Transport Roads & Maritime Services

NSW GOVERNMENT

Burrill Lake Bridge

Preliminary Environmental Investigations

APRIL 2013

RMS 13.292 ISBN 978-922245-45-8

This Report has been prepared by GHD for Roads and Maritime Services (RMS) and may only be used and relied on by RMS for the purpose agreed between GHD and RMS as set out in Section 1.3 of this Report.

GHD otherwise disclaims responsibility to any person other than RMS arising in connection with this Report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in the Report and are subject to the scope limitations set out in the Report.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described in this Report. GHD disclaims liability arising from any of the assumptions being incorrect.

Contents

Table Index

Figure Index

Appendices

1. Introduction

1.1 Introduction

Roads and Maritime Services (RMS) is investigating options for the future of the Burrill Lake Bridge which is located over Burrill Lake on the Princes Highway south of Ulladulla. The bridge is a key link on the southeast transport route along the Princes Highway. The bridge comprises a combination of a 55 metre bridge and causeway about 200 metres in length.

At 55 years, the bridge is half-way through a 100 year design life. The bridge piles have experienced cracking and deterioration of concrete due to the bridge's location in a saline environment. This has the potential to compromise the structural integrity of the bridge. It is expected that the bridge would require either replacement or substantial maintenance within the next 10 years to retain its functionality (RTA, 2010).

Burrill Lake Bridge is located in the City of Shoalhaven local government area (LGA) on the New South Wales south coast, about 230 kilometres south of Sydney, and six kilometres south of Ulladulla (see Figure 1-1).

The study area has been identified by RMS as a critical connection to the existing highway and the future Milton Ulladulla Bypass. The study area is shown in Figure 1-2, and is bounded by:

- Burrill Lake to the north of the bridge.
- Residential properties on the eastern foreshore of Burrill Lake.
- Commercial businesses adjacent to the Princes Highway along the eastern approach to the bridge.
- Burrill Lake to the south of the bridge, and the Burrill Lake inlet south of the study area.
- Lions Park on the western foreshore of Burrill Lake.
- Commercial and residential properties adjacent to the Princes Highway along the western foreshore of Burrill Lake.

Further details of the study area are provided in Section 2.

This environmental investigations report has been prepared by GHD Pty Ltd (GHD) on behalf of RMS Infrastructure, Southern Region. The purpose of the environmental investigations report is to identify potential opportunities and environmental constraints that may influence the development of design options for the upgrade of Burrill Lake Bridge.

LEGEND

Study area

0 0.5 1 2 3

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number 21-21478
Revision 0
Date 09 May 2013

Site locality

Figure 1-1

N:\AU\Sydney\Projects\21\21478\GIS\Maps\23_21478_Z003_Locality_Rev0.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011; Google image Jan 2011. Created by: qjchung

0 30 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Study area

GHD

CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number	21-21478
Revision	0
Date	28 Nov 2012

The study area

Figure 1-2

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

1.2 Strategic need for the investigations

The Princes Highway is the major road linking Sydney, Melbourne and Adelaide along the coast of New South Wales, Victoria and South Australia. The highway is subject to relatively high traffic volumes including local, commercial and freight traffic and seasonal increases in recreational and tourist traffic. The section of the Princes Highway at Burrill Lake is used as both a local and regional road. A 2006 traffic count 1.5 kilometres south of Burrill Lake showed an increase in annual average daily traffic (AADT) data to 6144 vehicles from 5603 vehicles in 2001. A traffic count on the Princes Highway (GHD, 2012), 100 metres east of the Burrill Lake Bridge between 21 May and 4 June 2012, indicated average vehicle movements of 8045 in week 1, and 7633 movements in week 2. The 2012 traffic counts indicated a substantial increase in traffic growth in the area (about 24 to 30 per cent between 2006 and 2012) which is inconsistent with the long term growth shown over the successive years. This could be due to an increase in nearby activity (such as RMS rehabilitation works about two kilometres south of the study area). RMS is proposing to undertake additional traffic counts and investigations during the design phase to verify vehicle numbers and assist with options development.

The current bridge structure was designed in 1956 and built in 1958. The bridge is 54.85 metres long and consists of six precast concrete spans, each 9.14 metres long, supported by seven piers within Burrill Lake.

At 55 years, the bridge is half way through its 100 year design life. It has been identified that the original design loading does not meet the current Australian Standard AS5100: Cracking and deterioration of concrete piles, partially due to exposure to the saline environment of the estuary, has also significantly reduced the load capacity of the bridge and ongoing deterioration could ultimately lead to structural failure of the piles. An investigation into the structure of the bridge in 2002 identified that the bridge would need upgrading and suggested alternative temporary measures that could be considered. In 2003 temporary brackets were installed on the bridge as a safety precaution. In addition to the above, the lane and shoulder width of the existing bridge does not meet current design standards.

The upgrading of the Burrill Lake Bridge is required due to the degradation of the existing bridge substructure and to ensure safety for users of the bridge. Upgrading of the existing bridge would provide for a safe crossing of Burrill Lake along the Princes Highway for all motorists, cyclists and pedestrians.

1.2.1 Relevant strategies and plans

NSW 2021

NSW 2021: A plan to make NSW number 1 (NSW 2021) (NSW Government, 2011a) is a 10 year plan that provides goals and targets to rebuild the economy, provide quality services, renovate infrastructure, restore government accountability, and strengthen the local environment and communities. It replaces the NSW State Plan as the NSW Government's strategic business plan, setting priorities for action and guiding resource allocation. *NSW 2021* lists a number of goals to achieve five strategies including 'return

quality services' and 'renovate infrastructure'. Relevant goals within these strategies areas include:

- Improve road safety.
- Invest in critical infrastructure.
- Protect our natural environment.

Any proposal to upgrade or replace Burrill Lake Bridge would assist in meeting the 'improve road safety' goal by providing a safe crossing over Burrill Lake along the Princes Highway for all motorists, cyclists and pedestrians. The proposal would provide critical infrastructure which allows for future traffic increase along the Princes Highway, and would support the proposed Milton Ulladulla Bypass. This Environmental Investigation has identified constraints in the study area, which would be taken into consideration in options development. The preferred option would be subject to further environmental assessment and would include measures to protect the natural environmental during construction and operation.

Any upgrade proposal would therefore be consistent with *NSW 2021*.

South Coast Regional Strategy 2006-2031

The *South Coast Regional Strategy* (Department of Planning, 2007) sets out land use plans for the South Coast and includes the Shoalhaven, Eurobodalla and Bega Valley LGAs.

The strategy identifies the Princes Highway as regionally significant infrastructure. It further notes that there are transport and accessibility limitations in the South Coast region due to the dispersed settlement pattern and lack of rail lines south of Bomaderry. The Princes Highway is acknowledged as very important in connecting communities, supporting economic development and linking to neighbouring regions.

Any proposal to upgrade or replace Burrill Lake Bridge would be consistent with the South Coast Regional Strategy as it would upgrade the Princes Highway, an important transport route in the region, and would continue to connect communities and link neighbouring regions. By improving land transport to the region, including freight, any upgrade proposal would also support the region's economic development.

NSW Long Term Transport Master Plan

The NSW Government released the Long Term Transport Master Plan (NSW Government, 2012) on 13 December 2012. The Master Plan sets a clear direction for transport in NSW for the next 20 years, bringing together all modes of transport, across all regions of the state into a world class, integrated network that puts the customer first.

The Master Plan was developed as a result of detailed technical analysis, research and extensive consultation with the people of NSW, key stakeholders, experts and customers. It contains a number of major projects which have both funding and delivery timeframes.

The Princes Highway is identified by the plan as one of the roads necessary for regional access. The Illawarra region is expected to experience population growth and demographic change. Links between Sydney and the Illawarra region are required to support population growth and tourism. The Princes Highway upgrade and the construction of bypasses will assist travel between Sydney and the Illawarra region.

The plan includes a number of State-wide challenges to be addressed within the next 20 years including:

- Stepping up efforts to provide safe travel options and networks for car or heavy vehicle drivers, passengers, pedestrians, cyclists, motorcyclists and waterway users.
- Promoting sustainability and protecting the environment in our transport planning, decisions and projects.

Works to upgrade the Burrill Lake Bridge would assist in creating a safer travel network for motorists, cyclists and pedestrians. The preferred option would be subject to further environmental assessment and would include providing measures to protect the natural environmental during construction and operation.

State Infrastructure Strategy 2012 - 2032

The State Infrastructure Strategy (Infrastructure NSW, 2012) assesses the current state of infrastructure and identifies strategic priorities. The strategy is independent advice to the Government on the specific infrastructure investments and reforms recommended to make NSW number one. The strategy addresses a broad range of sectors and identifies specific projects and programs for priority consideration. The strategy also recommends ways to fund these projects.

The strategy is separated into three areas: Global Sydney, Greater Sydney and Regional NSW. The study area falls within Regional NSW. The following are the predicted trends for Regional NSW as identified in the strategy:

- Population is expected to grow by 0.7 per cent annually.
- Coastal areas are expected to grow faster than the inland areas due to resource endowments and the impact of the sea change and tree change phenomenon.
- Around 7.5 million trips are made daily. Connecting people efficiently is central to the economic and social well-being of regional communities, businesses and individuals.
- The road network is vital to connecting regional people to employment, services and amenities. A total of nine out of 10 regional passenger trips are by car. Travel patterns are not expected to change over the next 20 years.
- Freight demand is forecast to grow more rapidly than passenger demand. Over the next 20 years the volume of freight being moved in NSW is expected almost to double.

The Burrill Lake Bridge is vital infrastructure for freight movement and tourists. Any proposal to upgrade or replace Burrill Lake Bridge would assist efficient traffic movements along the Princes Highway. This would ultimately support population

growth in Regional NSW, provide safer road infrastructure for efficient freight movements along the South Coast, and provide a safer travel network for motorists, cyclists and pedestrians.

1.3 Purpose and structure of the environmental investigations report

1.3.1 Purpose of the environmental investigation

The purpose of the environmental investigations report is to identify potential environmental opportunities and constraints that may influence the development of design options for the upgrade of Burrill Lake Bridge. These have been mapped and are discussed within Section 5.

Once a preferred option has been chosen and a concept plan developed, a detailed environmental impact assessment would be prepared to assess the potential environmental impacts of the preferred option and would detail the environmental management measures to be implemented.

The environmental investigations process represents the integration of environmental, social and economic concerns into the RMS decision making process. Integrating environmental, social and economic concerns into development decisions is a principle of ecologically sustainable development. The 'integration principle' of ecologically sustainable development is adopted in legislation governing development approval at both the State and Australian Government level. The environmental investigations report therefore assists RMS to fulfil its objective to consider ecologically sustainable development as part of the proposal development process.

1.3.2 Scope and methodology

The scope of the environmental investigations report is to identify potential environmental opportunities and constraints within the study area.

The environmental investigations report was prepared based on:

- **Site visit** – A site visit was undertaken on 23 April 2012 to gain appreciation of the study area and potential constraints and opportunities
- **Desktop assessments –** Desktop assessments generally investigated the study area and the immediate surrounds. Copies of search results are included in the specialist study reports. Databases and records accessed included:
  - NSW Wildlife Atlas database, 9 May 2012.
  - Protected Matters Online Search Tool for matters of national environmental significance (MNES), 9 May 2012.
  - Department of Primary Industries Threatened Species Records Viewer, 9 May 2012.
  - Office of Environment and Heritage (OEH) BioBanking Threatened Species Profile Database, 9 May 2012.

  - Vegetation mapping of the region (Tozer et al. 2010), 9 May 2012.
  - OEH Aboriginal Heritage Information Management System (AHIMS), 15 May 2012.
  - Previous investigations and reports relating to the study area, 15 May 2012.
  - National heritage list, 15 May 2012.
  - State heritage register, 15 May 2012.
  - RMS Section 170 register, 15 May 2012.
  - *Shoalhaven Local Environmental Plan 1985* (LEP) and Draft *Shoalhaven Local Environmental Plan 2009* (Draft LEP), 15 May 2012.
  - Historical non-Aboriginal research, 15 May 2012.
  - OEH Contaminated Land Record, 20 April 2012.
  - List of contaminated sites notified to the Environment Protection Authority (EPA), 20 April 2012.
  - National Pollutant Inventory, 29 June 2012.
- **Specialist investigations** – Specialist investigations were undertaken for:
  - Biodiversity – refer to Appendix A.
  - Hydrology and geomorphology – refer to Appendix B.
  - Aboriginal heritage – refer to Appendix C.
  - Non-Aboriginal heritage – refer to Appendix C.
  - Noise and vibration – refer to Appendix D.
  - Contamination and hydrogeology – refer to Appendix E.
  - Visual - refer to Appendix F.
  - Traffic – refer to Appendix G.

The methodologies of the specialist investigations can be found in the relevant appendices noted above.

Results of the specialist investigations have been discussed in Section 6 where potential environmental opportunities and constraints have been identified. Key constraints in the study area are summarised in Section 7 and are illustrated in Figure 7-1.

2. Study area

2.1 Location

The study area is located in the City of Shoalhaven LGA area on the New South Wales south coast, about 230 kilometres south of Sydney, 65 kilometres south of Nowra and six kilometres south of Ulladulla. The small suburb of Burrill Lake lies on the northern side of Burrill Inlet.

The study area is shown in Figure 1-2 and is bounded by:

- Burrill Lake to the north of the bridge.
- Residential properties on the eastern foreshore of Burrill Lake.
- Commercial businesses adjacent to the Princes Highway along the eastern approach to the bridge.
- Burrill Lake to the south of the bridge, and the Burrill Lake inlet around 700 metres south of the study area.
- Lions Park on the western foreshore of Burrill Lake.
- Commercial and residential properties adjacent to the Princes Highway along the western foreshore of Burrill Lake.

2.2 General description of the study area

Burrill Lake is a barrier-type estuary, formed by the drowning of a river valley following the last ice age some 6500 years ago. The lake consists of a relatively deep basin joined to the ocean by a shallow meandering inlet channel. The lake has a surface area of about four square kilometres with an entrance channel three kilometres long and between one and five hundred metres wide.

Burrill Lake is classified as an intermittently closed and opened lake or lagoon which is generally open to the sea however, displays very little tidal fluctuation. The channel is generally less than three metres in depth, with four major shoals along its length. The entrance shoal is the only active shoal. The lake has one major tributary, Stoney Creek.

The entrance to the sea is located between a rock platform at Dolphin Point and the Burrill Beach shoal (located south of the study area) resulting in a highly constricted mouth. Burrill Lake is generally open to the sea and has sufficient tidal exchange to maintain good water quality. However, it does close from time to time and can remain closed for long periods. Before 2005, it was last closed to the sea in 1987 when it remained closed for four months.

The Burrill Lake catchment covers an area of 78 square kilometres. It is largely covered by dry sclerophyll forest in the south and west (both National Park and private land) and agricultural grazing lands to the north. There are six urban areas in the catchment, including:

- Dolphin Point - south of the study area.
- Burrill Lake – east and west of the bridge.
- Bungalow Park - northwest of the study area.
- Kings Point - directly north of the study area, north of Wildflower Reserve.
- Milton - about 2.5 kilometres north of the study area.
- West Ulladulla – about four kilometres north of the study area.

Burrill Lake is surrounded by a variety of land uses, including a mix of residential, commercial and recreational (refer to Figure 6-18). Scattered patches of native vegetation occur adjacent to the Princes Highway near the bridge. Seagrass beds are present in Burrill Lake adjacent to the bridge.

Two potential archaeological deposit sites have been identified within the study area. One of these sites is located on the southern side of the eastern approach, the other on the southern side of the western approach. Aboriginal heritage is discussed in Section 6.3.

3. Background

RMS is investigating options for the potential upgrade or replacement of the Burrill Lake Bridge.

In 2010 RMS undertook a high level review of the future of Burrill Lake Bridge. This review examined engineering issues relating to the following options:

- Reinforcing the deteriorating concrete columns.
- Adding new concrete columns.
- Replacing the existing bridge between the causeway and the southern bank of the lake.
- Building a new 200 metre bridge on a new alignment.

A strategic concept and options study was prepared (Aurecon, 2010) which outlined potential engineering constraints and impacts associated with each of these options. This study did not take into consideration environmental and social constraints associated with an upgrade of the bridge.

Since completing the engineering based strategic study (Aurecon, 2010), RMS needed to gain a greater understanding of the potential environmental constraints within the study area. The scope of the current study is to investigate the potential environmental opportunities and constraints within the study area. These would then be taken into consideration during the options development phase.

Outcomes of community consultation (refer to Section 5) would also be considered in options development.

4. Planning constraints

4.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides the statutory basis for planning and environmental assessment in NSW. The Minister for Planning and Infrastructure, statutory authorities and local councils are responsible for implementing the EP&A Act. The EP&A Act provides the framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision making process.

Assessment and approvals may be carried out under various parts of the EP&A Act depending on the scale and nature of impacts of the proposal. As outlined in the following sections, the proposal may be subject to assessment under:

- Part 5 generally applies to public authorities that assess and self-determine activities that do not require approval under Part 5.1 or development consent under Part 4.
- Part 5.1 applies to State Significant Infrastructure that is approved by the Minister for Planning and Infrastructure.

Any proposal to upgrade or replace Burrill Lake Bridge would be a road infrastructure facility as defined under *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) (refer to Section 4.2.1).

As the chosen option would be for road infrastructure carried out by RMS, development consent from council is not required and would be assessed under Part 5 of the EP&A Act.

The assessment of the proposal and associated environmental impacts would be undertaken in accordance with clause 228 of the *Environmental Planning and Assessment Regulation 2000* (EP& A Regulation), the *Threatened Species Conservation Act 1995* (TSC Act), *the Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the requirements of section 111 of the EP&A Act would be considered, in that RMS examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

In assessing all matters affecting or likely to affect the environment as required under section 111 of the EP&A Act, if RMS finds that the preferred option is likely to result in a significant impact on the environment then an environmental impact statement would have to be prepared (Section 112 of the EP&A Act) and the upgrade works would be considered State significant infrastructure (Schedule 3 *State Environmental Planning Policy (State and Regional Development) 2011*). The upgrade works would then be assessed under Part 5.1 of the EP&A Act, requiring the approval of the Minister for Planning and Infrastructure.

4.2 Environmental planning instruments

The following sections outline the environmental planning instruments and environmental approval requirements that are potentially relevant to the proposal.

4.2.1 State environmental planning policies

State Environmental Planning Policy (Infrastructure) 2007

ISEPP aims to facilitate the effective delivery of infrastructure across the State.

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

As the chosen option would be for road infrastructure carried out by RMS, it may be assessed under Part 5 of the EP&A Act. If any upgrade worksare considered likely to have a significant impact it may be considered to be State significant infrastructure and assessment under Part 5.1 of the EP&A Act would be required.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities before the commencement of certain types of development. Consultation requirements under the ISEPP are discussed in Section 5.3.1.

State Environmental Planning Policy 71 – Coastal Protection

State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71) controls development within the Coastal Zone (as defined under the *Coastal Protection Act 1979*). The study area is located wholly within the Coastal Zone.

SEPP 71 applies when determining a development application for a development (refer Clause 7). Although this SEPP would not be strictly applicable to the upgrade works, as any further assessment would be undertaken under Part 5 of the EP&A Act, the intent of SEPP 71 should be considered during the environmental assessment stage of the preferred option.

Clause 8 of SEPP 71 lists the matters for consideration by a consent authority when it determines a development application under Part 4 of the EP&A Act to carry out development on any land to which this Policy applies. Table 4-1 outlines the matters for consideration under clause 8 of SEPP 71 and provides a response to each consideration.

Table 4-1 SEPP 71 matters for consideration

Matters for consideration	How addressed
(a) the aims of this Policy set out in clause 2	The options to upgrade or replace Burrill Lake Bridge are generally consistent with the aims of the policy.

Matters for consideration	How addressed
(b) existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved	The study area is not located along the coastal foreshore however the proposal would involve upgrading the Burrill Lake Bridge which is a key passenger transport corridor providing access to the south coast of NSW along the Princes Highway. Access to the lake and its foreshore would be retained where possible.
(c) opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability	The study area is not located along the coastal foreshore however the proposal would involve upgrading the Burrill Lake Bridge which is a key passenger transport corridor providing access to the south coast of NSW along the Princes Highway.
(d) the suitability of development given its type, location and design and its relationship with the surrounding area	During options development, consideration would be given to location, size, design and relationship with the surrounding area (refer to Section 6.10).
(e) any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore	The study area is not located along the coastal foreshore.
(f) the scenic qualities of the New South Wales coast, and means to protect and improve these qualities	Although the study area is located away from the coastal foreshore area, consideration would need to be given to potential impacts on the scenic qualities of the south coast. The preferred option is likely to be consistent with the existing visual landscape of an existing road corridor (refer to Section 6.10).
(g) measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats	The constraints and opportunities for ecology are considered in Section 6.1 with recommendations provided in Section 6.1.3.
(h) measures to conserve fish (within the meaning of Part 7A of the Fisheries Management Act 1994) and marine vegetation (within the meaning of that Part), and their habitats	The constraints and opportunities for fish, marine vegetation and their habitats are considered in Section 6.1 with recommendations provided in Section 6.1.3.

Matters for consideration	How addressed
(i) existing wildlife corridors and the impact of development on these corridors	Wildlife corridors are considered in Section 6.1 with recommendations provided in Section 6.1.3.
(j) the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards	The potential for impacts on coastal processes are considered minimal. These are further discussed in Section 6.2.
(k) measures to reduce the potential for conflict between land-based and water-based coastal activities	The potential for conflict between land-based and water-based coastal activities is considered minimal.
(l) measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals	Constraints and opportunities for cultural places, values, customs, beliefs and traditional knowledge of Aboriginals are considered in Sections 6.2 and 6.4. Recommendations are provided in Sections 6.3.3 and 6.4.3.
(m) likely impacts of development on the water quality of coastal waterbodies	Constraints and opportunities on the water quality of coastal waterbodies are considered in Section 6.2 with recommendations provided in Section 6.2.4.
(n) the conservation and preservation of items of heritage, archaeological or historic significance	Constraints and opportunities on items of heritage, archaeological or heritage significance are considered in Section 6.2.
(o) only in cases in which a council prepares a draft local environmental plan that applies to land to which this Policy applies, the means to encourage compact towns and cities	Not applicable.
(p) only in cases in which a development application in relation to proposed development is determined: (i) the cumulative impacts of the proposed development on the environment, and (ii) measures to ensure that water and energy usage by the proposed development is efficient.	A development application would not be required for the proposal (see Section 4.1).

State Environmental Planning Policy 14 - Coastal Wetlands

State Environmental Planning Policy 14 – Coastal Wetlands (SEPP 14) seeks to control development within coastal wetland areas for environmental and economic considerations. Any development within or near listed wetlands must be considered for the impact it might have on the environment, and whether or not the proposal is

avoidable within these areas, before consent is granted. A number of SEPP 14 coastal wetlands are associated with Burrill Lake (refer to Figure 1 in Appendix A).

The ecology assessment (attached in Appendix A) assesses ecological constraints regarding estuarine habitats associated with Burrill Lake and this is summarised in Section 6.1. All SEPP 14 wetlands associated with Burrill Lake are located over four kilometres upstream of the study area. While these are unlikely to be a constraint for the preferred option, the protection of SEPP 14 wetlands should be considered in any further impact assessment of the preferred option.

4.2.2 Local environmental plans

Shoalhaven Local Environmental Plan 1985

The study area is located within the Shoalhaven City LGA and therefore the *Shoalhaven Local Environmental Plan 1985* (Shoalhaven LEP) applies.

The provisions of the ISEPP override any development consent requirements of the Shoalhaven LEP.

Therefore development consent from Council would not be required and RMS would be the determining authority as described in Section 4.1.

Draft Shoalhaven Local Environmental Plan 2009

Shoalhaven Council has prepared a draft LEP in accordance with *Standard Instrument (Local Environmental Plans) Order 2006* and requirements set by the NSW Department of Planning & Infrastructure (DP&I). The draft LEP was exhibited in October 2011.

The provisions of the ISEPP override the consent requirements of the draft LEP. Development consent from Council would not be required and RMS would be the determining authority.

4.3 Other relevant environmental legislation

4.3.1 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists a number of threatened species, populations or ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats. If any of these could be impacted by the proposal, an Assessment of Significance that addresses the requirements of section 5A of the EP&A Act must be completed to determine the significance of the impact.

The ecology specialist investigation undertaken for this report identified threatened biota and their habitats in the study area (refer to Section 6.1). A detailed assessment of the impact of the preferred option on threatened biota and their habitats would need to be undertaken in line with the requirements described above.

4.3.2 Fisheries Management Act 1994

The objects of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. Burrill Lake is mapped as key fish habitat (DPI, 2012a).

The FM Act also lists threatened species, population and ecological communities. The ecology specialist investigation undertaken for this report, identified threatened biota listed under the FM Act that could be a potential constraint to upgrade options (refer to Appendix A and Section 6.1). Once the preferred option is determined, further survey may be required to target particular threatened species or their habitats. Any future impact assessment would need to also address section 5A of the EP&A Act and test of significance prepared if any threatened biota is likely to be affected by the preferred option.

To assist in the protection of key fish habitats, and the protection of seagrasses, the Minister for Primary Industries has gazetted the *Fish Habitat Management Plan No 1* and *Fish Management Plan No 2* respectively. These management plans would need to be considered as part of any future environmental assessment.

Under Section 199, RMS would need to notify the Minister for Primary Industries for any proposed dredging or reclamation works. If a new bridge is proposed, new piling works would be considered as dredging works. RMS is required to consider any matters raised by the minister within 28 days of notification.

Seagrass is listed as marine vegetation under the FM Act, and is located within the study area as mentioned in Section 6.1. Where the preferred option would impact seagrass, under Section 205 of the FM Act, RMS would require a permit to harm or disturb marine vegetation.

Depending on the proposed upgrade option, there may be temporary fish passage blocking during construction. Under section 219 of the Act, RMS requires a permit to create an obstruction, across or within a bay, inlet, river or creek, or across or around a flat. If the Minister for Primary Industries requests, a suitable fishway or fish by-pass, it would be included as part of the works.

4.3.3 NSW Heritage Act 1977

The *NSW Heritage Act 1977* (Heritage Act) is concerned with all aspects of heritage conservation ranging from basic protection against indiscriminate damage and demolition of buildings and sites, through to restoration and enhancement.

State significant items are listed on the NSW State Heritage Register and are given automatic protection under the Heritage Act against any activities that may damage an item or affect heritage significance.

No State Heritage Items or items subject to an interim heritage order have been identified in the study area. Therefore an approval under section 57 or 60 would not be required.

Under section 139 of the Heritage Act, approval from the NSW Heritage Council is required prior to the disturbance or excavation of land if a proposal would, or is likely to result in, disturbance to a relic.

Further heritage assessment is recommended to be undertaken as part of the environmental assessment of the preferred option (refer to Section 6.4). This would determine the need for an excavation permit.

4.3.4 National Parks & Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides the basis for legal protection and management of Aboriginal sites within NSW, and for the management of National Parks estate.

Part 6 of the Act provides provisions for the protection and management of Aboriginal sites. Implementation of the Aboriginal heritage provisions in the Act is the responsibility of the OEH.

All Aboriginal sites and objects, other than those made for sale, are protected under the NPW Act.

Under the NPW Act, it is an offence to:

- Knowingly harm or desecrate an Aboriginal object.
- Harm or desecrate an Aboriginal object or Aboriginal place.

Section 87 provides the following defences against prosecution of harm to Aboriginal objects:

- The harm or desecration concerned was authorised by an Aboriginal heritage impact permit (AHIP) and the conditions to which that AHIP was subject were not contravened.
- If due diligence was exercised to determine whether the proposal would harm an Aboriginal object and reasonably determined that no Aboriginal object would be harmed.

The study area is not located within or adjacent to land reserved under the NP&W Act. The implication of the NPW Act for the study area is that any item found to be of Aboriginal heritage significance is protected from direct harm, or harm to its heritage significance. Two potential archaeological deposits (PAD) sites are located within the study area. Once a preferred option is selected, there may be potential impacts to items of Aboriginal significance. Further assessment would be in accordance with DECCWs *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*.

4.3.5 Water Management Act 2000

The *Water Management Act 2000* (WM Act) controls the extraction and use of water, the construction of works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. ‘Water sources’ are defined very broadly and include

any river, lake, estuary, place where water occurs naturally on or below the surface of the ground and NSW coastal waters.

A controlled activity approval under the WM Act is required for certain types of developments and activities that are carried out in or near a river, lake or estuary. However under clause 38 of the *Water Management (General) Regulations 2011,* a public authority is exempt from these requirements. RMS is therefore exempt from these requirements.

Depending on the chosen upgrade option, groundwater may be intercepted during construction. If groundwater extraction/interference is required, an aquifer interference approval would be required for the work under clause 91(3) of the Water Management Act 2000.

4.4 Commonwealth legislation

4.4.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage matters of national environmental significance.

Under the Act a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land'. The matters of national environmental significance are:

- World Heritage properties.
- National Heritage places.
- RAMSAR wetlands.
- Listed threatened species and ecological communities.
- Listed migratory species.
- Commonwealth marine areas.
- Nuclear actions.
- Great Barrier Reef Marine Park.

The EPBC Act has been addressed in the current investigation through identifying threatened biota listed under the Act that could be a potential constraint to the upgrade options. No threatened biota listed under the EPBC Act was present within the study area. There is a high probability that three EPBC Act listed species may be present within the study area, including *Cryptostylis hunteriana* (Leafless Tongue, Orchid), *Genoplesium vernale* (East Lynne Midge-Orchid) and *Pandion cristatus* (Eastern Osprey). These are discussed in Section 6.1.2 and Appendix A. Once the preferred option is determined, further survey may be required to target particular threatened or migratory biota or their habitats. If the preferred option is likely to impact a MNES,

assessments of significance would be required, and the preferred option may need to be referred to the Commonwealth for determination.

4.5 Summary of potential approvals, licences and permits

Table 4-2 outlines the environmental legislation and approvals potentially relevant to the upgrade options.

Table 4-2 Potential relevant legislation and approvals

Applicable legislation	Approvals or requirements	Relevance
Environmental Planning and Assessment Act 1979	Approval under Part 5 of the EP&A Act	In accordance with the provisions of ISEPP, development consent from council would not be required for works on a road if carried out by RMS, and, therefore future upgrade works can be assessed under Part 5 of the EP&A Act.
	Approval under Part 5.1 of the EP&A Act	Where it is considered that proposed upgrade works are likely to result in a significant impact on the environment then the proposed works would be required to be assessed under Part 5.1 of the EP&A Act. Under Part 5.1 of the EP&A Act an environmental impact statement would need to be prepared and approval sought from the Minister for Planning and Infrastructure.

Applicable legislation	Approvals or requirements	Relevance
Ecology		
Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*	Assessment of significance for impact on threatened biota. Approval to carry out a 'controlled action', which is an action likely to have a significant impact on a 'matter of national environmental significance' or Commonwealth land.	Any impact on flora listed under the EPBC Act (a matter of environmental significance) would require a referral to the Minister for Sustainability, Environment, Water, Population and Communities to determine if approval under the EPBC Act is required. If the preferred option is likely to impact a MNES, assessments of significance would be required, and the preferred option may need to be referred to the Commonwealth for determination.
Threatened Species Conservation Act 1995	Assessment of significance for impact on threatened biota, addressing requirements of section 5A of the EP&A Act.	A species impact statement would be required where there would be a likely significant impact on threatened biota.
Heritage		
National Parks and Wildlife Act 1974	Section 90 Aboriginal heritage impact permit for impacts to Aboriginal objects or places.	An excavation AHIP may be required to determine the significance of the PAD. Consultation with Aboriginal stakeholders would need to be undertaken in accordance with DECCWs *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* and stage 3 of the RMS *Procedure for Aboriginal Cultural Heritage Consultation and Investigation and Code of Practice*.

Applicable legislation	Approvals or requirements	Relevance
Heritage Act 1977	Section 139 excavation permit is required for disturbance or excavation of land that would or would be likely to result in a relic being discovered, exposed, moved, damaged or destroyed.	An excavation permit may be required subject to results of further heritage assessment, recommended to be carried out as part of the environmental assessment of the preferred option (refer to Section 6.4).
Water, watercourses, fisheries		
Water Management Act 2000	Aquifer interference approval under Section 91F.	Depending on the upgrade option, groundwater aquifers may be impacted by drilling. Section 91F approval may be required where aquifer interference activities may be required.
Fisheries Management Act 1994	Section 199, RMS would have to give the Minister written notice and would have to consider any matters raised by the Minister in order to carry out any dredging or reclamation work.	RMS would need to notify the Minister for Primary Industries for any proposed dredging or reclamation works that would be required.
	Section 205 relating to the harm of marine vegetation.	RMS would require a permit if any sea grasses are to be harmed during construction (including the removal of live, dead or detached material)..
	Section 219 relating to the temporary blocking of fish passages.	RMS would require a permit if the proposal temporarily or permanently blocks fish passages.

5. Consultation

5.1 Community consultation to date

RMS has consulted with the Burrill Lake community since May 2012. The aim of consultation was to inform the community of the upgrade need and to identify potential upgrade options, while gathering feedback from the community on their values and potential issues with upgrade options. Consultation activities included:

- Community updates.
- Community drop in sessions in Ulladulla.
- Shopper survey to further understand the local socio-economic environment and community opinions of the upgrade works, particularly issues associated with local businesses.
- Survey of local businesses.

Community updates

A community update newsletter was issued to the Burrill Lake community in May 2012. The update was distributed to more than 5000 properties in the Burrill Lake, Dolphin Point, Kings Point, Ulladulla, Mollymook and Milton areas. The newsletter provided a brief explanation on why the proposal is required, and stated that RMS had not yet made a decision on whether replacement or maintenance would be the preferred future option. The update also encouraged feedback submissions on the options of maintenance or replacement, or meeting the team at drop in sessions held on 22 May and 2 June, 2012.

Community drop in sessions

Around 30 community members attended the two drop in sessions, with 49 written submissions receive by email and post. A total of 23 of these submissions were in the form of a petition requesting a new bridge on a new alignment. The petition did not specify why this was the preferred option. A summary of the main issues from the drop in session is provided in Table 5-1.

Table 5-1 Main issues and concern raised by the 26 submissions

Issue	Number of submissions
The Causeway has a negative impact on the lake's ecology and hydraulics	17
Support for a new bridge	10
Traffic congestion and safety	9
Sea level rise and flooding	8

Issue	Number of submissions
Improved pedestrian arrangements	7
Concerns about consultation undertaken as part of the project	3
Access for emergency services	3
Old bridge should be retained as a community asset	3
Ensuring bridge is integrated into the character of the area	2
Noise, dust and drainage impacts from realignment or during construction	2
Status of the Milton Ulladulla Bypass	2

Survey of Burrill Lake shoppers

The survey was administered to shoppers on Saturday 3 November 2012 between 11am and 3pm. A total of 42 people completed the survey.

The main theme raised by respondents was to replace the existing bridge with a new bridge. Another key theme raised related to lifting the bridge to a higher level to allow boats to pass underneath and to improve flooding issues. A variety of 'other comments' were made about issues associated with the bridge, lake, town and community. Other common themes related to the need to improve traffic congestion, and environmental issues associated with the lake.

Survey respondents were also asked to identify what they thought were important issues for RMS to consider in investigating options for the future of the bridge. The highest number of comments were associated with ensuing that current issues with traffic congestion in the area were addressed. There were also several comments received relating to the need to address pedestrian safety and to improve ecology and water quality of the lake.

Overall there was a strong community perception that the causeway has a negative impact on the ecology of the lake, with many comments received regarding the need to remove the causeway. Other key issues related to ensuring that RMS considers the impacts on businesses and tourism industry when investigation bridge options.

Survey of local businesses

Nine local businesses were surveyed. The survey revealed that businesses depended heavily on trade from tourists as well as passing motorists. Local shops, such as those in the shopping village also rely on trade from local residents.

Options on the preferred option for the bridge upgrade were mixed from surveyed business owners. Key issues identified for RMS consideration included maintaining access to businesses both during and post construction activities. Most respondents

commented on the need to ensure that passing motorists could continue to park in a location of convenience and their businesses remain visible from the highway.

5.2 Key issues

Comments and issues raised were sorted into categories as outlined in Table 5-2.

Table 5-2 Categories of comments and issues raised

Category	Issue	Section referred to in report
Water quality	Causeway impacts on lake hydraulics	Section 6.2.3
Traffic and access	Need to improve traffic efficiency and access	Section 6.10.3
	Bridge/road safety	Section 6.9
	General negative construction impacts for bridge maintenance works (delays, changes to business access)	Sections 6.5, 6.7, 6.8 and 6.10
Construction	Noise, dust and drainage impacts from realignment or during construction	Section 6.5
Visual	Local character and amenity should be considered in bridge design	Section 6.7.3
	Potential for retention of old bridge as a community asset	
Economic	Reliance of businesses on passing motorists	Section 6.11
	Impacts on the tourism industry	
General	Support for new bridge and pedestrian facilities	-
	Retain old bridge for fishing	-
	Require boat access under the bridge	-

5.3 Government agency and other organisation involvement

As part of any further environmental assessment, following consideration of final concept designs, statutory consultation with relevant government agencies and other organisations would be undertaken.

RMS has been in consultation with Shoalhaven City Council regarding the future of the Burrill Lake Bridge since March 2010. In mid 2012 Shoalhaven City Council wrote to RMS advising of its in principle support for the provision of a new bridge crossing, conditional on further consultation between the two organisations. RMS project staff met with council officers regarding the status of RMS investigations, in particular with regards to flood and hydraulic investigations. In December 2012 council officers participated in the RMS value management process and were involved in the considerations of the full range of options.

RMS has had preliminary consultations with the NSW Department of Primary Industries (Fisheries) which indicated a desire to continue to be consulted during the project development and requested RMS develop appropriate water quality control measures. Fisheries participated in the RMS value management process and were involved in the considerations of the full range of options.

It is recommended that consultation be undertaken with the NSW Heritage Office if it is recommended by a Statement of Heritage Impact prepared for any affected items of heritage significance.

5.3.1 State Environmental Planning Policy (Infrastructure) 2007

Clauses 13, 14, 15 and 16 of ISEPP require that public authorities undertake consultation with councils and other public authorities, when proposing to carry out development without consent. Table 5-3 lists the items to be considered, an assessment of whether these are relevant, and identifies requirements for ISEPP consultation. Once a preferred option is identified, these matters may need to be reconsidered.

Table 5-3 Assessment of items of clauses 13, 14, 15 and 16 of the ISEPP

Item	Response
Clause 13	
1(a) Substantial impact on stormwater management services provided by a council.	Impacts on stormwater management services provided by council are not anticipated. Formal consultation with Shoalhaven City Council is not likely to be required.
1(b) Likely to generate traffic to an extent that would strain the capacity of the road system in a local government area.	There is likely to be an increase in traffic generation during construction. However, in the long-term, there are likely to be improvements in the capacity of the road due to the removal of substandard road geometry and design. Formal consultation with Shoalhaven City Council is likely to be required.

Item	Response
1(c) Involves connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council.	There is unlikely to be impacts on a sewerage system provided by a council or the connection into such a system. Formal consultation with Shoalhaven City Council is unlikely to be required.
1(d) Involves connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council.	Depending on the preferred design option, substantial volumes of water are unlikely to be required for construction. Formal consultation with Shoalhaven City Council is unlikely to be required.
1(e) Involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.	The proposal is unlikely to require construction of a temporary structure on, or the enclosing of, a public place that is under Shoalhaven City Council's management or control. Formal consultation with Shoalhaven City Council is not likely to be required.
1(f) Involves excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the Roads Act 1993 (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath).	Depending on the design option, construction may involve substantial excavation of a road or footpath managed by Shoalhaven City Council. Formal consultation with Shoalhaven City Council is likely to be required.
Clause 14	
Is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area.	The nearest non-Aboriginal heritage items listed under the LEP are located around 600 metres east of the Burrill Lake Bridge. Bridge upgrade works are unlikely to impact these items. Formal consultation with Shoalhaven City Council is unlikely to be required.
Clause 15	
Development that is to be carried out on flood liable land that may be carried out without consent and that would change flood patterns other than to a minor extent.	The upgrade option would be located within the centre of a lake and has flood potential. Depending on the preferred option, flood patters may change. Formal consultation with Shoalhaven City Council may be required.

Item	Response
Clause 16	
Clause 16 of the ISEPP states that a consent authority must not carry out any of the following development without giving written notice to the specified authority and taken their responses into consideration: *(a) development adjacent to land reserved under the National Parks and Wildlife Act 1974—the Department of Environment and Climate Change (now the OEH),* *(b) development adjacent to a marine park declared under the Marine Parks Act 1997—the Marine Parks Authority,* *(c) development adjacent to an aquatic reserve declared under the Fisheries Management Act 1994—the Department of Environment and Climate Change (now the OEH),* *(d) development in the foreshore area within the meaning of the Sydney Harbour Foreshore Authority Act 1998—the Sydney Harbour Foreshore Authority,* *(e) development comprising a fixed or floating structure in or over navigable waters—the Maritime Authority of NSW,* *(f) development for the purposes of an educational establishment, health services facility, correctional centre or group home, or for residential purposes, in an area that is bush fire prone land (as defined by the Act)—the NSW Rural Fire Service.*	The study area is not located within or adjacent to land identified in Clause 16. Formal consultation with RMS, OEH, Department of Primary Industries, Department of Planning and Infrastructure and the NSW Rural Fire Service is unlikely to be required.

A review of the above consultation requirements under the ISEPP would need to be undertaken following preparation of the concept design.

It is likely that formal consultation with Shoalhaven City Council would be required during assessment of the preferred option.

6. Environmental issues and constraints

6.1 Biodiversity

An ecological constraints assessment for the study area was undertaken by GHD. A copy of this report is located in Appendix A. The methodology of the assessment included:

- Desktop literature review where information on native flora and fauna for a radius of 10 kilometres around the study area was obtained using:
  - NSW Wildlife Atlas database for records of threatened species listed under the TSC Act recorded in the locality.
  - Protected Matters Online Search Tool for MNES listed under the EPBC Act predicted to occur in the locality.
  - Department of Primary Industries Threatened Species Records Viewer for threatened species listed under the FM Act recorded within the Shoalhaven local government area.
  - OEH BioBanking Threatened Species Profile Database for threatened species known to occur in the Southern Rivers catchment management area.
  - Vegetation mapping of the region (Tozer et al. 2010).
- Field survey carried out over two days. The survey area used for the investigation includes the eastern and western approaches of the bridge, a distance of 50 metres to the north of the bridge, and 100 metres to the south of the bridge. The survey was designed primarily to:
  - Determine whether any vegetation within the study area meets the criteria for threatened ecological communities listed under either the TSC Act or the EPBC Act.
  - Assess the value of habitats at the site for native biota and the likelihood of occurrence of threatened species.
- Identify and compile a list of species occurring in the study area including the presence of threatened species.

Further details of the methodology for this investigation can be found in Appendix A. The results of the database searches are attached in Appendix A.

6.1.1 Existing environment

Vegetation communities

Three native terrestrial vegetation communities and one aquatic vegetation community were identified in the study area. All three native terrestrial vegetation communities are listed as threatened under the TSC Act and are shown in Figure 6-1. Seagrass is listed as protected marine vegetation, under the FM Act. No vegetation communities are listed under the EPBC Act. In addition to native vegetation communities, exotic grassland and planted trees and wetland communities associated with exotic

grasslands were also identified in the study area. Vegetation communities are listed in Table 6-1 and described in more detail in Appendix A.

Table 6-1 Native vegetation communities in the study area

Vegetation community (Tozer *et al* 2010)	Status	Details
Seagrass Meadows (*Zostera muelleri* subsp. *capricorni*)	Marine Vegetation (FM Act)	Shallow areas of Burrill Lake, on either side of Burrill Lake Bridge. Seagrass was not observed in the deeper channels. Previous mapping recorded this community in limited areas to the north and south of the bridge.
Estuarine Saltmarsh	**Coastal Saltmarsh** in the NSW North Coast, Sydney Basin and South East Corner Bioregions **(EEC – TSC Act)**	Narrow strips along the edges of Burrill Lake, on the northeast, southeast and southwest sides of the bridge. Areas of saltmarsh southwest and southeast of the bridge had not been identified in the preliminary environmental investigations (RTA, 2010).
Coastal Sand Forest	**Bangalay Sand Forest** of the Sydney Basin and South East Corner bioregions (EEC – TSC Act)	Small patches in the west of the study area, adjacent to the Princes Highway (both to the north and south) and in the east of the study area, particularly to the south of the Princes Highway. Previous mapping recorded this community to the southwest of the Burrill Lake Bridge and southeast of the Princes Highway to the northeast of the bridge.
Estuarine Fringe Forest	**Swamp Oak Floodplain Forest** of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC – TSC Act)	Small patches adjacent to Princes Highway on the approaches to the bridge. This community was not identified as occurring in the study area by Tozer et al (2010).
Exotic grassland and planted trees	n/a	Various areas of exotic grassland and planted trees located throughout the study area.

Vegetation community (Tozer *et al* 2010)	Status	Details
Wetland	n/a	Small area of wetland located within exotic grasslands associated with a stormwater drain.

Note Bold items are found in Figure 4-1

Note: EEC – Endangered ecological community

Flora species

A total of 39 flora species were identified in the study area. These included 24 native species and 15 introduced species. No threatened flora species were identified. No noxious weeds were identified in the study area.

Fauna species

A total of 39 fauna species were recorded over the two day field survey, including 32 bird species, one frog species, four fish species and two stingray species. No threatened species were recorded. One migratory species listed under the EPBC Act was recorded: the Eastern Great Egret (*Ardea modesta*). One introduced species was recorded: the House Sparrow (*Passer domesticus*).

Of the 32 bird species recorded, 12 species were waterbirds. These include a range of common ducks, herons, egrets, cormorants, gulls and terns. A large flock of Black Swans (*Cygnus atrata*) were present east of the bridge. One raptor, a Whistling Kite (*Haliastur sphenurus*), was observed flying over the estuary. The remaining birds included common birds typical of urban areas and parklands.

There is the potential for microbats such as the Eastern Bentwing Bat (*Miniopterus schrebersii oceanensis*) and the Large-footed Myotis (*Myotis macropus*) to roost on occasion under the Burrill Lake Bridge. There are few crevices in the bridge, and roosts would only be temporary in nature. There is no breeding habitat for these species in the study area and no microbat species were recorded during the anabat survey.

Fauna habitats

Fauna habitats in the study area include Burrill Lake, lake margins, open parkland and occasional stands of trees.

Burrill Lake and lake margins

Burrill Lake is an estuarine lake, with large expanses of seagrass beds present. While there are a range of waterbird species (identified in Appendix A) often found within or around Burrill Lake, there is no breeding habitats in the study area.

The seagrass community in Burrill Lake, as with all seagrass communities, is particularly valuable as nursery, feeding and shelter areas for many aquatic animals, including commercially and recreationally important fish, mollusc and crustacean

species. The field survey identified two rays and one is believed to be the Estuary Stingray (*Dasyatis fluviorum*). This species is uncommon in NSW, and disappeared from the Sydney area in the 1880s. It is also listed as 'vulnerable' on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. There is also the possibility for the EPBC Act listed Loggerhead Turtle (*Caretta caretta*) to be present in the area due to the presence of key habitat features and previous recordings of the turtle in the area. However no loggerhead turtles were observed during the field survey.

The margins of Burrill Lake in the study area are dominated by reeds and sedges. In some areas a narrow band of low saltmarsh vegetation is also present. Reedy areas and saltmarsh provide habitat for a range of waterbirds. Limited habitat is present for most migratory shorebirds due to the lack of wide mudflats and sandflats, although the Eastern Great Egret (*Ardea modesta*) was recorded in the study area during the field survey. A number of migratory shorebirds species (identified in Appendix A) may also utilise seagrass beds and saltmarsh for foraging.

There is the potential for microbats such as the Eastern Bentwing Bat and the Large-footed Myotis to roost on occasion under the Burrill Lake Bridge. There are few crevices in the bridge, and roosts would only be temporary in nature. There is no breeding habitat for these species in the study area.

Open parkland

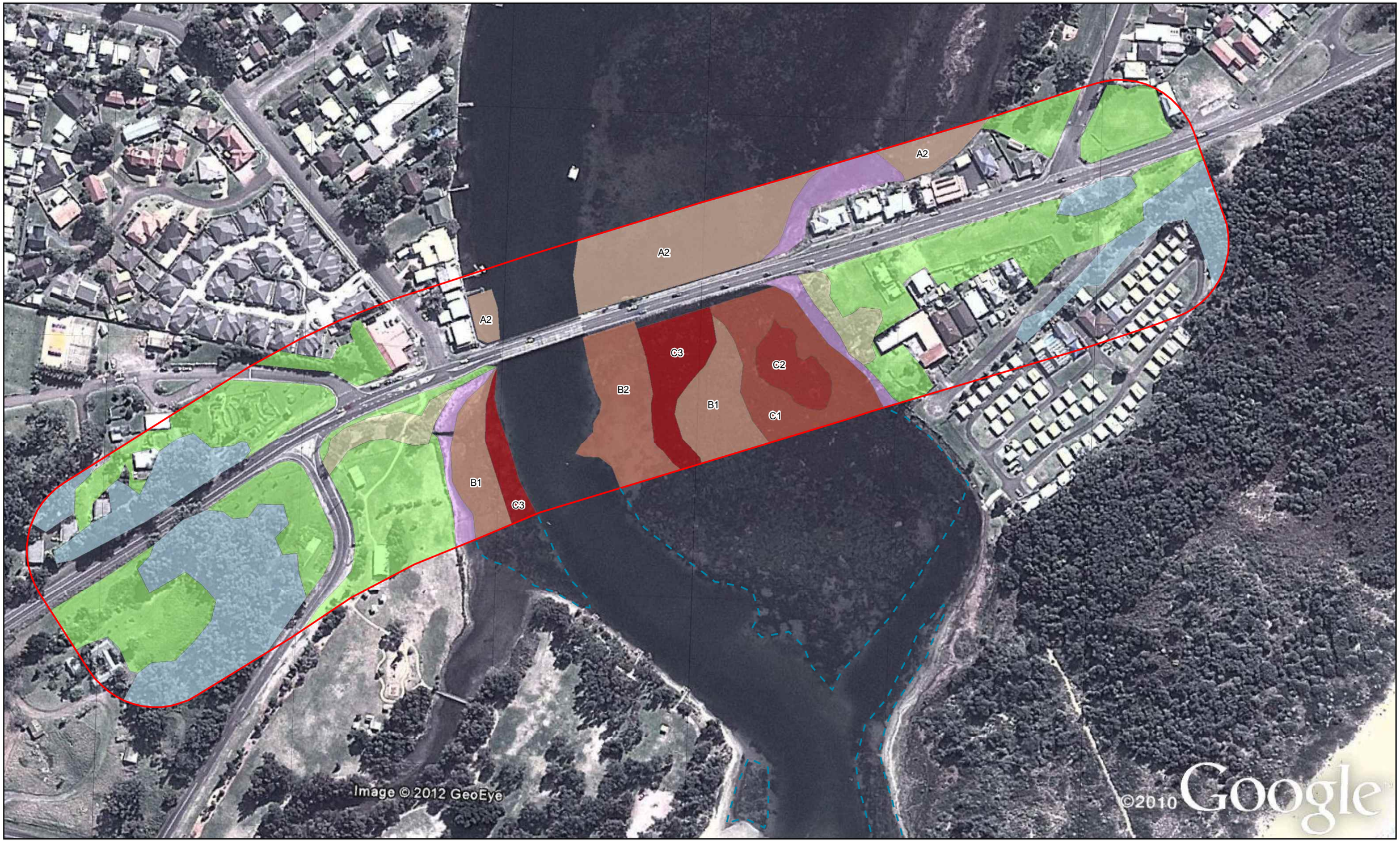
Open parkland is present to the east of the Princes Highway south of Burrill Lake Bridge. A mostly cleared parcel of land is present to the east of the Princes Highway north of Burrill Lake Bridge. There is limited habitat for mammals, reptiles and frogs in these areas.

Drains and drainage lines present in the parkland have a variety of in-stream flora, including species of *Juncus* and *Eleocharis*. A Common Eastern Froglet (*Crinia signifera*) was heard calling from a drain within forested area during the field survey. There are no records of this species in immediate area, the nearest records being in Ulladulla and at Meroo Lake. No Green and Golden Bell Frogs were observed basking during surveys.

Woodland and forest

Small, generally isolated patches of woodland are present in the study area. A stand of Swamp Oak Floodplain Forest is located to the east of the Princes Highway north of the bridge, near the margin of the lake. Yellow Thornbills (*Acanthiza nana*) and Little Wattlebirds (*Anthochaera chrysoptera*) were observed foraging in the Swamp Oak Floodplain Forest (shown on Figure 6-1).

Areas of Bangalay Sand Forest, which are listed as an EEC under the TSC Act are present in the study area (refer to Figure 6-1). These areas include a number of eucalypt and banksia species, which provide foraging habitat for various birds. A range of common birds were also recorded, and are identified in Appendix A. There is limited habitat present for threatened and migratory terrestrial species. There are no hollow-bearing trees present in the woodland and forest in the study area.



0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Study Area
- Apparent downstream extent of seagrass beds
- Coastal Sand Forest (Bangalay Sand Forest EEC)
- Estuarine Fringe Forest (Swamp Oak Floodplain Forest EEC)
- Estuarine Saltmarsh (Coastal Saltmarsh EEC)
- Exotic Grassland and planted trees

Seagrass Coverage (*Zostera muelleri subsp. capricornia*)

- A2 - Single Stands, Moderate Individuals
- B1 - Patchy, Single Individual Plants
- B2 - Patchy, Moderate Individuals
- C1 - Fairly Continuous, Single Individual Plants
- C2 - Fairly Continous, Moderate Individuals
- C3 - Fairly Continuous, Continuous Mat

GHD
CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge
Environmental Investigation

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Existing Vegetation

Figure 6-1

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

6.1.2 Potential opportunities and constraints

Overall there is little available habitat for threatened or migratory species within the study area. Three endangered ecological communities listed under the TSC Act and a marine vegetation species under the FM Act are present in the study area. Species and communities that are considered to have a high likelihood of occurrence, based on the existence of records and the presence of potential habitat are detailed in Table 6-2.

Table 6-2 Likelihood of occurrence of threatened species, ecological communities and marine vegetation in the study area

Common name	Listing	Likelihood of occurrence
Bangalay Sand Forest	EEC under the TSC Act	**Present.** Located adjacent to the Princes highway in the west and east of the study area.
Coastal Saltmarsh	EEC under the TSC Act	**Present.** Coastal Saltmarsh is located along the margins of Burrill Lake in the study area.
Swamp Oak Floodplain Forest	EEC under the TSC Act	**Present.** Located adjacent to the Princes Highway, east and west of the bridge.
Seagrass	Marine Vegetation under the FM Act	**Present.** Located within Burrill Lake, particularly in shallow areas to the north and south of the bridge.
Cryptostylis hunteriana Leafless Tongue Orchid	Vulnerable under TSC Act and EPBC Act	**High.** Potential habitat present in Bangalay Sand Forest in the west and east of the study area.
Galium australe Tangled Bedstraw	Endangered under TSC Act	**High.** Potential habitat present in Bangalay Sand Forest in the west and east of the study area.
Genoplesium vernale East Lynne Midge-Orchid	Vulnerable under TSC Act and EPBC Act	**High.** Potential habitat present in Bangalay Sand Forest in the west and east of the study area.

Common name	Listing	Likelihood of occurrence
Pandion cristatus Eastern Osprey	Vulnerable under TSC Act and EPBC Act	**High.** Likely to forage over Burrill Lake. Ospreys are known to nest in a communications tower in Ulladulla.
Haematopus longirostris Pied Oystercatcher	Endangered under TSC Act	**High.** May forage on occasion along the Burrill Lake Bridge embankment and in saltmarsh.
Haematopus fuliginosus Sooty Oystercatcher	Vulnerable under TSC Act	**High.** May forage on occasion along the Burrill Lake Bridge embankment.
Ephianura albifrons White-fronted Chat	Vulnerable under TSC Act	**High.** May forage on occasion along the Burrill Lake Bridge embankment and in saltmarsh.
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	Vulnerable under TSC Act	**High.** Could forage in study area on occasion. Possible roosting habitat present under Burrill Lake Bridge.
Myotis macropus Large-footed Myotis	Vulnerable under TSC Act	**High.** May forage over Burrill Lake. Possible roosting habitat present under Burrill Lake Bridge.
Litoria aurea Green and Golden Bell Frog	Endangered under TSC Act vulnerable under EPBC Act	**High.** Potential foraging and breeding habitat present. Anecdotal record from local resident for the park adjacent to the Princes Highway. There are no records for the species in this area in the Wildlife Atlas.

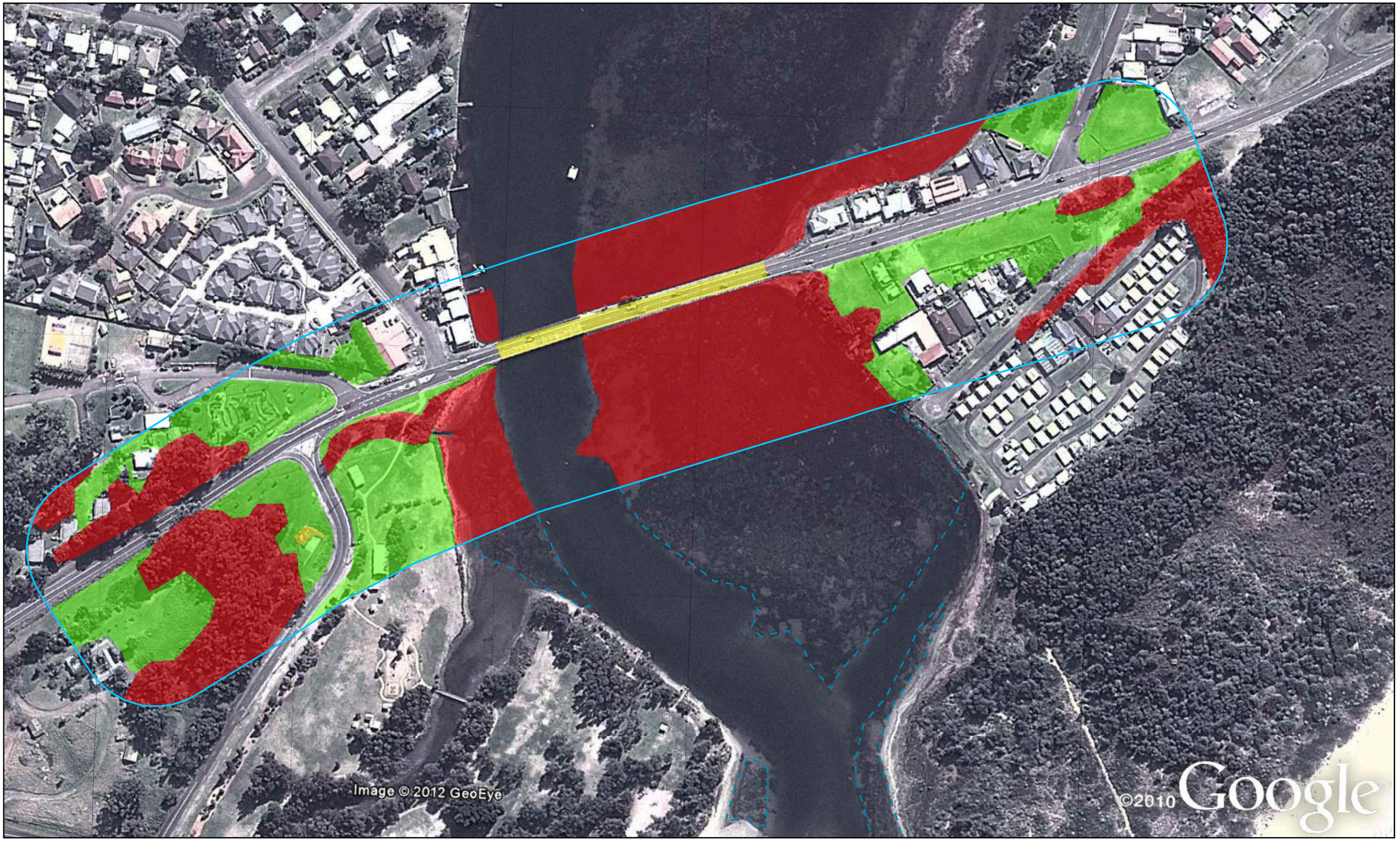
Ecological constraints identified in the study area have been classified as high, medium or low constraints based on the conservation significance of the vegetation or

habitat resource (refer to Table 6 in Appendix A). The key ecological constraints in the study area are:

- All areas of seagrass, saltmarsh, Swamp Oak Floodplain Forest and Bangalay Sand Forest. These are considered to be of high ecological constraint and where possible, impacts on these areas should be avoided.
- Areas of potential habitat for threatened species as listed in Table 6-2, that is not identified in threatened ecological communities, are considered to be a medium constraint (refer to Figure 6-2). These include drains and swampy areas that may be habitat for the Green and Golden Bell Frog, as well as Burrill Lake Bridge, which potentially may be used as roosting habitat by bats. These areas would be considered a low constraint if these fauna species are found not to be present in these areas.
- Areas of exotic grassland with planted trees and shrubs are considered to be of low ecological constraint.

Ecology constraints are mapped in Figure 6-2.

Should the preferred option be likely to have a significant impact on threatened species listed under the TSC Act or FM Act, a species impact statement would be required.



0 10 20 40 60 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Study Area
- Apparent downstream extent of seagrass beds
- High
- Low
- Medium

GHD

CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge
Environmental Investigation

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Ecological constraints

Figure 6-2

N:\AU\Sydney\Projects\21\21478\GIS\Maps\23_21478_Z011_EnvInv_EcologicalConstraints.mxd

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011. Created by: qjchung

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

6.1.3 Recommendations

Design

The following recommendations are made for consideration during the design process during selection of the preferred option.

- Minimise impacts on seagrass and endangered ecological communities. Any activity that may harm seagrass must be referred to DPI.
- Seasonal surveys may be required for some species to better determine potential for impacts resulting from the proposal, including:
  - Green and Golden Bell Frog – during summer.
  - Large-footed Myotis – late winter (prior to females leaving for maternity roosts), or pre-demolition surveys.
  - Eastern Bentwing Bat – late winter (prior to females leaving for maternity roosts), or pre-demolition surveys.
  - *Cryptostylis hunteriana* – during summer.
  - *Galium australe* – during summer.
  - *Genoplesium vernale* – during spring.

Environmental assessment

The following recommendations are made for consideration during the environmental assessment phase once the preferred option has been selected.

- Undertake a detailed ecology assessment which would include an assessment of the impacts of the chosen project option. The ecology assessment would also include an assessment of significance to determine whether any impact on threated biota would be significant.
- In reference to seagrass, as a general rule, DPI has a 2:1 habitat replacement policy, meaning that if a habitat is harmed, damaged or removed, then offsets must be provided for double the amount that originally occurred. RMS may be required to rehabilitate seagrass beds as a result of the proposal.

6.2 Water quality, hydrology and geomorphology

A hydrology investigation for possible upgrade options was undertaken by BMT WBM in July 2012. A copy of their report is provided in Appendix B. The methodology for this investigation included a review of previous investigations and reports relating to the study area, including:

- *Strategic Concept and Options Study, Burrill Lake Bridge* (Aurecon, December 2010).
- *Burrill Lake Bridge Preliminary Environmental Investigation* (RTA, December 2010).
- *Burrill Lake Flood Study* (BMT WBM, 2007).
- *Burrill Bridge Upgrade Options Investigation, Draft Report* (BMT WBM, July 2012).

6.2.1 Existing environment

Hydrology

The main tributary feeding into Burrill Lake is Stoney Creek at the northern end of the lake. There are two major basins within the lake, being the northern and southern basin. The catchment area is 78 square kilometres and the major land uses of the catchment include agricultural grazing to the north and eucalypt forest to the south and west.

The Burrill Lake Bridge is located around 700 metres upstream of the ocean entrance (inlet) to the lake (shown on Figure 6-3). As such, it is subject to influence of flow patterns both from the ocean (tidal influences) and riverine flows from upstream.

Deposition of sand at the entrance to the estuary occasionally results in closure of the entrance. During such periods, lake levels tend to increase gradually as water cannot discharge into the ocean.

When the entrance becomes closed, Council policy is to breach the sand deposits at specific levels, currently when the causeway gauge reaches 1.2 metres Australian height datum (AHD). The intention of this policy is to reduce flood risk to low lying development on the Burrill Lake foreshore during periods of entrance closure.

Flooding of the existing bridge and causeway can occur through a number of flood mechanisms including:

- Catchment flooding arising from periods of intense rainfall on catchments draining to Burrill Lake.
- Flooding from the ocean, including from high tides and storm surges.
- Flooding arising from gradual rises in lake levels as a result of catchment runoff during periods of entrance closure (distinct from the first dot point above in that it would not necessarily follow a period of intense rainfall).

The *Burrill Lake Flood Study* (BMT WBM, 2007) identified that the primary mode of flooding to the Burrill Lake Bridge is derived from catchment flooding arising from periods of intense rainfall.

The Burrill Lake Bridge soffit level (the bottom of the bridge deck) is about 1.5 metres AHD with a centreline road level of about 2.1 metres AHD. The causeway slopes, varying between 1.5 and 2 metres AHD.

0 30 60 120 180 240

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Study area

CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number	21-21478
Revision	0
Date	28 Nov 2012

Ocean inlet location

Figure 6-3

N:\AU\Sydney\Projects\21\21478\GIS\Maps\23_21478_Z014_Ocean_Inlet_LocationRev0.mxd

Data Source: Geoscience Australia: 250k Data - Jan 2011; Google Earth Pro: Imagery, Accessed: 12/07/2012. Created by: qjchung

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Flooding

Local knowledge of flooding is scarce and there is a lack of historical recorded data available. The villages of Burrill Lake and Bungalow Park are low lying and expected to have previously had flooding issues during high rainfall (WBM, 2007).

Table 6-3 presents a range of modelled flood levels at the bridge for catchment flooding (due to rainfall) and ocean derived flooding (due to the tide) for the 100-year average recurrence interval (ARI), 20-year ARI and 5-year ARI. Further details are included in Appendix B.

Table 6-3 Modelled flood levels, existing conditions

Peak flood level (m AHD)	100-year ARI (1% event)	20-year ARI (5% event)	5-year ARI (20% event)
Catchment flooding (lake entrance fully closed)	2.4	2.2	1.9
Catchment flooding (lake entrance fully open)	2.2	1.9	1.5
Ocean flooding	2.6	2.25	1.9

The results indicate that the road and causeway would be under significant amounts of water during a 100-year ARI event and in a 20-year ARI event. The results also indicate that the road and causeway would be partially or substantially under water during the 5-year ARI event (dependent on lake entrance conditions).

The duration for which the bridge would be under water during a 100-year ARI event would be expected to be at least 12 hours and more than a day for longer duration rain events.

It is noted that the bridge and causeway would be expected to flood more frequently in the future taking into consideration the potential effects of increased rainfall and sea level rise due to climate change.

Geomorphology

Burrill Lake is connected to the ocean by an approximate three kilometre long inlet channel. The inlet channel consists of a 50 metre wide and typically three metre deep channel inset within broader tidal flats.

Sediment inputs from the catchment to the inlet channel would be limited to suspended sediments due to the capture of larger sediments (sand and gravel) within the lake itself. As a result, the tidal flats experience relatively low rates of sediment accumulation. Downstream of the existing Princes Highway crossing, the inlet channel is subject to higher rates of change with reworking of the entrance channel shoals by tidal flows and flood events.

As shown in Table 6-4, channel flow velocities during large flood events are generally higher downstream of the existing bridge crossing than for upstream. This supports the

increased propensity for reworking of the entrance shoals downstream of the crossing compared to shoals upstream.

Tidal flow velocities are also summarised in Table 6-4 which indicates that the flood tide velocities are greater than the ebb tide flow velocities. This difference in flood and ebb tide velocities would result in an increased propensity for marine derived sediments to be transported upstream along the entrance channel by tidal flows. The tidal velocities consider predominantly tidal flow and only small catchment flows.

Table 6-4 Modelled flow velocities upstream and downstream of the bridge

Location	100-year ARI	5-year ARI	Ebb tide	Flood tide
Upstream	0.5 – 1.0 m/s	0.2 – 0.8 m/s	0.3 – 0.5 m/s	0.5 – 1.0 m/s
Downstream	1.0 – 1.5 m/s	0.5 – 1.0 m/s	0.3 – 0.8 m/s	0.5 – 1.0 m/s
Bridge opening	0.5 – 1.0 m/s	0.5 – 1.0 m/s	0.2 – 0.3 m/s	0.5 – 0.6 m/s

The 100-year ARI catchment flood event at the crossing significantly overtops the causeway generating relatively high flow velocities across the embankment as the flow spills over the causeway. Although the bridge is also substantially overtopped, under 100-year ARI flow conditions, higher velocities are experienced over the causeway than those generated through the bridge opening.

Under the 5-year ARI catchment flood event, the causeway is not as extensively overtopped as occurs during the 100-year ARI and 20-year ARI events. As a result, the flow velocities accelerate with the narrowing of the channel through the bridge opening. Overtopping of both the bridge and causeway occurs in the 5-year ARI catchment flood event.

Water quality

The Burrill Lake Estuary and Catchment Management Plan (Shoalhaven City Council 2002) was adopted by Shoalhaven Council in December 2002. The plan specifies the following water quality objectives for Burrill Lake:

- Nitrogen and phosphorous should remain below 0.5 and 0.05 mg/ml respectively.
- Turbidity should remain low.
- Water pH should not fall below 6.5.
- Water should be kept free of floating debris and litter.
- Implementation of the ANZECC water quality guidelines (long-term objective).

The plan (Shoalhaven City Council 2002) also identified that catchment runoff into the lake had a large impact on estuary water quality, in particular the effects of runoff from upstream grazing operations, followed by dairy and urban uses.

The most recent State of the Environment Report available for Shoalhaven City Council was undertaken in 2008/2012 (Shoalhaven City Council 2012a). It identified water quality in Burrill Lake to range between good and excellent throughout this

period. Data immediately following rainfall or flooding events was not provided. However, in some years (like the 2009/2010 reporting period), the State of Environment Report notes that water quality remained good despite high rainfall in early 2010.

Drainage

The surface water runoff flows into Burrill Lake before flowing towards the entrance to the sea.

Various stormwater drainage features were observed within the study area. Details of existing road drainage are not known at present. From aerial photography, it appears that surface water runoff on the bridge discharges via outlets located on either side of the bridge directly to the lake. Runoff on the causeway on the westbound lane would runoff directly into the lake. Runoff from the eastbound lane appears to be collected in a kerb inlet pit. Details of stormwater drainage infrastructure need to be confirmed.

6.2.2 High level options review

To identify constraints and opportunities for the hydrology aspects of the proposal, it was necessary at this stage to carry out modelling of preliminary bridge options.

The options were selected to provide a reasonable representation of the range of high level options identified to date, with consideration of the potential to alter the hydraulics and geomorphological processes in the vicinity of the bridge.

The options considered are described below, following which more general conclusions regarding potential environmental constraints and opportunities are drawn. The options considered are named in accordance with the terminology adopted for the *Strategic Concept and Options Study* (Aurecon, 2010) and include:

- Option 1 – Do nothing.
- Option 2 – Concrete casing of the existing piles above bed level.
- Option 3 – Headstock and pile strengthening.
- Option 4A – Bridge replacement.
- Option 4B – New bridge.

Option 1 was not considered further as it would not correct the current deficiencies with the bridge. Similarly, option 2 was not considered further as it only offered a short term solution. Option 3, option 4A and option 4B are summarised below. Further details regarding these options are provided in Appendix B.

Option 3 - Headstock and pile strengthening

This option considers retention of the existing bridge and causeway but with enhancements to include new piles and headstock strengthening. This option would result in a significant reduction in effective waterway area compared to existing conditions.

Option 4A - Bridge replacement

This option considers replacement of the existing bridge structure with a new bridge on the same alignment. The replacement bridge would have a greater span than the existing bridge (about 64 metres compared to 55 metres for the existing bridge). The replacement bridge would also have a lower soffit level (about one metre AHD compared to 1.5 metres AHD for the existing bridge). The causeway level would remain unchanged, however, the causeway embankment would require widening by about five metres on the downstream side.

This option would result in a small reduction in flood storage area associated with the increased footprint of the causeway embankment. All else being equal, the effective waterway area would be reduced from the existing case due to lowering of the soffit level.

Option 4B - New bridge

This option considers the complete replacement of the existing bridge and causeway on a modified alignment to the existing road. The new alignment would be about 20 metres downstream of the existing bridge. The new bridge would span about 200 metres across the full width of the Burrill Lake waterway, thereby providing minimal waterway encroachment. The deck level of the new bridge would be set above the 100-year ARI flood condition (including allowances for climate change and freeboard) to provide a flood free access route. The modelling incorporated raising of approach roads for this option, so the results take into account consequent changes in flood storage. The modelling incorporated raising of approach roads for this Option so the results take into account consequent changes in flood storage.

Findings

Modelling of option 3, option 4A and option 4B was undertaken to establish the flooding constraints of the preliminary options. A summary of the findings is presented below. Further details regarding the findings are provided in Appendix B.

Flooding

The change in flood levels for the 100-year ARI event are summarised in Table 6-5.

Table 6-5 Change in flood levels for various bridge options

Option	Impact on flood levels, 100-year ARI event
3	Insignificant (less than 20 mm change from existing)
4A	Insignificant (less than 20 mm change from existing)
4B	Localised increase within waterway at existing bridge location, localised decrease in residential areas immediately downstream of existing bridge location (5mm to 50mm)

As shown in Table 6-5, the impact of option 3 and option 4A on flood levels was found to be insignificant (less than 20 millimetre change from existing conditions). Because

there would be no change in bridge level, the road would continue to be under water during a 100-year ARI event. The preliminary options indicate no major difference to flood levels for surrounding residences.

Option 4B would provide a minor benefit (decrease in flood levels) to a localised residential area downstream of the existing bridge, although, at less than 50 millimetres it is not considered to be significant. The incidence of road flooding would be reduced for Option 4B in excess of the 100-year ARI flood event.

Geomorphology

The change in peak flow velocities for the 5-year ARI event and tidal flows are summarised in Table 6-6. The 5-year event has been considered because it is typically a more frequent event that influences channel geomorphology.

Table 6-6 Change in peak flow velocities for various bridge options

Option	5-year ARI	Flood tide	Ebb tide
3	Insignificant (less than 0.1 m/s change from existing)	Insignificant (less than 0.05 m/s change from existing)	Negligible (less than 0.02 m/s change from existing)
4A	Minimal (less than 0.2 m/s change from existing)	Negligible (less than 0.02 m/s change from existing)	Negligible (less than 0.02 m/s change from existing)
4B	Moderate with increases largely less than 0.5 m/s over the downstream tidal flats and similar reductions through the existing bridge opening	Minimal with 0.2 m/s increases over the downstream tidal flats and 0.2 m/s reduction through the existing bridge opening	Insignificant (less than 0.1 m/s change from existing)

The impact on flood and tidal flow velocities was found to be minimal for Option 3 and Option 4A. Hence, no significant changes in erosion and sedimentation processes are expected for these options.

For option 4B, through the removal of the flow constriction provided by the existing bridge and causeway, flow would be more evenly distributed across the broader inlet channel. As a result, flow velocity in the vicinity of the existing bridge opening would be reduced, while an increase in velocity would be experienced over the tidal flats along the left bank across the alignment of the existing causeway. These velocity changes would be experienced both upstream and downstream of the existing bridge location over a total distance of about 200 metres.

It is therefore expected that options that remove the causeway could result in reduced sediment transport potential through the existing bridge opening and the potential for some sediment accumulation here. This would occur if the channel at the existing bridge opening is scoured deeper than the channel upstream and downstream.

Accumulation in the scoured section would be expected to ultimately match upstream and downstream channel invert levels.

The velocity increases across the tidal flats in the 5-year ARI flood would be typically less than 0.5 m/s, with some very localised higher increases of around 0.6 to 0.8 m/s immediately adjacent to the left (northern) bank. The flow velocity increases across the tidal flats may result in some scour of sediments as the flats adjust to a new equilibrium. Such erosion may also affect the distribution of seagrasses. However, this impact would be localised to within 100 metres or so of the existing causeway alignment and would not affect the broader inlet channel.

Increases in peak flood tide velocities of the order of 0.2 m/s are predicted in the immediate vicinity of the existing causeway, but typically increases over a wider region would be less than 0.1 m/s. Such increases are not expected to result in scour of the tidal flat sediments.

Water quality

Water quality in the Burrill Lake estuary is largely driven by tidal flushing and large flood events which input fine sediments and nutrients to the system. No net change in the tidal exchange (the volume of water exchanged between an estuary and the ocean over a tidal cycle) at the location of the existing crossing is expected for the identified options. As a result, tidal flushing and general water quality in the broader estuary would be unaffected by the options considered.

There may be some temporary turbidity impacts associated with the potential scour of fine sediments across the tidal flats in response to the increased flood flow velocities due to the option 4B causeway removal. However, turbidity would be naturally high in such events and the additional sediment derived from the potential scour would not be expected to have a measurable influence on turbidity in such events.

6.2.3 Potential environmental opportunities and constraints

From the specific options assessed, broader constraints and opportunities with respect to hydrological aspects have been identified.

Flooding

The probability of the existing bridge flooding is currently relatively high. Given also that duration of bridge flooding could be in excess of 12 hours in a 100-year ARI event, severe disruption to bridge users could occur during flood events. Providing a new bridge at a higher level than the existing bridge would improve the incidence of road flooding such that it remains flood free in events up to and including the 100-year ARI flood event, with considerable potential benefit to road users. The modelled Option 4B shows that some flooding (along a length of about 75 metres) on the existing approach road to the east of the bridge still occurs, indicating that the preliminary option would need some refinement at design stage.

Geomorphology

No major constraints have been identified from a geomorphological point of view for options 3 and 4A. Any option adopted that maintains the causeway in its current form could therefore be expected to impose minimal constraints on the proposal.

Any option involving removal of the causeway (as with option 4B) would alter the flood and tidal flow velocity distributions over a total distance of up to about 200 metres upstream and downstream of the existing crossing. In this instance, flow velocities increase across the left bank tidal flats and decrease through the existing bridge opening. Hence, there is some potential for changes in patterns of erosion and sedimentation within the immediate vicinity of the existing bridge. These changes and potential impacts are:

- Increased potential for scour of sediments across the left bank tidal flats in response to increased flow velocities during flood events. Scour of the flats may have implications on the distribution of seagrass. This effect would be localised and not affect broader areas along the inlet channel.
- Reduced potential for sediment transport through the existing bridge opening leading to potential shallowing of the tidal channel through sediment accumulation. However, the velocity changes are considered minor given the variability and range of velocities experienced under existing tidal and flooding regimes.

Recommendations for further works to address this constraint are discussed in Section 6.2.4. The other options considered as part of this study can be considered to be neutral in terms of geomorphological processes.

No major opportunities have been identified with respect to geomorphology.

Water quality

Option 4B (causeway removal) was the only option that could present potential water quality constraints other than during construction. Without the causeway, some increased turbidity over the existing case may be expected during flood events, however as turbidity would be naturally higher in such events anyway, this has not been identified as a constraint (though it is noted that this has not been quantitatively assessed).

However, causeway removal is not expected to affect the net tidal exchange between the ocean and the lake as the tidal exchange within the estuary is predominantly controlled by entrance conditions. Therefore, removal of the causeway would have no impact on water quality conditions within the estuary (apart from during construction). The impacts of construction (for any option) on water quality are a potential constraint that would need to be addressed through appropriate construction methodologies.

Causeway removal is additionally not expected to influence entrance conditions as it is located relatively far upstream of the entrance (around 1 km).

6.2.4 Recommendations

Design

The following recommendations are made for consideration during the design process during selection of the preferred option.

- A detailed hydraulic assessment of the preferred option should be carried out during concept design.
- If the bridge realignment option is chosen, the design should raise the bridge level and approach roads and improve road flood immunity.
- Further assessment of the potential for scour of the tidal flats and impacts on seagrass should be undertaken if the causeway was to be removed. Mitigation could involve keeping the causeway or partial removal of the causeway to limit the extent of tidal flats potentially affected by increased velocities.

Environmental assessment

Consideration of water quality and hydrology impacts associated with the construction and operational phase of the upgrade would be required depending on the option adopted.

6.3 Aboriginal heritage

An Aboriginal heritage constraints assessment for the proposal was undertaken by Artefact Heritage Service in July 2012. A copy of their report is provided in Appendix C. The methodology for this investigation included:

- Desktop assessment including:
  - Search of the OEH Aboriginal Information Management System (AHIMS).
  - Review of previous investigations and reports relating to the study area.
- Aboriginal consultation in accordance with Stage 2 of RMS *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*.
- Field survey of the study area. The survey area used for the investigation reflects the study area described in Section 1.3.2, with the exception of the Burrill Lake water area (shown in Figure 6-4).

Further details of the methodology used for this investigation can be found in Appendix C.

6.3.1 Existing environment

A search of the AHIMS was conducted on 8 May 2012, for a five kilometre radius of the study area. A total of 70 Aboriginal sites are located in the vicinity of the study area, although none were located within the study area. The AHIMS data showed that the most common site types in the vicinity of the study area is shell midden mounds at 49 per cent with open camp sites at 13 per cent (refer to Table 6-7). The closest AHIMS site to the study area is item AHIMS #58-1-0304, located around 700 metres northwest of the western approach.

Localised disturbance were observed during the site survey of the study area (refer to Figure 19 in Appendix C). Construction of roads and associated ground modifications has resulted in disturbance along most of the road corridor. The park at the southern end of the bridge is relatively undisturbed with some minor landscaping and the construction of a toilet block. Historical aerial photos suggest that this area has remained undisturbed. The potential for Aboriginal burials within the study area was raised by the Ulladulla Local Aboriginal Land Council (ULALC). Burials have been known to occur within sandy soils and sand dune formations and are also known to be associated with midden deposits

Table 6-7 Frequency of site types from AHIMS data

Site type	Frequency within 5 km radius search area	Percentage
Shell midden	34	49%
Open camp site	9	13%
Isolated Find	6	9%
Artefact scatter	6	9%
Shell midden, open camp site	5	7%
Shelter with deposit	4	6%
Potential archaeological deposit	2	3%
Shelter with deposit and midden	1	1%
Shelter with midden	1	1%
Shelter with deposit, midden and axe grinding groove	1	1%
Scarred tree	1	1%

In addition, Burrill Lake is identified as an 'Indigenous place' on the Register of National Estate. The Register of the National Estate is a non-statutory list and is maintained as a publicly available archive and educational resource.

Field survey

No Aboriginal sites were located during the field survey, however there is potential for buried objects to be present.

All areas with high ground disturbance within the study area were found to have a low archaeological potential. The strip of land about five metres from the water line along both sides of the lake shore was also found to have a low archaeological potential as

no midden material was noted during the field survey. This area would have been affected by flooding, high tides and disturbance due to power boats.

Two areas of potential archaeological deposit (PAD) were identified during the field investigation (refer to Figure 6-4):

- PAD 1 is located on the southern side of the western approach on a hill slope and shoreline.
- PAD 2 is located on the southern side of the eastern approach on a relatively flat surface.

The hill slope section of PAD 1 would be highly likely to contain archaeological deposits as it is within the same landform unit as the area adjacent to it. The adjacent site yielded a high numbers of artefacts during previous investigations undertaken by Navin Officer in 2003. During the field survey, the ground surface visibility was zero within the park (adjacent to the shoreline), as it was obscured by thick turf. Artefacts or midden material may therefore be present beneath the grass, or may be buried beneath the ground surface. The Batemans Bay Archaeological Project found that seven per cent of Aboriginal sites recorded in the area were located on lake shores or river banks. There is therefore a potential for archaeological deposits to be buried within the shore flat and hill slope of PAD1.

PAD 2 comprises a section of lake shore that has been subject to minimal ground surface disturbance and therefore may contain midden deposits or other evidence of Aboriginal occupation.

0 25 50 100
Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- PAD 1
- PAD 2
- Study area

GHD
CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number	21-21478
Revision	0
Date	08 May 2013

PAD locations

Figure 6-4

G:\21\21478\GIS\Maps\23_21478_Z012_PAD Locations.mxd

Data Source: Artefact Heritage Services: PAD locations, 2012; Geoscience Australia: 250k Data - Jan 2011; Google Earth Pro: Imagery, Accessed: 12/07/2012. Created by: sdwoodger

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

6.3.2 Potential environmental opportunities and constraints

Discussions with the Aboriginal community during the site survey suggest that the Burrill Lake area is highly significant to Aboriginal people.

Although the field survey did not identify any Aboriginal sites with the study area, there is some potential for items to be discovered during construction. There is also potential for human remains to be located within the study area based on the information provided by ULALC. Evidence of burials may be discovered, particularly around areas around sandy soils, and sand dune formations and in association with midden deposits.

It is likely that there would be impacts on the PAD areas if the bridge is to be replaced. The level of constraint would therefore depend on the significance of the site, and would need to be assessed by further archaeological investigations. It is unlikely that maintenance of the bridge would impact on the PAD areas, in which case there would be no Aboriginal heritage constraints.

If, following further archaeological investigations, the PAD areas were found to be of a low or archaeological significance, there would be no Aboriginal heritage constraints on the proposal. If the PAD areas were found to be of moderate or moderate archaeological significance, further mitigation measures such as salvage excavation and an AHIP may be recommended before impacts were to occur. If the PAD areas were shown to have high archaeological significance it is possible that the area may be recommended as a conservation zone to protect its cultural heritage values. This would then be a constraint on the bridge replacement option if it were to impact on the PAD.

Further constraints may exist in regard to the cultural significance of the study area to Aboriginal people. These may be addressed by the ULALC in their report to RMS.

6.3.3 Recommendations

Pre-design

The following recommendations are to be considered prior to considering design options:

- Archaeological test excavations under the OEH Code of Practice would need to be conducted. Test excavations would be required to determine the level of significance of PAD areas and to inform an assessment of archaeological significance.

Environmental assessment

The following recommendations are made for consideration during the environmental assessment phase once the preferred option has been selected.

- An Aboriginal heritage assessment should form part of any further environmental assessment, particularly where it is determined that there may be impact on PADs.
- Comprehensive Aboriginal consultation to be undertaken by RMS if impacts are proposed on the PAD areas, as per RMS *Procedure for Aboriginal Cultural*

Heritage Consultation and Investigation, OEH *Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and Stage 3 of RMS' PACHCI.

- A cultural heritage assessment report in accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and Stage 3 of RMS' PACHCI would also be prepared. The cultural heritage assessment report would address appropriate management and mitigation measures for the project area.
- If it was identified that impacts to an Aboriginal site would occur, an AHIP would need to be obtained prior to construction commencing.

6.4 Non-Aboriginal heritage

A non-Aboriginal heritage constraints assessment was undertaken by Artefact Heritage Services. A copy of this report is located in Appendix C. The methodology for this investigation included:

- Desktop assessment including:
  - Search of the Commonwealth heritage and World heritage lists, the State heritage register, Section 170 registers, the LEP and Draft LEP.
  - Historical research.
- Field survey of the study area. The survey area used for the investigation is similar to the study area described in Section 2, excluding the water body north and south of the bridge (refer to Appendix C).

Further details of the methodology used for this investigation can be found in Appendix C.

6.4.1 Existing environment

Searches for non-Aboriginal heritage items were undertaken for the study area on 8 May 2012. The searches of the following heritage lists resulted in the following:

- Australian Heritage database (National Heritage List and Commonwealth Heritage List) – no items identified
- State heritage items – no items identified
- Section 170 registers – no items identified
- *Shoalhaven Local Environmental Plan 1985* and *Shoalhaven Draft Local Environmental Plan 2009* – two items identified

The two local heritage items identified include the Burrill Lake Community Hall, located within the eastern portion of the study area, and the post-war pseudo stone hall located around 600 metres east of the Burrill Lake Bridge.

Field survey

The study area was examined for unlisted heritage items, or areas of archaeological potential during the site survey. An assessment of heritage significance for the causeway and remains of the bridge was prepared in accordance with the 'Assessing

Heritage Significance' (2001) guidelines from the NSW Heritage Manual, based on the seven assessment criteria (shown in Table 1 in Appendix C). It was assessed that the stone causeway and remnants of the former bridge which date from the late 1800s are of heritage value, although they are not listed in the Shoalhaven LEP.

Figure 6-5 Stone construction of the causeway.

Figure 6-6 Remnants of the former bridge

6.4.2 Potential environmental opportunities and constraints

The study area has low non- Aboriginal archaeological potential. Photos from the GHD field investigation show remnants of the former bridge pylons or supports. The remains do not appear to be extensive, but if impacts were proposed, a further assessment would be required determine the significance of the impacts.

An assessment of heritage significance for the causeway and remains of the bridge has been prepared in Appendix C based on the seven assessment criteria (Table 1, Appendix C). The causeway and remains of the former bridge are of local significance for their association with the early development of the Burrill Lake township and as elements of the first crossing of the Burrill Lake inlet, and meet criteria A – historical significance.

Maintenance of the bridge is not likely to result in impacts to remains of the former bridge, or the causeway. Where the bridge were to be removed, and the remains are identified as a relic further approvals may be required.

If unexpected archaeological remains were encountered within the study area during works the RMS Unexpected Archaeological Find Procedure would need to be followed.

6.4.3 Recommendations

Environmental assessment

If the causeway or remains of the former wooden bridge are to be impacted or removed as a result of the preferred project option, a comprehensive Statement of Heritage Impacts including a detailed archaeological assessment would be required.

6.5 Noise and vibration

A preliminary noise and vibration assessment was undertaken by GHD in July 2012. A copy of this report is located in Appendix D.

The methodology for the investigation included:

- Ambient noise monitoring in two locations for a period of one week between 22 May and 29 May, 2012.
- Detailed inspection of the study area.
- Qualitative review of potential construction and operation noise impacts including:
  - Identification of sensitive land uses and receivers surrounding the study area.
  - Identification of planned construction work hours.

Further details of the methodology used for this investigation can be found in Appendix D.

6.5.1 Existing environment

The study area is located within the village of Burrill Lake. Residential receivers are located adjacent to the eastern and western approaches to the bridge. Table 2-1 in Appendix D identifies all sensitive receivers within and around the study area. These are shown on Figure 6-7. Noise monitoring was conducted at the closest sensitive receiver locations (shown in yellow on Figure 6-7):

- 113 Princes Highway – A residential property located five metres north of the eastern approach (Location 1).
- 39 Balmoral Road - A residential property located five metres north of the western approach (Location 2).

Attended and unattended noise monitoring results as well as site observations indicate that the existing noise environment is dominated by noise sources typical of a suburban environment.

A summary of attended noise monitoring results is provided in Table 2-4 in Appendix D. A summary of the calculated background L_{A90} noise levels (day, evening and night) for the monitoring period at Location 1 and Location 2 are provided in Table 2-5 and Table 2-6 of Appendix D, and are summarised in Table 6-8.

Table 6-8 Location 1 and 2 – Background LA90 noise levels, dB(A)

Date	RBL			L_{aeq}				
	Day 7am – 6pm	Evening 6pm –10pm	Night 10pm-7am	Day 7am – 6pm	Evening 6pm – 10pm	Night 10pm – 7am	$L_{Aeq(15\ hour)}$	$L_{aeq(9\ hour)}$
Location 1 (average)	48	38	36	67	63	60	66	60
Location 2 (average)	48	38	36	68	64	62	68	62

Figure 6-7 Sensitive receivers

R – Residential

A – Active recreational area

P – Passive recreational area

6.5.2 Noise criteria

Construction noise criteria

DECC's *Interim Construction Noise Guideline* (2009) (ICNG) provides a framework for identification and minimisation of noise from construction projects. The construction noise management levels at residential receivers as detailed in the ICNG are provided in Table 6-9.

The ‘noise affected level’ is the point above which there may be some community reaction to noise. The ‘high noise affected’ management level represents the point above which there may be strong community reaction to noise.

Table 6-9 ICNG construction noise management levels at residential receivers dB(A)

Time period	Management level $L_{Aeq(15min)}$
Recommended standard hours	Noise affected level: background noise level +10 dB(A) Highly noise affected level: 75 dB(A)
Outside recommended standard hours	Noise affected level: background noise levels + 5 dB(A)

Table 6-10 below identifies the ICNG construction noise management levels at residential received based on the background levels recorded and calculated as part of the ambient noise monitoring.

Table 6-10 ICNG construction noise management levels, dB(A)

Receiver type	Background level $L_{A90(period)}$ dB(A)			ICNG management level $L_{Aeq(15\ min)}$ dB(A)		
	Day	Evening	Night	Day (Background +10)	Evening (Background +5)	Night (Background +5)
Residential receivers, Princes Highway, Burrill Lake	48	38	36	58	43	41

Receiver type	Background level $L_{A90(period)}$ dB(A)			ICNG management level $L_{Aeq(15\ min)}$ dB(A)		
	Day	Evening	Night	Day (Background +10)	Evening (Background +5)	Night (Background +5)
Active recreational areas	Not applicable			65 (external noise level)		
Passive recreational areas				60 (external noise level)		
Commercial receivers				70 (external noise level)		

Construction vibration criteria

The vibration criteria to assess short term structural damage is noted in Table 6-11. The values are based on German Standard DIN 4150-3: 1999 *Structural Vibration – Part 3: Effects of vibration on structures.*

Table 6-11 Guideline values for short term vibration on structures (DIN 4150-3)

Type of structure	Guideline values for velocity, vi(t)[1] [mm/s]		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50Hz to 100Hz[1]
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (such as heritage listed buildings under preservation order).	3	3 to 8	8 to 10

Operational noise criteria

Based on criteria outlined in the OEH Road Noise Policy (RNP) (OEH, 2011), the Princes Highway is classified as an arterial road. Table 6-12 and Table 6-13 set out the assessment criteria for residences to be applied to the design of the preferred option.

Table 6-12 RNP road traffic noise assessment criteria for residential land uses

Type of project	Assessment criteria – dB(A)	
	Day (7am – 10pm	Night (10pm – 7am)
Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aaq\ (15\ hour)}$ 55 (external)	$L_{Aaq\ (9\ hour)}$ 50 (external)
Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads.	60 $L_{Aaq\ (15\ hour)}$ (external)	55 $L_{Aeq\ (9\ hour)}$ (external)

In addition to the assessment criteria detailed in Table 3-5, Section 2.4 of the RNP requires that any increase in the total traffic noise levels due to the proposal be considered. The relative increase criteria shown in Table 6-13 is intended to protect existing quiet areas from significant noise increases due to a road project which may adversely affect the amenity of those areas. The existing noise levels are already elevated, however, the preferred option should be assessed against this relative increase criteria along with the assessment criteria once it has been decided.

Table 6-13 RNP relative increase criteria for residential land uses

Type of project/land use	Total traffic noise level increase – dB(A)	
	Day (7am – 10pm)	Night (10pm – 7am)
New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing Traffic $L_{Aeq,\ (15\ hour)}$ +12 dB (external)	Existing Traffic $L_{Aeq,\ (9\ hour)}$ +12 dB (external)

Section 3.4 of the RNP states that where a road redevelopment causes an increase of more than 2 dB or acute levels of noise (65 dB(A) day or 60 dB(A) night) exist, reasonable and feasible noise mitigation measures are to be considered.

Table 6-14 relates to road traffic noise for non-residential land uses.

Table 6-14 RNP road traffic noise assessment criteria for non-residential land uses

Existing sensitive land use	Day (7am – 10pm)	Night (10pm – 7am)	Additional information
Open space (active use)	$L_{Aeq\ (15\ hour)}$ 60 dB(A) (external) when in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. playing chess, reading. Areas which may be a mix of passive and active recreation (such as school playgrounds), the most stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses.
Open space (passive use)	$L_{Aeq\ (15\ hour)}$ 55 dB(A) (external) when in use	-	

Sleep disturbance

The main noise factors that influence sleep during the night are 'the number of noisy events heard distinctly above background level, the emergence of these events and the highest noise level'. Although sleep assessment goals are not defined in the RNP, it does conclude, based on the research to date, that:

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

The RNP also recommends that an assessment of maximum noise levels be conducted where impacts may occur at night. The procedure for this assessment is provided in the RMS Environmental Noise Management Manual (ENMM) which recommends that:

- At locations where road traffic is continuous rather than intermittent, the Leq(9hr) (night) target noise levels should sufficiently account for sleep disturbance impacts.
- However, where the emergence of Lmax over the ambient Leq is equal to or greater than 15 dB(A), the Leq(9hr) criteria may not sufficiently account for sleep disturbance impacts.

6.5.3 Potential environmental opportunities and constraints

Construction noise

Typical plant and equipment used in construction activities are included in Table 4-1 in Appendix D. Typical noise levels of the plant equipment range from 97 to 108 dB(A). Typical construction equipment noise levels have been primarily obtained from *AS 2436 – 2010, Guide to noise and vibration control on construction, demolition and maintenance sites*. Other equipment may be used, however it is anticipated that they would produce similar noise emissions. As the preferred option has not been selected, the equipment identified may vary.

During construction, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. This could impact the neighbouring residents and tourists within the area.

The proposal has the potential to impact on sensitive receivers as a result of noise and vibration associated with the construction of the preferred project option. Rating background levels at Location 1 ranges between 36 dB(A) and 67 dB(A) throughout the day. Location 2 ranges between 36 dB(A) and 68 dB(A).

The rating background levels were used to establish the construction noise management levels which are described in Section 6.5.2. Table 4-2 in Appendix D identifies the estimated equipment noise levels at a distance during recommended standard construction hours. Standard construction hours are:

- Monday to Friday: 7:00 am to 6:00 pm.
- Saturday: 8:00 am to 1:00 pm.
- No work on Sunday or Public Holidays.

Table 6-15 outlines the estimated noise levels and exceedances for each receiver.

Table 6-15 Highest estimated noise levels at sensitive receivers

Receiver	Distance to existing bridge (Minimum)	Address/location/ description	Highest estimated noise level from construction equipment (dB(A))	Type
R1	5 m	39 Balmoral Road	106	Residential
R2	20 m	37 Balmoral Road	92-96	Residential
R3	40 m	35 Balmoral Road	86-92	Residential
R4	60 m	33 Balmoral Road	82-86	Residential
R5	25 m	119 Princes Highway	92	Residential
R6	80 m	Balmoral Road Lakewood Grove Maria Avenue Rackham Crescent George Street Thistleton Drive Ronald Avenue	80-82	Residential
R7	5 m	113 Princes Highway	106	Residential
R8	40 m	111 Princes Highway	86-92	Residential
R9	50 m	107 Princes Highway – The Fish Shop	86	Commercial
R10	85 m	105 Princes Highway – Bait and Tackle	80-82	Commercial
R11	115 m	103 Princes Highway – Pigeon House Opportunity Shop	76-80	Commercial
R12	130 m	101 Princes Highway – Bottle Shop	76-80	Commercial
R13	10 m	122/124 Princes Highway	100	Residential
R14	35 m	118 Princes Highway	86-92	Residential
R15	100 m	7 Princess Avenue	80	Residential
R16	105 m	9 Princess Avenue	76-80	Residential

Receiver	Distance to existing bridge (Minimum)	Address/location/ description	Highest estimated noise level from construction equipment (dB(A))	Type
R17	110m	11 Princess Avenue	76-80	Residential
R18	120 m	13 Princess Avenue	76-80	Residential
R19	125 m	15 Princess Avenue	76-80	Residential
R20	100 m	108 Princes Highway	80	Residential
R21	50 m	5 Princess Avenue South	86	Residential
R22	75 m	3 Princess Avenue South	82	Residential
R23	75 m	1 Princess Avenue South	82	Residential
R24	120 m	8 Princess Avenue South	76-80	Residential
R25	175 m	Princess Avenue McDonald Parade Queanbeyan Avenue Federal Avenue Commonwealth Avenue	74-76	Residential
R26	350 m	Jorgy's Way	<72	Residential
R27	75 m	109 Princes Highway – The Hot Glass Gallery and Studio	82	Commercial
A1	110 m	Princes Highway	6-80	Active recreational area
A2	210 m	McDonald Parade	72-74	Active recreational area
A3	415 m	Queanbeyan Avenue	<72	Active recreational area

Receiver	Distance to existing bridge (Minimum)	Address/location/ description	Highest estimated noise level from construction equipment (dB(A))	Type
A4	225 m	Marina Avenue	72-74	Active recreational area
A5	205 m	Dolphin Point Road	72-74	Active recreational area
P1	5 m	Princes Highway	106	Passive recreational area

Overall based on the estimated equipment noise levels and location of sensitive receivers:

- For receivers within 150 metres (R1-R24, R27, P1 and A1) construction activities are expected to exceed the construction noise management levels for the 'noise affected' criteria as shown in Table 6-9
- For receivers within 25 metres (R1, R2, R5, R7, R13 and P1) certain construction activities will exceed the highly noise affected construction noise management levels shown in Table 6-9.
- For receivers within 10 metres (R1, R7, R13 and P1) all construction activities will exceed the highly noise affected construction noise management levels shown in Table 6-9.

Noise constraints during construction, would therefore be the location of six sensitive receivers within 25 metres of the proposal. These receivers would be likely to receive in excess of 75 dB(A) of noise during construction activities.

Construction vibration

Construction works may cause vibration impacts and potentially impact on nearby building structures. It is possible that local sensitive receivers (such as residential properties located within close proximity to the study area) may perceive construction vibration at times. The level of annoyance, however, would depend on individuals.

The typical vibration levels for different plant activities sourced from the RMS Environmental Noise Management Manual (ENMM) are shown in Table 5-2 of Appendix D. These levels of vibration have been used to calculate vibration at a distance. Based on these levels there would be adverse vibration impacts during construction for dwellings located within 10 metres of construction activities. Within 10 metres of construction activities, the vibration levels are likely to exceed the recommended acceptable levels noted in Table 6-11 for maintaining structural integrity. These dwellings are:

- R1 - 39 Balmoral Road.
- R7 - 113 Princes Highway.
- R13 - 122/124 Princes Highway.

Therefore dwellings within 10 metres of construction activities may be a constraint due to the potential resultant vibration impacts from construction activities on the buildings.

Based on the British Standard BS5228:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: vibration,* it is possible that construction vibration may be noticeable at times at distance up to 100 metres from the works. This may be a constraint, given the number of sensitive receivers located within 100 metres of construction activities which may be affected by vibration from construction.

Future traffic noise levels

Increase in noise levels in the future is likely to be around 0.5 dB due to predicted traffic growth, not a future bridge design. Traffic volumes were determined using RMS historical data from 2000 to 2006 (shown in Table 6-16). Operational noise levels at sensitive receivers are not predicted to result in a significant increase. A significant increase is an increase of two dB in accordance with the accepted application of the DECCW Road Noise Policy (2011).

Changes in road alignment may cause significant variations in noise due to changes in road proximity and line of sight. An operational noise assessment should be undertaken to determine any predicted changes in noise levels due to the preferred option.

Table 6-16 Existing and future traffic volumes

Direction	Averaged vehicle counts (AADT, 2006)	Predicted vehicle count	Predicted increase
Northbound	3960	4462	502
Southbound	3878	4369	491
Combined	7838	8831	993

6.5.4 Recommendations

Environmental assessment

- Once the design of the proposal is determined a construction and operational noise and vibration assessment including modelling predictions of future operating scenarios is recommended. This may result in recommendations for construction and operational noise and vibration mitigation.

6.6 Geology, soils and groundwater

A preliminary contamination and hydrogeology investigation was undertaken by GHD Pty Ltd in May 2012. A copy of this report is located in Appendix E.

The methodology for the investigation included:

- Review of site history, including:
  - OEH searches (contaminated land record, environment protection licences).
  - Aerial photographs supplied by council.
  - Previous environmental / hydrogeological investigation reports supplied by council.
- Desktop review using:
  - Soils, geology and acid sulphate maps.
  - NSW Natural Resources Atlas (groundwater database).
  - Review of published aquifer characteristics.
  - Review of published salinity and acidity data.
- Detailed inspection of the study area on 23 April, 2012.

Further details of the methodology used for this investigation can be found in Appendix E.

6.6.1 Existing environment

Topography

The study area is located on a relatively flat coastal plain. Topographic maps (NSW Department of Lands, 2012) indicate that the study area has an elevation range of

about five to 20 metres Australian Height Datum. The southwest portion of the study area slopes gradually east towards the sea.

Soils and landscapes

The study area is situated on a low lying flood plain, previously a wetland, before being cleared for urban development around 1950. The soils of the area consist of marine sand and alluvial soils flushed from Stoney Creek. The unconsolidated nature of the soils in the study area would require consideration in the design and management of the proposed development. These soils are often flood prone with low permeability.

The Land and Water Conservation Map (Land and Water Conservation, 1997) indicates that there is a low potential for acid sulphate soils (ASS) within the alluvial deposits/bottom sediment within the estuary area.

Geology

The *Ulladulla 1:250,000 Geological Series Sheet* (Sheet 1 56-13, Rose, 1996) indicates that the study area is underlain by Quaternary sediments and surrounded by Permian bedrock. A search of geological information and registered boreholes information (OEH, 2012) suggests that the site in entirely underlain by Quaternary alluvial and marine deposits.

The coastal lake setting of the study area is likely to result in variations in composition of the Quaternary deposits. The calmer aquatic environment further upstream and within Burrill Lake results in finer more silty sand fluvial sediments, whereas in the coastal fringes of the study area are likely to be cleaner more sandy deposits.

Groundwater

The Quaternary deposits are likely to form a shallow unconfined aquifer system of relatively high permeability and high storage (per unit area) that is limited in lateral and vertical extent by the Permian deposits underlying and outcropping to the north, south, by the Pacific Ocean to the east and Burrill Lake to the north west. Due to this, hydraulically localised aquifer systems are also likely to form to the north and south of Burrill Lake Inlet with Burrill Lake Inlet acting as a primary discharge point for these aquifer systems. The anticipated groundwater discharge would be confirmed by conducting investigations into groundwater elevation data.

It is currently unknown if there is a hydraulic connection between the aquifer systems, however, if a connection exists it is likely that the Permian aquifer system discharges into the shallow Quaternary aquifer system.

Further information on hydrogeology is located in Appendix E.

There are six existing groundwater bores located within the site area and the use of the bores range from public use, recreation, domestic, stock and waste disposal. Given the coastal location of the study area, it is anticipated that groundwater in the shallow Quaternary aquifer system would be relatively shallow across the study area. The only available groundwater elevation data available within the study area is for well GW031493 (located around 10 metres south of the study area), which was recorded to have a standing water level of about 1.3 metres below ground level.

Given the topography across the study area it is unlikely that groundwater would be encountered at depths greater than eight metres below ground level. Further information on groundwater elevations is included in Appendix E.

Contamination

A search of the NSW OEH Contaminated Sites Register on 8 May 2012 did not identify any premises listed within a one kilometre radius of the study area.

A service station was located on the corner of the Princes Highway and McDonalds Road (eastern side), within the study area. The site is now vacant open space and is covered by native grasses. Potential contamination may occur within proximity to the former service station as a result of leaks from underground fuel storage tanks. This is discussed in more detail in Appendix E.

The bridge and traffic barriers are reportedly made of precast plank concrete with old timber studs/timber piers remaining from former bridge structure. The scupper pipes contain asbestos and are over 10 metres in length.

There are no records of the fill material used to construct the causeway, and there is potential for the fill material to contain contaminants, for example heavy metals, petroleum products or asbestos. While the causeway remains undisturbed, there is minimal risk of environmental harm, however, if the causeway is to be removed or disturbed there is the potential for mobilising contaminants (if present).

Based on the database searches and historical uses of properties in the area there does not appear to be any former contamination upstream or within the study area. There is a potential for contaminating activities due to road operations, through motor vehicles accidents or chemical transport spills from users of the roadways.

6.6.2 Potential environmental opportunities and constraints

The constraints encountered during the proposal would depend on the specific scope of works. The potential environmental constraints likely to be encountered are discussed below.

Soils and landscapes

Depending on the chosen design option, construction may cause soil instability and erosion on the unconsolidated quaternary sediments within the study area. This would need to be taken into consideration during design and construction planning and mitigation and management measures would need to be implemented.

Groundwater

Based on the available data, excavations as part of the proposal may encounter groundwater. Additionally, if pumping or dewatering is required during construction this may adversely affect the water quality and yield of the aquifer and surrounding groundwater extraction bores.

Dewatering of excavations may be required during construction of the proposal should groundwater be encountered. Given that groundwater is indicated to be present from

about one metre below ground level, any excavations that are planned for below this depth should consider dewatering at the planning stages. The shallow quaternary groundwater system is considered to be a potentially sensitive resource that is used for municipal and domestic purposes and has the potential to be impacted by saltwater intrusion (associated with excessive drawdown). If extensive groundwater dewatering is required, this has the potential to affect the water levels in any nearby groundwater extraction bores. If the works are to include dewatering of the aquifer system additional investigations should be completed to assess the quality of the groundwater and the potential impacts on surrounding groundwater users and on the Quaternary aquifer resource. Any potentially adverse impacts identified should be managed, mitigated and monitored appropriately.

Should a new bridge be proposed, the structure and the style of new foundations may change the surface, groundwater and tidal flow regime of the area which could result in undesirable impacts such as flooding or erosion.

Contamination

There are no records of the fill material used to construct the causeway. Therefore, there is potential for the fill material to contain contaminants. Pipes containing asbestos were identified as occurring within the study area. While the causeway remains undisturbed, there is minimal risk of environmental harm.

Should the causeway be removed, any former contamination could be mobilised. Potential human exposure to contamination may include:

- Ingestion of soils and dust.
- Indoor and outdoor inhalation of dust.
- Dermal contact with soil and dust.
- Indoor and outdoor inhalation of vapours.

Acid sulphate soils

There is a low possibility for ASS to occur. Localised deposits however, could be present within the study area. If any excavation is conducted within the study area, ASS management practices would need to be implemented.

6.6.3 Recommendations

Design

The following recommendations are made for consideration during the design phase.

- If the bridge and causeway are to be completely removed and a new structure built, geotechnical investigations would need to be carried out on the subsurface conditions in the area where the new bridge is likely to be built.
- The unconsolidated nature of the soils in the study area would require consideration in the design and management of the proposal.

Environmental assessment

The following recommendations are made for consideration during the environmental assessment phase once the preferred option has been selected.

- A piling/groundwater effects assessment should be undertaken as part of any further environmental assessment.
- If the causeway is to be removed or disturbed, further investigation into the nature of the material and potential for contaminants would need to be undertaken.
- If the removal of the asbestos pipe is required, a class B (bonded) asbestos license contractor would need to be contracted to prevent any risk of contamination migration.
- ASS should be considered in the design and management of the proposed development. The 'Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze' (RTA, 2005) should be used as a guide for management of ASS if additional structures were be built within the study area.

6.7 Visual and landscape character

A landscape character and visual constraints assessment for the proposal was undertaken by GHD. A copy of their report is provided in Appendix F. The methodology for this investigation included:

- Establishment of the existing landscape character and visual environment.
- Identification and assessment of the degree of sensitivity of the landscape character zones and sensitive visual receivers.
- Identification of potential sources and magnitude of impacts on landscape character and sensitive visual receivers.
- Prediction of the significance of landscape character and visual constraints.
- Identifying potential mitigation measures.

Further details of the methodology used for this investigation can be found in Appendix F.

6.7.1 Existing environment

The dominant visual aspects of the Burrill Lake Bridge include the carriageway, concrete safety railing and the concrete piles supporting the bridge. The bridge sits low over Burrill Lake and its visibility against the skyline is limited due to its low visual profile, as shown in Figure 6-8.

The surrounding landscape is dominated by Burrill Lake, its coastal setting, limited built foreshore elements and the surrounding forested areas. Due to the location of the proposal in a relatively undeveloped and open area, crossing an open expanse of water and within a visual environment dominated by natural characteristic, the existing bridge is a highly visible infrastructure element when viewed from the water.

The landscape character of the study area is defined predominantly by the lake and its associated ecological values, recreational and local commercial and social activity. The inlet entrance is also important to key environmental values including water quality, inundation of low-lying areas, and the ecology of the wetlands around the inlet channel.

Burrill Lake is a distinct area that retains much architecture from its origin as an early to mid-20th century holiday retreat when families took holidays in caravans and fibro cottages. The built character is however changing as new owners demolish existing buildings and construct new commercial, residential and holiday facilities.

Hydrology plays an important role in the character of the study area. It shapes the surrounding landscape, forms a dominant visual element and provides an environmental, social, recreational and commercial resource. The *Burrill Lake Estuary and Catchment Management Plan* (Shoalhaven City Council, 2002) is specific in its objectives to maintain the Burrill Lake entrance in 'as natural a state as possible within the constraints of property, flooding and inundation'.

The most frequently used part of Burrill Lake is the inlet entrance area. Recreational demand comes from three groups:

- High visitor levels during Christmas and Easter holiday periods.
- Normal lower level visitor usage throughout the remainder of the year.
- General recreational use by the local population.

Figure 6-8 Burrill Lake Bridge (northern elevation)

Landscape character

Landscape character zones have been defined based on the presence of similar defining visual characteristics and are mapped in Figure 6-9. A total of five dominant zones have been identified. The existing environments for each landscape character zone has been identified in Table 6-17 and included in Figure 6-10 and Figure 6-15.

Further landscape character zone descriptions are identified in Appendix F.

150.438 150.447 150.456

-35.3735 -35.3825 -35.3915 -35.4005

Burrill Lake Township and Residential

Burrill Lake

Uncleared Land / National Park

Uncleared Land / National Park

Burrill Lake Township and Residential

Burrill Lake

Burrill Lake

Burrill Lake Township and Residential

Recreational Open Space

Estuary Entrance and Ocean Foreshore

Uncleared Land / National Park

Dolphin Point Residential

Image © 2012 TerraMetrics
Image © 2012 GeoEye

©2010 Google

150.438 150.447 150.456

LEGEND

Landscape Character Zone

- 1. Estuary Entrance and Ocean Foreshore
- 2. Recreational Open Space
- 3a. Burrill Lake Township and Residential
- 3b. Dolphin Point Residential
- 4. Uncleared Land / National Park
- 5. Burrill Lake

1:15,000 @ A3

0 100 200 300 400

Metres

Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge:
Environmental Investigation

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Landscape character zones

Figure 6-9

N:\AU\Sydney\Projects\21\21478\GIS\Maps\23_21478_Z010_EnvInv_LandscapeCharacterZones.mxd

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 Australia **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com **W** www.ghd.com

Data source: Google Earth, Imagery, (2012). GHD, Landscape Character Zones (2102). Created by:qjchung

Table 6-17 Existing landscape character

Landscape character zone	Landscape character
Zone 1: Estuary entrance and ocean foreshore	The landscape within zone 1 is of distinctive natural character (shown on Figure 6-10). The area is dominated by natural features, recreational use and there are minimal existing built elements. Burrill Lake Bridge is a feature of this zone.
Zone 2: Recreational open space	The landscape within zone 2 is of distinctive character. It is dominated by natural elements and utilised by residents and visitors for recreation (shown in Figure 6-11).
Zone 3a: Burrill Lake township and holiday accommodation	The landscape within zone 3a is dominated by built elements and infrastructure (shown in Figure 6-12.
Zone 3b: Dolphin Point residential	The landscape within zone 3b is dominated by built elements and infrastructure (shown in Figure 6-13).
Zone 4: Uncleared land/National Park	The landscape within zone 4 provides a visually striking backdrop to Burrill Lake. The zone is highly sensitive to change (shown on Figure 6-14).
Zone 5: Burrill Lake	The landscape within zone 5 is dominated by Burrill Lake, and is of high scenic quality (shown in Figure 6-15). The bridge is a significant feature but its location, size and low profile limit its current visual exposure.

Figure 6-10 Zone 1: Estuary entrance and ocean foreshore

Figure 6-11 Zone 2: Recreational open space

Figure 6-12 Zone 3a: Burrill Lake township and holiday accommodation

Figure 6-13 Zone 3b: Dolphin Point residential

Figure 6-14 Zone 4: Uncleared land/National Park

Figure 6-15 Zone 5: Burrill Lake

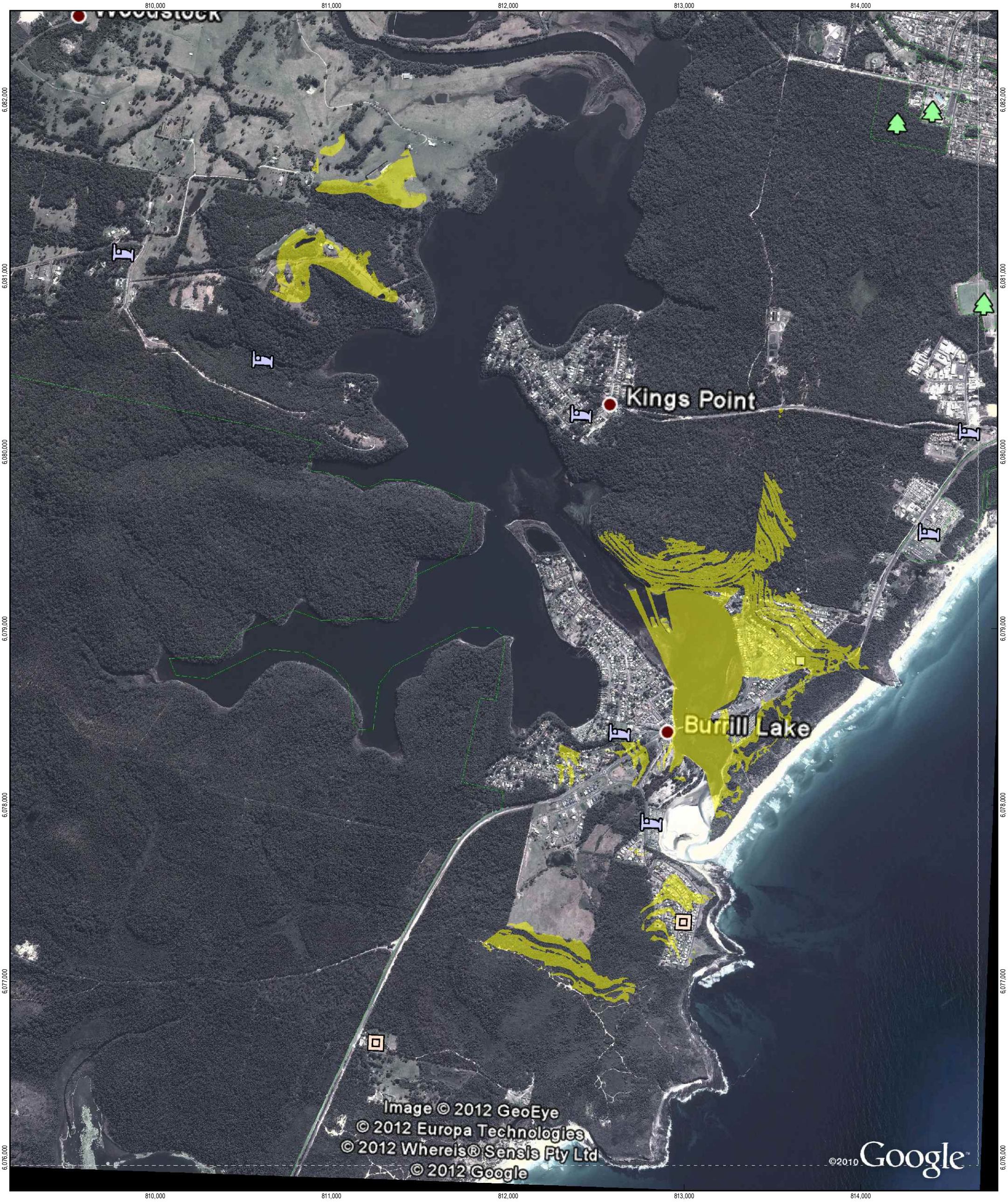
Visual envelope and sensitive visual receivers

The visual extent from the bridge has been limited to a five kilometre radius, as any sensitive visual receivers beyond that are unlikely to experience any substantial impact. A visual envelope map has been produced (shown on Figure 6-16), illustrating the potential visual catchment of the bridge. The visual envelope does not account for

views that may be intermittently blocked or interrupted by objects (buildings, plants etc) within the catchment.

The bridge is visible from residential dwellings, holiday accommodation and recreational areas and typical sensitive receivers are mapped in Figure 6-17.

The sensitive visual receivers within the study area and their relative level of sensitivity are included in Table 6-18. Photos from each viewpoint (identified as VP) are included in Appendix F.



LEGEND

Visible

1:20,000 @ A3

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

CLIENTS | PEOPLE | PERFORMANCE

Roads and Maritime Services
Burrill Lake Bridge:
Environmental Investigation

Visual envelope from current bridge (estimated bridge height is 1m)

Job Number 21-21478
Revision 0
Date 09 Apr 2013

Figure 6-16

N:\AU\Sydney\Projects\21\21478\GIS\Maps\Deliverables (Optional)\23_21478_CurrentBridge_Viewshed.mxd

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 Australia **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com **W** www.ghd.com

Data source: GHD, cb_1m, (2012), Imagery, Google, Image Date 17/9/2011 (2012). Created by:qjchung

LEGEND

Viewpoint location

1:12,000 @ A4

0 100 200 300 400

Metres

Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

N

CLIENTS | PEOPLE | PERFORMANCE

Roads and Maritime Services
Burrill Lake Bridge:
Environmental Investigation

Sensitive visual receiver viewpoints

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Figure 6-17

N:\AU\Sydney\Projects\21\21478\GIS\Maps\23_21478_Z009_EnvInv_Viewpoints.mxd Level 7, 16 Marcus Clarke Street Canberra ACT 2601 Australia **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com **W** www.ghd.com

Data source: Waypoints, GHD, (2012). Imagery, Google Earth, Image Date 17/9/2011 (2012). Created by:qjchung

Table 6-18 Sensitive visual receiver categories and sensitivity

Viewpoint (VP) location	Existing views	Sensitive visual receiver category	Quality of existing views	Relative number of sensitive visual receivers and degree of visibility	Sensitivity
VP1		Residential with direct views from residence	High quality view of water, natural landscape and recreational activity	Large number of residential dwellings within study area with direct visibility of bridge, predominantly those on the lake's eastern foreshore. These sensitive visual receiver views of the bridge would be frequent and of long duration.	High
VP2		Recreational-walking and cycling	High quality view of water, natural landscape and recreational activity	Bridge visibility is high from the main recreation area both on the foreshore and the lake. The bridge links the two main settlement areas and experiences a high volume of pedestrian traffic which would view the bridge on approach and from surrounding areas.	High
VP3		Recreational – lake users	High quality view of water, natural landscape and recreational activity	The lake is used for recreational activities by residents and visitors. The degree of visibility and duration of the view is likely to be high for these sensitive visual receivers.	High

Viewpoint (VP) location	Existing views	Sensitive visual receiver category	Quality of existing views	Relative number of sensitive visual receivers and degree of visibility	Sensitivity
VP4		Visitors	High quality view of water, natural landscape and recreational activity	The lake is visited for its natural setting and the availability of recreational activities. Visitors have temporary exposure to the visual elements (ie not permanent residents) and generally spend their time recreating. A high number of visitors would have direct and continued visibility of the bridge while recreating. This would be greater for passive activities such as fishing.	Moderate
VP5		Occupational – business operators and workers	Moderate quality views of road infrastructure and buildings within a quality landscape setting	There are a moderate number of businesses within the visual envelope. Views of the bridge are likely to be brief in duration and direct visibility restricted by other buildings.	Low
VP6		Travellers – motorists on Princes Highway	Low quality views of road infrastructure and buildings within a quality landscape setting	The bridge carries a high volume of commuter and holiday traffic. The speed limit of 60km/h means that the bridge is visible to drivers however the duration of the view is short.	Low

Viewpoint (VP) location	Existing views	Sensitive visual receiver category	Quality of existing views	Relative number of sensitive visual receivers and degree of visibility	Sensitivity
VP7		Travellers – motorists on local roads	Moderate quality views of settlement within a quality landscape setting	Visibility of the bridge from local roads is obscured by vegetation and buildings. Duration of the view is limited.	Low

6.7.2 Potential environmental opportunities and constraints

The habitat values have been recognised as diverse and productive as mentioned in Section 6.1. Any clearing of vegetation would impact both the visual and environmental values of the inlet.

There are many parks and open spaces in the immediate area surrounding the study area. These are included in Appendix F. The areas are well-used, well-maintained and offer moderate-high amenity. Maintaining the quality of the visual and recreational amenity offered by these resources is an important consideration in any development in the foreshore area. Table 6-19 identifies the landscape character zone constraints and sensitivity, based on the zones identified in Figure 6-9. The magnitude of any impact would vary with the magnitude of change to the existing bridge profile.

In relation to visual impacts on sensitive receivers, viewpoints 1, 2 and 3 would have high sensitivity to any proposal to upgrade or replace the bridge. The degree of sensitivity and visibility to the preferred option would vary depending on the design of the preferred option. Viewpoints 5, 6 and 7 have the lowest sensitivity.

The area's popularity as a recreational fishing destination and the need for foreshore access would need to be considered in the provision of any infrastructure over the water in the channel area.

The spatial qualities of the study area would be impacted by major or incompatible development around the foreshore; clearing of lakeside vegetation that would affect the forested backdrop or an increase in foreshore infrastructure.

Table 6-19 Landscape character zone constraints and sensitivity

Landscape character zone	Constraints	Sensitivity
Zone 1	The landscape is of a distinctive natural character and at present the bridge's low visibility as a contrasting element means it is relatively unimposing in this zone. The sensitivity of this zone to change is high.	High
Zone 2	Change that contrasts with the dominant elements would be highly visible. Impact on this landscape character zone is possible, as the site's sensitivity to change is classified as high.	High
Zone 3a	Sensitivity to change of this character zone is considered moderate given that the bridge provides access for recreation on the lake and within the township.	Moderate

Landscape character zone	Constraints	Sensitivity
Zone 3b	The sensitivity to change within this zone is moderate, as the bridge does not have a large influence on the character within this zone. The impact of change to the bridge would be moderate.	Moderate
Zone 4	This zone has high sensitivity to change. Change that contrasts with the steep landform and uniform visual texture and colour would be highly visible. As the bridge is not located adjacent to this zone, the impact would be negligible.	Negligible
Zone 5	Burrill Lake is the principal landscape feature within this zone. Therefore the sensitivity of change within the zone is high, and the proposal would be likely to impact the zone.	High

Visual envelope and sensitive visual receivers

The existing bridge has a low profile, with heavy vehicles in particular visible above the existing concrete safety railing. A change in alignment or height may therefore also impact the visibility of the traffic using the bridge, meaning this visual element needs to be considered in addition to the visibility of the bridge itself. An increase in traffic on the bridge, including trucks and buses, may increase visibility from sensitive receivers at certain times of the day. Also, certain weather conditions may result in an increase in reflectivity from traffic. An additional visual envelope showing the likely visual catchment of truck traffic on the bridge has been generated and included in Appendix F.

Potential magnitude of impact

Depending on the preferred option, the magnitude of possible impact may range from high to negligible. Construction activities often have a greater visual impact than operation, although are temporary in nature. Any construction staging works within the bridge's visual envelope would change the visual landscape and may extend beyond the immediate bridge location.

During operation, changes to height, mass or structure of existing dominant structural elements or materials may contribute to a higher magnitude change. Changes to underwater elements may be considered negligible. Three of the sensitive visual receivers identified as having a high sensitivity to change (in Table 6-17) have the potential to be highly impacted by changes to the bridge. These receivers are likely to suffer a major change in the character of their viewing experience, which may lead to a high impact grading.

6.7.3 Recommendations

Design

The following matters should be taken into consideration in developing the concept design:

- Avoid and minimise impacts on landscape character elements through sensitive siting of both temporary and permanent works to areas of low sensitivity where possible.
- Leverage opportunities to strengthen landscape character by removing existing elements that are inconsistent with the qualities that contribute to the sense of place.
- Avoid introducing visual elements that are inconsistent with the existing visual character.
- Reduce any visual impact through:
  - Responsive engineering.
  - Architectural treatment of the bridge structure that is considerate and sympathetic to the existing visual environment.
- Remedy or offset residual impacts through:
  - Leveraging opportunities to strengthen landscape character through the provision of infrastructure that would increase the level of existing amenity.
  - Leveraging opportunities to reduce existing negative visual elements such as overhead infrastructure.
  - Leveraging opportunities to strengthen the impact existing positive visual elements such as the water body and vegetation.
  - Increased planting to provide visual screening at selected off-site locations.
  - Offset planting at selected off-site locations.
- Where impacts on landscape character zones of high sensitivity cannot be avoided, appropriate design of maintenance elements or new structure may reduce any adverse visual impacts.

Environmental assessment

The following recommendations are made for consideration during the environmental assessment phase once the preferred option has been selected.

- A visual impact and landscape character assessment of the preferred option should be undertaken and included in the environmental assessment.
- Mitigation measures identified in Appendix F should be included where appropriate as part of the future environmental assessment.

6.8 Air quality

6.8.1 Existing environment

The study area is located on the east coast of NSW and is subject to sea breezes. The area is dominated by an urban environment, natural bushland and Burrill Lake. Local air quality within the study area is considered to be relatively good due the large tracts of natural vegetation in the vicinity. The most common pollutant source within the study area is motor vehicles which use the Princes Highway and the surrounding road network.

A search of the National Pollutant Inventory (NPI) was undertaken on June 29, 2012 for the postcode 2539, which is the suburb of Burrill Lake. The NPI contains data on 93 substances around Australia that have been identified by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities as important due to their possible effect on human health and the environment. The search indicated that there is one facility emitting two substances located around 4.5 kilometres northeast of the study area, the Ulladulla Sewage Treatment Plant (area), emitting nitrogen and phosphorus during the 2010/11 reporting period.

The Shoalhaven State of Environment Report (Shoalhaven City Council 2012a) indicates animals and poultry contributes to high odour issues within the LGA. Industrial air pollution has decreased since 2004 by around 20 per cent. Air pollution however is not a major contributor to pollution within the LGA.

6.8.2 Potential environmental opportunities and constraints

Depending on the option to upgrade the bridge, air quality may potentially decline for residents and businesses adjacent to the western approach if the bridge as roadway is moved closer to these receptors. A new bridge alignment may also increase distance between vehicles and properties, consequently improving air quality.

Air quality constraints would also be associated with the construction activities. However these would be short term in nature and appropriate safeguards would be implemented to minimise any potential impacts.

6.8.3 Recommendations

Environmental assessment

Air quality impacts should be assessed as part of any further environmental assessment. Mitigation measures within any environmental assessment completed for the preferred option would be implemented prior to the commencement of construction activities.

6.9 Land use

6.9.1 Existing environment

The study area is surrounded by an urban environment (including residential and commercial properties), Burrill Lake, and native vegetation areas. The Burrill Lake Bridge connects traffic on the Princes Highway travelling from Sydney, south towards Melbourne. The Burrill Lake catchment area is 78 square kilometres and the major land uses of the catchment include agricultural grazing to the north and eucalypt forest to the south and west.

There are a total of six urban areas around Burrill Lake, including Dolphin Point, Burrill Lake, Bungalow Park, Kings Point, Milton and West Ulladulla (referred to in Section 2.2). Some of the dwellings are occupied by permanent residents and some are holiday houses. The Dolphin Point suburb occupies high ground on the headland to the south of Burrill Inlet. The suburb of Bungalow Park occupies the southern bank of Burrill Inlet. A small portion of West Ulladulla (an area set aside for alternative rural development) is located along the eastern fringe of the catchment, to the north of the lake. The more recent suburb of Kings Point is located on a peninsula that extends westward into the northern basin of the lake. Ulladulla is closest large town to Burrill Lake, and is located around six kilometres north.

Land use immediately north of the eastern approach comprises low density residential properties, including a 200 metre stretch of commercial businesses and vacant open space. A wide setback is located south of the road before reaching the adjoining residential properties. Land use further south of the eastern approach comprises residential land uses and tourist accommodation.

Land immediately north of the western approach comprises a variety of commercial land uses including holiday apartments, tourist (caravan) parks and community services including hair dressers, post office, real estate agent, and supermarket. South of the western approach is recreational open space utilised by tourists and the community. Facilities within the area include a BBQ area, picnic tables and a children's playground. Figure 6-18 identifies the businesses, tourist facilities and accommodation surrounding the proposal.

A number of tourism businesses operate surrounding the lake, incorporating several types of accommodation and a range of water based activities. The industry is concentrated on the lake and its foreshores. Burrill Lake is a popular location for a range of recreational activities including fishing, sailing, water-skiing, boating and swimming. The sailing and water-skiing occur mainly in the lake body as the inlet is too shallow and narrow and tidal currents can be stronger at the mouth of the inlet. Commercial fishing occurred before 2002 when the lake was declared as a Recreational Fishing Haven, and oyster farming still occurs in the northernmost basin of the lake. Public space is valued by the community.

Parks and open space in the immediate area surrounding the bridge include:

- Surf beach.
- The north bank, downstream of the bridge.
- The estuary below the bridge.
- Holiday Haven visitors car park.
- The Lions park picnic area.
- The Lions park fishing site.
- The entrance area and flats.
- The channel west of the bridge.
- Thistleton Drive reserve.

0 25 50 100 150 200
Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Tourist accommodation
- Lakeview Gardens Seniors Living
- Open space
- Cadastre

GHD
CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Surrounding landuse

Figure 6-18

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

6.9.2 Potential environmental opportunities and constraints

The major land use constraint within the study area is the potential loss of open space, if a realignment option is chosen. Open space on the southern side of the western approach is often utilised by tourists and the community due to the presence of BBQ and picnic facilities and the children's playground. The open space provides the first glimpse of Burrill Lake for motorists in both directions before travelling over the bridge. Depending on the preferred option, the existing bridge could potentially be retained for recreational purposes such as fishing and provision of pedestrian access.

Another constraint within the study area is Burrill Lake which is an environmentally sensitive land use. As previously mentioned, the lake is a tourist destination for families due to its scenic qualities and recreational uses. Any construction work around the lake should avoid environmental impacts to the lake which would impact on the lake for tourism and recreational activities. In addition depending on the upgrade option for the bridge, the short term impacts on the lake may potentially impact the use of the lake for tourism and recreational activities.

The maintenance option to upgrade the bridge would alter adjacent land use during the construction phase as a result of the construction compound location, however this would be short-term in nature.

6.9.3 Recommendations

Design

The following recommendations are made for consideration during the design process during selection of the preferred option.

- Consultation with landowners, residents and businesses within the study area regarding scope and timing of the proposal should be undertaken once the concept design has been prepared.
- Sensitive land uses such as Burrill Lake, dwellings along Princes Highway, public open space and the retirement village should be considered during the development of the concept design to avoid or minimise any potential impacts.

Environmental assessment

Any further environmental assessment should include results of consultation undertaken with affected landowners, residents and businesses.

6.10 Traffic and access

6.10.1 Existing environment

Burrill Lake is located around four kilometres south of Ulladulla on the NSW South Coast. The Princes Highway forms part of Motorway 1. The two-lane undivided road crosses Burrill Lake on a causeway and low-level bridge that was built in 1958. The bridge is used for both vehicular and pedestrian crossing of Burrill Lake. The existing bridge is a composite prestressed unit bridge with six spans of 9.14 metres each and

an overall length of 54.86 metres. The bridge has a carriageway of 8.5 metres with a 1.53 metre footway on the western side of the bridge. Reinforced concrete safety barriers are provided on each side of the bridge. The causeway is the eastern approach of the bridge. The speed limit within the study area is 60 km/h.

Four local roads run off the Princes Highway within one kilometre of the bridge. McDonald Parade and Princess Avenue are located within 400 metres east of the existing bridge. Balmoral Avenue and Dolphin Point Road are located about 200 metres west of the existing crossing. The Jorgy's Way, 200 metres to the west of the existing bridge, provides access to Bungalow Caravan Park.

RMS annual average daily traffic (AADT) data for vehicle movement on the Princes Highway 1.5 kilometres south of the Burrill Lake Bridge indicate that an average of 6144 vehicles travelled across the bridge daily in 2006 (RMS, 2006). Of these vehicles, nine per cent comprise heavy vehicles. Using the 2006 data, AADT predictions are about 6947 vehicles for 2010 (13 per cent increase), 7546 vehicles for 2015 (23 per cent increase), 8146 vehicles for 2020 (33 per cent increase) and 9346 vehicles for 2030 (52 per cent increase).

A traffic count conducted by GHD on the Princes Highway (GHD, 2012), 100 metres east of the Burrill Lake Bridge, was undertaken between 21 May and 4 June 2012. The traffic count indicated that an average of 8045 vehicle movements in Week 1, and 7633 movements in Week 2 travelled across the bridge. The traffic count data has been included in Appendix G. the 2012 traffic counts indicated a substantial increase in traffic growth in the area (about 24 to 30 per cent between 2006 and 2012) which is inconsistent with the long term growth shown over the successive years. This could be due to an increase in nearby activity (such as RMS rehabilitation works about two kilometres south of the study area).

The numbers of vehicles using this road are likely to increase in school holiday periods due to tourism in the general area.

Commercial businesses are located along the highway within the study area. Access to these properties is generally via the highway on the eastern approach to the bridge, and mostly via Balmoral Road (around 20 metres west of the western approach). On-street parking is located along highway along the eastern and western approaches to the bridge. Balmoral Street also provides on-street parking for commercial properties adjacent to the western approach to the bridge.

Pedestrian paths are located on the northern side of the northbound lane of the highway within the study area. The pedestrian path along the bridge is utilised by local residents and tourists as the path connects the commercial properties and tourist accommodation on both sides of the bridge. A pedestrian island is located around 45 metres west of the western approach to the bridge. The island assists pedestrians walking between the post office and the recreational area. A pedestrian path is also located through the recreational area adjacent to the western approach to the bridge.

6.10.2 Potential environmental opportunities and constraints

The section of the Princes Highway in the study area is the only direct coastal route between Sydney and Melbourne, with other routes involving long detours (eg via Nerriga Road and Kings Highway, a western route between Nowra and Batemans Bay). Due to this section of road being a key component of Highway 1, the design would need to allow for the road to remain open at all times during construction.

The local road network would be a constraint for preliminary design as there is a need to ensure that traffic can access both sides of the bridge. Where an upgrade option is considered traffic may be inconvenienced by construction if a single lane is closed, restricting traffic to one operational lane. Other streets within close proximity to the bridge that require access from the Princes Highway include Balmoral Road (20 metres west of the bridge), Dolphin Point Road (120 metres west of the bridge), and Princess Avenue South (located 170 metres east of the bridge). These streets provide access to residential properties and recreational areas within the study area. Access to these local roads would be a constraint that would need to be considered in the design phase and construction planning phases.

Depending on the chosen design option, motorists accessing commercial businesses on each side of the bridge may be inconvenienced by an increased in travel time. It is important to maintain or preferably improve access to these areas.

During construction, access to commercial businesses may be restricted, resulting in economic losses throughout the area. The shoulder lane of the Princes Highway is currently used for parking and may not be accessible during construction. Adequate parking and access should be maintained throughout construction.

Ensuring continued access to emergency services throughout Burrill Lake is a key consideration for any potential maintenance or construction works on the bridge, particularly as the bridge provides the only connection for vehicles between each side of the lake (discussed further in Section 6.11).

The option to build a new bridge could be seen as an opportunity to provide infrastructure for increased traffic. A new bridge would accommodate for increased motorists.

There may also be the opportunity to provide separated cycle/pedestrian paths. As the area is predominantly a tourist destination, a cycle and pedestrian path would promote sustainable transport within the area. This could be provided as individual paths or as a shared user path where there is insufficient area for substantial additional widening of the road corridor. Furthermore, the preferred option would seek to maintain the structural integrity of the bridge, providing a safe road network for road users, pedestrians and cyclists.

6.10.3 Recommendations

Design

The following recommendations are made for consideration during the design process during selection of the preferred option.

- Additional traffic counts and investigations should be undertaken during the design phase to verify likely vehicle numbers and assist with options development. Suggested locations for traffic counts are at the 2006 location, the 2012 location, and some intersection counts at the highway and local road junctions (such as McDonald Parade, Balmoral Road and Dolphin Point Road).
- The design should ensure access is maintained onto side roads and the local road network.
- The design should take into account staging of the road to ensure accesses to all commercial businesses are maintained during construction.
- Design to consider opportunities for provision of cycle and pedestrian paths.

6.11 Social and economic

A socio economic issues investigation for the study area was undertaken by GHD in April 2013. A copy of the report is provided in Appendix H. The methodology for this investigation included:

- Review of various technical data and a land use survey.
- Demographic and social research, including analysis of ABS data.
- Review of previous consultation undertaken by RMS.
- Consultation with businesses and shoppers.

6.11.1 Existing environment

Demographic profile

The suburb of Burrill Lake is made up of three census collection districts, referred to as Burrill Lake East, Burrill Lake West and Burrill Lake South.

In 2011, the population of Burrill Lake suburb was 1328 people. Population forecasts for the area indicate that by 2036 there will be an increase of about 1135 people. The growth rate, over a 25 year period is 1.17 per cent per annum, which is lightly lower than the growth rate for the Shoalhaven LGA.

Burrill Lake is characterised by an older population, with almost half the population aged 50 years and over, reflecting the trend for many retirees making a ‘sea change’ to the area. All three Burrill Lake census collection districts have more seniors compared to the state average.

The 2006 Socio-Economic Indexes for Areas scores for the Burrill Lake and surrounding Collection Districts show that Burrill Lake West has a lower level of

disadvantage, while Burrill Lake South and Burrill Lake East have higher levels of disadvantage.

Social infrastructure

The social infrastructure located in Burrill Lake services a small catchment of residents and tourists. Key social infrastructure such as schools, libraries, large shopping centres, and childcare are located to the north in Ulladulla. Additionally, key social infrastructure is also located in Milton and Batemans Bay.

As well as the businesses fronting the highway, the eastern side of town features a medium sized sports field with a cricket pitch, and a small park with a playground. There is also a community hall located directly adjacent to the Princes Highway, heading towards Ulladulla, and a Lions Hall just to the north of the bridge on the southern side of the highway. A general practitioner operates from a small shopfront one day per week (Wednesdays between 9.30 and 12 pm).

Social infrastructure on the western side of town includes the small shopping village, seniors living accommodation, and Lions Park. Public beach access is located at Dolphins Point.

There is a pedestrian footpath on the northbound side of the highway which crosses the bridge. The pathway provides the only pedestrian access between the northern and southern sides of the town. The bridge also provides an opportunity for fishing in the lake.

Travel behaviour, transport and traffic patterns

Most of the suburb of Burrill Lake is within about 800 metres walk of the shopping village, shops to the north of the bridge and Lions Park. The area provides opportunities for short pedestrian and bicycle trips for local residents and tourists.

The majority of employed residents (71.2 per cent) are highly dependent on private motor vehicles to travel to work. It is likely that most people who travel to work by private car would travel via the Princes Highway on a daily basis, with many crossing Burrill Lake Bridge.

Additionally, 95.7 per cent of Burrill Lake households own motor vehicles, which is only slightly lower than the Shoalhaven LGA average (96.7 per cent of households).

Burrill Lake is connected to the north and south by a public bus service, provided by Ulladulla Bus Lines. The 740 and 741 bus routes run Monday to Friday, connecting Kioloa in the south to Narrawallee in the north, between approximately 7.30am and 5pm. The 740 service also operates on a Saturday morning. Ulladulla Bus Lines also operates school buses which service all schools within the Ulladulla Area. Other regular bus services which travel along the Princes Highway through Burrill Lake include:

- A daily service from Sydney to Melbourne operated by Premier Motor Service.
- A scenic bus service from Parramatta to Moruya (south of Batemans Bay) operated by Priors Scenic Express on Monday, Wednesday, Thursday, Friday and Sunday.

- A daily service which runs according to demand, from Milton to Batemans Bay, operated by Rixons.

As only a small proportion of Burrill Lake residents (6.8 per cent) travel to work by public transport, it is also likely that most residents travel by private car when travelling through the region.

With the Princes Highway, a major road connecting Sydney to Melbourne, running through the middle of town, Burrill Lake often experiences heavy traffic volumes, leading to traffic congestion at times. Consultation with Shoalhaven City Council staff has revealed that the Burrill Lake Bridge plays a vital role in the transport network, with a variety of road users such as freight companies, large supermarkets, significant services, or workers crossing the bridge on a daily basis.

Local economy

The major economic driver for Burrill Lake is tourism, which is also the key industry for the Shoalhaven LGA. This is reflected in the industrial structure of Burrill Lake, with the highest proportions of employed persons working in retail or accommodation and food services. Other key industries for Burrill Lake include health care & social assistance, and construction.

Compared to the LGA, Burrill Lake residents are more dependent on the tourism industry for their employment, revealing the importance of tourism to the local economy.

Shoalhaven is the most visited LGA in NSW outside of the Sydney region. The tourism sector is one of the major economic activities in Shoalhaven LGA. In the year ending June 2011, an estimated 1.27 million people visited the area. Most domestic overnight visitors (90.7 per cent) travel to the south coast by car.

Burrill Lake is a holiday destination for many families and offers a range of tourist accommodation options. In the year ending March 2012, the most popular accommodation options for visitors to the Shoalhaven were staying with friends/relatives, caravan/camping and holiday rentals (Shoalhaven City Council, 2011). This is reflected in the tourism accommodation options available in Burrill Lake and surrounds.

Census data for Burrill Lake indicates that 29.2 per cent (232 dwellings) of private dwellings are unoccupied. This is higher than the average for the LGA (27.5 per cent) and over double that for the state (9.7 per cent), and could indicate that a number of dwellings are used for holiday rental purposes.

The surveys with shoppers and businesses (refer to Section 5) demonstrate that most of the businesses in Burrill Lake rely on trade from tourists, with most of the shops which front the highway on either side of the bridge attracting trade from passing motorists. Observations and interviews with business owners/staff imply that a number of these shops attract customers due to their convenient location to the highway and ability for motorists to park their vehicles directly in front of businesses.

Community and health and safety

Burrill Lake is serviced by emergency services based in Ulladulla or Batemans Bay, with police, fire and ambulance located in both larger centres. The nearest hospitals are located at Milton and Batemans Bay.

Pedestrian and cyclist access and safety was raised as a key community concern by a number of respondents to the shopper and business surveys undertaken by GHD. There is a perception amongst community members that the Princes Highway can be unsafe for pedestrians to cross, and that the existing pathway which spans the bridge is not considered safe.

6.11.2 Potential environmental opportunities and constraints

The future options for the Burrill Lake Bridge would provide a number of potential social and economic opportunities. Retaining and maintaining the existing bridge could provide opportunities to improve pedestrian and road user safety, as well as maintain the local character and amenity of Burrill Lake, which attracts the many tourists which the town is economically dependent on.

Additionally, the replacement of the existing bridge with a bridge on a new alignment could lead to the removal of the causeway, which is associated by many community members with the poor health of the lake.

Given the older population of Burrill Lake, consideration should be given to vulnerability of this group to impacts resulting from any maintenance or construction works. These impacts could be related to noise and vibration, air quality and visual impacts or accessibility to services and businesses. These amenity constraints are further discussed in the following sections:

- Noise and vibration - Section 6.5.
- Visual impacts - Section 6.7.
- Air quality – Section 6.8.
- Land use – Section 6.9.
- Traffic and access - Section 6.10.

There is a high reliance on motor vehicles for travel within the area. The majority of Burrill Lake residents commute by motor vehicle to their place of work. In addition, emergency services, public bus users including school students, and other road users such as transport companies travel along the Princes Highway and access Burrill Lake Bridge. Any disruptions to traffic flow as a result of maintenance or construction works would be a constraint for road users as it could have a negative impact on the travel time for commuters and other road users.

Burrill Lake is the key feature of the town, and attracts many tourists in peak seasons. Additionally, the Lions Park which is adjacent to the highway is a key community facility, providing for recreational uses of residents, tourists and passing motorists.

As the Princes Highway is a key piece of infrastructure in the regional transport network, with high traffic volumes crossing the bridge on a daily basis, such as public

transport and freight companies, any change to this infrastructure would be a constraint for local road users. Improvement or replacement of the bridge has the potential to improve travel times, decrease congestion and improve road safety for all road users and is seen as a long term opportunity.

Burrill Lake is highly dependent on tourism to the area, with many businesses reliant on trade from visitors. Improvement or replacement of the bridge could provide an opportunity to address traffic congestion in Burrill Lake, leading to flow on benefits for tourists travelling through the area. Any maintenance or construction activities should ensure continued access to these businesses for motor vehicles which is convenient. Additionally, any designs for a replacement bridge should consider visibility of these businesses from the highway, as well as convenient access for motor vehicles. In the event of bridge realignment, opportunities to create or enhance adjacent open spaces could benefit passing trade, tourists and residents alike.

Commercial businesses within the study area reported various levels of dependence on trade from passing motorists. Access to these businesses are considered to be a constraint for the future upgrade of the Burrill Lake Bridge.

Potential maintenance and construction works could lead to noise, vibration and visual impacts, which could negatively impact on the tourism industry. Replacement of the bridge is also likely to lead to changes in the visual landscape.

Depending on the chosen design option, replacement of the bridge may provide an opportunity to improved safety for pedestrians and cyclists in Burrill Lake through improvements to road, pedestrian and cyclist infrastructure, addressing road safety concerns and improving road infrastructure.

6.11.3 Recommendations

Design

- Continue to engage with the community and stakeholders in the development of the future of the highway crossing to protect attributes that the community values and promote local ownership of the decision.
- Ensure that the key socio-economic opportunities and constraints which have been identified in socio economic investigation report (Appendix H) inform the development of future options for the Burrill Lake Bridge.
- Ensure the local community, businesses and stakeholders are kept informed on the progress of the options development, and preferably involved in their development.
- Any designs should seek to ensure continued convenient access to and visibility of businesses to passing motorists.
- Any designs should seek to ensure that local resident and tourist pedestrian/cyclist access to facilities is maintained or enhanced.
- Any potential options for the bridge should seek to minimise any negative impacts on public access to the lake for recreational purposes.

- Continued access to the park should be maintained for any potential option.
- Urban design would need to consider negative impacts on the local character of the area during the design phase.

Environmental assessment

- A socio-economic impact assessment should be completed based on the chosen design option.

Construction

- Any potential maintenance or construction activities should take the variations in traffic volumes on the bridge across days of the week and times of the day into consideration to reduce the impacts on the various road users, such as increased travel time.
- Develop a plan for construction works and activities in consultation with the community and stakeholders to avoid peak tourist times and times which will most impact on the local community.

6.12 Greenhouse gases and climate change

The landscape around Burrill Lake has changed significantly over time primarily in response to changing sea levels related to periods of global glaciation. During the last glacial maximum (around 24,000 to 17,000 years ago) the sea level was around 130 metres below the present level (Artefact Heritage Services, 2012).

Climate change refers to the warming temperatures and altered climate conditions associated with the concentration of gases in the atmosphere, known as greenhouse gases. In 2008 the NSW Government published refined climate change projections for each region in NSW including the Sydney region.

The projected regional climatic changes by 2050 for NSW Illawarra region show that 'it is projected that the Illawarra region would become warmer and, slightly wetter. Sea levels would rise, changing flood patterns and affecting the coast' (DECC, 2008).

Some regional changes are predicted to include changes in temperature as days are projected to be hotter over all seasons (1.5 to three degrees Celsius). The region is projected to experience a substantial increase in summer rainfall and a slight to moderate increase in spring/autumn rainfall, with evaporation increases for summer and spring. Changes in rainfall are projected to make conditions in winter and spring drier. Along the coast, storm events and sea level rise are projected to exacerbate coastal erosion, as well as subsequent inundation of low lying areas. Sea level is projected to rise up to 40 centimetres above 1990 mean sea level by 2050 and by 90 centimetres by 2100. There may be localised flooding impacts at river locations.

6.12.1 Potential environmental opportunities and constraints

Constraints associated with climate change mainly related to construction programming. Higher rainfall in the summer months may increase the chance of erosion and sedimentation from exposed soils within the study area and stockpiles.

Lower winter temperatures have the potential to slow the rate at which soils dry out, and potentially affect accessibility to excavated zones. This can prolong the period of soil exposure, and again increase the risk of erosion.

There is the opportunity to provide measures to accommodate additional stormwater levels to target potential increased rain events.

The construction phase would potentially result in a small amount of greenhouse gas emissions being produced through:

- Land clearing that may be required to accommodate additional road width.
- Liquid fuel use in plant and vehicles (diesel, petrol) during construction.

At this stage it is not possible to accurately estimate the emissions likely to be generated, as this is dependent on final construction methodology, materials and suppliers. The magnitude of these emissions would depend on the amount of earthworks required.

Apart from the vehicle or plant emissions, emission sources during the construction phase would mostly be associated with the materials used and any potential vegetation clearing.

The proposal may also have the effect of reducing emissions by having the opportunity to provide cycling and pedestrian facilities once in operation. This would reduce the need to depend on private vehicles and potentially reduce associated greenhouse gas emissions.

There is an opportunity for less greenhouse gases to be emitted during construction if rehabilitating the existing bridge option is chosen, rather than replacing the existing bridge. Rehabilitating the existing bridge may potentially require less materials to be transported to the study area and less construction equipment during construction.

During operation, the Princes Highway would continue to operate as an important transport corridor. As discussed in Section 6.10.1, traffic in the area is expected to grow, however this would not be a direct result of any future upgrade of Burrill Lake Bridge.

6.12.2 Recommendations

Design

The following recommendations are made for consideration during the design process during selection of the preferred option.

- Further investigation into the opportunity for reducing greenhouse gas emissions during construction and operation of the proposal would be undertaken during the detailed design phase.
- The design would need to consider potential vehicle emission increases likely to occur as a result of the proposal (such as minimising the bridge elevation to minimise vehicle acceleration, and increased emissions).
- Investigate the opportunities for provision of public transport.

Environmental assessment

Any further environmental assessment should include quantification of greenhouse gas emissions and an assessment of climate change risks.

7. Conclusion and recommendations

7.1 Summary of results

This environmental investigations report has been prepared to identify potential constraints to upgrade the Burrill Lake Bridge. The environmental investigations report focused on the study area identified in Figure 1-2, to assist in developing options for the Burrill Lake Bridge upgrade, minimising the potential for impacts to the local and regional environment and community.

Several key significant constraints have been identified in the environmental investigations report which could limit the upgrade potential of the Burrill Lake Bridge. The following constraints have been identified:

- Three threatened ecological communities listed under the TSC Act and one marine vegetation specie listed under the FM Act, are located within the study area and are considered to be of high ecological constraint, including:
  - Bangalay Sand Forest.
  - Coastal Saltmarsh.
  - Swamp Oak Floodplain Forest.
  - Seagrass.
- Potential habitats for threatened species within the study area are considered to be of medium ecological constraint. These include drains and swampy areas that may be habitat for the Green and Gold Bell Frog, as well as Burrill Lake Bridge which may be used as roosting habitat by bats.
- The existing causeway provides a degree of scour protection during 1 in 5 year ARI events and further consideration of full or partial removal should be undertaken.
- Two PAD locations were identified within the study area. It is likely that the proposal may impact on the PAD areas if the bridge is to be replaced to the east.
- Any proposed change to the Burrill Lake Bridge has the potential to impact on sensitive receivers as a result of noise and vibration associated with construction works, particularly those within 25 metres of the proposal. These sensitive receivers are:
  - R1 - 39 Balmoral Rd.
  - R2 - 37 Balmoral Rd.
  - R5 - 119 Princes Highway.
  - R7 - 113 Princes Highway.
  - R13 - 122/124 Princes Highway.
  - P1 – Passive recreation area, Princes Highway.

- The two closest sensitive receivers, which are located within five metres of the proposal, would potentially receive high levels of noise and vibration impact. These properties are located at:
  - 113 Princes Highway – five metres north of the eastern approach.
  - 39 Balmoral Road – five metres north of the western approach.
- The causeway structure may contain contaminants, for example heavy metals, petroleum products or asbestos which may result in contamination within Burrill Lake if the causeway was to be removed without appropriate safeguards in place.
- Upgrading the bridge, involving a new structure or style of foundations may change the surface, groundwater and tidal flow regime of the area which could result in impacts such as flooding or erosion.
- The proposal has the potential to impact on highly sensitive views from viewpoints 1, 2 and 3.
- The proposal may result in economic impacts to local businesses if traffic access and parking is not maintained.

These key constraints are identified in Figure 7-1.

A summary of recommendations as outlined in Section 6 is provided in Table 7-1.

.

0 25 50 100 150
Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Closest residential sensitive recievers
- Key local businesses
- Possible contamination
- PAD 1
- PAD 2
- Study area
- High ecological constraint
- Medium ecological constraint

GHD
CLIENTS | PEOPLE | PERFORMANCE

Roads & Maritime Services
Burrill Lake Bridge: Environmental Investigation

Job Number	21-21478
Revision	0
Date	09 Apr 2013

Potential constraints

Figure 7-1

N:\AU\Sydney\Projects\21\21478GIS\Maps\23_21478_Z007_SensitiveRecievers.mxd

Data Source: GHD: Ecological constraint areas, 2012; Artefact Heritage Services: PAD locations, 2012; Geoscience Australia: 250k Data - Jan 2011; Google Earth Pro: Imagery, Accessed: 12/07/2012. Created by: qjchung

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Table 7-1 Summary of recommendations

Environmental factors	Recommendations
Biodiversity	**Design** • Minimise impacts on seagrass and endangered ecological communities. Any activity that may harm seagrass must be referred to DPI. • Seasonal surveys may be required for some species to better determine potential for impacts resulting from the proposal, including: – Green and Golden Bell Frog – during summer. – Large-footed Myotis – late winter (prior to females leaving for maternity roosts), or pre-demolition surveys. – Eastern Bentwing Bat – late winter (prior to females leaving for maternity roosts), or pre-demolition surveys. – *Cryptostylis hunteriana* – during summer. – *Galium australe* – during summer. – *Genoplesium vernale* – during spring. **Environmental assessment** • Undertake a detailed ecology assessment which would include an assessment of the impacts of the chosen project option. The ecology assessment would also include an assessment of significance to determine whether any impact on threated biota would be significant. • In reference to seagrass, as a general rule, DPI has a 2:1 habitat replacement policy, meaning that if a habitat is harmed, damaged or removed, then offsets must be provided for double the amount that originally occurred. RMS may be required to rehabilitate seagrass beds as a result of the proposal.
Water quality, hydrology and geomorphology	**Design** • A detailed hydraulic assessment of the preferred option should be carried out during concept design. • If the bridge realignment option is chosen, the design should raise the bridge level and approach roads and improve road flood immunity. • Further assessment of the potential for scour of the tidal flats and impacts on seagrass should be undertaken if the causeway was to be removed. Mitigation could involve keeping the causeway or partial removal of the causeway to

Environmental factors	Recommendations
	limit the extent of tidal flats potentially affected by increased velocities. **Environmental assessment** Consideration of water quality and hydrology impacts associated with the construction and operational phase of the upgrade would be required depending on the option adopted.
Aboriginal heritage	**Pre-design** Archaeological test excavations under the OEH Code of Practice would need to be conducted. Test excavations would be required to determine the level of significance of PAD areas and to inform an assessment of archaeological significance. **Environmental assessment** • An Aboriginal heritage assessment should form part of any further environmental assessment, particularly where it is determined that there may be impact on PADs. • Comprehensive Aboriginal consultation to be undertaken by RMS if impacts are proposed on the PAD areas, as per RMS *Procedure for Aboriginal Cultural Heritage Consultation and Investigation,* OEH *Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and Stage 3 of RMS' PACHCI. • A cultural heritage assessment report in accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and Stage 3 of RMS' PACHCI would also be prepared. The cultural heritage assessment report would address appropriate management and mitigation measures for the project area. • If it was identified that impacts to an Aboriginal site would occur, an AHIP would need to be obtained prior to construction commencing.
Non-Aboriginal heritage	**Environmental assessment** If the causeway or remains of the former wooden bridge are to be impacted or removed as a result of the preferred project option, a comprehensive Statement of Heritage Impacts including a detailed archaeological assessment would be required.

Environmental factors	Recommendations
Noise and vibration	**Environmental assessment** Once the design of the proposal is determined an operational noise and vibration assessment including modelling predictions of future operating scenarios is recommended. This may result in recommendations for operational noise and vibration mitigation.
Geology, soils and groundwater	**Design** • If the bridge and causeway are to be completely removed and a new structure built, geotechnical investigations would need to be carried out on the subsurface conditions in the area where the new bridge is likely to be built. • The unconsolidated nature of the soils in the study area would require consideration in the design and management of the proposal. **Environmental assessment** • A piling/groundwater effects assessment should be undertaken as part of any further environmental assessment. • If the causeway is to be removed or disturbed, further investigation into the nature of the material and potential for contaminants would need to be undertaken. • If the removal of the asbestos pipe is required, a class B (bonded) asbestos license contractor would need to be contracted to prevent any risk of contamination migration. • ASS should be considered in the design and management of the proposed development. The 'Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze' (RTA, 2005) should be used as a guide for management of ASS if additional structures were be built within the study area.
Visual and landscape character	**Design** • Avoid and minimise impacts on landscape character elements through sensitive siting of both temporary and permanent works to areas of low sensitivity where possible. • Leverage opportunities to strengthen landscape character by removing existing elements that are inconsistent with the qualities that contribute to the sense of place. • Avoid introducing visual elements that are inconsistent with the existing visual character.

Environmental factors	Recommendations
	• Reduce any visual impact through: – Responsive engineering. – Architectural treatment of the bridge structure that is considerate and sympathetic to the existing visual environment. • Remedy or offset residual impacts through: – Leveraging opportunities to strengthen landscape character through the provision of infrastructure that would increase the level of existing amenity. – Leveraging opportunities to reduce existing negative visual elements such as overhead infrastructure. – Leveraging opportunities to strengthen the impact existing positive visual elements such as the water body and vegetation. – Increased planting to provide visual screening at selected off-site locations – Offset planting at selected off-site locations. • Where impacts on landscape character zones of high sensitivity cannot be avoided, appropriate design of maintenance elements or new structure may reduce any adverse visual impacts. **Environmental assessment** • A visual impact and landscape character assessment of the preferred option should be undertaken and included in the environmental assessment. • Mitigation measures identified in Appendix F should be included where appropriate as part of the future environmental assessment.
Air quality	**Environmental assessment** Air quality impacts should be assessed as part of any further environmental assessment. Mitigation measures within any environmental assessment completed for the preferred option would be implemented prior to the commencement of construction activities.
Land use	**Design** • Consultation with landowners, residents and businesses within the study area regarding scope and timing of the proposal should be undertaken once the concept design has

Environmental factors	Recommendations
	been prepared. • Sensitive land uses such as Burrill Lake, dwellings along Princes Highway, public open space and the retirement village should be considered during the development of the concept design to avoid or minimise any potential impacts. **Environmental assessment** Any further environmental assessment should include results of consultation undertaken with affected landowners, residents and businesses.
Traffic and access	**Design** • The design should ensure access is maintained onto side roads and the local road network • The design should take into account staging of the road to ensure accesses to all commercial businesses are maintained during construction. • Design to consider opportunities for provision of cycle and pedestrian paths.
Social and economic	**Design** • Continue to engage with the community and stakeholders in the development of the future of the highway crossing to protect attributes that the community values and promote local ownership of the decision. • Ensure that the key socio-economic opportunities and constraints which have been identified in socio economic investigation report (Appendix H) inform the development of future options for the Burrill Lake Bridge. • Ensure the local community, businesses and stakeholders are kept informed on the progress of the options development, and preferably involved in their development. • Any designs should seek to ensure continued convenient access to and visibility of businesses to passing motorists. • Any designs should seek to ensure that local resident and tourist pedestrian/cyclist access to facilities is maintained or enhanced. • Any potential options for the bridge should seek to minimise any negative impacts on public access to the lake for recreational purposes.

Environmental factors	Recommendations
	• Continued access to the park should be maintained for any potential option. • Urban design would need to consider negative impacts on the local character of the area during the design phase. **Environmental assessment** • Any potential maintenance or construction activities should take the variations in traffic volumes on the bridge across days of the week and times of the day into consideration to reduce the impacts on the various road users, such as increased travel time. • A socio-economic impact assessment should be completed based on the chosen design option. **Construction** • Develop a plan for construction works and activities in consultation with the community and stakeholders to avoid peak tourist times and times which will most impact on the local community.
Greenhouse gases and Climate change	**Design** • Further investigation into the opportunity for reducing greenhouse gas emissions during construction and operation of the proposal would be undertaken during the detailed design phase. • The design would need to consider potential vehicle emission increases likely to occur as a result of the proposal (such as minimising the bridge elevation to minimise vehicle acceleration, and increased emissions). • Investigate the opportunities for provision of public transport. **Environmental assessment** Any further environmental assessment should include quantification of greenhouse gas emissions and an assessment of climate change risks.

8. References

ABS, 2006, 2011. ‘Quick Stats: Postcode 2593’, Australian Bureau of Statistics.

Artefact Heritage Services, 2012. ‘DRAFT Aboriginal and non-Indigenous heritage constraints assessment’.

Aurecon, 2010. ‘Strategic Concept and Options Study Burrill Lake Bridge’, December 2010.

WBM, 2007. ‘Burrill Lake Catchment Flood Study’, WBM Pty Ltd.

Cropper, S.C. 1993. ‘Management of Endangered Plants’. Department of Conservation, Forests and Lands, Victoria and the Australian Nature Conservation Agency. CSIRO, Victoria.

DECC, 2008. ‘Summary of Climate Change Impacts: Illawarra Region’, Department of Environment and Climate Change.

DECCW, 2009. ‘NSW Sea Level Rise Policy Statement’, Department of Environment, Climate Change and Water NSW.

Department of Planning, 2007. ‘South Coast Regional Strategy 2006-31’, NSW Department of Planning. Retrieved 3 July 2012 from http://www.planning.nsw.gov.au/southcoast/p/southcoast_regionalstrategy.pdf

DPI, 2002. Seagrass mapping: Narrawallee Inlet, Mollymook Creek, Ulladulla and Burrill Lake. http://www.dpi.nsw.gov.au/research/areas/aquatic-ecosystems/estuarine-habitats-maps/IINSW_EstMac_map51.pdf

GHD, 2012. ‘Traffic Count’, GHD Pty Ltd. Conducted between 21 May and 4 June, 2012.

Infrastructure NSW, 2012. ‘State Infrastructure Strategy 2012’, Infrastructure NSW. October, 2012.

Land and Water Conservation, 1997, ‘The land and Water Conservation Map: Acid Sulfate Soil Risk Map’, Tabourie. Edition 2 December 1997

NSW Department of Lands, 2012, ‘Spatial Information Exchange’, NSW Department of Lands and Property Information. Retrieved 3 July 2012 from https://six.nsw.gov.au/wps/portal/

NSW Government, 2011a, ‘NSW 2021’, NSW Government. Retrieved 3 July 2012 from http://2021.nsw.gov.au/sites/default/files/NSW2021_Plan%20Goals.pdf

OEH, 2011. ‘NSW Road Noise Policy’, Office of Environment and Heritage. March 2011.

OEH, 2012, ‘NSW Natural Resource Atlas’ , Office of Environment and Heritage.

RMS, 2006. ‘Annual Average Daily Traffic data: Southern Region’, Roads and Maritime Services.

Rose G., 1966, Ulladulla 1:250 000 Geological Sheet SI/56-13, 1st edition, Geological Survey of New South Wales, Sydney

RTA, 2005, 'Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze', Roads and Traffic Authority. Retrieved from http://www.rta.nsw.gov.au/environment/downloads/rta_asm_guideline.pdf

RTA, 2010, 'Burrill Lake Bridge: Preliminary Environmental Investigation', Roads and Maritime Authority. December 2010

Specht, R.L., 1970.'Vegetation', in G.W. Leeper (ed.), The Australian Environment, 4th edition. CSIRO and Melbourne University Press, pp. 44–67.

Shoalhaven City Council, 2002. 'Burrill Lake Estuary and Catchment Management Plan, Shoalhaven City Council

Shoalhaven City Council, 2012a, 'State of the environment report- Comprehensive report 2008/12'. Shoalhaven City Council

Shoalhaven City Council, 2012b. 'Maps online', Shoalhaven City Council. Accessed on 10 July, 2012 from http://www.shoalhaven.nsw.gov.au/PlanningampBuilding/Mapsonline.aspx

Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, P. and Cox, S., 2010. Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11: 359-406.

NSW Government, 2012. 'NSW Long Term Transport Master Plan', NSW Government. December 2012.

9. Terms and acronyms used in this EI

AADT	Annual average daily traffic
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW.
Aboriginal place	Any place declared to be an Aboriginal place under s.94 of the *National Parks and Wildlife Act 1974*.
Acid sulphate soils	Naturally acid clays, muds and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen.
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Background noise level	The ambient sound-pressure noise level in the absence of the sound under investigation exceeded for 90 per cent of the measurement period. Normally equated to the average minimum A-weighted sound pressure level.
Catchment	The area drained by a stream or body of water, or the area of land from which water is collected.
CEMP	Construction Environmental Management Plan
Concept design	Initial functional layout of a concept, such as a road or road system, to provide a level of understanding to later establish detailed design parameters.
dBA	Frequency weighting filter used to measure 'A-weighted_ sound pressure levels, which conforms approximately to the human ear response, as out hearing is less sensitive at very low and very high frequency.
DECC	Department of Environment and Climate Change, now the NSW Office of Environment and Heritage.
DECCW	NSW Department of Environment, Climate Change and Water.
DSEWPC	NSW Department of Sustainability, Environmental, Water, Populations and Communities.
Earthworks	The process of extracting, moving and depositing earth during construction.

EI	Environmental investigations
EP&A Act	*Environmental Planning and Assessment Act 1979.*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
FM Act	*Fisheries Management Act 1994*
GHD	GHD Pty Ltd
Heritage Act	*NSW Heritage Act 1977*
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
IUCN	International Union for Conservation of Nature
LEP	Local Environmental Plan
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAD	Potential archaeological deposit
RNP	Road Noise Policy
RMS	Roads and Maritime Services
Section 170 register	A register established in accordance with section 170 of the *Heritage Act 1977* to record all heritage items in the ownership or under control of RMS (or other state government agency).
Sensitive receiver	A sensitive receiver refers to uses that would be particularly susceptible to impacts such as noise and vibration.
SEPP 14	*State Environmental Planning Policy 14 – Coastal Wetlands*
SEPP 44	*State Environmental Planning Policy 44 – Koala Habitat*
SEPP 71	*State Environmental Planning Policy 71 – Coastal Protection*
SoHI	Statement of Heritage Impacts
Study area	Refers to the area including and adjacent to the Burrill Lake Bridge and its approaches. The study area is identified on Figure 2 1.
The proposal	Refers to the potential upgrade or replacement of the

	existing Burrill Lake Bridge
TSC Act	*Threatened Species Conservation Act 1995*
ULALC	Ulladulla Local Aboriginal Land Council