6.4 Aboriginal heritage

A *Preliminary Aboriginal Archaeological Assessment* was undertaken by New South Wales Archaeology Pty Limited in 2008 to assist with the selection of a preferred corridor and identify any Aboriginal heritage constraints in the area. Following this assessment, a new alignment was developed during phase 1 and phase 2 of the option analysis (refer to **Section 2.4.2**). Consequently a revised *Preliminary Aboriginal Archaeological Assessment* was undertaken in 2010 which considered the Aboriginal heritage constraints for options considered during these phases. The two *Preliminary Aboriginal Archaeological Assessments* were undertaken in accordance with the RMS PACHCI stage 2 – due diligence requirements.

Due to the identification of PADs in the preliminary investigations an *Aboriginal Cultural Heritage Assessment Report* (CHAR) was undertaken in 2011, which included subsurface investigations. The CHAR was undertaken in accordance with the RMS (2011) PACHCI which adheres to relevant OEH Aboriginal heritage guidelines as identified previously in **Section 5.3**.

In 2011 during phase 3 and phase 4 of the option analysis additional options were identified that avoided impacts to Gulaga National Park and were instead routed through Kooraban National Park (refer to **Section 2.4.2**). This area had not been previously assessed for Aboriginal cultural heritage and consequently an Addendum CHAR was undertaken of these unsurveyed areas. The following is a summary of the findings of the CHAR and the Addendum CHAR which are included in **Appendix J** however due to confidentiality requirements Aboriginal cultural heritage items listed under the NPW Act, specific location information has been removed. The CHAR covers areas impacted by stage 1 of the proposal, while the Addendum CHAR covers the area impacted by stage 2 of the proposal. For further details of the Aboriginal cultural heritage process, including consultation undertaken with the Aboriginal community refer to **Section 5.3**.The study area for the proposal encompasses the area contained within the survey units as defined in **Figure 6-11**.

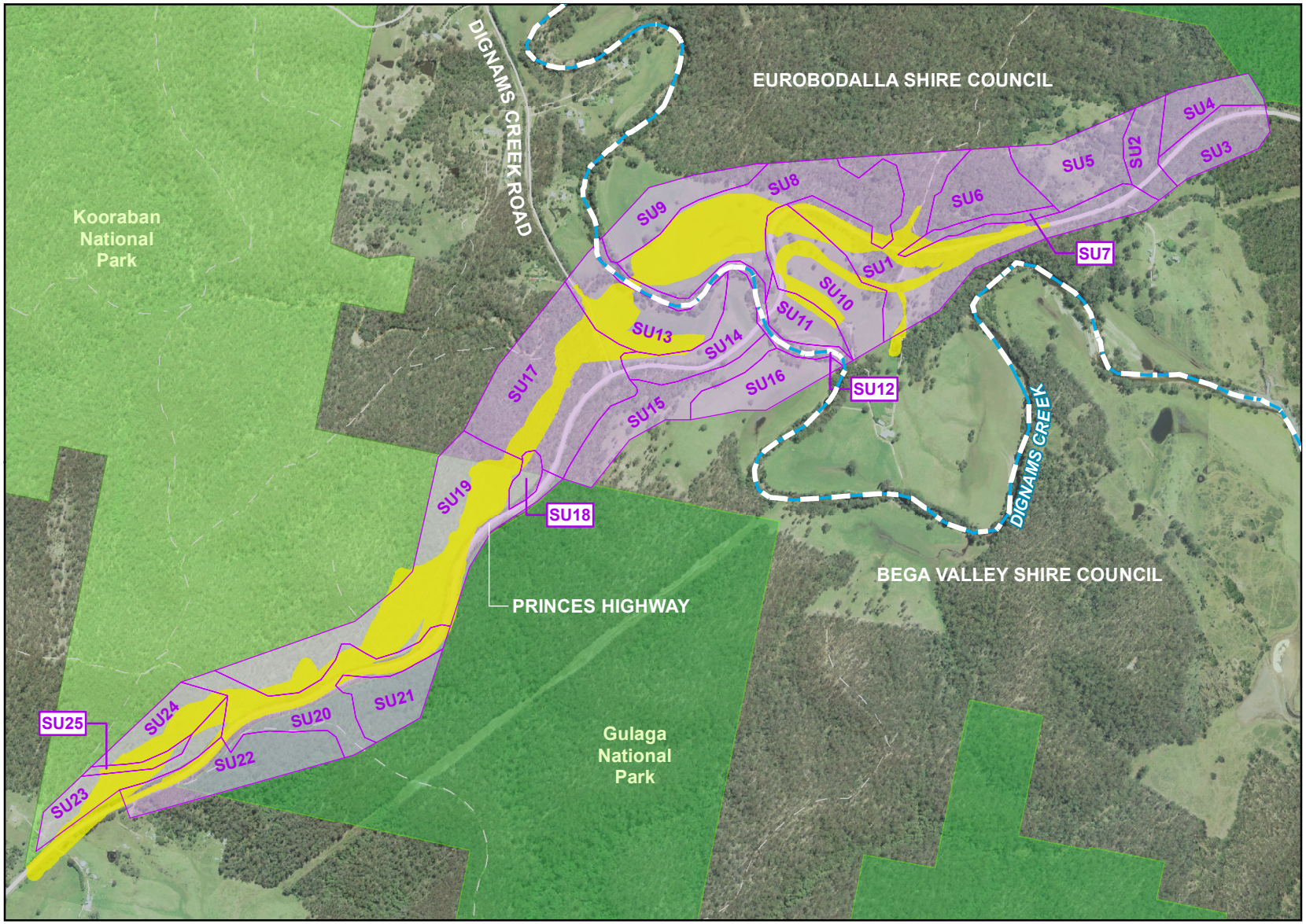
6.4.1 Historical background

The study area is situated within the area previously occupied by the Guyangal or ‘southern fisher people’. According to Wesson (2000), Warner defined these people as living south of Wagonga Inlet and around Wallaga Lake. The Dhurga (Thoorga) language was spoken over a large area extending from Jervis Bay in the north to Wallaga Lake in the south, and west to Braidwood (Eades 1976). Eades (1976) describes the Dyirringan language as being spoken in the area between Wallaga Lake and Twofold Bay, with the Thawa language spoken south of Twofold Bay.

Prior to European occupation the Aboriginal people of the region practiced a hunting, gathering and fishing economy. They survived on a diet of Zamia, Cabbage Tree Palm and native fauna (including fish, shellfish and eel). Weirs were used to capture fish and supported a large number people to come together.

Gulaga, the mountain situated to the north-west of the proposal, has high spiritual significance to the people of the south coast. In March 2001, Gulaga National Park was created out of an amalgamation of the existing Wallaga Lake National Park, Guora Nature Reserve and Mount Dromedary Flora Reserve.

Upgrade of the Princes Highway, Dignams Creek



LEGEND

- Aboriginal heritage survey unit (SU)
- Construction footprint
- Dignams Creek and LGA boundary
- Major road
- Local road
- Track

National Parks

- Gulaga National Park
- Kooraban National Park

DATA SOURCES
LPMA 2010
SKM 2011
NGH Environmental 2010

0 500
Metres

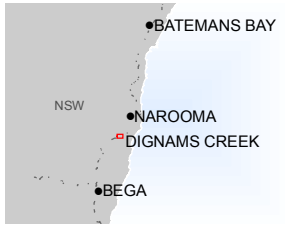


Figure 6-11 | Aboriginal assessment location of survey units

NSW GOVERNMENT Transport Roads & Traffic Authority

SINCLAIR KNIGHT MERZ SKM

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Newcastle Spatial Team - Prepared by : AL
Checked by : JC

6.4.2 Methodology

Activities undertaken as part of the four separate Aboriginal cultural heritage assessments have included:

- Three separate AHIMS searches were completed for the proposal in February 2008, October 2011 and April 2012 to determine whether or not previously recorded Aboriginal objects were present in the proposal area, and to list the type and range of those, known to be present within the local area.
- A review of local and regional archaeological reports and other relevant documents in order to provide a contextual framework to the study and heritage management process.
- Completion of an investigation of environmental context to establish whether the study area was suitable for Aboriginal occupation.
- A comprehensive field survey of the study area aimed at recording Aboriginal objects, areas of archaeological sensitivity and other areas of cultural value.
- A subsurface excavation program was undertaken following the preliminary investigations of PADS identified within survey units 11 and 16. The subsurface excavations were undertaken by NSW Archaeology in February 2011 and included representatives of the MLALC and Aboriginal knowledge holders.
- Oral history recordings were obtained from local Aboriginal knowledge holders selected in AFG meetings in 2011 (refer further to **Section 5.3**).
- Further consultation by RMS was undertaken in 2012 following the selection of the preferred option (refer to **Section 2.5**), with key knowledge holders to establish whether the proposal would impact on any significant cultural values inherent in the landscape.

6.4.3 Existing environment

The proposal is situated within the boundaries of the MLALC. The RMS Aboriginal Heritage Advisor has consulted with MLALC in regard to the proposal. MLALC sites officers have conducted two inspections of the study area during this consultation process, which includes all areas within the construction footprint (refer to **Figure 3-12**). Members of the local Aboriginal community have assisted with the subsurface test excavation and have provided oral history information to expand the knowledge of the Indigenous values of the area.

Database searches

Searches of the NSW AHIMS were undertaken on the February 2008, October 2011 and April 2012. The results of each search indicated that there are no previously recorded Aboriginal objects located within the proposal area.

Native title claims and Aboriginal land claims

A native title search was undertaken by RMS in December 2012, however no known native title claims were found within the footprint of the proposal. If native title claimants become known, they would be included in any future consultation.

An Aboriginal Land Claim (number 7761) has been made over Lot 7027 DP1069205 (refer to **Figure 3-14**) which is recognised as Crown Reserve 91754 under the ALR Act. This reserve is currently under the day to day care control and management of Eurobodalla Shire Council and is used for public recreation and as a resting place.

Site investigations

The *Preliminary Aboriginal Archaeological Assessment* undertaken by NSW Archaeology Pty Limited in 2008 included a comprehensive site inspection. This inspection was carried out from the 31 May to 1 June 2008. The assessment considered impacts associated with option 1 which was presented to the community as a preferred corridor in December 2010 (refer to **Section 2.4.2** and **Section 5.2**).

The study area was divided into 17 survey units for this first site inspection (refer to **Figure 6-11**) and the total area covered was around 69 hectares. No Aboriginal objects were recorded during the survey.

A prediction of potential artefact density in a subsurface context was made in respect of each of the 17 survey units identified. The majority of survey units were predicted to possess very low or low stone artefact density (survey units 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 15 and 17). Survey units 9, 11, 13, 14 (north end only) and 16 were predicted to possess artefacts in moderate density and accordingly were identified as PADs. The preliminary report recommended that subsurface test investigations be undertaken for the survey units identified as PADs.

A second *Preliminary Aboriginal Archaeological Assessment* was undertaken by NSW Archaeology Pty Limited in 2010 and included additional survey of areas to the west of the Princes Highway in Kooraban National Park which focused on the alignment of option 10 (refer to **Section 2.4.2**). An additional six survey units (Survey units 18 - 23) were defined and subject to field survey and assessment. This site inspection was completed on the 3 December 2010. No Aboriginal objects were recorded in the additional survey areas investigated in the second assessment, all of which was predicted to possess very low or low stone artefact density (refer to **Appendix J**). It was recommended that RMS develop a research design for test excavation to further investigate the PADs identified within survey units 11 and 16, located within the realignment proposal area. The assessment did not recommend testing at survey sites 9, 13 and 14 as the option being considered at this time (option 10) did not impact on these areas.

Due to the presence of PADs a *CHAR* was prepared in accordance with the stage 3 PACHCI requirements. This was completed by NSW Archaeology Pty Limited in May 2011. The CHAR included the following:

- A summary of all previous work.
- Undertaking a further site inspection with subsurface test excavation programs of PADs located within survey units 11 and 16.
- Additional consultation with the MLALC and nominated Aboriginal knowledge holders.
- Documentation of an Indigenous oral history recording program from knowledge holders selected in the AFG meetings (refer to **Section 5.3**). The oral history was undertaken by NSW Archaeology Pty Ltd and focused on Aboriginal history as identified within the study area for the proposal.

During the subsurface excavation program, a total of 592 stone artefacts were retrieved. The archaeological deposit in survey unit 11 was assessed to be of low archaeological significance, and the deposit in survey unit 16 was assessed to be of moderate archaeological significance. These two sites have been recorded with the AHIMS register and include AHIMS Site #62-3-0624 in survey unit 11 and AHIMS Site #62-3-0627 in survey unit 16. For detailed descriptions of the subsurface excavation results refer to **Appendix J**. Survey units 9 and 14 are located

immediately adjacent to the proposal and whilst no subsurface excavations were undertaken at these sites, have been assessed as having moderate archaeological potential (note this only includes the northern section of survey unit 14). Survey units 9 and 14 (northern section) have been registered with AHIMS and are identified as AHIMS sites #62-3-0623 and #62-3-0626 respectively.

The oral history recording obtained from the nominated Aboriginal knowledge holders found that the proposed activity areas adjacent to the creek hold historical associations for some members of the local Aboriginal community. The memories of the bean picking times in the district are recalled with fondness by those people interviewed. These were times when people had employment, worked together in family and community groups and interacted with the broader community in both work and recreation. Dignams Creek is a place associated with good times and happy memories. It is also a site of sadness due to a death on the 'big bend' of the Princes Highway.

During an earlier assessment the surveys of landforms, which are similar to those found in the extended study area, did not identify any Aboriginal objects. Accordingly, the proposal area is predicted to be of low archaeological sensitivity and potential.

The report made the following recommendations:

- There are no archaeological constraints relating to the proposal in the Princes Highway Dignams Creek upgrade test excavation areas. The archaeological deposit does not surpass significance thresholds which would act to preclude impacts.
- No impact mitigation is considered to be warranted in the proposed impact areas.
- The proponent would seek a section 90 AHIP from the OEH for the Aboriginal objects present in the two survey Units 11 and 16 which includes AHIMS Site #62-3-0624 and AHIMS Site #62-3-0627 respectively.
- Copies of this report would be sent to the registered Aboriginal stakeholders and OEH.
- Prior to applying for a Section 90 AHIP, the archaeological deposit in the test areas would be reported to the NSW DECCW AHIMS register.
- Any future community consultation and assessment would be undertaken in accordance with RMS PACHCI.

Following this subsurface investigation RMS began investigating additional alignment options for the proposal (refer to **Section 2.4.2**). As such an Addendum CHAR was undertaken in 2011. The Addendum CHAR included a field survey of the extended study area which was carried out in July 2011 to consider areas that had not previously surveyed and which may be impacted by stage 2 works through Kooraban National Park.

The field survey was conducted across an area around 8.4 hectares. The survey entailed an inspection of five survey units (19, 20, 23, 24 and 25). Survey units 19, 20 and 23 were originally defined and partially surveyed during the 2010 and 2011 earlier assessments. The area was extended as part of the Addendum CHAR and included two additional survey units (24 and 25) which were subject to additional survey and assessment. For detailed descriptions of the additional survey results refer to **Appendix J**.

The results of the comprehensive field survey undertaken in the Addendum CHAR found that there were no Aboriginal objects, areas or places were identified in the

survey area and no other issues regarding cultural heritage were identified. Additionally the report found that all areas surveyed were assessed to be of low or very low archaeological potential. The results of the Addendum CHAR identified that the additional survey area impacted by the proposal did not include any Aboriginal PAD sites. Although the proposal does impact on survey unit 13 (survey unit 13), which was previously assessed to be a PAD site, test excavations have confirmed that survey unit 13 is of extremely low archaeological significance and potential (refer to correspondence from NSW Archaeology dated August 2012 in **Appendix J)**.

The Addendum CHAR was distributed to registered stakeholders for review and comment at the 17 October 2012 AFG (refer to **Section 5.3**). No objections to the Addendum CHAR were raised. Following this AFG, RMS undertook further consultation with nominated knowledge holders which included additional interviews to identify whether there were any other significant cultural values inherent in the landscape that might be affected by the proposal. In addition, the AFG members for the Dignams Creek proposal have conducted a separate survey of the area assessed for the Addendum CHAR under the direction of RMS' Aboriginal Cultural Heritage Advisor Southern. No Aboriginal objects, areas, or places were identified by the AFG members in this survey. No additional issues were raised or submission/s were received as a result of this consultation/ additional survey work (refer to **Section 5.3**).

The Addendum CHAR concludes that, based on the results of the comprehensive field survey and assessment undertaken of the extended survey area, there are no Aboriginal objects, areas or places impacted by the proposal. Furthermore, all areas are assessed to be of low or very low archaeological potential.

6.4.4 Potential impacts

Construction

Based on the results of the four Aboriginal heritage assessments undertaken for the proposal there are no Aboriginal heritage constraints associated with the proposal. Additionally all areas surveyed that would be impacted by the proposal have a low or very low archaeological potential, except for survey units 9 and 14 (the northern section) which have moderate archaeological potential (refer to **Figure 6-11**).

The four AHIMs site identified as a result of the Aboriginal site inspections undertaken as part of this REF are located in close proximity to the proposal and hence could be indirectly impacted during construction. AHIMS site number 62-3-0623 (survey unit 9) and 62-3-0626 (survey unit 14) are located directly adjacent to the proposal and AHIMS site 62-3-0627 (survey unit 16) is around 80 metres from the proposal. The northern section of AHIMS site 62-3-0624 (survey unit 11) is directly impacted by stockpile sites, however as noted by NSW Archaeological in August 2012 (refer to **Appendix J**) survey unit 11 has extremely low archaeological significance and potential. The CHAR and Addendum CHAR have concluded that there would not be a significant impact to any known item of Aboriginal heritage which includes these four AHIMS sites.

RMS have obtained a proposal wide AHIP (number 1131201) from OEH (refer to **Section 5.3**) for all of the survey units identified in **Figure 6-11**, which would allow harm to these items. However whilst these items are mostly outside of the proposal construction footprint, indirect impacts to these items can be avoided and minimised by creating exclusion zones around them, refer further to **Section 6.4.5**.

The proposal would also impact on around 230 square metres of Lot 7027 DP1069205 which is Crown land and recognised as Crown Reserve 91754. This parcel of land currently has an Aboriginal Land Claim (no 7761) on it and would require partial acquisition.

Operation

While there would be no operational impacts to the identified Aboriginal objects, there would possibly be minor indirect impacts to the cultural values of the area during operation of the proposal.

6.4.5 Safeguards and management measures

Safeguards and mitigation measures to manage potential impacts to Aboriginal cultural heritage have been summarised in **Table 6-38.**

Table 6-38 Safeguards and mitigation measures to manage Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing
Indirect impacts to Aboriginal heritage	Whilst a proposal wide AHIP has been approved, RMS would avoid indirect impacts to AHIMS site numbers 62-3-0623 (survey unit 9), 62-3-0626 (survey unit 14), 62-3-0624 (survey unit 11) 62-3-0627 (survey unit 16) during construction where possible.	Construction Contractor	Construction
Unexpected Aboriginal heritage find	The following safeguards would be applied to manage unexpected Aboriginal heritage finds: • The CEMP would adopt the implementation of the RMS *Unexpected Archaeological Finds Procedure* (2011b). • Construction personnel would receive toolbox training in the recognition of Aboriginal cultural heritage material and sites and information about existing AHIMS sites. • When any soil, vegetation clearing or leaf litter removal activities are conducted, workers would be observant and keep a look out for rock engravings, surface shell, bone, rocks or any other Aboriginal cultural heritage material. • Should any Aboriginal objects be uncovered during construction, works would immediately cease in the vicinity of the find. Guidance would be sought from the RMS Aboriginal Cultural Heritage	Construction Contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
	Advisor. The Planning and Aboriginal Heritage Section of the OEH would then be notified by the RMS.		

6.5 Non-Aboriginal heritage

A *Non-Aboriginal Heritage Assessment* was prepared by NSW Archaeology Pty Ltd in 2010 and is provided in **Appendix H**. This report was prepared in accordance with RMS *Non-Aboriginal Heritage Assessment Guidelines*. The report was developed to identify heritage constraints within the study area and identify whether a Statement of Heritage Impact (SOHI) or excavation permits would be necessary under the Heritage Act. The following is a summary of the findings of this report.

6.5.1 Existing environment

Historical background

In the late 1820s the Bega area was occupied by squatters who had made the overland traverse via Cobargo. The area was perceived to be fertile and suitable for agriculture with cattle being brought into the area around 1830.

While there were a number of different agricultural and industrial actives that took place in around Dignams Creek, sleeper extraction, mills and dairy were the main industries up until 1950s. Gold mining was undertaken in the region from the 1850s to the 1890s.

Forestry has also been a major influence on the landscape, creating cleared valleys which have were subsequently used for agriculture and dairying. Dairying in the area reached a peak from 1870 to the 1950s, with only a limited number of farms continuing to present day. Bean growing was the commercial activity in the area which employed a number of the local indigenous community.

The route of rough roads and tracks (often impassable due to flooding) from Wollongong to Eden was established by 1858 and was known as 'The Main South Road'. Prior to the establishment of this road the area was reliant on boat transportation to ship goods and material to and from the region. Following the visit from the Prince of Wales in 1920 the route was renamed the Princes Highway and improvements were implemented.

Database and background searches

Searches have been conducted for previously recorded heritage listings in and around the proposal; these searches have included all of the relevant heritage registers for items of local through to world significance.

There are no previously recorded heritage listed items on the Australian Heritage Database, the State Heritage Inventory or the Register of the National Trust listed as being present within the study area. However, a search of the then RMS section 170 Heritage and Conservation Register (5 January 2009) revealed that the Dignams Creek Bridge is listed under section 170 of the Heritage Act. The existing Dignams Creek Bridge is a reinforced concrete beam bridge built in 1935 to replace the timber truss bridge that was washed away in a flood in 1934.

The Eurobodalla LEP and the Bega Valley LEP were also both searched for items and sites of heritage significance within and adjacent to the proposal. No listed heritage items were identified in either LEP.

Site inspection

An initial site inspection was carried out by NSW Archaeology Pty Ltd on 5 January 2009. A further site inspection took place on 3 December 2010 in order to assess additional proposed impact area south west of original survey.

Eleven potential heritage items were identified from the two site inspections within the study area (refer to **Figure 6-12)**, which included the following:

- DC1-Dignams Creek Bridge, which is listed on the RTA Section 170 Heritage and Conservation Register.
- DC2 -The old Princes Highway, including road alignments, culverts, drainage channels and bridge remains: northeast section (recorded during the 2009 field survey).
- DC3 -The old Bermagui Road.
- DC4 -The site of the first public school at Dignams Creek.
- DC5 - Remains of the second public school at Dignams Creek.
- DC6 – The site of the Dignams Creek community hall/war memorial.
- DC7 - Remains of a private residence/post office.
- DC8- The site of an associated dairy and machinery shed.
- DC9 - Silage pits.
- DC10 - Remains of a secondary creek crossing and associated road alignment.
- DC11 - The old Princes Highway, including road alignments, culverts and drainage channel remains, in the southwest section of the proposal area (recorded during the 2010 field survey.

The *Non-Aboriginal Heritage Assessment* undertook a significance assessment for each heritage item identified, which is summarised in **Table 6-39**. Where an item would be considered to be of State (or local) heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria (NSW Heritage Office & DUAP 1996, NSW Heritage Office 2001, Heritage Council of NSW 2008):

Criterion (a) an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area) – known as historic significance.

Criterion (b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area) – known as historic associations.

Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area) – known as aesthetic or technical significance.

Criterion (d) an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons– known as social significance.

Upgrade of the Princes Highway, Dignams Creek

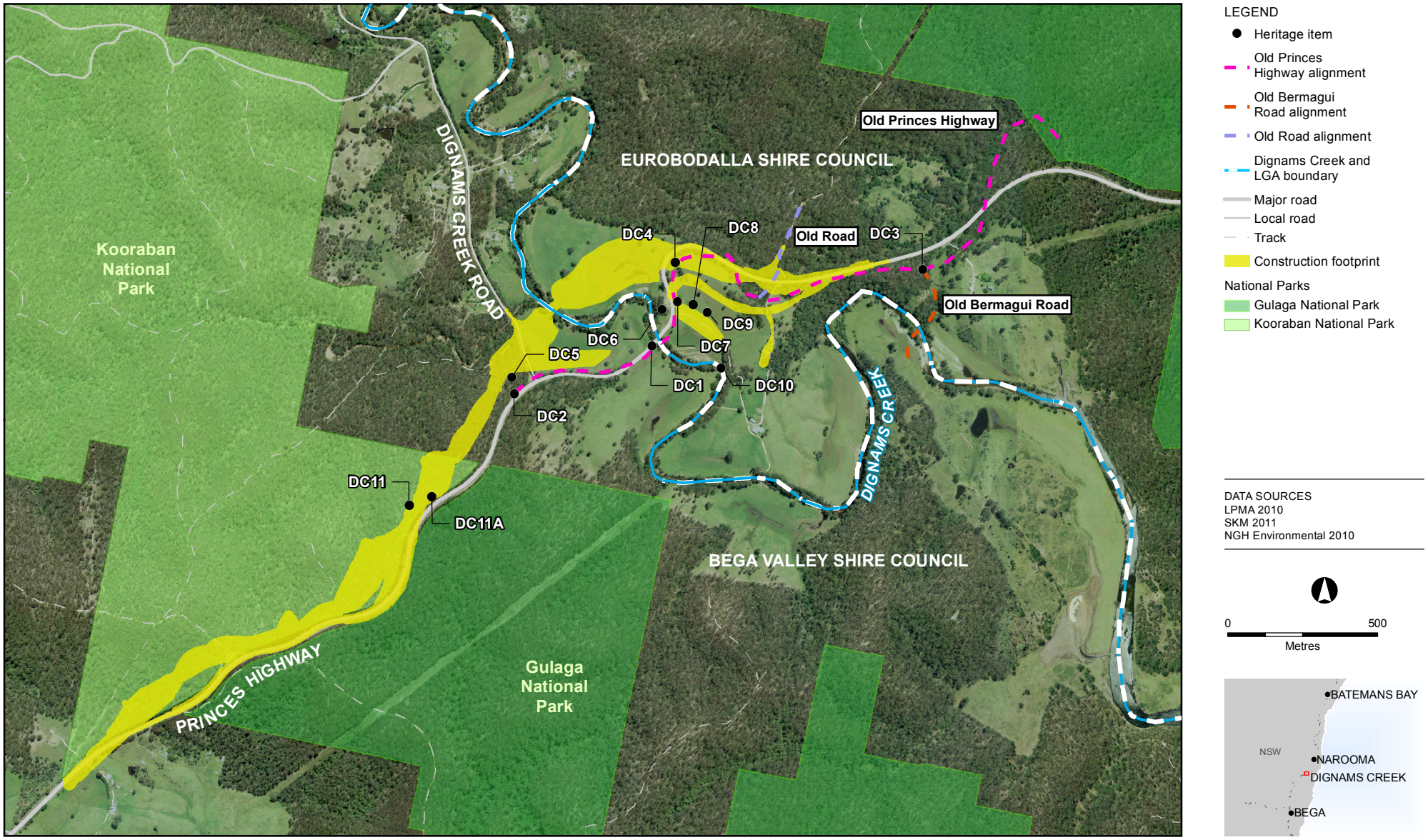

Figure 6-12 | Location of identified potential heritage items - non-Aboriginal heritage

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Newcastle Spatial Team - Prepared by : AL
Checked by : JC

Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area) – known as research potential or educational significance.

Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area) – known as rarity.

Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or a class of the local areas) – known as representative significance.

Table 6-39 Summary of the significance assessment

Recording	Significance	Criteria
DC1: Dignams Creek Bridge	Local	Is has been assessed to have significance at a local level against criteria 'a', 'c' and 'g. This means it has significance in terms of historical associations, its aesthetics and landmark qualities and its representativeness of an urgent replacement of a flood damaged timber bridge and as a concrete beam bridge of the South Coast. .
DC2: Remains of the old Princes Highway	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC3: Old Bermagui Road	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC4: Site of the first public school	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC5: Site of the second public school	Does not meet the criteria for heritage listing.	This item is assessed as having some limited significance at a local level against criteria 'd' however it does not warrant heritage listing.
DC6: Site of the community hall	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.

Recording	Significance	Criteria
DC7: Site of residence/post office	Does not meet the criteria for heritage listing.	This item has some limited research potential but that potential is not sufficient to warrant statutory listing.
DC8: Site of dairy and sheds	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC9: Silage pits	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC10: Remains of a secondary creek crossing	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.
DC11: Remains of the Old Princes Highway	Does not meet the criteria for heritage listing.	This item is not assessed to have significance against any of the criteria.

6.5.2 Potential impacts

Construction

During construction of the proposal, there is potential to directly impact on two identified potential heritage item, namely:

- Item DC2 – remains of the old Princes Highway.
- Item DC4 – site of the first Dignams Creek public school.

The heritage significance assessment as summarised in **Table 6-39** found that neither item meets the criteria for heritage listing. Additionally both items have limited archaeological research potential. As such there are no constraints from the proposal although the heritage assessment does recommend that DC2 should be avoided where possible.

There is also potential to indirectly impact DC5 the site of the second public school during the construction of the proposal. Currently this item is within 10 metres of the following items:

- Operational water quality control (basin B96.15L located at chainage 96170, refer to **Section 3.2.3** and **Figure 3-11**).
- Construction sediment basin (6 at chainage 96170, refer to **Section 3.3.1**).

Item DC5 has some limited significance however it does not warrant heritage listing at a local or State level or require further investigations.

DC1 Dignams Creek Bridge would cease to be an RMS asset following the realignment of the highway. The bridge would need to be delisted from the section

170 register in accordance with the Heritage Act. The NSW Heritage Branch would be notified of the delisting in accordance with s170A of the Act. The Dignams Creek Bridge would be managed by the new private property owners of 9523 Princess Highway as this would be part of the properties access road.

Operation

No impacts to Non-Aboriginal cultural heritage sites during operation of the proposal have been identified.

6.5.3 Safeguards and management measures

Safeguards and mitigation measures to manage potential impacts to non-Aboriginal heritage are summarised in **Table 6-40.**

Table 6-40 Safeguards and mitigation measures to manage Non-Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing
Indirect impacts to Non-Aboriginal heritage, specifically item DC5	An exclusion zone would be placed around DC5 to avoid indirect impacts. If impacts do occur, a section 140 permit would be required to undertake archival recording and salvage excavation prior to works occurring	RMS project manager	Pre-construction
Indirect impacts to Non-Aboriginal heritage, specifically item DC2	Where possible impacts to DC2 (sections of the Old Princes Highway) would be minimised where possible. No further archaeological investigations are warranted.	RMS project manager	Pre-construction
Unexpected non-Aboriginal heritage find	The following safeguards would be applied to manage unexpected non-Aboriginal heritage finds: • Should any relics (as defined by the Heritage Act 1977) or sites of heritage significance be found, construction would cease immediately in the vicinity of the find and advice sought from the RMS Environment Branch. This would allow as necessary an archaeologist to assess the find and notify the Heritage Branch in accordance with the Heritage Act. • Steps in the RMS *Standard Management Procedure: Unexpected Archaeological Finds* would be followed. • The CEMP would adopt the RMS *Unexpected Archaeological Finds Procedure* (2011b).	Construction Contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
Delisting of a heritage item	The bridge would be bypassed, and ceases to be an RMS asset. The bridge would need to be delisted from the section 170 register in accordance with the Heritage Act. The Dignams Creek Bridge would be managed by the new private property owners of 9523 Princess Highway as this would be part of the properties access road.	RMS project manager	Pre-construction and construction

6.6 Water quality and hydrology

The results for the assessment of water quality and hydrology impacts is summarised in this section, and is based on the following documents:

- A water quality assessment undertaken as part of the aquatic ecology survey completed in January 2013 as part of the *Biodiversity Assessment* (refer to **Appendix K**).
- A hydraulic investigation of the proposed bridge design entitled The *Bridge over Dignams Creek, South of Narooma Hydraulic Investigation Report*., undertaken in November 2010 (Khamphounvong, 2012) (refer to **Appendix D**).
- The *Erosion and Sedimentation Management Report* (SCS 2012, **Appendix F**), which provides an erosion and sedimentation assessment, undertaken to identify site constraints for the proposal and provide recommendations for water quality management.
- The *Operational Water Quality Basins Report*, prepared by SKM in 2013 to identify a surface water quality management strategy for the operation of the proposal (refer to **Appendix E**).

6.6.1 Existing environment

Catchment description

The proposal is located within the Dignams Creek and Narira Creek catchments, which both flow into Wallaga Lake. Dignams Creek is the main catchment impacted by the proposal and is important estuarine tributary of Wallaga Lake as shown in **Figure 6-6**). Dignams Creek receives flow via catchment runoff and numerous ephemeral watercourses within the 87.38km^2 catchment. Dignams Creek is of low to medium flow and its tributaries are largely ephemeral or exhibit low flow, resulting in a receiving environment that is largely depositional. It is tidally influenced at its downstream limit where it discharges into Wallaga Lake. Dignams Creek flows in a general easterly direction into Wallaga Lake, about 6.7 kilometres downstream of the existing Dignams Creek Bridge. Wallaga Lake contains five SEPP 14 wetland areas and is a nationally listed wetland under the *Directory of Important Wetlands in Australia.*

Under the *Marine Parks Amendment (Batemans) Regulation 2007*, the downstream reach of Dignams Creek is classified as the 'Dignams Creek Sanctuary Zone' and is part of the Batemans Marine Park. The Dignams Creek Sanctuary Zone (Batemans Marine Park) includes the whole of the tidal waters and tidal levels to the mean high water mark of Dignams Creek, as well as its creeks, bays and tributaries. A sanctuary zone provides the highest level of protection, only allowing activities that do not harm plants, animals or habitats. The upper sanctuary zone boundary is about 1.8 kilometres downstream of the proposal and the downstream boundary is just east

of the Dignams Creek discharge point into Wallaga Lake. **Figure 6-6** shows the location of Dignams Creek, the SEPP 14 wetlands and the Dignams Creek Sanctuary Zone (Batemans Marine Park).

The proposal would cross a number of small valleys and drainage channels that are tributaries of Dignams Creek (refer to **Plate 6-1**). These are ephemeral channels which flow only during and after rain (refer to **Plate 6-2**). One of the main tributaries of Dignams Creek is Blind Creek, which is a small waterway that flows into Dignams Creek to the north of the proposal. The majority of Blind Creek's upper tributaries are located to the north-west of the proposal within Kooraban National Park. Blind Creek flows generally in a south-easterly direction; however it only receives low to medium water flow following rainfall events.

As such Blind Creeks' tributaries are largely ephemeral or exhibit low flow, resulting in a receiving environment that is largely depositional.

Plate 6-1 Dignams Creek (source: SKM)

Plate 6-2 Drainage channels in pasture/bush land (source: SKM)

The proposal would also cross a few small ephemeral channel/tributaries of Narira Creek. From the proposal these upper tributaries of Narira Creek flows in a south-westerly direction for around 2.8 kilometres through Bradbury Gully before joining the main Narira Creek tributary which flows in an easterly direction for around 14.5 kilometres before discharging into Wallaga Lake. Only a small portion of the southern section of the proposal drains into the upper tributaries of Narira Creek. Like Dignams Creek and Blind Creek the upper catchments of Narira Creek are ephemeral or exhibit low flow, resulting in a receiving environment that is largely depositional.

Water quality

Dignams Creek is about six metres wide where it crosses the proposal (refer to **Plate 6-1**). Throughout the proposal area the creek is generally vegetated to the bankside with overhanging vegetation including trees. The creek bed substrate is generally a sandy gravel and cobble mix. Surrounding land use near the creek at the proposal and in the valley bottom upstream is pasture land. The higher slopes above the valley floor are vegetated with native forest. Visually the stream appears to contain some tannin discolouration and to be of reasonable clarity. The agricultural land uses are likely to cause some inputs of suspended sediments, nutrients, fertilisers and bacteria through runoff from farmland and stock access to waterways. There are currently no known existing water quality basins provided to treat runoff from the existing road.

Water quality was monitored over two days in November 2011, at two locations within Dignams Creek (refer to **Figure 6-13)**, AE1 and AE2. Water quality parameters that were measured include:

- Turbidity (NTU). This is a measure of the "muddiness" of the water and is important because the turbidity of water is an indication of the amount of suspended colloidal and particulate matter in the water and how much light can penetrate for important biochemical processes such as photosynthesis. Elevated levels of particulate matter can also impact on dissolved oxygen concentrations and pH.
- Conductivity (mS.cm-1): This is a measure of the amount of dissolved salts in the water and its ability to conduct an electrical current. It is important as some plant and animal species are salt sensitive whilst others require higher salt concentrations.
- Temperature (°C): This is a measure of the degree of hotness or coldness of water. It is a form of pollution and can impact on riverine biota and associated biological and chemical processes.
- pH: This is a measure of the acidity or alkalinity of water. Most freshwater and estuarine biota have a tolerance range of between 6.5 and 8.
- Dissolved oxygen (per cent saturation and $mg.L^{-1}$): This is a measure of the amount of oxygen dissolved in water. Dissolved oxygen is vital for many forms of riverine and estuarine biota including native fish and is also vital for the functioning of healthy aquatic ecosystems.

Table 6-41 summarises the results of the water quality monitoring. Water quality in Dignams Creek was found to be generally good with conductivity, pH and turbidity within the ANZECC/ARMCANZ (2000) guidelines for the protection of aquatic ecosystems. Dissolved Oxygen was the only parameter that fell below the lower ANZECC/ARMCANZ (2000) guideline of 85 per cent saturation with a mean concentration downstream of 79.43 ± 0.13 per cent saturation and upstream of 77.73 ± 0.63 per cent saturation.

Upgrade of the Princes Highway, Dignams Creek

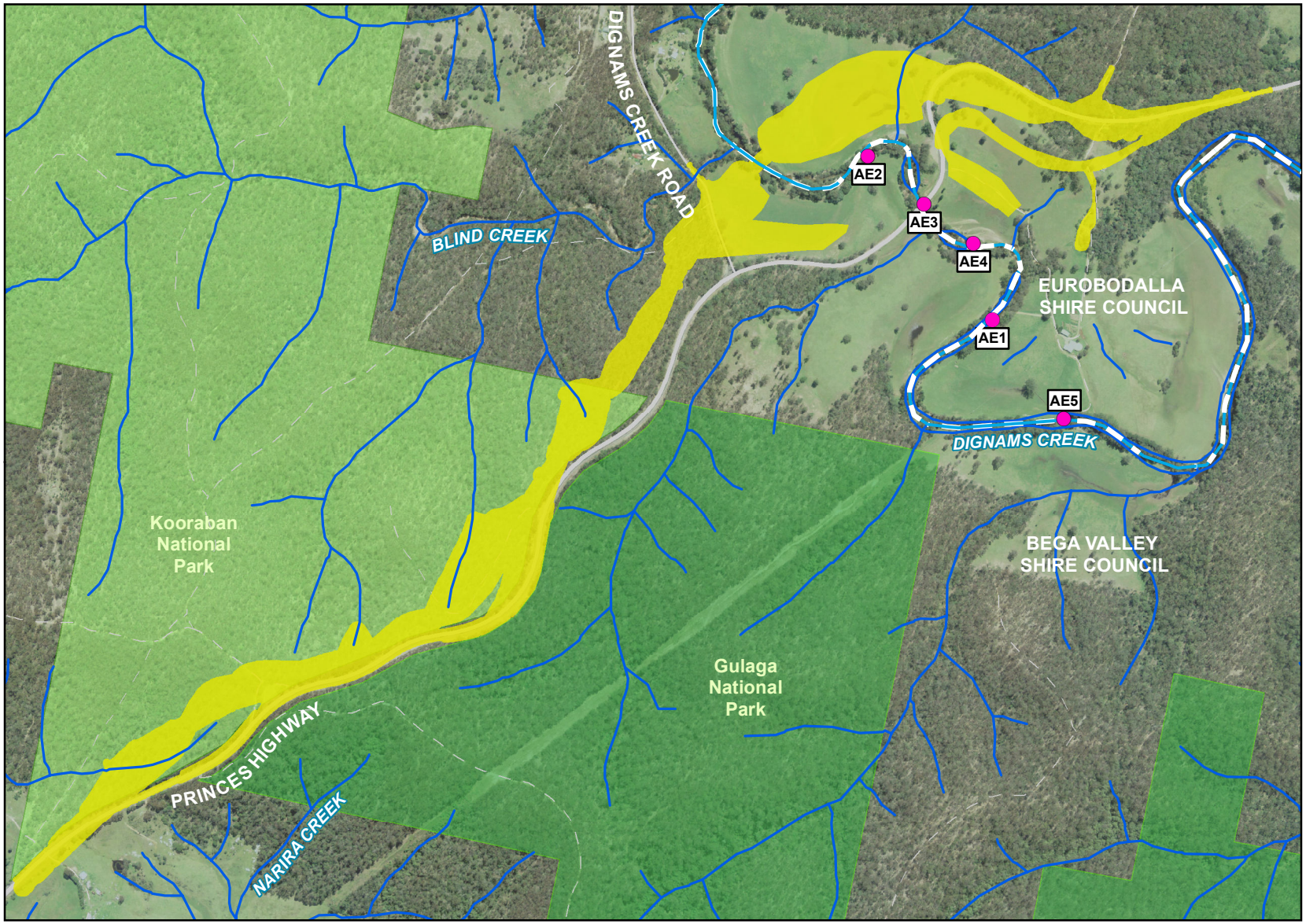

Figure 6-13 | Map of Dignams Creek catchment and water quality locations

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Newcastle Spatial Team - Prepared by : AL
Checked by : JC

Table 6-41 Water quality monitoring results

Site	Temperature (°C)	Conductivity (µS/cm)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%sat)	Turbidity (NTU)	ORP
AE1	18.88	200	6.92	7.44	79.43	3.43	261.67
AE2	19.54	200	6.92	7.17	77.73	1.93	231.33
	Outside the ANZECCC/ARMCANZ (2000) default trigger values for slightly disturbed aquatic ecosystems in upland rivers of South-East Australia.						

Construction water quality criteria

While the proposal is not subject to license conditions provided in an environmental protection licence (EPL) issued under the POEO Act, there is a legal responsibility to ensure that runoff leaving a construction site has an acceptable water quality. Typical water quality parameters for the proposal to meet are those outlined in **Table 6-42** (SCS 2012), refer to **Appendix F**.

Table 6-42 Construction surface water quality parameters

Total suspended solids (TSS)	<50 mg/l
pH	6.5 to 8.5
Oil and grease	<10 mg/l

Operational water quality criteria

To meet the quality objectives for the operation of the proposal, the NSW Office of Environment and Heritage design criteria for water quality have been adopted as the project design criteria. These load based criteria (listed in **Table 6-43)** have been applied to the operational stormwater assessment documented in the *Operational Water Quality Basins Report* refer to **Appendix E**.

Table 6-43 Operational surface water quality parameters

Pollutant	Minimum reduction of the annual average load
Total suspended solids (TSS)	80%
Total nitrogen (TN)	45%
Total phosphorous (TP)	45%
Oil and grease	None visible

Dignams Creek hydrology and flooding

The *Bridge over Dignams Creek, South of Narooma Hydraulic Investigation Report* involved modelling of the existing catchment hydrology, refer to **Appendix D**. **Table 6-44** provides an estimate of runoff in various events based on the 87.4 square kilometre catchment upstream of the Dignams Creek Bridge.

Table 6-44: Estimated runoff in Dignams Creek (Khamphounvong, 2010)

Flood frequency average recurrence interval (years)	Discharge (m^3/sec)
20	316
100	466
2000 (ultimate design)	700

Flooding events have previously been recorded at the Dignams Creek bridge site. Photos of the flood level in 1971 and 2010 were well below the soffit of the existing bridge. There has been no reported flood overtopping the bridge or the road approaches. The existing bridge deck level has a Relative Level (RL) of 11.97 metres and the predicted 1 in 100 flood level is below this at 8.18 metres RL.

Water use values

The watercourses in the vicinity of the proposal are likely to have a number of different uses and therefore values. These include:

- Providing for the aquatic ecology (eg macroinvertebrates, fish) within Dignams Creek and in downstream features such as the Dignams Creek Sanctuary Zone (Batemans Marine Park). Based on the relatively natural upstream catchment, it is likely that the river should support a good aquatic ecology.
- Provision of water for use including stock water drinking.
- Recreational activities that may include fishing/swimming/kayaking and bankside recreation on Dignams Creek and downstream. From comments on angling websites, kayaking and fishing is known to occur downstream on Dignams Creek in the Wallaga Lake area1. Other informal recreation activities may also occur downstream in the catchment. The water environment provides general amenity values to both locals and visitors.

The small ephemeral drainage channels are unlikely to be of note for water use, recreational or aesthetic values.

6.6.2 Potential impacts

Construction

Water quality

As discussed in **Section 3.3.6** a large volume of earthwork is required for the proposal, resulting in bare earth across a variety of different terrains and slopes. This includes the creation of large earth embankments in proximity to Dignams Creek to

[1] Source: http://www.kfdu.com.au/forum/viewtopic.php?f=22&t=14729 accessed 12/04/11

provide the batters for the new proposed bridge. Rain falling onto bare earth, water flowing downslope or wind has the potential to cause erosion and mobilise large volumes of sediment into streams in the proposal area. This potential impact is further compounded by local soil properties, with soils being dispersive and prone to slaking (refer to **Section 6.7**). The *Erosion and Sedimentation Management Report* (SCS 2012), refer to **Appendix F**, has also identified high rainfall intensities for the proposal area, which increases the risk of soil erosion and sedimentation. Activities such as vegetation clearing and grubbing, bulk earthworks, stockpiling and the discharge of water captured on the construction site also have the potential to cause pollution through the deposition of sediment.

Potential impacts associated with the placement of pavement and the construction of other structures may include the increase in pH from run-off from freshly placed concrete, and potential hydrocarbon contamination from the use of bituminous products in paving operations such as priming, sealing and asphalting. Poor storage or the accidental spillage of chemicals, fuels, oils and other hazardous materials also have the potential to cause water pollution if substances are not managed and stored correctly. Refer to **Section 6.7** for further details.

Construction of the bridge has the potential to impact the water quality of Dignams Creek. While there are no piers within the water way, there would be two piers construction at the top of the river bank, refer to **Section 3.2.3** and **Figure 3-6** and **Figure 3-7**. Potential impacts from construction of the bridge piers include the erosion of disturbed areas in the vicinity of the pier, poor management of drill water, contamination from the use of large amounts of concrete directly adjacent to the creek, and poor management of hazardous materials such as curing compounds. In addition, the creation of large earth embankments in close to Dignams Creek to provide the batters for the new proposed bridge would increase the potential for erosion.

The limited dry weather sampling undertaken as part of this REF provides an initial indication of the potential risks to water quality during construction. It is however recommended that further water quality monitoring be undertaken during preconstruction and construction to ensure that control measures are tailored and hence appropriate and effective.

A specific strategy to reduce construction impacts on water quality is proposed within the *Erosion and Sedimentation Management Report* (SCS 2012) (refer further to **Section 3.3.1** and **Appendix F**). SCS (2012) have identified 15 construction sediment basins (refer to **Figure 1-2** and **Table 3-7**) to ensure that quality of water leaving the construction site would meet appropriate limits. The design criteria for the construction sedimentation basins, including proposed location and sizing requirements, were based on the guidelines and procedures set out in *Managing Urban Stormwater: Soils and Construction – Volumes 1 and 2D* (Landcom 2004; DECC 2008). The locations of the temporary sediment basins are shown in **Appendix F**, while **Table 3-7** provides the area of each basin (ranging from 0.01 to 1.7 hectares) and volume (ranging from 50 to 663 cubic metres).

Flooding and hydrology

Potential impacts associated with the construction of the proposal are primarily associated with the change in topography and disruption to existing drainage patterns. As such there is potential for construction activities to have an impact on local hydrological flows, however, these are expected to be temporary and localised

in nature. There is also potential for flooding to impact on construction activities occurring on the Dignams Creek floodplain.

The proposal would not significantly change the patterns of ponding/retention of floodwaters, nor would it change the duration of inundation of the floodplain. As such, no adverse flooding impacts to adjacent properties are anticipated and no flood mitigation controls would be required.

Operation

Water quality

The proposal has the potential to affect existing local water quality due to the generation of additional pollutants from an increase in impervious surfaces and future vehicle traffic. However some sections of the existing highway that is made redundant would be removed and rehabilitated where possible to minimise the increase in impervious area. The operation of a road leads to the build-up of contaminants on the road surfaces, median areas and roadside corridors. During rain events the contaminants/pollutants can be mobilised and transported by road run-off into surrounding watercourses. Contaminants include roadside litter, suspended sediments, heavy metals, nutrients, oils, greases, combustion products of hydrocarbons, fuel and fuel additives, catalytic converter materials, metal from friction and corrosion of vehicle parts, lubricants, carbon, rubber, plastics and rust. Pollutants such as nutrients, heavy metals and hydrocarbons are usually attached to fine sediments, therefore trapping suspended solids is the primary focus of the water quality management strategy for the operational stages of the proposal.

The potential for contaminants/pollutants to enter watercourses already exists as a result of the current operation of the road network within the study area. However, long term operational effects associated with the proposal have the potential to increase in line with the increase in traffic and with the increase in impervious surfaces. Mitigation measures to reduce any additional impact to water quality as a result of the proposal have been provided in **Section 6.6.3**.

Poor water quality also has the potential to impact upon aquatic biota including fish and wetlands. Further discussion of the impact of water quality on aquatic ecology is provided in **Section 6.1**.

The *Operational Water Quality Basins Report* (refer to **Appendix F**) identified that during the operation of the proposal, a number of pavement drainage outlets flow to areas deemed to be sensitive receiving environments. Eight water quality controls have therefore been integrated with the proposal to treat water immediately downstream of these drainage outlets. During the detailed design stage opportunities for vegetated or biofiltration swales would be investigated to supplement the proposed water quality controls. The proposed water quality control devices include:

- One water quality pond located within 100 metres of a low flow/ ephemeral tributary of Dignams Creek.
- Five biofiltration basins, including:
  - Four basins located within 100 metres from waterways that drain into Dignams Creek.
  - One basin located within the Kooraban National Park and within 100 metres of the upstream reaches of predominantly ephemeral watercourses that drain to Dignams Creek.

- Two constructed wetlands, located less than 150 metres via overland flow to Dignams Creek on flat terrain suitable for a wetland.

These water quality controls have been designed using the water quality MUSIC model in order to meet the project quality design criteria. These controls incorporate mechanisms for capturing any accidental spills of hazardous liquids that may occur, such as spills of petroleum hydrocarbons. Further detail about the design of these water quality controls is included in **Section 3.2.3** and shown in **Figure 3-11**.

Accidental spillages from a collision or spillage by road users can also lead to pollution of the environment and into adjacent watercourses. Potential pollution impacts are also associated with maintenance practices, such as herbicide application, mowing, road surface cleaning and reparation. Without satisfactory means of containment, the spilled contaminants could pass rapidly into the drainage system and impact downstream ecosystems. Accidental spills of chemicals or petrol could cause severe damage to the ecology of waterways. Accordingly, the proposal has included emergency spill containment strategies for the operation phase of the proposal (refer to **Section 3.2.3**). This was informed by a risk based assessment which considered the potential risk of an accident and whether or not there were downstream sensitive environments present. As such operational spill containment and accidental spillage would be managed through the aforementioned eight water quality controls, which would also incorporate mechanisms for capturing any accidental spills of hazardous material (refer to **Figure 3-11**).

Flooding

The *Bridge over Dignams Creek, South of Narooma Hydraulic Investigation Report* (Khamphounvong, 2013) provides estimates of peak flow in Dignams Creek for the 100 year ARI events. The assessment also compared predicted flood levels upstream of the existing bridge against predicted flood levels upstream of the new bridge for the same scenarios. The assessment identified that the deck level of the new bridge would have an RL of 13.56 metres and 16.67 on the northern and southern approaches respectively. It would therefore be situated high enough to accommodate the predicted flood levels of 10.72 metres RL for the predicted 1 in 100 year.

The assessment also considered the afflux resulting from the proposed bridge. Afflux is the rise in water level upstream due to an obstruction of flow downstream. A modelled increase of 0.10 metres was identified immediately upstream of the proposed bridge, which gradually reduces to about zero metres approximately 250 metres upstream of the proposed bridge. All surveyed structures on properties up stream of the bridge are above the modelled 1:100 year ARI event. As such the predicted change in upstream flooding levels is considered minor and no further safeguards are required.

6.6.3 Safeguards and management measures

Safeguards and management measures are proposed and summarised in **Table 6-45** to control potential adverse effects on water quality arising from this proposal.

Table 6-45 Safeguards and mitigation measures to manage water quality and hydraulic impacts

Impact	Environmental safeguards	Responsibility	Timing
Pollution as a result of sediment entering waterways during construction	A Soil and Water Management Plan (SWMP) would be developed to include controls that would limit movement of sediment (erosion controls) and remove sediment from runoff before discharge to watercourses (sediment controls). It would be prepared in accordance with the *Managing Urban Stormwater – Soils and Construction, Volumes 1 and 2D* (Landcom, 2004 and DECCW, 2008) and *RTA Road Design Guideline: Section 8 Erosion and Sedimentation* (RTA 2003) and *QA Specification G38 Soil and Water Management (Soil and Water Management Plan)* (RMS 2011a). The SWMP would include, but not be limited to procedures for controlling the following standard activities: • Mud and litter transfer. • Maintenance and cleaning of sediment control works. • Soil and stockpile management (in accordance with RMS *Stockpile Site Management Guideline* (RTA 2011f). • Dewatering of sediment basins and excavations (in accordance with RMS *Technical guideline – Environmental Management of Construction Site Dewatering*).	Construction contractor	Pre-construction
Pollution as a result of sediment entering waterways during construction	The SWMP would include a preliminary Erosion and Sediment Control Plan (ESCP) prepared in accordance with Landcom (2004) and DECCW (2008), which would identify the erosion and sediment control measures that would be implemented on site for preliminary work. Progressive ESCPs would be developed throughout construction to reflect the changes in activities and risk throughout the construction process. The plan would include diagrams of erosion and sediment control techniques and details of	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	when and where these measures would be applied. Specific measures would include: • Work scheduling (installation of protective measure before earthworks commence, suspension of works during rain, etc). • Use of protective measures (silt curtains, use of bunds, site drainage, separation of 'clean' and 'dirty' water, sediment traps, etc). • Active management and maintenance of those measures (replacing damaged sediment control measures, modify sediment control and stormwater management systems if they are not working appropriately and removing accumulated sediment, ensuring the water quality of any run-off into the lake adheres to the Blue Book (Landcom, 2004) during construction and *Managing Urban Stormwater – Council Handbook* (EPA, 1997) during operation. • Rehabilitation of impacted environments such as riparian vegetation and stabilisation of creek banks upon completion of the works.		
Water quality management and prevention / minimisation of in-stream barriers	Construction traffic would be restricted to access tracks, and maintained until construction is complete. Chemicals and fuels would be appropriately stored in a bunded area. If construction works cause the temporary isolation of pools of water from the watercourse for any period of time and they become susceptible to drying or poor water quality, then any resident native fish that are trapped would be relocated to undisturbed areas. Appropriate sediment and erosion control measures would be put in place during the construction process to control turbidity generated	Construction contractor	Pre-construction and during construction

Impact	Environmental safeguards	Responsibility	Timing
	during the construction and restoration process. If the temporary creek crossing is constructed in Dignams Creek sediment and erosion control curtains would be required in Dignams Creek to control turbidity generated during the construction and restoration process No turbid water generated from the construction corridor or construction area would be discharged into any waterway. A Water Quality Monitoring Plan would be prepared to monitor water quality impacts. All construction materials for the temporary creek crossing (ie rocks and gravel) would be washed prior to being used to minimise turbidity.		
Pollution as a result of sediment entering waterways during construction	The SWMP would include a program for inspecting sediment and erosion controls, including: • Weekly inspection of erosion and sediment control measures and prior to forecast rainfall events to ensure measures are in place, and functioning in the event of a rainfall event. • Inspection of erosion and sediment control measures during rainfall events that cause runoff, to ensure controls are working effectively.	Construction contractor	Pre-construction
Pollution from construction disturbance of the ground surface	Construction traffic would be restricted to the construction footprint identified in **Figure 3-12**, and maintained until construction is complete. Chemicals and fuels would be appropriately stored in a bunded area. Downstream flow in Dignams Creek would be maintained however if construction works inadvertently cause the temporary isolation of pools for any period of time and they become susceptible to drying or poor water quality then any resident native fish that are trapped would be	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	relocated to areas not being disturbed and away from impacts. No turbid water generated from the construction corridor or construction area would be discharged into any waterway.		
Pollution as a result of sediment entering waterways during construction	In the preparation of the SWMP and associated ESCPs, the recommendations of the *Erosion and Sedimentation Management Report* prepared by SCS (2012) would be considered.	Construction contractor	Pre-construction
Construction water entering downstream environments	A water quality monitoring plan would be developed and implemented in accordance with the RMS *Guideline for Construction Water Quality Monitoring* (RTA undated). The plan would focus on water quality of Dignams Creek, with flow on benefits to downstream environments. Additional to that outlined in the abovementioned guideline, the plan would include: • Monitoring of pH, dissolved oxygen, conductivity, temperature, turbidity, total suspended solids, oils and grease would be undertaken. • Measurement of the variables described above would be undertaken during construction at identified water monitoring sites on Dignams Creek during rainfall events that produce runoff (receiving 10 millimetres in one rainfall event). • An assessment of the adequacy of all water quality erosion and sediment control measures would be undertaken should monitoring show a decline in water quality. The progressive erosion and sediment control plan(s) would be updated to reflect any revised controls.	Construction contractor	Pre construction/ Construction
Impacting on the water flow of Dignams Creek from	During the extraction of water from Dignams Creek for the purposes of road construction activities, water flows would be maintained to ensure the continuing supply of water to	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
extraction of water for the purposes of road construction.	downstream water bodies.		
Impact of flooding on the proposal during construction	A flood management plan would be prepared to manage any potential flooding in and around the proposal during construction. This would include: ▪ Regular weather monitoring. ▪ Procedures to move plant and equipment out of identified flood-prone areas into areas where items can be appropriately secured.	Construction contractor	Pre-construction, construction

6.7 Geology, topography and soils

RMS undertook geotechnical investigations for the proposal between January and August 2011 to provide information on the distribution of rock types, strength and weathering, provide geotechnical information to aid in the design of cutting and embankment batters and to identify foundation conditions. The results of these investigations are outlined in the *Concept Stage Geotechnical Investigation Factual Report for Proposed Dignams Creek Realignment* (RMS 2012), available online: http://www.rta.nsw.gov.au/roadprojects/projects/princes_hway/dignams_creek/public_information.html. The results of these investigations are summarised below.

As outlined in **Section 6.6**, an erosion and sedimentation assessment was undertaken for the proposal to identify site constraints including slope, soil erosion hazard and sedimentation potential and aspects for revegetation response. Outcomes from this assessment are documented in the *Erosion and Sedimentation Management Report* (SCS 2012), refer to **Appendix F**, and are summarised in the sections below.

For the purposes of the geotechnical investigations the study area is defined as the area immediately adjacent to the proposal within the construction footprint, refer to **Figure 3-12**.

6.7.1 Existing environment

Topography

Topography in the study area is characterised by hilly country with side slopes along the existing Princes Highway. The northern and southern sections of the study area are characterised by steep hilly country with excessive side slopes, with ground elevations up to 130 metres Australian Height Datum (AHD) in the south west of the study area. In the centre of the study area, the landform is relatively flatter, due to the floodplain valley of Dignams Creek, with ground elevations from 10 metres AHD.

Geology

The geotechnical investigation works for the proposal included drilling of 23 boreholes in proposed cuts and the bridge area including position and elevation survey for each borehole, installation of stand pipe piezometers in selected boreholes and site inspections.

The majority of the existing environment is underlain by metasediments comprised of sandstone and siltstone, and sedimentary layers from the Adaminaby Group, which was formed in a deep ocean setting during the Early Ordovician. The regional geology is dominated by greywacke, pelite (meta-siltstone), chert and shale, with exposures of monsonite and monzonic satellites to the north-east and granodiorite, hornblende-biotite granodiorite bodies to the south-west. The rock types encountered during the geotechnical investigations were generally consistent with the geology indicated on the 1:250,000 NSW geological map (Lewis and Glen 1995).

Soils

A site visit was undertaken to determine the direction of runoff, degree of ground cover and scale of site constraints in terms of soil and erosion. Five soil samples were collected with a 150 millimetre auger along the proposal (refer to **Figure 6-14** for their location). Results of the erosion and sedimentation assessment and geotechnical investigations found that:

- Soils in the study area are dominated by fine sand and silt with a shallow topsoil and very little clay.
- Soils within the study area are prone to dispersion and slaking, meaning that lumps of soils are prone to breaking down into smaller fragments in the presence of water. Together with the area's potential for high intensity rainfall, these soils are considered to be a risk of erosion (refer to **Section 6.6** for further detail).
- Topsoils appear to be stable if grass cover is maintained, but have low fertility.
- Within proposed cut areas, the thickness of the subsurface layer (shallow topsoil, residual and colluvial soils) ranges from 0.38 metres to 1.9 metres underlain by bedrock.
- Within areas where the bridge abutments and pier locations are expected, the subsurface layer (topsoil, fill, residual soils and alluvial soils) varies between thicknesses of 0.3 metres to 10.4 metres.

Acid sulfate soils

Acid sulfate soils are soils and sediments containing iron sulfides that, when disturbed and exposed to oxygen, generate sulfuric acid and toxic quantities of aluminium and other heavy metals. The sulfuric acid and heavy metals are produced in forms that can be readily released into the environment, with potentially adverse effects on the natural and built environment, and human health. The majority of acid sulfate soils are formed by natural processes under specific environmental conditions. This generally limits the occurrence of acid sulfate soils to low lying sections of coastal floodplains, rivers and creeks where surface elevations are less than about five metres AHD.

Upgrade of the Princes Highway, Dignams Creek

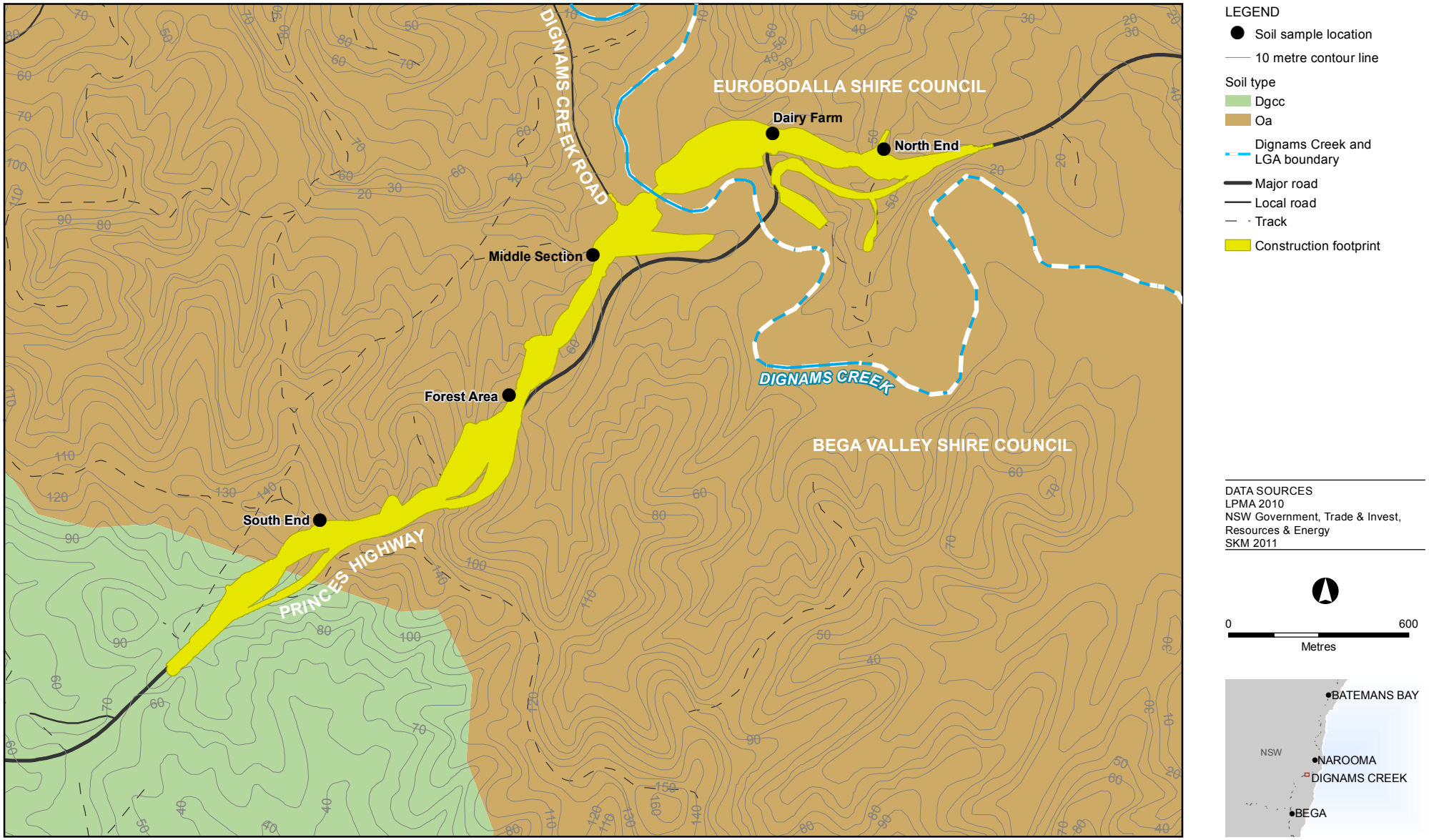

Figure 6-14 | Landform, geology and soils within the study area

NSW GOVERNMENT Transport Roads & Traffic Authority
SINCLAIR KNIGHT MERZ SKM
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Newcastle Spatial Team - Prepared by : AL
Checked by : JC

A review of the online acid sulfate soil maps (CSIRO 2011) for the study area was undertaken to assess the risk of encountering acid sulfate soils along the proposal alignment. Mapping indicates that the likelihood of acid sulfate soils at the proposal is considered to be of 'low' probability (refer to **Figure 6-14**). Additionally, there are no known occurrences of acid sulfate soils immediately adjacent to Dignams Creek. It is therefore considered unlikely that acid sulfate soils would be encountered during the construction of the proposed works.

Contamination

A search of the OEH contaminated land record for Bega Valley Shire Council and Eurobodalla Shire Council was conducted on the 23 January 2013. The search did not identify any declared and/or notified sites within the study area. In addition, a search of the POEO Public Register of environmental protection licences, applications, notices, audits or pollution studies and reduction programs for the Dignams Creek suburb returned no results indicating that there were no registered operations which require specific pollution prevention and monitoring. A search of the Australian Government Department of Defence returned no known unexploded ordinance contamination sites in the Bega Valley and Eurobodalla LGAs. A search of the NSW Department of Primary Industries cattle dip site locator found no known cattle dip sites within the Bega Valley and Eurobodalla LGAs.

Considering the long historical use of the surrounding area for agriculture, national park and natural bushland, there is considered to be a low risk that the study area would be significantly affected by localised/point source contamination associated with specific uses (generally industrial and commercial use) undertaken within and/or adjacent to the study area.

Contamination (if present) within and adjacent to the study area is likely to be associated with regional agricultural use including large scale pesticide and herbicide application and pasture improvement and contamination associated with road use. Potential contamination associated with agricultural activities is potentially both point and diffuse in nature. Point sources can include drainage pipes outlets, fuel storage (both above and below ground) and dip sites. Diffuse sources relate mainly to the use of fertilisers, pesticides and herbicides with accumulation of contaminants generally in sediments within drainage lines and waterways. Potential contamination associated with the existing bridge structure and road corridor could include treatment of historical wooden bridge components, degradation of painted surfaces, degraded asphalt, particulates from vehicle emissions and fuels (spills/accidental)..

Contamination, if present, is only likely to impact upon the construction of the bridge and associated infrastructure in areas associated with excavations. It is recommended that the excavation areas be investigated for potential contamination.

6.7.2 Potential impacts

Construction

Topography

Construction of the proposal would potentially alter the topography of the study area, due to the introduction of new cut and fill sites. In general, impacts associated with a change in topography are associated with potential impacts on soils and geology (refer to section below) and potential impacts on landscape character and visual amenity (discussed in **Section 6.3**).

Soils and geology

Construction of proposal would involve removal of vegetation (clearing and grubbing), disturbance of the ground surface, excavation and/or widening of cuts and/or side cuts and the construction of a multi-span bridge across Dignams Creek. The *Erosion and Sedimentation Management Report*, refer to **Appendix F**, considers that the proposal is a moderate erosion hazard site, and that it is likely that construction of the proposal would mobilise sediments because:

- Soils in the study area are prone to dispersion and slaking.
- Bare slopes with a gradient of up to 20 per cent and a length up to 200 metres would be created just after clearing and grubbing.
- The study area has potential for high rainfall which would further mobilise sediments.
- Large quantities of material would be excavated, stockpiled and transported within the site for construction, landscaping and rehabilitation.
- Mitigation measures to control erosion and sediment generated as a result of the construction phase are discussed in **Section 6.6.3**.

Contamination

Despite the low likelihood of encountering serious contamination within the study area, the potential risks to the health of workers, local residents, the general public, and the local environment as a result of contamination must be considered. During construction the proposal has the potential to expose and/or liberate contaminated material to workers, local residents, the general public, and the environment, should contamination be present. If not properly managed, contaminated material may also present a risk to the surrounding environment through transport and/or migration during construction activities. The introduction of new contaminants during construction works, such as fuels and oils used in construction equipment and plant, would also needs to be considered and managed accordingly. NSW EPA administers guidelines and criteria for the handling and disposal of contaminated material in order to mitigate and/or manage such risks. These guidelines would need to be followed if any contaminated material is identified during construction.

Operation

During operation, the proposal would operate with areas of exposed soils and bedrock. However, potential impacts to the bedrock as a result of the proposal is considered to be negligible and would not have wide-spread effects. Indirect impact to soils as a result of run-off and drainage during operation is possible; however, this potential impact would be managed through the implementation the construction of operational water quality measures and revegetation of exposed soils, which are described in further detail in **Section 6.6.3** and **Section 6.1.3** respectively.

6.7.3 Safeguards and management measures

Safeguards and mitigation measures to manage potential impacts to geology, topography and soils are summarised in **Table 6-46**. Environmental safeguards and mitigation measures to manage potential impacts to water quality as a result of erosion and sediment distribution are provided in **Section 6.6.3**.

Table 6-46 Safeguards and mitigation measures for managing geology, topography and soils

Impact	Environmental safeguards	Responsibility	Timing
Discovery of previously unidentified contaminated land in excavated areas	Excavated areas would be investigated for potential contaminations during construction. Where evidence of contamination is encountered (such as odorous or visually contaminated materials), work in the area would cease immediately and the RMS Senior environmental officer would be contacted to advise, in consultation with a contaminated land specialist on the appropriate action. Works that may disturb the identified contamination would not re-commence until advised by the RMS Senior environmental officer.	Construction contractor and RMS project manager	Construction
Contamination of environment from accidental chemical spills, machinery fuel and oil leaks	Fuel would be stored on an impervious surface in an appropriately bunded area and would carry spill kit material. Should fuels, chemicals and liquids be stored they would be: • Stored at least 40 metres away from any waterways or drainage lines. • Stored in an impervious surface or taken off-site. • Any refuelling of construction vehicles would occur at least 40 metres away from any waterways or drainage lines.	Construction contractor	Construction
Contamination of environment from machinery fuel and oil leaks	Machinery would be kept in good working order according to the manufacturers specifications and would be checked daily to ensure that no oil, fuel or other liquids are leaking from the machinery.	Construction contractor	Construction

6.8 Air quality and climate change

6.8.1 Existing environment

Climate

The climate within the region is characterised by warm to hot summers and cool winters. Average temperatures for the hottest month of February are between 15-25°C. Average temperatures in the coldest July are between 3-17°C (Weatherzone 2011).

The Bureau of Metrology owns and operates a weather station at Cobargo located around 10 kilometres to the south of Dignams Creek. Records of daily rainfall for the weather station date back to 1965. A summary of the monthly average rainfall is provided in **Table 6-47**. The wettest month is February receiving on average 123 millimetres of rain, the driest month is in July receiving 42 millimetres of rain on average. The average annual rainfall for Cobargo is 972 millimetres.

Table 6-47 Average Monthly Rainfall Statistics (mm) at Cobargo 1965-2010 (BoM 2001)

J	F	M	A	M	J	J	A	S	O	N	D	Annual
85	123	115	74	67	81	42	49	53	93	98	92	972

Air Quality

There is no routine air quality monitoring undertaken within close proximity to Dignams Creek, however the study area is predominantly surrounded by national park thus local air quality is likely to be relatively good with the major source of air emissions attributed to vehicles travelling along the Princes Highway.

The *Regional State of the Environment Report 2004-2009* (OCSE 2010) provides a description of air quality within both the Eurobodalla and Bega Valley LGAs during 2004 to 2009. Other than smoke from occasional bushfires and localised wood smoke from domestic heaters during the winter, air quality within both LGAs was considered to be acceptable during the reporting period.

In Eurobodalla sources contributing to a reduction in air quality include wood smoke from domestic heaters in winter, log sawmilling, timber dressing and mineral and metal chemical wholesaling. Temperature inversions that trap air pollution close to the ground are relatively common in winter, which can lead to relatively short-term reductions in air quality due to smoke solid fuel stoves (OCSE 2010).

In Bega Valley sources contributing to a reduction in air quality include smoke for fuel reduction burns, dairy product manufacturing and petroleum industry activities. The topography of the area generally results in well-mixed air emissions, due to drainage flows. Temperature inversions that would trap air pollution close to the ground are rare (OCSE 2010).

Climate change

Climate change refers to the projected long-term changes to global climatic patterns as a result of increases in the concentration of greenhouse gases in the atmosphere. There is a need to understand these projected changes to future climatic conditions and the effect they could have on existing and potential projects and infrastructure.

Climate change projections detailed in this assessment have utilised publicly available information. **Table 6-48** provides information on climate change forecasts for the South East region of NSW (an area stretching from north of Young and Crookwell to the NSW border in the south). The table provides details of the climatic change projections to the year 2050 (DECC 2010).

Table 6-48 Projected climatic change predictions for 2050 for the NSW Sydney and Central Coast Region

Season	Temperature		Seasonal rainfall	Evaporation
	Min	Max		
Spring	↑ 1.5-3.0 ºC	↑ 2.0-3.0 ºC	No change	No change
Summer	↑ 1.5-2.0 ºC	↑ 1.5-2.0 ºC	↑ 20-50%	↑ 10-20%
Autumn	↑ 1.0-3.0 ºC	↑ 2.0-3.0 ºC	↑ 5-10%	No clear pattern
Winter	↑ 1.0-3.0 ºC	↑ 2.0-3.0 ºC	No significant change	No clear pattern

Expected regional climatic changes for the South East region of NSW as defined in DECCW (2010c) are as follows:

- Increase in average daily maximum temperatures.
- Shifts in current patterns of climate variability, including increased rainfall in summer and decreased rainfall in winter.
- Increased intensity of extreme events (e.g. droughts, floods, severe storm events).
- Changes in seasonality and amount of precipitation (the direction and magnitude of changes will vary between geographic locations).

By 2050, the South East region of NSW is expected to experience a hotter climate, with temperatures projected to increase by between 1.5 °C to 3 °C throughout the year. Rainfall is projected to increase in summer and autumn, with no change in spring and winter. No clear change in evaporation is expected in spring, autumn and winter, but evaporation in summer will be higher, along with increases in run-off.

6.8.2 Air quality criteria

Air quality criteria are used to assess the potential for ambient air quality to give rise to adverse health or nuisance effects. Emissions from construction equipment and vehicles using the highway have the potential to impact on local amenity. The most significant emissions produced from motor vehicles are:

- Oxides of nitrogen (NO_x).
- Carbon monoxide (CO).
- Particulate matter (PM_{10}).

Of particular relevance to the proposed construction activities during early works are criteria for particulate matter. There are various classifications of particulate matter, with the OEH providing assessment criteria for:

- Total suspended particulates (TSP).
- Particulate matter with equivalent aerodynamic diameter less than or equal to 10 microns (PM10).
- Deposited dust.

The OEH has set air quality assessment criteria as part of their *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005). **Table 6-49** summarises the OEH air quality assessment criteria that are relevant to the proposal.

Table 6-49 OEH assessment criteria for relevant air pollutants

Pollutant	Averaging Time	Criterion
Carbon monoxide (CO)	Maximum 1-hour average	30 mg/m^3
	Maximum 8-hour average	10 mg/m^3
Nitrogen dioxide (NO2)	Maximum 1-hour average	246 µg/m^3
	Annual average	62 µg/m^3
Particulate matter (as PM10)	Maximum 24-hour average	50 µg/m^3
	Annual average	30 µg/m^3
Total suspended particulates (TSP)	Annual average	90 µg/m^3
Dust deposition	Annual average (maximum increase)	2 g/m^2/month
	Annual average (maximum total)	4 g/m^2/month

6.8.3 Potential impacts

Construction

Air Quality

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with road construction. The total amount of dust generated would depend on the silt and moisture content of the soil, the types of operations being carried out, the size of exposed areas, and the frequency of water spraying and the speed of machinery. Particulate emissions from construction have the potential to affect amenity and, in extreme cases, health.
It is anticipated that construction activities would include:

- Site establishment and preliminary works, including:
  - Installation of erosion, sedimentation and drainage controls and other pre-construction environmental management measures.
  - Establishment of a compound and stockpile sites.
- Removal of vegetation and adjustment of utilities (where required).
- Surface preparation including earthworks, blasting (where required) and drainage works including drainage of dams and creek diversions.
- Transport of cut and fill material and importation of gravel materials.
- Construction of road pavement and kerbing, bridge foundations and culverts.
- Signposting, line marking and installation of signs and guide posts.
- Decommissioning and removal of redundant pavement.
- Landscaping and rehabilitation.

A range of construction plant and equipment would be required for the above activities. These would typically include excavators, cranes, graders, vibratory rollers, haul trucks, backhoes, bitumen and asphalt spraying plants, line-marking equipment, water carts and bulldozers.

Primary sources of emissions of airborne particulate matter associated with the proposal may include:

- Clearing of vegetation and topsoil by bulldozers and/or backhoes.
- Excavation and levelling of soil by bulldozers, backhoes and/or excavators.
- Movement of soil and fill by dump trucks and scrapers.
- Wind erosion from unsealed surfaces and stockpiles.
- Vehicle (exhaust) emissions from construction.
- Wheel generated dust by construction vehicles travelling along unsealed areas.

Typically, air quality management for road construction activities, addresses spoil handling, machinery operating procedures and monitoring of potential impacts. The main focus of air quality management is to control dust emissions and thereby mitigate impacts to ensure that the proposal does not result in exceedances of air quality criteria at sensitive receptors. Relevant criteria for air quality management are those specified by the DECCW, as per **Table 6-49**.

As some of the construction works would occur within 20 metres of a nearby resident, dust has the potential to be a nuisance. The degree of dust nuisance would depend on the amount of earth works involved, the duration of construction time, and the local meteorology at the time of works (e.g. wind speed and direction).

Climate change

Construction of stage 1 would occur over an 18 to 24 month period. During the short construction period for stage 1, construction of the proposal would result in greenhouse gas emissions being produced, which would include:

- Emissions generated from land clearing (decomposition of vegetation).
- Carbon dioxide, methane and nitrous oxide would be generated from liquid fuel use in plant and vehicles (diesel, petrol).
- Embedded emissions associated with the manufacture and delivery of construction materials.
- Methane generated from land filling any carbon based waste.

The impacts on climate change from construction of the proposal would however be minimal. Construction of stage 2 is a long term plan which is unlikely to be built for some time. Impacts on climate change from the proposal would be similar to those produced in stage 1 and are also considered to be minor.

Operation

Air Quality

No adverse air quality impacts have been expected to result from the proposal during operation.

Climate change

In the long-term (20-100 years), climate change may have a more substantial effect on the proposal. Climate change scenarios for the proposal area have been outlined in Section 6.8.1, and can be found in more detail in the NSW *Climate Impact Profile* (DECCW 2010c). The key impacts of climate change for the proposal are likely to include:

- Changes in rainfall patterns and increased flooding.
- Increases in temperature (both average temperature and number of days in excess of 35 degrees Celsius).
- Increased severity of seasonal drought.
- Increases in atmospheric carbon dioxide concentrations.

Increased rainfall intensity and associated peak flood flows are considered to be the key climate change risks to the proposal. This is expected to result in increases in the frequency and magnitude of localised flooding in the vicinity of the proposal, as well as associated drainage and stormwater impacts. Potential implications include infrastructure deterioration. An assessment of the predicted flood levels upstream of the new bridge identified that the new bridge deck height (RL of 13.56 metres at its lowest point) would be high enough to avoid being over-topped during the predicted 100 year ARI flood levels with and without climate change (10.07 metres and 10.35 metres respectively) as well as the predicted 1 in 2000 year ARI flood (refer to **Section 6-6**). The bridge and associated embankments would result in increases in flood levels of up to 0.1 metres adjacent to the bridge reducing to about nil around 250 metres upstream of the proposed bridge. The proposed bridge and embankments have been designed with consideration to the impacts of climate change.

Storms with greater rainfall intensity or water velocity than projected may subject the bridge and associated works to increased scour and erosion along the banks of Dignams Creek. In addition, increased erosion along the river banks would require additional maintenance to sediment and erosion controls. Underestimating scour at the bridge piers during flood events may result in risk to the bridge. The proposed bridge has been assessed against increases in rainfall of 15 per cent and 50 per cent as a result of climate change and can cater for the increased flows.

Increases in average temperature and heatwave may affect the integrity of pavement, bridges and other construction materials. Direct impacts include more rapid deterioration of infrastructure, which may result in higher operational and maintenance costs. Indirectly, evaporative changes can result in changes to soil moisture content and soil instability, which may impact foundations of structures, cause cracking and/or softening of pavements and road rutting.

Increases in carbon dioxide concentrations in the atmosphere over the long term (60-100 years) may result in enhanced deterioration of reinforced concrete through increased carbonation of the concrete and exposure of reinforcement (Wang et al 2010). For the bridge this may involve enhanced deterioration of the reinforced concrete elements of the structure.

6.8.4 Safeguards and management measures

The elements of the proposal that have been identified as having the highest potential for causing air quality impacts are the construction activities. The safeguards and management measures for construction activities are listed in **Table 6-50**.

Table 6-50 Safeguards and mitigation measures for air quality

Impact	Environmental safeguards	Responsibility	Timing
Dust from construction activities	An air quality management plan would be prepared before any pre-construction or clearing activities and would provide guidance on the use of appropriate dust suppression methods which would include (but are not limited to): • Stabilising of areas with the capacity to cause dust, with water spraying, compaction or progressive revegetation. • Covering of stockpile and storage areas. • Covering of all materials transported to and from the construction site. • Consideration of speed limits for equipment on unsealed surfaces. • Locating stockpiles as far away from residences as practically possible. • Minimising the extent of disturbed areas as far as practicable. This may be achieved by staging the works to minimise the number of disturbed areas at any one time. • Rehabilitating disturbed areas as quickly as possible. • Suppressing dust on unsealed surfaces, temporary roadways, stockpiles and other exposed areas using water trucks, hand held hoses, temporary vegetation and other practices. • Modifying or stopping dust generating activities during very windy conditions or when dust can't be controlled. • Operating and maintaining vehicles and equipment in accordance with manufacturer's specifications. • Local residents would be advised of hours of operation and provided with contact details for queries regarding air quality.	Construction Contractor	Construction
Impacts on climate change from	During construction the following would be considered:	Construction Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
construction activities	• The life cycle environmental impact of materials and plant used in the construction process during procurement. • Establishing operating procedures for site vehicles to increase efficiency of vehicle fuel use. • Reducing clearing of vegetation to as great an extent as feasible, and re-establish vegetation in suitable areas when construction is completed. • Reducing site wastage by reusing and recycling wasted materials as a preference before disposing to landfill.		
Impacts of flooding on infrastructure	During detailed design, the following would be considered: • Sizing drainage system to accommodate the impact of climate change on maximum storm/ rainfall level predictions. • Whether the increase in frequency or intensity of flood events is likely to require modification to concept design scour protection of bridge piers, piles and other infrastructure. • Projected climate change when selecting suitable vegetation for landscaping. Consider vegetation suitable for regular inundation, increased rainfall and evaporation and seasonal droughts where applicable to the area.	Design contractor	Detailed design
Increased average temperature and heatwave	During detailed design, projected temperature extremes would be considered when: • Selecting bridge expansion joints. • Selecting bitumen design. • Selecting suitable vegetation and management plans for the maintenance of landscaped areas. • Developing suitable vegetation and management plans.	Design contractor	Detailed design
Carbon dioxide concentration in the atmosphere	The detailed design would be reviewed to take into account potential increase in carbonation levels for the future life of the asset. Where appropriate, design and	Design contractor	Detailed design

Impact	Environmental safeguards	Responsibility	Timing
alongside increased temperatures	construction measures would take account of increased carbon dioxide concentrations through enhanced design specification.		

6.9 Land Use and Property

6.9.1 Existing environment

The proposal is located within the Bega Valley and Eurobodalla shires. Existing land use zones are shown in **Figure 6-15**. Land use in both shires is dominated historically by conservation, timber production, agricultural crops and grazing. Land use surrounding the proposal includes:

- Rural residential properties.
- Agricultural lands, used predominantly for cattle grazing and occasionally for cropping.
- Conservation areas including two national parks.
- Forestry.

The main land uses surrounding the proposal consist of rural and rural residential properties, national parks which have been previously logged and agriculture. The main agricultural practices consist of grazing. No intensive agricultural activities occur in the proposal area.

The proposal is adjacent to Kooraban National Park on the western side of the existing Princes Highway and Gulaga National Park on the eastern side of the existing Princes Highway. The proposal would also pass through privately owned property, which has been grazed and contains forested bushland.

Land use surrounding Dignams Creek includes rural residential properties and agricultural lands used predominantly for cattle grazing supporting scattered trees, strips of riparian vegetation along Dignams Creek and small patches of forest. The proposal crosses the existing Princes Highway alignment once in addition to the proposed tie in points and Dignams Creek Road south of Dignams Creek.

Forestry and timber has had a major influence on the landscape since European settlement, creating cleared valleys subsequently used for agriculture and dairying. Clearing of forests has also increased erosion of slopes contributing to sediment accumulation on the flood plains, and increasing the depth and prevalence of creek lines and gullies.

An area of approximately 36.95 hectares would be required for the proposal. This would be made up of ten DP Lots that have already been fully acquired, and one with two lots (around 1.32 hectares) proposed for partial acquisition (refer to **Table 3-12**). **Section 3.6** provides a summary of the proposed properties (both private and public) that would be impacted by the proposal and describes the estimated area of acquisition.

Upgrade of the Princes Highway, Dignams Creek

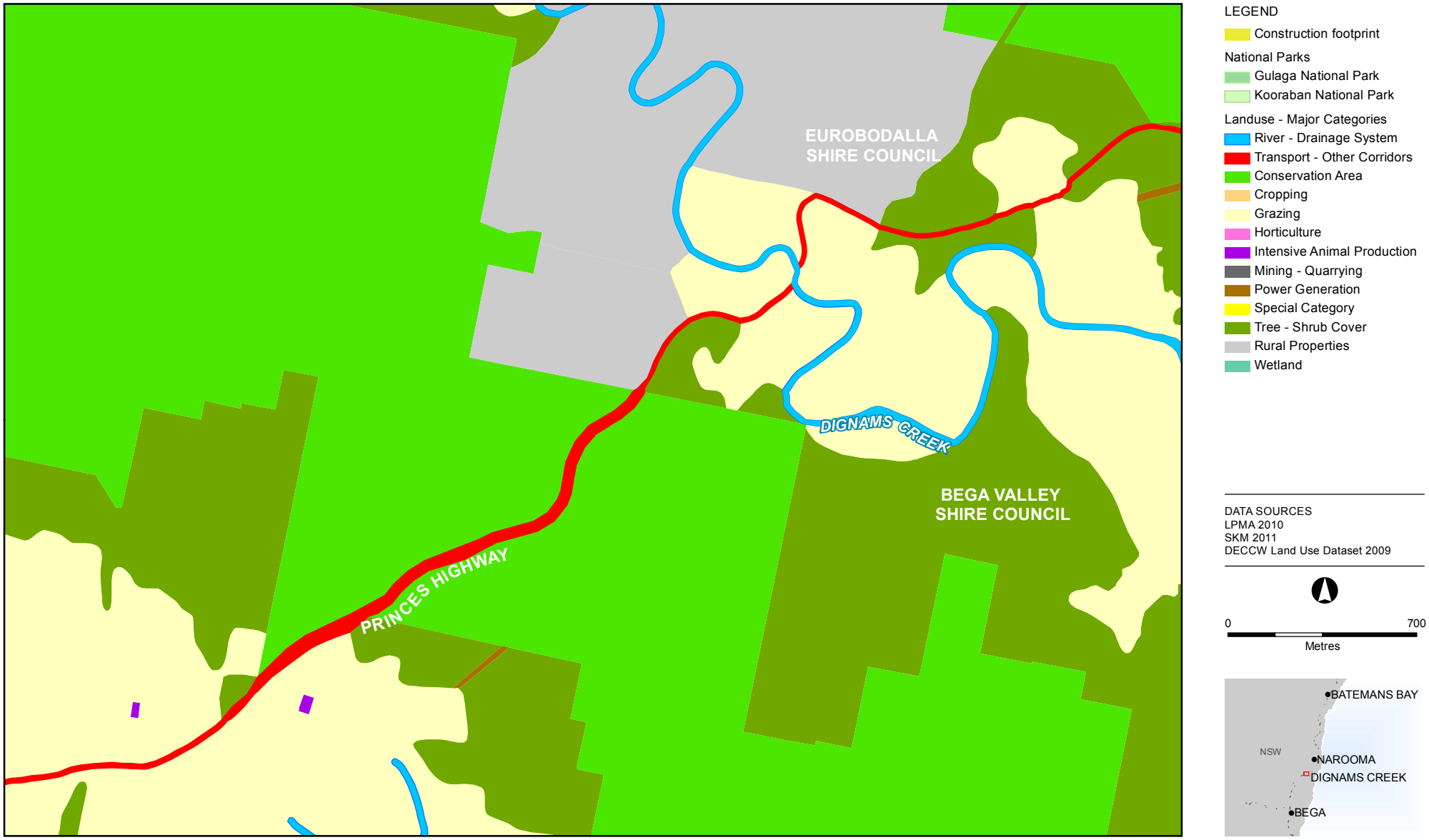

Figure 6-15 | Land uses adjacent to the proposal

NSW GOVERNMENT Transport Roads & Traffic Authority

SINCLAIR KNIGHT MERZ SKM

8/05/2013 | I:\ENVR\Projects\EN02937\Technical\GIS\Spatial_Directory\ArcGIS\REF_Ver3\EN02937_GIS_REF2_F028_r2v1_Landuse.mxd
Newcastle Spatial Team - Prepared by : AL
Checked by : JC

6.9.2 Potential impacts

There would be a range of potential land use related impacts, particularly for owners, occupants and operators of properties along and near the proposal. Land use impacts relating to biodiversity (**Section 6.1**), noise (**Section 6.2**), visual amenity (**Section 6.3**) and traffic (**Section 6.10**) are discussed in detail in the relevant sections of this REF. The social and economic impacts of the proposal are discussed in **Section 6.11**.

Ten land lots would be directly impacted by the proposal. Eight of the ten land lots are contained within one property which has already been purchased by RMS during the options assessment and design process and two land lots still require partial acquisition (refer to **Section 3.6**). Full or partial acquisition of property required for the proposal affects the following land uses:

- Kooraban National Park (partial ie strip acquisition).
- Agricultural land (varies from full to partial).
- Residences (varies from full to partial).

Land would be fragmented by the proposal specifically where the proposal would be located to the west of the existing Princes Highway. Fragmentation impacts on biodiversity have been provided in **Section 6.1**. Property access including internal and external farm access arrangement would also be affected for four properties. Provision for alternative access has been addressed by the design.

The number and extent of property impacts as a result of the proposal would be subject to further refinement during detailed design. Property acquisitions would be subject to negotiation between the landholder and RMS in accordance with RMS *Land Acquisitions Policy Statement* and the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*. The acquisition areas provided in **Section 3.6** are approximate only and would be finalised through further discussion with land owners.

As stated in **Section 4.3.1**, about 18.28 hectares of the land previously recognised as Kooraban National Park was included in the *National Parks and Wildlife Amendment (Adjustment of Areas) Bill 2012* passed by the NSW Parliament for the purposes of use as road reserve for the Dignams Creek proposal. An offset package is currently being developed to compensate for the revocation. While the final package is yet to be confirmed with OEH the residual impacts on biodiversity would be improved through the offset strategy that aims to maintain or improve biodiversity values in the proposal area in the long-term.

The proposal would also impact on around 230 square metres of Lot 7027 DP1069205 which is crown land and recognised as Crown Reserve 91754. This parcel of land currently has an Aboriginal Land Claim (no 7761) on it and would require partial acquisition. RMS is investigating acquiring the entire property and has consulted with the Land and Property Management Authority and the NSW Aboriginal Land Council (refer to **Section 5.5**).

Construction

The main construction impacts to land use include property acquisition, temporary and permanent relocation of fences and occasional temporary impacts to property access. During construction some acquisitions would result in long-term changes in land use (refer to **Section 6.10**).

The establishment of the ancillary facilities (construction compound sites and stockpile sites) would only temporarily affect the land use. After construction is complete, ancillary construction facilities would be removed, the land would be cleared of all rubbish and materials before being rehabilitated. The land that is not being transferred as part of the offset package would then revert to its original land use.

As stated in **Section 3.3.1**, 15 temporary sediment basins would be located adjacent to the proposed alignment on public and private land. Seven of the 15 sediment basins would be removed following construction of the proposal. The remaining eight would be reconstructed as operational water quality controls as outlined in **Table 3-5**. The land use changes for seven of the construction sediment basins would be temporary and the land would revert to its original use following construction. Land use for the remaining eight operational water quality controls would be changed to road reserve.

Two private property access roads located at the start of the proposal within Stage 1 would be relocated as described in **Section 2.6.4.** Whilst there is a large change in the access arrangements for these two properties (9526 and 9523 Princes Highway), the relocation of these property access roads would result in improvements to road safety and sight visibility for vehicles entering and exiting the new access roads. Access to two private properties at the end of the proposal within Stage 2 would also be impacted during construction, however these impacts are considered to be minor and access points would be improved to current Austroads road design standards. The public access roads within the national parks would also be impacted during construction of the proposal. The access points would be improved and relocated to achieve current sight distance requirements (refer to **Section 2.6.4**). Access to private and public properties would occasionally have temporary restrictions/traffic control in order to maintain safety during construction of the proposal. Any temporary restrictions to property access would be arranged with the effected property owner prior to restrictions occurring.

Operation

The main impact to land use during operation would be the permanent change to land use from primary production, rural lands or national park and nature reserve to a transport corridor through property acquisition. Additionally, land that would be transferred to OEH as part of the offset package currently being negotiated between RMS and OEH (refer to **Section 6.1** and **Appendix K**) would have the existing land use changed to national park or nature reserve.

This would include a loss of around 25 hectares of land identified as agricultural or grazing land from the proposal and includes 17.55 hectares of cleared land. However in the Bega Valley and Eurobodalla LGAs there is around 151,000 hectares of existing agricultural/grazing land which equates to a loss of 0.02 per cent. This is not considered significant.

There would be a permanent change in the location of the access road to properties 9526 and 9523 Princes Highway. For the property located at 9526 Princes Highway the access road would be required about 413 metres to the south of the original access point (refer to **Figure 2-12**). For the property owner at 9523 Princes Highway, the access road would be relocated about one kilometre to the eastern side of Dignams Creek Road around 200 metres from the intersection with the Princes Highway (refer to **Figure 2-13**). The owner of this property is currently RMS. There

would also be permanent changes to the Kooraban National park access track which would be formalised and consolidated during stage 1 of the proposal and relocated during stage 2 of the proposal.

6.9.3 Safeguards and management measures

The amenity impacts associated with changes to land use, property acquisition, visual, noise, traffic and associated socio-economic impacts are addressed in (Refer to **Section 6.91).** The safeguards and management measures proposed to address and control ecology impacts and promote biodiversity offsets (refer to **Section 6.1.4)**. Safeguards and mitigation measures to manage potential impacts to land use and property are summarised in **Table 6-51**.

Table 6-51 Summary of mitigation measures for land use and property

Impact	Environmental safeguards	Responsibility	Timing
Change in land use	Consultation would be undertaken with property owners impacted by the proposal.	RMS	Detailed design
Property acquisition	Property acquisition would be managed in accordance with the provisions of the Road and Maritime Services' *Land Acquisition Policy* and the *Land Acquisition (Just Terms Compensation) Act 1991.*	RMS project manager	Detailed design
Property access	Property access would be maintained wherever possible. Prior to any unavoidable disruption to access, consultation would be undertaken with the affected property owner.	Contractor	Prior and during construction

6.10 Traffic and access

6.10.1 Existing environment

The *Dignams Creek Options Report* (RTA, 2006) identified the Princes Highway as a key piece of infrastructure on the south coast of NSW. Key considerations for the Princes Highway include:

- Its economic significance as the key freight route in South East NSW where there are no rail services.
- Its role as a major tourist route for key destinations along the south coast and far south coast, with high peak volumes on key holiday dates.
- Its role as a major commuter route between Bega, Narooma, coastal communities and Bodalla.
- Its role as a local route for residents of surrounding smaller towns and rural residences.

The study area is characterised by low traffic volumes, approximately AADT 1600 vehicles with a linear traffic growth rate of 0.8 per cent (RMS 2013). AADT has been estimated from annualised tube counts from 2005, 2007 and 2010. The tubes were placed on Princes Highway north of the intersection with Dignams Creek Road. The 2010 tube traffic count on Dignams Creek Road is approximately 108 AADT based

on a week average from 16-26 October 2010. Traffic composition is about 85 per cent cars and 15 per cent heavy vehicles based on classified traffic counts undertaken by RMS. As the traffic volumes and predicted traffic growth on the Princes Highway are relatively low the current and predicted level of service along the Princes Highway at Dignams Creek is considered acceptable.

There are currently school mini buses servicing the Dignams Creek area, which stop at individual houses along the school bus route. There are no existing provisions for cyclists.

As stated in **Section 2.1.2**, currently the crash rate on the Princes Highway at Dignams Creek is 214.1 per 100 MVKT. This is around seven times the typical casualty crash rate for this type of road in NSW. The casualty crash rate is 132.6 per 100 MVKT, which is nearly eleven times the casualty crash rate for NSW.

As described in **Section 2.2** there are two public access tracks into the National Parks and around four unnamed access private property roads connected to the Princes Highway along the length of the proposal. There are also two driveways that allow direct access to the Princes Highway at the southern end of the proposal.

6.10.2 Potential impacts

Partial road closures, construction speed limits

The proposal would require partial closure of portions of the Princes Highway and Dignams Creek Road during various stages of construction, such as tie in with the Princes Highway and Dignams Creek Road. This would result in potential delays and increased travel time for motorists. In some cases, this may result in additional waiting times at Dignams Creek Road and the private and public property accesses. Construction speed limits would also apply to road segments directly adjacent to construction areas and may lead to short term travel delays for motorists.

These minor changes to travel time and longer-than-usual queue lengths onto the Princes Highway would be localised and would not cause secondary impacts to the broader road network. Moreover, although these impacts could be experienced for a period of up to 18 to 24 months, they would be variable and temporary in nature, and accordingly are considered acceptable within the context of the construction activity. While these impacts would be unavoidable, the construction staging would assist in limiting the potential impacts to traffic flows. This would involve maintaining one lane of traffic in each direction at all times throughout the construction period where construction activities would be undertaken on existing roads such as the Princes Highway and Dignams Creek Road.

Construction traffic

Construction traffic would use the existing Princes Highway via the proposed construction access road at the start of the proposal. There would be an increase in construction traffic using the Princes Highway both within the study area and wider road network. This would generally be comprised of utility vehicles, delivery trucks and heavy vehicles. These vehicles would be associated with construction workers travelling to and from the construction site, the delivery of heavy vehicles and machinery, the delivery of construction materials and the movement of spoil or materials within the construction site. The proposal would result in an estimated 70-100 two-way vehicle movements per day for the construction period. This would comprise of an estimated 20-25 heavy vehicles and 20-30 light vehicles, although

vehicle movements may increase during the earthworks and bridge construction phases. Given the low traffic volumes that currently use Princes Highway and Dignams Creek Road, the additional traffic associated with construction would not be expected to have a substantial impact on existing traffic flows.

Traffic control would be used to manage heavy vehicle entry and exit from the construction site and the movement of materials within the construction site. These movements would be limited to the beginning and end of shifts where practicable. In addition, to reduce the impact to motorists, only left-in/left-out movements from the construction site would be permitted. Traffic control would be likely to result in some traffic delays for motorists, however, these delays would be localised and of a short duration.

Provision would need to be made for staff parking at the construction site. It is anticipated that up to 70 workers would require car parking spaces. A temporary parking area would be provided at the construction compound area for use by construction staff.

Access

Access to some private and public properties would be affected during construction. For instance, modified access would be provided for two private properties at the northern end of the proposal during stage 1 as described in **Section 2.6.4**. In stage 2 access points into the national parks and two private properties would also be modified and the access point into Kooraban National Park at the top of Dignams Hill would be relocated and consolidated during stage 1 of the proposal and relocated during stage 2. While interruptions to access would be required at various times, any interruptions would be for a short period. Affected property owners would be notified before any such access interruptions, and where necessary alternative arrangements would be put in place.

Traffic would potentially experience delays during construction, but this is not expected to have an impact on emergency service access, as vehicular access along all roads would be maintained and emergency vehicle would be given priority where possible.

Public transport

As road access would be maintained during construction, bus routes would not be affected by the proposal. There is, however, potential for delays to bus commuters due to increased travel times through the intersection.

Safety

There may be safety risks associated with construction activities occurring directly adjacent to traffic specifically at tie in points. In addition, construction access points where construction vehicles would slow down, enter and turn into work sites has the potential to affect the safety of other road users. This would be managed through the implementation of a Traffic Management Plan (discussed further in **Section 6.10.3**).

Heavy vehicles

Heavy vehicles access, particularly forestry trucks, to Dignams Creek Road may potentially be impacted during construction, during the Stage 1 works. As such there would be potential for delays to the delivery and pick up of goods and materials for

heavy vehicles, specifically B-doubles, accessing the Princes Highway and Dignams Creek Road during construction of the proposal.

Operation

The proposal would improve road safety along the Dignams Creek section of the Princes Highway; refer to **Chapter 2** and **Chapter 3**. There would also be improvements in travel times and travel efficiency for freight, commuters and tourists. The proposal would not alter traffic volumes once operational as it would not in itself generate new traffic or cater for a substantial increase in traffic volumes. In addition the proposal would maintain access to Dignams Creek Road and private and public property access along the Princes Highway in the Dignams Creek area.

The relocation of two private property access tracks would increase travel times slightly for residents of these properties due to increases in travel distances. However the relocation of the property access track would improve road safety by providing increased sight distance for traffic accessing property to and from the Princes Highway. Overall this is considered an improvement to the existing situation.

6.10.3 Safeguards and management measures

A traffic management plan would be prepared for the proposal prior to construction and would include the safeguards and mitigation measures outlined in **Table 6-52**.

Table 6-52 Traffic and transport safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Impacts to traffic flow and property access during construction	A detailed Traffic Management Plan would be prepared in accordance with the RTA's *Traffic Control at Work Sites* Manual (2010a) and *RTA Specification G10 – Control of Traffic*, and would be approved by RMS prior to implementation. The Traffic Management Plan would address: • Maintaining access along the Princes Highway during construction. • Maintaining access for local traffic using Dignams Creek Road. • Maintaining access into the national parks, other forest lands and residential property along the proposal route. • Maintaining property access wherever possible. Where changes to access arrangements are necessary, owners and tenants and would be advised and consulted with on alternate access arrangements. • Providing safe access points to work areas from the adjacent road network, eg safety barriers where necessary,	Construction contractor	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
	temporary speed restrictions etc. • Construction traffic would enter/exit the construction zone only in areas designated for this purpose in the Traffic Management Plan. • Approval for road occupancy would be obtained for any lane closures or road traffic changes. Procedure for informing the community about upcoming road construction activities. • Where possible haulage routes would be designed to minimise impacts on residential receivers.		
Impacts to traffic flow and property access during construction	Traffic control plans (TCPs) would be prepared for the appropriate stage of works and implemented by suitably qualified personnel. Implementation of TCPs would be inspected as required for the duration of the construction phase in accordance with the RMS *Traffic Control at Worksites Manual*.	Construction contractor	Pre-construction & construction

6.11 Socio-economic

6.11.1 Existing environment

The following provides an overview of population and demographic data for the suburb of Dignams Creek within the Bega Valley and Eurobodalla LGAs, based on Census data from 2011.

In 2011, the suburb of Dignams Creek had a population of 160 people. Dignams Creek was characterised by population with a median age of 55. Of the families within Dignams creek 47.1 per cent were without children and 35 per cent had both partners no working. According to the 2011 census, 52.3 per cent of those within Dignams Creek travelled to work by motor vehicle and 19.4 per cent worked from home.

Values that have been identified as important to the Dignams Creek community during consultation (refer to **Chapter 5**) undertaken as part of the proposal include the following:

- Rural/agricultural lifestyle.
- Self-sustainable lifestyle.
- Biodiversity and protection of threatened species specifically the Koala.
- Environmental appreciation.
- The Dignams Creek gateway and sense of place.
- Importance of the Reedy Creek Road and historical items in the region.
- Movement through the Dignams Creek and Princes Highway intersection.
- Social.
- Visual amenity.

- Access to recreational opportunities within the surrounding environment, including the adjacent national parks.
- Protection of Dignams Creek, Wallaga Lake and the Dignams Creek Sanctuary Zone (Batemans Marine Park).

A summary of the main demographic characteristics of the suburb of Dignams Creek is shown in **Table 6-53**.

Table 6-53 ABS demographic characteristics in 2011

Characteristics	Dignams Creek
Population (2011)	
Total population	160
Median age (years)	55
14 years or below	12.6%
65 years or over	21.4%
Households and families (2011)	
Total families	81.8%
Couple families with children	33.35
Couple families without children	47.1%
One parent families	13.7%
Income and employment (2011)	
Median family income ($ per week)	$791
Labour force participation	50.7%
Unemployed	2.17%
Travel to work (2011)	
Car – as driver	47.8%
Car – as passenger	4.5%
Train	0%
Bus	0%
Motor bike Scooter	4.5%
Worked at home	19.4%

Land use/businesses

Existing land use is described in **Section 6.9** and comprises forestry, conservation, rural residential properties and agriculture lands used predominantly for cattle grazing. No intensive agricultural activities occur within the proposal.

Businesses situated along the Princes Highway and adjacent to the proposal include:

- Cattle grazing.
- Dairy farms.

- Forestry.
- Small scale agriculture.

Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being. This includes education facilities, child care centres, open space and recreation facilities, and emergency services. In the immediate area surrounding the proposal there is no existing social infrastructure.

The nearest towns are Narooma located around 27 kilometres to the north and Cobargo around 10 kilometres to the south. Both are accessed via the Princes Highway. These towns provide essential services including medical and community facilities, shopping and schools.

6.11.2 Potential impacts

Land use change and property acquisition have been discussed in **Section 6.10** and **Section 3.6** respectively. Given that the degree of change in land use within the wider community resulting from the proposal would be small there is unlikely to be a notable direct economic or social impact from these changes.

There would be some notable visual impact from the development, both during construction and operation of the road, refer to **Section 6.3**. However this impact is not considered to be significant as areas that would be cleared as part of the proposal would be revegetated. The landscaping plan uses fast growing pioneering species as well as species that take time to establish. As such cleared areas would be revegetated quickly and includes species that are indigenous and endemic to the area so that the area would integrate with the surrounding landscape.

Construction

The proposal has the potential to generate socio-economic impacts during the anticipated 18 to 24 months of construction (refer to **Chapter 3** for description of works and timeframe). These impacts are summarised below.

Visual Amenity

The community would be affected through the degradation of visual amenity. These impacts would be temporary and are addressed in **Section 6.3**.

Noise and vibration and air quality

Noise and vibration impacts and air quality impacts associated with road plant and machinery would directly impact on residents near the highway. These have the potential to affect sensitive receivers such as local residents with properties immediately adjacent to the proposal along the most eastern extent of Dignams Creek Road and sensitive receivers along the southern section of the proposal at 9859 and 9860 Princes Highway. These are discussed in **Sections 6.1** and **Section 6.8** respectively.

Traffic, parking, access and connectivity

During the construction period there would be localised temporary traffic changes, specifically related to access tracks / roads and the reconfiguration of Dignams Creek Road, and during tie in works with the Princes Highway. During these periods, delays may be experienced. There would also be the potential for disruptions to public bus services as a result changes to bus stop location and access. These have been discussed in **Section 6.10**.

There would be some inconvenience to local commuters during construction. This would primarily affect residents located adjacent to the proposal on the Princes Highway and on Dignams Creek Road and Reedy Creek Road (located at the north-western end of Dignams Creek Road). This impact would be restricted to the period during construction of the proposal during Stage 1 and potentially during Stage 2 works.

Heavy vehicles (specifically forestry trucks) access to the Princes Highway, Dignams Creek Road and Reedy Creek Road may potentially be impacted during construction Stage 1 works. As such there would be potential for delays to the delivery and pick up of goods and materials for heavy vehicles accessing these roads during construction of the proposal. One lane would be kept open and traffic signals would be used to minimise delays.

Property acquisition

Property acquisition requirements for the proposal are outlined in **Section 3.6** and are illustrated in **Figure 3.14**. Due to the limited extent of acquisition, there is not expected to be a wide social impact associated with property acquisition for this proposal.

Utilities and services

There would be potential for disruptions to services (power and telecommunications) for neighbouring properties during the relocation and adjustment of utility services during construction (refer to **Section 3.5**). RMS would consult with the utility provider and property owner prior to any adjustments.

Social infrastructure

The proposal does not have any direct impacts on social infrastructure; however, construction works may impact on access to the Princes Highway and Dignams Creek Road through potential traffic and transport disruptions and delays at Dignams Creek. The wider regional area would experience a minor short-term increase in employment opportunities and procurement of local goods and services from the temporary increase in workforce.

Operation

Visual amenity

The visual amenity of the area would change, mainly as a result of the proposed bridge embankments and removal of vegetation from shoulders on the existing Princes Highway. The visual impact has been assessed in **Section 6.3**.

Social infrastructure

The operation of the proposal would provide various social and economic benefits, since it would improve accessibility and safety on this section of the Princes Highway.

Operational noise

Operational noise impacts are anticipated for one sensitive receiver along Dignams Creek Road. Noise impacts have been assessed in **Section 6.2**.

Property acquisition

The proposal would require eleven DP Lot (3 properties) acquisitions, ten of which have already been undertaken by the RMS (refer to **Section 3.6**). Properties subject to acquisition for easements may have development restrictions placed on this land, and any proposed development within the easement would need to be discussed with RMS prior to acquisition. RMS would be responsible for the maintenance of the easement. Details of property acquisition would be confirmed during detailed design of the proposal. As stated in **Section 3.6** some agricultural and national park land would be acquired for construction of the proposal. This land would be within the proposed road corridor. Impacts to agricultural land and associated agricultural businesses would be minor in nature as the majority of the proposal has been contained within the existing road corridor. Property acquisition would be managed in accordance with the provisions of the Road and Maritime Services' *Land Acquisition Policy* and the *Land Acquisition (Just Terms Compensation) Act 1991*

Traffic and Access

Access would be maintained for all properties during construction of the proposal.

During construction, property access to 9526 and 9523 Princes Highway would be maintained directly on to the highway, but during operation of the proposal, the access for these properties would be altered. . During operation the private property access road into number 9526 Princes Highway would utilise the old Princes Highway alignment prior to connecting to the proposal. The private property access road into number 9523 Princes Highway would not have direct access to the Princes Highway, as access would be via Dignams Creek Road (refer to **Figure 2-13)**.

In stage 2 access points into the national parks would be modified and the access point into Kooraban National Park at the top of Dignams Hill would be relocated. The relocation of the access tracks would increase travel time for road users due to increased travel distances, but provides a road safety improvement allowing better sight distances for traffic accessing property to and from the Princes Highway. Overall this is considered an improvement to the existing situation.

The proposal would improve travel times, road safety and travel efficiency for freight, commuters and tourists. Additionally it would have a beneficial socio-economic impact.

6.11.3 Safeguards and management measures

Specific measures to manage impacts associated with noise, dust, traffic and transport, and visual disturbance are outlined in the following sections:

- Noise and vibration (refer to **Section 6.2**).
- Landscape, visual impact and urban design (refer to **Section 6.3**).
- Land use and property (refer to **Section 6.9**).
- Traffic and access (refer to **Section 6.10**).
- Air quality (refer **to Section 6.8**).

Additional measures to manage the potential socio-economic impacts have been summarised in **Table 6-54**.

Table 6-54 Safeguards and mitigation measures for managing socio-economic impacts

Impact	Environmental safeguards	Responsibility	Timing
Commencing construction with adequate notification	Local residents would be notified prior to works commencing and would be kept regularly informed of construction activities during the construction process.	RMS	Pre-construction and construction
Complaints	A complaints-handling procedure and register would be included in the CEMP.	RMS	Pre-construction
Change of conditions and disruptions	Road users, pedestrians and cyclists would be informed of changed conditions including likely disruptions to access.	Contractor	Construction
Changes to property access	Property access would be maintained wherever possible. Prior to any unavoidable disruption to access, consultation would be undertaken with the affected property owner.	RMS	Construction
Emergency vehicle access	Access would be maintained for emergency vehicles in the vicinity of construction works. Ongoing consultation would be undertaken with emergency services during construction to ensure that potential impacts are identified and appropriately managed.	RMS	Construction
Interruptions to utility services	Residents would be informed before any interruptions to utility services that may be experienced as a result of utilities relocation.	RMS	Construction
Commencing construction with adequate notification	Prior to construction starting, RMS would notify residents that are located adjacent to the proposal of the forthcoming works.	RMS	Construction
Property acquisition	Property acquisition would be managed in accordance with the provisions of the Road and Maritime	RMS	Construction

Impact	Environmental safeguards	Responsibility	Timing
	Services' *Land Acquisition Policy* and the *Land Acquisition (Just Terms Compensation) Act 1991.*		
Local goods and services	Goods and services would be sourced locally during construction wherever possible.	Contractor	Construction

6.12 Waste minimisation and management

6.12.1 Policy setting

Waste Avoidance and Resource Recovery Act 2001.

Waste management would be undertaken in accordance with the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The objectives of this Act include:

- To encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development.
- To ensure that resources management options are considered against a hierarchy of the following order:
  - Avoidance of unnecessary resource consumption.
  - Resource recovery (including reuse, reprocessing, recycling and energy recover).
  - Disposal.
- To provide for the continual reduction in waste generation.
- To minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste.
- To ensure that industry shares with the community the responsibility for reducing and dealing with waste.

By adopting the above principles, RMS encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development, as outlined in **Section 8.3** of this REF.

6.12.2 Existing environment

The existing road and bridge would create little waste, there may be some green waste associated with maintenance of roadside vegetation, road side litter and potentially some material from clearing of any roadside drainage features.

6.12.3 Potential impacts

Construction Impacts

Construction would generate waste streams typical of road construction works, including:

- Green waste from cleared vegetation (estimated at 20.6 hectares), refer to **Section 6.1**.
- Construction and installation of the new bridge.

- Construction of the new road.
- Bitumen containing hardcore from the old road surface and base.
- Excess soil and rock from the excavation of cuttings that would not be used as fill on site.
- Roadside materials (guide posts, guard rails etc).
- Oil, grease and other liquid wastes from the maintenance of construction plant and equipment.
- General wastes and sewage from site compounds and offices.
- Plant and equipment maintenance waste including liquid wastes from cleaning, repairing and maintenance.
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials.

The quantities of each type of waste would be confirmed during detailed design.

Operational Impacts

Potential impacts associated with the operation of the proposal include littering by road users and spills of materials, including hazardous materials resulting from vehicle collisions.

6.12.4 Safeguards and management measures

Measures to manage the potential waste impacts are summarised in **Table 6-55.** Measures to manage any contaminated material are summarised in **Section 6.7**.

Table 6-55 Safeguards and mitigation measures for managing waste

Impact	Environmental safeguards	Responsibility	Timing
Generation of construction waste	Resource management hierarchy principles are to be followed: • Avoid unnecessary resource consumption as a priority. • Avoidance is followed by resource recovery (including reuse of materials, reprocessing, and recycling and energy recovery). • Disposal is undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2*001).	Contractor	Construction
Generation of construction waste	A Waste Management Plan would be completed in accordance with the requirements of the RMS's *QA Specification G36 – Environmental Protection (Management System)*.	Contractor	Construction
Generation of construction waste	Housekeeping at the construction site would be addressed regularly. This includes collection and sorting of recycling, general waste and green waste. Waste would be disposed regularly at a licensed waste facility.	Contractor	Construction

6.13 Cumulative impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of the proposal with other external projects. RMS is required under clause 228 (2) of the EP&A Act, to take into account potential cumulative impacts as a result of the proposal.

6.13.1 Existing environment

Princes Highway works

The proposal forms part of progressive ongoing upgrades works for the Princes Highway, within the RMS Southern region. The only works with the vicinity of Dignams Creek is the Victoria Creek upgrade which includes the replacement of the existing bridge at Victoria Creek, new overtaking lanes in both directions, and new access points linking the old highway with the new highway. Victoria Creek is approximately 10 kilometres north of the proposal.

Local development

No local developments are proposed within a reasonable distance of the proposal.

6.13.2 Potential impacts

Potential cumulative impacts could occur if other planned or proposed developments, works or land uses occur in the vicinity of and at the time of the construction of the Dignams Creek realignment. Cumulative impacts could affect a range of environmental factors including impacts of sediment in waterways, forestry and native vegetation loss, land use and social-economic changes etc.

Once the proposal is compete, a positive cumulative impact is likely as the proposal would complement the other upgrades planned or completed along the Princes Highway resulting in improved road design, improved safety and cumulative reduction in travel time for motorists using the Princes Highway.

The only works within the vicinity of Dignams Creek is the Victoria Creek upgrade which includes the replacement of the existing bridge at Victoria Creek, new overtaking lanes in both directions, and new access points linking the old highway with the new highway. Victoria Creek is approximately 10 kilometres north of the proposal.. Cumulative effects on traffic using the Princes Highway could occur if both proposals were to be constructed at the same time. As both proposals are likely to plan for and manage traffic impacts this is not considered likely to notably affect road users even if these proposals were to be constructed at the same time.

Native forest outside the national parks in the valley could experience logging in the future. This has the potential to cause soil erosion and sediment loss into streams. The proposal could then have a cumulative impact upon these waterways. Area and dates of any proposed forestry operations are not known, however with the proposed erosion and sediment control methods and Soil and Water Management Plan to be employed in this proposal any discharges associated with the proposal per se would be minimised so that they do not cause increased stress to the environment irrespective of other existing impacts.

No other large scale land use changes are known that may have the potential to cause cumulative impacts in combination with this proposal.

6.13.3 Safeguards and management measures

The potential for adverse cumulative impacts is most effectively addressed by the application of the individual safeguards recommended throughout the REF and summarised **in Section 7.2.** No additional safeguards are required.

6.14 Summary of beneficial effects

A summary of the beneficial effects resulting from the proposal include:

- Improvements to road safety of the Princes Highway by improving road geometry and alignment at Dignams Creek.
- Improvements in traffic and freight efficiency, including an improvement in travel times along the Princes Highway.
- Improvements to the Dignams Creek crossing due to the construction of a new bridge with higher flood clearance than the existing Dignams Creek Bridge.
- Long term increase in the area of native vegetation due to the plantings and increased protected areas from the biodiversity offsets.
- Provision of better connectivity strategies for fauna including threatened species that are aimed at facilitating the natural movements of fauna across the proposal corridor. The strategy includes two dedicated fauna underpasses, two combined fauna underpasses/drainage culverts and a fauna rope canopy bridge. Fauna fencing is proposed in all areas of bushland and national park in the southern part of the proposal along the alignments for stage 1 and stage 2. Fauna fencing is not required at the tops of cut batters. Fauna fencing is intended to guide fauna towards the wildlife crossing structures and prevent fauna accessing the road.
- The new bridge would allow views of Dignams Creek Valley when travelling to the south and background view of Mount Dromaderry when travelling north.

6.15 Summary of adverse effects

A summary of the adverse effects resulting from the proposal include:

- Removal of about 20.6 hectares of native vegetation (a portion of which currently occurs in areas identified as Kooraban National Park), including the removal of known foraging habitat and potential breeding habitat for a number of threatened species and areas of the TEC recognised as River-Flat Eucalypt Forest on Coastal Floodplains listed as endangered under the TSC Act. . However, this adverse effect is unlikely to have a significant impact as only a small proportion of vegetation would be affected, and large areas of alternative habitat are present in the adjacent protected areas. Additional habitat would be available due to the plantings and increased protected areas from the Biodiversity offsets
- Impacts on riparian vegetation and in-stream flora within Dignams Creek, which would be limited to the area immediately adjacent to the proposed bridge. Also impacts on a portion of a population of the threatened species Square Raspwort (*Haloragis exaltata subsp. exaltata)* listed as vulnerable listed under the TSC Act and EPBC Act.
- Indirect effects on flora and fauna during construction and operation, including edge effects, permanent modification of native vegetation, light and noise,

erosion and sedimentation, dispersal of weed propagules, the potential spread of soil-borne pathogens, and fauna mortality.

- Potentially contribute further to the barrier effect of the highway within an important wildlife corridor connecting the two national parks and the broader east-west landscape.
- Increase in noise from the Princes Highway during operation. In particular, sensitive receiver 7 located at Lot 321 DP873421 would exceed the base noise criteria and has been identified for consideration of mitigation.
- Generation of additional pollutants from an increase in impervious surfaces and future vehicle traffic.
- Property acquisition of ten properties of which eight are already purchased. Lot 11 DP836045 and Lot 7027 DP1069205 would require partial acquisition to be used as road reserve.
- Temporary impacts during construction to visual and urban amenity from the clearing of vegetation, generation of wastes and construction activities associated with the proposal.
- Changes to the visual environment with removal of vegetation, roadside scenery and the road been less responsive to the physical features of landscape.
- Temporary construction impacts including disruptions to traffic and property accesses, noise and vibration, dust generation, increased risk of spills and contamination and the occurrence of erosion and sedimentation.