMS regulatory and directional signage, steel ‘W beam’ barriers, and National Park signage.
3 THE PROPOSAL

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3.1 PROPOSAL DESIGN

3.11.3 ROAD DESIGN PARAMETERS

The Princes Highway is classified as a class 4 rural (4R) road which allows for a design speed of 110 km/hr.

The proposal design parameters include the following:
- **Lane width:** 3.5 m.
- **Shoulder width:** 3 m (narrowing to 2.5 m on the Stage 1 road safety section).
- **Verge:** Typically 1 m.
- **Median width:** 1-3.5 m (painted median in Stage 1 road safety section; there would be no median in realigned sections).
- **Design speed:** Design speed is 100 km/hr for all realigned sections and in Stage 1. However some existing sections of the highway in Stage 1 do not meet the minimum requirements - these would be rectified in the Stage 2 realignment.
- **Posted speed:** 100 km/hr.
- **Maximum grade:** 8%. However the Stage 1 maximum grade is 9.5%, which would be rectified in the Stage 2 realignment.
- **Minimum horizontal curve radius for the proposal is 600 m.**
- **R460 is the minimum standard for a 100 km/hr design speed.**

3.11.4 CROSS SECTION AND ROAD SPACE ALLOCATION

The proposal would comprise a single carriageway and one lane in each direction, with the exception of the southbound overtaking lane. The highway geometry has been designed to an operating speed of 100 km/hr. Provisions for further widening have not been provided in the design as this has been determined not to be a requirement. The key features are the same as the Road Design Parameters previously mentioned in Section 3.2.

3.11.5 INTERSECTIONS, LOCAL ROAD AND PROPERTY ACCESS

Some local access points would be connected to the local service road (existing highway in Dignams Creek valley) via the intersection at Dignams Creek Road and an underpass beneath the proposal bridge crossing. Properties with existing access points would retain access to the highway however the access arrangements would be modified and safety improved.

3.11.6 BRIDGES

Bridge superstructure and substructure components have been selected based on constructability, value for money, similarity to other nearby structures and visibility of the bridge to highway users and local residents.

RETAINING WALLS

In addition to the bridge, the proposal would have retaining walls at several locations. Where required, retaining walls would generally not be visible to highway users or local residents. The walling system employed would be designed to allow plant growth.

3.11.7 EARTHWORKS

Extensive earthworks would be required to implement the proposal. The majority of cut and fill batters on the proposal would be designed to 2H:1V, which is steep enough to assist with minimising the construction footprint, but which also allows several revegetation methodologies to be employed.

Cuts would not be revegetated as they would generally be in rock. Steeper slopes of 0.75H:1V and 1.5H:1V would be designed for higher-strength rock cuttings, where possible, which are similar to existing cut batters along this stretch of the Princes Highway (refer Plate 3.1).

Flatter slopes of 4H:1V would be designed for low fill batters where existing vegetation and other constraints are not present.

3.11.8 DRAINAGE DESIGN

Road drainage for the proposal would generally consist of three key elements; cross drainage, longitudinal drainage and water quality treatment.

Cross drainage transfers existing stormwater flows across the proposal carriageway using bridges and culverts. The cross drainage would be designed for a 1 in 100 year storm event. The cross drainage for local roads would be designed to maintain or improve existing flood immunity levels (typically for a minimum 1 in 10 year storm event).

Cross drainage would be provided on fill embankments. Inlets would be located at low points where the water would naturally pond or be re-directed by channels if required. Drains would take the form of open channels lined with roughened concrete such as shotcrete (to darken over time and slow water velocities) or be vegetated with native grasses. Biodegradable systems such as coir logs and jute matting would also be used to stabilise drainage lines.

Longitudinal drainage would be used to drain stormwater from the road pavement and be designed for a 1 in 10 year storm event. This drainage would consist of piped and open channel systems to direct water to new water treatment facilities where required (generally in the form of detention basins and grassed swales). Boulders, rubble and planting would be provided in order to minimise scour protection and erosion control.

Vegetated water quality basins would be provided at sensitive receptors to collect and treat runoff from the proposal. These basins detain stormwater runoff, allowing suspended sediments to settle out and nutrients to be taken up by plants, prior to the water being discharged downstream free of sediment.

Water would be further treated for suspended sediments and nutrients where possible by the use of grassed swales and channels. Given the location of the proposal within an estuarine catchment, emergency spill facilities may also be required to capture and contain major spills (e.g fuel, oil). This inclusion would be based on a risk assessment during detailed design.

Refer RMS Princes Highway deviation, Dignams Creek Stage 1 Concept Report (2013) for detailed information regarding road design parameters.
3.2 PROPOSAL STAGING

The proposal is split into two stages in order to facilitate a value for money proposal that would improve road safety in the short term and also provide a plan for future improvement works (refer Figure 3.1).

Stage 1 of the proposal would include:
- Realignment of about 2 km of single carriageway from the northern end of the proposal extending to about 600 m south of the existing Dignams Creek intersection.
- Construction of a new single carriageway bridge over Dignams Creek (91 m in length).
- Construction of a new relocated intersection with Dignams Creek Road with protected turning lanes.
- Tying into the existing Princes Highway alignment about 600 m south of the existing intersection of Dignams Creek Road.
- Provision of about 1.4 km of road safety treatments along the existing Princes Highway alignment between 600 to 2,000 m south of the existing intersection with Dignams Creek Road.

Stage 2 of the proposal would include:
- Realignment of 1.5 km of single carriageway from 2 km south of the northern end of the proposal and extending to the southern end of the proposal.
- Tie in works to the existing Princes Highway at the southern end of the proposal.
- Provision of two fauna underpasses and one rope canopy bridge.
- Removal of the existing Princes Highway between Dignams Creek Road and the access road to Gulaga National Park and then backfilling, rehabilitating and landscaping the old road alignment.

The following general features would be included for both stages of the proposal:
- Installation of operational water quality controls including grass swales, bioretention basins, and a constructed wetland.
- Installation of retaining walls.
- Provision of ancillary facilities such as temporary sedimentation basins, site compound and stockpile sites and access tracks.
- Relocation of overhead utilities to accommodate the proposal.

Figure 3.1: Proposal staging improvements at Dignams Creek. Note: oblique aerial view looking west.
4 URBAN DESIGN STRATEGY

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4.1 STRATEGY OVERVIEW

An integrated design approach has been adopted for the proposal in order to ensure that the best possible outcomes are achieved. This integration is achieved through the regular collaboration with a multidisciplinary team to resolve design challenges as opposed to working in isolation.

This approach has resulted in the development of an urban design strategy that feeds urban design values into the overall concept design throughout the development of the proposal. This urban design strategy would continue to influence the development of the proposal as it proceeds through detailed design and construction.

4.2 URBAN DESIGN OBJECTIVES & PRINCIPLES

4.2.1 URBAN DESIGN AIM

The over-arching aim of the urban design strategy is to ensure that the proposal is physically and visually integrated with its surrounding environment and, where possible, maximises engagement of the road user in a local context to provide a more enjoyable and interesting driving experience. The proposal would be designed in such a way as to demonstrate consistency with other nearby Princes Highway upgrade projects in the southern region.

4.2.2 URBAN DESIGN OBJECTIVES

In order to meet this aim, a set of key urban design objectives and related design principles has been developed for the proposal. These objectives and principles reference the RMS’s *Beyond the Pavement* guidelines and are based on an understanding of the key existing landscape and urban values of the proposal study area as well as the landscape and urban design issues that would be affected by the proposal.

The urban design objectives for the proposal at Dignams Creek are:

A. To improve the safety and operational efficiency of the highway.
B. To retain the existing character of the natural and cultural landscapes through which the highway passes.
C. To maintain the integrity of existing ecological systems.
D. To minimise the construction and operational impacts of the highway on the local community and existing environment.
E. To maintain and improve the amenity and economic viability of the local area.
F. To retain and enhance the essential qualities of the existing highway travel experience.
G. To ensure that the proposal makes a positive contemporary contribution to the local and regional landscape.

4.2.3 URBAN DESIGN PRINCIPLES

A series of urban design principles has been developed to ensure that the urban design objectives are achieved by the proposal. The purpose of these principles is to integrate good urban design practice into all aspects of the concept design development and to be carried forward throughout the process to inform the subsequent detailed design and construction phases of the proposal.

The urban design principles relating to each urban design objective are outlined on the following page in Table 4.1. The table describes the interrelationship between the urban design objectives, the associated urban design principles and the areas of the highway design that would influence the development of the proposal. In some instances, a design principle may apply to more than one objective.

4.2.4 AREAS OF DESIGN INFLUENCE

The urban design principles for the proposal relate to three broad areas of design influence that include:

- **Road alignment design/general arrangement.**
  The design of the location and geometry of the proposal and related local access roads.
- **Road elements design.**
  Input into the design of bridges and safety barriers that are necessary to achieve the road alignment or are required for the effective operation of the proposal.
- **Revegetation and planting design.**
  The design of new planting or bushland reconstruction areas in order to integrate the proposal with the existing local landscape character and natural patterns, and to provide interest to the motoring experience.
Table 4.1: URBAN DESIGN OBJECTIVES AND PRINCIPLES

<table>
<thead>
<tr>
<th>Areas of design influence</th>
<th>Road alignment design</th>
<th>Road elements design</th>
<th>Softworks design</th>
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<tbody>
<tr>
<td><strong>URBAN DESIGN OBJECTIVES &amp; RELATED PRINCIPLES</strong></td>
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<tr>
<td>A</td>
<td>To improve the safety and operational efficiency of the highway.</td>
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<tr>
<td>A1</td>
<td>Reduce the number of local road intersections and direct property connections along the proposal.</td>
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<td>A2</td>
<td>Provide continuous local access routes wherever possible.</td>
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<td>A3</td>
<td>Improve facilities for all road users – including motorists, pedestrians and cyclists.</td>
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<td>B</td>
<td>To retain the existing character of the natural and cultural landscapes through which the highway passes.</td>
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<tr>
<td>B1</td>
<td>Minimise the physical footprint of the proposal, including during the construction stages.</td>
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<tr>
<td>B2</td>
<td>Design the proposal to be physically and visually integrated with the surrounding landscape.</td>
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<tr>
<td>B3</td>
<td>Minimise the physical and visual intrusion of road-related elements (such as safety barriers and fencing) on the local landscape.</td>
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<td>B4</td>
<td>Preserve the integrity of cultural heritage sites and areas of cultural importance, regardless of whether or not they contain heritage items.</td>
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<td>B5</td>
<td>Minimise the impact of the proposal on native vegetation and existing cultural plantings.</td>
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<tr>
<td>C</td>
<td>To maintain the integrity of existing ecological systems.</td>
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<tr>
<td>C1</td>
<td>Minimise the physical footprint of the proposal, including during the construction stages.</td>
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<tr>
<td>C2</td>
<td>Minimise the impact of the proposal on native vegetation.</td>
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<td>C3</td>
<td>Avoid the introduction of environmental weeds.</td>
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<td>C4</td>
<td>Implement comprehensive water quality control measures.</td>
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<td>C5</td>
<td>Provide connectivity and safe, effective crossings for native fauna.</td>
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<td>C6</td>
<td>Maintain the integrity of endemic plant communities and topsoils.</td>
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<td>C7</td>
<td>Maintain the ecological functionality and long-term sustainability of revegetated areas.</td>
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<tr>
<td>D</td>
<td>To minimise the construction and operational impacts of the highway on the local community.</td>
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<tr>
<td>D1</td>
<td>Minimise the physical footprint of the proposal, including during the construction stages.</td>
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<tr>
<td>D2</td>
<td>Design the proposal to be physically and visually integrated with the surrounding landscape.</td>
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<td>D3</td>
<td>Provide continuous local access options wherever possible.</td>
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<td>D4</td>
<td>Provide generous and direct local vehicular and pedestrian connections across the highway of appropriate scale and character to the significance of the crossing.</td>
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<td>D5</td>
<td>Minimise the potential noise impacts of the proposal.</td>
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<tr>
<td>D6</td>
<td>Consider opportunities for public transport in the proposal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D7</td>
<td>Provide safe and effective crossings for livestock where necessary.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>To maintain and improve the amenity and economic viability of the local area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>Provide continuous local access routes wherever possible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Provide straightforward connections between the proposal and the local road network.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>To retain and enhance the essential qualities of the existing highway travel experience.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>Make the character of the local topography a tangible experience for the motorist by providing, as much as possible, a constantly varying horizontal (curving) and vertical (undulating) road alignment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Minimise the visual scale of the proposal from the motorist’s perspective.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>Maxmise the motorist’s experience of, and visual connection to, the surrounding natural and cultural landscapes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Retain and where possible improve, regional views and views to important landmarks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>To ensure that the proposal makes a positive contemporary contribution to the local and regional landscape.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>Avoid the use of token ‘gateway’ statements. Instead, utilise unique features of the local area and functional elements of the highway as visual markers and experiences that provide a sense of arrival or sense of place along the highway journey.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Recognise that large-scale road elements (such as walls, cuttings, bridges and tunnels) have iconic potential and provide important visual and landscape markers. Design these elements accordingly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>Design the visual expression of the road elements to be true to their infrastructural function, using robust materials and streamlined, uncomplicated forms.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3 URBAN DESIGN ELEMENTS

4.3.1 OVERVIEW

Urban design elements include bridges, walls and cuttings, that are necessary to achieve the road alignment, or safety barriers and other roadside components, that are necessary for the effective operation of the highway.

The general approach to the design of road elements would be undertaken in such a way as to satisfy the functional requirements for the safe and efficient operation of the highway while also being appropriate to their location. In all cases, the design and implementation of the road elements would need to satisfy the requirements of Austroads and RMS design guidelines and practice notes.

It is also important that, in their detailed resolution, the visual expression of the road elements is true to their function as items of contemporary highway infrastructure. Respect for the character of the local area would not be achieved by the appropriation of stylistic cues or fashions, rather through sensitive consideration of the location, placement and scale of the new elements.

Principles specific to Road Design elements

To aid the implementation of the road design elements principles in the road elements design, a series of urban design recommendations has been developed for each of the road elements that would be required for the proposal. The development of these recommendations has been guided by the following specific design criteria:

- Simplicity in the design expression of the elements relating to the highway, in order to allow the existing natural and cultural landscapes to provide the primary interest to the motoring experience.
- Practicality for ease of construction and reduced long-term maintenance.
- Site specific design that acknowledges and responds to the character of the local area, while not necessarily replicating existing features.
- Consistency with the overall Princes Highway by using elements that are identifiable part of the highway experience in this region.
- Integrity to the materials and method of construction in the final finish and appearance of the road elements.
- Sustainability in the choice of materials and resources.

Categories

Three categories of urban design elements have been identified for the proposal. These are as follows:

- Landscape structures & formations - such as retaining walls, cuttings and embankments.
- Major structures - the bridge at Dignams Creek.
- Roadside furniture - such as safety barriers and noise attenuation walls.

Refer to individual sections of this report for recommendations regarding urban design elements.

4.3.2 LANDSCAPE STRUCTURES & FORMATIONS

Landscape structures and formations are required to reconcile the new highway levels with the levels of the existing ground (refer Figure 4.1). The types of landscape structures and formations required for this proposal are:

- Drainage and water quality structures required to ensure the proposal is adequately drained, protected from flooding and impacts on local waterways are minimised.
- Cuttings where the proposal would be situated below the existing ground, requiring excavation.
- Fill embankments and retaining walls where the proposal would be situated above the existing ground, requiring the road to be elevated.

Figure 4.1 describes the principles used to determine the types of landscape elements used on this proposal.

Drainage and water quality structures

The proposal is situated within a sensitive catchment comprising National Parks, SEPP 14 wetlands and the Dignams Creek Sanctuary Zone. Water quality controls would be required during the construction and operation phases of the proposal in order to minimise impacts on these environments.

Up to 20 water quality basins (spread over the 2 stages at different times) would be required during construction. The permanent facilities would include water quality pond, biofiltration basins, constructed wetlands and biofiltration swales, the design of which would be finalised during the detailed design stage.

Key Considerations

The key landscape and urban design considerations relating to drainage and water quality structures are:

- In steep bushland areas:
  - The large size and footprint of the basins due to the undulating terrain.
  - The clearing of vegetation necessary to construct the basins and associated access tracks.
- The visual impact of the drainage channels, particularly those in highly visible or visually sensitive locations such as along the roadside, in medians, and along the tops of cutting benches parallel to the highway (which would be visible on approach to the cuttings).

Refer to Plate 4.1 for examples of drainage structures, which indicate the need for careful integration with the surrounding landscape forms and visual character and emphasise the need for quality design outcomes to improve performance.

For a detailed discussion of Water and sediment control measures refer to the Erosion and Sedimentation Management Report (Soil Conservation Services) and the Operational Water Quality Report (SKM 2013).
Insufficient rock protection at base of swale

Described channels with insufficient roughening have a greater visual impact

Concrete lined channels with insufficient roughening have a reduced visual impact

Rock lined and vegetated channels have a reduced visual impact

Highway above existing ground, requiring the road to be elevated.

Areas with sensitive existing site conditions (vegetation, drainage lines, heritage items etc) that require preservation.

Areas where the existing terrain is very steep.

Areas with less sensitive site conditions, where change can be accommodated.

Areas where the underlying geology would be self-supporting (possibly with some stabilisation) after excavation.

Areas where the underlying geology would be self-supporting (possibly with some stabilisation) after excavation.

Areas where the underlying geology would be self-supporting (possibly with some stabilisation) after excavation.

Highway below existing ground, requiring excavation.

Areas where the underlying geology would be self-supporting (possibly with some stabilisation) after excavation.

Areas where the underlying geology would be self-supporting (possibly with some stabilisation) after excavation.

Retaining wall *

Bridge *

Fill embankment, 2H:1V and revegetate

Natural rock cutting at steepest possible grade (0.75H:1V)

Layback cutting to flatter grade (2H:1V) and locally stabilise

Layback cutting to flatter grade (2H:1V) and revegetate

* Note: the decision to provide retaining walls or bridges would be based on a number of factors, including cost and constructibility. Generally, bridges and walls would not be employed on this proposal to address landform-only issues.

* Note: A grade of 2H:1V would be used as it is the steepest allowable in order to minimise the construction footprint. Revegetation techniques can be successfully employed at this grade.

* Note: Steepest possible grade may result in flatter grades than desired due to geotechnical concerns. Steeper grades not suitable for all rock types.

* Note: Generally, road side cuttings would remain as exposed rock with fissures and springs in-filled with either quarry rock, stabilised vegetation or shotcrete.

* Note: Retaining walls would generally only be used where the road corridor boundary is not sufficient to accommodate batter design. Walls do not form part of the current design proposal.

* Note: Retaining walls laid back to 2H:1V would be revegetated where possible, predominantly the upper slopes, to minimise long-term erosion of exposed softer rock.

Figure 4.1: Urban design elements organisational chart

Plate 4.1: Drainage elements from recent highway projects

Source: Pacific Highway Glenugie Upgrade SMM

Source: Hume Highway Woomargama Bypass SMM

Source: Hume Highway Woomargama Bypass SMM
4.3.3 CUTTINGS

Table 4.4 provides the following recommendations are for all cuttings along the proposal.

<table>
<thead>
<tr>
<th>CUTTING ATTRIBUTE</th>
<th>RECOMMENDATION</th>
<th>RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting finish</td>
<td>¬ Where roadside cuttings are required, the natural rock surface would be maintained wherever possible. Fissures and springs are to be infilled with either quarry rock, stabilised vegetation or shotcrete. ¬ Where the cutting face needs to be stabilised, rock anchors are preferred over shotcrete as they allow the natural rock to remain visible. ¬ Soft rock or topsoil pockets would be revegetated or backfilled with quarry rock (refer Plate 4.5). ¬ The use of shotcrete is to be avoided unless absolutely necessary and its use would be limited to fissures only. Where shotcrete is required, its application is to be designed to minimise its visibility. Techniques include matching the colour and texture of the concrete to the surrounding rock, and recessing the shotcrete from the cutting face. Refer the RMS’s Shotcrete Design Guidelines. ¬ Revegetation of cut batters would be undertaken where rock is very weak or friable and likely to require substantial stabilisation. Rock surface would then be ripped and a soil medium and vegetative overlay provided (Refer Section 5 &amp; Plate 4.2).</td>
<td>¬ Maintaining the natural rock cutting face allows the geological character of the local landscape to be expressed in the highway corridor, providing a strong sense of place (refer Figure 4.2 &amp; 4.3). ¬ Exposure of rock face and use of quarry rock sourced from the site provides a consistency of rock colour (refer Figure 4.2 &amp; 4.5).</td>
</tr>
<tr>
<td>Cutting profile</td>
<td>¬ Cutting angles would be as steep as possible, while taking into account the geotechnical constraints of each particular cutting location (refer Figures 4.2 &amp; 4.3). This has resulted in the removal of benches from the proposal. ¬ Tails of cuttings are to be shaped back into the existing landform and progressively laid back in order to integrate with the existing contours (refer Figure 4.4).</td>
<td>¬ Steep cutting angles would reduce the overall footprint of the cutting, which in turn would minimise impacts on the surrounding landscape. ¬ Batter rounding both over and back allows for less abrupt integration with existing landform and reduces visible impact when viewed from expected road user viewing angles.</td>
</tr>
<tr>
<td>Shoulder of cutting</td>
<td>¬ Would be rounded and revegetated where residual topsoils present (refer Figure 4.5).</td>
<td>¬ Rounding visually softens the edges of cut batters to assist with better integration with existing landform. ¬ Rounding and revegetation of cuttings would assist with integration of the cutting with the surrounding landscape.</td>
</tr>
<tr>
<td>Toe of cutting</td>
<td>¬ Wherever possible, provide space at the base of cuttings for grassing. In such cases, over-excavation is required to provide a suitable depth planting medium (refer Figures 4.2 &amp; 4.3).</td>
<td>¬ Grassing at the base of cuttings allow the cuttings to be integrated with the character of the surrounding landscape. ¬ A grassing area at the base of a cutting can also function as a space to capture any loose material that is eroded from the cutting before it reaches the road surface.</td>
</tr>
</tbody>
</table>

Batter tails and upper slopes revegetated to minimize erosion and mitigate visual impact

Softer rock batters laid back and natural rock left exposed

Grassing at base of cutting to trap loose material

Steep rock batter overlain with vegetated soil batter above

Batter rounding at ends, softens the transition back to natural landform

Quarry rock used to infill fissures and springs in the cut face

Source: Pacific Highway Glenugie Upgrade SMM

Source: Hume Highway Woomargama Bypass SMM

Plate 4.2: Partially revegetated sloped cutting

Plate 4.3: Partially revegetated steep cutting

Plate 4.4: Batter tail rounding

Plate 4.5: Cut face treatments
### 4.3.4 EMBANKMENTS

Table 4.5 provides the following recommendations are for all embankments along the proposal.

#### Table 4.5: RECOMMENDATIONS FOR EMBANKMENTS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>RECOMMENDATION</th>
<th>RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally</td>
<td>- Reduce footprint by steepening fill batters to maximum grade of 2H:1V.</td>
<td>- In open areas, limit tree planting to clusters to ensure vistas are maintained through to the broader landscape.</td>
</tr>
<tr>
<td></td>
<td>- Revegetate with applied topsoil and either mulched planting or hydroseeding.</td>
<td>- Views from the road improve the driving experience, sense of place and orientation.</td>
</tr>
<tr>
<td></td>
<td>- In open areas, limit tree planting to clusters to ensure vistas are maintained through to the broader landscape.</td>
<td>- Views of the road can be improved where the embankments are integrated with the existing landscape through shaping and revegetation.</td>
</tr>
<tr>
<td></td>
<td>- Views of the road can be improved where the embankments are integrated with the existing landscape through shaping and revegetation.</td>
<td>- Minimising the physical footprint of the highway reduces the need for clearing of native vegetation in bushland areas.</td>
</tr>
<tr>
<td></td>
<td>- Minimising the physical footprint of the highway reduces the need for clearing of native vegetation in bushland areas.</td>
<td>- Revegetation of embankments allows for better integration of the embankments with the character of the surrounding landscape.</td>
</tr>
<tr>
<td>In bushland areas</td>
<td>- Minimise the loss of bushland by steepening fill batters to maximum grade of 2H:1V.</td>
<td>- Minimising the physical footprint of the highway reduces the need for clearing of native vegetation in bushland areas.</td>
</tr>
<tr>
<td></td>
<td>- Application of Bushland Reconstruction technique utilising seed material embedded in existing topsoil, mulched tree material including seed, shredded trunk and branch material for stabilisation and soil ameliorants.</td>
<td>- Revegetation of embankments allows for better integration of the embankments with the character of the surrounding landscape.</td>
</tr>
<tr>
<td>Outside of bushland areas</td>
<td>The response would depend on the specific landscape characteristics of each embankment location of the proposal. Nonetheless, in all cases embankments would be vegetated using planting that corresponds to the adjoining landscape.</td>
<td>- Minimising the physical footprint of the highway reduces impacts on adjacent landscape.</td>
</tr>
<tr>
<td></td>
<td>- Where the existing landform is relatively flat and space permits, provide a flatter embankment profile (eg. 4H:1V) to better fit with the surrounding landform.</td>
<td>- Where views of highway seen as substantial, flattening of batters would assist with visual mitigation.</td>
</tr>
<tr>
<td></td>
<td>- Where the existing landform is steep or where space is limited, provide steeper embankments to minimise extent.</td>
<td>- Where views of highway seen as substantial, flattening of batters would assist with visual mitigation.</td>
</tr>
<tr>
<td></td>
<td>- In all cases a minimum angle of 2H:1V is preferred to facilitate planting.</td>
<td>- Where views of highway seen as substantial, flattening of batters would assist with visual mitigation.</td>
</tr>
<tr>
<td>In agricultural areas</td>
<td>- Minimise the loss of arable and scenic land by steepening fill batters to maximum grade of 2H:1V.</td>
<td>- Arable land close to settlements is highly valued.</td>
</tr>
<tr>
<td></td>
<td>- It may prove beneficial to flatten out batters on the western side of the Dignams Creek valley in order to integrate with localised land forms. This requires a detailed analysis in future stages.</td>
<td>- Cultural views associated with rural settlements provide a 'sense of place.'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Revegetation (grassing) of embankments would allow for better integration of the embankments with the character of the surrounding landscape, particularly where outside of the road corridor boundary fence.</td>
</tr>
</tbody>
</table>
4.3.5 MAJOR STRUCTURES

Bridges

The concept design for the proposal includes one highway bridge over Dignams Creek. Table 4.6 summarises the urban design outcomes for the bridge. The bridge drawings (refer Figure 4.2) summarise the approach taken to bridge design.

Simple, streamlined concrete parapets with no vertical articulation would be adopted for the bridge. The parapets would incorporate twin rail barriers and panels with subtly expressed vertical joints. Consistency in the detailing of the parapets and railings with the nearby upgrade at Victoria Creek, provides continuity in the regional road journey.

Piers would consist of a reinforced concrete pier and headstock substructure with tapering of headstock ends. Care would be taken to retain existing creek inverts through careful construction management (refer Plate 4.6).

The twin rail barriers reduce the visual ‘bulk’ of the bridges when viewed from their surroundings. They also allow for views out from the bridges to the surrounding landscape, which provides a sense of connection to the local area when travelling along the highway (refer Plate 4.7).

Table 4.4: RECOMMENDATIONS FOR BRIDGES

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>CHAINAGE</th>
<th>DESCRIPTION</th>
<th>LENGTH (M)</th>
<th>SPANS</th>
<th>HEIGHT (M) APPROX</th>
<th>GIRDERS</th>
<th>PIER TYPE</th>
<th>ABUTMENTS &amp; CURTILAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR01</td>
<td>95,832.000 -</td>
<td>Bridge over</td>
<td>91</td>
<td>3</td>
<td>3</td>
<td>Super T</td>
<td>Concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>95,923.000</td>
<td>Dignams Creek</td>
<td>1,200mm</td>
<td></td>
<td></td>
<td>column and headstock</td>
<td>pier</td>
<td></td>
</tr>
</tbody>
</table>

FURTHER URBAN DESIGN RECOMMENDATIONS TO BE CONSIDERED FURTHER DURING DETAILED DESIGN DEVELOPMENT

¬ The pier and headstock arrangement of this bridge type is less critical from a visual perspective, as only the adjacent local property owner would view the bridge structure.
¬ Headstock tapering would reduce the visual bulk of the headstocks (only applied where visible to the proposal or local roads).
¬ Column piers would maximise light penetration to the undercroft of the bridge and are more difficult to vandalise than blade piers due to reduced surface area.
¬ Structural elements would be designed in such a way to allow other functions to occur, such as fauna passage and would minimise disturbance to the creek invert due to the smaller footprint and ease of construction.

Plate 4.6: Retention of existing creek invert and scour protection provided on abutments.
Plate 4.7: Typical highway bridge responding to curvature of highway alignment. Open rail allow views.
Bridge elevation (BR01) - looking east

Preferred option - Voided pier improves light penetration to undercroft

Preferred option - Open pier allows light penetration to undercroft

NOTE: These drawings illustrate the urban design recommendations to be considered further during detailed design development. Refer to the structural concept design reports for the individual bridges for more detailed discussion of bridge options and drawings of the bridge designs.

Figure 4.2: Proposed Dignams Creek bridge design (Pier options 1 & 2) - looking south

Source: SMM
### 4.3.6 ROADSIDE FURNITURE

Roadside furniture elements are ancillary items necessary for the effective operation of the highway. These include roadside safety barriers and kerbs (refer Plate 4.7). Urban design recommendations are provided for these roadside elements as they can contribute positively to the character of both the highway and the local landscape.

**Fauna Crossings**

Culverts, whilst also allowing drainage under the proposal, allow passage of ground dwelling animals such as flightless birds and lizards. Aerial rope-ways provide crossing points between areas of existing vegetation that have been identified as habitat and/or movement corridors.

**Headlight Glare Attenuation**

Headlight glare requires mitigation in certain circumstances to reduce light glare to oncoming traffic, local residents and other sensitive receivers. Screen planting would be provided in several locations in order to mitigate headlight glare.

**Safety Barriers**

Safety barriers along the road side generally would consist of ‘W’ beam guard rails, as verge width is limited. Other barriers include Monowills steel tube barriers where pedestrian or maintenance staff safety is a potential issue.

**Fencing**

Fencing on the proposal consists of road corridor boundary fencing and fauna fencing. To minimise fencing requirements a combined boundary/ fauna fence would be employed in some locations. The design of the fence would be finalised in the detailed design stage and would be subject to approval by relevant authorities.

Locations for these elements would be finalised during the detailed design stage. Urban design recommendations for roadside furniture elements are provided in Table 4.5.

A detailed description of roadside furniture requirements can be found in the Princes Highway Deviation, Dignams Creek Stage I Concept Design Report (2013).

### Table 4.5: RECOMMENDATIONS FOR ROADSIDE FURNITURE ELEMENTS

<table>
<thead>
<tr>
<th>ROAD ELEMENT</th>
<th>LOCATION</th>
<th>RECOMMENDATION</th>
<th>RATIONALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAUNA CROSSINGS</td>
<td>All locations</td>
<td>Fauna crossings are generally to be located under bridges and in culverts under the highway.</td>
<td>Avoid the physical and visual intrusion of road-related elements on the local landscape.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fauna crossings in culverts under the highway would have planting at either end of the culvert.</td>
<td>Integrate the fauna crossing into the surrounding landscape, and to provide some protection for fauna entering and exiting the culvert.</td>
</tr>
<tr>
<td>HEADLIGHT GLARE ATTENUATION</td>
<td>All locations</td>
<td>Avoid use of concrete barriers or solid fencing as glare reduction, particularly in prominent locations and intersections.</td>
<td>Avoid the physical and visual intrusion of road-related elements on the local landscape.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landscape mounding to be planted to integrate with the surrounding landscape.</td>
<td>Landscape mounding integrates with the surrounding landscape treatments.</td>
</tr>
<tr>
<td>SAFETY BARRIERS</td>
<td>All locations</td>
<td>The preferred type of road safety barrier depends on the location.</td>
<td>Allow for visual connections from the highway to the local landscape, to avoid the creation of an anonymous motoring experience.</td>
</tr>
<tr>
<td></td>
<td>Adjacent to bridge abutments</td>
<td>A combination of ‘Type F’ concrete barriers and ‘W beam’ guard rails would be used depending on the location, type of bridge and hazard.</td>
<td>Consistency with other sections of the Princes Highway in this region.</td>
</tr>
<tr>
<td></td>
<td>At the top of fill embankments and other roadside situations</td>
<td>‘W beam’ guard rail would be employed due to spatial constraints and safety requirements.</td>
<td>Facilitate views from the highway to the surrounding landscape, to provide a sense of connection to the local area.</td>
</tr>
<tr>
<td>FENCING</td>
<td>Boundary</td>
<td>Combine standard RMS boundary fencing and fauna fencing where required.</td>
<td>Combination fencing avoids doubling up of fence types, which is both costly and visually intrusive for the proposal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In cut batters, locate fences in higher tiers</td>
<td>Care needs to be taken in fauna fencing design to ensure that harm to specific fauna species is minimised.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fence type finishes would be dark in preference to galvanised finishes where visible from the road.</td>
<td>Locate in upper tiers of cut batters to reduce visibility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark colours used in order to reduce visual visibility.</td>
<td></td>
</tr>
</tbody>
</table>
4.4 URBAN DESIGN AND LANDSCAPE STRATEGY PLAN

The following drawings represent the urban design landscape strategy plan design intent for the proposal through the various revegetation methodologies. A key plan (refer Figure 4.3) shows the two main sections that are illustrated in more detail on the following pages (refer Figure 4.4 and Figure 4.5).
Figure 4.4: Urban design and landscape strategy plan (1 of 2)

Source: SMM.
Figure 4.5: Urban design and landscape strategy plan (2 of 2)

Source: SMM.
5 LANDSCAPE DESIGN STRATEGY

5.1 Landscape Design Approach 36
5.2 Urban Design & Landscape Concept Plan 38
5.1 LANDSCAPE DESIGN APPROACH

5.1.1 OVERVIEW

Highway planting and revegetation aims to integrate the proposal with the surrounding landscape, thereby assisting to minimise the potential visual and ecological impact of the new works. Refer Table 5.1 for a summary of the urban design principles that relate to planting design.

The general approach to the planting design is to provide a well vegetated road corridor that aims to integrate the highway with the surrounding landscape and provide motorists with a sense of place along the highway journey. In order to achieve this, the planting must strike a balance between screening the highway from the sensitive views from surrounding areas and maintaining key views from the highway to the surrounding landscape.

The planting and revegetation design also aims to minimise the potential ecological impacts of the proposal by stabilising earthworks to prevent erosion, and reinforce existing habitats and ecological corridors through species selection. Several different techniques have been developed to achieve these goals. Techniques employed would be based on landscape context and the best and most efficient methodologies, for a summary of the urban ecological impact of the new works. Refer Table 5.1 for a summary of the urban landscape revegetation works.

5.1.2 LANDSCAPE STRATEGY

The planting concept has been guided by the following design principles:

• Revegetation of all areas affected by highway construction work.
• Revegetation of residual land affected by the proposal that is not viable for re-sale. The type of revegetation would be determined by a combination of surrounding landscape character eg, rural as well proximity to existing ecological habitats and wildlife corridors.
• Use of bush reconstruction and regeneration as a revegetation technique for off-line sections of highway that pass through dense bushland.
• Revegetation of outside verges wherever possible to minimise the visual scale of the highway, and of roadside cuttings and retaining walls.
• Revegetation of fill embankments and shallow cut batters to stabilise the earthworks, minimise their visual impact and integrate them with the character of the surrounding landscape.
• Provision of planting and revegetation to screen the highway from sensitive adjacent land uses.
• Limited use of ‘feature’ planting at key intersections and important cultural areas along the highway to provide visual landmarks and enhance local identity.
• Use of provenance plant material (plants grown from locally collected seeds) wherever possible.

5.1.3 IMPLEMENTATION METHODS

The proposal would be broken up into three main landscape implementation methodologies, (refer Figure 5.2) these are:

• Planting.
• Revegetation (Seeding applications).
• Bushland reconstruction.

Planting

Planting may be undertaken on some cut and fill batters, in feature areas adjacent to intersections and potentially in areas outside of the road corridor to mitigate headlight glare. Other areas to be planted include areas adjacent to culverts and other fauna crossing structures. All planted areas would be mulched with hardwood mulch sourced from site.

Revegetation/ Seeding

Seeding would be undertaken utilising a combination of techniques, as follows:

• Cover crop - Hydroseeding.
• Native seed - Hydroseeding & Direct Drill Seeding.

Bushland Reconstruction

The proposal, particularly south of the Dignams Creek Road intersection through the Gulaga and Kooralbyn National Parks, presents an opportunity to work with natural forest ecosystem processes. The enclosed nature of the forest ensures an abundance of local seed allowing for native forest regeneration and establishment to occur naturally. There is also an availability of mulch material from clearing operations that can be used for soil erosion, sediment and weed control and landscape revegetation works.

Table 5.1: REVEGETATION URBAN DESIGN PRINCIPLES

<table>
<thead>
<tr>
<th>URBAN DESIGN PRINCIPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2. Design the highway to be physically and visually integrated with the surrounding landscape.</td>
</tr>
<tr>
<td>B3. Minimise the physical and visual intrusion of road-related elements (such as noise walls and water quality control measures) on the local landscape.</td>
</tr>
<tr>
<td>C3. Avoid the introduction of environmental weeds.</td>
</tr>
<tr>
<td>C6. Maintain the integrity of endemic plant communities and topsoils.</td>
</tr>
<tr>
<td>C7. Maintain the ecological functionality and long-term sustainability of revegetated areas.</td>
</tr>
<tr>
<td>F2. Minimise the visual scale of the highway from the motorist’s perspective.</td>
</tr>
<tr>
<td>F3. Maximise the motorist’s experience of and visual connection to, the surrounding natural and cultural landscapes.</td>
</tr>
<tr>
<td>F4. Retain, and where possible improve, regional views and views to important landmarks.</td>
</tr>
<tr>
<td>G1. Avoid the use of token “gateway” statements. Instead, utilise unique features of the local area and functional elements of the highway as visual markers and experiences that provide a sense of arrival or sense of place along the highway journey.</td>
</tr>
</tbody>
</table>

Plate 5.1: Bushland reconstruction areas with regrowth in progress after approximately 18 months.
## 5.1.4 Revegetation Summary

Table 5.2 summarises the revegetation methods for the proposal.

<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>LOCATION OF USE</th>
<th>DOCUMENTATION</th>
<th>OPPORTUNITIES</th>
<th>CONSTRAINTS</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeding: Native shrub and grass seeding.</td>
<td>Online sections of the proposal where the proposal passing through agricultural areas.</td>
<td>Standard RMS specifications (R176 Seed procurement, R179 Vegetation).</td>
<td>Cost-effective broad-scale solution utilising endemic seed material sourced from the local region.</td>
<td>Limited control over where specific species germinate.</td>
<td>Where communities share similar species and structural composition they have been merged. This is proposed in order to enable a more legible approach to revegetation.</td>
</tr>
<tr>
<td></td>
<td>Cut batters where bushland reconstruction not suitable and hard rock not encountered.</td>
<td></td>
<td>Provides better long-term outcome than planting as seedlings develop faster.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Verge generally.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Offline sections of the proposal or where the proposal passing through agricultural areas.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting: Native tree and shrub planting.</td>
<td>Feature locations (interchanges, roundabouts etc) and areas where seeding or bushland reconstruction not suitable.</td>
<td>Standard RMS specifications (R179 Planting).</td>
<td>Allows detailed locating of species to provide specific functions.</td>
<td>Expensive in relation to other techniques.</td>
<td>Tree and shrub species selections would be based on suitability to location as a priority to relationship to vegetation community origin.</td>
</tr>
<tr>
<td></td>
<td>Cut and fill batters where bushland reconstruction method not suitable and hard rock not encountered.</td>
<td></td>
<td>Ensures Frangible/non-frangible* species are planted in appropriate locations.</td>
<td>Generally slower performance (with regards to larger pot sizes).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not to be used where sightlines impeded or within clear zones.</td>
<td></td>
<td>Promotes day-1/short term impact.</td>
<td>Spacing/density controlled by available budget.</td>
<td></td>
</tr>
<tr>
<td>Bushland reconstruction: involving the stockpiling and reuse of local topsoil combined with forest mulch containing seed.</td>
<td>Offline sections of the proposal passing through or immediately adjacent to dense bushland and unlikely to contain weeds.</td>
<td>Modification of standard RMS specifications.</td>
<td>Extremely cost-effective broad-scale solution utilising combination of endemic topsoil, seed and mulch material sourced from the local region.</td>
<td>Successful outcomes depend largely on contractor education and buy-in; this needs to be driven from the outset.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Generally not to be used or clear zones.</td>
<td>Pacific Highway Glenugie Upgrade and Hunter Expressway precedents.</td>
<td>Provides best erosion-resistant outcome due to media composition.</td>
<td>Short-term appearance considered unsightly to general public.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No species lists required as based on seed content of local topsoil and mulch.</td>
<td>Refer species lists for likely species.</td>
<td>Long-term benefits due to substantially reduced maintenance requirements.</td>
<td>Difficult to determine which areas are performing initially.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refer species lists for indicative species.</td>
<td></td>
<td></td>
<td>Agency and general public expectations need to be carefully managed through consultation and education.</td>
<td></td>
</tr>
</tbody>
</table>
5.2 URBAN DESIGN & LANDSCAPE CONCEPT PLAN

5.1.5 URBAN DESIGN AND LANDSCAPE CONCEPT PLAN

The following drawings represent the urban design and landscape concept plan for the proposal through the various revegetation methodologies. A key plan (refer Figure 5.1) shows the five main sections that are illustrated in more detail on the following pages (refer Figures 5.2 - 5.6.)

![Concept key plan](image-url)
Figure 5.2: Urban design and landscape concept plan (1 of 5)

Source: SMM.
Figure 5.3: Urban design and landscape concept plan (2 of 5)

Source: SMM.

PRINCES HIGHWAY UPGRADE | DIGNAMS CREEK | URBAN DESIGN REPORT AND LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT - FINAL REPORT
Figure 5.4: Urban design and landscape concept plan (3 of 5)

Source: SMM.
Figure 5.5: Urban design and landscape concept plan (4 of 5)

Source: SMM.
Figure 5.6: Urban design and landscape concept plan (5 of 5)

Source: SMM.